PROJECT SPECIFICATIONS

The Contractor shall comply with the ***Contract Terms and Conditions*** provided with the Bid Documents including but not limited to the following:

INSURANCE REQUIREMENTS – In accordance with the ***Contract Terms and Conditions***, the Contractor is required to have in place during the term of the Contract and any renewals or extensions thereof, the following types of insurance, issued by companies acceptable to the Commonwealth and authorized to conduct such business under the laws of the Commonwealth of Pennsylvania:

A. **Worker's Compensation Insurance** for all of the Designer/Contractor's employees and those of any subcontractor, engaged in Work at the site of the project as required by law.

B. **Builders Risk Insurance** the Designer/Contractor shall, until all physical on-site work is complete, maintain insurance on all insurable work included in the Contract against loss or damage by fire and lightning and those perils covered by the extended coverage endorsement. Insurable work includes work both interior and exterior of any building being constructed. The property insurance must include a Builder's Risk Policy or an installation floater that covers all risks. The risk of damage to the construction work is that of the Designer/Contractor and surety. No claims for such loss or damage will be recognized by the agency, nor will such loss or damage excuse the complete and satisfactory performance of the Contract by the Contractor. The Designer/Contractor and all subcontractors are required to produce certificates of insurance, naming the Commonwealth of Pennsylvania and Pennsylvania Game Commission as an additional insured.

C. **Public Liability and Property Damage Insurance** to protect the Commonwealth, the Designer/Contractor, and any and all subcontractors from claims for damages for personal injury (including bodily injury), sickness or disease, accidental death and damage to property including the loss of use resulting from any property damage, which may arise from the activities performed under the Contract or the failure to perform under the Contract, whether such performance or non-performance be by the Designer/Contractor, by any subcontractor, or by anyone directly or indirectly employed by either. **The minimum amounts of coverage shall be $250,000 per person and $1,000,000 per occurrence for bodily injury, including death, and $250,000 per person and $1,000,000 per occurrence for property damage.** Such policies shall be occurrence rather than claims-made policies and shall not contain any endorsements or any other form designated to limit and restrict any action by the Commonwealth, as an additional insured, against the insurance coverage in regard to Work performed for the Commonwealth.

Prior to commencement of the Work under the Contract and at each insurance renewal date during the term of the Contract, the Contractor shall provide the Commonwealth with current certificates of insurance. **These certificates or policies shall name the Commonwealth AND Pennsylvania Game Commission as additional insured and shall contain a provision that the coverage's afforded under the policies will not be cancelled or changed until at least thirty (30) days written notice has been given to the Commonwealth.**

COMPLIANCE WITH LAW – The Contractor shall comply with all applicable federal and state laws and regulations and local ordinances in the performance of the Contract.

WORKMANSHIP - All Work shall be performed in a Workmanlike manner and all materials and labor shall be in strict and entire conformity with the Drawings and Specifications.

INSPECTION AND CHANGES - All Work is subject to review and acceptance by the Pennsylvania Game Commission. Any Work rejected as unsatisfactory or unsuitable shall be redesigned and resubmitted with suitable design at the sole cost of the designer to the complete satisfaction of the Game Commission.

Changes shall be in accordance with the ***Contract Terms and Conditions.***

TEMPORARY SERVICES AND JOB CONDITIONS - The Contractor shall be responsible for providing any and all temporary facilities necessary to execute and protect the Work. The Contractor shall accept all conditions as found upon examination of the site and shall coordinate, plan, and execute the Work accordingly. The Contractor shall cooperate in the arrangements of the Work as necessary to least affect the administration or operations of existing buildings, facilities, and infrastructure. The Contractor shall keep the Work site clean at all times.

PREVAILING WAGE – Prevailing minimum wages apply to this project. See ***Contract Terms and Conditions*** and attached Prevailing Wage Determination.

The Contractor and each Subcontractor shall file a statement each week and a final statement at the conclusion of the Work on the contract with the contracting agency, under oath, and in form satisfactory to the Secretary, certifying that workmen have been paid wages in strict conformity with the provisions of the contract as prescribed by this section or if wages remain unpaid to set forth the amount of wages due and owing to each workman respectively. The PA Labor and Industry "Weekly Payroll Certification for Public Works Projects" form shall be used. The initial and final Payroll Certifications shall be notarized.

PAYMENT TERMS - A schedule of values is provided with the bid. Payment will be made on a monthly basis upon satisfactory completion of items listed on the Schedule of Values and in accordance with the ***Contract Terms and Conditions.***

All payments due to the Contractor shall be processed after all Work has been inspected and approved by an agent of the Pennsylvania Game Commission. Payment will not be made for Work that is not progressing satisfactorily or for unsuitable or defective Work.

Payments may be withheld for failure to provide required documentation for the project including but not limited to required submittals / shop drawings and weekly submission of Certified Payrolls.

INVOICING – All Project invoices shall be submitted directly to:

Mr. Austin Kieffer, P.E., Chief of Engineering
Pennsylvania Game Commission
2001 Elmerton Avenue
Harrisburg PA 17110
Office: 717-787-4250 Ext:73613
Email: akieffer@pa.gov

All invoices must be submitted in black and white with no color and shaded areas. Invoices must include the Purchase Order Number, Contractor's SAP Vendor Number, Dates of services and the Contractor's name and address as listed on the Purchase Order. Payment items on invoices shall match the items on the Purchase Order. Failure to submit invoices that meet these requirements will result in a delay of payment.

Please Note: Vendors are reminded to **NOT** include employer identification numbers, Social Security Numbers, bank account information, or other personally identifiable information on their invoices. That information is uniquely tied to your SAP Vendor Number and, for security purposes, should not be explicitly stated on an invoice.

CONTRACT TERM - The Contract shall commence upon delivery of Purchase Order to Contractor and shall terminate on **February 28, 2024**. Contract time is of the essence of the Project. All Work must be completed and accepted by this date.

EXCISE TAXES, PENNSYLVANIA SALES TAX - The Commonwealth is exempt from all Excise Taxes. See ***Contract Terms and Conditions.***

OFFSET PROVISION - The Designer/Contractor agrees that the Commonwealth may set off the amount of any state liability or other debt of the Contractor or its subsidiaries that is owed to the Commonwealth and not being contested on appeal against any payments due the Contractor under this or any other contract with the Commonwealth.

PERFORMANCE SECURITY / CONTRACT BONDS – Within 10 days after award of the purchase order, the Bidder to whom the Contract is awarded, shall provide **Contract Performance Security** and a **Payment Bond** in a form acceptable to the Commonwealth for the amounts listed below and in accordance with the ***Contract Terms and Conditions.***

A **Performance Bond** at one hundred percent (100%) of the contract amount, conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions of the contract.

A **Payment Bond** in an amount equal to one hundred percent (100%) of the contract amount.

Performance and Payment Bonds shall be executed by a surety company authorized to do business in the Commonwealth and listed on the current U.S. Dept. of Treasury, Bureau of Fiscal Service, Department Circular 570 (https://fiscal.treasury.gov/surety-bonds/list-certified-companies.html). Bonds shall include a current Power of Attorney dated the same as the date of the bond. Bonds shall be made payable to the Commonwealth.

GUARANTY / WARRANTY – See ***Contract Terms and Conditions*** – all items are warranted for a period of one year following delivery by the Contractor and acceptance by the Commonwealth.

ADDENDA TO THE INVITATION FOR BID (IFB) – See ***Contract Terms and Conditions*** – If the issuing office deems it necessary to revise any part of this IFB before the bid response date, the issuing office will post an addendum to the DGS website at www.emarketplace.state.pa.us. It is the Contractor's responsibility to periodically check the website for any new information or addenda to the IFB.

HOLD HARMLESS PROVISION - See ***Contract Terms and Conditions*** - The Contractor shall hold the Commonwealth harmless from and indemnify the Commonwealth against any and all third party claims, demands and actions based upon or arising out of any activities performed by the Contractor and its employees and agents under this Contract, provided the Commonwealth gives Contractor prompt notice of any such claim of which it learns.

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project Name:	PGC HQ Training Wing Addition
Awarding Agency:	PA Game Commission
Contract Award Date:	4/18/2023
Serial Number:	23-02548
Project Classification:	Building
Determination Date:	3/16/2023
Assigned Field Office:	Harrisburg
Field Office Phone Number:	(717)787-4763
Toll Free Phone Number:	(800)932-0665
Project County:	Dauphin County

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	6/28/2021		$35.80	$28.26	$64.06
Asbestos & Insulation Workers	7/27/2022		$35.80	$30.01	$65.81
Asbestos & Insulation Workers	6/26/2023		$35.80	$32.01	$67.81
Asbestos & Insulation Workers	7/1/2024		$35.80	$34.06	$69.86
Boilermaker (Commercial, Institutional, and Minor Repair Work)	1/1/2019		$29.26	$18.48	$47.74
Boilermakers	1/1/2021		$49.32	$34.90	$84.22
Boilermakers	1/1/2022		$50.17	$35.30	$85.47
Boilermakers	1/1/2023		$51.27	$35.30	$86.57
Bricklayer (Pointer, Cleaner, Caulker, Cement Mason, Plasterer, Tile Setter)	5/1/2022		$36.37	$18.18	$54.55
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2021		$34.62	$17.78	$52.40
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/1/2022		$36.37	$18.18	$54.55
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/30/2023		$38.27	$18.18	$56.45
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	4/28/2024		$40.12	$18.18	$58.30
Bricklayers, Stone Masons, Pointers, Caulkers, Cleaners	5/4/2025		$41.97	$18.18	$60.15
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2021		$31.77	$17.41	$49.18
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2022		$33.56	$17.72	$51.28
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2023		$35.06	$17.72	$52.78
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2024		$36.56	$17.72	$54.28
Cement Finishers & Plasterers	5/2/2021		$27.25	$20.25	$47.50
Cement Finishers & Plasterers	5/1/2022		$29.38	$20.98	$50.36
Cement Finishers	5/1/2017		$27.20	$22.45	$49.65
Cement Masons	5/1/2021		$30.70	$22.85	$53.55
Drywall Finisher	5/1/2021		$29.65	$20.74	$50.39
Drywall Finisher	5/1/2022		$29.81	$21.43	$51.24
Electricians	6/1/2021		$33.50	$25.94	$59.44
Electricians	6/1/2022		$35.25	$26.31	$61.56
Electricians	6/1/2023		$35.25	$28.41	$63.66
Electricians	6/1/2024		$35.25	$30.51	$65.76
Electricians	6/1/2025		$35.25	$32.50	$67.75
Electricians	6/1/2026		$35.25	$34.43	$69.68
Elevator Constructor	1/1/2021		$49.95	$40.35	$90.30
Elevator Constructor	1/1/2022		$51.66	$37.48	$89.14
Elevator Constructor	1/1/2023		$53.93	$38.34	$92.27
Glazier	5/1/2021		$25.63	$13.45	$39.08
Glazier	5/1/2022		$31.23	$19.26	$50.49
Glazier	5/1/2023		$31.23	$20.66	$51.89
Iron Workers (Bridge, Structural Steel, Ornamental,	7/1/2021		$34.01	$31.13	$65.14

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Precast, Reinforcing)					
Laborers (Class 01 - See notes)	5/1/2021		$22.61	$16.03	$38.64
Laborers (Class 01 - See notes)	5/1/2022		$23.01	$17.28	$40.29
Laborers (Class 02 - See notes)	5/1/2021		$24.61	$16.03	$40.64
Laborers (Class 02 - See notes)	5/1/2022		$25.01	$17.28	$42.29
Laborers (Class 03 - See notes)	5/2/2021		$26.61	$16.02	$42.63
Laborers (Class 03 - See notes)	5/1/2022		$28.81	$17.28	$46.09
Laborers (Class 04 - See notes)	5/2/2021		$27.91	$16.03	$43.94
Laborers (Class 04 - See notes)	5/1/2022		$29.31	$17.28	$46.59
Laborers (Class 05 - See notes)	5/2/2021		$28.61	$16.02	$44.63
Laborers (Class 05 - See notes)	5/1/2022		$28.86	$16.84	$45.70
Laborers (Class 06 - See notes)	5/1/2021		$24.61	$16.03	$40.64
Laborers (Class 06 - See notes)	5/1/2022		$25.01	$16.84	$41.85
Marble Mason	5/1/2021		$31.55	$17.34	$48.89
Marble Mason	5/1/2022		$32.85	$17.74	$50.59
Marble Mason	5/1/2023		$34.80	$17.74	$52.54
Marble Mason	5/1/2024		$36.75	$17.74	$54.49
Marble Mason	5/1/2025		$38.70	$17.74	$56.44
Millwright	5/1/2020		$36.04	$19.31	$55.35
Operators (Building, Class 01 - See Notes)	5/1/2021		$39.87	$27.94	$67.81
Operators (Building, Class 01 - See Notes)	5/1/2022		$41.41	$28.40	$69.81
Operators (Building, Class 01 - See Notes)	5/1/2023		$42.57	$29.24	$71.81
Operators (Building, Class 01A - See Notes)	5/1/2021		$42.12	$28.60	$70.72
Operators (Building, Class 01A - See Notes)	5/1/2022		$43.66	$29.06	$72.72
Operators (Building, Class 01A - See Notes)	5/1/2023		$44.82	$29.90	$74.72
Operators (Building, Class 02 - See Notes)	5/1/2021		$39.59	$27.85	$67.44
Operators (Building, Class 02 - See Notes)	5/1/2022		$41.13	$28.31	$69.44
Operators (Building, Class 02 - See Notes)	5/1/2023		$42.29	$29.15	$71.44
Operators (Building, Class 02A - See Notes)	5/1/2021		$41.84	$28.52	$70.36
Operators (Building, Class 02A - See Notes)	5/1/2022		$43.38	$28.98	$72.36
Operators (Building, Class 02A - See Notes)	5/1/2023		$44.54	$29.82	$74.36
Operators (Building, Class 03 - See Notes)	5/1/2021		$36.87	$27.04	$63.91
Operators (Building, Class 03 - See Notes)	5/1/2022		$38.41	$27.50	$65.91
Operators (Building, Class 03 - See Notes)	5/1/2023		$39.57	$28.34	$67.91
Operators (Building, Class 04 - See Notes)	5/1/2021		$35.72	$26.72	$62.44
Operators (Building, Class 04 - See Notes)	5/1/2022		$37.27	$27.17	$64.44
Operators (Building, Class 04 - See Notes)	5/1/2023		$38.42	$28.02	$66.44
Operators (Building, Class 05 - See Notes)	5/1/2021		$35.27	$26.59	$61.86
Operators (Building, Class 05 - See Notes)	5/1/2022		$36.82	$27.04	$63.86
Operators (Building, Class 05 - See Notes)	5/1/2023		$37.97	$27.89	$65.86
Operators (Building, Class 06 - See Notes)	5/1/2021		$34.40	$26.32	$60.72
Operators (Building, Class 06 - See Notes)	5/1/2022		$35.95	$26.77	$62.72
Operators (Building, Class 06 - See Notes)	5/1/2023		$37.10	$27.62	$64.72
Operators (Building, Class 07A- See Notes)	5/1/2021		$48.31	$31.86	$80.17

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Building, Class 07A- See Notes)	5/1/2022		$50.17	$32.40	$82.57
Operators (Building, Class 07A- See Notes)	5/1/2023		$51.63	$33.34	$84.97
Operators (Building, Class 07B- See Notes)	5/1/2021		$47.96	$31.77	$79.73
Operators (Building, Class 07B- See Notes)	5/1/2022		$49.81	$32.31	$82.12
Operators (Building, Class 07B- See Notes)	5/1/2023		$51.28	$33.24	$84.52
Painters Class 1 (see notes)	5/1/2021		$25.84	$16.50	$42.34
Painters Class 1 (see notes)	5/1/2022		$26.42	$17.03	$43.45
Painters Class 2 (see notes)	5/1/2020		$27.43	$15.99	$43.42
Painters Class 3 (see notes)	5/1/2020		$33.18	$15.99	$49.17
Pile Driver Divers (Building, Heavy, Highway)	1/1/2021		$54.75	$20.10	$74.85
Pile Driver Divers (Building, Heavy, Highway)	1/1/2022		$56.40	$20.50	$76.90
Pile Driver Divers (Building, Heavy, Highway)	1/1/2023		$58.70	$21.22	$79.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2024		$60.95	$21.97	$82.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2025		$62.82	$22.72	$85.54
Pile Driver Divers (Building, Heavy, Highway)	1/1/2026		$64.70	$23.47	$88.17
Piledrivers	1/1/2021		$36.50	$20.10	$56.60
Piledrivers	1/1/2022		$37.60	$20.50	$58.10
Piledrivers	1/1/2023		$39.13	$21.22	$60.35
Piledrivers	1/1/2024		$40.63	$21.97	$62.60
Piledrivers	1/1/2025		$41.88	$22.72	$64.60
Piledrivers	1/1/2026		$43.13	$23.47	$66.60
Plasterers	5/1/2021		$28.33	$20.98	$49.31
Plumber/Pipefitter	5/1/2021		$38.77	$28.46	$67.23
Plumber/Pipefitter	5/1/2022		$40.28	$28.70	$68.98
Roofers (Composition)	5/1/2021		$40.33	$33.12	$73.45
Roofers (Composition)	5/1/2022		$41.48	$33.87	$75.35
Roofers (Shingle)	5/1/2020		$29.50	$21.25	$50.75
Roofers (Slate & Tile)	5/1/2020		$32.50	$21.25	$53.75
Sheet Metal Workers	6/1/2021		$36.08	$42.65	$78.73
Sheet Metal Workers	6/1/2022		$40.22	$41.01	$81.23
Sign Makers and Hangars	7/17/2021		$29.49	$23.90	$53.39
Sign Makers and Hangars	7/15/2022		$30.54	$24.35	$54.89
Sprinklerfitters	4/1/2021		$40.33	$26.94	$67.27
Sprinklerfitters	4/1/2022		$42.29	$27.48	$69.77
Sprinklerfitters	4/1/2023		$44.33	$28.04	$72.37
Terrazzo Finisher	5/1/2021		$33.23	$19.03	$52.26
Terrazzo Finisher	5/1/2022		$34.46	$19.24	$53.70
Terrazzo Finisher	5/1/2023		$35.79	$19.25	$55.04
Terrazzo Finisher	5/1/2024		$37.16	$19.26	$56.42
Terrazzo Grinder	5/1/2021		$33.94	$19.03	$52.97
Terrazzo Grinder	5/1/2022		$35.19	$19.24	$54.43
Terrazzo Grinder	5/1/2023		$36.54	$19.25	$55.79
Terrazzo Grinder	5/1/2024		$37.92	$19.26	$57.18
Terrazzo Mechanics	5/1/2021		$33.83	$20.78	$54.61

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Terrazzo Mechanics	5/1/2022		$35.12	$20.99	$56.11
Terrazzo Mechanics	5/1/2023		$36.51	$21.00	$57.51
Terrazzo Mechanics	5/1/2024		$37.94	$21.01	$58.95
Terrazzo Setter	5/1/2019		$31.81	$19.67	$51.48
Tile & Marble Finisher	5/1/2021		$29.61	$15.14	$44.75
Tile & Marble Finisher	5/1/2022		$30.96	$15.49	$46.45
Tile & Marble Finisher	5/1/2023		$32.91	$15.49	$48.40
Tile & Marble Finisher	5/1/2024		$34.86	$15.49	$50.35
Tile & Marble Finisher	5/1/2025		$36.81	$15.49	$52.30
Tile Setter	5/1/2021		$31.55	$17.34	$48.89
Tile Setter	5/1/2022		$32.85	$17.74	$50.59
Tile Setter	5/1/2023		$34.80	$17.74	$52.54
Tile Setter	5/1/2024		$36.75	$17.74	$54.49
Tile Setter	5/1/2025		$38.70	$17.74	$56.44
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28
Window Film / Tint Installer	6/1/2019		$24.52	$12.08	$36.60

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter	5/1/2021		$33.12	$17.74	$50.86
Carpenter	5/1/2022		$34.02	$18.39	$52.41
Cement Finishers	5/1/2016		$26.40	$22.35	$48.75
Electric Lineman	5/31/2021		$49.22	$27.36	$76.58
Electric Lineman	5/30/2022		$50.28	$28.47	$78.75
Electric Lineman	5/29/2023		$51.40	$29.62	$81.02
Electric Lineman	6/3/2024		$52.80	$30.61	$83.41
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		$34.01	$31.13	$65.14
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	7/1/2021		$34.01	$31.13	$65.14
Laborers (Class 01 - See notes)	5/1/2021		$23.21	$18.09	$41.30
Laborers (Class 01 - See notes)	5/1/2022		$24.01	$18.54	$42.55
Laborers (Class 01 - See notes)	5/1/2023		$24.81	$18.99	$43.80
Laborers (Class 01 - See notes)	5/1/2024		$25.61	$19.49	$45.10
Laborers (Class 02 - See notes)	5/1/2021		$29.83	$18.09	$47.92
Laborers (Class 02 - See notes)	5/1/2022		$30.63	$18.54	$49.17
Laborers (Class 02 - See notes)	5/1/2023		$31.43	$18.99	$50.42
Laborers (Class 02 - See notes)	5/1/2024		$32.23	$19.49	$51.72
Laborers (Class 03 - See notes)	5/1/2021		$26.82	$18.09	$44.91
Laborers (Class 03 - See notes)	5/1/2022		$27.62	$18.54	$46.16
Laborers (Class 03 - See notes)	5/1/2023		$28.42	$18.99	$47.41
Laborers (Class 03 - See notes)	5/1/2024		$29.22	$19.49	$48.71
Laborers (Class 04 - See notes)	5/1/2021		$27.17	$18.09	$45.26
Laborers (Class 04 - See notes)	5/1/2022		$27.97	$18.54	$46.51
Laborers (Class 04 - See notes)	5/1/2023		$28.77	$18.99	$47.76
Laborers (Class 04 - See notes)	5/1/2024		$29.57	$19.49	$49.06
Laborers (Class 05 - See notes)	5/1/2021		$27.84	$18.09	$45.93
Laborers (Class 05 - See notes)	5/1/2022		$28.64	$18.54	$47.18
Laborers (Class 05 - See notes)	5/1/2023		$29.44	$18.99	$48.43
Laborers (Class 05 - See notes)	5/1/2024		$30.24	$19.49	$49.73
Laborers (Class 06 - See notes)	5/1/2021		$27.26	$18.09	$45.35
Laborers (Class 06 - See notes)	5/1/2022		$28.06	$18.54	$46.60
Laborers (Class 06 - See notes)	5/1/2023		$28.86	$18.99	$47.85
Laborers (Class 06 - See notes)	5/1/2024		$29.66	$19.49	$49.15
Laborers (Class 07 - See notes)	5/1/2021		$27.55	$18.09	$45.64
Laborers (Class 07 - See notes)	5/1/2022		$28.35	$18.54	$46.89
Laborers (Class 07 - See notes)	5/1/2023		$29.15	$18.99	$48.14
Laborers (Class 07 - See notes)	5/1/2024		$29.95	$19.49	$49.44
Laborers (Class 08 - See notes)	5/1/2021		$28.03	$18.09	$46.12
Laborers (Class 08 - See notes)	5/1/2022		$28.83	$18.54	$47.37
Laborers (Class 08 - See notes)	5/1/2023		$29.63	$18.99	$48.62
Laborers (Class 08 - See notes)	5/1/2024		$30.43	$19.49	$49.92
Operators (Heavy, Class 01 - See Notes)	5/1/2021		$38.44	$27.52	$65.96
Operators (Heavy, Class 01 - See Notes)	5/1/2022		$39.98	$27.98	$67.96

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Heavy, Class 01 - See Notes)	5/1/2023		$41.14	$28.82	$69.96
Operators (Heavy, Class 01 - See Notes)	5/1/2024		$42.30	$29.66	$71.96
Operators (Heavy, Class 01 - See Notes)	5/1/2025		$43.46	$30.50	$73.96
Operators (Heavy, Class 01 - See Notes)	5/1/2026		$44.61	$31.35	$75.96
Operators (Heavy, Class 01A - See Notes)	5/1/2021		$40.69	$28.18	$68.87
Operators (Heavy, Class 01A - See Notes)	5/1/2022		$42.23	$28.64	$70.87
Operators (Heavy, Class 01A - See Notes)	5/1/2023		$43.39	$29.48	$72.87
Operators (Heavy, Class 01A - See Notes)	5/1/2024		$44.55	$30.32	$74.87
Operators (Heavy, Class 01A - See Notes)	5/1/2025		$45.71	$31.16	$76.87
Operators (Heavy, Class 01A - See Notes)	5/1/2026		$46.86	$32.01	$78.87
Operators (Heavy, Class 02 - See Notes)	5/1/2021		$38.16	$27.43	$65.59
Operators (Heavy, Class 02 - See Notes)	5/1/2022		$39.70	$27.89	$67.59
Operators (Heavy, Class 02 - See Notes)	5/1/2023		$40.86	$28.73	$69.59
Operators (Heavy, Class 02 - See Notes)	5/1/2024		$42.02	$29.57	$71.59
Operators (Heavy, Class 02 - See Notes)	5/1/2025		$43.18	$30.41	$73.59
Operators (Heavy, Class 02 - See Notes)	5/1/2026		$44.34	$31.25	$75.59
Operators (Heavy, Class 02A - See Notes)	5/1/2021		$40.41	$28.10	$68.51
Operators (Heavy, Class 02A - See Notes)	5/1/2022		$41.95	$28.56	$70.51
Operators (Heavy, Class 02A - See Notes)	5/1/2023		$43.11	$29.40	$72.51
Operators (Heavy, Class 02A - See Notes)	5/1/2024		$44.27	$30.24	$74.51
Operators (Heavy, Class 02A - See Notes)	5/1/2025		$45.43	$31.08	$76.51
Operators (Heavy, Class 02A - See Notes)	5/1/2026		$46.59	$31.92	$78.51
Operators (Heavy, Class 03 - See Notes)	5/1/2021		$35.24	$26.57	$61.81
Operators (Heavy, Class 03 - See Notes)	5/1/2022		$36.78	$27.03	$63.81
Operators (Heavy, Class 03 - See Notes)	5/1/2023		$37.95	$27.86	$65.81
Operators (Heavy, Class 03 - See Notes)	5/1/2024		$39.11	$28.70	$67.81
Operators (Heavy, Class 03 - See Notes)	5/1/2025		$40.26	$29.55	$69.81
Operators (Heavy, Class 03 - See Notes)	5/1/2026		$41.43	$30.38	$71.81
Operators (Heavy, Class 04 - See Notes)	5/1/2021		$34.10	$26.24	$60.34
Operators (Heavy, Class 04 - See Notes)	5/1/2022		$35.65	$26.69	$62.34
Operators (Heavy, Class 04 - See Notes)	5/1/2023		$36.80	$27.54	$64.34
Operators (Heavy, Class 04 - See Notes)	5/1/2024		$37.96	$28.38	$66.34
Operators (Heavy, Class 04 - See Notes)	5/1/2025		$39.12	$29.22	$68.34
Operators (Heavy, Class 04 - See Notes)	5/1/2026		$40.28	$30.06	$70.34
Operators (Heavy, Class 05 - See Notes)	5/1/2021		$33.65	$26.11	$59.76
Operators (Heavy, Class 05 - See Notes)	5/1/2022		$35.20	$26.56	$61.76
Operators (Heavy, Class 05 - See Notes)	5/1/2023		$36.35	$27.41	$63.76
Operators (Heavy, Class 05 - See Notes)	5/1/2024		$37.51	$28.25	$65.76
Operators (Heavy, Class 05 - See Notes)	5/1/2025		$38.67	$29.09	$67.76
Operators (Heavy, Class 05 - See Notes)	5/1/2026		$39.83	$29.93	$69.76
Operators (Heavy, Class 06 - See Notes)	5/1/2021		$32.77	$25.84	$58.61
Operators (Heavy, Class 06 - See Notes)	5/1/2022		$34.31	$26.31	$60.62
Operators (Heavy, Class 06 - See Notes)	5/1/2023		$35.48	$27.14	$62.62
Operators (Heavy, Class 06 - See Notes)	5/1/2024		$36.64	$27.98	$64.62

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Heavy, Class 06 - See Notes)	5/1/2025		$37.80	$28.82	$66.62
Operators (Heavy, Class 06 - See Notes)	5/1/2026		$38.96	$29.66	$68.62
Operators (Heavy, Class 07A - See Notes)	5/1/2021		$46.59	$31.37	$77.96
Operators (Heavy, Class 07A - See Notes)	5/1/2022		$48.45	$31.91	$80.36
Operators (Heavy, Class 07A - See Notes)	5/1/2023		$49.93	$32.83	$82.76
Operators (Heavy, Class 07A - See Notes)	5/1/2024		$51.39	$33.77	$85.16
Operators (Heavy, Class 07A - See Notes)	5/1/2025		$52.85	$34.71	$87.56
Operators (Heavy, Class 07A - See Notes)	5/1/2026		$54.32	$35.64	$89.96
Operators (Heavy, Class 07B - See Notes)	5/1/2021		$46.25	$31.26	$77.51
Operators (Heavy, Class 07B - See Notes)	5/1/2022		$48.10	$31.81	$79.91
Operators (Heavy, Class 07B - See Notes)	5/1/2023		$49.58	$32.73	$82.31
Operators (Heavy, Class 07B - See Notes)	5/1/2024		$51.04	$33.67	$84.71
Operators (Heavy, Class 07B - See Notes)	5/1/2025		$52.51	$34.60	$87.11
Operators (Heavy, Class 07B - See Notes)	5/1/2026		$53.97	$35.54	$89.51
Operators (Highway, Class 01 - See Notes)	5/1/2021		$39.10	$25.70	$64.80
Operators (Highway, Class 01 - See Notes)	5/1/2022		$39.10	$27.70	$66.80
Operators (Highway, Class 01 - See Notes)	5/1/2023		$40.25	$28.55	$68.80
Operators (Highway, Class 01 - See Notes)	5/1/2024		$41.41	$29.39	$70.80
Operators (Highway, Class 01 - See Notes)	5/1/2025		$42.56	$30.24	$72.80
Operators (Highway, Class 01 - See Notes)	5/1/2026		$43.72	$31.08	$74.80
Operators (Highway, Class 01a - See Notes)	5/1/2021		$41.35	$26.38	$67.73
Operators (Highway, Class 01a - See Notes)	5/1/2022		$41.35	$28.38	$69.73
Operators (Highway, Class 01a - See Notes)	5/1/2023		$42.50	$29.23	$71.73
Operators (Highway, Class 01a - See Notes)	5/1/2024		$43.66	$30.07	$73.73
Operators (Highway, Class 01a - See Notes)	5/1/2025		$44.81	$30.92	$75.73
Operators (Highway, Class 01a - See Notes)	5/1/2026		$45.97	$31.76	$77.73
Operators (Highway, Class 02 - See Notes)	5/1/2021		$37.93	$25.35	$63.28
Operators (Highway, Class 02 - See Notes)	5/1/2022		$37.93	$27.35	$65.28
Operators (Highway, Class 02 - See Notes)	5/1/2023		$39.08	$28.20	$67.28
Operators (Highway, Class 02 - See Notes)	5/1/2024		$40.24	$29.04	$69.28
Operators (Highway, Class 02 - See Notes)	5/1/2025		$41.39	$29.89	$71.28
Operators (Highway, Class 02 - See Notes)	5/1/2026		$42.55	$30.73	$73.28
Operators (Highway, Class 03 - See Notes)	5/1/2021		$37.23	$25.16	$62.39
Operators (Highway, Class 03 - See Notes)	5/1/2022		$37.23	$27.15	$64.38
Operators (Highway, Class 03 - See Notes)	5/1/2023		$38.39	$27.99	$66.38
Operators (Highway, Class 03 - See Notes)	5/1/2024		$39.55	$28.83	$68.38
Operators (Highway, Class 03 - See Notes)	5/1/2025		$40.70	$29.68	$70.38
Operators (Highway, Class 03 - See Notes)	5/1/2026		$41.87	$30.51	$72.38
Operators (Highway, Class 04 - See Notes)	5/1/2021		$36.77	$25.03	$61.80
Operators (Highway, Class 04 - See Notes)	5/1/2022		$36.77	$27.03	$63.80
Operators (Highway, Class 04 - See Notes)	5/1/2023		$37.94	$27.86	$65.80
Operators (Highway, Class 04 - See Notes)	5/1/2024		$39.10	$28.70	$67.80
Operators (Highway, Class 04 - See Notes)	5/1/2025		$40.26	$29.54	$69.80
Operators (Highway, Class 04 - See Notes)	5/1/2026		$41.41	$30.39	$71.80

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 23-02548 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Highway, Class 05 - See Notes)	5/1/2021		$36.26	$24.87	$61.13
Operators (Highway, Class 05 - See Notes)	5/1/2022		$36.26	$26.88	$63.14
Operators (Highway, Class 05 - See Notes)	5/1/2023		$37.42	$27.72	$65.14
Operators (Highway, Class 05 - See Notes)	5/1/2024		$38.58	$28.56	$67.14
Operators (Highway, Class 05 - See Notes)	5/1/2025		$39.73	$29.41	$69.14
Operators (Highway, Class 05 - See Notes)	5/1/2026		$40.89	$30.25	$71.14
Operators (Highway, Class 06 - See Notes)	5/1/2021		$39.33	$25.78	$65.11
Operators (Highway, Class 06 - See Notes)	5/1/2022		$39.33	$27.77	$67.10
Operators (Highway, Class 06 - See Notes)	5/1/2023		$40.48	$28.62	$69.10
Operators (Highway, Class 06 - See Notes)	5/1/2024		$41.64	$29.46	$71.10
Operators (Highway, Class 06 - See Notes)	5/1/2025		$42.80	$30.30	$73.10
Operators (Highway, Class 06 - See Notes)	5/1/2026		$43.95	$31.15	$75.10
Operators (Highway, Class 06/A - See Notes)	5/1/2021		$41.58	$26.43	$68.01
Operators (Highway, Class 06/A - See Notes)	5/1/2022		$41.58	$28.43	$70.01
Operators (Highway, Class 06/A - See Notes)	5/1/2023		$42.73	$29.28	$72.01
Operators (Highway, Class 06/A - See Notes)	5/1/2024		$43.89	$30.12	$74.01
Operators (Highway, Class 06/A - See Notes)	5/1/2025		$45.05	$30.96	$76.01
Operators (Highway, Class 06/A - See Notes)	5/1/2026		$46.21	$31.80	$78.01
Operators (Highway, Class 07/A - See Notes)	5/1/2021		$47.08	$29.49	$76.57
Operators (Highway, Class 07/A - See Notes)	5/1/2022		$47.38	$31.59	$78.97
Operators (Highway, Class 07/A - See Notes)	5/1/2023		$48.86	$32.51	$81.37
Operators (Highway, Class 07/A - See Notes)	5/1/2024		$50.32	$33.45	$83.77
Operators (Highway, Class 07/A - See Notes)	5/1/2025		$51.79	$34.38	$86.17
Operators (Highway, Class 07/A - See Notes)	5/1/2026		$53.25	$35.32	$88.57
Operators (Highway, Class 07/B - See Notes)	5/1/2021		$45.66	$29.08	$74.74
Operators (Highway, Class 07/B - See Notes)	5/1/2022		$45.97	$31.17	$77.14
Operators (Highway, Class 07/B - See Notes)	5/1/2023		$47.44	$32.10	$79.54
Operators (Highway, Class 07/B - See Notes)	5/1/2024		$48.91	$33.03	$81.94
Operators (Highway, Class 07/B - See Notes)	5/1/2025		$50.37	$33.97	$84.34
Operators (Highway, Class 07/B - See Notes)	5/1/2026		$51.84	$34.90	$86.74
Painters Class 1 (see notes)	5/1/2018		$23.92	$14.37	$38.29
Painters Class 2 (see notes)	5/1/2021		$27.97	$16.50	$44.47
Painters Class 2 (see notes)	5/1/2022		$28.55	$17.03	$45.58
Painters Class 3 (see notes)	5/1/2021		$33.72	$16.50	$50.22
Painters Class 3 (see notes)	5/1/2022		$34.30	$17.03	$51.33
Pile Driver Divers (Building, Heavy, Highway)	1/1/2021		$54.75	$20.10	$74.85
Pile Driver Divers (Building, Heavy, Highway)	1/1/2022		$56.40	$20.50	$76.90
Piledrivers	5/1/2021		$33.12	$17.74	$50.86
Piledrivers	5/1/2022		$34.02	$18.39	$52.41
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2022		$48.43	$40.28	$88.71
Truckdriver class 1(see notes)	5/1/2021		$37.72	$0.00	$37.72
Truckdriver class 2 (see notes)	5/1/2021		$37.79	$0.00	$37.79
Truckdriver class 3 (see notes)	5/1/2021		$38.28	$0.00	$38.28

RECIPROCAL LIMITATIONS ACT
REQUIREMENTS

Please Complete Applicable Portion of Pages 3 & 4 and Return with Bid.

NOTE: These Requirements Do Not Apply To Bids Under $10,000.00

I. REQUIREMENTS

A. The Reciprocal Limitations Act requires the Commonwealth to give preference to those bidders offering supplies produced, manufactured, mined or grown in Pennsylvania as against those bidders offering supplies produced, manufactured, mined or grown in any state that gives or requires a preference to supplies produced, manufactured, mined or grown in that state. The amount of the preference shall be equal to the amount of the preference applied by the other state for that particular supply.

The following is a list of states which have been found by the Department of General Services to have applied a preference for in-state supplies and the amount of the preference:

	STATE	PREFERENCE	
1.	Alaska	7%	(applies only to timber, lumber, and manufactured lumber products originating in the state)
2.	Arizona	5%	(construction materials produced or manufactured in the state only)
3.	Hawaii	10%	
4.	Illinois	10%	for coal only
5.	Iowa	5%	for coal only
6.	Louisiana	4%	meat and meat products
		4%	catfish
		10%	milk & dairy products
		10%	steel rolled in Louisiana
		7%	all other products
7.	Montana	5%	for residents *
		3%	for non-residents*
			*offering in-state goods, supplies, equipment and materials
8.	New Mexico	5%	
9.	New York	3%	for purchase of food only
10.	Oklahoma	5%	
11.	Virginia	4%	for coal only
12.	Washington	5%	(fuels mined or produced in the state only)
13.	Wyoming	5%	

B. The Reciprocal Limitations Act requires the Commonwealth to give preference to those bidders offering printing performed in Pennsylvania as against those bidders offering printing performed in any state that gives or requires a preference to printing performed in that state. The amount of the preference shall be equal to the amount of the preference applied by the other state for that particular category of printing.

The following is a list of states which have been found by the Department of General Services to have applied a preference for in-state printing and the amount of the preference:

	STATE	PREFERENCE
1.	Hawaii	15%
2.	Idaho	10%
3.	Louisiana	3%
4.	Montana	8%
5.	New Mexico	5%
6.	Wyoming	10%

C. The Reciprocal Limitations Act, also requires the Commonwealth to give resident bidders a preference against a nonresident bidder from any state that gives or requires a preference to bidders from that state or exclude bidders from states that exclude nonresident bidders. The amount of the preference shall be equal to the amount of the preference applied by the state of the nonresident bidder. The following is a list of the states which have been found by the Department of General Services to have applied a preference for in-state bidders and the amount of the preference:

	STATE	PREFERENCE	
1.	Alaska	5%	(supplies only)
2.	Arizona	5%	(construction materials from Arizona resident dealers only)
3.	California	5%	(for supply contracts only in excess of $100,000.00)
4.	Connecticut	10%	(for supplies only)
5.	Montana	3%	
6.	New Mexico	5%	(for supplies only)
7.	South Carolina	2%	(under $2,500,000.00)
		1%	(over $2,500,000.00) This preference does not apply to construction contracts nor where the price of a single unit exceeds $10,000.
8.	West Virginia	2.5%	(for the construction, repair or improvement of any buildings
9.	Wyoming	5%	

	STATE	PROHIBITION
1.	New Jersey	For supply procurements or construction projects restricted to Department of General Services Certified Small Businesses, New Jersey bidders shall be excluded from award even if they themselves are Department of General Services Certified Small Businesses.

D. The Reciprocal Limitations Act also requires the Commonwealth not to specify, use or purchase supplies which are produced, manufactured, mined or grown in any state that prohibits the specification for, use, or purchase of such items in or on its public buildings or other works, when such items are not produced, manufactured, mined or grown in such state. The following is a list of the states which have been found by the Department of General Services to have prohibited the use of out-of-state supplies:

	STATE	PROHIBITION
1.	Alabama	Only for printing and binding involving "messages of the Governor to the Legislature", all bills, documents and reports ordered by and for the use of the Legislature or either house thereof while in session; all blanks, circulars, notices and forms used in the office of or ordered by the Governor, or by any state official, board, commission, bureau or department, or by the clerks of the supreme court . . ./and other appellate courts/; and all blanks and forms ordered by and for the use of the Senate and Clerk or the House of Representatives, and binding the original records and opinions of the Supreme Court . . . /and other appellate courts/
2.	Georgia	Forest products only
3.	Indiana	Coal
4.	Michigan	Printing
5.	New Mexico	Construction
6.	Ohio	Only for House and Senate bills, general and local laws, and joint resolutions; the journals and bulletins of the Senate and house of Representatives and reports, communications, and other documents which form part of the journals; reports, communications, and other documents ordered by the General Assembly, or either House, or by the executive department or elective state officers; blanks, circulars, and other work for the use of the executive departments, and elective state officers; and opinions of the Attorney General.
7.	Rhode Island	Only for food for state institutions.

*If the bid discloses that the bidder is offering to supply one of the above-listed products that is manufactured, mined, or grown in the listed state, it shall be rejected. Contractors are prohibited from supplying these items from these states.

II. CALCULATION OF PREFERENCE

In calculating the preference, the amount of a bid submitted by a Pennsylvania bidder shall be reduced by the percentage preference which would be given to a nonresident bidder by its state of residency (as found by the Department of General Services in Paragraph C above). Similarly, the amount of a bid offering Pennsylvania goods, supplies, equipment or materials shall be reduced by the percentage preference which would be given to another bidder by the state where the goods, supplies, equipment or materials are produced, manufactured, mined or grown (as found by the Department of General Services in Paragraphs A and B above).

THIS FORM MUST BE COMPLETED AND RETURNED WITH THE BID

III. STATE OF MANUFACTURE

All bidders must complete the following chart by listing the name of the manufacturer and the state (or foreign country) of manufacture for each item. If the item is domestically produced, the bidder must indicate the state in the United States where the item will be manufactured. **This chart must be completed and submitted with the bid or no later than two (2) business days after notification from the** Issuing Office **to furnish the information. Failure to complete this chart and provide the required information prior to the expiration of the second business day after notification shall result in the rejection of the bid.**

ITEM NUMBER	NAME OF MANUFACTURER	STATE (OR FOREIGNCOUNTRY) OF MANUFACTURE

IV. BIDDER'S RESIDENCY

A. In determining whether the bidder is a nonresident bidder from a state that gives or requires a preference to bidders from that state, the address given on the first page of this invitation to bid shall be used by the Commonwealth. If that address is incorrect, or if no address is given, the correct address should be provided in the space below:

Correct Address: _____

_____

_____

_____

B. In order to claim the preference provided under Section I.B., Pennsylvania resident bidders must complete the following or have such information on file with the Issuing Office:

1. Address of bidder's bona fide establishment in Pennsylvania at which it was transacting business on the date when bids for this contract/requisition were first solicited: _____

2. **a.** If the bidder is a corporation:

(1) The corporation ☐ is or ☐ is not incorporated under the laws of the Commonwealth of Pennsylvania.

(a) If the bidder is incorporated under the laws of the Commonwealth of Pennsylvania, provide date of incorporation: _____

(b) If the bidder is not incorporated under the laws of the Commonwealth of Pennsylvania, it must have a certificate of authority to do business in the Commonwealth of Pennsylvania from the Pennsylvania Department of State as required by the Pennsylvania Business Corporation Law (15 P.S. §2001). Provide date of issuance of certificate of authority: _____

(2) The corporation ☐ is or ☐ is not conducting business in Pennsylvania under an assumed or fictitious name. If the bidder is conducting business under an assumed or fictitious name, it must register the fictitious name with the Secretary of the Commonwealth and the office of the prothonotary of the county wherein the registered office of such corporation is located as required by the Fictitious Corporate Name Act, as amended 15 P.S. §51 et seq. Corporate bidders conducting business under an assumed or fictitious name must provide date of registry of the assumed or fictitious name: _____

b. If the bidder is a partnership:

(1) The partnership ☐ is or ☐is not conducting business in Pennsylvania under an assumed or fictitious name. If the bidder is conducting business under an assumed or fictitious name, it must file with the Secretary of the Commonwealth and the office of the prothonotary the county wherein the principal place of business is located as required by the Fictitious Name Act of May 24, 1945, P.L. 967, as amended 54 P.S. §28.1. Partnerships conducting business under an assumed or fictitious name must provide the date of filing of the assumed or fictitious name with the Secretary of the Commonwealth: _____

(2) The partnership ☐is or ☐ is not a limited partnership formed under the laws of any jurisdiction other than the Commonwealth of Pennsylvania. If the bidder is an Out-of-state limited partnership, it must register with the Pennsylvania Department of State as required by the Act of July 10, 1981, P.L. 237, as amended, 59 Pa. C.S.A. §503. Out-of-state limited partnerships must provide the date of registry with the Pennsylvania Department of State: _____

c. If the bidder is an individual:

He or she ☐ is or ☐ is not conducting business under an assumed or fictitious name. If the bidder is conducting business under an assumed or fictitious name, he or she must file with the Secretary of the Commonwealth and the office of the prothonotary in the county wherein the principal place of business is located as required by the Fictitious Name Act of May 24, 1945, P.L. 967, as amended, 54 P.S. §28.1. Individuals conducting business under an assumed or fictitious name must provide the date of filing of the assumed or fictitious name with the Secretary of the Commonwealth: _____

WORKER PROTECTION AND INVESTMENT CERTIFICATION FORM

A. Pursuant to Executive Order 2021-06, *Worker Protection and Investment* (October 21, 2021), the Commonwealth is responsible for ensuring that every worker in Pennsylvania has a safe and healthy work environment and the protections afforded them through labor laws. To that end, contractors and grantees of the Commonwealth must certify that they are in compliance with Pennsylvania's Unemployment Compensation Law, Workers' Compensation Law, and all applicable Pennsylvania state labor and workforce safety laws including, but not limited to:

1. Construction Workplace Misclassification Act
2. Employment of Minors Child Labor Act
3. Minimum Wage Act
4. Prevailing Wage Act
5. Equal Pay Law
6. Employer to Pay Employment Medical Examination Fee Act
7. Seasonal Farm Labor Act
8. Wage Payment and Collection Law
9. Industrial Homework Law
10. Construction Industry Employee Verification Act
11. Act 102: Prohibition on Excessive Overtime in Healthcare
12. Apprenticeship and Training Act
13. Inspection of Employment Records Law

B. Pennsylvania law establishes penalties for providing false certifications, including contract termination; and three-year ineligibility to bid on contracts under 62 Pa. C.S. § 531 (Debarment or suspension).

CERTIFICATION

I, the official named below, certify I am duly authorized to execute this certification on behalf of the contractor/grantee identified below, and certify that the contractor/grantee identified below is compliant with applicable Pennsylvania state labor and workplace safety laws, including, but not limited to, those listed in Paragraph A, above. I understand that I must report any change in the contractor/grantee's compliance status to the Purchasing Agency immediately. I further confirm and understand that this Certification is subject to the provisions and penalties of 18 Pa. C.S. § 4904 (Unsworn falsification to authorities).

Signature ***Date***
Name (Printed)
Title of Certifying Official (Printed)
Contractor/Grantee Name (Printed)

SDB-1

INSTRUCTIONS FOR COMPLETING THE SMALL DIVERSE BUSINESS (SDB) PARTICIPATION SUBMITTAL

GENERAL CONTRACT ONLY 10% SDB PARTICIPATION

PLEASE READ BEFORE COMPLETING THESE DOCUMENTS

The following instructions include details for completing the SDB Participation Submittal which Bidders or Offerors must submit in order to be considered responsive.

This form also includes instructions for completing the SDB Listing, which Bidders or Offerors must submit for any portion of the SDB participation goal the Bidder or Offeror commits to meeting.

Bidder/Offeror shall attempt to achieve the SDB participation goal set forth in the **SDB and VBE Participation Summary Sheet**. Bidder/Offeror agrees to exercise Good Faith Efforts to carry out the requirements set forth in these Instructions.

I. **SDB Participation Goal:** The SDB participation goal is set forth in the **SDB and VBE Participation Summary Sheet**. The Bidder/Offeror is encouraged to use a diverse group of subcontractors and suppliers from the SDB classifications to meet the SDB participation goal.

II. **SDB Eligibility**:

1. Finding SDB firms: The directory of **DGS-verified** SDB firms can be accessed from the DGS Supplier Search directory at: http://www.dgs.internet.state.pa.us/suppliersearch.

2. **Only SDBs verified by DGS** and as defined herein may be counted for purposes of achieving the SDB participation goal. In order to be counted for purposes of achieving the SDB participation goal, the SDB firm, including an SDB prime, must be DGS-verified for the services, materials or supplies that it is committed to perform.

   a. SDB prime bidders or offerors. An SDB prime firm whose SDB verification is pending or incomplete as of the bid or proposal due date and time may not satisfy the SDB participation goal through its own performance. A self-certified SB prime that does not have its SDB verification as of the bid or proposal due date and time cannot satisfy the SDB participation goal through its own performance.

   b. SDB subcontractors, manufacturers, or suppliers. To receive credit toward meeting the SDB participation goal, the SDB subcontractor, manufacturer, or supplier must be a DGS-verified SDB as of the date the work to be completed by the SDB has commenced. A self-certified SB subcontractor, manufacturer, or supplier that does not have its SDB verification as of the date the work to be completed by the subcontractor, manufacturer, or supplier has commenced cannot be used to satisfy the SDB participation goal.

3. SDB Requirements: To be considered an SDB, a firm must be a **DGS-verified** small minority business enterprise (MBE), woman business enterprise (WBE), LGBT business enterprise (LGBTBE), Disability-owned business enterprise (DOBE), or other small business as approved by DGS, that is owned and controlled by a majority of persons, not

limited to members of minority groups, who have been deprived of the opportunity to develop and maintain a competitive position in the economy because of social disadvantages.

Additional information on the DGS verification process can be found at: https://www.dgs.pa.gov/Small%20Diverse%20Business%20Program/Pages/default.aspx

4. Dually verified firms. If a DGS-verified SDB is dually verified as a VBE, the firm may receive credit towards both the SDB participation goal and the VBE participation goal.

   Example: The SDB participation goal is separate and independent from the VBE participation goal. Therefore, an SDB firm also verified as a VBE may be used towards fulfilling both the SDB participation goal and the VBE participation goal. However, an SDB firm verified as both a WBE and MBE may not be double counted toward satisfying the SDB participation goal.

5. Participation by SDB firms as prime bidders/offerors or subcontractors. A Bidder/Offeror that qualifies as an SDB and submits a bid or proposal as a prime contractor is not prohibited from being included as a subcontractor in separate proposals submitted by other Bidders/Offerors. An SDB may be included as a subcontractor with as many prime contractors as it chooses in separate bids or proposals.

6. Questions about SDB verification. Questions regarding the SDB program, including questions about the self-certification and verification processes can be directed to:

   Department of General Services
   Bureau of Diversity, Inclusion and Small Business Opportunities (BDISBO)
   Room 611, North Office Building
   Harrisburg, PA 17125
   Phone: (717) 783-3119
   Fax: (717) 787-7052
   Email: RA-BDISBOVerification@pa.gov
   Website: www.dgs.pa.gov

III. Guidelines Regarding SDB Prime Self-Performance.

1. An SDB firm participating as a prime bidder or offeror on a procurement may receive credit towards the SDB Participation goal established for the procurement through their own self-performance.

   Example: A solicitation has a 15% SDB participation goal and a 4% VBE participation goal. An SDB prime offeror self-performing only 10% of the work on the contract (if permitted by the solicitation documents) must still satisfy the remaining 5% SDB participation goal and the total 4% VBE participation goal

through subcontracting or must request a Good Faith Efforts Waiver for the unmet SDB and VBE participation goals.

2. For an SDB prime bidder or offeror to receive credit for self-performance, the SDB prime bidder or offeror must be a **DGS-verified** SDB as of the solicitation due date and time and must list itself in the **SDB Listing**.

3. The SDB prime bidder or offeror must also include the classification category (MBE, WBE, LGBTBE, and/or DOBE) under which it is self-performing and include information regarding the work it will self-perform. For any portion of the SDB participation goal not met through the SDB prime bidder or offeror's self-performance, the SDB bidder or offeror must also identify on the **SDB Listing** the portion of the SDB participation goal that will be performed by SDB subcontractors, manufacturers, or suppliers it will use to meet the unmet portion of the goal or must request a Good Faith Efforts waiver.

4. If the SDB prime bidder or offeror is dually verified as a VBE, the bidder or offeror may satisfy both the SDB participation goal and the VBE participation goal through its self-performance. In this instance, the SDB/VBE prime bidder or offeror must also complete the **VBE Participation Submittal** and associated required documents.

IV. **Calculating SDB participation during compliance**. BDISBO will credit the selected offeror for SDB participation as follows:

1. SDB subcontractors. An SDB subcontractor, through its own employees, shall perform at least 50% of the amount of the subcontract. 100% of the total subcontract amount shall be counted towards the SDB participation goal, unless the SDB subcontractor is performing one of the functions listed in paragraphs 2-4 below.

2. SDB manufacturers. An SDB manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles or equipment required under the contract and of the general character described by the specifications. 100% of the total cost of the materials or supplies purchased from the SDB manufacturer shall be counted towards the SDB participation goal.

3. SDB stocking suppliers. An SDB stocking supplier is a firm that owns, operates or maintains a store, warehouse or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock and regularly sold or leased to the public in the usual course of business. 60% of the total cost of the materials or supplies purchased from the SDB stocking supplier shall be counted towards the SDB participation goal.

Example for illustrative purposes of applying the 60% rule:
Overall contract value: $2,000,000
Total value of supplies: $100,000

Apply 60% Rule: $100,000 x 60% = $60,000
Divide 60% Rule result by contract value: $60,000/$2,000,000 = 3%
In this example, 3% would be counted towards the SDB participation goal for the SDB supplier.

4. SDB nonstocking suppliers. An SDB nonstocking supplier is credited at only the amount of the fee or commission charged by the SDB nonstocking supplier for assistance in the procurement of the materials and supplies, provided that the fees or commissions are reasonable and not excessive as compared with fees customarily allowed for similar services, and with the understanding that under no circumstances shall the credit for an SDB nonstocking supplier exceed 10 percent of the purchase order cost. A nonstocking supplier does not carry inventory but orders materials from a manufacturer, manufacturer's representative, or a stocking supplier. In order for a nonstocking supplier to receive credit, it must perform a useful business function by engaging in meaningful work (i.e., negotiating price; AND determining quality and quantity; AND ordering materials; AND paying for the materials) and the fee or commission must be provided with the purchase order and the Utilization Report. Industry practices and other relevant factors will be considered.

V. Document Submittal Errors.

1. **Fatal errors.** The following errors will result in rejection of a bid or proposal as non-responsive**:**

   a. Failure to submit a completed **SDB Participation Submittal**;

   b. Failure to submit an **SDB Listing,** unless the bidder or offer is seeking a complete Good Faith Efforts waiver;

   c. Failure to submit a **Good Faith Efforts waiver request** when not meeting, in full, the SDB participation goal.

2. **Potentially curable errors.** The Issuing Office and BDISBO will provide Bidders or Offerors 72 hours to provide clarifications or to correct errors not listed as fatal errors above. In the event that the additionally submitted information does not adequately address the error, the bid or proposal is subject to rejection. **Bidders or Offerors are not permitted to make material changes during clarifications and corrections in order to meet the SDB Participation Goal.**

3. **Solicitations with Multiple Lots or Base Bids**. If the Bid or Proposal contains separate Lots or multiple Base Bids, an Offeror must complete and submit a separate **SDB Participation Submittal** and accompanying required documentation for EACH Lot or Base Bid for which it is submitting a bid or proposal. Each separate **SDB Participation Submittal** and accompanying required documentation must be labeled to identify the corresponding Lot or Base Bid. Failure to submit an **SDB Participation Submittal** and

accompanying required documentation for each Lot or Base Bid will result in the rejection of the bid or proposal for each Lot or Base Bid for which an **SDB Participation Submittal** was not submitted.

SDB-2
SDB PARTICIPATION SUBMITTAL

CHECK ONE, AND ONLY ONE, BOX. FAILURE TO SUBMIT A COMPLETED SDB PARTICIPATION SUBMITTAL WILL RESULT IN REJECTION OF YOUR BID/PROPOSAL.

☐ **I agree to meet the SDB participation goal in full.**

I have completed and am submitting with my bid or proposal an **SDB Listing**, which is required in order to be considered for award.

☐ **I am requesting a partial waiver of the SDB participation goal.**

After making good faith outreach efforts as more fully described in the **Guidance for Documenting Good Faith Efforts to Meet the SDB Participation Goal**, I am unable to achieve the total SDB participation goal for this solicitation and am requesting a partial waiver of the SDB participation goal.

I have completed and am submitting with my bid or proposal both of the following, which are required in order to be considered for award:

1. an **SDB Listing** for that portion of the SDB participation goal for which I intend to meet; AND

2. a **Good Faith Efforts Waiver Request** for any portion of the SDB participation goals that I do not intend to meet.

☐ **I am requesting a full waiver of the SDB participation goal**

After making good faith outreach efforts as more fully described in the **Guidance for Documenting Good Faith Efforts to Meet the SDB Participation Goal**, I am unable to achieve any part of the SDB participation goal for this solicitation and am requesting a full waiver of the SDB participation goal.

I have completed and am submitting with my bid or proposal a **Good Faith Efforts Waiver Request** for the complete SDB participation goal, which is required in order to be considered for award.

NOTE: SDB primes who are submitting as bidders or offerors must complete an **SDB Listing** identifying any self-performance towards the SDB participation goal.

SDB-3
SDB LISTING

If the Prime Bidder/Offeror is a DGS-verified SDB, complete the following:

SAP Vendor Number (6-digit number): _____

SDB Verification Number (located on DGS SDB verification certificate): _____

Type of SDB: ☐ MBE

☐ WBE

☐ LGBTBE

☐ DOBE

Description of Work to be Performed (Statement of Work/Specification reference): _____

% of work to be self-performed by SDB bidder/offeror: %_____

Associated dollar value of work to be self-performed by SDB bidder/offeror: $_____

SDB participation goal to be met through the use of SDB subcontractors, suppliers, or manufacturers: Bidders/offerors are not required to identify the specific SDB subcontractors, suppliers, or manufacturers within this SDB Listing. However, the selected bidder/offeror must submit Utilization Reports identifying the SDB subcontractors, suppliers, or manufacturers used to meet the portion of the SDB participation goal listed below. To receive credit toward meeting the SDB participation goal, the SDB subcontractor, manufacturer, or supplier must be a DGS-verified SDB as of the date the work to be performed by the SDB has commenced.

% of work to be performed by SDB subcontractors, suppliers, or manufacturers: %_____

Associated dollar value of work to be performed by SDB subcontractors, suppliers, or manufacturers: $_____

SDB-4
GUIDANCE FOR DOCUMENTING GOOD FAITH EFFORTS TO MEET THE SMALL DIVERSE BUSINESS (SDB) PARTICIPATION GOAL

In order to show that the Bidder/Offeror has made Good Faith Efforts to meet the SDB participation goal on a solicitation, the Offeror must either (1) meet the SDB participation goal and document its commitments for participation of SDB firms, or (2) when it does not meet the SDB participation goal, submit a Good Faith Efforts waiver request as set forth in Section IV below and the Good Faith Efforts Documentation to Support Waiver Request of SDB Participation Goal.

I. Definitions

SDB participation goal – "SDB participation goal" refers to the SDB participation goal set for a procurement for MBE, WBE, LGBTBE, and DOBE utilization.

Good Faith Efforts - The "Good Faith Efforts" requirement means that when requesting a waiver, the Offeror must demonstrate that it took all necessary and reasonable steps to achieve the SDB participation goal. Those steps are considered necessary and reasonable when their scope, intensity, and relevance could reasonably be expected to obtain sufficient SDB participation, even if those steps were not fully successful. The Issuing Agency and Department of General Services' Bureau of Diversity, Inclusion and Small Business Opportunities (BDISBO) will determine whether or not the Offeror that requests a Good Faith Efforts waiver made adequate Good Faith Efforts by considering the quality, quantity, and intensity of the Offeror's efforts. Mere *pro forma* efforts are not Good Faith Efforts to meet the SDB participation requirements. The determination concerning the sufficiency of the Offeror's Good Faith Efforts is subjective; meeting quantitative formulas is not required.

Identified Items of Work – all of the items of work the Offeror identified as possible items of work for performance by SDBs and should include all reasonably identifiable work opportunities.

Identified SDBs– all of the SDBs the Offeror identified as available to perform the Identified Items of Work and should include all DGS-verified SDBs that are reasonably identifiable.

Offeror – for purposes of this **Good Faith Efforts Documentation to Support Waiver Request**, the term "Offeror" includes any entity responding to a solicitation, including invitations for bids, requests for proposals, and other types of best value solicitations.

SDB – "SDB" refers to Minority Business Enterprises (MBE), Women Business Enterprises (WBE), Disability-Owned Business Enterprises (DOBE), and LGBT-Owned Business Enterprises (LGBTBE) verified by BDISBO.

II. Types of Actions Agency and BDISBO will Consider

The following is a list of types of actions the procuring agency and BDISBO will consider as part of the Offeror's Good Faith Efforts when the Offeror fails to meet, in full, the SDB participation goal. This list is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases.

A. Identify Proposal Items as Work for SDBs

1. Identified Items of Work
   (a) Offerors should reasonably identify sufficient items of work to be performed by SDBs.

(b) Where appropriate, Offerors should break out contract work items into economically feasible units to facilitate SDB participation, rather than perform these work items with their own forces. **The ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the Offeror of the responsibility to make Good Faith Efforts to meet the SDB participation goal.**

B. Identify SDBs to Solicit

1. Identified SDBs

   (a) Offerors should reasonably identify the SDBs that are available to perform the Identified Items of Work.

   (b) Any SDBs identified as available by the Offeror should be certified to perform the Identified Items of Work.

C. Solicit SDBs

1. Solicit all Identified SDBs for all Identified Items of Work by providing written notice. The Offeror should:

   (a) provide the written solicitation to the Identified SDBs at least 10 days prior to Bid or Proposal due date to allow sufficient time for the Identified SDB to respond;

   (b) send the written solicitation by first-class mail, facsimile, or e-mail using contact information in the BDISBO Directory, unless the Offeror has a valid basis for using different contact information; and

   (c) provide adequate information about the plans, specifications, anticipated time schedule for portions of the work to be performed by the Identified SDB, and other requirements of the contract to assist Identified SDBs in responding. (This information may be provided by including hard copies in the written solicitation or by electronic means as described in C.3 below.)

2. "All" Identified SDBs includes any SDB Firms the Offeror identifies as potentially available to perform the Identified Items of Work, but it does not include Identified SDBs who are no longer certified to perform the work as of the date the Offeror provides written solicitations.

3. "Electronic Means" includes, for example, information provided *via* a website or file transfer protocol (FTP) site containing the plans, specifications, and other requirements of the contract. If an interested SDB cannot access the information provided by electronic means, the Offeror must make the information available in a manner that is accessible to the interested SDB.

4. Follow up on initial written solicitations by contacting Identified SDBs to determine their interest in bidding. The follow up contact may be made:

   (a) by telephone using the contact information in BDISBO's Directory, unless the Offeror has a valid basis for using different contact information; or

(b) in writing *via* a method that differs from the method used for the initial written solicitation.

5. In addition to the written solicitation set forth in C.1 and the follow up required in C.4, use all other reasonable and available means to solicit the interest of Identified SDBs certified to perform the work of the contract. Examples of other means include:

   (a) attending any Supplier Forums, or Pre-Proposal or Pre-Bid conferences at which SDBs could be informed of contracting and subcontracting opportunities; and

   (b) if recommended by the procurement, advertising with or effectively using the services of at least two diversity-focused entities or media, including trade associations, minority/women/disability/LGBT community organizations, minority/women/disability/LGBT contractors' groups, and local, state, and federal minority/women/disability/LGBT business assistance offices.

D. Negotiate with Interested SDBs

Offerors must negotiate in good faith with interested SDBs.

1. Evidence of negotiation includes, without limitation, the following:

   (a) the names, addresses, and telephone numbers of SDBs that were considered;

   (b) a description of the information provided regarding the plans and specifications for the work selected for subcontracting and the means used to provide that information; and

   (c) evidence as to why additional agreements could not be reached for SDBs to perform the work.

2. In negotiating with subcontractors, the Offeror should consider a firm's price and capabilities as well as the SDB participation goal.

3. Additional costs incurred in finding and using SDBs are not sufficient justification for the Offeror's failure to meet the SDB participation goal, as long as such costs are reasonable. Factors to take into consideration when determining whether an SDB's quote is excessive or unreasonable include, without limitation, the following:

   (a) dollar difference between the SDB subcontractor's quote and the average of other subcontractors' quotes received by the Offeror;

   (b) percentage difference between the SDB subcontractor's quote and the average of other subcontractors' quotes received by the Offeror;

   (c) percentage that the SDB subcontractor's quote represents of the overall contract amount;

   (d) whether the work described in the SDB and Non-SDB subcontractor quotes (or portions thereof) submitted for review is the same or comparable; and

(e) number of quotes received by the Offeror for that portion of the work.

4. The factors in paragraph 3 above are not intended to be mandatory, exclusive, or exhaustive, and other evidence of an excessive or unreasonable price may be relevant.

5. The Offeror may not use its price for self-performing work as a basis for rejecting an SDB's quote as excessive or unreasonable.

6. The "average of the other subcontractors' quotes received" by the Offeror refers to the average of the quotes received from all subcontractors. Offeror should attempt to receive quotes from at least three subcontractors, including one quote from an SDB and one quote from a non-SDB.

7. The Offeror shall not reject an SDB as unqualified without sound justification based on a thorough investigation of the firm's capabilities. For each SDB that is rejected as unqualified or that placed a subcontract quotation or offer that the Offeror concludes is not acceptable, the Offeror must provide a written detailed statement outlining the justification for this conclusion. The Offeror also must document the steps taken to verify the capabilities of the SDB and non-SDB Firms quoting similar work.

   (a) The factors to take into consideration when assessing the capabilities of an SDB include, but are not limited to the following: financial capability, physical capacity to perform, available personnel and equipment, existing workload, experience performing the type of work, conduct and performance in previous contracts, and ability to meet reasonable contract requirements.

   (b) The SDB's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of Proposals in the efforts to meet the SDB participation goal.

E. Assisting Interested SDBs

When appropriate under the circumstances, the procuring agency and BDISBO will consider whether the Offeror made reasonable efforts to assist interested SDBs in obtaining:

1. The bonding, lines of credit, or insurance required by the procuring agency or the Offeror; and

2. Necessary equipment, supplies, materials, or related assistance or services.

III. Other Considerations

In making a determination of Good Faith Efforts, the procuring agency and BDISBO may consider engineering estimates, catalogue prices, general market availability and availability of certified SDBs in the area in which the work is to be performed, other Proposals or offers and subcontract Proposals or offers substantiating significant variances between SDB and non-SDB costs of participation, and their impact on the overall cost of the contract to the Commonwealth and any other relevant factors.

The procuring agency and BDISBO may consider whether the Offeror decided to self-perform subcontract work with its own forces. The procuring agency and BDISBO also may consider the performance of other Offerors in meeting the SDB participation goal. For example, when the apparent successful Offeror fails to meet the SDB participation goal, but others meet it, this raises the question of whether, with additional reasonable efforts, the apparent successful Offeror could have met the SDB participation goal. If the apparent successful Offeror fails to meet the SDB participation goal but meets or exceeds the average SDB participation obtained by other Offerors, this, when viewed in conjunction with other factors, could be evidence of the apparent successful Offeror having made Good Faith Efforts.

IV. Documenting Good Faith Efforts

At a minimum, the Offeror seeking a Good Faith Efforts waiver of the SDB participation goal or a portion thereof must provide written documentation of its Good Faith Efforts along with its bid or proposal. The written documentation shall include the following:

A. Items of Work (complete SDB 5, Part 1 – Identified Items of Work Offeror Made Available to SDBs)

A detailed statement of the efforts made to select portions of the work proposed to be performed by SDBs in order to increase the likelihood of achieving the SDB participation goal.

B. Outreach/Solicitation/Negotiation

1. A detailed statement of the efforts made to contact and negotiate with SDBs including:

   (a) the names, addresses, and telephone numbers of the SDBs who were contacted, with the dates and manner of contacts (letter, fax, e-mail, telephone, etc.) (**complete SDB 5, Part 2 – Identified SDB Firms and Records of Solicitations. Include letters, fax cover sheets, e-mails, etc. documenting solicitations**); and

   (b) a description of the information provided to SDBs regarding the plans, specifications, and anticipated time schedule for portions of the work to be performed and the means used to provide that information.

2. The record of the Offeror's compliance with the outreach efforts set forth in **SDB 5, Part 3 - Outreach Efforts Compliance Statement.**

C. Rejected SDBs (complete SDB 5, Part 4 - Additional Information Regarding Rejected SDB Quotes)

1. For each SDB that the Offeror concludes is not acceptable or qualified, a detailed statement of the reasons for the Offeror’s conclusion, including the steps taken to verify the capabilities of the SDB and non-SDB firms quoting similar work.

2. For each SDB that the Offeror concludes has provided an excessive or unreasonable price, a detailed statement of the reasons for the Offeror’s conclusion, including the quotes received from all SDB and non-SDB firms proposing on the same or comparable work. **(Include copies of all quotes received.)**

D. Unavailable SDBs (complete SDB 5, Part 5 – SDB Subcontractor Unavailability Certificate)

1. **For each SDB that the Offeror contacted but found to be unavailable, submit an SDB Subcontractor Unavailability Certificate** signed by the SDB, an email from the SDB indicating the SDB is unavailable, or a statement from the Offeror that the SDB refused to sign the SDB Subcontractor Unavailability Certificate.

E. Other Documentation

1. Submit any other documentation requested by BDISBO or the Procuring Agency to ascertain the Offeror's Good Faith Efforts.

2. Submit any other documentation the Offeror believes will help BDISBO or the Procuring Agency ascertain its Good Faith Efforts.

SDB-5

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF SDB PARTICIPATION GOAL

Project Description:	
Commonwealth Agency Name:	
Solicitation #:	
Solicitation Due Date and Time:	

Bidder/Offeror Company Name:	
Bidder/Offeror Contact Name:	
Bidder/Offeror Contact Email:	
Bidder/Offeror Contact Phone Number:	

Part 1 – Identified Items of Work Offeror Made Available to SDBs

Identify those items of work that the Offeror made available to SDBs. This includes, where appropriate, those items the Offeror identified and subdivided into economically feasible units to facilitate the SDB participation. For each item listed, show the anticipated percentage of the total contract amount. It is the Offeror's responsibility to demonstrate that enough work to meet the SDB participation goal was made available to SDBs, and the total percentage of the items of work identified for SDB participation met or exceeded the SDB participation goal set for the procurement.

Identified Items of Work	Was this work listed in the solicitation?	Does Offeror normally self-perform this work?	Was this work made available to SDB Firms? If not, explain why.
	Yes ○ No ◉	Yes ○ No ◉	Yes ○ No ◉
	Yes ○ No ◉	Yes ○ No ◉	Yes ○ No ◉
	Yes ○ No ◉	Yes ○ No ◉	Yes ○ No ◉
	Yes ○ No ◉	Yes ○ No ◉	Yes ○ No ◉
	Yes ○ No ◉	Yes ○ No ◉	Yes ○ No ◉

Attach additional sheets if necessary.

SDB-5

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF SDB PARTICIPATION GOAL

Part 2 – Identified SDBs and Record of Solicitations

Identify the SDBs solicited to provide quotes for the Identified Items of Work made available for SDB participation. Include the name of the SDB solicited, items of work for which quotes were solicited, date and manner of initial and follow-up solicitations, whether the SDB provided a quote, and whether the SDB is being used toward meeting the SDB participation goal.

Note: Copies of all written solicitations and documentation of follow-up calls to SDBs must be attached to this form. For each Identified SDB listed below, Offeror should submit an SDB Subcontractor Unavailability Certificate signed by the SDB or a statement from the Offeror that the SDB refused to sign the SDB Subcontractor Unavailability Certificate.

Name of Identified SDB and Classification	**Describe Item of Work Solicited**	**Initial Solicitation Date & Method**	**Follow-up Solicitation Date & Method**	**Details for Follow-up Calls**	**Quote Received?**	**Quote Used?**	**Reason Quote Rejected**
SDB Name: ☐ MBE ☐ WBE ☐ LGBTBE ☐ DOBE		Date: ☐ mail ☐ email ☐ fax	Date: ☐ mail ☐ email ☐ fax	Date and Time of Call: Spoke with: Left Message:	☐ yes ☐ no	☐ yes ☐ no	☐ Used other SDB ☐ Used non-SDB ☐ Self performing
SDB Name: ☐ MBE ☐ WBE ☐ LGBTBE ☐ DOBE		Date: ☐ mail ☐ email ☐ fax	Date: ☐ mail ☐ email ☐ fax	Date and Time of Call: Spoke with: Left Message:	☐ yes ☐ no	☐ yes ☐ no	☐ Used other SDB ☐ Used non-SDB ☐ Self performing

Attach additional sheets as necessary.

SDB-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF SDB PARTICIPATION GOAL

Part 3 – SDB Outreach Compliance Statement

1. **List the Identified Items of Work (subcontracting opportunities) for the solicitation along with specific work categories:**

_____

_____

_____

2. **Attach to this form copies of written solicitations (with Bid or Proposal instructions) used to solicit Identified SDBs for these subcontract opportunities.**

3. **Offeror made the following attempts to personally contact the Identified SDBs:**

_____

_____

_____

4. **Bonding Requirements (Please Check One):**

☐ This project does not involve bonding requirements.

☐ Offeror assisted Identified SDBs to fulfill or seek waiver of bonding requirements.
(DESCRIBE EFFORTS):

_____

_____

_____

5. **Pre-Bid/Proposal Conference or Supplier Forum (Please Check One):**

☐ Offeror did attend the pre-Bid/Proposal conference or Supplier Forum

☐ No pre-Bid/Proposal conference or Supplier Forum was held

☐ Offeror did not attend the pre-Bid/Proposal conference or Supplier Forum

SDB-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF SDB PARTICIPATION GOAL

Part 4 – Additional Information Regarding Rejected SDB Quotes

This form must be completed if Part 2 indicates that an SDB quote was rejected because the Offeror is using a non-SDB or is self-performing the Identified Items of Work. List the Identified Items Work, indicate whether the work will be self-performed or performed by a non-SDB, and if applicable, state the name of the non-SDB firm. Also include the names of all SDBs and non-SDB firms that provided a quote and the amount of each quote.

Describe Identified Items of Work not being performed by SDBs (include specific section from bid or proposal)	**Self-performing or using non-SDB (provide name of non-SDB if applicable)**	**Amount of non-SDB quote**	**Name of other firms that provided quotes and whether they are SDB**	**Amount quoted**	**Reason why SDB quote was rejected along with brief explanation**
	☐ self-performing ☐ using Non-SDB Name: ___________	$	_______________ SDB ___________ Non-SDB	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-SDB Name: ___________	$	_______________ SDB ___________ Non-SDB	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-SDB Name: ___________	$	_______________ SDB ___________ Non-SDB	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-SDB Name: ___________	$	_______________ SDB ___________ Non-SDB	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-SDB Name: ___________	$	_______________ SDB ___________ Non-SDB	$	☐ price ☐ capabilities ☐ other

Attach additional sheets as necessary.

SDB-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF SDB PARTICIPATION GOAL

Part 5 – SDB Subcontractor Unavailability Certificate

1. It is hereby certified that the firm of _____
(Name of SDB)

located at_____
(Number) (Street)

_____
(City) (State) (Zip)

was offered an opportunity to bid on Solicitation No. _____

by _____
(Name of Prime Contractor's Firm)

****

2. _____(SDB), is either unavailable for the work/service or unable to prepare a Proposal for this project for the following reason(s):

_____

_____
(Signature of SDB's Representative) (Title) (Date)

_____
(DGS SDB Certification #) (Telephone #)

****

3. If the SDB does not complete this form, the prime contractor must complete the following:

To the best of my knowledge and belief, the above-listed SDB is either unavailable for the work/service for this project, is unable to prepare a Proposal, or did not respond to a request for a price Proposal and has not completed the above portion of this submittal.

_____
(Signature of Prime Contractor) (Title) (Date)

VBE-1

INSTRUCTIONS FOR COMPLETING THE VETERAN BUSINESS ENTERPRISE (VBE) PARTICIPATION SUBMITTAL.

GENERAL CONTRACT ONLY 3% VBE PARTICIPATION

PLEASE READ BEFORE COMPLETING THESE DOCUMENTS

The following instructions include details for completing the VBE Participation Submittal which Bidders or Offerors must submit in order to be considered responsive.

This form also includes instructions for completing the VBE Listing, which Bidders or Offerors must submit for any portion of the VBE participation goal the Bidder or Offeror commits to meeting.

Bidder/Offeror shall attempt to achieve the VBE participation goal set forth in the **SDB and VBE Participation Summary Sheet**. Bidder/Offeror agrees to exercise Good Faith Efforts to carry out the requirements set forth in these Instructions.

I. **VBE Participation Goal:** The VBE participation goal is set forth in the **SDB and VBE Participation Summary Sheet**. The Bidder/Offeror is encouraged to use a diverse group of subcontractors and suppliers to meet the VBE participation goal.

II. **VBE Eligibility**:

1. Finding VBE firms: The directory of **DGS-verified** VBE firms can be accessed from the DGS Supplier Search directory at: http://www.dgs.internet.state.pa.us/suppliersearch.

2. **Only VBEs verified by DGS** and as defined herein may be counted for purposes of achieving the VBE participation goal. In order to be counted for purposes of achieving the VBE participation goal, the VBE firm, including a VBE prime, must be DGS-verified for the services, materials or supplies that it is committed to perform.

   a. VBE prime bidders or offerors. A VBE prime firm whose VBE verification is pending or incomplete as of the bid or proposal due date and time may not satisfy the VBE participation goal through its own performance. A self-certified SB prime that does not have its VBE verification as of the bid or proposal due date and time cannot satisfy the VBE participation goal through its own performance.

   b. VBE subcontractors, manufacturers, or suppliers. To receive credit toward meeting the VBE participation goal, the VBE subcontractor, manufacturer, or supplier must be a DGS-verified VBE as of the date the work to be completed by the VBE has commenced. A self-certified SB subcontractor, manufacturer, or supplier that does not have its VBE verification as of the date the work to be completed by the subcontractor, manufacturer, or supplier has commenced cannot be used to satisfy the VBE participation goal.

3. VBE Requirements: To be considered a VBE, a firm must be a **DGS-verified** Veteran-Owned Small Business Enterprise or Service-Disabled Veteran-Owned Small Business Enterprise.

Additional information on the DGS verification process can be found at: https://www.dgs.pa.gov/Small%20Diverse%20Business%20Program/Pages/default.aspx

4. Dually verified firms. If a DGS-verified VBE is dually verified as an SDB, the firm may receive credit towards both the VBE participation goal and the SDB participation goal.

   Example: The VBE participation goal is separate and independent from the SDB participation goal. Therefore, a VBE firm also verified as an SDB may be used towards fulfilling both the VBE participation goal and the SDB participation goal.

5. Participation by VBE firms as prime bidders/offerors or subcontractors. A Bidder/Offeror that qualifies as a VBE and submits a bid or proposal as a prime contractor is not prohibited from being included as a subcontractor in separate proposals submitted by other Bidders/Offerors. A VBE may be included as a subcontractor with as many prime contractors as it chooses in separate bids or proposals.

6. Questions about VBE verification. Questions regarding the VBE program, including questions about the self-certification and verification processes can be directed to:

   Department of General Services
   Bureau of Diversity, Inclusion and Small Business Opportunities (BDISBO)
   Room 611, North Office Building
   Harrisburg, PA 17125
   Phone: (717) 783-3119
   Fax: (717) 787-7052
   Email: RA-BDISBOVerification@pa.gov
   Website: www.dgs.pa.gov

III. Guidelines Regarding VBE Prime Self-Performance.

1. A VBE firm participating as a prime bidder or offeror on a procurement may receive credit towards the VBE Participation goal established for the procurement through their own self-performance.

   Example: A solicitation has a 15% VBE participation goal and a 4% SDB participation goal. A VBE prime offeror self-performing only 10% of the work on the contract (if permitted by the solicitation documents) must still satisfy the remaining 5% VBE participation goal and the total 4% SDB participation goal through subcontracting or must request a Good Faith Efforts Waiver for the unmet VBE and SDB participation goals.

2. For a VBE prime bidder or offeror to receive credit for self-performance, the VBE prime bidder or offeror must be a **DGS-verified** VBE as of the solicitation due date and time and must list itself in the **VBE Listing**.

3. The VBE prime bidder or offeror must also identify whether it is a Veteran-Owned Small Business Enterprise or Service-Disabled Veteran-Owned Small Business Enterprise,and include information regarding the work it will self-perform. For any portion of the VBE participation goal not met through the VBE prime bidder or offeror's self-performance, the VBE bidder or offeror must also identify on the **VBE Listing** the portion of the VBE participation goal that will be performed by VBE subcontractors, manufacturers, or suppliers it will use to meet the unmet portion of the goal or must request a Good Faith Efforts waiver.

4. If the VBE prime bidder or offeror is dually verified as an SDB, the bidder or offeror may satisfy both the VBE participation goal and the SDB participation goal through its self-performance. In this instance, the VBE/SDB prime bidder or offeror must also complete the **SDB Participation Submittal** and associated required documents.

IV. **Calculating VBE participation during compliance**. BDISBO will credit the selected offeror for VBE participation as follows:

1. VBE subcontractors. A VBE subcontractor, through its own employees, shall perform at least 50% of the amount of the subcontract. 100% of the total subcontract amount shall be counted towards the VBE participation goal, unless the VBE subcontractor is performing one of the functions listed in paragraphs 2-4 below.

2. VBE manufacturers. A VBE manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles or equipment required under the contract and of the general character described by the specifications. 100% of the total cost of the materials or supplies purchased from the VBE manufacturer shall be counted towards the VBE participation goal.

3. VBE stocking suppliers. A VBE stocking supplier is a firm that owns, operates or maintains a store, warehouse or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock and regularly sold or leased to the public in the usual course of business. 60% of the total cost of the materials or supplies purchased from the VBE stocking supplier shall be counted towards the VBE participation goal.

Example for illustrative purposes of applying the 60% rule:
Overall contract value: $2,000,000
Total value of supplies: $100,000
Apply 60% Rule: $100,000 x 60% = $60,000
Divide 60% Rule result by contract value: $60,000/$2,000,000 = 3%

In this example, 3% would be counted towards the VBE participation goal for the VBE supplier.

4. VBE nonstocking suppliers. A VBE nonstocking supplier is credited at only the amount of the fee or commission charged by the VBE nonstocking supplier for assistance in the procurement of the materials and supplies, provided that the fees or commissions are reasonable and not excessive as compared with fees customarily allowed for similar services, and with the understanding that under no circumstances shall the credit for a VBE nonstocking supplier exceed 10 percent of the purchase order cost. A nonstocking supplier does not carry inventory but orders materials from a manufacturer, manufacturer's representative, or a stocking supplier. In order for a nonstocking supplier to receive credit, it must perform a useful business function by engaging in meaningful work (i.e., negotiating price; AND determining quality and quantity; AND ordering materials; AND paying for the materials) and the fee or commission must be provided with the purchase order and the Utilization Report. Industry practices and other relevant factors will be considered.

V. Document Submittal Errors.

1. **Fatal errors.** The following errors will result in rejection of a bid or proposal as non-responsive**:**

   a. Failure to submit a completed **VBE Participation Submittal**;

   b. Failure to submit a **VBE Listing,** unless the bidder or offer is seeking a complete Good Faith Efforts waiver;

   c. Failure to submit a **Good Faith Efforts waiver request** when not meeting, in full, the VBE participation goal.

2. **Potentially curable errors.** The Issuing Office and BDISBO will provide Bidders or Offerors 72 hours to provide clarifications or to correct errors not listed as fatal errors above. In the event that the additionally submitted information does not adequately address the error, the bid or proposal is subject to rejection. **Bidders or Offerors are not permitted to make material changes during clarifications and corrections in order to meet the VBE Participation Goal.**

3. **Solicitations with Multiple Lots or Base Bids**. If the Bid or Proposal contains separate Lots or multiple Base Bids, an Offeror must complete and submit a separate **VBE Participation Submittal** and accompanying required documentation for EACH Lot or Base Bid for which it is submitting a bid or proposal. Each separate **VBE Participation Submittal** and accompanying required documentation must be labeled to identify the corresponding Lot or Base Bid. Failure to submit a **VBE Participation Submittal** and accompanying required documentation for each Lot or Base Bid will result in the rejection

of the bid or proposal for each Lot or Base Bid for which a **VBE Participation Submittal** was not submitted.

VBE-2
VBE PARTICIPATION SUBMITTAL

CHECK ONE, AND ONLY ONE, BOX. FAILURE TO SUBMIT A COMPLETED VBE PARTICIPATION SUBMITTAL WILL RESULT IN REJECTION OF YOUR BID/PROPOSAL.

☐ **I agree to meet the VBE participation goal in full.**

I have completed and am submitting with my bid or proposal a **VBE Listing**, which is required in order to be considered for award.

☐ **I am requesting a partial waiver of the VBE participation goal.**

After making good faith outreach efforts as more fully described in the **Guidance for Documenting Good Faith Efforts to Meet the VBE Participation Goal**, I am unable to achieve the total VBE participation goal for this solicitation and am requesting a partial waiver of the VBE participation goal.

I have completed and am submitting with my bid or proposal both of the following, which are required in order to be considered for award:

1. a **VBE Listing** for that portion of the VBE participation goal for which I intend to meet; AND

2. a **Good Faith Efforts Waiver Request** for any portion of the VBE participation goals that I do not intend to meet.

☐ **I am requesting a full waiver of the VBE participation goal**

After making good faith outreach efforts as more fully described in the **Guidance for Documenting Good Faith Efforts to Meet the VBE Participation Goal**, I am unable to achieve any part of the VBE participation goal for this solicitation and am requesting a full waiver of the VBE participation goal.

I have completed and am submitting with my bid or proposal a **Good Faith Efforts Waiver Request** for the complete VBE participation goal, which is required in order to be considered for award.

NOTE: VBE primes who are submitting as bidders or offerors must complete a **VBE Listing** identifying any self-performance towards the VBE participation goal.

VBE-3
VBE LISTING

If the Prime Bidder/Offeror is a DGS-verified VBE, complete the following:

SAP Vendor Number (6-digit number): _____

VBE Verification Number (located on DGS SDB verification certificate): _____

Type of VBE: ☐ Veteran-Owned Small Business Enterprise

☐ Service-Disabled Veteran-Owned Small Business Enterprise

Description of Work to be Performed (Statement of Work/Specification reference): _____

% of work to be self-performed by VBE bidder/offeror: %_____

Associated dollar value of work to be self-performed by VBE bidder/offeror: $_____

VBE participation goal to be met through the use of VBE subcontractors, suppliers, or manufacturers: Bidders/offerors are not required to identify the specific VBE subcontractors, suppliers, or manufacturers within this VBE Listing. However, the selected bidder/offeror must submit Utilization Reports identifying the VBE subcontractors, suppliers, or manufacturers used to meet the portion of the VBE participation goal listed below. To receive credit toward meeting the VBE participation goal, the VBE subcontractor, manufacturer, or supplier must be a DGS-verified VBE as of the date the work to be performed by the VBE has commenced.

% of work to be performed by VBE subcontractors, suppliers, or manufacturers: %_____

Associated dollar value of work to be performed by VBE subcontractors, suppliers, or manufacturers: $_____

VBE-4
GUIDANCE FOR DOCUMENTING GOOD FAITH EFFORTS TO MEET THE VETERAN BUSINESS ENTERPRISE (VBE) PARTICIPATION GOAL

In order to show that the Bidder/Offeror has made Good Faith Efforts to meet the VBE participation goal on a solicitation, the Offeror must either (1) meet the VBE participation goal and document its commitments for participation of VBE firms, or (2) when it does not meet the VBE participation goal, submit a Good Faith Efforts waiver request as set forth in Section IV below and the Good Faith Efforts Documentation to Support Waiver Request of VBE Participation Goal.

I. Definitions

VBE participation goal – "VBE participation goal" refers to the VBE participation goal set for a procurement for Veteran-Owned Small Business Enterprise and Service-Disabled Veteran-Owned Small Business Enterprise utilization.

Good Faith Efforts - The "Good Faith Efforts" requirement means that when requesting a waiver, the Offeror must demonstrate that it took all necessary and reasonable steps to achieve the VBE participation goal. Those steps are considered necessary and reasonable when their scope, intensity, and relevance could reasonably be expected to obtain sufficient VBE participation, even if those steps were not fully successful. The Issuing Agency and Department of General Services' Bureau of Diversity, Inclusion and Small Business Opportunities (BDISBO) will determine whether or not the Offeror that requests a Good Faith Efforts waiver made adequate Good Faith Efforts by considering the quality, quantity, and intensity of the Offeror's efforts. Mere *pro forma* efforts are not Good Faith Efforts to meet the VBE participation requirements. The determination concerning the sufficiency of the Offeror's Good Faith Efforts is subjective; meeting quantitative formulas is not required.

Identified Items of Work – all of the items of work the Offeror identified as possible items of work for performance by VBEs and should include all reasonably identifiable work opportunities.

Identified VBEs– all of the VBEs the Offeror identified as available to perform the Identified Items of Work and should include all DGS-verified VBEs that are reasonably identifiable.

Offeror – for purposes of this **Good Faith Efforts Documentation to Support Waiver Request**, the term "Offeror" includes any entity responding to a solicitation, including invitations for bids, requests for proposals, and other types of best value solicitations.

VBE – "VBE" refers to Veteran-Owned Small Business Enterprises and Service-Disabled Veteran-Owned Small Business Enterprises verified by BDISBO.

II. Types of Actions Agency and BDISBO will Consider

The following is a list of types of actions the procuring agency and BDISBO will consider as part of the Offeror's Good Faith Efforts when the Offeror fails to meet, in full, the VBE participation goal. This list is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases.

A. Identify Proposal Items as Work for VBEs

1. Identified Items of Work
   (a) Offerors should reasonably identify sufficient items of work to be performed by VBEs.

(b) Where appropriate, Offerors should break out contract work items into economically feasible units to facilitate VBE participation, rather than perform these work items with their own forces. **The ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the Offeror of the responsibility to make Good Faith Efforts to meet the VBE participation goal.**

B. Identify VBEs to Solicit

1. Identified VBEs

   (a) Offerors should reasonably identify the VBEs that are available to perform the Identified Items of Work.

   (b) Any VBEs identified as available by the Offeror should be certified to perform the Identified Items of Work.

C. Solicit VBEs

1. Solicit all Identified VBEs for all Identified Items of Work by providing written notice. The Offeror should:

   (a) provide the written solicitation to the Identified VBEs at least 10 days prior to Bid or Proposal due date to allow sufficient time for the Identified VBE to respond;

   (b) send the written solicitation by first-class mail, facsimile, or e-mail using contact information in the BDISBO Directory, unless the Offeror has a valid basis for using different contact information; and

   (c) provide adequate information about the plans, specifications, anticipated time schedule for portions of the work to be performed by the Identified VBE, and other requirements of the contract to assist Identified VBEs in responding. (This information may be provided by including hard copies in the written solicitation or by electronic means as described in C.3 below.)

2. "All" Identified VBEs includes any VBE Firms the Offeror identifies as potentially available to perform the Identified Items of Work, but it does not include Identified VBEs who are no longer certified to perform the work as of the date the Offeror provides written solicitations.

3. "Electronic Means" includes, for example, information provided *via* a website or file transfer protocol (FTP) site containing the plans, specifications, and other requirements of the contract. If an interested VBE cannot access the information provided by electronic means, the Offeror must make the information available in a manner that is accessible to the interested VBE.

4. Follow up on initial written solicitations by contacting Identified VBEs to determine their interest in bidding. The follow up contact may be made:

   (a) by telephone using the contact information in BDISBO's Directory, unless the Offeror has a valid basis for using different contact information; or

(b) in writing *via* a method that differs from the method used for the initial written solicitation.

5. In addition to the written solicitation set forth in C.1 and the follow up required in C.4, use all other reasonable and available means to solicit the interest of Identified VBEs certified to perform the work of the contract. Examples of other means include:

   (a) attending any Supplier Forums, or Pre-Proposal or Pre-Bid conferences at which VBEs could be informed of contracting and subcontracting opportunities; and

   (b) if recommended by the procurement, advertising with or effectively using the services of at least two veteran-focused entities or media, including trade associations, veteran community organizations, veteran contractors' groups, and local, state, and federal veteran business assistance offices.

D. Negotiate with Interested VBEs

Offerors must negotiate in good faith with interested VBEs.

1. Evidence of negotiation includes, without limitation, the following:

   (a) the names, addresses, and telephone numbers of VBEs that were considered;

   (b) a description of the information provided regarding the plans and specifications for the work selected for subcontracting and the means used to provide that information; and

   (c) evidence as to why additional agreements could not be reached for VBEs to perform the work.

2. In negotiating with subcontractors, the Offeror should consider a firm's price and capabilities as well as the VBE participation goal.

3. Additional costs incurred in finding and using VBEs are not sufficient justification for the Offeror's failure to meet the VBE participation goal, as long as such costs are reasonable. Factors to take into consideration when determining whether a VBE's quote is excessive or unreasonable include, without limitation, the following:

   (a) dollar difference between the VBE subcontractor's quote and the average of other subcontractors' quotes received by the Offeror;

   (b) percentage difference between the VBE subcontractor's quote and the average of other subcontractors' quotes received by the Offeror;

   (c) percentage that the VBE subcontractor's quote represents of the overall contract amount;

   (d) whether the work described in the VBE and Non-VBE subcontractor quotes (or portions thereof) submitted for review is the same or comparable; and

(e) number of quotes received by the Offeror for that portion of the work.

4. The factors in paragraph 3 above are not intended to be mandatory, exclusive, or exhaustive, and other evidence of an excessive or unreasonable price may be relevant.

5. The Offeror may not use its price for self-performing work as a basis for rejecting a VBE's quote as excessive or unreasonable.

6. The "average of the other subcontractors' quotes received" by the Offeror refers to the average of the quotes received from all subcontractors. Offeror should attempt to receive quotes from at least three subcontractors, including one quote from a VBE and one quote from a non-VBE.

7. The Offeror shall not reject a VBE as unqualified without sound justification based on a thorough investigation of the firm's capabilities. For each VBE that is rejected as unqualified or that placed a subcontract quotation or offer that the Offeror concludes is not acceptable, the Offeror must provide a written detailed statement outlining the justification for this conclusion. The Offeror also must document the steps taken to verify the capabilities of the VBE and non-VBE Firms quoting similar work.

   (a) The factors to take into consideration when assessing the capabilities of a VBE include, but are not limited to the following: financial capability, physical capacity to perform, available personnel and equipment, existing workload, experience performing the type of work, conduct and performance in previous contracts, and ability to meet reasonable contract requirements.

   (b) The VBE's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of Proposals in the efforts to meet the VBE participation goal.

E. Assisting Interested VBEs

When appropriate under the circumstances, the procuring agency and BDISBO will consider whether the Offeror made reasonable efforts to assist interested VBEs in obtaining:

1. The bonding, lines of credit, or insurance required by the procuring agency or the Offeror; and

2. Necessary equipment, supplies, materials, or related assistance or services.

III. Other Considerations

In making a determination of Good Faith Efforts, the procuring agency and BDISBO may consider engineering estimates, catalogue prices, general market availability and availability of certified VBEs in the area in which the work is to be performed, other Proposals or offers and subcontract Proposals or offers substantiating significant variances between VBE and non-VBE costs of participation, and their impact on the overall cost of the contract to the Commonwealth and any other relevant factors.

The procuring agency and BDISBO may consider whether the Offeror decided to self-perform subcontract work with its own forces. The procuring agency and BDISBO also may consider the performance of other Offerors in meeting the VBE participation goal. For example, when the apparent successful Offeror fails to meet the VBE participation goal, but others meet it, this raises the question of whether, with additional reasonable efforts, the apparent successful Offeror could have met the VBE participation goal. If the apparent successful Offeror fails to meet the VBE participation goal but meets or exceeds the average VBE participation obtained by other Offerors, this, when viewed in conjunction with other factors, could be evidence of the apparent successful Offeror having made Good Faith Efforts.

IV. Documenting Good Faith Efforts

At a minimum, the Offeror seeking a Good Faith Efforts waiver of the VBE participation goal or a portion thereof must provide written documentation of its Good Faith Efforts along with its bid or proposal. The written documentation shall include the following:

A. Items of Work (complete VBE 5, Part 1 – Identified Items of Work Offeror Made Available to VBEs)

A detailed statement of the efforts made to select portions of the work proposed to be performed by VBEs in order to increase the likelihood of achieving the VBE participation goal.

B. Outreach/Solicitation/Negotiation

1. A detailed statement of the efforts made to contact and negotiate with VBEs including:

   (a) the names, addresses, and telephone numbers of the VBEs who were contacted, with the dates and manner of contacts (letter, fax, e-mail, telephone, etc.) (**complete VBE 5, Part 2 – Identified VBE Firms and Records of Solicitations. Include letters, fax cover sheets, e-mails, etc. documenting solicitations**); and

   (b) a description of the information provided to VBEs regarding the plans, specifications, and anticipated time schedule for portions of the work to be performed and the means used to provide that information.

2. The record of the Offeror's compliance with the outreach efforts set forth in **VBE 5, Part 3 - Outreach Efforts Compliance Statement.**

C. Rejected VBEs (complete VBE 5, Part 4 - Additional Information Regarding Rejected VBE Quotes)

1. For each VBE that the Offeror concludes is not acceptable or qualified, a detailed statement of the reasons for the Offeror’s conclusion, including the steps taken to verify the capabilities of the VBE and non-VBE firms quoting similar work.

2. For each VBE that the Offeror concludes has provided an excessive or unreasonable price, a detailed statement of the reasons for the Offeror’s conclusion, including the quotes received from all VBE and non-VBE firms proposing on the same or comparable work. **(Include copies of all quotes received.)**

D. Unavailable VBEs (complete VBE 5, Part 5 – VBE Subcontractor Unavailability Certificate)

1. **For each VBE that the Offeror contacted but found to be unavailable, submit a VBE Subcontractor Unavailability Certificate** signed by the VBE, an email from the VBE indicating the VBE is unavailable, or a statement from the Offeror that the VBE refused to sign the VBE Subcontractor Unavailability Certificate.

E. Other Documentation

1. Submit any other documentation requested by BDISBO or the Procuring Agency to ascertain the Offeror's Good Faith Efforts.

2. Submit any other documentation the Offeror believes will help BDISBO or the Procuring Agency ascertain its Good Faith Efforts.

VBE-5

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF VBE PARTICIPATION GOAL

Project Description:	
Commonwealth Agency Name:	
Solicitation #:	
Solicitation Due Date and Time:	

Bidder/Offeror Company Name:	
Bidder/Offeror Contact Name:	
Bidder/Offeror Contact Email:	
Bidder/Offeror Contact Phone Number:	

Part 1 – Identified Items of Work Offeror Made Available to VBEs

Identify those items of work that the Offeror made available to VBEs. This includes, where appropriate, those items the Offeror identified and subdivided into economically feasible units to facilitate the VBE participation. For each item listed, show the anticipated percentage of the total contract amount. It is the Offeror's responsibility to demonstrate that enough work to meet the VBE participation goal was made available to VBEs, and the total percentage of the items of work identified for VBE participation met or exceeded the VBE participation goal set for the procurement.

Identified Items of Work	Was this work listed in the solicitation?	Does Offeror normally self-perform this work?	Was this work made available to VBE Firms? If not, explain why.
	Yes ○ No ○	Yes ○ No ○	Yes ○ No ○
	Yes ○ No ○	Yes ○ No ○	Yes ○ No ○
	Yes ○ No ○	Yes ○ No ○	Yes ○ No ○
	Yes ○ No ○	Yes ○ No ○	Yes ○ No ○
	Yes ○ No ○	Yes ○ No ○	Yes ○ No ○

Attach additional sheets if necessary.

VBE-5

GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF VBE PARTICIPATION GOAL

Part 2 – Identified VBEs and Record of Solicitations

Identify the VBEs solicited to provide quotes for the Identified Items of Work made available for VBE participation. Include the name of the VBE solicited, items of work for which quotes were solicited, date and manner of initial and follow-up solicitations, whether the VBE provided a quote, and whether the VBE is being used toward meeting the VBE participation goal.

Note: Copies of all written solicitations and documentation of follow-up calls to VBEs must be attached to this form. For each Identified VBE listed below, Offeror should submit a VBE Subcontractor Unavailability Certificate signed by the VBE or a statement from the Offeror that the VBE refused to sign the VBE Subcontractor Unavailability Certificate.

Name of Identified VBE and Classification	**Describe Item of Work Solicited**	**Initial Solicitation Date & Method**	**Follow-up Solicitation Date & Method**	**Details for Follow-up Calls**	**Quote Received?**	**Quote Used?**	**Reason Quote Rejected**
VBE Name: ☐ Veteran-Owned Business Enterprise ☐ Service-Disabled Veteran-Owned Business Enterprise		Date: ☐ mail ☐ email ☐ fax	Date: ☐ mail ☐ email ☐ fax	Date and Time of Call: Spoke with: Left Message:	☐ yes ☐ no	☐ yes ☐ no	☐ Used other VBE ☐ Used non-VBE ☐ Self-performing
VBE Name: ☐ Veteran-Owned Business Enterprise ☐ Service-Disabled Veteran-Owned Business Enterprise		Date: ☐ mail ☐ email ☐ fax	Date: ☐ mail ☐ email ☐ fax	Date and Time of Call: Spoke with: Left Message:	☐ yes ☐ no	☐ yes ☐ no	☐ Used other VBE ☐ Used non-VBE ☐ Self-performing

Attach additional sheets as necessary.

VBE-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF VBE PARTICIPATION GOAL

Part 3 – VBE Outreach Compliance Statement

1. **List the Identified Items of Work (subcontracting opportunities) for the solicitation along with specific work categories:**

_____

_____

_____

2. **Attach to this form copies of written solicitations (with Bid or Proposal instructions) used to solicit Identified VBEs for these subcontract opportunities.**

3. **Offeror made the following attempts to personally contact the Identified VBEs:**

_____

_____

_____

4. **Bonding Requirements (Please Check One):**

☐ This project does not involve bonding requirements.

☐ Offeror assisted Identified VBEs to fulfill or seek waiver of bonding requirements.

(DESCRIBE EFFORTS):

_____

_____

_____

5. **Pre-Bid/Proposal Conference or Supplier Forum (Please Check One):**

☐ Offeror did attend the pre-Bid/Proposal conference or Supplier Forum

☐ No pre-Bid/Proposal conference or Supplier Forum was held

☐ Offeror did not attend the pre-Bid/Proposal conference or Supplier Forum

VBE-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF VBE PARTICIPATION GOAL

Part 4 – Additional Information Regarding Rejected VBE Quotes

This form must be completed if Part 2 indicates that a VBE quote was rejected because the Offeror is using a non-VBE or is self-performing the Identified Items of Work. List the Identified Items Work, indicate whether the work will be self-performed or performed by a non-VBE, and if applicable, state the name of the non-VBE firm. Also include the names of all VBEs and non-VBE firms that provided a quote and the amount of each quote.

Describe Identified Items of Work not being performed by VBEs (include specific section from bid or proposal)	Self-performing or using non-VBE (provide name of non-VBE if applicable)	Amount of non-VBE quote	Name of other firms that provided quotes and whether they are VBE	Amount quoted	Reason why VBE quote was rejected along with brief explanation
	☐ self-performing ☐ using Non-VBE Name: ___________	$	______________ VBE __________ Non-VBE	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-VBE Name: ___________	$	______________ VBE __________ Non-VBE	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-VBE Name: ___________	$	______________ VBE __________ Non-VBE	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-VBE Name: ___________	$	______________ VBE __________ Non-VBE	$	☐ price ☐ capabilities ☐ other
	☐ self-performing ☐ using Non-VBE Name: ___________	$	______________ VBE __________ Non-VBE	$	☐ price ☐ capabilities ☐ other

Attach additional sheets as necessary.

VBE-5
GOOD FAITH EFFORTS DOCUMENTATION TO SUPPORT WAIVER REQUEST OF VBE PARTICIPATION GOAL

Part 5 – VBE Subcontractor Unavailability Certificate

1. It is hereby certified that the firm of _____
(Name of VBE)

located at_____
(Number) (Street)

_____
(City) (State) (Zip)

was offered an opportunity to bid on Solicitation No. _____

by _____
(Name of Prime Contractor's Firm)

****

2. _____(VBE), is either unavailable for the work/service or unable to prepare a Proposal for this project for the following reason(s):

_____
(Signature of VBE's Representative) (Title) (Date)

_____
(DGS VBE Certification #) (Telephone #)

****

3. If the VBE does not complete this form, the prime contractor must complete the following:

To the best of my knowledge and belief, the above-listed VBE is either unavailable for the work/service for this project, is unable to prepare a Proposal, or did not respond to a request for a price Proposal and has not completed the above portion of this submittal.

_____
(Signature of Prime Contractor) (Title) (Date)

TECHNICAL SPECIFICATION SECTION 1 - SUMMARY OF WORK

1.1 – SCOPE OF PROJECT

The Pennsylvania State Game Commission (PGC) is soliciting for three construction contracts to provide coordinated services and materials for an addition to the existing PGC Headquarters Building. The addition will serve primarily for storage means for training and instructional materials. The three contracts being awarded will be designated as General, Mechanical and Electrical. The selected contractor(s) will be responsible to coordinating activities amongst one another with PGC Administrative Oversight and Management. The project duration will take place during the full operation of the PGC and coordination with material staging and activities can be anticipated. The general contractor is anticipated to be denoted as the "Lead Contractor" and is responsible for providing a coordination schedule for all contracts. The General Contractor is responsible for updating the schedule on a bi-weekly basis or as needed with project delays. The project will be inspected by the PGC and Labor and Industry for safety, integrity, and workmanship. Existing building plans and site plans will be provided to the contractor for reference in building tie-ins or as-needed. The project site should remain closed to the public and contractors shall be responsible for barricades (as needed) preventing public access.

1.2 – WORK AREA

The proposed buildings are located at 2001 Elmerton Ave. which is approximately 0.85 miles west of progress avenue in Harrisburg, Pennsylvania. The site and adjacent property are owned by the PA Game Commission (PGC). The site can be accessed from PGC parking lots located off of Elmerton Ave and Gene Cook Way.

1.3 – WORK HOURS

The work hours at the project site are during regular PGC business hours which are Monday through Friday, 7:45AM to 4:00PM. Work during different hours must have prior written approval by the PGC. Requests for different working hours must be submitted in writing three days in advance.

1.4 – ACCESS TO WORK AREA

Access to the building site is from a paved driveway and parking area at the Headquarters parking lot from Elmerton Ave. The large sod area adjacent to the proposed building site provides ample area for staging and stock piles of any necessary material. It can be assumed that the designer/contractor may need to visit the site several times to acquire detailed measurements and dimensions.

1.5 – CONTROL OF WORK AREA

The area will be accessible during normal business hours however, the exterior grounds is not secured by fencing or obstructed by gates. During construction, signage and barricades may be

necessary to prevent unauthorized access from the general public or PGC employees. At the completion of the project, the general contractor will be responsible for the cleaning of the project area prior to the transfer of PGC ownership.

1.6 – PERMITS, LAWS AND REGULATIONS

The Contractor shall construct the structure to meet all applicable codes and permits using the relative regulations for the standards. The project is to conform to all standards implements under the Pennsylvania Department of Labor and Industry. The ICC, NFPA, NEC, ASHRAE and Energy Code are all examples of regulations that the project will meet.

The Contractor shall comply with all laws, ordinances, rules, orders and regulations relating to the performance of the work.

All applicable Federal and State laws and regulations, municipal ordinances and rules and regulations of all authorities, having jurisdiction over construction of the project shall apply to the contract throughout, and they shall be deemed to be included in the contract as a part, thereof, the same as though herein written out in full.

All regulations of the Occupational Safety and Health Act are in effect on this contract. It will be the Consultants' responsibility to make themselves aware of all appropriate County, State and Federal regulations that apply to this contract.

1.7 – DOCUMENTATION

The respective contractor is responsible for all record keeping and documentation in regards to the project. Each contractor will be responsible for as-built drawings, coordination drawings related to the project. As needed, warranty and product registrations will be the responsibility of the respective contractor(s). Owners and Maintenance manuals for equipment or materials will be supplied to the PGC at the end of the project electronically. Each contractor is responsible for routine photograph documentation related to installed conditions and progress reasons.

1.8 – TEMPORARY FACILITIES & PROVISIONS

The General Contractor is responsible for temporary toilet facilities for all contracts. The PGC will make the reasonable accommodations for water needs that the projects may have for normal construction. Temporary electric will be deemed the responsibility of the respective contractors. Generators generating beyond 70 dB from 50 feet of distance will not be permitted on the project. The general contractor will be responsible for providing trash receptacles/dumpsters for project related debris from the project only.

Any selective demolitions should be phased in manner to maintain security to the existing structure. The areas and security of the existing building shall remain the highest importance of the contractor(s). Items and components used to protect workmanship shall remain fire-retardant, free of any components which may be deleterious to the environment. Any

temporary heat will be the responsible of the general contractor. The fuel source for the temporary heat will be reviewed on an as-needed basis.

TECHNICAL SPECIFICATION SECTION 1-11-00 - SUMMARY OF MULTIPLE CONTRACTS

1.1 – GENERAL CONSTRUCTION

The general contractor is responsible for the providing and installing following but not limited to:

Erosion and sediment controls, temporary restroom facilities, trash removal, staging areas, barricades, fencing, demolition, building envelope construction, weatherproofing, insulation, masonry, concrete, wall construction, steel fabrication, blocking, room finishes, floor finishes, egress apparatus', and related activities and components.

The general contractor is responsible for creating, coordination and updated a construction schedule for all trades. This trade will be responsible to attend a monthly job conference meeting held at the PGC HQ site.

1.2 – MECHANICAL CONSTRUCTION

The mechanical contractor is responsible for the providing and installing following but not limited to:
Mechanical equipment, ductwork, thermostats, heating components, diffusers, vents, fresh air intake equipment, all fuel intake plumbing (applicable tanks), component wiring from rough-in stage. Any penetrations through walls and floors will be designated and supplied by the mechanical contractor but coordinated with activities with other trades.

The mechanical contractor is responsible for coordinating their work with the respected trades at the project. This trade will be responsible to attend a monthly job conference meeting held at the PGC HQ site.

1.3 – ELECTRICAL CONSTRUCTION

The electrical contractor is responsible for the providing and installing following but not limited to:
Electrical equipment, fixtures, wiring, receptacles, diffusers, vents, fresh air intake equipment, all fuel intake plumbing (applicable tanks), component wiring from rough-in stage. Any penetrations through walls and floors will be designated and supplied by the mechanical contractor but coordinated with activities with other trades.

The mechanical contractor is responsible for coordinating their work with the respected trades at the project. This trade will be responsible to attend a monthly job conference meeting held at the PGC HQ site.

TECHNICAL SPECIFICATION SECTION - SUBMITTALS

1 – SECTION INCLUDES/CONTENT

A. Included in this section of the specifications is a list of approvals required for all materials incorporated into the project. The Pennsylvania Game Commission reserves the right to require additional approvals if necessary. No material, equipment or supplies listed herein shall be incorporated into the work until the Contractor has obtained prior approval from the Department.

B. Submittals required by each prime contract are indicated in the description of items to be submitted, Paragraph 2.8.

1.2 - SUBMITTAL PROCEDURES

A. Comply with the following or resubmission will be required:

1. Indicate contract number and specification section on each item submitted.
2. Signify approval by stamp, initialing and dating each item prior to submission to the Designer.

B. Items requiring testing shall be forwarded directly to the approved laboratory. The Contractor shall pay all costs associated with testing.

C. Expedite critical materials, equipment and shop drawings, and other required submissions.

D. Incomplete submissions will be returned for resubmission.

E. Use of substitutions for materials or details shown on the contract drawings or called for in these specifications require written approval from the Department.

1.3 - PRODUCT DATA

A. Manufacturer's printed directions and manufacturer's standard specifications showing all dimensions, cuts, finishes, etc., as well as catalog cuts and ratings of all material will be required and shall be submitted in advance prior to application and/or installation.

1.4 - TESTS

A. Submit required reports listing items tested, tests conducted, and results obtained as specified.

1.5 - CERTIFICATIONS

A. Submit required certifications in written form identifying authorized representative, manufacturer, systems designer, and other required data as specified.

1.6 - WARRANTIES

A. Refer to Specifications for required warranties. Copies of proposed warranties specified for products shall accompany the designated submittal of that product.

1.7 - OPERATION AND MAINTENANCE MANUALS

A. Manual Format (Use 3-ring binder):

1. Title page with the following information for each system covered:
   a. Project Title and Contract Number (in capital letters)
   b. Name of Company
   c. Name of the individual to be called
   d. Normal telephone numbers
   e. Contractor's account number for project
2. Index listing all sections of the Manual.
3. Copies of all warranties for equipment or materials furnished in contract. (Index tabbed)
4. Complete system circuit diagrams, block diagrams, copies of all approved shop drawings, which shall clearly illustrate how all the components relate and how they are interconnected and a point wiring diagram.
5. Reports, testing analysis.
6. Operating instructions and maintenance instructions for all equipment and finish materials furnished.
7. All approved, shop drawings, descriptive data, and any certifications.

1.8 - SUBMITTALS LIST

A. Abbreviations

1. Mfr - for Manufacturer
2. Prod - for Producer or Supplier
3. SHDR - for Shop Drawings
4. DeDa - for Descriptive Data or Catalog Cuts
5. Samp - for Samples
6. Cert - for Certification
7. Tests - required Test Reports
8. Warr – for Warranties

GENERAL CONSTRUCTION								
DESCRIPTION OF ITEMS TO BE SUBMITTED	MFR	PROD	SHDR	DeDa	SAMP	CERT	TESTS	WARR
CONCRETE	X	X		X			X	
FRAMING & ENGINEERIED LUMBER	X	X		X			X	
STEEL FABRICATION COMPONENTS (SHOP DRAWINGS)	X	X	X	X		X		
INSULATED CONCRETE FORMS	X	X		X	X	X		X
SNOW GUARDS	X	X		X				
NEW SEAMLESS ALUMINUM GUTTERS & DOWNSPOUTING	X	X		X				
REINFORCING STEEL	X	X		X				
BATT INSULATION	X	X		X				
RIGID FOUNDATION INSULATION	X	X		X				
STEEL DOORS, FRAMES & HARDWARE	X	X		X				X
O.H. DOORS, MAN. OPERATORS & HARDWARE	X	X		X				
WINDOWS	X	X		X				
ARCHIECTURAL CASE WORK & COUNTERTOPS	X	X	X	X				
FLOORING	X	X		X				
DRYWALL SYSTEM	X	X		X				
SEALANTS	X	X		X			X	
PROJECT SCHEDULE				X				
MECHANCIAL CONSTRUCTION								
DESCRIPTION OF ITEMS TO BE SUBMITTED	MFR	PROD	SHDR	DeDa	SAMP	CERT	TESTS	WARR
HEAT PUMP & AIR HANDLER	X	X		X				X
INSULATED DUCTORK	X	X	X	X				
THERMOSTAT/CONTROLS	X	X		X				
AIR REGISTERS AND DAMAPERS	X	X		X				
NATURAL GAS FIRED UNIT HEATER W/DIRECT VENT	X	X		X				X
PROJECT SCHEDULE				X				
ELECTRICAL CONSTRUCTION								
DESCRIPTION OF ITEMS	MFR	PROD	SHDR	DeDa	SAMP	CERT	TESTS	WARR

TO BE SUBMITTED								
BATTERY BACK UP EMERGENCY EXIT SINAGE w/ EXIT LIGHTING	X	X		X				
LIGHTING FIXTURES & CONTROLS	X	X		X				
WIRING DEVICES AND DUPLEX RECEPTACLES	X	X		X				
ELECTRICAL POWER CONDUCTORS & CONDUIT	X	X		X				
GROUNDING AND BONDING ELECTRICAL SYSTEMS	X	X		X				
NEW SERVICE, METER BASE, PANELBOARD	X	X		X				
PROJECT SCHEDULE				X				

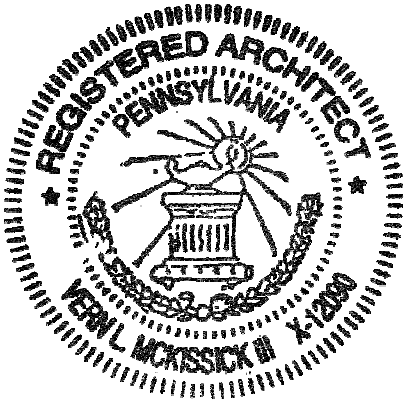
TECHNICAL SPECIFICATIONS

VOLUME 2 OF 2

TRAINING WING ADDITION

At the

PENNSYLVANIA GAME COMMISSION
HEADQUARTERS BUILDING
2001 Elmerton Avenue
Harrisburg, PA 17110



MCKISSICK ASSOCIATES PC – ARCHITECTS
317 North Front Street
Harrisburg, PA 17101
717.238.6810 FAX 717.238.6830

WZG STRUCTURAL CONSULTING ENGINEERS, INC. – STRUCTURAL
1137 Gravel Pike
Zieglerville, PA 19492
610-831-0555

FIRST CAPITAL ENGINEERING, INC.– SITE/CIVIL
48 South Richland Avenue
York, PA
717-845-3227

SCHADE ENGINEERING, INC. –MEP
929 Glenbrook Avenue
Bryn Mawr, PA
610-513-9860

ISSUED FOR PERMIT

McKissick Associates PC
Architect of Record
317 North Front Street
Harrisburg, PA 17101
info@mckissickassociates.com
717.238.6810 FAX 717.238.6830

DECEMBER 16, 2022	

SECTION 02 41 19 - SELECTIVE STRUCTURAL DEMOLITION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Selective Building Demolition:

1. Selective demolition of interior partitions, systems, and building components designated to be removed.
2. Selective demolition of exterior facade, structures, and components designated to be removed.
3. Protection of portions of building adjacent to or affected by selective demolition.
4. Removal of abandoned utilities and wiring systems.
5. Notification to Owner of schedule of shut-off of utilities which serve occupied spaces.
6. Pollution control during selective demolition, including noise control.
7. Removal and legal disposal of materials.
8. Protection of designated site improvements and adjacent construction.
9. Salvage of designated items.
10. Interruption, capping or removal of utilities as applicable.

B. Hazardous Materials:

1. Not present.
2. Removed under separate prior contract.
3. Removed as a part of this contract.

1.3. DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4. MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5. SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings as applicable, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.

C. Predemolition Photographs or Video Recordings: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations.

D. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6. CLOSEOUT SUBMITTALS

Inventory: Submit a list of items that have been removed and salvaged.

1.7. QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site.

1.8. PROJECT CONDITIONS

A. Owner may occupy portions of building immediately adjacent to selective demolition areas. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: There are no known hazardous materials present in buildings and structures to be demolished.

1. If at any time the Demolition Contractor uncovers materials that may be suspect to be hazardous, contact the Architect for direction.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing Pennsylvania Department of Environmental Protection and EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Verify that utilities have been shut-off, disconnected and/or capped. Verify that utilities have been shut-off, disconnected and/or capped before starting selective demolition operations.

B. Review documents of existing construction for reference provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

F. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

G. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.

H. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2. UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

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

1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3. PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities And Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

3.4. PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Cover and protect furnishings, and equipment that have not been removed.

3. Comply with requirements for temporary enclosures, dust control, specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.5. SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Dispose of demolished items and materials promptly.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6. SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts. All cuts shall be patched with toothed-in joints. Salvage full bricks for wall infill and use in new construction where indicated. Store and clean salvaged brick material on site. Coordinate permissible temporary storage location on-site with Owner and Architect. Remove unused salvaged brick masonry after all brick masonry patchwork and infill is completed.

3.7. DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Comply with requirements specified in Division 01 Section "Construction Waste Management and Cleaning."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8. CLEANING

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

END OF SECTION 02 41 19

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Supply and installation of Insulated Concrete Forms, installation of reinforcing steel and placement of concrete within formwork.
2. Adequate bracing and false work shall be provided by the Contractor to comply with all applicable Codes.

B. Additional Products to be provided under this section.

1. *EPS* compatible modified bituminous sheet damproofing/waterproofing membrane over ICF forms

C. Products Installed but not Specified or Supplied Under This Section

1. Sleeves
2. Inserts
3. Anchors
4. Bolts
5. Reinforcing Steel
6. Window and Door Opening Bucks
7. Concrete
8. Embedded steel plates

D. Related Sections

1. Division 03 Section “Cast-In-Place Concrete.”
2. Division 03 Section “Insulated Concrete Forms Assemblies - Integrated Door Opening Assemblies.”
3. Division 03 Section “Precast Structural Concrete.”
4. Division 04 Section “Unit Masonry.”
5. Division 05 Section “Metal Fabrications.”
6. Division 06 Section “Rough Carpentry.”
7. Division 07 Section “Air Barrier, Vapor Barrier and Dampproofing”
8. Division 07 Section “Self-Adhering Sheet Waterproofing.”
9. Division 07 Section “Siding.”
10. Division 09 Section “Gypsum Board.”
11. Division 09 Section “Non-Structural Metal Framing.”

1.3. REFERENCES

A. ACI 318 Building Code Requirements for Reinforced Concrete

B. ACI 332 Guide to Residential Cast-in-Place Concrete Construction

C. ASTM C236 Steady State Thermal Performance of Building Assemblies

D. ASTM C473 Physical Testing of Gypsum Board Products and Gypsum Lath

E. ASTM D1761 Mechanical Fasteners in Wood

F. ASTM E84 Surface Burning Characteristics of Building Materials

G. IBC 26-3 Uniform Building Code Standard Room Fire Test

1.4. DEFINITIONS

A. EPS- Acronym for “Expanded Polystyrene”

B. ICF- Acronym for “Insulated Concrete Form”

C. Trained Installer- An installation contractor, who has received instructional training in the installation of Insulated Concrete Forms from one of the listed manufacturers.

D. Technical Associate- A technical representative, usually a staff member of a Distribution Firm, who has received instructional training in the installation of the ICF forms and is in the capacity of supervising an installation crew on site.

E. Window or Door Opening Buck- a pre-manufactured or site constructed frame assembly consisting of wood or plastic material (or combination thereof) used to frame a rough opening within the forming system that will retain concrete around the opening. The frame can also provide for subsequent anchorage of doors and windows within the wall assembly.

1.5. SYSTEM DESCRIPTION

A. Insulated concrete wall forming system shall consist of 2 flame resistant panels of expanded polystyrene (EPS) connected by either high-density polypropylene hinged pin foldable webs or EPS embedded polystyrene fastening strips interconnected with slide in format - high density polypropylene web connectors.

B. All web fastening strips to run full height of form and be fitted top and bottom with reversible fitting, “triple-tooth” interlocking mechanisms to enable positive vertical interlocking of forms with each other. Wall system webs to provide min. 1 ½” (38mm) wide fastening strips @ 8” (200mm) o/c approx 1/2” (13mm) below wall face for full wall height to facilitate finish fastening of both interior and exterior finishes.

C. Full height fastening strips also to be positioned within corner forms to provide capability of connecting finishes full height within 4” (100mm) or less of all corner conditions.

D. All form units shall be capable of being shipped to site in folded condition to minimize shipping cost and site storage space requirement and be capable of being deployed to installation ready condition by simply unfolding the unit in a single pull motion or pull motion combined with insertion of a single web (at corner condition).

E. EPS foam panels shall be moulded with single socket 1” (25mm) wide reversible tooth interlocks positioned in pairs along top of all panels.

F. Wall system to provide min. 8" concrete core and wider concrete core widths up to 12" wide as noted to specific conditions on drawings. ICF core thicknesses in this project include 8", 10" and 12".

G. Wall system to provide accurate positioning of steel within form cavity to conform to reinforcing requirements of ACI 318.

H. EPS foam panels with concrete to provide min. insulation level of R 22.4 across full line of form unit cavity widths:

I. EPS foam to provide maximum vapor permeation of 3.5 Perm-in. (200 ng/Pa.s.m^2)/25mm

J. Finished wall assembly must be listed to provide min. FRR fire resistance ratings under UL classification ANSI/UL 263 – 13th edition when installed as per classification UL-930

1. 8" (100mm) minimum core form - FRR 2 hours

1.6. SUBMITTALS

A. Submit relevant laboratory tests or data that validate product compliance with performance criteria specified prior to commencement of work under this Section.

B. Submit product data for materials furnished under this section and installed as the work of another section.

C. Submit copy of manufacturer's product installation manual.

D. Submit copy of valid product evaluation report for applicable code jurisdiction of ICC-ES ESR-2092.

1.7. QUALITY ASSURANCE

A. Contractor shall engage the services of a manufacturer trained ICF Installer or Technical Associate for the duration of the work under this Section.

B. Trained Installer /Technical Associate shall furnish proof of training documentation to Contractor prior to commencement of work under this Section.

C. Site Mock-up: If required, construct sample wall mock-up panel to include full wall system and details, located where directed by Consultant. Panel may form part of finished work if approved by Consultant.

D. Trained Installer/Technical Associate to meet with Contractor prior to material delivery on site to co-ordinate provision of access, storage area, protection of ICF product, spatial requirements for form alignment, placement of steel, storage and forming.

1.8. DELIVERY STORAGE AND HANDLING

A. Deliver products in original factory packaging, bearing identification of product, manufacturer and batch/lot number.

B. Trained Installer shall furnish product packaging labels to contractor as required to maintain traceability of product for duration of contract.

C. Handle and store products in location to prevent damaging and soiling.

D. Ensure that UV protection is provided for material, should on-site storage extend beyond 30 days.

1.9. PROJECT CONDITIONS

A. Use appropriate measures for protection and supplementary heating when required to ensure proper curing conditions in accordance with manufacturer's recommendations if installation is carried out during periods of weather where temperatures are below minimum specified by governing Building Code for concrete and masonry.

1.10. SEQUENCING AND SCHEDULING

A. Ensure those materials listed under paragraphs titled "Products Installed but not Furnished under this Section" or "Products in Related Sections" are provided to Contractor Installer prior to commencement of work under this Section.

1.11. WARRANTY

A. Contact Manufacturer for supply of written copy of specific warranties of the product.

PART 2 - PRODUCTS

2.1. MANUFACTURER

A. Basis-of-Design Product: Subject to compliance with requirements, provide NUDURA® Corporation; NUDURA® Integrated Building Technology Insulated Concrete Forms or a comparable product by one of the following:

1. Amvic Systems
2. Fox Blocks
3. Or equal as approved by the Architect in accordance with Division 01 Section "Product Requirements."

2.2. COMPONENTS

A. Insulating concrete form system shall be capable of forming ALL of following concrete core thicknesses: 4, 6, 8, 10 or 12-inches wall sections (as required for various locations throughout project scope with standard form line-up) (See form dimensions summary)

B. Provide Insulated Concrete Forms as listed in Table 2.3 as may be required for proper execution of the work:

TABLE 2.3

Product	Feature	4" (100mm)		6" (150mm)		8" (200mm)		10" (250mm)		12" (300mm)	
		inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
Standard	Length	96	2438	96	2438	96	2438	96	2438	96	2438
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438

Form Unit	**Height**	18	457	18	457	18	457	18	457	18	457
	EPS Thickness	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67
90 Degree Form Unit	**Length (a) (lng)**	31 5/8	803	31 5/8	803	33 5/8	854	35 5/8	905	37 5/8	956
	Length (b) (sht)	15 5/8	397	15 5/8	397	17 5/8	448	19 5/8	498	21 5/8	549
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438
	Height	18	457	18	457	18	455	18	455	18	455
45 Degree Form Unit	**Length (a) (lng)**	26 1/2	673	26 1/2	673	26 1/2	673	28 1/2	724	30 1/2	775
	Length (b) (sht)	10 1/2	267	10 1/2	267	10 1/2	267	12 1/2	318	14 1/2	368
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438
	Height	18	457	18	457	18	457	18	457	18	457
One & Two Sided Tapered Top Form Units*	**Length**	48	1219	48	1219	48	1219	48	1219	48	1219
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438
	Height	18	457	18	457	18	457	18	457	18	457
	EPS Thickness	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67
Molded Brick Ledge*	**Length**	48	1219	48	1219	48	1219	48	1219	48	1219
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438
	Height	18	457	18	457	18	457	18	457	18	457
T-Form Units (main and T-wall core thickness matching)	**Lg. T Mn. Lgth**	18	457	20	508	22	559	24	610	26	660
	Sh. T Mn. Lgth	50	1270	52	1321	54	1372	56	1422	58	1473
	Height	18	457	18	457	18	457	18	457	18	457
	EPS Thickness	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67
Molded Brick Ledge & Tapered Top Unit	**Length**	48	1219	48	1219	48	1219	48	1219	48	1219
	Width	9 1/4	235	11 1/4	286	13 1/4	337	15 1/4	387	17 1/4	438
	Height	18	457	18	457	18	457	18	457	18	457
Brick Ledge Extension	**Length**	32	813	32	813	32	813	32	813	32	813
	Width	4 1/2	114	4 1/2	114	4 1/2	114	4 1/2	114	4 1/2	114
	Height	13 1/2	343	13 1/2	343	13 1/2	343	13 1/2	343	13 1/2	343
End Cap	**Width**	4 1/4	108	6 1/4	159	8 1/4	210	10 1/4	260	12 1/4	311
	Height	18	457	18	457	18	457	18	457	18	457
	EPS Thickness	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67	2 5/8	67
	Fast. Strip Op.	YES		YES		YES		YES		YES	

Height Adjuster	**Length**	32	813	32	813	32	813	32	813	32	813
	Height	3	76	3	76	3	76	3	76	3	76
	Fast. Strip Op.	YES		YES		YES		YES		YES	

2.3. CONCRETE

A. Concrete supplied under Division 03 Section "Cast-in-Place Concrete: shall be of strength as specified by the design engineer (measured at 28 days). Recommended maximum aggregate size to be 1/2" aggregate for 4" and 6" cavity forms and, ¾" (19mm) aggregate for the 8" cavity forms and higher.

B. Recommended concrete slump is 4" to 6" +/- 1" (subject to design revision to suit application).

2.4. REINFORCING STEEL

A. Reinforcing steel shall be as specified in Division 03 "Cast-in-Place Concrete" and shall be supplied under that Section for placement by the NUDURA® Trained Installer.

2.5. WALL ALIGNMENT SYSTEM

A. The *Trained Installer* shall furnish and utilize the Wall Access and *Form Alignment System* (as supplied by the Manufacturer or approved equivalent) to facilitate construction of the wall assembly, and to provide adjustment for ensuring plumbness and straightness of the wall system during construction, just prior to concrete placement and immediately after concrete placement while form system is still adjustable to final finished position.

B. *Form Alignment System* shall be OSHA compliant. *Technical Associate* shall supply engineering documentation pertaining to the "base" *Form Alignment System* components to verify compliance upon request.

A. As specified under Submittals, for wall heights above 12-feet (3.6 m), the contractor shall provide scaffold engineering for *Form Alignment System* support or shall ensure this engineering is included by the engineer of record for support of the form system during construction.

2.6 WATERPROOFING AND DAMPPROOFING

A. Provide water based damproofing system against ICF walls. The material shall be confirmed to be type documented as being compatible with the submitted ICF manufacturer. The product shall be self-adhering and composed of SBS modified bitumen with a tri-laminated woven polyethylene facer.

1. Product: Nudura Waterproofing/Dampproofing Membrane or approved equal.
    a. Provide without primer at Dampproofing conditions presuming conditions are clean and suitable for adhesion to ICF substrate.
    b. Provide with primer at Waterproofing conditions.

B. Waterproofing material shall be a self-adhering type that is EPS foam compatible, and supplemented by a drainage cover panel product where ever the waterproofing is installed. The waterproofing material shall be compatible with the EPS foam, such that the waterproofing material will not degrade the integrity of the EPS foam by chemical reaction.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Inspect all areas included in Scope of Work to establish extent of work and verify site access conditions.

3.2. SITE VERIFICATION OF CONDITIONS

A. Verify that site conditions are as set out in Part 1- General Conditions.

B. Examine footings installed under Division 03 Section "Cast-in-Place Concrete" are within +/-¼"of level and that steps footing increments are 18" in height. Where partial or half course is intended for starting course elevation, ensure step footing increment is equal to cut form unit less ½".

C. If specified, ensure reinforcing steel dowels are in place at specified centers along footing lengths.

3.3. PREPARATION

A. Clean all debris from top of footings prior to commencing work.

3.4. INSTALLATION

A. Installation of forms to be in strict accordance with manufacturer's product installation manual as supplied in evidence to contractor under Sub Section "Submittals" of this Section.

B. The trained installer shall ensure manufacturer's procedures for the following work are employed on site (as outlined in the manufacturer's product Installation manual):

1. First Course Placement
2. Horizontal Reinforcement Placement
3. Successive Course Placement
4. Door *and* Window Opening Construction
5. Form Alignment *and* Scaffolding Installation
6. Vertical Reinforcement Placement
7. Stirrup Reinforcement Placement
8. Pre-Concrete Placement Inspection
9. Concrete Placement
10. Access *and* Form Alignment Assembly Removal

C. Service Penetrations

1. Service penetrations (e.g.- electrical service conduits, water service pipes, air supply and exhaust ducts etc.) shall be installed at the required locations as indicated by the appropriate trade.
2. Service penetrations exceeding 12" x 12" in area shall be reinforced.

3. Prior to concrete placement, install service penetration sleeves (supplied by others) at designated locations to create voids where services can be passed through at later date.

D. Waterproofing/Damproofing

1. Install in accordance with manufacturer's instructions.
2. Coordinate installation with completion of concrete form pouring and sequence of installation of exterior wall coverings such as veneer masonry, panels and portland cement stucco.

3.5. CLEANING

A. Clean up and properly dispose of all debris remaining on job site related to the installation of the insulated concrete forms.

3.6. PROTECTION

A. Provide temporary coverage of installation to reduce exposure to Ultra Violet light should final finish application be delayed longer than 60 days.

END OF SECTION 03 11 19

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Slabs-on-grade.
2. Suspended slabs.
3. Concrete toppings.

1.3. DEFINITIONS

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

1.4. ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Include documentation of compressive strength in accordance with ACI 318.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

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

1.5. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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. Bonding agents.
7. Adhesives.
8. Semi-rigid joint filler.
9. Joint-filler strips.
10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

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

E. Minutes of pre-installation conference.

1.6. QUALITY ASSURANCE

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

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

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

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

1. ACI 301, "Specifications for Structural Concrete,"
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

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

G. Pre-installation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. 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 design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7. DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1. FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. 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.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

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

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.

2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2. STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

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

2.3. REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4. CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray.
   a. Fly Ash: ASTM C 618, Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size:
   a. Elevated Slabs and Slabs-on-grade: 3/4 inch (nom) maximum
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5. ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6. CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

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

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure 200.
   b. Conspec by Dayton Superior; W.B. Resin Cure.
   c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
   d. Edoco by Dayton Superior; Res X Cure WB.
   e. L&M Construction Chemicals, Inc.; L&M Cure R.
   f. Meadows, W. R., Inc.; 1100-CLEAR.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure 1315.
   b. Conspec by Dayton Superior; Sealcure 1315 WB.
   c. Edoco by Dayton Superior; Cureseal 1315 WB.
   d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
   e. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
   f. Meadows, W. R., Inc.; Vocomp-30.

2.7. UNDERSLAB VAPOR BARRIER

A. Underslab Vapor Barrier: Use virgin polyethylene or polyolefin products

1. Acceptable Products.

a. W.R. Meadows, Perminator, 15 mil thickness
b. Stego Industries, Vapor Barrier, 15 mil thickness
c. Poly America L.P., Husky Yellow Guard, 15 mil thickness

B. Or equal as approved by the Professional

2.8. RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

1. Provide at all interior joints exposed where finished flooring material is not installed.

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

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, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Joint Filler/Sealant: Self-leveling, polyurethane elastomeric sealant:

1. Products: Subject to compliance with requirements, provide one of the following:
a. SIKA Corporation USA: SIKAFlex-2c SL.
b. The Euclid Chemical Company: Eucolastic 1SL
c. BASF: MasterSeal SL 2.
d. Or equal as approved by the Professional.

2.9. REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface 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 topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10. CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

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

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11. CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Suspended Slabs (topping for metal deck): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on Drawings.
2. Slump Limit: 4 inches, plus of minus 1 inch, except as otherwise approved by Architect.
3. Air Content: For interior trowel finished floor slabs, do not allow air content to exceed 3 percent. For other slabs, air content shall be 6 percent, plus or minus 1.5 percent at point of delivery of 3/4 inch nominal maximum aggregate size.

B. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on Drawings.
2. Slump Limit: 4 inches, plus of minus 1 inch, except as otherwise approved by Architect.

3. Air Content: For interior trowel finished floor slabs, do not allow air content to exceed 3 percent. For other slabs, air content shall be 6 percent, plus or minus 1.5 percent at point of delivery for 3/4 inch nominal maximum aggregate size.
4. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturers recommended rate, but not less than 1.0 lb/cu yd.

2.12. FABRICATING REINFORCEMENT

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

2.13. CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.14. VAPOR BARRIERS

A. Sheet Vapor Barrier: Refer to Section 071000 “Air-Moisture Barrier, Vapor Barrier and Dampproofing.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.15. LIQUID FLOOR TREATMENT

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Basis-of-Design Products: Subject to compliance with requirements, provide L&M Construction Chemicals, Inc; Seal Hard or comparable product by one of the following:
   a. Dayton Superior: Sure Hard Densifier J17.
   b. Euclid Chemical Company (The); an RPM company: Eucosil

B. Application: Provide in all concrete slabs-on-grade.

PART 3 - EXECUTION

3.1. FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

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

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

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

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2. EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3. REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4. SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5. STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6. JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7. UNDERSLAB VAPOR BARRIER MEMBRANE

A. Location: Required under new slabs on grade and at patched areas of existing floor slabs.

B. Application: All concrete floor slabs on crushed stone base shall be preceded by one ply of vapor barrier placed in position immediately before pouring of concrete. Lap all side edges 6" and ends 12". Patch any holes and rips in film to satisfaction of Architect. Turn up vapor barrier 3" at walls against expansion joint material. Coordinate placement with the insulation specified.

C. At Walls: Membrane shall be carried up the walls to top of finished concrete slab.

3.8. CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) 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.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9. FINISHING FORMED SURFACES

A. 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.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10. FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated, to receive concrete floor toppings, or to receive mortar setting beds for bonded cementitious floor finishes.

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

1. Apply float finish to surfaces indicated, to receive trowel finish, or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view, or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
    a. 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; for slabs-on-grade.
    b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.11. MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.12. 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

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

3.13. LIQUID FLOOR TREATMENTS

A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14. JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
    1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15. CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) 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 (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16. FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
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.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. 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/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
    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/C 39M; 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 (3.4 MPa).

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
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.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.17. PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Concrete Masonry Units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.
8. Dampproofing for masonry

B. Related Sections:

1. Section 03 30 00 "Cast-in-Place Concrete"
2. Section 04 73 23 “Manufactured Stone Masonry”
3. Section 09 91 23 “Interior Painting”
4. Section 07 60 00 "Flashings and Sheet Metal "

1.3. DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4. PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5. PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

4. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6. ACTION SUBMITTALS

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

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Colored mortar.
2. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Accessories embedded in masonry.

1.7. INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
    a. Include data on material properties.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.8. QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Preinstallation Conference: Conduct a conference at the Project site to review coordination of the work and material mock-ups as applicable prior to the start of concrete masonry installation.

1.9. DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10. PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1. MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2. CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.
3. Provide field-ground bullnose corners at interior partition outside wall corner locations.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        (1) ACM Chemistries; RainBloc.
        (2) BASF Aktiengesellschaft; Rheopel Plus.
        (3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

C. CMUs: ASTM C 90.

1. Density Classification: Normal weight.
2. Size: Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

4. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3. CONCRETE AND MASONRY LINTELS

A. General: Provide the following, as indicated:

B. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4. MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Euclid Chemical Company (The); Accelguard 80.
   b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
   c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
   d. Water: Potable.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ACM Chemistries; RainBloc for Mortar.
   b. BASF Rheopel Plus Mortar Admixture.
   c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

2.5. REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6. TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
6. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.7. MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.8. EMBEDDED FLASHING MATERIALS

A. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is fully concealed, use metal flashing.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane, polysulfide or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9. MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10. MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

2.11. DAMPPROOFING

A. Dampproofing: To be Cold-Applied, Emulsified-Asphalt for masonry cavity walls with concrete or masonry back-up walls and below grade walls exposed to soil where waterproofing is not specified.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Karnak Corporation. AF100 Non-Fibered Emulsion
    b. W.R. Meadows Sealmastic Emulsion
    c. EP Henry Company, 788 Non-Fibered Emulsion
    d. Or approved equal as approved by the Professional.
3. Trowel Coats: ASTM D 1227, Type II, Class 1.
4. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
5. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
6. VOC Content: 0.25 lb/gal. or less
7. Provide manufacturers recommended fabric reinforcing at joints

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3. INSTALLATION: MODIFICATION AND INFILL OF EXISTING CMU OPENINGS

A. Review existing conditions to confirm existing cmu joinery and toothing.

1. Non-structural infill of existing masonry openings shall have CMU toothed-in where existing walls are not painted or especially if they are single wythe construction. See reinforcing requirements below.
2. Non-structural infill of existing masonry openings are not required to have toothed-in joinery where existing walls are painted. See reinforcing requirements below.

B. Provide renovation type masonry anchor tabs where infill masonry meets existing wall jambs at 16” o.c. vertically. Also provide horizontal joint reinforcing 16” o.c. for the length of each masonry course.

C. Provide vertical rebar reinforcing as noted on details. Otherwise presume to provide #4 rebar with grouted cells at ends and 32” o.c. maximum. All rebar into existing concrete shall be anchored with adhesive anchors.

D. Existing floor slabs that overlap wall foundations at doorways being eliminated shall be cut and demolished on exterior walls in order to connect existing cmu wall below with cmu infill. At concrete grade beams, anchor rebar directly into grade beam and construct cmu infill from that point.

E. Where lintels are installed in structural back-up walls or in single wythe walsl, masonry shall be cut and toothed-in.

F. At the bottom of where existing steel or masonry lintels are to remain in existing openings to be infilled or reduced in height, provide welded #4 rebar or #4 anchored in existing lintel in order to pin existing wall with new wall elements. Methods can be field adjusted per review and approval by the Professional.

G. Masonry wall surfaces shall be installed flush and with masonry joinery in alignment with existing wall surfaces, typical. Field verify and adjust mortar joint depth as needed to maintain visual alignment with existing masonry.

3.4. TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.5. LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.6. MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.7. MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8. ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9. CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry:

1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

3.10. LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.11. FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.12. REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.13. DAMPPROOFING

A. Location: Provide typically to be provided in masonry cavity walls and at below grade portions of masonry and concrete walls exposed to soil where waterproofing is not specified/noted.

1. Provide waterproofing at the elevator pit and at all walls and foundations below grade next to occupied rooms and levels of the building.
2. Dampproofing to also to applied to the back of cavity wall rigid insulation and used as adhesive for cavity wall rigid insulation.

B. Surface preparation: Parge honeycombing in concrete and tool mortar joints before application. Comply with manufacturer’s recommendations.

C. In cavity walls at above grade conditions, the General Contractor shall provide metal studs clad with 5/8” gypsum sheathing around steel columns and beams before applying this product. All joints shall be filled with spray foam insulation and sealed before application of damp proofing as well.

D. In cavity walls where steel column bases are near the specified new grade elevation, the General Contractor shall pour concrete into the cavity space 8" higher than the planned grade elevation to protect the steel from moisture. General Contractor to provide accordingly as field conditions arise.

E. Application: Spray or Roll-on.

F. Confirm that the application has gone into all recesses and crevices before moving on to other areas. Reapply material until surfaces are completely covered.

3.14. FIELD QUALITY CONTROL

A. Quality Control Testing Agency: The Contractor shall engage in a qualified testing and inspecting agency (Quality Control Testing Services) to perform tests and inspections and to submit reports, in accordance with specifications.

B. Quality Assurance Special Inspections: The Professional will engage a special inspector and qualified testing and inspecting agency (Quality Assurance Agency) to perform field tests and inspections and prepare test reports, in accordance with specifications.

3.15. PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.16. REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.17. MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner’s property.

1.

END OF SECTION 04 22 00

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. Structural steel.
2. Grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Division 9 Paint Specifications

1.3. DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4. COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5. PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6. ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.8. QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or a fabricator experienced in work of this section with a record of successful performance of completing a minimum of five previous projects of similar nature, size, and extent to that indicated for this Project.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE or an installer experienced in work of this section with a record of successful performance of completing a minimum of five previous projects of similar nature, size, and extent to that indicated for this Project.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9. DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2. STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade C, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.3. BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain.

C. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
3. Finish: Plain.

2.4. PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5. GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6. FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7. SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Types:
    a. Snug tightened unless otherwise indicated

b. Slip critical joints shall be provided at all bracing locations and where indicated.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8. SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9. GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and items indicated on Drawings attached to structural-steel frame and located in exterior walls.

2.10. SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2. PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3. ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates, Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4. FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Types:
    a. Snug tightened unless otherwise indicated
    b. Slip critical joints shall be provided at all bracing locations and where indicated.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5. FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

c. Ultrasonic Inspection: ASTM E 164.

d. Radiographic Inspection: ASTM E 94.

3.6. REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 05 12 00

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. Roof deck
2. Composite floor deck
3. Acoustic roof deck

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
4. Division 9 Painting specification.

1.3. ACTION SUBMITTALS

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

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.

1.4. INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck.

1.5. QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2. MANUFACTURERS

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

1. Epic Metals Corporation.
2. Canam United States; Canam Group Inc.
3. Nucor Corp.; Vulcraft Group.
4. Consolidated Systems, Inc.
5. United Steel Deck, Inc.
6. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
7. .

2.3. ACOUSTICAL ROOF DECK

A. Acoustical Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Basis of Design: Acoustic roof deck Epic ER2RA 20 gage

2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
    a. Color: Gray top surface with white underside.
3. Cellular Deck Profile: As indicated, with bottom plate.
4. Profile Depth: 2 inches
5. Design Uncoated-Steel Thickness: 0.0358 inch (20 gage) unless otherwise noted.
6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: 0.0358/0.0474 inch .
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped.
9. Acoustical Perforations: Cellular deck units with manufacturer's standard perforated flat-bottom plate welded to ribbed deck.
10. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
    a. Sound-absorbing insulation is specified in Division 07 Section "Thermal Insulation."
    b. Acoustical Performance: NRC 0.95, tested according to ASTM C 423.

2.4. COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray top surface with white underside baked-on, rust-inhibitive primer.
2. Profile Depth: 2 inches.
3. Design Uncoated-Steel Thickness: 0.0358 inch (20 gage) unless otherwise noted.
4. Span Condition: Triple span or more.

2.5. ACCESSORIES

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

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Provide vulcanized, closed-cell, synthetic rubber or equivalent product made for specific condition to stop air infiltration at roof deck perimeters. Also provide insulation at such conditions to further stop potential for air infiltration joints.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates, Riding Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A 780.

J. 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.

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

3.2. INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, 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.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3. ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
3. Weld Washers: Install weld washers at each weld location where uncoated steel thickness is less than 0.028 inch.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (457 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4. FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5. PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

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. Exterior non-load-bearing wall framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092116 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

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: For cold-formed steel framing.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5. QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

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."

1.6. DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

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

1. Clark Dietrich Building Systems, Inc.
2. MarinoWARE.
3. Nuconsteel; a Nucor Company.
4. Steel Network, Inc. (The).
5. Knight Wall Systems

2.2. PERFORMANCE REQUIREMENTS

A. Coordinate with other Part 2 articles, deleting prescriptive requirements such as steel thickness and minimum yield strength unless imposing minimum design restrictions. Insert other performance and design criteria below to suit Project or add to Drawings. AIA Document A201 requires Owner or Architect to specify performance and design criteria to be satisfied.

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

C. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
    b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
    c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.

d. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.

e. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.

f. Ceiling Joist Framing: Vertical deflection of 1/240 of the span for live loads and 1/240 for total loads of the span.

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 (67 deg C).

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 (25 mm).

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

D. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

E. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

F. Fire-Resistance Ratings: Comply with ASTM E 119; 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.

2.3. COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As indicated.
2. Coating: G90 (Z275) or equivalent.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As indicated.
2. Coating: G90 (Z275).

2.4. 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: 0.0428 inch (1.09 mm) .
2. Flange Width: As required to meet structural performance requirements.

3. Section Properties: As required to meet structural performance requirements.

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: Matching steel studs.
2. Flange Width: As required to meet structural performance requirements.
3. Section Properties: As required to meet structural performance requirements.

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 (1.09 mm) .
2. Flange Width: As required to meet structural performance requirements.
3. Section Properties: As required to meet structural performance requirements.

2.5. EXTERIOR NON-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: 0.0428 inch (1.09 mm) .
2. Flange Width: As required to meet structural performance requirements.
3. Section Properties: As required to meet structural performance requirements.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

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.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Clark Dietrich Building Systems, Inc.
   b. MarinoWARE.
   c. Nuconsteel; a Nucor Company.
   d. Steel Network, Inc. (The).
   e. Knight Wall Systems

D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   a. Minimum Base-Metal Thickness: 0.0677 inch (1.72 mm).
   b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0677 inch (1.72 mm).

b. Flange Width: Outer deflection track flange width plus 1 inch (25 mm).

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.

2.6. FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight 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. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.7. ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8. MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

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 screw penetrating joined members by no fewer than three exposed screw threads.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies 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. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) 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 (3 mm).

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine supporting substrates 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 (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets 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 and to 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 (1.6 mm).

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 and install according to Shop Drawings, and complying 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 comparable in intensity 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, specified in Section 072100 "Thermal Insulation," in built-up exterior framing 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.

J. Erection Tolerances: 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 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4. LOAD-BEARING WALL INSTALLATION

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:

1. Anchor Spacing: As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb 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 as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. 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 as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner 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 (1220 mm). Fasten at each stud intersection.

1. 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 (150 mm) deep.
2. 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. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

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. EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

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 double deep-leg deflection tracks and anchor outer track to building structure.
2. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
3. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. 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. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. 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. FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

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. Remove and replace work where test results indicate that it does not comply with specified requirements.

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

3.7. REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. 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 05 40 00

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. Rooftop equipment bases and support curbs.
2. Wood blocking**, cants,** and nailers.
3. Wood furring **and grounds**.
4. Wood sleepers.

1.3. ACTION SUBMITTALS

A. Product Data:

1. For each type of process and factory-fabricated product.
2. For preservative-treated wood products.

1.4. INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

PART 2 - PRODUCTS

2.1. WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum Moisture Content:

1. Boards: **15** percent.
2. Dimension Lumber: 15 percent for **2-inch nominal** thickness or less; 19 percent for more than **2-inch nominal** thickness.

2.2. PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
   b. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   c. Application: Treat items indicated on Drawings, and the following:
      (1) Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
      (2) Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
      (3) Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
      (4) Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
      (5) Wood floor plates that are installed over concrete slabs-on-grade.

2.3. FIRE-RETARDANT-TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior type is suitable for both exterior and interior applications. Interior type is only for interior applications.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
    a. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
    b. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
    c. Application: Treat items indicated on Drawings, and the following:
        (1) Concealed blocking.
        (2) Framing for non-load-bearing partitions.
        (3) Framing for non-load-bearing exterior walls.
        (4) Roof construction.
        (5) Plywood backing panels.

2.4. MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
    1. Blocking.
    2. Nailers.
    3. Rooftop equipment bases and support curbs.
    4. Cants.
    5. Furring.
    6. Grounds.

B. Dimension Lumber Items: #2 Prime grade lumber of any species.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
    1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
    2. Eastern softwoods; No. 2 Common grade; NeLMA.
    3. Northern species; No. 2 Common grade; NLGA.
    4. Western woods; No. 2 Common grade; WCLIB or WWPA.

2.5. FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
    1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
        a. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
        b. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on as appropriate for the substrate.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.
    a. Where #2 Grade is used, hand-pick as required from quantities of acquired lumber and do not install portions of wood products that contact “wane”/bark surfaces. This would be an acceptable alternative in lieu of purchasing larger quantities of #2 Prime grade lumber for blocking. The intent is that all blocking and rough carpentry be solid rectangular material without gaps or surface exclusions that would undermine damp proofing, weather barriers and finish material installation.

3.2. PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes the following:

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment
3. Flexible flashing at openings in sheathing. (provide around window and louver openings and joints between dissimilar materials)
4. Plywood Backing Panels

B. Related Sections include the following:

1. Division 06 Section Rough Carpentry.

1.3. SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
6. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Building wrap.

1.4. QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory".

1.5. DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1. WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2. PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA C9.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3. FIRE-RETARDANT-TREATED PLYWOOD

A. General: Comply with performance requirements in AWPA C27.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Exterior type for exterior locations and where indicated.
3. Use Interior Type A, High Temperature (HT) for roof sheathing and where indicated.
4. Use Interior Type A, unless otherwise indicated.

B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat all plywood, unless otherwise indicated.

1. Roof sheathing.
2. Partition reinforcement and substrate for fastening surface mounted materials.
3. Exterior wall substrate sheathing.

2.4. PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.5. WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

1. Span Rating: Not less than 32/16
2. Provide thickness as noted

B. Glass-Mat Gypsum Sheathing

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. G-P Gypsum Corporation.
   b. Temple-Inland Forest Products Corporation.
   c. Or approved equal.
2. Type X and Thickness: 5/8” unless otherwise noted.
3. Size: 48 by 96 inches minimum for vertical installation.
4. Nominal Thickness: 5/8” Typical unless otherwise noted.

C. Extruded-Polystyrene-Foam Wall Sheathing: Refer to Section 07 21 00

D. Foil Faced Polyisocyanurate-Foam Wall Sheathing. Refer to Section 07 21 00

2.6. ROOF SHEATHING

A. Glass-Mat Gypsum Sheathing

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. G-P Gypsum Corporation.
   b. Temple-Inland Forest Products Corporation.
   c. Or approved equal.
2. Type X and Thickness: 5/8” unless otherwise noted.
3. Size: 48 by 96 inches minimum for vertical installation.
4. 4. Nominal Thickness: 5/8” Typical unless otherwise noted.

B. Refer to roofing specifications for additional information for roofing cover board and substrate board.

2.7. FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. For roof[and wall] sheathing, provide fasteners[with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing to comply with ASTM C 954.

2.8. SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.9. MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Use adhesives that have a VOC content of **50**g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Hunter Xci VP-SA-WRB (weather resistive barrier), vapor permeable air and water resistive barrier, and compatible liquid joint sealant,

      AND

   b. Hunter Xci FlexShield™ flexible flashing membrane for window sills.
   c. Or approved equal.

C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1. INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
   4. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2. WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Subflooring:
    a. Glue and screw to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch (3 mm) apart at edges and ends.
2. Wall and Roof Sheathing:
    a. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

3.3. GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with **screws**.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

3.4. WEATHER-RESISTANT BARRIER INSTALLATION

A. General: Cover plywood and sheathing with self-adhering weather-resistant barrier and sealant as follows:

1. Comply with manufacturer's written instructions.
    a. Seal seams, edges, fasteners, and penetrations with tape and sealant per conditions.
    b. Extend into jambs of openings and seal corners with flexible flashing.

3.5. SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
3. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.6. FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.7. PROTECTION

A. Paper-Surfaced Gypsum Sheathing: Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing paper securely fastened to framing. Apply covering immediately after sheathing is installed.

END OF SECTION 06 16 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. The work required under this Section includes engineered lumber framing system used as perimeter wood blocking for doors and windows in ICF walls. This material shall only be used as concealed blocking for the anchorage/attachment of windows and door frames in ICF walls.

B. Related Sections:

1. Division 03 Section “Cast-In-Place Concrete.”
2. Division 03 Section “Insulated Concrete Forming.”
3. Division 04 Section “Unit Masonry.”
4. Division 05 Section “Cold Metal Framing”
5. Division 05 Section “Metal Fabrications.”
6. Division 05 Section “Structural Steel”
7. Division 06 Section “Rough Carpentry”
8. Division 07 Thermal and Moisture Protection Sections
9. Division 08 openings sections.
10. Division 09: Finish sections.
11. Division 26 electrical sections.

1.3. REFERENCES

A. American Wood Protection Association (AWPA):

1. AWPA U1-15, UC2 Interior/Damp Use.

B. ASTM International (ASTM):

1. ASTM E 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus. (R-Value).

C. ICC Evaluation Service:

1. ICC-ES Report ESR-1387 -StrandGuard TimberStrand LSL 1.30E treated with zinc borate.

1.4. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product Data: For each type of product specified, include details of construction, material descriptions, hardware preparations, internal components, profiles, and finishes.

C. Shop Drawings: Submit drawings depicting the rough openings dimensions applicable to each specified door and window opening size or type.

1.5. QUALITY ASSURANCE

A. Engage the services of an ICF Manufacturer designated Trained Installer or Technical Associate for the duration of the work under this Section.

B. Site Mock Up: Provide a wall mock up assembly to include exterior façade and interior drywall channels or as directed.

C. Prior to assembly delivery conduct an onsite pre-installation meeting of the job superintendent or general works contractor, ICF wall contractor, mason, and other necessary trades to coordinate proper installation, form product, and spatial requirements for form assembly, alignment, forming, and bracing.

1.6. DELIVERY, STORAGE, HANDLING

A. Deliver assembly work palletized, wrapped, or crated to provide protection during transit and project site storage.

B. Deliver assemblies with two removable spreader bars across the bottom of assemblies, tack welded to jambs and mullions.

C. Inspect assemblies upon delivery for damage. Remove and replace damaged items as directed.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide ICF engineering lumber framing system/materials as manufactured by Acceptable Manufacturer: PreBuck, which is located at: 2555 28th St. SW; Wyoming, MI 49519; Tel: 616-309-6256; Email: request info at sales@prebuckproducts.com; Web:http://www.prebuckproducts.com

1. Or equal engineered lumber product field fabricated by the general contractor.
    a. General contractor shall provide the necessary

2.2. WINDOW AND DOOR BUCK ENGINEERED FRAMING SYSTEM

A. Window and Door Buck Engineered Framing System: StrandGuard TimberStrand LSL 1.30E Engineered Lumber by PreBuck Engineered Framing Systems.

1. Meets AWPA U1-15 for Use Category 2 (UC2).
2. NAHB Research Center Green Approved.
3. MDI resin, 100 percent waterproof when cured.
4. Treated with zinc borate through complete cross section.
5. Typical material 1-1/2 inches (38 mm) thick; built-up as required.
6. Metal flange, 1-1/2 inch (38 mm) x 1-1/2 inch (38 mm), 20 gauge galvanized metal as applicable.
7. Fasteners, 3-4 16D nails, minimum, each corner.
8. Two continuous dovetail keyways at entire perimeter to eliminate air infiltration.

9. Non-obstructive with insulated concrete forming (ICF) web.
10. Unit self-aligns on wall.
11. Acceptable for direct contact with concrete, non-corrosive to metals, insect and fungi resistive.
12. Materials: StrandGuard TimberStrand LSL 1.30E Engineered Lumber, ICC ESR-1387.
    a. Treatment: Zinc borate through complete cross section.
    b. Bending Strength: 1900 psi.
    c. Tensile Strength: 1075 psi.
    d. Shear Strength: 150 psi.
    e. Compression - Perpendicular to Grain: 670 psi.
    f. Specific Gravity: 0.50 into the face, 0.42 into the edge.

B. R-value of 1-1/2 inch thickness (ASTM E 518): 1.86.

PART 3 - EXECUTION

3.1. SITE PROTECTION AND PREPARATION

A. It shall be the responsibility of the General Contractor to see that any scratches caused in shipping or handling are promptly cleaned and touched-up with rust inhibitive primer.

3.2. INSTALLATION

A. Place assemblies accurately in position, plumbed, aligned, and braced securely to receive temporary construction loads. Place ICF wall snug and tight in position with wall pushed all the way against the inside of jamb. If outside floor anchors are used, attach as shown and detail below slab.

B. Assemblies are permanent units and require to be “set” square and plum to receive final doors and hardware as specified in other sections. Assemblies must be periodically checked during wall erection and initial set-up.

C. Avoid discharging concrete from pump (limit impact and pumping head) directly on assembly head and jambs. Concrete should be placed such that vibration and impact is limited and concrete flows along head and jambs until covered completely.

D. Concrete placement needs to be “balanced” on both sides of the assembly jambs (with one foot maximum differential). Unbalanced loads could cause twisting and torque on assembly if not braced with sufficient “X-Bracing” or “Bulkhead”.

E. Bracing should occur within the concrete area of the assembly and spread with blocking.

F. Various bracing options and pour sequences should be discussed, determined, and addressed. Wall thickness, pour sequence, outside jamb floor anchors, concrete load above head, etc. will all determine bracing required for handling temporary construction loads.

3.3. CLEANING AND TOUCH UP

A. Remove any concrete debris on assembly which occurred during installation.

END OF SECTION 06 17 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Mineral-wool blanket insulation.
3. Rigid Mineral-wool for acoustic metal roof decks.
4. Glass-fiber blanket insulation.

1.3. SUBMITTALS

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

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.4. MOCK-UP

A. Provide mock-up of typical exterior stud framed wall that will be faced with exterior siding or metal panels.

1. Include all components in a layered sample constructed approximately 4’-0” tall by 4’-0” for review by the Architect before construction.
2. The mock-up should include rough-in of an opening to convey the installation of air and weather barrier materials as well.

1.5. QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1. FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed cell, and minimum compressive strength of 25 psi, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84. Provide with tongue and groove and/or shiplap long edges features.

1. This type of insulation in walls and in underslab in locations as indicated on drawings.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Dow Chemical Company.
    b. Owens Corning.
    c. Pactiv Building Products.
    d. Or equal product as approved by Architect.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2. GLASS-FIBER BLANKET INSULATION

A. The requirements for glass-fiber blanket insulation is specified as a standard in order to establish a standard of quality for where existing fiberglass blanket insulation may require cutting and patching within existing wall assemblies being affected by renovations.

B. Glass-fiber blanket insulation shall be provided in locations and thicknesses as indicated on the drawings.

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

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

D. Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3. MINERAL WOOL INSULATION

A. Mineral Wool Insulation: provide in exterior wall assemblies and interior framed partitions as indicated on Drawings.

1. ASTM C665, Type 1.
2. Fire performance:
    a. Non-combustibility: ASTM E136.
    b. Surface Burning Characteristics: ASTM E84.
    c. Flame spread: 0.
    d. Smoke developed: 0.
3. Thermal resistance: ASTM C518.
4. Density: 2 lb/ft^3 :ASTM C167
5. Provide unfaced in metal stud walls in thickness as indicated on drawings.
6. Minimum STC performance = 45 in 3-5/8" stud walls spaced at 16" O.C.
7. R-value =4.2 per inch thickness.
8. Acceptable Manufacturers:
    a. Rockwool, ComfortBatt
    b. Thermafiber
    c. Johns Manville
    d. Equal product by other manufacturer as approved by Architect.

2.4. RIGID MINERAL WOOL INSULATION FOR ACOUSTIC ROOF DECKS

A. Rigid Mineral Wool Insulation to be installed within flutes of acoustic metal roof decks specified in Section 05 31 00.

B. Lightweight board insulation for firestopping installations to ASTM C612.

C. Fire performance:

1. Non-combustibility: ASTM E136.
2. Firestopping: ASTM E814.
3. Surface Burning Characteristics: ASTM E84.
4. Flame spread: 0.
5. Moisture sorption: 0.04 % ASTM C1104/C1104M.
6. Corrosive resistance: ASTM C665, Corrosive to steel - Pass.
7. Stainless steel stress corrosion: To ASTM C795.
8. Density: To ASTM C303, 4.5 lb/ft^3
9. Provide 4.5 pcf minimum density in 2" thickness, cut to the shape of the furnished metal roof deck flutes. R-value =4.2 per inch thickness.
10. Manufacturer:
    a. Rockwool, RoxulSafe
    b. Thermafiber
    c. Johns Manville
    d. Equal product by other manufacturer as approved by Architect

2.5. AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Use Karnac 100 as manufactured by Karnac, Clark, New Jersey, or equal as approved by Architect. Apply to block at the rate of 2 to 3 gallons per 100 square feet. Product shall comply with ASTM D-1187, Type B.

B. Product to serve as adhesive and vapor barrier as well on masonry and concrete back-up walls.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

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

3.2. PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3. INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4. INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. All foundation walls around the exterior perimeter of the building shall receive extruded polystyrene insulation board cemented to the vertical inside face of foundation wall down to the top of footing. Provide horizontal sections of additional insulation below the vapor barrier if indicated for specific conditions. Thickness of insulation shall be as noted on the drawings.

1. If not indicated on drawings, extend insulation to the top of foundation footings, typical.

B. Rooms at perimeter of building with floor slabs on grade shall be isolated from exterior walls with ½" rigid insulation, unless otherwise detailed differently with thicker insulation at specific conditions.

C. Exterior wall insulation in cavity walls shall continue to top of footing elevation below to thermally isolate interior slabs on grade from exterior soil temperature. Provide insulation thickness as noted on drawings.

D. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

3.5. INSTALLATION OF CAVITY WALL INSULATION

A. Apply with dampproofing and mastic adhesive applied to outer face of block backup. Apply the insulating board to the outer surface of the inner masonry wythe after dampproofing or waterproofing is applied as the wall is laid with sufficient manual pressure to assure tight joints and good contact. Cavity wall masonry ties shall occur only at regular joints in the insulation. Coordinate the work with the mason's work.

1. See additional installation instructions regarding the provision of adhesive between insulation panel joints for air tightness when installed cavity walls as noted in Section 04 21 00.
2. Coordinate application of dampproofing. Reapply dampproofing as need to fully seal masonry ties.

B. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Division 4 Section "Masonry."

C. Provide insulation at exterior cavity walls and lining concrete block backup, around the building as detailed or scheduled.

3.6. INSTALLATION OF MINERAL WOOL INSULATION.

A. At exterior walls, install both inside and outside facing rows of studs, and as noted on the drawings.

1. Coordinate installation around bridging channels and blocking between rows of studs.

B. Fill all gaps around roof joists, beams and girders at intersections of exterior walls with mineral wool insulation. Install on inside facing side of the wall 3 to 4 inches thick, and then install spray foam insulation on the exterior side of joints in the wall cavity, and underside of roof deck at roof eave and rake conditions.

3.7. INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Provide all fasteners and accessories.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

D. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

E. Provide mineral wool insulation in all framed partitions, typical, and as noted for detailed conditions.

3.8. PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

PART 1 - GENERAL

1.1. GENERAL REQUIREMENTS

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

1.2. DESCRIPTION

A. Provide labor, materials and equipment to complete the Work as shown on the Drawings and as specified herein to provide:

1. Continuous spray applied polyurethane foam building insulation meeting ASTM E 2357
    a. This material is to be provided at locations primarily to fill gaps at top of exterior walls where they meet roof decks in order to enhance thermal breaks and air tightness. See drawings for specific other similar conditions where material is noted to be provided at exterior walls.

1.3. RELATED REQUIREMENTS

A. Section 04 21 00 Veneer Masonry Cold-Formed Metal Framing

B. Section 05 40 00 Cold-Formed Metal Framing

C. Section 06 16 00 Sheathing

D. Section 07 10 00 Weather Resistive Barrier, Vapor Barrier and Dampproofing

E. Section 07 21 00 Thermal Insulation

F. Section 07 21 60 Continuous Insulation Wall Panels

1.4. REFERENCES

A. Referenced Standards: These standards form part of this specification only to the extent they are referenced as specification requirements.

1. ASTM E 2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
2. ASTM E 84: Surface Burning Characteristics
3. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials
4. ASTM E 96: Water Vapor Transmission of Materials
5. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
6. International Building Code, Section 2603.0 Foam Plastic
7. AC377: Acceptance Criteria For Spray-Foam Plastic Insulation
8. NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

1.5. SUBMITTALS

A. Submit documentation from an approved independent testing laboratory certifying the air leakage rates of the air barrier membranes assembly, including primary membrane, primer, sealants and spray polyurethane foam building insulation have been tested to meet ASTM E 2357.

B. Submit documentation from an approved independent testing laboratory certifying the air leakage of the air barrier membranes, including primary membrane, transition sheets, sealants and spray polyurethane foam building insulation in accordance with ASTM E 2178.

C. Test report submittals shall include test results on a porous substrate and include sustained wind load and gust load air leakage results.

D. Submit manufacturers' current product data sheets for the air barrier membrane system and spray polyurethane foam building insulation.

E. Submit documentation from an approved independent testing laboratory certifying the long term thermal value and aged R value of 6.45 minimum per inch for spray foam insulation.

F. Submit documentation from manufacturer certifying compatibility of primary air/vapor barrier membrane and spray polyurethane foam building insulation, including transition sheets, flashings and sealants.

G. Submit two samples 6x6 inches size of each air/vapor barrier material required for project.

1.6. QUALITY ASSURANCE

A. Submit document stating the applicator of the primary air/vapor barrier membranes and insulation spray polyurethane foam building insulation specified in this section is qualified by the manufacturer as suitable for the execution of the Work.

B. Perform Work in accordance with manufacturer's written instructions and this specification.

C. Maintain one copy of manufacturer's written instructions on site.

D. Allow access to Work site by the spray polyurethane foam building insulation manufacturer's representative.

E. Components used shall be sourced from one manufacturer including primary air/vapor barrier membrane, air barrier sealants, primers and spray polyurethane foam building insulation,

1. Obtain air/vapor barrier, flexible flashing and spray polyurethane foam building insulation materials from a single manufacturer regularly engaged in manufacturing the product.
2. Provide products which comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.7. MOCK-UP

A. Construct mock-up in accordance with Division 1. Coordinate with mock-ups required in other specification sections.

B. Provide mock-up of air/vapor barrier, flashing and spray polyurethane foam building insulation under provisions of Division 1.

C. Construct typical exterior wall panel, 4 foot long by 4 foot high, incorporating substrate, window frame, insulation & air barrier and showing air barrier membrane application details.

D. Owner may exercise option to test mock-up for air leakage in accordance with ASTM E783 and water leakage in accordance with E1105 at the Owners' expense.

E. Allow 48 hours for inspection of mock-up by architect consultant before proceeding with air barrier work. Mock-up may not remain as part of the Work.

1.8. PRE-INSTALLATION CONFERENCE

A. Contractor shall convene prior to commencing Work of this section

B. Ensure all contractors responsible for creating a continuous plane of air tightness and insulation are present.

1.9. DELIVERY, STORAGE AND HANDLING

A. Refer to current Product Technical Data sheets for proper storage and handling.

B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product. Protect stored materials from direct sunlight.

C. Keep solvent away from open flame or excessive heat.

1.10. CO-ORDINATION

A. Ensure continuity of the air/vapor barrier membrane assembly throughout prior to start.

B. Ensure continuity of spray polyurethane foam building insulation throughout the scope of this section.

1.11. WARRANTY

A. Manufacturer's Material Warranty

1. Contractor hereby warrants the Insulation & Air Barrier and membrane flashings for water intrusion and leak coverage for two years.
2. Insulation & Air Barrier manufacturer hereby warrants the insulation and membrane flashings against faulty materials for a period of 15 years from the date of substantial completion.

1.12. MANUFACTURER'S SYSTEM WARRANTY

1. Contractor hereby warrants the Insulation & Air Barrier and membrane flashings for leak coverage for two years.
2. Insulation manufacturer hereby warrants the insulation and membrane flashings for leak coverage as a result of faulty materials for a period of 15 years from the date of substantial completion.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Spray Foam Insulation Acceptable Manufacturers:

1. Basis of Design: Henry Company: Permax 2.0
2. Demelic: Heatlok Soy
3. Johns Manville
4. GAF

2.2. SPRAY POLYURETHANE FOAM INSULATION

A. Primary spray polyurethane foam building insulation shall be HE735 PERMAX 2.0 a spray applied polyurethane foam material as manufactured by Henry, the B Component of a 2-part Polyurethane Foam system which, when combined with the appropriate A Component, will react to produce a seamless, monolithic and durable polyurethane closed cell foam insulation suitable for commercial insulating and air barrier applications. Insulation shall have the following physical properties and 3rd party accreditations:

1. Air leakage: <0.0006 L/(s.m^2) @ 75Pa, per ASTM E 2178
2. Tested to ASTM E 2357 for the air barrier assembly
3. Meet ICC AC377 standards
4. Vapor permeance minimum: 0.95 perms @ 1in, 0.47 perms @ 2in, per ASTM E96
5. Aged R value minimum: >6.45/in @ 1 inch thickness, > 6.2/in @ 4 inches
6. Nominal Density: 2.0 pounds per cubic foot
7. Tested ASTM E-84 for FSI and SDI
8. Accreditation and current full system listing by ABAA as found on www.airbarrier.org

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions over which the primary spray polyurethane foam building insulation will be applied with installer present for compliance with requirements.

B. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Prior to commencement of Work, report in writing to the Architect any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.

D. Do not proceed with installation of spray applied polyurethane foam insulation until placement of masonry ties, clips, connectors and continuous air/vapor barrier Work has been completed and reviewed by Architect

E. Commencement of work shall be deemed as acceptance of substrate and site conditions by installing contractor.

3.2. SURFACE PREPARATION

A. Clean, prepare and treat substrate according to manufacturer's written instructions. Provide clean, dust-free and dry substrate for spray polyurethane foam building insulation application.

B. Ensure installed air/vapor barrier membrane, transition and flashing membranes are fully adhered to all applicable surfaces and capable of receiving spray polyurethane foam.

3.3. PROTECTION

A. Mask and cover adjacent areas to protect from over spray.

B. Ensure any required foam stop or back up material are in place to prevent over-spray.

C. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes do not contribute to airborne particles. Provide for make-up air where necessary.

D. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

3.4. APPLICATION OF SPRAYED POLYURETHANE FOAM

A. Spray-application of spray polyurethane foam building insulation shall be installed in accordance with manufacturer's written instructions.

B. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer.

C. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings and to achieve the specified R-Value. Passes shall be not less than ½ inch and not greater than 3 inches.

D. Do not install spray polyurethane foam building insulation within 3 inches of heat emitting devices such as light fixtures and chimneys. Follow manufacturers' recommendation to detail.

E. Finished surface of spray polyurethane foam building insulation to be free of voids and fully sealed around embedded objects.

F. Remove masking materials and over spray from adjacent areas immediately after the foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.

G. Trim as required any excess thickness that would interfere with the application of cladding/covering system by other trades.

H. Clean and restore surfaces soiled or damaged by Work of the section.

I. Do not permit adjacent Work to be damaged by Work of this section. Damage to work of this section caused by other trades shall be repaired at the expense of the subcontractor causing the damage.

3.5. FIELD QUALITY CONTROL

A. Site Tests

1. The Authorized Installer shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the ULC S705.2-02 Installation Standard and recorded in the Daily Work Record and kept at site for routine inspections. Copies of the Daily Work Record shall be forwarded to the owner or owner's representative upon request. Costs incurred for daily testing and inspection by the installer shall be borne by the contractor.
2. If the inspection reveals defects, the Licensed Contractor shall immediately rectify all such defects at his cost.

3.6. TOLERANCES

A. Maximum variation from indicated thickness: minus (-) ¼ inch; plus (+) ½ inch.

3.7. PROTECTION

A. Protect the spray polyurethane foam from ultraviolet radiation when installed on the exterior of a building.

B. When installed on the interior of the building, cover the spray polyurethane foam per applicable building code.

C. Repair damaged or compromised spray polyurethane foam using specified materials prior to Substantial Completion.

END OF SECTION 07 21 29

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section describes plywood faced wall insulation panels (nailbase insulation panels).

B. Related Sections include the following:

1. Division 03 Section “Cast in place concrete.
2. Division 04 Masonry.
3. Division 05 Cold Formed Framing
4. Division 07 Air and Moisture Barriers

1.3. REFERENCES

A. ASTM C 209 – Methods of Testing Insulating Board, Structural and Decorative.

B. ASTM C 1289 – Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulating Board.

C. ASTM D 1621 – Test Methods for Compressive Properties of Rigid Cellular Plastics.

D. ASTM D 2126 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.

E. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. ASTM E 96 - Test Method for Water Vapor Transmission of Materials.

H. ASTM C518 - Steady State Thermal Transmission By Means Of The Heat Flow Meter Apparatus (R Value)

I. ICC-ESR- 3174

J. NFPA 285 - Standard Fire Test Method For Evaluation Of Fire Propagation Characteristics Of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.4. SYSTEM DESCRIPTION

A. Base Wall: either masonry or stud framed with clad with 5/8” Type X Gypsum Sheathing each side.
B. Fire-stopping at floor lines
C. Exterior Insulation
D. Exterior Sheathing, Sheathing
E. WRB on Exterior Plywood Sheathing face (vapor permeable barrier required)

F. Exterior Cladding

1.5. DESIGN REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Physical properties (Foam Core):

1. Flame Spread Index: ASTM E 84; less than 25
2. Smoke Developed: ASTM E 84; less than 250.
3. Compressive Strength: ASTM D 1621; Grade 3 (25 psi / 172 kPa).
4. Dimensional Stability: ASTM D 2126, 2 percent linear change (7 days).
5. Moisture Vapor Permeance: ASTM E 96, 1.1 perm (57.5ng/(Pa•s•m2)).
6. Water Absorption: ASTM C 209, less than 0.1 percent by volume.
7. Service Temperature: Minus 100 degrees F to 250 degrees F (Minus 73 degrees C to 122 degrees C).
8. Resistance to Mold: ASTM D 3273 Passed (10).
9. 3rd Generation Zero ODP Blowing Agent; Contains zero CFCs, HCFCs, or HFC; Virtually no Global Warming Potential (GWP)

C. Fire Treated Plywood:

1. Flame Spread Index: ASTM E 84; less than 25
2. Smoke Developed: ASTM E 84; less than 250.
3. 5-Ply CDX

1.6. SUBMITTALS

A. Product Data: Manufacturer's data sheets on wall panels and fasteners to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Fastening Guidelines: Manufacturer's 3rd party engineering evaluations for attachment of Xci Ply (Class A), including:

1. DrJ TER 2102-05: For all non-structural applications of Xci Ply (Class A) to wood and steel studs, concrete, and CMU.

C. Manufacturer's Certificate: Certify panels will conform to specified performance requirements.

1.7. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a company that regularly manufactures and assembles specified insulation in house with no outside fabrication operations.

B. Pre-Installation Meeting: Convene minimum one week prior to commencing Work of this section. Review installation procedures and coordination required with Related Work and include the following:

1. Participants: Authorized representatives of the Contractor, Architect, Installer, and Manufacturer.
2. Review wall assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.

3. Review continuous insulation wall panels installation methods and procedures related to application, including manufacturer's installation guidelines.
4. Review firestopping requirements and weather resistive membrane requirements and placement locations.
5. Review field quality control procedures.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Store products off the ground, in dry conditions, under cover and in manufacturer's unopened packaging until ready for installation.

1. Good construction practice dictates that all insulations should be protected from moisture and direct sunlight during job-site storage. Panels shall be protected with a two-step packaging process using **shrink wrap and a UV resistant polyethylene bag**. This moisture resistant package is designed for protection from the elements during flatbed shipment from factory to the job-site. Outdoor storage for extended periods of time requires waterproof tarpaulins and elevated storage above ground level a minimum of 1'-0"/ 1 foot. Additionally, we recommend slitting the bundle packaging vertically down the center of the two short sides to prevent moisture accumulation within the package.

B. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.9. SEQUENCING

A. Coordinate with the installation of vapor retarders and air seal materials specified in Division 7.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10. PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Basis of Design Manufacturer: Insulating panels shall be XCI (Class A) products produced by Hunter Panels, 15 Franklin Street, Portland, Maine 04101. ASD. Phone: (207) 761-5678 or (888) 746-1114. Fax: (207) 775-1769. E-mail: info@hpanels.com.

B. Or approved equal

2.2. BOARD INSULATION

A. Board Insulation Bonded to Plywood: Hunter Panels Xci Ply are a high thermal resistive rigid insulation panel composed of a closed cell polyisocyanurate foam core bonded on one side to a premium performance coated glass facer on one side and fire treated plywood on the other.

1. Foam Core:
    a. Grade 3 (25 psi).
2. Fire Retardant Treated Plywood Thickness:
    a. 3/4 inch.
3. Panel Size:
    a. 4 feet by 8 feet
4. Thickness / R Value: based on ASTM C 518 at 75 degrees F (23.9 degrees C)
    a. 1.7 inches / R Value 7 with 3/4 inch plywood facing
    b. 2.2 inches / R Value 10with 3/4 inch plywood facing
    c. 2.7 inches / R Value 13.1with 3/4 inch plywood facing
    d. 3.2 inches / R Value 16.3 with 3/4 inch plywood facing
    e. 3.7 inches / R Value 19.5 with 3/4 inch plywood facing
    f. 4.2 inches / R Value 22.7 with 3/4 inch plywood facing
    g. 4.7 inches / R Value 22.7 with 3/4 inch plywood facing
    h. Provide to the thickness at locations as indicated on the Drawings.

2.3. PANEL FASTENERS

A. Fasteners shall be approved panel manufacturer fasteners. Fasteners are a corrosion resistant type with oversized heads. Length of fasteners shall be as recommended by the panel manufacturer.

1. Hunter SIP/HD and SIP/HD-PT (Partial Thread): 12-16 gauge steel studs
2. Hunter SIP/SD and SIP/SD-PT (Partial Thread): 18-22 gauge steel studs
3. Hunter SIP/SD: Concrete and CMU (pre-drilling required)
4. Hunter SIP/WD: Wood studs
5. Hunter SIP/WD: Concrete and CMU (pre-drilling required)

B. Engineering Evaluations for fastening patterns (DrJ TER 2102-05 or DrJ TER 1508-01)

2.4. WEATHER RESISTIVE BARRIER

A. Vapor permeable barrier recommended for exterior of Xci Ply (Class A) panels (10-60 perms)

B. Provide Single-source system: Xci VP-SA-WRB (weather resistive barrier), vapor permeable air and water resistive barrier available from Hunter Panels or approved equal that complies with NFPA 285.

1. Provide supplemental quantities as necessary to bridge adjacent connecting building assemblies and conditions.

2.5. LIQUID JOINT SEALANT

A. BarriBond XL

B. BarriBond

C. Dyna-Trol I-XL Hybrid

2.6. INSULATION ACCESSORIES

A. General: Furnish insulation accessories recommended by continuous insulation wall panel manufacturer for intended use and compatibility with continuous insulation wall panels.

1. Fasteners shall be corrosion resistant type with oversized heads. Length of fasteners shall be provided by the contractor as recommended by the panel manufacturer.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Do not begin installation until exterior walls have been properly prepared.

C. Verify that all exterior wall assembly construction has been completed to the point where the insulation may correctly be installed.

D. Verify that mechanical and electrical services in walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive insulation.

E. Confirm that all structural studs and structural wall substrates are in alignment to create flat wall substrates without waves or scalloping.

1. All metal stud walls that will be clad with Continuous Insulation Wall Panels shall be first clad with a layer of 5/8” exterior gypsum sheathing, and in specific instances, additional sheathing materials to compensate for dimensional discrepancy between different structural systems.

F. If wall assembly preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions..

C. Vapor Barrier Installation - Self-Adhering Membrane:

1. Surfaces: Thoroughly remove debris before installing vapor barrier.
2. Application: Vapor barrier shall be installed in accordance with manufacturer’s printed installation recommendations.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in exterior spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

E. Insulation must be protected from open flame and stored in accordance with the manufacturer's instructions.

F. Fasten composite insulation to the structural base wall. Coordinate with the cladding or wall finish manufacturer for the attachment requirements over insulation panels. Contact continuous insulation wall panel manufacturer for guidance when determining fastening pattern.

G. Install vapor retarders over insulation panels as specified in Division 7.

H. Continuous Insulation Wall Panels are not intended to be left exposed for extended periods of time. During the time between the installation of the Continuous Insulation Wall Panels and the application of the exterior cladding it is recommended that the WRB be installed as soon as possible. If the WRB is not being installed right away it is recommended that the Continuous Insulation Wall Panels be protected from excess moisture and UV. All unfaced foam exposed directly to daylight can be taped with a compatible waterproof tape and the edges of the boards can be buttered with a compatible sealant.

I. Install exterior cladding as recommended by the cladding manufacturer and as specified in other sections of this specification. Note: the cladding manufacturer may require you to fasten the exterior cladding through the composite insulation to the structural wall.

3.4. PROTECTION

A. Protect installed products until completion of project.

B. Cover the top and edges of unfinished roof panel work to protect it from the weather and to prevent accumulation of water in the cores of the panels.

C. Do not leave panels exposed to moisture. Wet panels shall be removed or allowed to completely dry prior to application of vapor barrier and/or roof covering.

D. Repair or replace damaged products before they are clad with finish materials.

END OF SECTION 07 21 60

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Section includes ventilated nailbase insulation panel system

1.2. RELATED SECTIONS

A. Section 053100 - Steel Deck.

B. Section 061600 - Sheathing

C. Section 071000 - Vapor Retarders.

D. Section 074114 – Standing Seam Metal Roof Panels

1.3. REFERENCES

A. ASTM C 209 – Methods of Testing Insulating Board, Structural and Decorative.

B. ASTM C 1289 – Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulating Board.

C. ASTM D 1621 – Test Methods for Compressive Properties of Rigid Cellular Plastics.

D. ASTM D 2126 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.

E. ASTM E 84 – Surface Burning Characteristics of Building Materials.

F. ASTM E 96 - Test Method for Water Vapor Transmission of Materials.

G. UL 1256 - Fire Test of Roof Deck Constructions.

H. PS2-92 - Performance Standard for Wood-based Structural-use Panels.

I. Miami Dade Product Control – Notice of Acceptance NOA No. 14-0505.08

1.4. SYSTEM DESCRIPTION

A. Physical properties (Foam Core):

1. Blowing Agent: Zero ODP, 3rd generation
2. Compressive Strength: ASTM D 1621 and ASTM C 1289, Type II, Class 1, 25 psi (172 kPa) minimum for Grade 3.
3. ASTM C 1289, Type II, Class 2 25 psi (172 kPa) minimum for Grade 3.
4. Dimensional Stability: ASTM D 2126, 2 percent linear change (7 days).
5. Moisture Vapor Transmission: ASTM E 96, < 1 perm ((57.5ng/(Pa•s•m2)).
6. Water Absorption: ASTM C 209, < 1 percent by volume.
7. Service Temperature: Minus 100 degrees to 250 degrees F (minus 73 degrees C to 122 degrees C).

8. Foam core flame spread index of 75 or less and smoke developed of 450 or less when tested in accordance with ASTM E 84.

B. Foam Core R Values: Based on LTTR (Long Term Thermal Resistance) in accordance with ASTM C 1289.

C. UL Assemblies: Insulated steel deck assemblies - UL 1256 (nos. 120, 123) TGDY. R20624 Shingle Deck Accessory; H-Shield Nail Base roof insulation is classified for use with any Class A, B, or C asphalt glass mat or asphalt organic shingles, standing seam metal or tile roof coverings.

1.5. SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Manufacturer's data sheets on nailbase insulation panels and fasteners to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Verification Samples: For each finish product specified, two samples, representing actual product.

1. Submit 6 by 6 inch (152 mm by 152 mm) samples of each board type required.
2. Submit samples of each fastener type required.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a company that regularly manufactures polyisocyanurate insulation panels and fully assembles ventilated nailbase insulation in-house with no outside fabrication.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with the manufacturer recommendations.

B. Store product on a solid flat foundation and elevate a minimum of 2” above the finished surface.

C. Slit the bundle packaging vertically down the center of the two short sides and cover with a waterproof tarpaulin

D. Protect insulation from open flame and keep dry at all times.

1.8. PROJECT CONDITIONS

A. Install only as much insulation as can be covered the same day by a completed roof covering material.

1.9. SEQUENCING/SCHEDULING

A. Erection of the ventilated insulation shall be coordinated with the roofing contractor so the roofing is applied as soon as possible after insulation is in place.

PART 2 - PRODUCTS

2.1. SPECIFICATION:

A. Basis of Design: H-Shield NB produced by Hunter Panels , 15 Franklin Street, Portland, Maine 04101. Phone: (207) 761-5678 or (888) 746-1114. Fax: (877) 775-1769. E-mail: info@hpanels.com. Web: www.hunterpanels.com.
1. Provide with fire retardant 3/4" CDX plywood.

B. Or equal product as approved by Architect with the panel construction properties noted herein.

2.2. PANEL CONSTRUCTION

A. Panels shall consist of a top layer of APA fire retardant grade 5-ply CDX plywood laminated off-line to fiber-reinforced facers (GRF) polyisocyanurate foam insulation. Also available with coated glass facers (CGF) polyisocyanurate foam insulation.
1. Polyisocyanurate foam insulation shall conform to ASTM C 1289, Type II.
2. Compressive Strength: 25 pounds per square inch (172 kPa) Grade 3
3. Multiple top layer substrate shall conform to PS2 and shall be as follows:
    a. CDX Plywood:
        (1) Type:
            (a) Fire-treated sheathing grade.
        (2) Thickness:
            (a) 3/4 inch
        (3) Edge Detail
            (a) Rabbeted

2.3. PANEL TYPE

A. Provide panels in combination of thicknesses with the ability to achieve minimum R- Value of 30 to comply with the 2018 IBC Energy Code.

B. Basic of Design Product: H-Shield-NB panels 3/4 inch (19 mm) 5-ply CDX plywood foam size shall be 48 inches by 96 inches (1220 mm by 2438 mm) with an overall thickness, R-value, and flute spanability as follows:

1. Thickness: 4.2 inches (107 mm), R Value 21.1, flute spanability 4-3/8 inches (111.13 mm). Thickness includes thickness of plywood.

C. Additional roof insulation: Provide Unfaced, Polyisocyanurate Board Insulation: ASTM C 591, Type II, compressive strength of 25 psi (240 kPa), with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed. Provide insulation for multiple layer installation under Composite Nail-Base Roof Insulation.

1. Thickness: 2 inches minimum. R Value 11 minimum.

2.4. PANEL FASTENERS

A. Fasteners shall be FM Approved Hunter Panel SIP/SD Panel Fasteners for steel deck application. Fasteners have a 3/16 inch (5 mm) shank, and are corrosion resistant with oversized heads. Length of fasteners shall be as recommended by Hunter Panels. Use of 2 inch (51 mm) round plates are not required. See the manufacturer application guide for instructions.

1. Fasteners shall penetrate the top flute of steel deck a minimum of 1 inch (25 mm).
2. Penetration of fastener into bottom flute is not acceptable.

B. Fasteners shall be FM Approved SIP/WD Panel fasteners for plywood deck application. Fasteners have a 3/16 inch (5 mm) shank, and are corrosion resistant with oversized heads. Length of fasteners shall be as recommended by the manufacturer. Use of 2 inch (51 mm) round plates are not required. See the panel manufacturer application guide for instructions.

1. Fasteners shall penetrate the plywood deck a minimum of 1 inch (25 mm).
2. Fasteners shall not be exposed to view from interior spaces with exposed acoustic metal roof deck. Connections shall be made on top side of the metal roof deck profile where no acoustic perforations exist.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Do not begin installation until structural deck has been properly prepared.

B. Verify deck, adjacent materials, and structural backing is dry and ready to receive insulation.

C. Verify deck surface is flat, free of fins or protrusions and irregularities.

D. If deck preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2. PREPARATION

A. Apply vapor barrier and or retarder, as specified by the Architect or required by the local building code, to decking prior to the installation.

B. Apply proper ridge and soffit vents to create an effective eave to ridge venting system in conjunction with Cool-Vent.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install panels with the wood (Plywood) side face up. Place panels in the manufacturers recommended pattern. Only factory assembled panels will be accepted. Fasten panels through the top nailable surface and also through the wood block panel spacers using Hunter Panels approved threaded fasteners.

C. For application on steel deck provide a minimum of 16 SIP/SD fasteners per 4 foot by 8 foot (1220 mm by 2440 mm) panel. Fasteners shall penetrate the top flute of the steel deck.

D. For multiple layered installations, install the base layer of panels loose-laid, and stagger the joints of subsequent layers in accordance with good roofing practice. Fasten panels through the top nailable surface and also through the wood block panel spacers using Hunter Panels approved threaded fasteners.

1. Before installing roof insulation layers, install 5/8" gypsum substrate board for code required fire protection thermal barrier, and then overlaid by a vapor barrier.

E. For roof slopes up to 7/12 pitch, 7 inches (178 mm) rise in 12 inches (304 mm), the minimum number of fasteners shall be 18 per 4 foot by 8 foot (1220 mm by 2440 mm) panel.

F. For roof slopes over 7/12 pitch, 7 inches (178 mm) rise in 12 inches (304 mm), the minimum number of fasteners shall be 24 per 4 foot by 8 foot (1220 mm by 2440 mm) panel.

G.

3.4. PROTECTION

A. Protect installed products until completion of project.

B. Cover the top and edges of unfinished roof panel work to protect it from the weather and to prevent accumulation of water in the cores of the panels.

C. Do not leave panels exposed to moisture. Wet panels shall be removed or allowed to completely dry prior to application of vapor barrier and/or roof covering.

D. Apply only enough insulation panels per day that can be covered the same day by a completed roof covering material.

END OF SECTION 07 22 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section includes standing-seam metal roof panels.

1.3. PREINSTALLATION MEETING

A. Pre-installation Conference: Conduct conference at Project site.

1.4. DESIGN AND PERFORMANCE REQUIREMENTS

A. Complete engineered system by manufacturers engineering department including

B. Design Load:

1. Calculate wind uplift using ASCE-‘10
2. Calculate clip spacing
3. Verify stress and deflection of panel meet project design load
4. Verify project design load conditions with ASTM 1592
5. Verify project design load conditions with UL580 class 90

C. Air Infiltration:

1. No air infiltration with 20 psf pressure differential per ASTM E 1680

D. Air Exfiltration:

1. No air exfiltration with 20 psf pressure differential per ASTM E 1680

E. Water Resistance:

1. No water penetration under 5 gal/hr spray at 20 psf pressure differential per ASTM E 1646

F. UL-Approved Rated Fire Roofs:

1. 1, 1 ½ and 2 hour fire-rated assemblies per UL construction numbers P225, P510, P514, P516, P701 and P715

1.5. UL90 RATING:

A. 0.032" aluminum panels with stainless steel clips spaced at maximum of 2'-0" o.c. over 3/4" plywood decking.

B. ASTM 1592:

1. Design uplift loads for 0.032" aluminum panels are 48.48 psf for 5'-0" clip spacing and 66.67 psf for 2'-6" clip spacing.

1.6. SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
3. 3. If a WTW is required, shop drawings or Fabrals standard details must be reviewed by the manufacturer prior to installation

C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
2. Include similar Samples of trim and accessories involving color selection.

D. Qualification Data: For Installer.

E. Product Test Reports: For each product, for tests performed by a qualified testing agency.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

H. Maintenance Data: For metal panels to include in maintenance manuals.

1.7. QUALITY ASSURANC

A. Installer Qualifications: [An entity that employs installers and supervisors who are trained and approved by manufacturer.][Installer of sheet metal roofing for a minimum of 10 years documented experience.]

B. Panel Manufacturer: Minimum of 10 years experience in manufacturing architectural roof panels in a permanent stationary indoor facility. Provide facility information if requested.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store panels, flashings and accessories ion a safe, dry environment under a waterproof breathable covering to prevent water damage. Allow for adequate ventilation to prevent condensation. Panels and flashings with strippable film shall not be stored in direct sunlight.

D. Remove strippable protective covering on metal panels during installation.

E. Upon receipt of delivery of metal panel system, and prior to signing the delivery ticket, the installer is to examine each shipment for damage and for completion of the consignment.

1.9. FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10. COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11. WARRANTY

A. Material and Workmanship Warranty: Manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Paint Finish Warranty: 30 years from date of Substantial Completion. If metallic colors are used, the “fade” part of the warranty shall be removed.

1. 30 years for Kynar type finish.

C. Installer's Warranty: Submit installer's warranty, signed by Installer, covering the Work of this Section, including all components of roof panels for the following warranty period:

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

D. Weather-tight Warranty:

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

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS:

A. Basis of Design: Fabral Facilities: Lancaster, PA 17601Telephone: 800.477.2741

1. 2-1/2" Stand-N-Seam, 12" to 18" panel width.
2. Capability to be installed on fascia to match existing building

B. Metal Sales Manufacturing Corporation, Orwigsburg, PA, 1-800-406-7387

1. 2-3/8" T-Armor Series 12" to 18" panel width, minor rib.
2. Capability to be installed on fascia to match existing building

C. Or equal product as approved by the Architect

2.2. STANDING-SEAM METAL ROOF PANEL MATERIALS

A. Provide roofing with the following:

1. Aluminum:
   a. Material Thickness: **0.032** thick.
   b. Surface: **Smooth, flat** finish.
   c. Exterior Finish: As selected from manufacturer's premium finishes.
   d. Color: As selected from manufacturer's full range.
2. Rib Spacing: Manufacturer's standard.
3. Panel Coverage: 12 to 16". General Contractor to confirm existing spacing provide product option in width to nearest existing metal roof panel dimension.
4. Panel Height: 2 1/2 inch

2.3. MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

2.4. MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub-framing and Furring: Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weather-tight panel system including trim, copings, fasciae, mullions, sills, corner units, panel clips, flashings, sealants, gaskets, fillers, panel closures, and similar items. Match material and finish of metal panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Roof Vapor Barrier

1. Provide 31 mil self-adhering SBS modified bitumen air barrier/vapor retarder. Product shall be laminated and woven. Provide basis of design product below or approved equal.
    a. Basis of design : Soprema Sopravap'r with recommended primer under certain application or temperature conditions or approved equal product.
2. Install in accordance with manufacturers recommendations and instructions.

E. Self-Adhered Roofing Underlayment

1. Provide the following products as roofing underlayment or equal approved products with same performance:
    a. GCP Applied Technologies: Grace Ice & Water Shield HT (High Temperature) for typical roof surfaces.
    b. GCP Applied Technologies: Grace Ultra for tie in to EPDM expansion joint materials or other miscellaneous flashings that could react with the primary roofing underlayment.
    c. Provide necessary surface primers on substrates as required according to manufacturer's product data for the above or other approved products.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.

1. Sealant Tape: Buytl
2. Joint Sealant: One Part Poly
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5. SNOW GUARDS

A. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, fasteners, clamps, or hooks for anchoring.

1. Seam-Mounted, Rail-Type Snow Guards: Cast Aluminum rails designed for attachment to vertical ribs of standing-seam metal roof panels with stainless-steel set screws.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        (1) Basis of Design: Alpine SnowGuard.; SnoMax Standing Seam Fence-Style Snow Guards.
        (2) Berger Bros. Co.; Snow Guard.
        (3) Ace Clamp Metal Roof Snow Guards

2.6. FABRICATION

A. General: Provide factory-formed metal roof panel system complying with ASTM E 1514 requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Form panels in continuous lengths, endlaps are not permitted.

D. Field forming of panels shall be done by factory employees operating the machines.

E. Fabricate metal panel joints with factory-installed butyl sealant that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

F. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and
2. tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
4. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
5. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
6. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
7. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7. FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Three-Coat Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
3. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3. METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Refer to manufacturers recommendations.
3. Install flashing and trim as metal panel work proceeds.
4. Panels to be in one continuous length, long length roofs must be field formed by Manufacturer.
5. Provide weather-tight escutcheons for pipe- and conduit-penetrating panels.
6. Install metal roof panels over high temperature resistant self-adhering underlayment throughout. Coordinate sequence of installation with expansion joint seals and bridging flashings that will be necessary where underlayment is non-compatible for direct contact.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so metal roof panels, and factory-applied sealant are completely engaged.

F. Accessory Installation: Install accessories with positive anchorage to building and weather tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

H. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

I. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4. ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Prepare inspection reports.

D. Installer must have installation shop drawings on site at all times.

3.6. CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures..

END OF SECTION 07 14 14

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. DESCRIPTION

A. Work described in this section:

1. The Work to be performed under this Section shall include furnishing all labor, materials, equipment and appliances required to do the composite siding and metal trim work in accordance with the intent of the Contract Documents. The Work of this Section shall include, but be limited to, the following:
    a. Prefinished Composite wood lap siding
    b. Prefinished Fiber-Cement lap siding (alternative product option in lieu of composite wood siding)
    c. Prefinished Fiber-Cement trim boards
    d. Concealed fasteners and fastening accessories

1.3. SUMMARY

A. Section Includes:

1. Fiber-cement Siding (as alternative product to composite wood siding)
2. Fiber-cement trim boards

B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
2. Division 06 Section "Sheathing" for wall sheathing and weather-resistive barriers.
3. Division 07 Section “Joint Sealant”
4. Division 07 Section “ Thermal Insulation”

1.4. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For siding and soffit including related accessories.

C. Samples for Verification:

1. 12-inch long-by-actual-width Sample of siding and trimboards.
2. 12-inch long-by-actual-width Sample of soffit.

D. Qualification Data: For qualified vinyl siding Installer.

E. Product Certificates: For each type of siding and trimboard from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

G. Research/Evaluation Reports: For each type of siding required, from the ICC.

H. Maintenance Data: For each type of siding and soffit and related accessories to include in maintenance manuals.

I. Warranty: Sample of special warranty.

1.5. QUALITY ASSURANCE

A. Siding Manufacturer: Firm shall possess manufacturing and delivery capacity required for the project. Manufacturer shall have successfully completed at least 5 projects of similar scale and quality required within the past five years.

B. Siding Installer: Firm with no less than three years successful experience in installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

C. Mock up: Install a siding sample building end section mocking at the project site as selected and approved by Architect, including all removals, substrate preparation and installation of siding and components of the system specified. Mock-up must be approved by the architect prior to the start of the system installation specified herein.

D. Qualification of Installer: Workers shall be skilled in their designated tasks, and under the supervision of trained foremen.

E. Coordination: The contractor for the work of this section shall coordinate requirements and materials with other trades.

F. Applicable Standards:

1. American Society for Testing and Materials:
    a. B117: Method of Salt Spray Testing.
    b. D822: Practice for operating light and water exposure apparatus (carbon arc type) for testing paint.
    c. D1735: Method for water for testing of organic coatings.
2. Federal Test Method Standards (FSC 8010):
    a. 141A/6152: Accelerated weathering (enclosed arc apparatus).
    b. 141A/6160: Conducting exterior exposure tests of paints on metals.
3. National Coil Coaters Association:
    a. NCCA II-6: Test Method for measurement of impact resistance of painted aluminum or steel.
    b. NCCA II-12: Specification for determination of relative pencil hardness.
4. NCCA II-16: Test method for determination of film adhesion by 4.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.7. COORDINATION

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.8. WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and soffit that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including cracking, deforming.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Finish Warranty: Limited product warranty against manufacturing finish defects.

1. When used for its intended purpose, properly installed and maintained according to manufacturer's published installation instructions, the manufacturer's integral finish system will not crack, peel or chip for a period of 15 years from the date of substantial completion. Finish warranty includes the coverage for labor and material.

1.9. EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of siding and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1. FIBER-CEMENT LAP SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie; "Artisan" lap siding smooth with tongue and groove ends or comparable product by one of the following:
   a. Or equal as approved by the Architect.
2. Horizontal Pattern: Provide boards in depth wide enough to creat a 5 1/2 inch wide exposure and 5/16" thick. Exposure is to match the building's lap siding.
3. Texture: Smooth Finish.
4. Factory Finish:
   a. Product: ColorPlus Technology by James Hardie .
   b. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
   c. Process:
      (1) Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing process.

(2) Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photospectrometer and verified by third party.

d. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed

e. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.

f. Color: As selected by the Architect from manufacturer's full range of colors.

2.2. FIBER-CEMENT TRIMBOARDS

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie; "Hardie Trim" in 5/4 and 4/4 thicknesses or comparable product by one of the following:
   a. Allura Fiber Cement Lap Siding
   b. Nichia; Nichiboard ™ Lap Siding
   c. Or equal as approved by the Architect.
2. Board widths shall be provided in various sizes as noted on the architectural drawings. Widths indicated on drawings are nominal widths and shall be provided to the nearest next
   a. Texture: Smooth Finish- note: Textured finish will not be accepted.
3. Factory Finish:
   a. Product: ColorPlus Technology by James Hardie or Factory Finished Color to match adjacent School Building light yellow lap siding color.
   b. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
   c. Process:
      (1) Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing process.
      (2) Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photospectrometer and verified by third party.
   d. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed
   e. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.
   f. Color: As selected by the Architect from manufacturer's full range of colors.

2.3. ACCESSORIES

A. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.

1. Texture: Smooth.
2. Nominal Thickness: 0.024 inch
3. Finish: Manufacturer's standard three-coat PVDF.

B. Decorative Accessories: Provide the following fiber-cement accessories installed in accordance with the siding manufacturer's installation manual and standard details:

1. Door and window trim casings.
2. Fasciae.
3. Moldings and trim.
4. Preformed Prefinished Decorative Counter Flashing
5. Preformed Prefinished Drip Flashing (provide Drip Flashing as accessories to the Fiber Cement Trimboards if Composite Wood Siding is elected to be provided in lieu of Fiber-cement siding)

C. Weather Barrier Wrap:

1. Provide non-woven, non-perforated polyolefin water-resistive barrier compliant with ICC ES- AC38 lastest edition.
2. In addition provide seaming tape as recommended by the weather barrier wrap manufacturer.
3. Provide sealant around any wall penetrations before installation of weather barrier.

D. Weather Barrier/Self Adhering Flashing for Window and Door Openings

1. Provide self adhering/self sealing butyl material on tear-resistant top sheets that are applied around windows and doors to manage water and air intrusion.
    a. Provide in accordance with manufacturer's recommended standard details.
    b. Coordinate installation with sequence of installation of preformed prefinished drip flashing and counter flashing components.

E. Fasteners:

1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
2. For fastening fiber cement, use stainless-steel fasteners.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and soffit and related accessories.

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

3.2. PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3. INSTALLATION

A. General: Comply with siding and soffit manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.

2. Center nails in elongated nailing slots without binding siding to allow for thermal movement.

B. Install aluminum soffit and related accessories according to AAMA 1402.

1. Install fasteners no more than 24 inches (600 mm) o.c.

C. Install composite siding and fiber-cement siding and related accessories.

1. Install fasteners no more than 16 o.c. or in accordance with manufacturer's recommendations.

D. Install joint sealants as specified in Division 07 Section "Joint Sealants" and to produce a weathertight installation.

E. Where aluminum siding will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.4. ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, reglets, gravel stop fascia, copings and underlayment.
2. Shop fabricated flashings acceptable as approved by Architect.

1.3. RELATED WORK SPECIFIED ELSEWHERE

A. Section 06 10 00 Rough Carpentry

B. Section 07 53 23 – EPDM Roofing System

C. General Contractor to coordinate and install all vent and stack penetration flashings in order to assure proper roofing weatherization, positive drainage and warranty compliance.

1.4. SCOPE

A. The extent of each type of flashing and sheet metal work is indicated on the drawings and by provisions of this section.

1.5. SITE CONDITIONS

A. Inspection of Surfaces: Contractor shall inspect the substrates to which the work of this section adjoins. The contractor shall be responsible for field checking all dimensions, elevations and slopes on the connecting work affecting the work of this section to insure a proper fit and weathertight construction.

B. Job Conference: Before fabricating and applying any sheet metal work, a job conference shall be called with the sheet metal applicator; General Contractor and the Architect present to assure that these specifications are thoroughly understood. The contractor shall inspect roofing and other adjoining surfaces to see that all subbases and cants are firm, smooth, dry and finished correctly. If any condition exists which would prevent satisfactory work, notify the Architect immediately.

1.6. REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2015.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

E. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction; 2012.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

G. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2012.

H. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2014.

I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

J. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.

K. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a.

L. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.7. SUBMITTALS

A. Shop Drawings: Except flashings made from prefinished coiled material, submit shop drawings to the Architect for review. Shop drawings shall be in accordance with Division 1.

B. Samples: Samples of finish shall be submitted to the Architect for approval upon request. In the case of special finishes, these samples shall show extremes from light to dark within the allowable commercial tolerances. All materials installed shall fall within the range of the approved samples. Samples shall be clearly identified as to project and type of finish.

1.8. QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.9. DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.10. WARRANTY

A. Finish shall be warranted for twenty years against fading, cracking and peeling.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Sheet Metal Flashing/Trim (Roof):

1. Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) thick; anodized finish of color as selected.
    a. Clear Anodized Finish: AAMA 611 AA-M12C22A41 Class I clear anodic coating not less than 0.7 mils thick.
    b. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils thick
2. Pre-Finished Aluminum: ASTM B209 (ASTM B209M)[<>]; 20 gage (0.032 inch) thick; plain finish shop pre-coated with modified silicone coating.
    a. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
    b. Color: As selected by Architect from manufacturer's standard colors.
    c. 30-year manufacturer’s warranty.
3. Flexible Thru-Wall Stainless Steel Flashing: Refer to Specification Section 07 65 00.

2.2. MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder: For use with stainless steel, provide 60 - 40 tin/lead solder (ASTM D-32) with acid-chloride type flux, except use rosin flux over tinned surfaces.

B. Fasteners: Same metal as flashing/sheet metal or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

C. Bituminous Coating: SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulphur compounded for 15 mil dry film thickness per coat

D. Elastomeric Sealant: Type recommended by manufacturer of metal and fabricator of components being sealed; comply with ASTM C-920.

E. Adhesives: Type recommended by flashing sheet manufacturer for waterproof weather-resistant seaming and adhesive application of flashing sheet

F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.

G. Plastic Roofing Cement: ASTM D4586/D4586M, Type I.

2.3. UNDERLAYMENT MATERIAL

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. ATAS International, Inc.
    b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    c. GCP Applied Technologies Inc.
    d. Henry Company.
        (1)
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

B. Slip Sheet material between sheet metal and underlayment: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

1. Provide at conditions where bonding is not desired or to allow expansion and contraction movement of sheet metal cladding materials.

2.4. LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Drain Flashing: Fabricate from the following materials:

B. Stainless Steel: 0.016 inch

2.5. GRAVEL STOP FASCIA

A. Gravel stop fascia at edge of cornices, as scheduled and indicated on drawings, shall be 0.040" gauge aluminum formed to profile shown as manufactured by:

1. ATAS International, Inc.; Edge-Lok 2 Fascia
2. Metal Era Inc.
3. OMG Edge Systems
4. Manufacturer standard as required for system warranty
5. Equal as approved by the Architect.

B. The finish shall be in Kynar 500 with clear coat as required to achieve specified warranty, color, as selected by Architect.

C. Gravel stop to be installed with internal splice plate type expansion joints, 8'-0" on centers, allowing a full 3/16" for expansion. Fasteners shall be 1-3/4" screw shank aluminum nails. Holes in top of gravel stop to be spaced 4" on center nailed to roof blocking. Fascias of gravel stop shall not be nailed. All corners and miters shall be formed and heli arc-welded.

2.6. COPING

A. Coping at parapet walls, where indicated on drawings, shall have 22 gauge continuous steel cleat and 0.050" thickness aluminum coping cover, formed to profile shown as manufactured by:

1. ATAS International, Inc.; Continuous Cleat Coping
2. Metal Era Inc.
3. OMG Edge Systems
4. Manufacturer standard as required for system warranty
5. Equal as approved by the Architect.

B. The finish shall be in Kynar 500 with clear coat as required to achieve specified warranty, color, as selected by Architect.

2.7. SCUPPER AND COLLECTOR BOX

A. Scupper and collector boxes shall be provided where indicated on drawings. 0.060" thickness aluminum, formed to profile shown as manufactured by:

1. ATAS International, Inc.
2. Metal Era Inc.
3. OMG Edge Systems
4. Equal as approved by the Architect.

B. Size shall be as indicated on drawings.

C. The finish shall be in Kynar 500 with clear coat as required to achieve specified warranty, color, as selected by Architect.

2.8. REGLETS AND COUNTERFLASHINGS

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

1. Fry Reglet Corporation.
2. OMG Edge Systems
3. Metal-Era, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Stainless Steel: 0.025 inch (0.64 mm) thick.
2. Corners: Factory mitered and continuously welded.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Stainless Steel: 0.025 inch (0.64 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Stainless-Steel Finish: No. 3 (coarse, polished directional satin).

2.9. GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM). Size and profile as indicated on drawings.

B. Downspouts: Size and profile as indicated on drawings.

C. Provide gutter and downspout supports, brackets and anchors per SMACNA.

D. Provide precast concrete splash pads at each rooftop downspout discharge location, set on protective walkway mat.

E. Provide square cast iron downspout boot receptor at grade level. Extend min 24" above finished grade. Size to accept aluminum downspout.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Underlayment: Install underlayment for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3. INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Retain subparagraph below if required to prevent galvanic corrosion between graphite and aluminum or aluminum-zinc alloy-coated steel. See the "Metal Considerations" Article in the Evaluations.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.4. SHEET METAL FLASHINGS

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. All base flashings and curbs shall be counterflashed with Stainless steel as specified above. The flashing cap shall lie against the base flashing and overlap the same not less than 4 "; end joints shall be clinch-locked and soldered; provide expansion joints in cap flashing for 100 lineal feet of run, maximum, using sliding lap 3" joints; lower edge of all cap flashings shall be stiffened with a 1/2" high folded hem. Metal at corners shall be continuous around the angle or shall be locked and soldered.

C. Flashing at Rising Wall: Install 26 gauge stainless steel through-wall as detailed. Outer edge shall be formed to receive and lock in cap flashing. Cap flashing shall be formed as shown and lock into receiver. Turn down cap flashing a minimum of 4". Lap end joints 3" or provide lock seams.

D. Coping Through-Wall Flashing: Install .26 gauge stainless steel combination through-wall under stone coping as detailed. Seal eye bolts and dowels with silicone sealant. Lap end joints 3" and seal with sealant or provide lock seams.

E. Flashing at Grade: Use 26 gauge stainless steel lap joints 3" and set in sealant. At locations where vertical distance exceeds 1'-4", the portion of flashing in cavity and in backup may be copper membrane. Lap membrane over Stainless steel a minimum of 4" and seal. Stainless steel shall terminate 1/2" behind exterior face of wall. Where membrane waterproofing occurs, turn stainless steel down over membrane a minimum of 8" and seal.

3.5. MEMBRANE FLASHINGS

A. For through-wall flashings shown at nonexposed areas, i.e., at juncture of face brick with concrete wall, beneath windowsills, overhead of windows and doors where shown. Include membrane flashings at all locations noted on drawings. Terminate flashing 1/2" behind exterior face of wall.

B. Install membrane flashings in accordance with manufacturer's directions using mastic to stick membranes to substrate insulation and board attached to masonry. Make side laps at least 3" wide, sealing folds with plastic cement where membranes are joined or pan-formed at ends. Use plastic cement where columns and pipes intercept the membrane for weathertight installation.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

E. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6. ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7. CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

B. Clean off any discoloration of exposed metal. At soldered joints, remove all flux residues and neutralize acid. Rinse with clean water.

C. Flashing sheets shall not be broken or perforated in any manner when the roofing work has been completed. The formed metal shall not permit any accumulation of water on the surface; the end joints shall interlock and overlap at least 2", and the integral reglet shall allow insertion of cap flashings without bending after built-up base flashing has been completed.

D. Protection: Installer shall advise contractor of required procedures for protection of flashing and sheet metal work during construction to ensure that work will be without damage or deterioration at time of substantial completion.

END OF SECTION 07 62 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls, floors and roofs.
2. Penetrations in horizontal and shaft assemblies.

B. Scope of firestop work:

1. Contractor to seal openings for work performed.
2. Contractor to seal openings from where materials are removed. Fill openings with materials compatible with adjacent construction.
3. Also refer to additional requirements described on the Drawings.

1.3. SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system, include location and design designation of qualified testing and inspecting agency. Include through penetration system schedule for pipes, conduits, wires, cable trays, etc.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
2. Provide schedule as noted under submittals to identify UL (Underwriter's Laboratories) design number, rating and compatibility for material penetrating a UL wall, floor, root system. Provide all manufacturer's installation instructions, including environmental conditions for drying.

C. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

D. Product test reports.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by UL.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.

C. Preinstallation Conference: Conduct conference at Project site with General Contractor and installer.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

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

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. Passive Fire Protection Partners.
8. RectorSeal Corporation.
9. Specified Technologies Inc.
10. 3M Fire Protection Products.
11. Tremco, Inc.; Tremco Fire Protection Systems Group.
12. USG Corporation.

2.2. PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

D. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes. Do not paint if prohibited by the manufacturer.

E. Where pipes, conduits, etc. are in the same opening, provide a single sealing manufacturer which is capable of protecting all utilities and materials.

F. Where Owner's reviewing agency inspects installed systems and notes deficiency, make all corrections to installation to agency's satisfaction.

3.2. IDENTIFICATION

A. Identify concealed penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

B. Identify exposed penetration system in mechanical, electrical or storage spaces not normally occupied.

3.3. FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.4. PENETRATION FIRESTOPPING SCHEDULE

A. UL-classified systems listed in this specification refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ. Unless indicated on the drawings, Contractors shall use the specified firestop systems where required and as appropriate for the penetrated construction.

B. Firestopping with No Penetrating Items:

1. UL-Classified Systems: F-A-0001 thru 0003; W-J-0001 thru 0005; W-L-0001 thru 0009.

C. Firestopping for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: F-A-1018 thru 1020; W-J-1001 thru 1103; W-L-1001 thru1234.

D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: F-A-2002, 2021; ; W-J- 2001-2077.

E. Firestopping for Electrical Cables:

1. UL-Classified Systems: F-A-3003 thru 3015; W-J-3001 thru 3065; W-L-3001 thru 3172.

F. Firestopping for Cable Trays with Electric Cables:

1. UL-Classified Systems: F-A-4002; W-J-4001 thru 4025; W-L-4001 thru 4003.

G. Firestopping for Insulated Pipes:

1. UL-Classified Systems: F-A-5010, 5011, 5013; W-J-5001 thru 5060; W-L-5001 thru 5129.

H. Firestopping for Miscellaneous Electrical Penetrants:

1. UL-Classified Systems: F-A-6001 thru 6006.

I. Firestopping for Miscellaneous Mechanical Penetrants:

1. UL-Classified Systems: W-J-7001 thru 7032; W-L-7001 thru 7062.

J. Firestopping for Groupings of Penetrants:

1. UL-Classified Systems: F-A-8002, 8004; W-J-8001 thru 8014; W-L-8001 thru 8028.

END OF SECTION 07 84 13

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated construction.

B. Related Sections:

1. Division 7 Section "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3. SUBMITTALS

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

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For qualified Installer.

D. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
    a. Fire-resistive joint system products bear classification marking of qualified testing agency.

b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:

(1) UL in its "Fire Resistance Directory."

C. Preinstallation Conference: Conduct conference at Project site.

1.5. PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6. COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1. FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Fibrex Insulations, Inc.
    b. IIG Miniwool LLC
    c. RectorSeal Corporation.
    d. Rockwool Manufacturing Co.
    e. Roxul Inc.
    f. 3M Fire Protection Products.

g. Thermafiber, Inc.
h. USG Corporation.
i. W.R. Grace & Co.

C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. VOC Content: Provide fire-resistive joint systems that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2. PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3. INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4. IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5. FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6. CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7. FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN.

B. Head-of-Wall, Fire-Resistive Joint Systems FRJS-1 (for Masonry):

1. UL-Classified Systems: HW-D-0415.
2. Assembly Rating: 1 hour or 2 hours as indicated by the wall rating.
3. Nominal Joint Width: 1 and 2 inches.
4. Movement Capabilities: Class II – 25 percent.
5. L-Rating at Ambient: Less than 1 cfm/ft. (cu. m/s x m).
6. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/ft. (cu. m/s x m).

C. Head-of-Wall, Fire-Resistive Joint Systems FRJS-2 (for Masonry):

1. UL-Classified Systems: HW-D-0442.
2. Assembly Rating: 1 hour or [2 hours as indicated by the wall rating.
3. Nominal Joint Width: 2 inch.
4. Movement Capabilities: Class II - 13 percent compression or extension.
5. L-Rating at Ambient: Less than 13 cfm/ft. (cu. m/s x m).
6. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/ft. (cu. m/s x m).

D. Head-of-Wall, Fire-Resistive Joint Systems FRJS-3 (for Gypsum Board):

1. UL-Classified Systems: HW-D-0443.
2. Assembly Rating: 1 hour and 2 hours as indicated by the wall rating.
3. Nominal Joint Width: 2 in. maximum.
4. Movement Capabilities: Class II - 33 percent compression only.

E. Head-of-Wall, Fire-Resistive Joint Systems FRJS-4:

1. UL-Classified Systems: HW-D-0445.
2. Assembly Rating: 1 hour or 2 hours as indicated by the wall type.
3. Nominal Joint Width: 2 inch maximum.
4. Movement Capabilities: Class II - 33 percent compression only.

F. Head-of-Wall, Fire-Resistive Joint Systems FRJS-5:

1. UL-Classified Systems: HW-D-0447.
2. Assembly Rating: 2 hours.
3. Nominal Joint Width: 2 inches.
4. Movement Capabilities: Class II - 25 percent compression or extension.

END OF SECTION 07 84 20

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

B. Related Sections:

1. Division 04 Sections for for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
4. Division 09 Section "Porcelain Tile" for sealing tile joints.
5. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3. PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
    a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
        (1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4. SUBMITTALS

A. Product Data: For each joint-sealant product indicated

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.

4. Joint-sealant color.

E. Qualification Data: For qualified Installer.

F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

I. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

J. Field-Adhesion Test Reports: For each sealant application tested.

K. Warranties: Sample of special warranties.

1.5. QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6. PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7. WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1. MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2. SILICONE JOINT SEALANTS

A. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; Omniplus.
   b. Dow Corning Corporation; 786 Mildew Resistant.
   c. GE Advanced Materials - Silicones; Sanitary SCS1700.
   d. May National Associates, Inc.; Bondaflex Sil 100 WF.
   e. Tremco Incorporated; Tremsil 200 Sanitary.

2.3. URETHANE JOINT SEALANTS

A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Tremco Incorporated; Dymeric 240
   b. Pecora Corporation; Dynatrol II.
   c. Polymeric Systems, Inc.; PSI-270.

B. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use T.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Tremco Incorporated; Dymeric 240 FC.
   b. Polymeric Systems, Inc.; PSI-270.

2.4. LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; Sonolac.
   b. Bostik, Inc.; Chem-Calk 600.
   c. May National Associates, Inc.; Bondaflex 600.
   d. Pecora Corporation; AC-20+.
   e. Schnee-Morehead, Inc.; SM 8200.
   f. Tremco Incorporated; Tremflex 834.

2.5. ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; AC-20 FTR.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2.6. JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7. MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2. PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3. INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, -sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4. FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5. CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6. PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7. JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
    a. Isolation and contraction joints in cast-in-place concrete slabs.
    b. Tile control and expansion joints.

c. Other joints as indicated.

2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior and interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Construction joints in cast-in-place concrete.
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
   f. Other joints as indicated.

2. Urethane Joint Sealant: Multicomponent, nonsag,, Class 50.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

4. Silicone based sealant may also be used to at exterior locations at non-exposed conditions or if colored type may be considered for use at certain exposed exterior envelope conditions.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation joints in cast-in-place concrete slabs.
   b. Other joints as indicated.

2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
   d. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   e. Other joints as indicated.

2. Joint Sealant: Latex acrylic based.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

4. Silicone based sealant may also be used at certain interior locations as approved by the Architect. Clear type may used where visual conditions allow the installation to be inconspicuous; verify condition of use with the Architect.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:
    a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    b. Tile control and expansion joints where indicated.
    c. Other joints as indicated.
2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:
    a. Acoustical joints where indicated.
    b. Other joints as indicated.
2. Joint Sealant: Acoustical.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1. SCHEDULES

A. Provide doors and frames indicated on the Door Schedule as represented on the drawings.

1. The door and frame schedule can be extracted from the drawing database by the Architect into an excel spreadsheet after the award of bids; which then can be issued to the contractors to facilitate shop drawing preparation and field coordination.

B. In addition provide doors and frames per A6# Series of Drawings and as labeled and located in the remainder of the Drawings.

C. Also refer to Section 08 71 00 “Door Hardware” for project scope describing requirements for Door Hardware Components.

END OF SECTION 08 06 00

DOOR AND FRAME SCHEDULE

	DOOR							FRAME			
	DOOR NO.	TYPE	MATL	SIZE WIDTH	SIZE HT	FINISH	DOOR GLAZING TYPE	TYPE	FRAME ELEVATION NUMBER	FIRE RATING LABEL	REMARKS
FIRST FLOOR											
TRAINING WING ADDITION											
	TW1	HM	HM	36"+24"	84"	PAINT		HMF			KEYED DBL CYLINDER DEADBOLT, FLUSH BOLT INACTIVE LEAF
	TW1A	G	ALUM	48"	84"	KYNAR	1" LOW E	ALUM			DARK GREEN KYNAR FINISH, EXIT DEVICE, CARD READER BY OWNER,
	TW2	HM	HM	36"+24"	84"	PAINT		HMF			SINGLE CYLINDER DEADBOLT- KEY ON FITNESS ROOM SIDE, FLUSH BOLT INACTIVE LEAF
	TW2A	F	HM	36"	84"	PAINT		HM			EXIT DEVICE, CARD READER BY OWNER
	TW2B	OH	STL	144"	144"	FAC		STL			INSULATED OVERHEAD DOOR, VIEW SLOTS, OVERHEAD RAIN DRIP GUARD (2) X 76" WITH SPLICE PLATE
	TW3	F	HM	44"	84"	PAINT		HMF		45 MIN.	OFFICE LOCK WITH SINGLE CYLINDER DEADBOLT. FIRE RATED

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide the following door hardware. The work shall include all components, accessories and labor necessary for a complete installation.

PART 2 - PRODUCTS

2.01 DOOR HARDWARE SETS

1. The door hardware sets represent the 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. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   a. Quantities listed are for each pair of doors, or for each single door.
   b. The supplier is responsible for handing and sizing all products.
   c. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   d. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

2.02 MANUFACTURER'S ABBREVIATIONS:

1. MK - McKinney
2. MR - Markar
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. BE - BEST Access Systems
7. RF - Rixson
8. PE - Pemko
9. OT - Other

2.03 DOOR HARDWARE SETS

Set: 1.0

Doors: TW2B

2	Rain Guard	346C		PE

Set: 2.0

Doors: TW1A

1	Continuous Hinge	FM100 CTP - DOOR HEIGHT	628	MR
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit Device, Storeroom	16 43 55 56 72 AD8504 862	US32D	SA
2	Cylinder Core (SFIC)	1C - MATCH EXISTING	626	BE
1	Drop Plate (PA)	351D	EN	SA
1	Blade Stop Spacer	581-2	EN	SA
1	Surface Closer	351 CPS	EN	SA
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Perimeter/Mtg Stile Seal	BY FRAME / DOOR SUPPLIER		OT
1	Sweep (w/drip edge)	3452CNB		PE
1	Frame Harness	QC-C1500P		MK
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK
1	Card Reader	BY SECURITY		OT
1	Door Position Switch	BY SECURITY		OT
1	Power Supply	AQL4-R8E1		SU

Notes:
• Electronic Operation: Valid card retracts latchbolt; key retracts latchbolt. Free egress at all times. In case of power loss or fire alarm (if rated), door remains locked and latched.

Set: 3.0

Doors: TW2A

1	Continuous Hinge	FM300 CTP - DOOR HEIGHT	630	MR
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit Device, Storeroom	16 43 55 56 72 8804 862	US32D	SA
2	Cylinder Core (SFIC)	1C - MATCH EXISTING	626	BE
1	Surface Closer	351 CPS	EN	SA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Threshold	278x292AFGPK MSES25SS		PE
1	Rain Guard	346C		PE
1	Gasketing (head/jamb)	S773BL		PE
1	Sweep (w/drip edge)	3452CNB		PE
1	Frame Harness	QC-C1500P		MK
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK
1	Card Reader	BY SECURITY		OT
1	Door Position Switch	BY SECURITY		OT

1	Power Supply	AQL4-R8E1		SU

Notes:
• Electronic Operation: Valid card retracts latchbolt; key retracts latchbolt. Free egress at all times. In case of power loss or fire alarm (if rated), door remains locked and latched.

Set: 4.0

Doors: TW3

3	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Office Lock	70 8205 LNL	US26D	SA
1	Cylinder Core (SFIC)	1C - MATCH EXISTING	626	BE
1	Surf Overhead Stop	10-X36	652	RF
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Gasketing (head/jamb)	S88BL		PE

Set: 5.0

Doors: TW1, TW2

6	Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt (manual)	555 (or) 557	US26D	RO
1	Store Door Lock	70 8226 LNL	US26D	SA
2	Cylinder Core (SFIC)	1C - MATCH EXISTING	626	BE
1	Surf Overhead Stop	10-X36	652	RF
1	Surface Closer	351 PS	EN	SA
2	Kick Plate	K1050 10" CSK BEV	US32D	RO
1	Gasketing (head/jamb)	S88BL		PE
1	Astragal	357SP		PE
1	Astragal	S771C		PE

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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. When modifications are exposed to view, use concealed fasteners, when possible.
2. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
   a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
   b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
   c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

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

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. 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. Lock Cylinders:

1. Replace construction cores with permanent cores as indicated in keying section.

J. Wiring: Coordinate with Division 26, ELECTRICAL ections for:

1. Conduit, junction boxes and wire pulls.

2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. 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.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. 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.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 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.

1. 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.

3.05 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.

END OF SECTION 08 71 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Fire rated and non-fire rated standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors
4. Light frames and glazing installed in hollow metal doors.

1.3. RELATED SECTIONS

A. Section 07 60 00 - Flashings

B. Section 07 92 00 - Joint Sealants

C. Section 08 44 13 - Glazed Aluminum Curtain Walls

D. Section 08 71 00 - Door Hardware

E. Section 08 88 00 - Glass and Glazing

1.4. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of the Steel Door Institute.

E. REFERENCE STANDARDS

1. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
2. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
3. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A653/ASTM A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ANSI/BHMA A156.15 - Hardware Preparation in Steel Doors and Frames.
9. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
10. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
11. NFPA 105: Standard for the Installation of Smoke Door Assemblies.
12. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
13. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
14. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
15. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.5. QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.7. PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8. COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide hollow metal door and frame products by one of the following:

1. CECO Door Products
2. Republic Doors
3. Steelcraft

2.2. MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3. STANDARD HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush and raised panel. Refer to Drawings.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Acoustical Doors: Provide manufacturer’s core or as needed to provide sound-transmission class rating indicated.

1. Sound Transmission Class (STC) Rating: 46 with 864 sq. in. maximum per ASTM E90-90 for Glazed Doors.
2. Provide higher STC rating for doors with less than 864 sq. in. of glass.
3. At acoustic doors, provide lite kits that are capable of allowing 3/8” to ¼” dual glazing for added sound attenuation or provide acoustic door with glazing installed as part of a manufacturer tested assembly.
4. All acoustic doors shall have acoustic seals provided around the door frames and thresholds to enhance acoustic isolation. Door thresholds shall not hinder handicapped accessibility.
5. Acoustic Doors shall be provided with wood veneer to match other Flush Wood doors on the project. Color: Red Oak with stain color nearest match to selected Flush Wood doors.

2.4. STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames, with the exception of knock down types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
3. Frames for Level 3 Steel Doors (up to 48 inches in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.

4. Frames for Level 3 Steel Doors (48 inches and up in width): Minimum 12 gauge (0.081-inch -2.7-mm) thick steel sheet.
5. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
6. Manufacturers Basis of Design:
    a. Curries Company M/G Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
3. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
4. Frames for Level 3 Steel Doors (up to 48 inches in width): Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.]
5. Frames for Level 3 Steel Doors (48 inches and up in width): Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.]
6. Frames for Wood Doors: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
7. Frames for Borrowed Lights: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
8. Manufacturers Basis of Design:
    a. Curries Company M/G Series (Masonry Profile).

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5. FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6. HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7. LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 90 minutes and less.

1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.8. LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

E. Glazing: Comply with requirements in Division 08 Section "Glazing" and with the hollow metal door manufacturer's written instructions.

1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

2.9. ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.10. ELECTRIFIED DOOR HARDWARE AND FRAMES

A. Provide concealed wiring assembly with 12 lead cables to operate electronic locks, signs, switches, monitors, card readers etc., where electrically operated hardware is required at certain doors.

1. Provide “Electrolynx” by Ceco Doors as the basis of design product. Wiring connections shall be compatible with ASSA ABLOY Group Products and shall be provided with Universal Connector Plugs as needed for connection to other manufacturer’s components.
    a. All doors equipped with such hardware shall be tagged with a factory provided identification labels after installation into the door the panels prior to delivery to the project site. (Necessary for prevention of damage to wiring assembly during door installation)
    b. Provide with UL Label for fire rate doors depending upon fire rating of specified door panel location(s).

B. Installation of wiring assembly shall be performed at the factory or shop from where the door panels are manufactured to maintain quality and certainty of proper installation.

1. The wiring assembly shall be pretested for continuity to assure functionality at the factory before being sent to the project site for installation.
2. The installer shall refer to the manufacturer’s recommendations for recommended placement of components in door panels and frame assembly as well as coordinate with requirements for field installed door hardware components.

2.11. FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        (1) Two anchors per jamb up to 60 inches high.
        (2) Three anchors per jamb from 60 to 90 inches high.
        (3) Four anchors per jamb from 90 to 120 inches high.
        (4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
        (1) Three anchors per jamb up to 60 inches high.
        (2) Four anchors per jamb from 60 to 90 inches high.
        (3) Five anchors per jamb from 90 to 96 inches high.
        (4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        (5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.12. STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for all rough openings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3. INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4. ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08 11 13

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Insulated rolling service doors

1.2. REFERENCES

A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

C. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.

D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

F. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

G. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

H. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

J. NEMA MG 1 - Motors and Generators.

1.3. DESIGN / PERFORMANCE REQUIREMENTS

A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.4. SUBMITTALS

A. Submit under provisions of Section 01300.

B. 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. Details of construction and fabrication.
4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

1.7. PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8. COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.9. WARRANTY

A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.

C. PowderGuard Finish

1. PowderGuard Max: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Max Finish warranty for 5 years.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Basis of Design: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site

B. Cornell Innovative Door Solutions, Mountain Top, PA

C. Raynor Garage Doors, Dixson, IL

2.2. INSULATED ROLLING SERVICE DOORS

A. Basis of Design Model: Overhead Door Corporation Stormtite AP Model 627.

1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
   a. Flat profile type FIT-265 for doors up to 40 feet (12.19 m) wide.
   b. Front slat fabricated of:
      (1) 20 gauge galvanized steel.
   c. Back slat fabricated of:
      (1) 24 gauge galvanized steel.
   d. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.
      (1) R-Value: 10.9, U-Value: 0.09.
2. Performance:
   a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
   b. Installed System Sound Rating: STC-21 as per ASTM E 90.
   c. U-factor: 0.84 NFRC test report, maximum U-factor of no higher than 1.00.
   d. Air Infiltration: Meets ASHRAE 90.1 and IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft2.

3. Slats and Hood Finish:
    a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
        (1) Powder Coat:
            (a) PowderGuard Max powder coat, color as selected by Architect.
        (2) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
4. Weatherseals:
    a. Vinyl bottom seal and internal hood seals.
    b. Interior and exterior EPDM triple-seal finned guide weatherseal.
    c. Lintel weatherseal.
    d. Air Infiltration Package: IECC 2012/2015 listed; product to meet C402.4.3 2012 Air leakage <1.00 cfm/ft2.
        (1) Air infiltration perimeter seal package includes: guide cover, guide cap, PVC weatherseal on exterior of guide, EPDM triple finned weatherseal on interior of guide, lintel weatherseal and vinyl bottom seal.
5. Bottom Bar:
    a. Two stainless steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
6. Guides: Three structural steel angles.
7. Brackets:
    a. Galvanized steel to support counterbalance, curtain and hood.

8. Finish; Guides, Headplate and Brackets:
    a. PowderGuard Max powder coat color as selected by the Architect..
9. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
10. Hood: Provide with internal hood baffle weatherseal.
    a. Aluminum hood with intermediate supports as required.
11. Manual Operation:
    a. Chain hoist.
    b. Crank operation.
12. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
    a. Sensing Edge Protection:
        (1) Electric sensing edge.
    b. Operator Controls:

        (1) Push-button and key operated control stations with open, close, and stop buttons.
        (2) Controls for interior location.

(3) Controls surface mounted.

c. Motor Voltage: 115/230 single phase, 60 Hz.

13. Wind Load Design:
    a. Standard wind load shall be 20 PSF.

14. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
15. Locking:
    a. Chain keeper locks for chain hoist operation.
    b. Interior slide bolt lock for electric operation with interlock switch.
    c. Cylinder lock for electric operation with interlock switch.
16. Wall Mounting Condition:
    a. Face-of-wall mounting.
    b. Between jambs mounting.
17. Insulated Vision Lites: 10 inches by 1 inch (254 mm by 25.4 mm) uniformly spaced openings.
    a. Provide with dual-wall polycarbonate.
    b. See exterior building elevation for location of vision lites on door panel.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Verify opening sizes, tolerances and conditions are acceptable.

B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.

G. Install perimeter trim and closures.

H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4. ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5. CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6. PROTECTION

A. Protect installed products until completion of project.

END OF SECTION 08 33 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Work under this section includes all aluminum doors, frames, transoms, sidelights, storefronts and operable windows within storefront framing. Provide specified glazing of all units provided under this section.

1. Refer to detailed framing elevations for specific notes delineating where storefront framing is to be provided.
2. Provide clear anodized finishes on all aluminum doors, storefront framing and curtainwall framing in this project unless otherwise noted.

B. Related Sections

1. Division 7 Air Barriers and Dampproofing
2. Division 7 Joint Sealants
3. Division 8 Glazed Aluminum Curtain Walls
4. Division 8 Glazing

1.3. DESIGN CRITERIA

A. Thermal Movement: Fabricate exterior components from manufacturer's stock systems, which have been designed to provide for expansion and contraction resulting from ambient temperature range of 120 degrees F (49 degrees C).

B. Wind Loading: Fabricate exterior components from manufacturer's stock systems which have been tested in accordance with ASTM E-330 to withstand at least the following loadings:

1. Uniform pressure of 20 pounds per square foot inward and 20 pounds per square foot outward.

C. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 6.24 psf (300 Pa).

D. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501.

E. Uniform Load: A static air design load of 35 psf (1680 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

F. Deviations: Plans, elevations and details show spacings of members as well as profile and similar dimensional requirements of aluminum entrances and storefront work. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in Architect's sole judgment; such deviations do not materially detract from design concept or intended performances.

1.4. STANDARDS

A. Reference: Comply with applicable provisions of "Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual" by AAMA.

1.5. SITE CONDITIONS

A. Field Measurements: Take field measurements; check elevations and connecting work affecting work of this section.

B. The finish hardware supplier shall be responsible for furnishing physical hardware to the entrance manufacturer prior to fabrication. The finish hardware supplier shall also be responsible for coordinating hardware delivery requirements with the hardware manufacturer, the general contractor and the entrance manufacturer to insure the building project is not delayed.

1.6. SUBMITTALS

A. Shop Drawings: Submit shop drawings to the Architect for review. Shop drawings shall be in accordance with the General Conditions and the supplement to the General Conditions.

1. Include elevations, detail sections of typical composite members, anchorages, reinforcement and expansion provisions.

B. Samples: Submit samples of each type and color of aluminum finish on 12" long sections of extrusions or formed shapes and on 6" square sheets.

C. Product Data: Submit manufacturer's specifications, standard details and installation recommendations for components of aluminum entrances and storefronts required for project, including data that products have been tested and comply with performance requirements.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed storefront.

E. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.7. QUALITY ASSURANCE

A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements”. Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements.

1.8. WARRANTIES. GUARANTEES. TESTING

A. Provide written Two (2) year Warranty, from date of Project Substantial Completion, signed by manufacturer, installer and contractor agreeing to replace aluminum entrances and storefront, which fail in materials or workmanship within two years. Failure of materials or workmanship includes excessive leakage or air infiltration, excessive deflections, faulty operation of entrances, deterioration of finish or construction in excess of normal weathering and defects in hardware, weather-stripping and other components of the work.

PART 2 - PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Refer to drawings for locations. Subject to compliance with requirements, provide products of one of the following:

B. Aluminum Storefront Frames, including transoms and sidelights:

1. Basis-of-Design Product:
   a. Kawneer Company Inc.
   b. Trifab VG 451T Frontset glazing, (Thermal) for exterior locations
   c. System Dimensions: 2" sightline x 4-1/2" depth
2. Glass: ¾” or 1” insulated glass as allowable by glazing stop, with Low-E coating on #2 surface.. U-value </=. 29 center of glass.
3. Approved equal manufacturers:
   a. EFCO Series 433: Frontset glazing, Thermal (exterior locations)
   b. YKK YES 45 TU: Frontset glazing, Thermal (exterior locations)

C. Operable vents windows :

1. Basis of Design: Kawneer GLASSvent UT windows for storefront framing.
   a. Project-Out or Outswing Casement
   b. 3" nominal system depth with capability for (1" Infill) for insulated glazing.
   c. Provide with exterior trim caps in black anodized finish.

d. Heavy Commercial

e. Insect Screens: Extruded aluminum frames, 6063-T6 alloy and temper, joined at corners: 18 x 16 mesh fiberglass screen cloth; frames finished to match aluminum windows; splines shall be extruded vinyl, removable to permit rescreening. Provide hand-hole access as required.

f. Hardware:

(1) General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.

(2) Project-Out / Outswing Casement Windows: Provide the following operating hardware:

(a) Stainless Steel 4-Bar Hinges

(b) Cast White Bronze Cam Locking Handles

2. Approved equal frameless windows:

a. EFCO WV410 Vent

b. YKK YES SSG Vent

D. Materials:

1. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
2. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components.
3. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
4. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plate steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
5. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
6. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.
7. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC-PS 12 compounded for 30 mil thickness per coat.
8. Sill shall be extruded aluminum with joint covers and hold down clips. Joints shall occur at columns. Provide formed, concealed aluminum sheet at columns as detailed. Clear anodized finish.

2.2. STILE AND RAIL-TYPE DOORS

A. Basis of Design : Kawneer 500 Standard Entrance

1. Wide stile, 5" vertical stile dimension, 5" top rail, 10" bottom rail, 1-3/4" depth.
2. High traffic applications.
3. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.
4. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
5. Glazing: Doors shall have extruded aluminum snap-in-glass stops with neoprene insets for puttyless glazing.
6. Insulated Low-E glass at doors facing the exterior.
7. Glazing in doors within interior entrance vestibules facing only the interior shall be ¼" tempered Glass, unless otherwise specified.
8. Approved equal manufacturers:
    a. EFCO D500
    b. YKK 50D

2.3. ALUMINUM CLOSURES AND COLUMN COVERS

A. Where closures and column covers are indicated and required, provide angles and covers formed of .063 minimum thickness aluminum matching finish of adjacent aluminum.

2.4. ALUMINUM SPANDREL PANELS FOR DOORS WITH BOTTOM INFILL PANELS.

A. Provide 1" thick nominal anodized aluminum smooth faced insulated panels with an R-value of 3 min. Front/outside aluminum face shall be .040" min. thick aluminum and shall be reinforced with 1/8" MDF. Back face shall be .063" thick aluminum.
    1. Provide by
        a. H&H Metals
        b. MapeSpan
        c. Laminators Inc.

2.5. DRIP MOLDING

A. Provide over exposed door openings drip molding as Zero No.142; Reese No. R201A, with finish to match storefront.
    1. Do not install where door(s) is/are directly under an overhead roof or canopy. Consult with Architect as to where installation is not required.

2.6. FINISHES

A. Painted Finish
    1. All exposed surfaces shall be free of die marks, grinding marks, spots, streaks or other blemishes and shall be painted with 70% fluoropolymer coating system meeting or exceeding requirements of AAMA 2605.. Color to be as selected by Architect.
        a. Color: Hartford Green or other similar dark green

PART 3 - EXECUTION

3.1. INSPECTION

A. Condition of Surfaces: Installer shall inspect the substrates to which the work of this section adjoins. No work shall be installed until corrections to substrates have been performed by the trades involved.

3.2. INSTALLATION

A. Framing Members: Install in accordance with manufacturer's approved shop drawing in prepared opening. Members shall be level, square, plumb and at proper elevations and in alignment with other work.

B. Cutting and Fitting: All materials shall be accurately cut and fitted and rigidly secured in place. All cut and machined ends and recesses shall be true, accurate and free of burrs or rough edges.

C. Fastenings: For block walls, use only with toggles with finished heads; fastenings in concrete walls may be made with bolts let into expansion sleeves. Provide 1" diameter access hole in aluminum tube for installation of anchoring bolts. Access hole shall be located under door stop.

D. Where storefront framing is installed at locations without a roof overhang provide sill flashing with end-dams to prevent water intrusion at the base of the sill and side jambs. Provide such installation in accordance with manufacturer’s recommendations.

E. Use care in subsequent operations to prevent distortion or damage and replace any damaged work with new material.

F. Caulking: Provide clearance between storefront metal and opening substrate for caulking with adjoining building construction. All joints in storefront metal shall be sealed during fabrication.

G. Hardware: Properly install and adjust. Final adjustment shall be made for proper and easy operation of the doors after glazing.

3.3. CLEANING AND PROTECTION

A. Cleaning: After installation, framing members shall be cleaned following procedure recommended by the manufacturer.

B. Dissimilar Materials: In addition to the finish specified, aluminum surfaces that will contact masonry, concrete, wood or steel shall be protected from contact by a coat of bituminous paint to prevent galvanic or corrosive action.

C. Masking: Apply waterproof masking tape to aluminum surfaces remaining exposed on the interior of the building, which may be splattered with mortar, plaster, paint or other disfiguring materials.

D. Protection shall be as recommended by the manufacturer. The contractor shall protect storefront from damage during subsequent construction activities. Damaged materials shall be replaced at no additional cost to the Owner .

3.4. OWNER'S INSTRUCTIONS

A. Instructions: Owner's representative shall be given written and verbal instructions as to the procedures required for keeping the work herein specified, maintained and adjusted.

B. Tools: Adjusting wrenches and small tools furnished with operating hardware shall be turned over to Owner's representative, properly tagged.

C. Control: The foregoing shall not relieve the contractor of any responsibilities under the guarantee specified hereinbefore.

END OF SECTION 08 41 13

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. WORK INCLUDED

A. Furnish and install aluminum architectural windows complete with hardware and related components as shown on drawings and specified in this section.

B. Glass and Glazing

1. Typical window units shall be factory glazed with the exception of the window unit located within the stair tower in Main Hall which may be field glazed in consideration of the units size.
2. Reference Section 08 80 00 for Glass and Glazing.

C. Single Source Requirement

1. All products listed in Section 1.2A shall be by the same manufacturer.

1.3. RELATED WORK

A. Section 07 92 00 Joint Sealants

B. Section 08 80 00 for Glass and Glazing.

1.4. LABORATORY TESTING AND PERFORMANCE REQUIREMENTS

A. Test Units

1. Air, water, and structural test unit shall conform to requirements set forth in AAMA/WDMA/CSA 101/I.S.2/A440-08 and manufacturer's standard locking/operating hardware and insulated glazing configuration.
2. Thermal test unit sizes shall be 48" (1219 mm) x 72" (1828 mm). Unit shall consist of a project-out over fixed over project-in window.

B. Test Procedures and Performances

1. Windows shall conform to all AAMA/WDMA/CSA 101/I.S.2/A440-08 requirements for the window types indicated on the drawings. In addition, the following specific performance requirements shall be met.
2. Life Cycle Testing
    a. Test in accordance with AAMA 910. There shall be no damage to fasteners, hardware parts, support arms, activating mechanisms, or any other damage that would cause the window to be inoperable. Air infiltration and water resistance tests shall not exceed specified requirements.
3. Air Infiltration Test
    a. With ventilators closed and locked, test unit in accordance with ASTM E 283 at a static air pressure difference of 6.24 psf (299 Pa).

b. Air infiltration shall not exceed .10 cfm/SF (.50 l/s•m²) of unit.

4. Water Resistance Test
   a. With ventilators closed and locked, test unit in accordance with ASTM E 331/ASTM E 547 at a static air pressure difference of 12.0 psf (574 Pa).
   b. There shall be no uncontrolled water leakage.
5. Uniform Load Deflection Test
   a. With ventilators closed and locked, test unit in accordance with ASTM E 330 at a static air pressure difference of 110.0 psf (5267 Pa), positive and negative pressure.
   b. No member shall deflect over L/175 of its span.
6. Uniform Load Structural Test
   a. With ventilators closed and locked, test unit in accordance with ASTM E 330 at a static air pressure difference of 165.0 psf (7900 Pa), both positive and negative.
   b. At conclusion of test there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms, nor any other damage that would cause the window to be inoperable.
7. Forced Entry Resistance
   a.Windows shall be tested in accordance to ASTM F 588 or AAMA 1302.5 and meet the requirements of performance level 40.
8. Condensation Resistance Test (CRF)
   a. Test unit in accordance with AAMA 1503.1.
   b. Condensation Resistance Factor (CRF) shall not be less than 45 when glazed with .52 center of glass U-Factor. (See chart at end of section).
9. Condensation Resistance (CR)
   a.With ventilators closed and locked, test unit in accordance with NFRC 500-2010.
   b.Condensation Resistance (CR) shall not be less than 33 when glazed with .29 center of glass U-Factor. (See chart at end of section).
10. Thermal Transmittance Test (Conductive U-Factor)
    a. With ventilators closed and locked, test unit in accordance with NFRC 100-2010.
    b. Conductive thermal transmittance (U-Factor) shall not be more than .52 BTU/hr•ft²•°F
    (3.00 W/m²•K) when glazed with .29 center of glass U-Factor. (See chart at end of section).
11. Project Wind Loads
    a. 1.The system shall be designed to withstand the following loads normal to the plane of the wall:
       (1) Positive pressure of +26 psf at non-corner zones.
       (2) Negative pressure of -28 psf at non-corner zones.

1.5. QUALITY ASSURANCE

A. Provide test reports from AAMA accredited laboratories certifying the performance.

B. Test reports shall be accompanied by the window manufacturer's letter of certification, stating the tested window meets or exceeds the referenced criteria for the appropriate window type.

1.6. SUBMITTALS

A. Contractor shall submit shop drawings; finish samples, test reports, and warranties.

1. Samples of materials as may be requested without cost to owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.

B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2010.

C. Test reports documenting compliance with requirements of Section 1.05.

D. A sample window, 36" (914 mm) x 24" (610 mm) single unit, as per requirements of architect.

1.7. WARRANTIES

A. Total Window Installation

1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total window installation which includes that of the windows, hardware, glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, water, and structural adequacy as called for in the specifications and approved shop drawings.
2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at their expense during the warranty period.

B. B.Window Material and Workmanship

1. Provide written guarantee against defects in material and workmanship for 10 (ten) years from the date of final shipment.

C. Glass

1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
2. Warranty period shall be for 10 (ten) years.

D. Coated Finish

1.Warranty period shall be for 10 years from the date of final shipment.

PART 2 - PRODUCTS

2.1. WINDOWS WITH DUAL PANE GLASS (TYPICAL EXTERIOR WINDOWS)

A. Basis of Design: Kawneer 8225TL Thermal Windows Fixed and Project-Uut Awning

B. EFCO Series 2700 Thermal AW-PG110-AP Grade Projected Windows

C. Graham Archtitectural Products S6500 Series Projected

D. Equal as approved by Architect

2.2. WINDOWS WITH TRIPLE PANE GLASS (EXTERIOR CLERESTORY HIGH-BAY ONLY LOCATIONS)

A. Basis of Design: Kawneer AA6400 Series Fixed.

B. EFCO Product series comparable to basis of design to basis of design product for triple glazed windows.

C. Graham Architectural Product series comparable to basis of design product for triple glazed windows

2.3. MATERIALS

A. Aluminum

1. Extruded aluminum shall be 6063-T6 alloy and tempered.

B. Hardware

1. Locking handles shall be cam type and manufactured from a white bronze alloy with a US25D brushed finish.
2. Operating hardware shall be 4-bar stainless steel arms or equal.

C. Weather-Strip

1. All weather-strip shall be Santoprene® or equal.

D. Glass

1. See glass types noted on drawings for particular windows.

E. Thermal Barrier

1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.
2. The perimeter frame thermal barrier shall be thermal struts, consisting of glass reinforced polyamide nylon, mechanically crimped in raceways extruded in the exterior and interior extrusions.
3. The sash and intermediate rails shall be poured and debridged thermal barrier made of two-part polyurethane.

2.4. FABRICATION

A. General

1. All aluminum frame and vent extrusions shall have a minimum wall thickness of .125” (3mm).
2. Mechanical fasteners, welded components, and hardware items shall not bridge thermal barriers. Thermal barriers shall align at all frame and vent corners.
3. Depth of frame and vent shall not be less than 2” (50 mm).

B. Frame

1. Frame components shall be mortise and tenon. Other means of mechanically fastening, i.e., screws shall not be permitted.

C. Ventilator

1. All vent extrusions shall be tubular.
2. Each corner shall be mitered, reinforced with an extruded corner key, hydraulically crimped, and "cold welded" with epoxy adhesive.
3. Each vent shall utilize two rows of weather stripping installed in specifically designed dovetail grooves in the extrusion. The exterior gasket will be omitted at the vent bottom rail for project-out vents and at the vent top rail for project-in vents, allowing air to pressure equalize the void between the vents and frame.

D. Screens

1. Screen frames shall be extruded.
2. Screen mounting holes in the window frame shall be factory drilled.
3. Screen mesh shall be aluminum

E. Glazing

1. All units shall be glazed with the manufacturer's standard sealant process provided the glass is held in place by a removable, extruded aluminum, glazing bead. The glazing bead must be isolated from the glazing material by a gasket.
2. All units shall be glazed with a minimum of 1/2” glass bite.

F. Painted Finish

1. All exposed surfaces shall be free of die marks, grinding marks, spots, streaks or other blemishes and shall be painted with 70% fluoropolymer coating system meeting or exceeding requirements of AAMA 2605.. Color to be as selected by Architect.
    a. Color: Hartford Green or other similar dark green

PART 3 - EXECUTION

3.1. INSPECTION

A. Job conditions.

1. Verify that openings are dimensionally within allowable tolerances, plumb, level, clean, provide a solid anchoring surface, and are in accordance with approved shop drawings.
2. General Contractor shall complete rough in work and full perimeter weather barrier installation and flashing prior to window installation, typical.

3.2. INSTALLATION

A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.

B. Plumb and align window faces in a single plane for each wall plane, and erect windows and materials square and true. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

C. Adjust windows for proper operation after installation.

D. Furnish and apply sealants to provide a weather tight installation at all joints and intersections and at opening perimeters. Wipe off excess material and leave all exposed surfaces and joints clean and smooth.

3.3. ANCHORAGE

A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.4. PROTECTION AND CLEANING

A. After completion of window installation, windows shall be inspected, adjusted, put into working order and left clean, free of labels, dirt, etc. Protection from this point shall be the responsibility of the general contractor.

END OF SECTION 08 51 13

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes glazing for the following products and applications:

1. Doors.
2. Glazed entrances.
3. Interior borrowed lites.
4. Storefront framing.
5. Windows.
6. Curtainwall framing.

1.3. RELATED SECTIONS

A. Section 04 22 00 Concrete Unit Masonry

B. Section 08 11 13 Hollow Metal Doors and Frames

C. Section 08 14 16 Flush Wood Doors

D. Section 08 41 13 Aluminum Doors, Frames and Storefront

E. Section 08 44 13 Glazed Aluminum Curtainwalls

F. Section 09 29 00 Gypsum Board

1.4. DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, float glass or fabricated glass, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.5. REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.

F. ASTM C1036 - Standard Specification for Flat Glass; 2011.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials;

J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

K. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2014a.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

M. ASTM F1233-98 - Standard Test Method for Security Glazing Materials And Systems

N. GANA (GM) - GANA Glazing Manual; 2009.

O. GANA (SM) - GANA Sealant Manual; 2008.

P. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.

Q. ICC (IBC) - International Building Code.

R. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).

S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.

T. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2012.

U. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.

V. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.

W. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.

X. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.

Y. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

Z. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.6. SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: 12-inch-square, for each type of glass product indicated, other than monolithic clear float glass.

C. Glazing Schedule: Use same designations indicated on Drawings.

D. Sealant compatibility and adhesion test reports.

E. Shop Drawings: Submit in accordance with Section 01 33 00 Submittal Procedures.

1.7. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified and with at least five (5) years' experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five (5) years' experience, and approved by glazing manufacturer.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type required.

D. Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

E. Fire-Rated Assemblies: Where glazing products are used in fire-rated assemblies, comply with requirements of specific assembly specified in other sections of these Specifications.

1. Door Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
2. Window Assemblies: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

F. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

G. Fire Protective and Fire Resistive Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

H. Standards as applicable and required by the current Pennsylvania Department of Labor and Industry Safety Glazing Materials regulations and agencies having jurisdiction, provide safety glass manufactured, tested, permanently labeled and installed per these requirements.

1.8. WARRANTY

A. Special Warranty: Manufacturer's standard form, made out to Owner and signed by manufacturer, in which manufacturer agrees to furnish replacements for units that deteriorate from normal use by developing defects attributable to the manufacturing process, f.o.b. the nearest shipping point to Project site, within warranty period.

1. Coated Glass (Low E Glass)
    a. Defects: Peeling, cracking, and other indications of degradation of metallic coating.
    b. Warranty Period: 10 years from date of Substantial Completion.
2. Laminated Glass:
    a. Deterioration: Edge separation, delamination that materially obstructs vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
    b. Warranty Period: 5 years from date of Substantial Completion.
3. Insulating Glass:
    a. Deterioration: Failure of hermetic seal resulting in obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.9. PERFORMANCE REQUIREMENTS – EXTERIOR GLAZING ASSEMBLIES

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to North Carolina State Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
    a. Wind Design Data: As indicated on Drawings.
    b. Basic Wind Speed: 90 mph (40 m/s) Importance Factor: 1.15.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Comply with ASTM E 1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.

E. Seismic Loads : Design and size glazing components to withstand the seismic loads and sway displacement in accordance with IBC 2009 and requirements outlined on structural drawings.

F. Insulating-Glass Certification Program: Permanently marked with certification label of Insulating Glass Certification Council.

G. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBNL's WINDOW 6.3 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient: Center-of-glazing values, according to NFRC 200 and based on LBNL's WINDOW 6.3 computer program.
3. Visible Light Reflectance and Visible Light Transmittance: Center-of-glazing values, according to NFRC 300.

PART 2 - PRODUCTS

2.1. GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
2. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

B. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

2.2. MANUFACTURERS

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

1. Vitro Architectural (Basis of Design)
2. Pilkington
3. Guardian
4. Manufacturer as approved by Architect.

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

1. Cardinal Glass Industries
2. Viracon
3. Manufacturer as approved by Architect.

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

1. Pilkington - Opti-View

2. Vetrotech Saint Gobain - SGG Vision-Lite
3. Guardian - AR
4. Manufacturer as approved by Architect.

2.3. GLASS MATERIALS

A. Annealed Float Glass: Comply with ASTM C 1036, Type I (transparent clear glass, flat), Quality q3 (glazing select).

B. Heat Strengthened and Fully Tempered Float Glass: Comply with ANSI Z97.1, ASTM C 1048 and 16 CFR 1201 (for Fully Tempered); Type I (transparent clear glass, flat); Quality q3 (glazing select).

1. Provide HS (heat-strengthened) coated float glass in place of coated annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide FT (fully tempered) where safety glass is indicated.
2. Provide Kind HS (heat-strengthened) coated float glass, except provide Kind FT (fully tempered) products where coated safety glass is indicated.

C. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified.

1. Refer to locations where laminated glass noted on the drawings and where described in this section.
2. Laminate Safety Glass: Complies with ANSI A97.1 and 16 CFR 1201.
3. Interlayer: 0.060” thick Polyvinyl butyral (PVB) sheet, clear, obscure or in colors, and of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
4. Provide laminated glass with Safety Film for Laminated Glass: .060 inch/ 1.52 mm thick interlayer film, Saflex QS71 by Eastman or approved equal.
5. For use with Tempered 1/4” overall thickness glass and with insulated dual pane glass panels at exterior entrances and where noted for improved security or strength for impact resistance.

D. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article.

1. Provide FT (fully tempered).
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal per manufacturer’s standard.
4. Spacer: Standard
5. Corner Construction: Manufacturer's standard
6. Overall Unit Thickness and Thickness of Each Lite:
7. Interspace Content: Air.

E. Glazing Glass Fronts for Display Cases:

1. Use 1/4" thickness clear safety (laminated) plate; shelves to have 1/4 " thick clear tempered float rounded leading edges, both sides.

F. Other Lights In Doors and Screens:

1. Glaze with 1/4 " clear tempered glass. Face glaze with architectural grade compound or with neoprene snap-in beads.

G. Spandrel Glass:

1. Double pane ¼" spandrel glass, ½" air space, and ¼" inner lite. Color and obscurity to be selected by Architect.
2. Total thickness 1" min.

H. Anti-Glare Glass:

1. Single pane, 1/4" thickness
2. Provide manufacturer's proprietary sputter-coat anti-reflective coating on substrate glass.

I. Transparent Mirror Glass:

1. Single pane, 1/4" thickness, grey tinted
2. Provide manufacturer's proprietary mirrored reflective coating on substrate glass.

2.4. MONOLITHIC FLOAT-GLASS SCHEDULE

A. Uncoated Clear Fully Tempered Float Glass, Class 1, Kind FT (fully tempered).

2.5. INSULATED GLAZING SCHEDULE

A. Type IGU1: Dual Glazed 1" Insulated Glass

1. Outer Lite: Clear tempered VITRO Solarban 60 (#2) surface, 1/4" Thickness
2. Inner Lite: Clear tempered, 1/4" Thickness

B. Type IGU1L: Dual Glazed 1" Insulated Laminated Glass

1. Base Bid Outer Lite: Clear tempered , 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.
2. Base Bid Inner Lite: Clear tempered VITRO Solarban 60 (#3) surface, 1/4" Thickness.

C. Type IGU1P: Dual Glazed 1" Insulated Privacy Glass

1. Outer Lite: Clear tempered VITRO Solarban 60 (#2) surface, 1/4" Thickness
2. Inner Lite : Clear tempered 1/4" Thickness; Full 100% opacity translucent ceramic frit pattern (#4) surface.

D. Type IGU1LP: Dual Glazed 1" Insulated Laminated Privacy Glass

1. Outer Lite: Clear tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.
2. Inner Lite: Clear tempered VITRO Solarban 60 (#3) surface, 1/4" Thickness; Full 100% opacity translucent ceramic frit pattern (#4) surface.

E. Type IGU1S: Dual Glazed 1" Low E Insulated Glass with Spandrel Panel

1. Outer Lite: Clear tempered; VITRO Solarban 60 (#2) surface, 1/4" Thickness
2. Inner Lite: Clear tempered; opacifier (#4) surface; 1/4" Thickness
3. 14 gauge aluminum panel, flush mounted to interior face of curtainwall framing, or as detailed for special conditions.

F. Type IGU2: Triple Glazed 1" Insulated Glass

1. Outer Lite: Clear tempered VITRO Solarban 60 (#2) surface, 1/8" Thickness
2. Center Lite: Clear tempered, 1/8" Thickness
3. Inner Lite: Clear tempered, 1/8" Thickness

G. Type IGU2P: Triple Glazed 1" Insulated Privacy Glass

1. Outer Lite: Clear tempered VITRO Solarban 60 (#2) surface, 1/8" Thickness
2. Center Lite: Clear tempered, 1/8" thickness
3. Inner Lite: Clear tempered 1/8" Thickness; Full 100% opacity translucent ceramic frit pattern (#6) surface.

H. Type IGU2LP: Triple Glazed 1" Insulated Laminated Privacy Glass

1. Outer Lite: Clear tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.
2. Center Lite: Clear tempered VITRO Solarban 60 (#3) surface, 1/8"
3. Inner Lite: Clear tempered 1/8" Thickness; Full 100% opacity translucent ceramic frit pattern (#6) surface.

2.6. NON-INSULATED GLAZING SCHEDULE

A. Type TG1:

1. Single pane; clear fully tempered (FT) safety glazing; 1/4" thickness

B. Type TG1L:

1. Single pane; Clear, fully tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.

C. Type TG1LM:

1. Single pane; grey tinted, fully tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film, mirrored coating on exterior face.

D. Type TG1LP:

1. Single pane; Clear, fully tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.
2. Full 100% opacity translucent ceramic frit pattern (#2) surface.

E. Type TG2:

1. Single pane; Clear, fully tempered, 1/4" Thickness: (2) Layers each at 1/8"; interspace layer laminated with 0.060" thick PVB clear safety glass film.
2. Full 100% opacity translucent ceramic frit pattern (#2) surface.

F. Type TG3:

1. Single pane; clear fully tempered (FT) safety glazing; 1/2" thickness

G. Type TG3L:

1. Single pane; clear fully tempered (FT) safety glazing; 1/2" thickness; 0.060" PVB interlayer; 1/4" clear fully tempered (FT) layer

2.7. FIRE RATED GLAZING SCHEDULE

A. Type FG20:

1. Fire Rated Glazing for typical Corridor Doors (20 minute fire rating): Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies
2. Locations: Provide at all doors with glazing that open onto corridors with the exception of those doors noted to be provided higher than 20 minutes.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. SafiFirst; SuperLite I
    b. Vetrotech Saint-Gobain; Pyroswiss
    c. Schott North America; Pyran Platinum 20

B. Type FG45:

1. Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 80, NFPA 252 for door assemblies and NFPA 257 or UL-9 for window assemblies.
2. Locations: Glazing in 60 minute or less fire protection rated assemblies that require 45 minute or less rating on the glazing. See drawings and schedules for minute requirements.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. SafiFirst; Superlite II-XL 45
    b. Pilkington Group Limited (distributed by Technical Glass Products); Pyrostop
    c. Schott North America; Pyran Platinum 45

C. Type FG45L:

1. Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 80, NFPA 252 for door assemblies and NFPA 257 or UL-9 for window assemblies.
2. Locations: Glazing in 60 minute or less fire protection rated assemblies that require 45 minute or less rating on the glazing. See drawings and schedules for minute requirements.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Schott North America; Pyran Platinum 45L
    b. Vetrotech Saint-Gobain; Keralite Select Laminated

2.8. FIRE RESISTIVE RATED GLAZING:

A. Fire-resistive glazing types and related assemblies complying with ASTM E119 / UL263.

B. The following glazing types and related assemblies are specified in Section 08 80 01.

1. FG60, FG90

2.9. GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. EPDM complying with ASTM C 864.
2. Silicone complying with ASTM C 1115.
3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.10. GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   c. May National Associates, Inc.; Bondaflex Sil 290.
   d. Pecora Corporation; 890.
   e. Sika Corporation, Construction Products Division; SikaSil-C990.
   f. Tremco Incorporated; Spectrem 1.

C. Applications: Where recommended by glass manufacturer for use with glazing tape.

2.11. GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.12. MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

D. Spacers: Super Spacer-Tri-Seal, by EdgeTech or equal manufacturer continuous blocks with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Framing Angles for Fire-Protection-Rated Glazing: Provide steel angles for fire-protection rated glazing in wall construction as recommended by the glazing manufacturer.

2.13. FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1. GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
2. Protect glass edges from damage during handling and installation. Remove glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance from Project site and legally dispose of off Project site.

3. Apply primers to joint surfaces where required for adhesion of sealants, as determined by sealant compatibility and adhesion testing.
4. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

B. Protection:

1. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface.
2. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter.

C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged, including natural causes, accidents, and vandalism, during construction period.

3.2. INSTALLATION

A. Glazing Standards: Install glazing with written instructions of glass, gaskets and other glazing material manufacturers, unless more stringent requirements are indicated, including those in referenced glazing standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM) and manufacturer's instructions.

C. Glazing shall not be done when the temperatures are below 40 degrees Fahrenheit. When circumstances require the glazing below 45 degrees Fahrenheit, steps shall be taken to assure clean, dry and frost-free surfaces as approved by the Architect.

D. Channel Glazing: All glass to be set with a minimum of 1/8" spacers on both sides of glass with setting blocks at quarter points. Against rabbet and channel, apply butyl tape. Cut off tape flush with channel and stop.

E. Neoprene Beads: Glass in aluminum door frames and screens held by neoprene extruded beads, snap-in type shall be inserted into stops with slight buttering at corners with channel glazing compound. Install glass per manufacturer's instructions.

F. Wood Frames: Do not set glass in wood frames or beads of doors until after the wood, including glazing rabbets and beads, has been Stained and filled or primed. All glass held in place with wood beads shall be bedded in architectural glazing compound on both faces.

G. Lights in Borrowed Lights: Glaze with metal stops as detailed. Channel glaze as specified above.

3.3. CLEANING AND REPLACEMENT

A. This contractor shall properly protect all glass installed by him from injury or breakage during construction of the building. The contractor shall assume all responsibility for breakage by whoever caused and shall replace all cracked, broken, scratched or otherwise defective glass when directed to do so by the Architect.

B. Wash, rinse and dry glass at frequent intervals during construction in accordance with manufacturers' recommendations.

END OF SECTION 08 80 00

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Refer to all project drawings and other sections of this specification to determine the type and extent of work therein affecting the work of this section, whether or not such work is specifically mentioned herein.

B. Portland Cement Stucco System

1.2. RELATED SECTIONS

A. Division 03 Concrete and Insulated Concrete Form Substrates

B. Division 04 Masonry substrates

C. Section 05 40 00 Cold-formed metal framing

D. Section 06 10 00 Rough Carpentry

E. Section 06 16 00 Sheathing

F. Section 07 10 00 Air barrier, Vapor Barrier and Dampproofing

G. Section 07 62 00 Sheet metal flashing and trim

H. Section 07 92 00 Joint Sealants

I. Division 08 for Window and Door Openings

1.3. REFERENCES

A. ASTM C150 Standard Specification for Portland Cement

B. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster

C. ASTM C1063 Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster

D. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

E. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds

F. ICC-ES AC11 Cementitious Exterior Wall Coatings

G. ICC-ES AC275 Glass Fiber Lath

H. ESR-1064 ICC Evaluation Service, Inc., ES ReportTM (STUCCOBASE™/ STUCCOBASE™ PREMIX)

I. ESR-2429 ICC Evaluation Service, Inc., ES ReportTM (PERMALATH® 1000)

J. ESR-1878 ICC Evaluation Service, Inc., ES ReportTM (SENERSHIELD-R)

1.4. SUBMITTALS

A. Submit under provisions of Section 01 33 00

B. Product Data: Provide data on Portland Cement Stucco product characteristics, performance criteria, limitations and durability.

C. Code Compliance: Provide manufacturer's applicable code compliance report.

D. Samples: Submit [2] Two 12 x 12 inch size samples of Senergy Sentry Stucco Ultra System illustrating Finish Coat color and texture range.

1. Color to be selected from manufacturer's full range of colors.

E. Certificate: System manufacturer's approval of applicator.

F. Sealant: Sealant manufacturer's certificate of compliance with ASTM C1382.

G. System manufacturer's typical details, system design guide and related product literature which indicate preparation required, storage, installation techniques, jointing requirements and finishing techniques.

1.5. QUALITY ASSURANCE

A. Manufacturer: More than 10 years in the cement plaster stucco industry, with more than 1000 completed cement plaster stucco projects.

B. Applicator: Approved by Portland Cement Wall System's manufacturer in performing work of this section.

C. Regulatory Requirements: Conform to applicable code requirements for cement plaster stucco.

D. Field Samples

1. Provide under provisions of Division 1 Specifications.
2. Construct one field sample panel for each color and texture, 4 x 4 feet in size of system materials illustrating method of attachment, surface Finish color and texture.
3. Prepare each sample panel using the same tools and techniques to be used for the actual application.
4. Locate sample panel where directed.
5. Accepted sample panel [may] [may not] remain as part of the work.
6. Field samples shall be comprised of all wall assembly components including substrate, air/moisture barrier, DRAINAGE MAT DF PERMALATH 1000, plaster trim accessories, STUCCOBASE™ Premix, Senergy BASE COAT, STUCCOPRIME, FINISH COAT, and typical sealant/flashing conditions.

1.6. DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products under provisions of Division 1 specifications.

B. Deliver Senergy Sentry Stucco Ultra System materials in original unopened packages with manufacturer's labels intact.

C. Protect Senergy Sentry Stucco Ultra System materials during transportation and installation to avoid physical damage.

D. Store Senergy Sentry Stucco Ultra System materials in cool, dry place protected from exposure to moisture and freezing.

E. Store at no less than 4°C/40°F.

F. Store insulation boards flat and protected from direct sunlight and extreme heat.

1.7. PROJECT/SITE CONDITIONS

A. Do not apply Senergy Sentry Stucco Ultra System in ambient temperatures below 4°C/40°F .

B. Provide properly vented, supplementary heat during installation and drying period when temperatures less than 4°C/40°F.

C. Do not apply Senergy Sentry Stucco Ultra System materials to frozen surfaces.

D. Maintain ambient temperature at or above 4°C/40°F during and at least 24 hours after Senergy Sentry Stucco Ultra System installation and until dry.

1.8. SEQUENCING AND SCHEDULING

A. Coordinate and schedule installation of Senergy Sentry Stucco Ultra System with related work of other sections.

B. Coordinate and schedule installation of trim, flashing, and joint sealers to prevent water infiltration behind the system.

1.9. WARRANTY

A. Provide (15) fifteen year limited materials and drainage warranty for Portland Cement Stucco System installations under provisions of Section [01 70 00].

B. Comply with Master Builders Solutions notification procedures to assure qualification for warranty.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturers

1. Basis of Design: Senergy Sentry Stucco Ultra System with a 15 year minimum warranty.
2. Sto Systems, StoPowerwall with 15 year minimum warranty
3. Approved equal as accepted by Architect. Approved equals must able to provide a 15-year minimum warranty

2.2. MATERIALS

A. Dampproofing/Waterproofing (Air Moisture Barrier): Refer to Sections and 03 11 19.

1. Refer to Division 3 for provision of dampproofing/waterproofing material to be provided by Insulated Concrete Forms (ICF) material manufacturer. Walls with ICF substrate are to be provided with this self-adhering dampproofing/waterproofing material per Section 03 11 19.
2. Provide dampproofing self-adhered membrane in below grade locations.

B. DRAINAGE MAT DF: a three-dimensional drainage core bonded to a breathable fabric. The mat consists of fused, entangled filaments designed to provide an unobstructed drainage path.

C. Lath: PERMALATH® 1000:

1. PermaLath® 1000: 3/4"–7/8" thick stucco PERMALATH® 1000: Open weave, three dimensional, self furred, nominal 1/4" thick glass fiber reinforcing lath designed for use with STUCCOBASE™ Premix at a minimum thickness of 3/4" in "scratch and brown" applications.

D. Plaster Sand: Must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter. Sampling and testing must comply with ASTM C897. Plaster sand must be graded within the following limits:

1. Percent retained by weight Retained on ± 2 Percent

U.S. Standard Sieve	Min.	Max.
No. 4	-	0
No. 8	0	10
No. 16	10	40
No. 30	30	65
No. 50	70	90
No. 100	95	100

E. Water: clean and potable without foreign matter.

F. Portland Cement Stucco Base:

1. STUCCOBASE™ PREMIX: Factory-blended stucco mixture of Portland cement, reinforcing fibers, sand, and proprietary ingredients; supplied by Master Builders Solutions for scratch and brown coats.

G. Senergy BASE COAT / EPS insulation adhesive

1. ALPHA DRY BASE COAT: Dry-mix base coat containing Portland cement; manufactured by Master Builders Solutions.

H. Senergy REINFORCING MESH: Balanced, open weave glass fiber reinforcing mesh; twisted multi-end strands treated for compatibility with Senergy System components.

1. INTERMEDIATE 6: standard/medium weight, 6 oz.
2. STRONG 15: heavy weight, 15 oz. used in combination with INTERMEDIATE 6.

I. Senergy STUCCOPRIME: 100% acrylic-based primer; color to closely match the selected Senergy FINISH COAT color; manufactured by Master Builders Solutions.

J. SENERFLEX Finish, 100% acrylic polymer based finish; air cured, compatible with Base Coat; Finish texture: Textured finish to match existing building orange peel texture; as manufactured by Master Builders Solutions.

1. Color to be selected by Architect from Manufacturer's full range of colors.

2.3. ACCESSORIES

A. Trim: Casing bead, corner bead, expansion joint and weep screed accessories shall meet the requirements of ASTM C1063. Accessories shall be: zinc, meeting ASTM B69.

1. Foundation weep screed: Beveled edge designed to terminate finish system and drain internal moisture.
2. Casing bead: Square edge style.
3. Corner bead: Small radius nose style.
4. Control joints: W-shaped accordion profile style
    a. Model: Clark Dietrich #15 Zinc Double V Control Joint
5. Expansion joints: Two piece type slip-joint design or pair of casing beads spaced for application of sealant bead.
6. Drip Flashing with 3-1/2" flange for window and door heads with the exception of overhead.
    a. See overhead door drawing detail for special requirement

PART 3 - EXECUTION

3.1. EXAMINATION

A. Verify project site conditions under provisions of Division 1 Specifications

B. Walls

1. Substrates: Acceptable substrates are PermaBase® Cement Board and other cement-boards conforming with ASTM C1325 (Type A-exterior), poured concrete/unit masonry, Fiberock® Aqua-ToughTM sheathing, e2XPTM sheathing (ASTM C1177), GlasRoc® sheathing (ASTM C1177), SecurockTM glass-mat sheathing (ASTM C1177), DensGlassTM exterior sheathing (ASTM C1177), gypsum sheathing (ASTM 79/C1396), Exposure I or exterior plywood (Grade C/D or better), or Exposure I OSB.
2. Sheathings must be securely fastened per applicable building code requirements and manufacturers recommendations.
3. Examine surfaces to receive system and verify that substrate and adjacent materials are dry, clean, and sound. Verify substrate surface is flat, free of fins or planar irregularities greater than 6 mm in 3 m (1/4" in 10').
4. Flashings:
5. All flashings are by others and must be installed in accordance with specific manufacturer's requirements. Where appropriate, end-dams must be provided.
6. Openings must be flashed prior to window/door, HVAC, etc. installation. Refer to Senergy's Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin for further guidance.
7. Windows and openings shall be flashed according to design and building code requirements.
8. Individual windows that are ganged to make multiple units require continuous head flashing and/or the joints between the units must be fully sealed.
9. Roof: Verify that all roof flashings have been installed in accordance with the guidelines set by the Asphalt Roofing Manufacturers Association (ARMA).

10. Kick-out flashing: Kick-out flashing must be installed where required. The kick-out flashing must be leak-proof and angled (min 100˚) to allow for proper drainage and water diversion. Refer to Senergy's Sentry Stucco Ultra System typical details.

C. Do not proceed until all unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Protect all surrounding areas and surfaces from damage and staining during application of Senergy Sentry Stucco Ultra System.

B. Protect finished work at end of each day to prevent water penetration.

3.3. MIXING

A. General: No additives are permitted unless specified in product mixing instructions. Close containers when not in use. Prepare in a container and/or mixer that is clean and free of foreign substances. Do not use a container and/or mixer which has contained or been cleaned with a petroleum-based product. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

B. Air/Moisture Resistive Barriers

1. Install in accordance with Division 3 and 7 Specifications.

C. Stucco Base Coat: STUCCOBASE™ PREMIX

1. Use mixer which is clean and free of foreign substances.
2. Add 7.6–9.5 liters (2–2.5 gallons) of clean potable water to mixer.
3. Slowly add one bag of STUCCOBASE™ PREMIX.
4. Mix for one minute at normal mixing speed. Allow material to set for 2–4 minutes with mixing blades at rest. Then re-mix, adding water to achieve desired consistency. Desired consistency varies with type of application (trowel or gun), substrate (paper-backed lath or block) and whether the stucco is applied to a wall or a ceiling.
5. Note: Continuous mixing may cause excessive air entrainment.

D. Senergy skim coat / EPS insulation adhesive: ALPHA DRY BASE COAT

1. Mix and prepare each bag in a 19-liter (5-gallon) pail.
2. Fill the container with approximately 5.6-liters (1.5-gallons) of clean, potable water.
3. Add ALPHA DRY in small increments, mixing after each additional increment.
4. Mix ALPHA DRY and water with a mixer to a homogeneous consistency.
5. Additional ALPHA DRY or water may be added to adjust workability.

E. Senergy FINISH COAT SENERFLEX

1. Thoroughly mix the factory-prepared material with a clean paddle and drill until thoroughly blended.
2. A small amount of clean, potable water may be added to adjust workability.
3. Additives are not permitted.
4. Close container when not in use.
5. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

3.4. APPLICATION

General: Apply Senergy Sentry Stucco Ultra System materials in accordance with all Sentry Stucco Ultra System typical details, system specification and related product literature.

A. Air/Water Resistive Barrier

1. All sheathing joints and windows/openings must be protected and the SENERSHIELD-R air/water-resistive barrier applied in accordance with Senergy's Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin. Openings must be flashed prior to window/door, HVAC, etc. installation.
2. Substrate shall be dry, clean, sound, and free of releasing agents, paint, or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 6.4 mm in 3 m (1⁄4" in 10').
3. Unsatisfactory conditions shall be corrected before application of the SENERSHIELD-R.
4. Wrap openings with sheathing fabric by applying mixed SENERSHIELD-R to all surfaces and immediately embedding sheathing fabric. Once dry, apply a second coat to ensure a complete, void-free membrane. Apply fabric in accordance with Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin.
5. Spot all fasteners and pre-coat sheathing joints, terminations, inside and outside corners with mixed SENERSHIELD-R using a 101 mm (4") wide by 20 mm (3/4") nap roller, brush or spray.
6. Immediately place and center sheathing fabric over wet SENERSHIELD-R at all sheathing joints, terminations, inside and outside corners, as well as knot holes and check cracks that may exist in plywood or OSB. Ensure fabric extends evenly on both sides of the sheathing joint.
7. Lap sheathing fabric 63.5 mm (2 1/2") minimum at intersections. Allow to dry to the touch before applying SENERSHIELD-R to entire wall surface.
8. Apply Air/Moisture Barrier to plywood, OSB substrate(s) or CMU with a 20 mm (3/4") nap roller to a uniform consistent thickness of a nominal 10 wet mils. Prior to application of a second coat, visually inspect to assure sheathing surface is blister free and coating is free of voids and pinholes. Repair if needed and then apply a second coat after the initial coating is sufficiently dry.
9. Apply Two (2) coats of Air/Moisture Barrier are required on plywood, OSB and CMU.
10. Apply Air/Moisture Barrier to other acceptable substrate(s) with a 20 mm (3/4") nap roller to a uniform consistent thickness of nominal 10 wet mils that is free of voids and pinholes.
11. Installed materials should be completely dry and checked before continuing system application.
12. Coordinate work with other trades to assure proper sequencing, detailing and installation of materials.

B. Drainage Mat DF

1. Apply DRAINAGE MAT DF horizontally over SENERSHIELD-R. DRAINAGE MAT DF should be free of wrinkles, creases and tears.
2. Secure DRAINAGE MAT DF to substrate with sufficient building staples or galvanized nails to remain in place prior to application of exterior cladding system.

C. Trim junction

1. When two pieces of trim abut:

a. Set intersection of trim in a minimum 100 mm (4”) bed of acceptable trim sealant.Allow 3–5 mm (1/8”–3/16”) gap between the abutting trim pieces. Do not overlap trim. Attach the trim in accordance with manufacturer’s specifications. True expansion joints must be fastened to the structural substrate.

2. When two or more pieces of trim intersect:
   a. The vertical trim piece shall be continuous with all horizontal pieces. Miter all corners at intersections of trim. Set intersection of trim in a minimum 100 mm (4”) bed of acceptable trim sealant. Allow 3–5 mm (1/8”– 3/16”) gap between the intersecting trim pieces. Do not overlap the trim Attach the trim in accordance with manufacturers’ specifications and ASTM C1063.

D. Lath : PERMALATH® 1000

1. Apply PERMALATH® 1000 over substrate with minimum 3” overlap at vertical and horizontal edges and overlap on flange of trim accessories. PERMALATH® 1000 can be applied horizontally or vertically and should be applied such that it is flat and free of ripples, wrinkles, etc. Fastener System: type appropriate for application and substrate, as recommended by Master Builders Solutions.
2. PERMALATH® 1000 Fasteners: Lath Plate Mechanical Fastening Systems by Wind-Lock Corp.
3. Masonry: masonry type [M] expansion fastener with lath plates 25 mm (1”) minimum penetration into masonry. Fastener spacing 6” o.c. vertically and 16” o.c. horizontally.
4. Cold rolled steel framing/furring spaced maximum 16” o.c.: minimum No.6, 1 1⁄4” long, Type S, self drilling, corrosion resistant coated, bugle head screws or 1 1⁄4” long x 0.10” diameter VersaPIN Gripshank® fasteners by Aerosmith Fastening Systems with 1 1⁄4” diameter lath plates, 16 mm (5/8”) minimum penetration into framing, 6” o.c. vertically and 16” o.c. horizontally.
5. Apply STUCCOBASE™ PREMIX within 60 days of PERMALATH® 1000 application.

E. STUCCOBASE™ PREMIX Base Coat: System Application (3/4”– 7/8” thickness)

1. Total thickness of base coats must meet code requirements for fire rated construction.
2. Nominal plaster base coat thickness:

   First coat “scratch”: 3/8”– 1/2”

   Second coat “brown”: 3/8”– 1/2”
3. Apply STUCCOBASE™ PREMIX mixture to the lath by hand troweling or machine spraying with sufficient force to develop full adhesion between STUCCOBASE™ PREMIX mixture and the lath.
4. Apply first coat to completely embed lath. Cross rake slightly to provide key for second brown coat. Coat must be uniform in thickness. Ensure the first coat is properly “scratched” and sufficiently rigid to resist cracking prior to application and leveling of the second or “brown” coat.
5. Apply second brown coat to provide the required total thickness. Trowel STUCCOBASE™ PREMIX into trim to seat trim. The lath shall be fully embedded in the stucco and shall be completely covered. Coat must be uniform in thickness. Rod off to desired thickness, leveled with screeds, to provide a true, flat plane. Follow this by wood floating or darbying the surface.
6. After surface has sufficiently hardened, use sponge or hard rubber float as required to fill voids, holes or imperfections, leaving the surface ready to receive Senergy Finish.

7. Damp cure for at least 48 hours by lightly and evenly fogging the surface with water a least twice a day. Direct sunlight, hot temperatures, low humidity and wind may make additional fogging necessary.
8. Allow STUCCOBASE™ PREMIX to cure a minimum of 6 days prior to application of Senergy BASE COAT skim coat, EPS insulation board shapes and Senergy FINISH COAT application.

F. Senergy BASE COAT:

1. Apply a skim coat of Senergy BASE COAT, approximately 1/16" thick to properly cured "brown coat" of STUCCOBASE™ PREMIX.
2. Allow to dry hard (normally 8 to 10 hours).

G. Reinforcing Mesh: Base Coat shall be applied so as to achieve Reinforcing Mesh embedment with no Reinforcing Mesh color visible.

1. Reinforcing Mesh.
2. Install STRONG 15 with FLEXGUARD 6 Reinforcing Mesh over properly cured Senergy Sentry Stucco Ultra System "brown coat" of STUCCOBASE™ PREMIX.
3. Apply mixed Senergy Base Coat to entire surface of "brown coat" with a stainless steel trowel to embed the Reinforcing Mesh.
4. Immediately place Reinforcing Mesh against wet Base Coat and embed the Reinforcing Mesh into the Base Coat by troweling from the center to the edges.
5. Lap Reinforcing Mesh 64 mm (2 1⁄2") minimum at edges.
6. Ensure Reinforcing Mesh is continuous at corners, void of wrinkles and embedded in Base Coat so that no Reinforcing Mesh color is visible.
7. Allow Base Coat with embedded Reinforcing Mesh to dry hard (normally 8 to 10 hours).

H. Senergy STUCCOPRIME:

1. Apply STUCCOPRIME to the dried base coat skim coat with a sprayer, 10 mm (3/8") nap roller, or good-quality latex paint brush at a rate of approximately 3.6–6.1 m2 per liter (150–250 ft2 per gallon).
2. STUCCOPRIME shall be dry to the touch before proceeding with the Senergy FINISH COAT application.

I. Senergy FINISH COAT

1. SENERFLEX FINISH: Textured finish to match existing building orange peel texture..
2. Apply FINISH directly to the dried base coat with a clean, stainless steel trowel.
3. Apply and level FINISH during the same operation to minimum obtainable thickness consistent with uniform coverage. Maintain a wet edge on FINISH by applying and texturing continually over the wall surface. Work FINISH to corners, joints or other natural breaks and do not allow material to set up within an uninterrupted wall area. Float FINISH to achieve final texture.

3.5. CLEANING

A. Clean work under provisions of Division 1 Specifications.

B. Clean adjacent surfaces and remove excess material, droppings, and debris.

3.6. PROTECTION

A. Protect finished work under provisions of Division 1 Specifications.

END OF SECTION 09 24 23

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Refer to all project drawings and other sections of this specification to determine the type and extent of work therein affecting the work of this section, whether or not such work is specifically mentioned herein.

B. Portland Cement Stucco System

1.2. RELATED SECTIONS

A. Division 03 Concrete substrates

B. Division 04 Masonry substrates

C. Section 05 40 00 Cold-formed metal framing

D. Section 06 10 00 Rough Carpentry

E. Section 06 16 00 Sheathing

F. Section 07 10 00 Air barrier, Vapor Barrier and Dampproofing

G. Section 07 62 00 Sheet metal flashing and trim

H. Section 07 92 00 Joint Sealants

I. Division 08 for Window and Door Openings

J. Division 09 for Supports for plaster and gypsum board

K. Division 09 for Non-structural metal framing

L. Division 09 for Gypsum board

1.3. REFERENCES

A. ASTM C150 Standard Specification for Portland Cement

B. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster

C. ASTM C1063 Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster

D. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

E. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds

F. ICC-ES AC11 Cementitious Exterior Wall Coatings

G. ICC-ES AC275 Glass Fiber Lath

H. ESR-1064 ICC Evaluation Service, Inc., ES ReportTM (STUCCOBASE™/ STUCCOBASE™ PREMIX)

I. ESR-2429 ICC Evaluation Service, Inc., ES ReportTM (PERMALATH® 1000)

J. ESR-1878 ICC Evaluation Service, Inc., ES ReportTM (SENERSHIELD-R)

1.4. SUBMITTALS

A. Submit under provisions of Section 01 33 00

B. Product Data: Provide data on Senergy Sentry Stucco Ultra System materials, product characteristics, performance criteria, limitations and durability.

C. Code Compliance: Provide manufacturer's applicable code compliance report.

D. Samples: Submit [2]Two 12 x 12 inch size samples of Senergy Sentry Stucco Ultra System illustrating Finish Coat color and texture range.

1. Color to be selected from manufacturer's full range of colors.

E. Certificate: System manufacturer's approval of applicator.

F. Sealant: Sealant manufacturer's certificate of compliance with ASTM C1382.

G. System manufacturer's typical details, system design guide and related product literature which indicate preparation required, storage, installation techniques, jointing requirements and finishing techniques.

1.5. QUALITY ASSURANCE

A. Manufacturer: More than 10 years in the cement plaster stucco industry, with more than 1000 completed cement plaster stucco projects.

B. Applicator: Approved by Portland Cement Wall System's manufacturer in performing work of this section.

C. Regulatory Requirements: Conform to applicable code requirements for cement plaster stucco.

D. Field Samples

1. Provide under provisions of Division 1 Specifications.
2. Construct one field sample panel for each color and texture, 4 x 4 feet in size of system materials illustrating method of attachment, surface Finish color and texture.
3. Prepare each sample panel using the same tools and techniques to be used for the actual application.
4. Locate sample panel where directed.
5. Accepted sample panel [may] [may not] remain as part of the work.
6. Field samples shall be comprised of all wall assembly components including substrate, air/moisture barrier, DRAINAGE MAT DF PERMALATH 1000, plaster trim accessories, STUCCOBASE™ Premix, Senergy BASE COAT, STUCCOPRIME, FINISH COAT, and typical sealant/flashing conditions.

1.6. DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products under provisions of Division 1 specifications.

B. Deliver Senergy Sentry Stucco Ultra System materials in original unopened packages with manufacturer's labels intact.

C. Protect Senergy Sentry Stucco Ultra System materials during transportation and installation to avoid physical damage.

D. Store Senergy Sentry Stucco Ultra System materials in cool, dry place protected from exposure to moisture and freezing.

E. Store at no less than 4°C/40°F.

F. Store insulation boards flat and protected from direct sunlight and extreme heat.

1.7. PROJECT/SITE CONDITIONS

A. Do not apply Senergy Sentry Stucco Ultra System in ambient temperatures below 4°C/40°F .

B. Provide properly vented, supplementary heat during installation and drying period when temperatures less than 4°C/40°F.

C. Do not apply Senergy Sentry Stucco Ultra System materials to frozen surfaces.

D. Maintain ambient temperature at or above 4°C/40°F during and at least 24 hours after Senergy Sentry Stucco Ultra System installation and until dry.

1.8. SEQUENCING AND SCHEDULING

A. Coordinate and schedule installation of Senergy Sentry Stucco Ultra System with related work of other sections.

B. Coordinate and schedule installation of trim, flashing, and joint sealers to prevent water infiltration behind the system.

1.9. WARRANTY

A. Provide (15) fifteen year limited materials and drainage warranty for Portland Cement Stucco System installations under provisions of Section [01 70 00].

B. Comply with BASF Wall Systems notification procedures to assure qualification for warranty.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturers

1. Basis of Design: Senergy Sentry Stucco Ultra System with a 15 year minimum warranty.
2. Sto Systems, StoPowerwall with 15 year minimum warranty
3. Approved equal as accepted by Architect. Approved equals must able to provide a 15-year minimum warranty

2.2. MATERIALS

A. Dampproofing/Waterproofing (Air Moisture Barrier): Refer to Sections and 03 11 19 and 07 10 00.

1. Refer to Division 3 for provision of dampproofing/waterproofing material to be provided by Insulated Concrete Forms (ICF) material manufacturer. Walls with ICF substrate are to be provided with this self-adhering dampproofing/waterproofing material per Section 03 11 19.
2. Above Grade Walls with substrates other than ICF's shall be provided with materials specified in Section 07 10 00.

B. DRAINAGE MAT DF: a three-dimensional drainage core bonded to a breathable fabric. The mat consists of fused, entangled filaments designed to provide an unobstructed drainage path.

C. Lath: PERMALATH® 1000:

1. PermaLath® 1000: 3/4"–7/8" thick stucco PERMALATH® 1000: Open weave, three dimensional, self furred, nominal 1/4" thick glass fiber reinforcing lath designed for use with STUCCOBASE™ Premix at a minimum thickness of 3/4" in "scratch and brown" applications.

D. Plaster Sand: Must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter. Sampling and testing must comply with ASTM C897. Plaster sand must be graded within the following limits:

1. Percent retained by weight Retained on ± 2 Percent

U.S. Standard Sieve	Min.	Max.
No. 4	-	0
No. 8	0	10
No. 16	10	40
No. 30	30	65
No. 50	70	90
No. 100	95	100

E. Water: clean and potable without foreign matter.

F. Portland Cement Stucco Base:

1. STUCCOBASE™ PREMIX: Factory-blended stucco mixture of Portland cement, reinforcing fibers, sand, and proprietary ingredients; supplied by BASF Wall Systems for scratch and brown coats.

G. Senergy BASE COAT / EPS insulation adhesive

1. ALPHA DRY BASE COAT: Dry-mix base coat containing Portland cement; manufactured by BASF Wall Systems.

H. Senergy REINFORCING MESH: Balanced, open weave glass fiber reinforcing mesh; twisted multi-end strands treated for compatibility with Senergy System components.

1. INTERMEDIATE 6: standard/medium weight, 6 oz.
2. STRONG 15: heavy weight, 15 oz. used in combination with INTERMEDIATE 6.

I. Senergy STUCCOPRIME: 100% acrylic-based primer; color to closely match the selected Senergy FINISH COAT color; manufactured by BASF Wall Systems.

J. SENERFLEX Finish, 100% acrylic polymer based finish; air cured, compatible with Base Coat; Finish texture: CLASSIC; as manufactured by BASF Wall Systems.

1. Color to be selected by Architect from Manufacturer's full range of colors.

2.3. ACCESSORIES

A. Trim: Casing bead, corner bead, expansion joint and weep screed accessories shall meet the requirements of ASTM C1063. Accessories shall be: zinc, meeting ASTM B69. Vinyl or zinc accessories are recommended where highly humid or salt-laden service conditions exist. Refer to Senergy's Accepted Stucco Wall Systems Lath and Trim Accessories bulletin for additional information.

1. Foundation weep screed: Beveled edge designed to terminate finish system and drain internal moisture.
2. Casing bead: Square edge style.
3. Corner bead: Small radius nose style.
4. Control joints: W-shaped accordion profile style.
5. Expansion joints: Two piece type slip-joint design or pair of casing beads spaced for application of sealant bead.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Verify project site conditions under provisions of Division 1 Specifications

B. Walls

1. Substrates: Acceptable substrates are PermaBase® Cement Board and other cement-boards conforming with ASTM C1325 (Type A-exterior), poured concrete/unit masonry, Fiberock® Aqua-ToughTM sheathing, e2XPTM sheathing (ASTM C1177), GlasRoc® sheathing (ASTM C1177), SecurockTM glass-mat sheathing (ASTM C1177), DensGlassTM exterior sheathing (ASTM C1177), gypsum sheathing (ASTM 79/C1396), Exposure I or exterior plywood (Grade C/D or better), or Exposure I OSB.
2. Sheathings must be securely fastened per applicable building code requirements and manufacturers recommendations.
3. Examine surfaces to receive system and verify that substrate and adjacent materials are dry, clean, and sound. Verify substrate surface is flat, free of fins or planar irregularities greater than 6 mm in 3 m (1/4" in 10').
4. Flashings:
5. All flashings are by others and must be installed in accordance with specific manufacturer's requirements. Where appropriate, end-dams must be provided.
6. Openings must be flashed prior to window/door, HVAC, etc. installation. Refer to Senergy's Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin for further guidance.
7. Windows and openings shall be flashed according to design and building code requirements.

8. Individual windows that are ganged to make multiple units require continuous head flashing and/or the joints between the units must be fully sealed.
9. Roof: Verify that all roof flashings have been installed in accordance with the guidelines set by the Asphalt Roofing Manufacturers Association (ARMA).
10. Kick-out flashing: Kick-out flashing must be installed where required. The kick-out flashing must be leak-proof and angled (min 100˚) to allow for proper drainage and water diversion. Refer to Senergy's Sentry Stucco Ultra System typical details.

C. Do not proceed until all unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Protect all surrounding areas and surfaces from damage and staining during application of Senergy Sentry Stucco Ultra System.

B. Protect finished work at end of each day to prevent water penetration.

3.3. MIXING

A. General: No additives are permitted unless specified in product mixing instructions. Close containers when not in use. Prepare in a container and/or mixer that is clean and free of foreign substances. Do not use a container and/or mixer which has contained or been cleaned with a petroleum-based product. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

B. Air/Moisture Resistive Barriers

1. Install in accordance with Division 3 and 7 Specifications.

C. Stucco Base Coat: STUCCOBASE™ PREMIX

1. Use mixer which is clean and free of foreign substances.
2. Add 7.6–9.5 liters (2–2.5 gallons) of clean potable water to mixer.
3. Slowly add one bag of STUCCOBASE™ PREMIX.
4. Mix for one minute at normal mixing speed. Allow material to set for 2–4 minutes with mixing blades at rest. Then re-mix, adding water to achieve desired consistency. Desired consistency varies with type of application (trowel or gun), substrate (paper-backed lath or block) and whether the stucco is applied to a wall or a ceiling.
5. Note: Continuous mixing may cause excessive air entrainment.

D. Senergy skim coat / EPS insulation adhesive: ALPHA DRY BASE COAT

1. Mix and prepare each bag in a 19-liter (5-gallon) pail.
2. Fill the container with approximately 5.6-liters (1.5-gallons) of clean, potable water.
3. Add ALPHA DRY in small increments, mixing after each additional increment.
4. Mix ALPHA DRY and water with a mixer to a homogeneous consistency.
5. Additional ALPHA DRY or water may be added to adjust workability.

E. Senergy FINISH COAT SENERFLEX

1. Thoroughly mix the factory-prepared material with a clean paddle and drill until thoroughly blended.
2. A small amount of clean, potable water may be added to adjust workability.
3. Additives are not permitted.
4. Close container when not in use.

5. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

3.4. APPLICATION

General: Apply Senergy Sentry Stucco Ultra System materials in accordance with all Sentry Stucco Ultra System typical details, system specification and related product literature.

A. Air/Water Resistive Barrier

1. All sheathing joints and windows/openings must be protected and the SENERSHIELD-R air/water-resistive barrier applied in accordance with Senergy's Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin. Openings must be flashed prior to window/door, HVAC, etc. installation.
2. Substrate shall be dry, clean, sound, and free of releasing agents, paint, or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 6.4 mm in 3 m (1⁄4" in 10').
3. Unsatisfactory conditions shall be corrected before application of the SENERSHIELD-R.
4. Wrap openings with sheathing fabric by applying mixed SENERSHIELD-R to all surfaces and immediately embedding sheathing fabric. Once dry, apply a second coat to ensure a complete, void-free membrane. Apply fabric in accordance with Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall Systems bulletin.
5. Spot all fasteners and pre-coat sheathing joints, terminations, inside and outside corners with mixed SENERSHIELD-R using a 101 mm (4") wide by 20 mm (3/4") nap roller, brush or spray.
6. Immediately place and center sheathing fabric over wet SENERSHIELD-R at all sheathing joints, terminations, inside and outside corners, as well as knot holes and check cracks that may exist in plywood or OSB. Ensure fabric extends evenly on both sides of the sheathing joint.
7. Lap sheathing fabric 63.5 mm (2 1/2") minimum at intersections. Allow to dry to the touch before applying SENERSHIELD-R to entire wall surface.
8. Apply Air/Moisture Barrier to plywood, OSB substrate(s) or CMU with a 20 mm (3/4") nap roller to a uniform consistent thickness of a nominal 10 wet mils. Prior to application of a second coat, visually inspect to assure sheathing surface is blister free and coating is free of voids and pinholes. Repair if needed and then apply a second coat after the initial coating is sufficiently dry.
9. Apply Two (2) coats of Air/Moisture Barrier are required on plywood, OSB and CMU.
10. Apply Air/Moisture Barrier to other acceptable substrate(s) with a 20 mm (3/4") nap roller to a uniform consistent thickness of nominal 10 wet mils that is free of voids and pinholes.
11. Installed materials should be completely dry and checked before continuing system application.
12. Coordinate work with other trades to assure proper sequencing, detailing and installation of materials.

B. Drainage Mat DF

1. Apply DRAINAGE MAT DF horizontally over SENERSHIELD-R. DRAINAGE MAT DF should be free of wrinkles, creases and tears.
2. Secure DRAINAGE MAT DF to substrate with sufficient building staples or galvanized nails to remain in place prior to application of exterior cladding system.

C. Trim junction

1. When two pieces of trim abut:
    a. Set intersection of trim in a minimum 100 mm (4”) bed of acceptable trim sealant.Allow 3–5 mm (1/8”–3/16”) gap between the abutting trim pieces. Do not overlap trim. Attach the trim in accordance with manufacturer’s specifications. True expansion joints must be fastened to the structural substrate.
2. When two or more pieces of trim intersect:
    a. The vertical trim piece shall be continuous with all horizontal pieces. Miter all corners at intersections of trim. Set intersection of trim in a minimum 100 mm (4”) bed of acceptable trim sealant. Allow 3–5 mm (1/8”– 3/16”) gap between the intersecting trim pieces. Do not overlap the trim Attach the trim in accordance with manufacturers’ specifications and ASTM C1063.

D. Lath : PERMALATH® 1000

1. Apply PERMALATH® 1000 over substrate with minimum 3” overlap at vertical and horizontal edges and overlap on flange of trim accessories. PERMALATH® 1000 can be applied horizontally or vertically and should be applied such that it is flat and free of ripples, wrinkles, etc. Fastener System: type appropriate for application and substrate, as recommended by BASF Wall Systems.
2. PERMALATH® 1000 Fasteners: Lath Plate Mechanical Fastening Systems by Wind-Lock Corp.
3. Masonry: masonry type [M] expansion fastener with lath plates 25 mm (1”) minimum penetration into masonry. Fastener spacing 6” o.c. vertically and 16” o.c. horizontally.
4. Cold rolled steel framing/furring spaced maximum 16” o.c.: minimum No.6, 1 1⁄4” long, Type S, self drilling, corrosion resistant coated, bugle head screws or 1 1⁄4” long x 0.10” diameter VersaPIN Gripshank® fasteners by Aerosmith Fastening Systems with 1 1⁄4” diameter lath plates, 16 mm (5/8”) minimum penetration into framing, 6” o.c. vertically and 16” o.c. horizontally.
5. Apply STUCCOBASE™ PREMIX within 60 days of PERMALATH® 1000 application.

E. STUCCOBASE™ PREMIX Base Coat: System Application (3/4”– 7/8” thickness)

1. Total thickness of base coats must meet code requirements for fire rated construction.
2. Nominal plaster base coat thickness:

    First coat “scratch”: 3/8”– 1/2”

    Second coat “brown”: 3/8”– 1/2”
3. Apply STUCCOBASE™ PREMIX mixture to the lath by hand troweling or machine spraying with sufficient force to develop full adhesion between STUCCOBASE™ PREMIX mixture and the lath.
4. Apply first coat to completely embed lath. Cross rake slightly to provide key for second brown coat. Coat must be uniform in thickness. Ensure the first coat is properly “scratched” and sufficiently rigid to resist cracking prior to application and leveling of the second or “brown” coat.
5. Apply second brown coat to provide the required total thickness. Trowel STUCCOBASE™ PREMIX into trim to seat trim. The lath shall be fully embedded in the stucco and shall be completely covered. Coat must be uniform in thickness. Rod off to desired thickness, leveled with screeds, to provide a true, flat plane. Follow this by wood floating or darbying the surface.
6. After surface has sufficiently hardened, use sponge or hard rubber float as required to fill voids, holes or imperfections, leaving the surface ready to receive Senergy Finish.

7. Damp cure for at least 48 hours by lightly and evenly fogging the surface with water a least twice a day. Direct sunlight, hot temperatures, low humidity and wind may make additional fogging necessary.
8. Allow STUCCOBASE™ PREMIX to cure a minimum of 6 days prior to application of Senergy BASE COAT skim coat, EPS insulation board shapes and Senergy FINISH COAT application.

F. Senergy BASE COAT:

1. Apply a skim coat of Senergy BASE COAT, approximately 1/16" thick to properly cured "brown coat" of STUCCOBASE™ PREMIX.
2. Allow to dry hard (normally 8 to 10 hours).

G. Reinforcing Mesh: Base Coat shall be applied so as to achieve Reinforcing Mesh embedment with no Reinforcing Mesh color visible.

1. Reinforcing Mesh.
2. Install STRONG 15 with FLEXGUARD 6 Reinforcing Mesh over properly cured Senergy Sentry Stucco Ultra System "brown coat" of STUCCOBASE™ PREMIX.
3. Apply mixed Senergy Base Coat to entire surface of "brown coat" with a stainless steel trowel to embed the Reinforcing Mesh.
4. Immediately place Reinforcing Mesh against wet Base Coat and embed the Reinforcing Mesh into the Base Coat by troweling from the center to the edges.
5. Lap Reinforcing Mesh 64 mm (2 1⁄2") minimum at edges.
6. Ensure Reinforcing Mesh is continuous at corners, void of wrinkles and embedded in Base Coat so that no Reinforcing Mesh color is visible.
7. Allow Base Coat with embedded Reinforcing Mesh to dry hard (normally 8 to 10 hours).

H. Senergy STUCCOPRIME:

1. Apply STUCCOPRIME to the dried base coat skim coat with a sprayer, 10 mm (3/8") nap roller, or good-quality latex paint brush at a rate of approximately 3.6–6.1 m2 per liter (150–250 ft2 per gallon).
2. STUCCOPRIME shall be dry to the touch before proceeding with the Senergy FINISH COAT application.

I. Senergy FINISH COAT

1. SENERFLEX FINISH: CLASSIC
2. Apply FINISH directly to the dried base coat with a clean, stainless steel trowel.
3. Apply and level FINISH during the same operation to minimum obtainable thickness consistent with uniform coverage. Maintain a wet edge on FINISH by applying and texturing continually over the wall surface. Work FINISH to corners, joints or other natural breaks and do not allow material to set up within an uninterrupted wall area. Float FINISH to achieve final texture.

3.5. CLEANING

A. Clean work under provisions of Division 1 Specifications.

B. Clean adjacent surfaces and remove excess material, droppings, and debris.

3.6. PROTECTION

A. Protect finished work under provisions of Division 1 Specifications.

END OF SECTION 09 24 23

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.

B. Related Sections include the following:

1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
2. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
3. Division 07 Section "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
4. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
5. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
6. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
7. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3. SUBMITTALS

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

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4. QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.5. STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6. PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1. PANELS, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 10 percent by weight.

B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2. INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Gypsum.
   b. Armstrong Ceiling & Wall Solutions.
   c. Certainteed; SAINT-GOBAIN.
   d. Georgia-Pacific Gypsum LLC.
   e. Gold Bond Building Products, LLC provided by National Gypsum Company.
   f. PABCO Gypsum.
   g. USG Corporation.

B. Regular Type:

1. Thickness: As indicated.
2. Long Edges: Tapered.

C. Type X:

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

D. Type C:

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

F. Abuse-Resistant Type: Provide paper-faced type in compliance with ASTM C1629 and manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board. Provide paper face type to allow for uniform finish transition at joints merging with standard Type X gypsum board. See partition construction notes on partition detail drawing and specific notes for where abuse-resistant type is required beyond stated basic requirements on partition detail drawing.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

G. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.

2.3. EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.

1. Core: As indicated on Drawings.

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
   a. American Gypsum; M-GLASS® Type X Exterior Gypsum Sheathing.
   b. Certainteed; SAINT-GOBAIN; GlasRoc Sheathing.
   c. USG Corporation; USG Securock® Brand UltraLight Glass-Mat Sheathing.
2. Core: As indicated on Drawings.

2.4. CEILING AND SOFFIT SUPPORT MATERIALS

A. Hanger Anchorage Devices: Screws, clips, bolts or other devices compatible with indicated structural anchorage for ceiling hangers and whose suitability has been proven through standard construction practices or by certified test data.

B. Powder-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers [and with capability to sustain, without failure, a load equal to 10x calculated loads].

C. Hangers:

1. Steel wire or rods, sizes to comply with requirements of ASTM C754 for ceiling or soffit area and loads to be supported.
2. Wire: ASTM A 641, soft, Class 1 galvanized.
3. Rods and flats:
    a. Mild steel components.
    b. Finish:Galvanized or painted with rust-inhibitive paint for interior work; galvanized for exterior work.

D. Framing System:

1. Main runners:
    a. Cold-rolled, "C" shaped steel channels, 16 gauge minimum.
    b. Finish: Galvanized with G40 hot-dip galvanized coating per ASTM A525 [for exterior work]; galvanized or painted with rust-inhibitive paint for other interior work.
    c. Form to required radius at curved ceilings.
2. Cross furring: Hat-shaped steel furring channels, ASTM C645, 7/8 inch high, 25 gauge, galvanized.
3. Furring anchorages: 16 gauge galvanized wire ties, manufacturer's standard wire-type clips, bolts, nails or screws recommended by furring manufacturer and complying with ASTM C754.
4. Provide compression posts and other accessories as required to comply with seismic requirements.

2.5. TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board:

1. Complying with ASTM C1177/C 1177M.
    a. Product: Subject to compliance with requirements, provide "DensSheild Tile Backer" by G-P Gypsum or approved equal.
2. Core: 1/2 inch

2.6. TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, or rolled zinc at outside corners.
    a. Paper-faced galvanized steel sheet type may be used at inside corners.
2. Shapes:
    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (control) joint.

3. Provide outside corner trims in full length pieces for length of corners.
4. At overhead bulkheads/soffits segmented corners may be assembled in pieces where the length of the corner condition exceeds manuf. standard full lengths.
    a. Piece segments tight where multiple pieces are required to accomplish installation.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, or rolled zinc.
2. Shapes:
    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.7. JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.8. AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Also provide sound attenuation insulation material type according to architectural drawings for specific notes.

E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Seal gypsum board and framing construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

1. At fire rated assemblies substitute sealant type in compliance with UL Fire Rated Assembly necessary for the specified fire rating.

J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3. APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X shall be typical: Vertical surfaces and horizontal surfaces, unless otherwise indicated.
2. Non Type X: for gypsum wallboard conditions specified as 3/8” and 1/2" thick.
3. Type C: Where required for specific fire-resistance-rated assembly indicated.
4. Ceiling Type: As indicated on Drawings other than Moisture and Mold Resistant Type.
5. Abuse-Resistant Type with Type X label: As indicated on Drawings.
6. Moisture- and Mold-Resistant Type: Vertical surfaces and ceilings in spaces subject to moisture and scheduled for finish other than ceramic tile.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4. APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5. INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

D. Where plastic laminate or solid surfacing material is to be provided on a wall that is surfaced with gypsum wallboard, provide LC-bead finished edge in align with the blocking and/or stud channel at the top of the wall to assure a straight finished edge beneath the countertop, window stool or wall cap conditions.

1. This item is to be coordinated by the contractor responsible for the installation of the gypsum wallboard.

3.6. FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.

3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
    a. Primer and its application to surfaces are specified in other Division 09 Sections.
5. Level 5: Where new gypsum board surfaces are installed in spaces that have existing gypsum plaster.
    a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.7. PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes acoustical panels, exposed suspension systems, luminous shapes, canopies, cable hangers and fasteners, and perimeter trim for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3. DEFINITIONS

A. CAC: Ceiling Attenuation Class.

B. LR: Light Reflectance coefficient.

C. NRC: Noise Reduction Coefficient.

1.4. SUBMITTALS

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

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system, luminous shapes and canopy system members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of two full-size Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
3. Luminous Ceilings: Minimum 2 inch x 3 inch samples of specified canopy
4. Metal Ceiling: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees
5. Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

D. Research/Evaluation Reports: For each acoustical panel ceiling and components.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.5. QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.
3. Luminous Ceilings: Provide canopies and method of attachment by a single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    a. Identify materials with appropriate markings of applicable testing and inspecting agency.
2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, luminous shapes, canopies, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, luminous shapes, and canopies, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels, luminous shapes, and canopies carefully to avoid chipping edges or damaging units in any way.

1.7. PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Proper size openings shall be made by the contractor at electric light locations and ventilation openings for installation of fixtures by the Mechanical-Electrical Contractors. The contractors shall cooperate with others so that the locations of fixtures and access panels will fit the layout making regular, symmetrical patterns in finished ceilings.

1.8. COORDINATION

A. Coordinate layout and installation of panels, luminous shapes, canopies and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. This Contractor shall coordinate the installation of the acoustical tile with the installation of the recessed diffusers and recessed light fixtures that will be supported from the acoustical suspension system.

1.9. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.5 percent of quantity installed.
2. Acoustical Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed
3. Suspension System Components: Quantity of each exposed component equal to 2.5 percent of quantity installed.

1.10. WARRANTY

A. Acoustical tile shall be warranted not to sag or warp for a period of ten (10) years.

B. Grid shall be warranted not to rust for a period of ten (10) years.

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

PART 2 - PRODUCTS

2.1. ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

B. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2. ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILINGS – TYPICAL OF ALL AREAS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Calla HealthZone or a comparable product by one of the following:

a. USG-United States Gypsum

b. Certainteed

c. Or equal as approved by the Professional

2. Surface Texture: Fine Textured
3. Composition: Mineral Fiber
4. Color: White
5. Size: 24 x 24 x 1”
6. Edge Profile: Beveled Tegular 15/16” x 15/16”
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.80 minimum.
8. Ceiling Attenuation Class (CAC) : ASTM C 1414; Classified with UL label on product carton 38.
9. Flame Spread: ASTM E 1264; Class A (HPVA)
10. Light Reflectance White Panel: ASTM E 1477; 0.85
11. Dimensional Stability: HumiGuard Plus

2.3. METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

2.4. METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

A. Metal Suspension System

1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; SUPRAFINE 9/16" Exposed Tee or a comparable product by one of the following:
   a. Or equal as approved by the Architect.
2. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 Heavy Duty
   b. Color: Manuf. Standard Options
3. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
4. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

2.5. METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Prelude ML or a comparable product by one of the following:

1. CertainTeed, Inc.; Classic Hook System.
2. Chicago Metalic; Snap-Grid™ 200.
3. Or equal as approved by the Architect.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6. ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:
    a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
    b. Pecora Corporation; BA-98.
    c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

A. Measure each ceiling area and establish layout of panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

B. Measure each ceiling area and establish layout of luminous shapes and canopies. Comply with reflected ceiling plans. Coordinate panel layout with mechanical, electrical and sprinkler fixtures

3.3. INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

F. Install Infusion products as directed in the manufacturer's installation instructions and in compliance with the authorities having jurisdiction

3.4. CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, luminous shapes and canopies, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

PART 1 - GENERAL

1.1. SUMMARY

A. Products Supplied

1. Resilient athletic flooring.
2. Accessories required for installation, maintenance and repair.

1.2. REFERENCES

A. ASTM International (ASTM)

B. ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.

C. ASTM D2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as measured by the James Machine.

D. ASTM D2240: Standard Test Method for Rubber Property (Durometer Hardness).

E. ASTM D3389: Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader).

F. ASTM E492: Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.

G. ASTM E648: Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

H. ASTM E1643: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

I. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

J. ASTM E2180: Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials.

K. ASTM F386: Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces.

L. ASTM F710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

M. ASTM F925: Standard Test Method for Resistance to Chemicals of Resilient Flooring.

N. ASTM F970: Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.

O. ASTM F1514: Standard Test method for Measuring Heat Stability of Resilient Flooring by Color Change.

P. ASTM F1515: Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change.

Q. ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

R. ASTM F2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

S. State of California (CA)

1. CA Section 01350. Standard Method for the Testing and Evaluation of Volatile Organic Compound Emissions from Indoor Sources Using Environmental Chambers.

T. Grenelle Environment Forum

1. Decree № 2011-321. French decree on labeling requirement for construction materials, wall and floor coverings, and paint and varnishes, as it pertains to their emissions of volatile pollutants.

U. GREENGUARD Environmental Institute (GEI)

1. GREENGUARD Certification. Compliant with stringent emission levels for over 360 VOCs, plus a limit on the total of all chemical emissions combined (TVOC).
2. GREENGUARD Gold. Compliant with safety factors to account for sensitive individuals (such as children and the elderly) and ensures that a product is acceptable for use in environments such as schools and healthcare facilities.

V. International Organization for Standardization (ISO)

1. ISO 9001: Quality management systems – Requirements.
2. ISO 16000-9: Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
3. ISO 22196: Measurement of antibacterial activity on plastics and other non-porous surfaces.

1.3. SUBMITTALS

A. Action Submittals

1. Provide copies of Original Equipment Manufacturer (OEM)’s ISO 9001 certification.
2. Provide current printed data sheets for all Products Supplied.
3. Provide samples, 6 inches x 6 inches, for verification of such characteristics as color and surface texture for each Manufactured Product specified.
4. As necessary, provide shop drawings prepared for project illustrating layouts, details, dimensions and other pertinent data.

B. Informational Submittals

1. Provide Manufacturer’s current printed substrate surface preparation guidelines.
2. Provide Manufacturer’s current printed installation guidelines for Products Supplied.

C. Closeout Submittals

1. Provide Manufacturer’s current printed maintenance guidelines for Manufactured Product.
2. Provide Manufacturer’s current printed standard warranty for Manufactured Product.

D. Maintenance Material Submittals

1. Provide extra stock materials from original dye lots, for use in facility operations and maintenance (approximately 2% of the total floor surface for each color, surface texture and format of Manufactured Product specified).

1.4. QUALITY ASSURANCE

A. Manufacturer must be certified ISO 9001.

B. Manufacturer must have a minimum of fifteen (15) years of experience in the manufacturing of prefabricated resilient rubber flooring.

C. Manufactured Product must have undergone a vulcanization process; factory lamination should not be accepted as equivalent.

D. Surfacing Contractor to be recognized and approved by the Manufacturer.

E. Surfacing Contractor shall be fully acquainted with the existing facility and utilities and shall fully understand the difficulties and restrictions attending the execution of the work under contract. Surfacing Contractor to advise the Owner of any restrictions or anticipated difficulty, in writing and before submitting bids.

F. Installer must be approved by the Surfacing Contractor and must have performed installations of the same scale in the last three (3) years.

G. A mock-up installation is highly recommended; always follow the same procedures and use the same materials that have been specified for the actual project. The Owner or Architect will be responsible for deeming the mock-up acceptable.

1. Mock-up size: 2-0” x 2’-0”.

1.5. DELIVERY, STORAGE AND HANDLING

A. Products Supplied must be delivered in Manufacturer’s original, unopened and undamaged packaging with identification labels intact.

B. Products Supplied must be protected from exposure to harmful weather conditions and must be safely stored on a clean, dry, flat surface. Store rolls of resilient athletic flooring upright; store tiles of resilient athletic flooring on a flat surface, carefully protecting corners and edges.

C. Climate controlled storage is recommended. Storage temperature must not be below 40oF (4oC) and must not exceed 100oF (38oC). Materials must be delivered to site a minimum of 24 hours before work is scheduled to begin so that they may acclimate.

D. Avoid storing Manufactured Product for extended periods of time or additional material trimming may be required.

E. Products Supplied need not suffer damage during delivery, storage and handling (i.e. dents/scratches, excessive compression or warping, chipped edges, etc.).

1.6. SITE CONDITIONS

A. The General Contractor shall be responsible for ensuring all site conditions meet the requirements of the Manufacturer, as referenced herein at sections 3.2 and 3.3. Refer to current version of ASTM F710 for additional information.

B. Concrete slabs, on or below grade, must be installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and the standard specification ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010 in).

C. No sealers or curing compounds are applied to or mixed into the concrete where the rubber flooring is to be installed.

D. Installation of the resilient athletic flooring to be carried out no sooner than the specified curing time of the concrete (normal density concrete curing time is approximately 28 days for development of design strength, having a minimum 3500 psi or 25 MPa in compressive strength).

E. Substrate surface must be free of all contaminants that can inhibit bond (paint, wax, dust, oil or grease, sealer, curing compound, solvent, asphalt, old adhesive residues, etc.). All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.

F. Concrete must have a smooth finish, proper density and be highly compacted with a tolerance of 1/8th of an inch in a 10-foot radius (3.2 mm in 3.05 m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.

G. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with the current version of ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with the current version of ASTM F1869 (anhydrous calcium chloride).

H. Maintain stable room and substrate temperatures prior to moisture testing and flooring installation, during the flooring installation, as well as a minimum of 48 hours after the flooring has been completely installed. Recommended ambient temperature range is between 65oF and 86oF (18oC and 30oC) and recommended ambient humidity range is between 35% and 55%.

I. If installing over wood substrates, ensure exterior grade plywood with at least one good side, such as: APA (Engineered Wood Association) Exterior grade plywood (A-A Exterior, A-B Exterior or A-C Exterior) and CANPLY (Canadian Plywood Association) Exterior certified plywood (Canada: Grade G2S A-A or G1S A-C. USA: G2S A-A, A-B, B-B, or G1S A-C, B-C). There must be proper underfloor ventilation, plywood must be dry and should have a moisture content ranging between 6 and 12%, when measured with a quality wood moisture meter (electronic hygrometer).

J. Installation of resilient athletic flooring will not commence until the building is enclosed and all other trades have completed their work. It is the General Contractor's responsibility to maintain a secure and clean working area before, during and after the installation of the resilient athletic flooring.

1.7. WARRANTY

A. The resilient athletic flooring is warranted to be free from manufacturing defects for a period of one (1) year from the date that is 30 days from shipment from the Manufacturer, per the terms and conditions of the Manufacturer's written Limited Warranty.

B. For standard applications, the resilient athletic flooring is warranted against excessive wear under normal usage for a period of ten (10) years from the date that is 30 days from shipment from the Manufacturer, per the terms and conditions of the Manufacturer's written Limited Warranty. For applications in ice arenas/ice skate use, the resilient athletic flooring is warranted against excessive wear under normal usage for a period of five (5) years from the date that is 30 days from shipment from the Manufacturer, per the terms and conditions of the Manufacturer's written Limited Warranty.

C. Refer to current copy of Manufacturer's written Limited Warranty for all terms and conditions, which shall be obtained directly from Manufacturer. In no event shall any warranties provided by any third parties (including distributors, insurance and/or private label providers) be considered a valid.

PART 2 - PRODUCTS

2.1. MANUFACTURED PRODUCT

A. Manufacturer

1. Basis of Design: Mondo Sport & Flooring, Sport Impact Series- 10 mm. Dealer: Miller Flooring, West Chester, PA, 610-626-1000.
2. Substitutions by Nora Rubber if still available will be considered but must be able to provide same impact resistance, no off-gassing, and color choice. Other manufacturers as well will be considered if they are available.

B. Description

1. Sport Impact is prefabricated resilient athletic flooring, calendered and vulcanized, with a base of natural and synthetic rubbers, stabilizing agents and pigmentation, as manufactured by Mondo Luxembourg S.A. or approved equal.
2. Dual durometer construction, vulcanized into a single prefabricated sheet/tile for optimal performance and durability. The Shore hardness of the top layer (wear layer) will be greater than that of the bottom layer (backing); Shore hardness of layers to be recommended by the Manufacturer and to respect limits specified.
3. Health-Conscious Production: Sport Impact is free from red listed ingredients (LBC Red List) and is manufactured without bisphenol A (BPA), formaldehyde, halogens, heavy metals, isocyanates, phthalates and polyvinyl chloride (PVC).
4. Thickness: 0.394''/ 3/8" thick(10 mm).
5. Colors: Provided in standard, solid background colors with randomly dispersed colored chips throughout the wear layer's entire depth.
6. Surface Texture: Sealskin.
7. Formats: Available in sheets that are 6'1" (1.86 m) wide and 29'6" (9 m) long [min. 19'8" (6 m)/max. 36'1" (11 m)]; available in tiles that are 36" x 36" (91.35 cm x 91.35 cm).

C. Performance

1. Performance of the Manufactured Product to conform to the following criteria:

Performance Criterion	Test Method	Requirement	Result*
Elongation at Break	ASTM D412	≥100%	≥120%
Tensile Strength	ASTM D412	≥300 psi	≥550 psi
Static Coefficient of Friction (neolite heel)	ASTM D2047	≥0.50 (dry)	≥0.80 (dry)
Hardness of Top Layer (Shore A)	ASTM D2240	80 ± 5	80
Hardness of Bottom Layer (Shore A)	ASTM D2240	70 ± 8	75
Abrasion Resistance (H18 wheel, 1000g, 1000 cycles)	ASTM D3389	≤1.0 g	≤0.4 g
Impact Insulation Class	ASTM E492	-	≈ 59 dB (IIC)
Critical Radiant Flux	ASTM E648	≥0.22 W/cm² (Class 2)	≥0.45 W/cm² (Class 1)
Reduction of Bacterial Activity - *MRSA (ATC 43300)*	ASTM E2180	-	≥99,99% reduction
Thickness	ASTM F386	10 mm (±0.2 mm) 0.394" (±0.008")	Compliant
Resistance to Chemicals	ASTM F925	≤Slight Change	Compliant **
Static Loading (Tested at 250psi)	ASTM F970	≤0.008 in	0.002 in
Heat Resistance	ASTM F1514	ΔE ≤8.0	Compliant
Light Resistance	ASTM F1515	ΔE ≤8.0	Compliant
Reduction of Bacterial Activity - *MRSA (ATC 43300)*	ISO 22196	-	≥99,999% reduction
Indoor Air Quality (IAQ) Certifications			
CA Section 01350	CA: V1.1-2010	-	Compliant
Greenguard Gold	Greenguard	-	Compliant
Greenguard Certification	Greenguard	-	Compliant
French Decree №2011-321	ISO 16000-9	-	Compliant (Class A+)

*Results obtained from manufacturing controls can vary between production lots and do not constitute representations or warranties as to any particular production lot. Mondo reserves the right to modify product design and/or specifications at any time without notice.

**For complete list of chemicals tested, concentration and contact time, please communicate with Mondo's Technical Department.

D. Limitations

1. For areas subject to surface impacts, such as designated free weight areas, it is recommended to adhere the resilient athletic flooring directly to the concrete substrate for optimal performance. Whenever possible, avoid installing resilient athletic flooring on weaker surfaces that may offer less resistance to continuous impacts.

E. Materials

1. Provide Sport Impact rubber flooring manufactured by Mondo Luxembourg S.A. or approved equal.
2. Provide Manufactured Product as specified in section 2.1.2 Description.

2.2. ACCESSORIES

A. Provide adhesive certified by Manufacturer: Mondo PU 105 (polyurethane) adhesive is recommended for installations over concrete. For suitability, recommendations and use, please refer to Manufacturer's current printed adhesive data sheets. In some cases, Mondo EP 55 (epoxy) may be used in areas that have not been specified for use of Mondo Everlay products, and that will not be subject to surface impacts or heavier dynamic loads (bleachers, equipment, etc.). For acceptable installations over wood or Mondo Everlay products (where surface impacts are not a concern), please consult Mondo's Technical Department for current adhesive recommendations.

B. Portland cement based patching or leveling compound to be supplied or recommended/approved by Manufacturer.

2.3. RESILIENT BASE

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

1. Nora by Interface
    a. Accepted Products:
        (1) Nora wall base
2. Roppe Corporation, U.S.A.
    a. Accepted Products:
        (1) Pinnacle Rubber Base and Accessories
3. Flexco, Corp.
    a. Accepted Products:
        (1) Wall flowers Premium Base
4. Tarkett Company, Johnsonite,
    a. Accepted Products:
        (1) Traditional Thermoset Rubber Wall Base and Accessories

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).
4. Minimum Thickness: 0.125 inch (3.2 mm).
5. Height: 4 inches (102 mm).
6. Lengths: Cut lengths from manufacturer's standard seamless roll length.
7. Outside Corners: Preformed.
8. Inside Corners: Preformed.
9. Finish, Colors & Patterns: Please reference the room material and product color schedule.

PART 3 - EXECUTION

3.1. INSTALLERS

A. Refer to section 1.4 of this document for information on installers.

3.2. EXAMINATION

A. Prior to resilient athletic flooring installation, ensure substrate is ready to receive resilient flooring and has been prepared according to Manufacturer's current substrate surface preparation guidelines. Refer to current version of ASTM F710 for additional information.

B. Ensure that concrete slabs, on or below grade, are installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and the standard specification ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010 in).

C. Ensure that no concrete sealers or curing compounds have been applied to or mixed into the concrete (refer to Section 03 05 00 – Common Work Results for Concrete of Division 3).

D. Installation of the resilient athletic flooring to be carried out no sooner than the specified curing time of the concrete (normal density concrete curing time is approximately 28 days for development of design strength, having a minimum 3500 psi or 25 MPa in compressive strength).

E. Ensure that concrete surface is free of any contaminant that could inhibit bond (paint, wax, dust, oil or grease, sealer, curing compound, solvent, asphalt, old adhesive residues, etc.). All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.

F. Confirm concrete has a smooth finish, proper density and is highly compacted with a tolerance of 1/8th of an inch in a 10-foot radius (3.2 mm in a 3.05 m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.

G. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with the current version of ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with the current version of ASTM F1869 (anhydrous calcium chloride).

H. Ensure room and substrate temperatures are maintained prior to moisture testing and flooring installation, during the flooring installation, as well as a minimum of 48 hours after the flooring has been completely installed. Recommended ambient temperature range is between 65oF and 86oF (18oC and 30oC) and recommended ambient humidity range is between 35% and 55%.

I. If installing over wood substrates, ensure exterior grade plywood with at least one good side, such as: APA (Engineered Wood Association) Exterior grade plywood (A-A Exterior, A-B Exterior or A-C Exterior) and CANPLY (Canadian Plywood Association) Exterior certified plywood (Canada: Grade G2S A-A or G1S A-C. USA: G2S A-A, A-B, B-B, or G1S A-C, B-C). There must be proper underfloor ventilation, plywood must be dry and should have a moisture content ranging between 6 and 12%, when measured with a quality wood moisture meter (electronic hygrometer).

J. Installation of resilient athletic flooring will not commence until the building is enclosed and all other trades have completed their work. It is the General Contractor's responsibility to ensure that a secure and clean working area is maintained before, during and after the installation of the resilient athletic flooring.

3.3. PREPARATION

A. Specifier Note: The surface of the concrete (or wood when specified) is to be prepared according to Manufacturer's current printed guidelines; it is recommended that the Specifier review said guidelines. A copy of the substrate surface preparation guidelines can be obtained from the Technical Department at Mondo America, Inc. (United States 1-800-361-3747 • Canada 1-800-663-8138). The guidelines are considered common practice for the preparation and verification of substrates that will be receiving resilient flooring, and as such should not be omitted or altered in any case.

B. Prepare substrate surface in accordance with Manufacturer's current printed guidelines.

3.4. INSTALLATION

A. Install sheets of resilient athletic flooring following Manufacturer's current printed guidelines.

B. Install tiles of resilient athletic flooring following Manufacturer's current printed guidelines.

C. Install all accessories following Manufacturer's current printed guidelines.

3.5. REPAIR

A. Refer to section 1.3.4 for extra stock materials. Repair material must come from the same original dye lot as the Manufactured Product initially installed.

B. Repairs are to be performed by Surfacing Contractor's qualified installers/technicians only.

3.6. CLEANING

A. Always wait at least a minimum of 72 hours after the resilient athletic flooring has been completely installed before performing initial maintenance. Always maintain the resilient athletic flooring following Manufacturer's current printed guidelines.

3.7. PROTECTION

A. As needed, protect resilient athletic flooring with 1/8" Masonite during and after the installation, prior to its acceptance by the Owner.

B. Preserve the integrity of the installation and protect against direct sunlight/UV exposure; always ensure that windows and glass doors have inherent UV protection and/or are fitted with blinds/UV film.

END OF SECTION 09 65 66

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SECTION INCLUDES

A. Interior paint and coating commercial systems including surface preparation.

B. Exterior paint and coating systems including surface preparation.

1.3. RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 04 20 00 - Unit Masonry: Concrete Masonry Units (CMU) and brick.

C. Section 05 12 16 - Fabricated Fireproofed Steel Columns.

D. Section 05 50 00 - Metal Fabrications.

E. Section 06 20 00 - Finish Carpentry.

F. Section 06 40 00 - Architectural Woodwork.

G. Section 08 11 13.16 - Hollow Metal Doors and Frames.

H. Section 09 21 16.23 - Gypsum Board Shaft Wall Assemblies.

I. Section 23 05 00 - Common Work Results for HVAC.

J. Section 26 05 00 - Common Work Results for Electrical.

1.4. REFERENCES

A. Steel Structures Painting Council (SSPC):

1. SSPC-SP 1 - Solvent Cleaning.
2. SSPC-SP 2 - Hand Tool Cleaning.
3. SSPC-SP 3 - Power Tool Cleaning.
4. SSPC-SP5/NACE No. 1, White Metal Blast Cleaning.
5. SSPC-SP6/NACE No. 3, Commercial Blast Cleaning.
6. SSPC-SP7/NACE No. 4, Brush-Off Blast Cleaning.
7. SSPC-SP10/NACE No. 2, Near-White Blast Cleaning.
8. SSPC-SP11, Power Tool Cleaning to Bare Metal.
9. SSPC-SP12/NACE No. 5, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
10. SSPC-SP 13 / NACE No. 6 Surface Preparation for Concrete.

B. Material Safety Data Sheets / Environmental Data Sheets: Per manufacturer's MSDS/EDS for specific VOCs (calculated per 40 CFR 59.406). VOCs may vary by base and sheen.

C. California Department of Public Health (CDPH):

1. CDPH v1.1-2010 and V1.2-2017

1.5. SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: For each paint system indicated, including.

1. Product characteristics.
2. Surface preparation instructions and recommendations.
3. Primer requirements and finish specification.
4. Storage and handling requirements and recommendations.
5. Application methods.
6. Cautions for storage, handling and installation.

C. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's products, colors and sheens available.

D. Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.

E. Coating Maintenance Manual: Upon conclusion of project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams, "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used. "

F. Only submit complying products based on project requirements (i.e. LEED). One must also comply with the regulations regarding VOCs (CARB, OTC, SCAQMD, LADCO). To ensure compliance with district regulations and other rules, businesses that perform coating activities should contact the local district in each area where the coating will be used.

G. USGBC LEED V4 Submittals:

1. MRc2 Environmental Product Declaration Product Language: Products shall be selected with a preference to products that have product-specific environmental product declaration documentation.
2. EQc2 Low Emitting Materials: The VOC content of all adhesives, sealants, paints and coatings in this Section shall not exceed the VOC limits established in Division 01 Sustainable Design sections.

1.6. QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors and sheens available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish surfaces for verification of products, colors and sheens.
2. Finish area designated by Architect.
3. Provide samples that designate primer and finish coats.
4. Compatibility and Adhesion: Check after one week of drying and curing by testing in accordance with ASTM D3359; Adhesion by tape test. If coating system is incompatible, additional surface preparation up to and including complete removal may be required.
5. Do not proceed with remaining work until the Architect approves the mock-up.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information.

1. Product name, and type (description).
2. Application and use instructions.
3. Surface preparation.
4. VOC content.
5. Environmental handling.
6. Batch date.
7. Color number.

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

D. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.8. PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9. EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

B. Furnish Owner with an additional one percent of each material and color, but not less than 1 gal (3.8 l) or 1 case, as appropriate.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturer: Sherwin-Williams, which is located at: 101 Prospect Ave.; Cleveland, OH 44115; ASD Toll Free Tel: 800-524-5979; Tel: 216-566-2000; Fax: 440-826-1989; Email: request infospecifications@sherwin.com; Web:www.swspecs.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2. APPLICATIONS/SCOPE

A. Interior Paint and Coating Commercial Systems:

1. Concrete: Poured, precast, tilt-up, cast-in-place, cement board, plaster.
2. Concrete: Non-vehicular floors.
3. Masonry: Concrete masonry units, including split-face, scored, and smooth block.
4. Metal: Aluminum, galvanized steel.
5. Metal: Structural steel, joists, trusses, beams, partitions and similar items.
6. Wood: Walls, ceilings, doors, trim and similar items.
7. Drywall: Drywall board, Gypsum board.

B. Exterior Paint and Coating Systems:

1. Metal: Aluminum, galvanized steel.
2. Metal: Miscellaneous iron, ornamental iron, ferrous metal.
3. Architectural PVC, plastic, fiberglass.
4. Drywall: Gypsum board, and exterior drywall.
5. Vinyl: Siding, EIFS, synthetic stucco.

2.3. PAINT MATERIALS - GENERAL

A. Paints and Coatings:

1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color. Or follow manufactures product instructions for optimal color conformance.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.

D. Color: Colors to be selected by Architect. Color selection to be determined based on product submittals and coordination of other material colors.

2.4. INTERIOR PAINT AND COATING COMMERCIAL SYSTEMS

A. Concrete: Walls and Ceilings, Poured Concrete, Precast Concrete, Unglazed Brick, Cement Board, Tilt-Up, Cast-In-Place including Plaster Walls and Ceilings.

1. Alkyd Systems; Waterbased:
    a. Low Sheen Finish:
        (1) 1st Coat: S-W Loxon Concrete and Masonry Primer Sealer, LX02W50 (8 mils wet, 3.2 mils dry).
        (2) 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Low Sheen, B53-1250 Series.
        (3) 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Low Sheen, B53-1250 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).

B. Masonry CMU: Concrete, Split Face, Scored, Smooth, High Density, Low Density, and Fluted.

1. Latex Systems:
    a. Semi-Gloss Finish: High Performance (HP) Upgrade.
        (1) 1st Coat: S-W PrepRite Block Filler, B25W25 (75-125 sq ft/gal).
        (2) 2nd Coat: S-W ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series.
        (3) 3rd Coat: S-W ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series (4 mils wet, 1.6 mils dry per coat).

C. Metal: Aluminum and Galvanized.

1. Alkyd Systems; Waterbased:
    a. Semi-Gloss Finish:
        (1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).
        (2) 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series.
        (3) 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).

D. Metal; Galvanized: Ceilings and Duct work.

1. Dryfall Waterborne Topcoats:
    a. Flat Finish:
        (1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry). Painter to inspect field conditions of these items and recommend primer type prior to installation.
        (2) 2nd Coat: S-W Pro Industrial Waterborne Acrylic Dryfall, B42-181 Series.

E. Metal: Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous and Ornamental Iron, Structural Iron, and Ferrous Metal.

1. Alkyd Systems; Waterbased:
    a. Semi-Gloss Finish:
        (1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).
        (2) 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series.
        (3) 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).
2. Dryfall Waterborne Topcoat:

a. Flat Finish:
(1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).
(2) 2nd Coat: S-W Pro Industrial Waterborne Acrylic Dryfall, B42-181 Series.

F. Wood: Walls, ceilings, doors, and trim.

1. Alkyd Systems; Waterbased:
a. Low Sheen Finish:
(1) 1st Coat: S-W Premium Wood and Wall Primer, B28W8111 (4 mils wet, 1.8 mils dry).
(2) 2nd Coat: S-W Industrial Waterbased Alkyd Urethane Enamel Low Sheen, B53-1250 Series.
(3) 3rd Coat: S-W Industrial Waterbased Alkyd Urethane Enamel Low Sheen, B53-1250 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).
2. Stain and Varnish System:
a. Satin Finish:
(1) 1st Coat: SW Minwax Performance Series Tintable Wood Stain 250 VOC.
(2) 2nd Coat: S-W Minwax Waterbased Oil-Modified Polyurethane.
(3) 3rd Coat: S-W Minwax Waterbased Oil-Modified Polyurethane (4 mils wet, 1.0 mil dry per coat).

G. Drywall: Walls, Ceilings, Gypsum Board and similar items.

1. Latex Systems:
a. Eg-Shel / Satin Finish: High Performance (HP) Upgrade.
(1) 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.5 mils dry).
(2) 2nd Coat: S-W ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1950 Series.
(3) 3rd Coat: S-W ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1950 Series (4 mils wet, 1.7 mils dry per coat).
b. Flat Finish:
(1) 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.5 mils dry).
(2) 2nd Coat: S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series.
(3) 3rd Coat: S-W ProMar 200 Zero VOC Latex Flat, B30-12600 Series (4 mils wet, 1.6 mils dry per coat).
c. Provide paint finishes on gypsum wallboard substrates for conditions as follows:
(1) Gypsum wallboard/drywall walls: provide “satin” finish.
(2) Gypsum wallboard/drywall ceilings: provide “flat finish” on ceilings and soffits, with the exception of restrooms, janitors and service areas, provide satin finish in those areas.

2.5. EXTERIOR PAINT AND COATING SYSTEMS

A. Metal: Aluminum, Galvanized.

1. Alkyd Systems; Waterbased:
a. Semi-Gloss Finish:
(1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).
(2) 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel

Semi-Gloss, B53-1150 Series.

(3) 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).

B. Metal: Miscellaneous. Iron, Ornamental Iron, Structural Iron and Steel, Ferrous Metal.

1. Alkyd Systems; Waterbased:

a. Semi-Gloss Finish:

(1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).

(2) 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series.

(3) 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series (4.0-5.0 mils wet, 1.4 - 1.7 mils dry per coat).

C. Architectural PVC, Plastic, and Fiberglass:

1. Latex Systems:

a. Satin Finish:

(1) 1st Coat: S-W Extreme Bond Bonding Primer, B51W00150 (3.1 mils wet, 0.9 mils dry).

(2) 2nd Coat: S-W A-100 Exterior Latex Satin, A82 Series.

(3) 3rd Coat: S-W A-100 Exterior Latex Satin, A82 Series (4.0 mils wet, 1.5 mils dry per coat).

D. Drywall: Gypsum Board and Exterior Drywall. (Not anticipated to be required, but applicable to any such incidental exposed materials)

1. Latex Systems:

a. Satin Finish:

(1) 1st Coat: S-W Exterior Latex Wood Primer, B42W08041 (4.0 mils wet, 1.4 mils dry).

(2) 2nd Coat: S-W A-100 Exterior Latex Satin, A82 Series.

(3) 3rd Coat: S-W A-100 Exterior Latex Satin, A82 Series (4.0 mils wet, 1.5 mils dry per coat).

PART 3 - EXECUTION

3.1. EXAMINATION

A. Do not begin installation until substrates have been properly prepared; notify Architect of unsatisfactory conditions before proceeding. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

B. Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

C. Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Architect immediately if lead based paints are encountered.

3.2. SURFACE PREPARATION

A. General: Surfaces shall be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

1. Prior to attempting to remove mildew, it is recommended to test any cleaner on a small, inconspicuous area prior to use. Bleach and bleaching type cleaners may damage or discolor existing paint films. Bleach alternative cleaning solutions are advised.
2. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply solution and scrub the mildewed area. Allow solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow surface to dry before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.
3. Remove items including but not limited to thermostats, electrical outlets, switch covers and similar items prior to painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
4. No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50 degrees F (10 degrees C), unless products are designed specifically for these conditions. On large expanses of metal siding, the air, surface and material temperatures must be 50 degrees F (10 degrees F) or higher to use low temperature products.

B. Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.

C. Block (Cinder and Concrete): Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Concrete and mortar must be cured at least 30 days at 75 degrees F (24 degrees C). The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement patching compound.

D. Concrete, SSPC-SP13 or NACE 6: This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

E. Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Pressure clean, if needed, with a minimum of 2100 psi pressure to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments.

F. Copper and Stainless Steel: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP 2, Hand Tool Cleaning.

G. Exterior Composition Board (Hardboard): Some composition boards may exude a waxy material that must be removed with a solvent prior to coating. Whether factory primed or unprimed, exterior composition board siding (hardboard) must be cleaned thoroughly and primed with an alkyd primer.

H. Drywall - Exterior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds.

I. Drywall - Interior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting.

J. Galvanized Metal: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP16 is necessary to remove these treatments.

K. Plaster: Must be allowed to dry thoroughly for at least 30 days before painting unless the products are designed to be used in high pH environments. Room must be ventilated while drying; in cold, damp weather, rooms must be heated. Damaged areas must be repaired with an appropriate patching material. Bare plaster must be cured and hard. Textured, soft, porous, or powdery plaster should be treated with a solution of 1 pint household vinegar to 1 gallon of water. Repeat until the surface is hard, rinse with clear water and allow to dry.

L. Steel: Structural, Plate, And Similar Items: Should be cleaned by one or more of the surface preparations described below. These methods are used throughout the world for describing methods for cleaning structural steel. Visual standards are available through the Society of Protective Coatings. A brief description of these standards together with numbers by which they can be specified follow.

1. Solvent Cleaning, SSPC-SP1: Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation.
2. Hand Tool Cleaning, SSPC-SP2: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.
3. Power Tool Cleaning, SSPC-SP3: Power Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.
4. White Metal Blast Cleaning, SSPC-SP5 or NACE 1: A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
5. Commercial Blast Cleaning, SSPC-SP6 or NACE 3: A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.

6. Brush-Off Blast Cleaning, SSPC-SP7 or NACE 4: A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
7. Power Tool Cleaning to Bare Metal, SSPC-SP11: Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods.
8. Near-White Blast Cleaning, SSPC-SP10 or NACE 2: A Near White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
9. High- and Ultra-High Pressure Water Jetting for Steel and Other Hard Materials: SSPC-SP12 or NACE 5: This standard provides requirements for the use of high- and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream.
10. Water Blasting, SSPC-SP12/NACE No. 5: Removal of oil grease dirt, loose rust, loose mill scale, and loose paint by water at pressures of 2,000 to 2,500 psi at a flow of 4 to 14 gallons per minute.

M. Vinyl Siding, Architectural Plastics, EIFS and Fiberglass: Clean vinyl siding thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color unless the paint system features Sherwin-Williams VinylSafe technology. Painting with darker colors that are not Sherwin-Williams VinylSafe may cause siding to warp. Follow all painting guidelines of the vinyl manufacturer when painting. Only paint properly installed vinyl siding. Deviating from the manufacturer's painting guidelines may cause the warranty to be voided.

N. Stucco: Must be clean and free of any loose stucco. If recommended procedures for applying stucco are followed, and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9 unless the products are designed to be used in high pH environments such as Loxon.

O. Wood: Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

3.3. INSTALLATION

A. Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendations.

B. Do not apply to wet or damp surfaces. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days. Test new concrete for moisture content. Wait until wood is fully dry after rain or morning fog or dew.

C. Apply coatings using methods recommended by manufacturer.

D. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

E. Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.

F. Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.

G. Inspection: The coated surface must be inspected and approved by the Architect just prior to the application of each coat.

3.4. PROTECTION

A. Protect finished coatings from damage until completion of project.

1. Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION 09 90 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:
    a. Portable fire extinguishers to be furnished by Owner.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

F. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4. QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
    a. Schedules and coordination requirements.

1.5. COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1. Fire extinguishers shall be provided by Owner, and furnished to the Contractor for installation prior to final building inspection.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1. MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Extruded Shapes: ASTM B 221 (ASTM B 221M).

C. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 6 mm thick, with Finish 1 (smooth or polished).

2.2. FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis of Design: Larsen's Manufacturing Company; Cameo AL-C-2409-5R. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. J. L. Industries, Inc., a division of Activar Construction Products Group.
   b. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
   c. Potter Roemer LLC.
   d. Other manufacturer as approved by Architect.

B. Cabinet Construction: Nonrated typical where installed in masonry walls. Provide fire rated in where mounted in metal stud partitions.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet.
2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: Provide this type at most conditions, unless specifically noted otherwise. Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Extruded-aluminum shapes.

H. Door Style: Fully glazed panel with frame.

I. Door Glazing: Break acrylic bubble.

1. Acrylic Bubble Color: Clear, transparent.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

K. Gymnasium and Locker Rooms:

1. Provide fire extinguisher cabinets for locations indicated of aluminum door construction with full clear wire glass panel door with minimum size 9-1/2” wide x 7” deep x 24” high.
2. Cabinet shall be constructed with 18 gauge white baked enamel steel box. Box shall be provided with extra heavy-duty bracket for extinguisher. Back shall be reinforced to accept the heavier bracket and extinguisher. Door and frame shall be extruded aluminum. Frame shall have 1-1/4” return. Aluminum shall be finished in anodized satin diamond luster finish. Unit shall be Cameo model as manufactured by Larsen’s Manufacturing Company, Minneapolis, MN; J.L. industries; Standard Fire Hose Company; Potter-Roemer; Advance Fire Equipment, or equal as approved by the Architect.

L. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
   a. Exterior of cabinet except for those surfaces indicated to receive another finish.
   b. Interior of cabinet.
2. Aluminum: Clear anodic.

2.3. FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4. GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. 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.

2.5. ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6. STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.

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

3.2. PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3. INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4. ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

PART 1 - GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. This Section includes the following types of fans:

    (1) High volume, low speed (HVLS) propeller circulation fans with fan speed controllers.

C. REFERENCES

1. International Organization for Standardization (ISO)
2. National Electrical Code (NEC)
3. National Fire Protection Association (NFPA)
4. Underwriters Laboratory (UL)
5. Nationally Recognized Testing Laboratory (NRTL)

D. ACTION SUBMITTALS

1. Shop Drawings: Drawings detailing product dimensions, weight, and attachment methods
2. Product Data: Specification sheets on the ceiling-mounted fan, specifying electrical and installation requirements, features and benefits, and controller information.
    a. Provide Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.
3. Installation Guide: The manufacturer shall furnish a copy of all installation, operation, and maintenance instructions for the fan..

E. CLOSEOUT SUBMITTALS

1. Maintenance data for fans, for inclusion in Operating and Maintenance Manuals.
    a. Data shall include detailed instructions for bearing maintenance, including lubration intervals, lubricant type, and procedures.

F. QUALITY ASSURANCE

1. The fan assembly, as a system, shall be Nationally Recognized Testing Laboratory (NRTL)-certified and built pursuant to the guidelines set forth by UL standard 507.
2. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
3. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code".
4. UL Standards:
    a. UL 1004-1. Standard for Safety for Rotating Electrical Machines - Part 1 General Requirements.
    b. UL 1004-3. Standard for Safety for Thermally Protected Motors.
    c. UL 1004-7. Standard for Safety for Electronically Protected Motors.

G. DELIVERY, STORAGE, AND HANDLING

1. Lift and support units with the manufacturer's designated lifting or supporting points.
2. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
3. The fan and its components must be stored in a safe, dry location until installation.

H. SEQUENCING, SCHEDULING, AND COORDINATION

1. Coordinate the size and location of structural steel support and framing members.
2. Coordinate fan motor size, starter type, local disconnecting means, voltage, and phase with the Electrical Contractor.

I. WARRANTY

1. The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the manufacturer's commercial warranty for dry installation conditions.
    a. Provide a 3 year minimum warranty.

PART 2 - PRODUCTS

1. MANUFACTURERS
    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

        (1) High Volume Low Speed (HVLS) Propeller Circulation Fans:
            (a) Basis of Design : Model I6 by Delta T LLC, dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575. Phone (877) 244-3267. Fax (859) 233-0139. Website: www.bigassfans.com
            (b) Or equal approved by the Architect

2. HIGH VOLUME LOW SPEED (HVLS) PROPELLER CIRCULATION FANS
    a. Complete Unit
        (1) Regulatory Requirements: The fan assembly, as a system, shall be NRTL-certified and built pursuant to relevant safety standards as described above.
        (2) Sustainability Characteristics: The fan shall possess the ENERGY STAR® Most Efficient 2021 designation.
        (3) Quality: The fan shall display good workmanship in all aspects of its construction. Field balancing of the airfoils shall not be necessary.
        (4) Colors: Airfoil colors may be selected by the architect or owner as described in 2.2.C, "Airfoils."
        (5) Optional Accessories
            (a) An LED light may be selected at the time of order.
            (b) A 0–10 V module may be selected at the time of order. The module shall enable the fan to be integrated with a home or building automation

system or a third-party 0–10 V dimmer using an industry-standard protocol.

b. Mounting System
   (1) The universal mount shall be suitable for flat or sloped ceilings with heights ranging from 9–18 ft (2.7–5.5 m).
   (2) The fan shall be equipped with a mounting bracket, wiring cover and trim, downrod assembly, motor cover, and motor unit.
   (3) The fan shall be available with a diameter of 60” (1.5 m), 72” (1.8 m), 84” (2.1 m), or 96” (2.4 m).
   (4) The fan shall include one (1) downrod. The length of the downrod may be selected at the time of order.
      (a) Provide a 60” long down-rod in the Fitness Room, and 36” long down-rod in the Multipurpose Training Room.
   (5) The General Contractor shall provide supplemental steel plates anchored to steel beams to compensate for steel beam anchor and size of factory mounting kit. Coordinate mounting kit and port holes in supplemental plates that may be necessary for connection of electrical and control wiring into fan mortar assembly.
      (a) Review proposed mounting connection with Architect prior to installation.

c. Airfoils:
   (1) The fan shall be equipped with six airfoils spanning a total diameter of 72 inches.
   (2) Airfoils shall be made of aircraft-grade aluminum.
   (3) Airfoils shall be available in Black, White, Silver, Oil-Rubbed Bronze, or Driftwood. Color to be selected up shop drawing review.
   (4) Airfoils shall be suitable for indoor and covered outdoor spaces.

d. Motor
   (1) The fan shall have an electronically commutated motor (ECM) rated for 100–277 VAC, single phase.
   (2) The motor shall draw 41.6–73.3 watts depending on the speed at which the fan is operated and if a light is installed.
   (3) The fan shall be designed for continuous operation in ambient temperatures of 32–104°F (0–40°C) and a humidity range of 20–90% (non-condensing).
   (4) The fan’s motor unit and motor unit trim shall be available in a Black, White, Silver, or Oil-Rubbed Bronze finish. Color to be selected up shop drawing review.

e. Safety Cable:
   (1) The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 2.4 mm in diameter and fabricated of aircraft stainless steel.
   (2) Field construction of safety cables is not permitted.

f. Controls: Remote, wall-mounted NEMA 1 or 4X-rated interface control station with an LCD touchscreen or LED indicators with pushbuttons to control fan on-off, direction of rotation, and rotational speed.

(1) Communications between the control station and the VFD may be wireless or wired. If wired, provide all required control wiring.

g. LED Light
   (1) The fan shall be equipped with an LED ligh.
   (2) The LED light kit shall include an LED light module with a diffused translucent lens.
   (3) The LED light shall use a twist lock mechanism to attach to the bottom of the fan for downward-directed lighting.
   (4) The LED light shall allow the user to adjust the color temperature to 2700 K or 4000 K.
   (5) The LED light shall have a standard lumen option of 1,770 lumens and shall be capable of dimming down to 1%.

h. 0–10 V Module
   (1) The fan shall be equipped with a 0–10 V module.
   (2) The module shall be installed in the fan's heatsink.
   (3) The module shall provide independent control of fan speed and light intensity.
   (4) The module shall be compatible with any 0–10 V sinking/sourcing dimmer and with most home or building automation systems.

i. Wall Control
   (1) The fan shall be equipped with a Bluetooth wall control for each individual fan in this project.
   (2) The wall control shall allow intuitive operation of the fan speed and light brightness in the following modes:
      (a) Fan speeds 0 (Off) through 7 (High)
      (b) Auto Mode
      (c) Light brightness 0–100%
   (3) The wall control shall be 1.77" wide x 4.25" tall x 1.69" thick (45 mm wide x 108 mm tall x 43 mm thick).
   (4) The wall control shall be made from durable polycarbonate and shall feature backlight illumination and a white finish.
   (5) The wall control shall have an operating voltage of 100–277 VAC, 1Φ, 50/60 Hz and shall draw < 0.2 W.
   (6) The wall control shall provide control of up to four fans.
   (7) The wall control shall install to a wall junction box using standard AC wiring and shall require a dedicated circuit.

PART 3 - EXECUTION

1. EXAMINATION
   a. Examine areas and conditions for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
   b. Do not proceed until unsatisfactory conditions have been corrected.
2. INSTALLATION, GENERAL
   a. Install fans level and plumb, in accordance with manufacturer's written instructions.
   b. Install unit to permit access for maintenance.

c. Install parts and accessories shipped loose.

d. The fan location must have an appropriate ceiling-mounted outlet box marked "Acceptable for Fan Support" of 70 lb (31.8 kg) or less. If there is not an appropriate outlet box already installed at the location, one must be installed on a ceiling joist or beam and be properly wired. Additional mounting options may be available. Consult the installation guide for additional details.

e. The fan location must be free from obstacles such as lights, cables, or other building components.

f. Check the fan location for proper electrical requirements.

3. CONNECTIONS

   a. Connect wiring and ground equipment according to applicable Division 26 provisions.

4. ADJUSTING AND CLEANING

   a. Clean unit interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

5. FIELD QUALITY CONTROL

   a. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

      (1) Remove shipping blocking and bracing.

      (2) Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.

      (3) Perform cleaning and adjusting specified in this Section.

   b. Starting procedures for fans:

      (1) Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

      (2) Measure and record motor electrical values for voltage and amperage.

6. DEMONSTRATION

   a. Demonstration Services: Train Owner's maintenance personnel on the following:

      (1) Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.

      (2) Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 11 31 00

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes requirements for the provision of roller shades and shade operators.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

C. Provide Roller Shades at exterior glazed openings, including exit door of the Fitness Gym.

1.3. SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Shade mounting assembly and attachment.
2. Size and location of access to shade operator and adjustable components.
3. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
2. For the following products:
    a. Shade Material: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.
    b. Valance: Full-size unit, not less than 12 inches (300 mm) long.

F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

G. Product Certificates: For each type of roller shade, signed by product manufacturer.

H. Qualification Data: For Installer.

I. Product Test Reports: For each type of roller shade.

J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Product Standard: Provide roller shades complying with WCMA A 100.1.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6. PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed, but not fewer than two units.

PART 2 - PRODUCTS

2.1. ROLLER SHADES GENERAL

A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper, Inc.; Clutch-Operated NEXD with SheerWeave® -BASIC 3% openness by *Phifer* or a comparable product by one of the following:

1. Hunter Douglas, Inc.
2. Mechoshade Systems, Inc.
3. or approved equal.

B. Shade Band Material: Vinyl coated polyester, flame retardant, woven into a 2 x 2 basketweave

1. Fabric Width: per width of glazed opening
2. Fabric Thickness: 0.036 inches average
3. Fabric Weight: 19.20 ounces per square yard.
4. Pattern: As selected by Architect from manufacturer's full range.
5. Colors: As selected by Architect from manufacturer's full range
6. Material Openness Factor: 3 percent.
7. Bottom Hem: Straight.
8. Trim: As indicated by manufacturer's designation for style and color.
9. Fabric Certifications: Must be Greenguard Certified with Microban Protection

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method] for attaching shade material. Provide capacity for three roller shade band(s) per roller, unless otherwise indicated on Drawings.

D. Direction of Roll: Regular, from back of roller.

E. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.

F. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

G. Mounting: Inside mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

H. Side Channels: Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.

I. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.

1. Position of Clutch Operator: Left side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.
2. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
3. Lift-Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
4. Loop Length: Full length of roller shade.
5. Bead Chain: Nickel-plated metal.
6. Cord Tensioner Mounting: Wall.
7. Operating Function: Stop and hold shade at any position in ascending or descending travel.

2.2. ROLLER SHADES FOR DOORS WITH HALF OR FULL VISION PANELS

A. Provide with Slim Fit/Smaller Coil Housing Roller Shades at Door Vision Panels and within Office Areas Typical where obcure/privacy glass is not specified.

1. Provide by same manufacturer as for interior and exterior windows/glazed openings or other manufacturer acceptable by Architect with same quality fabric and color as used for Interior and Exterior glazed openings.
2. Exclude from Doors with Narrow Lite Vision Panels.

2.3. ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

3.3. ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4. CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensures that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section “Project Closeout."

END OF SECTION 12 24 13

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1. SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

B. PERFORMANCE REQUIREMENTS

1. Retain first paragraph below if Contractor is required to assume responsibility for design.
2. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
3. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **ASCE/SEI 7**
    a. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
    b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. ACTION SUBMITTALS

1. Product Data: For each type of product indicated.
2. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
    a. Revise list below to suit Project.
    b. Trapeze pipe hangers.
    c. Equipment supports.
3. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1. METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of **copper-coated steel**

2.2. TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3. THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: [**ASTM C 552, Type II cellular glass**

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4. FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, **zinc-coated** steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5. EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6. MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

PART 3 - EXECUTION

3.1. HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment support in first paragraph below requires calculating and detailing at each use.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.
    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
3. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2. EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3. METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for **trapeze pipe hangers and equipment supports**.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

D. ADJUSTING

1. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
2. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches**

E. PAINTING

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

3.4. HANGER AND SUPPORT SCHEDULE

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

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

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel [**pipe hangers and supports**] [**and**] [**metal trapeze pipe hangers**] and attachments for general service applications.

F. Use copper-plated pipe hangers and **copper** attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes requiring clamp flexibility and up to 4 inches of insulation.
3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes
4. Single-Pipe Rolls (MSS Type 41): For suspension of pipes, from two rods if longitudinal movement caused by expansion and contraction might occur.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb
    b. Medium (MSS Type 32): 1500 lb
    c. Heavy (MSS Type 33): 3000 lb

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
10. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    a. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
    b. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
    c. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

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

N. Use **powder-actuated fasteners or mechanical-expansion anchors** instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Open-spring isolators.
2. Housed-spring isolators.
3. Restrained-spring isolators.
4. Housed-restrained-spring isolators.
5. Resilient pipe guides.
6. Air-spring isolators.
7. Spring hangers.
8. Vibration isolation equipment bases.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-spring mounts and restrained-air-spring mounts to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

2.2 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

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

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Kinetics Noise Control, Inc.
   d. Mason Industries, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Isolation.
   g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

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

1. California Dynamics Corporation.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Isolation.
6. Vibration Mountings & Controls, Inc.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices 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.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

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

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.

e. Craftmark Pipe Markers.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Seton Identification Products.

2. Material and Thickness: 0.025-inch aluminum, 0.032-inch or anodized aluminum minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

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

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. LEM Products Inc.
8. Marking Sevices Inc.
9. National Marker Company.
10. Seton Identification Products.
11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: White.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 DUCT LABELS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.

4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Sevices Inc.
10. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: White .

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.4 STENCILS

A. Stencils for Piping:

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

a. Brimar Industries, Inc.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. Marking Sevices Inc.

2. Lettering Size: Size letters according to ASME A13.1 for piping At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Aluminum Brass

4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

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

    a. Brimar Industries, Inc.
    b. Carlton Industries, LP.
    c. Champion America.
    d. Craftmark Pipe Markers.
    e. Kolbi Pipe Marker Co.
    f. Marking Sevices Inc.
2. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Aluminum Brass Fiberboard Fiberboard or metal <Insert material>.
4. Stencil Paint: Exterior, gloss, alkyd enamel acrylic enamel <Insert paint type>. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel acrylic enamel <Insert paint type>. Paint may be in pressurized spray-can form.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

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

    a. Brimar Industries, Inc.
    b. Carlton Industries, LP.
    c. Champion America.
    d. Craftmark Pipe Markers.
    e. Kolbi Pipe Marker Co.
    f. Marking Sevices Inc.
2. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Aluminum .
4. Stencil Paint: Exterior, gloss, alkyd enamel . Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

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

1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark Pipe Markers.

7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Sevices Inc.
11. Seton Identification Products.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark Pipe Markers.
6. emedco.
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Sevices Inc.
10. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum Approximately 4 by 7 inches <Insert size>.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in " Section 099600 "High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.5 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue : For cold-air supply ducts.
2. Yellow : For hot-air supply ducts.
3. Green : For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

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

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.
f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

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

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems: Constant-volume air systems.
2. Duct leakage tests.
3. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following available TAB specialists that may be engaged include, but are not limited to, the following:

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) and metric (SI) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Construction Manager commissioning authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor

amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.8 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.9 TOLERANCES

A. Set HVAC system's airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent .
2. Air Outlets and Inlets: Plus or minus 10 percent .

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly biweekly monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.

3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. VAVboxes
4. Balancing stations.
5. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit & Air-Rotation Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Cooling-coil static-pressure differential in inches wg.
g. Heating-coil static-pressure differential in inches wg.
h. Outdoor airflow in cfm.
i. Return airflow in cfm.
j. Outdoor-air damper position.
k. Return-air damper position.
l. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.

j. Refrigerant suction temperature in deg F.

G. Gas- Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.

H. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in VAV boxes, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in KW/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.

i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.12 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect Owner Construction Manager commissioning authority.

B. Architect Owner Construction Manager Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either

10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner design professional Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Outdoor, exposed supply and return.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

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

a. Aeroflex USA, Inc.
b. Armacell LLC.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I Type II with factory-applied vinyl jacket Type III with factory-applied FSK jacket Type III with factory-applied FSP jacket . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket with factory-applied ASJ with factory-applied FSK jacket . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Armacell LLC.

2.2 ADHESIVES

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

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

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

    a. Dow Corning Corporation.
    b. Johns Manville; a Berkshire Hathaway company.
    c. P.I.C. Plastics, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

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

    a. Foster Brand; H. B. Fuller Construction Products.
    b. Knauf Insulation.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 permat 43-mildry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg FSolids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 permt 35-milry film thickness.
3. Service Temperature Range: 0 to 180 deg F
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 permt 30-milry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg FSolids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Knauf Insulation.
    e. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 permst 0.0625-inchry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg FColor: White.

2.5 SEALANTS

A. FSK Flashing Sealants:

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

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg FColor: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg FColor: White.
4. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

5. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   3. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   4. Vinyl Jacket: White vinyl with a permeance of 1.3 permshen tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. in a Leno weave, for ducts.

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Foster Brand; H. B. Fuller Construction Products.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

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

      a. Johns Manville; a Berkshire Hathaway company.
      b. P.I.C. Plastics, Inc.
      c. Proto Corporation.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White Color-code jackets based on system. Color as selected by Architect .

D. Self-Adhesive Outdoor Jacket: 60-mil-ick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with white stucco-embossed aluminum-foil facing.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Compac Corporation.
    c. Ideal Tape Co., Inc,; an American Biltrite company.
    d. Knauf Insulation.
2. Width: 3 inches
3. Thickness: 11.5 mils
4. Adhesion: 90 ounces force/inchin width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inchin width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

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

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Compac Corporation.
    c. Ideal Tape Co., Inc,; an American Biltrite company.
    d. Knauf Insulation.
2. Width: 3 inches
3. Thickness: 6.5 mils
4. Adhesion: 90 ounces force/inchin width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inchin width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

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

    a. Compac Corporation.
    b. Ideal Tape Co., Inc,; an American Biltrite company.
2. Width: 2 inches
3. Thickness: 6 mils
4. Adhesion: 64 ounces force/inchin width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inchin width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches
2. Thickness: 3.7 mils
3. Adhesion: 100 ounces force/inchin width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inchin width.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316 ; 0.015 inchthick, 1/2 inch 3/4 inch wide with wing seal or closed seal .
3. Aluminum: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inchthick, 1/2 inch 3/4 inch wide with wing seal or closed seal .
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-0.135-inch-ameter shank, length to suit depth of insulation indicated.

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

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-0.135-inch-ameter shank, length to suit depth of insulation indicated with integral 1-1/2-inchgalvanized carbon-steel washer.

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

1) AGM Industries, Inc.
2) CL WARD & Family Inc.
3) Gemco.
4) Hardcast, Inc.
5) Midwest Fasteners, Inc.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

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

        1) AGM Industries, Inc.
        2) Gemco.

    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inchthick by 2 inchessquare.
    c. Spindle: Copper- or zinc-coated, low-carbon steel Aluminum Stainless steel , fully annealed, 0.106-inch-ameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) Gemco.

    b. Baseplate: Perforated, nylon sheet, 0.030 inchthick by 1-1/2 inchesin diameter.
    c. Spindle: Nylon, 0.106-inch-ameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

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

        1) AGM Industries, Inc.
        2) Gemco.
        3) Hardcast, Inc.

    b. Baseplate: Galvanized carbon-steel sheet, 0.030 inchthick by 2 inchessquare.
    c. Spindle: Copper- or zinc-coated, low-carbon steel Aluminum Stainless steel , fully annealed, 0.106-inch-ameter shank, length to suit depth of insulation indicated.
    d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-ick, galvanized-steel aluminum stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inchesin diameter.

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

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-ick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inchesin diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Gemco.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-de, stainless steel or Monel.

D. Wire: 0.080-inchnickel-copper alloy 0.062-inchsoft-annealed, stainless steel 0.062-inchsoft-annealed, galvanized steel .

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

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

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-de strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 incheso.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches

1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches place pins 16 inches o.c. each way, and 3 inche smaximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inchoutward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg Fat 18-footintervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-de strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 50 <Insert number> percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inchoutward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg Fat 18-footintervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches

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

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inchoverlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-ick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inchlaps at longitudinal seams and 3-inch-de joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inchoverlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inchoverlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed oven and ware wash exhaust.
6. Indoor, exposed oven and ware wash exhaust.
7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
9. Outdoor, concealed supply and return.
10. Outdoor, exposed supply and return.
11. Items not insulated
12. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
13. Factory-insulated flexible ducts.
14. Factory-insulated plenums and casings.
15. Flexible connectors.
16. Vibration-control devices.
17. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches and 0.75-lb/cu. ft. nominal density.

C. Round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches and 0.75-lb/cu. ft. nominal density.

D. Concealed, rectangular, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches and 1.5-lb/cu. ft. nominal density.

E. Concealed, rectangular, return-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

F. Concealed, rectangular, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches and 0.75-lb/cu. ft. 1.5-lb/cu. ft. nominal density.

G. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
   1. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. . nominal density.

H. Concealed, return-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. 3nominal density.

I. Concealed, outdoor-air plenum insulation shall be the following:

   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

J. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Board: 2 inches thick and 1.5-lb/cu. Ft nominal density.

K. Exposed, round and flat-oval, return-air duct insulation shall be the following:
   1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

L. Exposed, rectangular, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Board: 2 inches thick and 1.5-lb/cu. ft. nominal density.

M. Exposed, rectangular, return-air duct insulation shall be the following:
   1. Mineral-Fiber Board: 1-1/2 inches thick and. 1.5-lb/cu. ft. nominal density.

N. Exposed, rectangular, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Board: 2 inches thick and 1.5-lb/cu. ft. nominal density.

O. Exposed, supply-air plenum insulation shall be the following:
   1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

P. Exposed, return-air plenum insulation shall be the following:
   1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. Ft.nominal density.

Q. Exposed, outdoor-air plenum insulation shall be the following:

   1. Mineral-Fiber Board: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

3.13 OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 3 inches and 3-lb/cu. ft. nominal density.

C. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Board: 3 inches and 3-lb/cu. ft. nominal density.

D. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 3 inches and 3-lb/cu. ft. nominal density.

E. Exposed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches 3 inches and 3-lb/cu. ft. nominal density.

F. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 3 inches thick 6-lb/cu. ft. nominal density.

G. Exposed, return-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 3 inches thick 6-lb/cu. ft. nominal density.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Exposed:
1. PVC, Color-Coded by System: 20 mils 30 mils thick.

END OF SECTION 23 07 13

SECTION 23 23 00 – REFRIGERANT PIPING

PART 1 - GENERAL

1.1 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) Refrigerant pipes and fittings.
   (2) Refrigerant piping valves and specialties.
   (3) Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty.
   (4) Include pressure drop, based on manufacturer's test data, for the following:
      a. Thermostatic expansion valves.
      b. Solenoid valves.
      c. Filter dryers.
      d. Strainers.
      e. Pressure-regulating valves.

B. Shop Drawings:
   (5) Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
   (6) Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
   (7) Show interface and spatial relationships between piping and equipment.
   (8) Shop Drawing Scale: 1/4 inch equals 1 foot

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410a:
(9) Suction Lines for Air-Conditioning Applications: 230 psig -Gas and Liquid Lines: 380 psigLine Test Pressure for Refrigerant R-410A:
(10) Suction Lines for Air-Conditioning Applications: 300 psig Suction Lines for Heat-Pump Applications: 535 psig Hot-Gas and Liquid Lines: 535 psig Coordinate first two articles below with piping application articles in Part 3. See "Writing Guide" Article in the Evaluations. Materials included in this Section are examples listed in the ASHRAE HANDBOOK - "HVAC Systems and Equipment" (Ch. 45, "Pipes, Tubes, and Fittings").

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or LSTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. Flexible Connectors:
(11) Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
(12) End Connections: Socket ends.
(13) Offset Performance: Capable of minimum 3/4-inchisalignment in minimum 7-inch- assembly.
(14) Working Pressure Rating: Factory test at minimum 500 psigMaximum Operating Temperature: 250 deg FSTEEL PIPE AND FITTINGS

G. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.

H. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

I. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

J. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

K. Flanged Unions:
(15) Body: Forged-steel flanges for NPS 1 to NPS 1-1/2nd ductile iron for NPS 2 to NPS 3Apply rust-resistant finish at factory.
(16) Gasket: Fiber asbestos free.
(17) Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
(18) End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
(19) Offset Performance: Capable of minimum 3/4-inchisalignment in minimum 7-inch- assembly.
(20) Pressure Rating: Factory test at minimum 400 psigMaximum Operating Temperature: 330 deg FFlexible Connectors:
(21) Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket.
(22) End Connections:
a. NPS 2nd Smaller: With threaded-end connections.
b. NPS 2-1/2nd Larger: With flanged-end connections.
(23) Offset Performance: Capable of minimum 3/4-inchisalignment in minimum 7-inch- assembly.
(24) Pressure Rating: Factory test at minimum 500 psigMaximum Operating Temperature: 250 deg FVALVES AND SPECIALTIES

L. Diaphragm Packless Valves:
(25) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Danfoss Inc.
b. Heldon Products; Henry Technologies.
c. Parker Hannifin Corp.
d. Paul Mueller Company.
(26) Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
(27) Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
(28) Operator: Rising stem and hand wheel.
(29) Seat: Nylon.
(30) End Connections: Socket, union, or flanged.
(31) Working Pressure Rating: 500 psigMaximum Operating Temperature: 275 deg FPacked-Angle Valves:
(32) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
e. Danfoss Inc.
f. Heldon Products; Henry Technologies.
g. Parker Hannifin Corp.
h. Paul Mueller Company.
(33) Body and Bonnet: Forged brass or cast bronze.
(34) Packing: Molded stem, back seating, and replaceable under pressure.
(35) Operator: Rising stem.
(36) Seat: Nonrotating, self-aligning polytetrafluoroethylene.
(37) Seal Cap: Forged-brass or valox hex cap.

(38) End Connections: Socket, union, threaded, or flanged.
(39) Working Pressure Rating: 500 psigMaximum Operating Temperature: 275 deg FCheck Valves:
(40) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  i. Danfoss Inc.
  j. Emerson Climate Technologies.
  k. Heldon Products; Henry Technologies.
  l. Parker Hannifin Corp.
  m. Paul Mueller Company.
(41) Body: Ductile iron, forged brass, or cast bronze; globe pattern.
(42) Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
(43) Piston: Removable polytetrafluoroethylene seat.
(44) Closing Spring: Stainless steel.
(45) Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
(46) End Connections: Socket, union, threaded, or flanged.
(47) Maximum Opening Pressure: 0.50 psigWorking Pressure Rating: 500 psigMaximum Operating Temperature: 275 deg FService Valves:
(48) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  n. Danfoss Inc.
  o. Emerson Climate Technologies.
  p. Heldon Products; Henry Technologies.
  q. Parker Hannifin Corp.
  r. Paul Mueller Company.
  s. Refrigeration Sales, Inc.
(49) Body: Forged brass with brass cap including key end to remove core.
(50) Core: Removable ball-type check valve with stainless-steel spring.
(51) Seat: Polytetrafluoroethylene.
(52) End Connections: Copper spring.
(53) Working Pressure Rating: 500 psig

2.3 SOLENOID VALVES: COMPLY WITH AHRI 760 AND UL 429; LISTED AND LABELED BY A NATIONAL RECOGNIZED TESTING LABORATORY (NRTL).

(54) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  a. Danfoss Inc.
  b. Emerson Climate Technologies.
  c. Heldon Products; Henry Technologies.
  d. Parker Hannifin Corp.
  e. Paul Mueller Company.
(55) Body and Bonnet: Plated steel.
(56) Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
(57) Seat: Polytetrafluoroethylene.
(58) End Connections: Threaded.

(59) Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inchonduit adapter, and 24 115 208-V ac coil.
(60) Working Pressure Rating: 400 psigMaximum Operating Temperature: 240 deg FRetain "Safety Relief Valves" Paragraph below for optional manual opening feature.

B. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
(61) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Danfoss Inc.
b. Heldon Products; Henry Technologies.
c. Parker Hannifin Corp.
d. Paul Mueller Company.
(62) Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
(63) Piston, Closing Spring, and Seat Insert: Stainless steel.
(64) Seat: Polytetrafluoroethylene.
(65) End Connections: Threaded.
(66) Working Pressure Rating: 400 psigMaximum Operating Temperature: 240 deg FThermostatic Expansion Valves: Comply with AHRI 750.
(67) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
e. Danfoss Inc.
f. Emerson Climate Technologies.
g. Heldon Products; Henry Technologies.
h. Paul Mueller Company.
(68) Body, Bonnet, and Seal Cap: Forged brass or steel.
(69) Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
(70) Packing and Gaskets: Non-asbestos.
(71) Capillary and Bulb: Copper tubing filled with refrigerant charge.
(72) Suction Temperature: 40 deg F
(73) Superheat: Adjustable Nonadjustable.
(74) Reverse-flow option (for heat-pump applications).
(75) End Connections: Socket, flare, or threaded union.
(76) Working Pressure Rating: 700 psig 450 psig

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install diaphragm packless packed-angle valves on inlet and outlet side of filter dryers.

D. Install a full-size, three-valve bypass around filter dryers.

E. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

F. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   (77) Install valve so diaphragm case is warmer than bulb.
   (78) Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   (79) If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

G. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

I. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
   (80) Solenoid valves.
   (81) Thermostatic expansion valves.
   (82) Hot-gas bypass valves.
   (83) Compressor.

J. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

K. Install receivers sized to accommodate pump-down charge.

L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:
   (84) Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   (85) Install horizontal suction lines with a uniform slope downward to compressor.
   (86) Install traps and double risers to entrain oil in vertical runs.
   (87) Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
   (88) Shot blast the interior of piping.
   (89) Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
   (90) Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   (91) Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   (92) Finally, draw a clean, dry, lintless cloth through the tube or pipe.
   (93) Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
(94) Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.

E. Welded Joints: Construct joints according to AWS D10.12M/D10.12.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
(95) Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
(96) Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
(97) Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
(98) Spring hangers to support vertical runs.
(99) Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters : Verify actual supported loads for hanger sizes and spacing. Consult structural engineer. Spacing and sizes in subparagraphs below are from the ASHRAE HANDBOOK – “HVAC Systems and Equipment.”
(100) NPS 3/8: Maximum span, 48 inches ; minimum rod, 1/4 inch.
(101) NPS 1/2: Maximum span, 60 inches ; minimum rod, 1/4 inch.
(102) NPS 5/8: Maximum span, 60 inches ; minimum rod, 1/4 inch.
(103) NPS 1: Maximum span, 72 inches ; minimum rod, 1/4 inch.
(104) NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch .
(105) NPS 1-1/2: Maximum span, 96 inches ; minimum rod, 3/8 inch .

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
(106) Comply with ASME B31.5, Chapter VI.

(107) Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
(108) Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:
(109) Install core in filter dryers after leak test but before evacuation.
(110) Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
(111) Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
(112) Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
(113) Open shutoff valves in condenser water circuit.
(114) Verify that compressor oil level is correct.
(115) Open compressor suction and discharge valves.
(116) Open refrigerant valves except bypass valves that are used for other purposes.
(117) Check open compressor-motor alignment and verify lubrication for motors and bearings.

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

END OF SECTION 23 23 00

SECTION 23 31 13 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

a. Ductmate Industries, Inc.
b. Lindab Inc.
c. McGill AirFlow LLC.
d. MKT Metal Manufacturing, Inc.
e. SEMCO Incorporated.

f. Sheet Metal Connectors, Inc.
g. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. All ductwork to be paintable refer to arch specifications

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 G90.
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches 4 inches 6 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger

Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

B. All ductwork in finished spaces to be prepped for painting

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

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

D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive 2-inch wg .
    b. Minimum SMACNA Seal Class: A .
    c. SMACNA Leakage Class for Rectangular: 6 .
    d. SMACNA Leakage Class for Round and Flat Oval: 6 12 24 .

2. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive 2-inch wg .
    b. Minimum SMACNA Seal Class: A B.
    c. SMACNA Leakage Class for Rectangular: 3 6 12 .
    d. SMACNA Leakage Class for Round and Flat Oval: 3 6 12 .

B. Return Ducts:

1. Ducts Connected to Air-Handling Units

    a. Pressure Class: negative 1-inch wg .
    b. Minimum SMACNA Seal Class: A .
    c. SMACNA Leakage Class for Rectangular: 6 .
    d. SMACNA Leakage Class for Round and Flat Oval: 6 .

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel Carbon steel coated with zinc-chromate primer Galvanized steel or carbon steel coated with zinc-chromate primer.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Velocity 1000 fpm or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

    b. Velocity 1000 to 1500 fpm:
        1) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

    c. Velocity 1500 fpm or Higher:
        1) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    a. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Flange connectors.
7. Duct silencers.
8. Turning vanes.
9. Remote damper operators.
10. Duct-mounted access doors.
11. Flexible connectors.
12. Flexible ducts.
13. Duct security bars.
14. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper,ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
2. NCA Manufacturing, Inc.
3. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1250 fpm

D. Maximum System Pressure: 3-inch wg

E. Frame: Hat-shaped, 0.094-inch-hick, galvanized sheet steel with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, off-center pivoted, end pivoted, maximum 6-inchwidth, 0.025-inch-thick, roll-formed aluminum 0.050-inch-thick aluminum sheet noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel/Stainless steel.
2. Diameter: 0.20 inch

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gageminimum.
    b. Sleeve Length: 6 inchesminimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel.

8. Screen Type: Bird.
9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. NCA Manufacturing, Inc.
   3. Ruskin Company.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm

D. Maximum System Pressure: 3-inch wg

E. Frame: Hat-shaped, 0.094-inch-hick, galvanized sheet steel with welded corners or mechanically attached and mounting flange.

F. Blades:

   1. Multiple, 0.025-inch-ick, roll-formed aluminum.
   2. Maximum Width: 6 inches.
   3. Action: Parallel.
   4. Balance: Gravity.
   5. Eccentrically pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Stainless steel.

I. Tie Bars and Brackets:

   1. Material: Galvanized steel.
   2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Stainless steel.

L. Accessories:

   1. Flange on intake.
   2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

a. Greenheck Ruskin Company
b. NCA Manufacturing, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped, 0.094-inch-hick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Stainless-steel, 0.064 inchthick.

6. Blade Axles: Stainless steel.
7. Bearings:

    a. Oil-impregnated stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Greenheck Ruskin Company
    b. NCA Manufacturing, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch-hick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch-hick extruded aluminum.

6. Blade Axles: Stainless steel
7. Bearings:

    a. Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Greemheck Ruskin Company
   b. NCA Manufacturimg, Inc.
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:

   a. Hat shaped.
   b. 0.094-inch-hick, galvanized sheet steel
   c. Mitered and welded corners.
   d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064 inch thick.

7. Blade Axles: Stainless steel.
8. Bearings:

   a. Oil-impregnated stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered stainless steel.
11. Tie Bars and Brackets: Galvanized steel.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Greenheck Ruskin Company
   b. NCA Manufacturing, Inc.
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Roll-Formed Aluminum Blades: 0.10-inch-hick aluminum sheet.
d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Blade Axles: Stainless steel.
8. Bearings:

a. Oil-impregnated stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered stainless steel.
11. Tie Bars and Brackets: Galvanized steel.
12. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inchdiameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-hick zinc-plated steel, and a 3/4-inchhexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Coorporation.
2. NCA Manufacturing, Inc.
3. Ruskin Company

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. 0.094-inch-hick, galvanized sheet steel
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches
2. Parallel- and opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: PVC.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-iameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F

F. Bearings:

1. Oil-impregnated stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Coorporation
2. NCA Manufacturing, Inc.
3. Ruskin Company
4. Vent Products Co., Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wgstatic pressure class and minimum 2000-fpmvelocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream Multiple-blade type fabricated with roll-formed, 0.034-inch-hick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch-hick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-hick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg Frated, fusible links.

K. Heat-Responsive Device: Electric, resettable link and switch package, factory installed, 165 deg Frated.

2.8 FLANGE CONNECTORS

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

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Hardcast, Inc.
4. Nexus PDQ.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.9 DUCT SILENCERS

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

1. Dynasonics.
2. Ruskin Company.
3. Emprice
4. IAC

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 G60, galvanized sheet steel, 0.034 inch 0.040 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90 G60, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inchthick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 G60 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch-diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss to achieve STC 45.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative Film-lined type with fill material.

    a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
    b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints: Lock formed and sealed continuously welded or flanged connections.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:

1. Integral 1-1/2 3-hour fire damper with access door. Access door to be high transmission loss to match silencer.
2. Factory-installed end caps to prevent contamination during shipping.
3. Removable splitters.
4. Airflow measuring devices.

L. Source Quality Control: Test according to ASTM E 477.

1. Testing of mockups to be witnessed by Architect Owner.
2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

M. Capacities and Characteristics:

1. Configuration: Straight 90-degree elbow.
2. Shape: Rectangular.
3. Attenuation Mechanism: Acoustical glass fiber with protective film liner.
4. Maximum Pressure Drop: 0.35-inch wg
5. Casing:

    a. Attenuation: Standard
    b. Outer Material: Galvanized steel
    c. Inner Material: Galvanized steel

6. End Connection: 1-inchslip joint Flange.

2.10 TURNING VANES

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

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Duro Dyne Inc.
5. Elgen Manufacturing.
6. Hardcast, Inc.
7. METALAIRE, Inc.
8. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

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

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 incheswide and double wall for larger dimensions.

2.11 DUCT-MOUNTED ACCESS DOORS

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

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a divsion of MESTEK, Inc.
4. CL WARD & Family Inc.

5. Ductmate Industries, Inc.
6. Elgen Manufacturing.
7. Flexmaster U.S.A., Inc.
8. Greenheck Fan Corporation.
9. McGill AirFlow LLC.
10. Nailor Industries Inc.
11. Pottorff.
12. Ventfabrics, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 InchesSquare: No hinges and two sash locks.
    b. Access Doors up to 18 InchesSquare: Continuous and two sash locks.
    c. Access Doors up to 24 by 48 InchesContinuous and two compression latches with outside and inside handles.
    d. Access Doors Larger Than 24 by 48 InchesContinuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch-hick, fibrous-glass or polystyrene-foam board.

2.12 DUCT ACCESS PANEL ASSEMBLIES

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

1. 3M.
2. Ductmate Industries, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inchcarbon.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F

F. Minimum Pressure Rating: 10-inch wg positive or negative.

2.13 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Hardcast, Inc.
5. JP Lamborn Co.
6. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches 5-3/4 inches wide attached to two strips of 2-3/4-inch-de, 0.028-inch-thick, galvanized sheet. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. Tensile Strength: 480 lbf/inchin the warp and 360 lbf/inchin the filling.
2. Service Temperature: Minus 40 to plus 200 deg F

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inchin the warp and 440 lbf/inchin the filling.
3. Service Temperature: Minus 50 to plus 250 deg F

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.14 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers with flexible duct connectors.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-footspacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches
2. Two-Hand Access: 12 by 6 inches
3. Head and Hand Access: 18 by 10 inches
4. Head and Shoulders Access: 21 by 14 inches
5. Body Access: 25 by 14 inches
6. Body plus Ladder Access: 25 by 17 inches

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wgand more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply duct with maximum 12-inchlengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers or light troffer boots to ducts with maximum 60-inchlengths of flexible duct clamped or strapped in place.

Q. Connect flexible ducts to metal ducts with liquid adhesive plus tape and adhesive plus sheet metal screws.

R. Install duct test holes where required for testing and balancing purposes.

S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inchmovement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES

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. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear bar diffusers.
4. Modular core supply grilles.
5. Adjustable bar registers and grilles.
6. Fixed face registers and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

A. Rectangular and Square Ceiling Diffusers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: 24 by 24 inches
6. Face Style: Four cone.
7. Mounting: T-bar.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade.
10. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

B. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Mounting: T-bar.
6. Pattern: Two-way corner Three-way core style.
7. Dampers: Radial opposed blade.
8. Accessories:

    a. Square to round neck adaptor.

b. Adjustable pattern vanes.
c. Throw reducing vanes.
d. Equalizing grid.
e. Plaster ring.
f. Safety chain.
g. Wire guard.
h. Sectorizing baffles.
i. Operating rod extension.

9. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
10. Material: Aluminum.
11. Finish: Baked enamel, color selected by Architect.
12. Face Blade Arrangement: Horizontal Vertical spaced 3 inches [1-1/2 inches3/4 inch 1/2 inch apart.
13. Core Construction: Removable.
14. Rear-Blade Arrangement: Horizontal Vertical spaced 3/4 inch1/2 inch apart.
15. Frame: 1-1/4 inches1 inch wide.
16. Mounting: Concealed Lay In.
17. Damper Type: Adjustable opposed blade NRTL listed, opposed blade, spring closing, and with fusible link for 160 deg F
18. Accessories:

    a. Rear-blade gang operator.
    b. Filter.

C. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal Vertical] spaced 3 inches1-1/2 inches3/4 inch [1/2 inch apart.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Horizontal Vertical spaced 3/4 inch1/2 inchapart.
7. Frame: 1-1/4 inches1 inch wide.
8. Mounting: Concealed.

D. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inchgrid core.
5. Core Construction: Removable.
6. Frame: 1-1/4 inches1 inch wide.
7. Mounting: Concealed Lay in.
8. Damper Type: Adjustable opposed blade NRTL listed, opposed blade, spring closing, and with fusible link for 160 deg F
9. Accessory: Filter.

E. Fixed Face Grille :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anemostat Products; a Mestek company.
   b. Carnes Company.
   c. Kees, Inc.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch core.
5. Core Construction: Removable.
6. Frame: 1-1/4 inches1 inch wide.
7. Mounting Frame: Filter.
8. Mounting: Concealed.
9. Accessory: Filter.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

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

END OF SECTION 23 37 13

SECTION 23 81 26 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.

3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

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

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

1.8 COORDINATION

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

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mitsubishi Electric & Electronics USA, Inc.
2. Daikin.
3. Trane.

B. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Enclosure Type: Totally enclosed, fan cooled.
    d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    f. Mount unit-mounted disconnect switches on exterior interior of unit.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:

    a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
        2) Depth: A minimum of 1 inch deep.

    b. Single-wall, galvanized -steel sheet.
    c. Double-wall, galvanized s-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
    d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end both ends of pan.

        1) Minimum Connection Size: NPS 1 .

    e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:

    a. General Requirements for Air Filtration Section:

        1) Comply with NFPA 90A.
        2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch.
3) Arrestance according to ASHRAE 52.1: 80
4) Merv according to ASHRAE 52.2: 5
5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.2 OUTDOOR UNITS

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Variable speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-407C R-410A
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to -20 deg F.
7. Mounting Base: Polyethylene.

2.3 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

4. Fan-speed selection including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

F. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install compressor-condenser components on equipment supports.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

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

END OF SECTION 23 81 26

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. Alpha Wire Company.
2. Belden Inc.
3. Cerro Wire LLC.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. General Cable; General Cable Corporation.
7. Senator Wire & Cable Company.
8. Service Wire Co.
9. Southwire Company.

B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2 Type THHN/THWN-2 Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC metal-clad cable with ground wire.

2.2 CONNECTORS AND SPLICES

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

1. 3M.
2. AFC Cable Systems, Inc.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
9. Tyco Electronics Corp.

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

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 & No. 12 AWG; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway Armored cable, Type AC Metal-clad cable, Type MC Mineral-insulated, metal-sheathed cable, Type MI Nonmetallic-sheathed cable, Type NM.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway Armored cable, Type AC Metal-clad cable.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway Underground feeder cable, Type UF.

D. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors larger than No. 1/0 AWG Armored cable, Type AC Metal-clad cable.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway Armored cable, Type AC Metal-clad cable.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Armored cable, Type AC Metal-clad cable.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway Underground branch-circuit cable, Type UF.

H. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors larger than No. 1/0 AWG Armored cable, Type AC Metal-clad cable.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

J. VFC Output Circuits: Type XHHW-2 in metal conduit Type TC-ER cable with braided shield with dual tape shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

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

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

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

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 23 – CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Multimode optical-fiber cabling.
2. UTP cabling.
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat eggshell black latex alkyd paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 OPTICAL-FIBER CABLE

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

1. 3M.
2. AMP NETCONNECT; a Tyco Electronics brand; a TE Connectivity Ltd. company.
3. Belden CDT Networking Division/NORDX.
4. Belden Inc.
5. Berk-Tek; a Nexans company.
6. CommScope, Inc.

7. Corning Cable Systems.
8. Emerson Connectivity Solutions.
9. General Cable; General Cable Corporation.
10. Mohawk; a division of Belden Networking, Inc.
11. Nexans.
12. Optical Connectivity Solutions Division.
13. Siemon.
14. Siemon Co. (The).
15. Superior Essex Inc.
16. SYSTIMAX Solutions; a CommScope Inc. brand.
17. Tyco Electronics Corporation; a TE Connectivity Ltd. company.

B. Description: Multimode, 50/125 62.5/125-micrometer, 24 -fiber, nonconductive, tight-buffer, optical-fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA-B TIA-492AAAB-A for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

    a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    b. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
    c. Plenum Rated, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
    d. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
    e. Riser Rated, Nonconductive: Type OFNR or Type OFNP, complying with UL 1666.
    f. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.
    g. Riser Rated, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
    h. General Purpose, Nonconductive: Type OFN or Type OFNG.
    i. General Purpose, Nonconductive: Type OFNR or Type OFNP.
    j. General Purpose, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in listed communications raceway.
    k. General Purpose, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
    l. Plenum Rated, Conductive: Type OFCP or Type OFNP, complying with NFPA 262.
    m. Plenum Rated, Conductive: Type OFCP, or Type OFNP in listed plenum communications raceway.
    n. Plenum Rated, Conductive: Type OFC, Type OFN, Type OFCG, Type OFNG, Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
    o. Riser Rated, Conductive: Type OFCR; or Type OFNR, Type OFCP, or Type OFNP; complying with UL 1666 and ICEA S-103-701.
    p. Riser Rated, Conductive: Type OFCP, Type OFNP, or Type OFCR or Type OFNP in listed riser or plenum communications raceway.
    q. Riser Rated, Conductive: Type OFC, Type OFN, Type OFCG, Type OFNG, Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit.

r. General Purpose, Conductive: Type OFC or Type OFCG; or Type OFC, Type OFN, Type OFCG, Type OFNG, Type OFCR, Type OFNR, Type OFCP, or Type OFNP.
s. General Purpose, Conductive: Type OFC, Type OFN, Type OFCG, Type OFNG, Type OFCP, Type OFNP, Type OFCR, or Type OFNR in listed communications raceway.
t. General Purpose, Conductive: Type OFC, Type OFN, Type OFCG, Type OFNG, Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit.

5. Conductive cable shall be steel aluminum-armored type.
6. Maximum Attenuation: 3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125 Orange for 62.5/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 UTP CABLE

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

1. 3M.
2. ADC.
3. Alpha Wire Company.
4. AMP NETCONNECT; a Tyco Electronics brand; a TE Connectivity Ltd. company.
5. Belden CDT Networking Division/NORDX.
6. Berk-Tek; a Nexans company.
7. CommScope, Inc.
8. Draka USA.
9. General Cable; General Cable Corporation.
10. Genesis Cable Products; Honeywell International, Inc.
11. KRONE Incorporated.
12. Mohawk; a division of Belden Networking, Inc.
13. Nexans.
14. Siemon.
15. Siemon Co. (The).
16. Superior Essex Inc.
17. SYSTIMAX Solutions; a CommScope Inc. brand.

B. Description: 100-ohm, four-pair UTP, 24-pair UTP, formed into four-pair binder groups with no overall jacket,, 25-pair UTP covered with a thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.
3. Comply with TIA-568-C.1 for performance specifications.
4. Comply with TIA-568-C.2, Category 5e Category 6 Category 6A.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NEMA WC 66, UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
b. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
c. Communications, Riser Rated: Type CMR complying with UL 1666 and ICEA S-103-701.
d. Communications, Riser Rated: Type CMP, or Type CMR in listed plenum or riser communications raceway.
e. Communications, Riser Rated: Type CMP or Type CMR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
f. Communications, General Purpose: Type CM or Type CMG; or Type CM, Type CMG, Type CMP, or Type CMR in listed communications raceways.
g. Communications, General Purpose: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
h. Communications, Limited Purpose: Type CMX; or Type CM, Type CMG, Type CMP, or Type CMR.

2.6 UTP CABLE HARDWARE

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

1. ADC.
2. American Technology Systems Industries, Inc.
3. AMP NETCONNECT; a Tyco Electronics brand; a TE Connectivity Ltd. company.
4. Belden CDT Networking Division/NORDX.
5. Belden Inc.
6. Corning Cable Systems.
7. Dynacom Corporation.
8. Hubbell Incorporated; Wiring Device-Kellems.
9. Hubbell Premise Wiring.
10. KRONE Incorporated.
11. Leviton Manufacturing Co., Inc.
12. Molex Premise Networks.
13. Panduit Corp.
14. Siemon Co. (The).

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e 110-style IDC for Category 6 66-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.

G. Patch Cords: Factory-made, four-pair cables in 36-inch 48-inch <Insert dimension> lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

H. Workstation Outlets: Two Four -port-connector assemblies mounted in single or multigang faceplate.

I. Faceplates:

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
2. Metal Faceplate: Stainless steel Brass , complying with requirements in Section 262726 "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of UTP, optical-fiber, and coaxial work area cords.

a. Flush-mounted jacks, positioning the cord at a 45-degree angle.

J. Legend:

1. Factory labeled by silk-screening or engraving for stainless steel brass faceplates.
2. Machine printed, in the field, using adhesive-tape label.
3. Snap-in, clear-label covers and machine-printed paper inserts.

2.7 TWIN-AXIAL DATA HIGHWAY CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, pairs, No. 20 No. 22 No. 24 AWG, stranded (7x28) (7x30) (7x32) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, pairs, No. 20 No. 22 No. 24 AWG, stranded (7x28) (7x30) (7x32) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, one pair two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One Multi-pair, twisted, No. 16 AWG, stranded (19x29) No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One Multi-pair, twisted, No. 16 AWG, stranded (19x29) No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.10 CONTROL-CIRCUIT CONDUCTORS

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

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2 Type XHHW-2, in raceway, complying with UL 44 UL 83.

C. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway Type XHHW-2, in raceway power-limited cable, concealed in building finishes power-limited tray cable, in cable tray, complying with UL 44 UL 83.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway Type XHHW-2, in raceway power-limited cable, concealed in building finishes power-limited tray cable, in cable tray Type TW or Type TF, in raceway, complying with UL 44 UL 83.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables according to TIA-568-C.2.

C. Factory test optical-fiber cables according to TIA-568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test optical-fiber cable to determine the continuity of the strand end to end. Use optical-fiber flashlight optical loss test set optical-fiber flashlight or optical loss test set <Insert test>.
2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by 1-1/2 inches 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches <Insert dimension> above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced.
5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.

7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
10. Support: Do not allow cables to lay on removable ceiling tiles.
11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. UTP Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271500 "Communications Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Optical-Fiber Cable Installation:

1. Comply with TIA-568-C.3.
2. Terminate cable on connecting hardware that is rack or cabinet mounted.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches <Insert dimension> apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical-Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for links shall be less than 2.0 dB that calculated according to equation in TIA-568-C.0.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 05 23

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
1. Ground rods.
2. Ground rings.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding 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. Instructions for periodic testing and inspection of grounding features at ground rings grounding connections for separately derived systems based on NETA MTS NFPA 70B.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

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

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad Zinc-coated Stainless steel, sectional type; 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

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

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install with new transformer and panelboard equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

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

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding

terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

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

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches <Insert dimension> from building's foundation.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. Flex-Strut Inc.
   e. GS Metals Corp.
   f. G-Strut.
   g. Haydon Corporation.
   h. Metal Ties Innovation.
   i. Thomas & Betts Corporation, A Member of the ABB Group.
   j. Unistrut; an Atkore International company.
   k. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

      1) Hilti, Inc.
      2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. To Existing Concrete: Expansion anchor fasteners.
4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi , 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033053 "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. FSR Inc.
6. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
7. Patriot Aluminum Products, LLC.
8. Picoma Industries.
9. Republic Conduit.
10. Robroy Industries.
11. Southwire Company.
12. Western Tube and Conduit Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel or aluminum.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

    a. Material: Steel or die cast.
    b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

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

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

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

a. Hubbell Incorporated; Wiring Device-Kellems.
b. MonoSystems, Inc.
c. Panduit Corp.

C. Data-Power Poles:

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

a. MonoSystems, Inc.
b. Panduit Corp.

2. Material: Galvanized steel with ivory baked-enamel finish.

3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

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

1. Adalet.
2. Cooper Technologies Company.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of Pentair Equipment Protection.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. MonoSystems, Inc.
11. Oldcastle Enclosure Solutions.
12. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
13. RACO; Hubbell.
14. Robroy Industries.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum galvanized, with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches.

K. Gangable boxes are allowed.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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

   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. NewBasis.
   d. Oldcastle Precast, Inc.
   e. Quazite: Hubbell Power Systems, Inc.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC IMC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-80-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT or ENT .
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC IMC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

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

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-footintervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, or IMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

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

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 44 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

    a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

    a. Advance Products & Systems, Inc.
    b. CALPICO, Inc.
    c. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel Plastic Stainless steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

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

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER HIGH VOLTAGE WIRING."

D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

F. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

G. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 FLOOR MARKING TAPE

A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

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

B. Color and Printing:

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

C. Tag: Type I

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft..
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

D. Tag: Type II

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 12 mils.
3. Weight: 36.1 lb/1000 sq. ft..
4. 3-Inch Tensile According to ASTM D 882: 400 lbf, and 11,500 psi.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

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

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. <Insert names and wording of warning signs or labels; e.g., arc-flash, multiple services and voltages, and others>.

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face <Insert colors>.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

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

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

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

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

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

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl Snap-around labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label self-adhesive vinyl tape applied in bands. Install labels at 10-foot 30-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

    a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:

        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-laminating polyester labels with the conductor designation.

J. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

M. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

O. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

P. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Motor-control centers.
    j. Enclosed switches.

k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery racks.
s. Power-generating units.
t. Monitoring and control equipment.
u. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 09 23 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Photoelectric switches.
   2. Standalone daylight-harvesting switching controls.
   3. Indoor occupancy sensors.
   4. Emergency shunt relays.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 OUTDOOR/INDOOR PHOTOELECTRIC SWITCHES

A. See control schedule on electrical plans.

B. Description: Solid state, with SPST DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive , to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.

5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

6. Warranty for 5 years

2.2 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. See control schedule on electrical plans.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

   a. When no daylight is present (target level).
   b. When significant daylight is present.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: 30 to 50 fc.
5. System programmed by Bluetooth app.

2.3 INDOOR OCCUPANCY SENSORS

A. See control schedule on electrical plans.

B. General Requirements for Sensors: wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
6. Bypass Switch: Override the "on" function in case of sensor failure.

C. Ceiling mounted; detect occupants in coverage area using PIR & ultrasonic detection methods.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

4. Warranty for 5 years

D. Wall mounted; detect occupants in coverage area using PIR & ultrasonic detection methods.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within 180-degree pattern of 1000 sq. ft.

4. Warranty for 5 years

2.4 EMERGENCY SHUNT RELAY

A. See control schedule on electrical plans.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with automatic switching contacts; complying with UL 924.

1. Device capable of bringing lighting fixture up to full lumen output and bypassing the local switching when normal power is lost.

2. The device uses relay switching circuitry, test switch, a normal power indicator light and an alternate power source indicator light.

3. Rated for 20 amps of lighting load and 120-277 VAC, 50/60 HZ normal and emergency circuits.

4. Warranty for 5 years

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies. Maintain at least 6’ distance between occupancy/vacancy sensors and air devices.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to program, test and inspect components, assemblies, and equipment installations, including connections.

B. Testing Agency: Engage a qualified testing agency to perform the functional testing required to comply with IECC 2018 for lighting control systems.

C. Perform the following tests and inspections :

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 24 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two day visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

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: Distribution dry-type transformers rated 600 V and less

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Controlled Power Company; an Emerson company.
2. Eaton Electrical Sector; Eaton Corporation.
3. General Electric Company.
4. Sq D
5. Siemens

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1 energy-efficiency levels as verified by testing according to NEMA TP 2.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer wall brackets fabricated from design drawings signed and sealed by a licensed structural engineer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Secure transformer to concrete base according to manufacturer's written instructions.

D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Tamper-resistant receptacles.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Communications outlets.
8. Pendant cord-connector devices.
9. Cord and plug sets.
10. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

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

a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
b. Hubbell Premise Wiring.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.4 GFCI RECEPTACLES

A. General Description:

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

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

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

a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

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

a. Hubbell Incorporated; Wiring Device-Kellems.

b. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

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

   a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

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

   a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description:

   a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
   b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

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

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

1. Single Pole:

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

      1) Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

2. Two Pole:

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

      1) Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

3. Three Way:

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

      1) Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

4. Four Way:

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

      1) Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

C. Pilot-Light Switches, 20 A:

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

    a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

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

    a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.

2.9 WALL PLATES COLOR TO BE DETERMINED BY ARCHITECT

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

2.11 FINISHES TO BE DETERMINED BY ARCHITECT

A. Device Color:

1. Wiring Devices Connected to Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pig tailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up down, and on horizontally mounted receptacles to the right left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black white red-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Panelboards.
    c. Enclosed controllers.
    d. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann; a division of Cooper Industries.
2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
3. Littelfuse, Inc.
4. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.

4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: 250-V, zero- to 1200-A 600-V, zero- to 800-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Feeders: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class RK5, fast acting Class RK5, time delay Class J, fast acting Class J, time delay.
2. Motor Branch Circuits: Class RK1 Class RK5 Class CC, motor duty, time delay.
3. Large Motor Branch (601-4000 A): Class L, time delay.

4. Power Electronics Circuits: Class J, high speed Class T, fast acting.
5. Other Branch Circuits: Class RK1, time delay Class RK5, time delay Class J, fast acting Class J, time delay Class CC, fast acting.
6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic ground-fault trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered Remote mounted and powered; 24-V ac 120-V.

2.4 MOLDED-CASE SWITCHES

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

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.

10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered Remote mounted and powered; 24-V ac 120-V.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1 .
2. Outdoor Locations: NEMA 250, Type 3R .
3. Other Wet or Damp, Indoor Locations: NEMA 250.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 26 28 16

SECTION 26 51 19 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Shop drawing submittal: For each type of light fixture.
   1. Arrange in order of luminaire designation on fixture schedule.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   5. Photometric data and adjustment factors based on laboratory tests[**,** complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Samples as requested: For each luminaire and for each color and texture with standard factory-applied finish.

D. Mock up fixtures as requested: For each type of luminaire with custom factory-applied finishes.
   1. Include Samples of luminaires and accessories involving color and finish selection.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Lighting luminaires.
   2. Suspended ceiling components.
   3. Partitions and millwork that penetrate the ceiling or extend to within 24 inches of the plane of the luminaires.
   4. Structural members to which auxiliary equipment and luminaires will be attached.
   5. Initial access modules for acoustical tile, including size and locations.
   6. Items penetrating finished ceiling, including the following:
      a. Other luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Ceiling-mounted projectors.
   7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

D. 5 year warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all details necessary to reorder lamps or failed fixtures used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least two of each type.
2. Diffusers and Lenses: Five for every 100 of each type and rating installed. Furnish at least two of each type.
3. Globes and Guards: Five for every 100 of each type and rating installed. Furnish at least two of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty peri

B. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements. Provide specified fixture or approved equal.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

2.3 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Recessed Fixtures: Comply with NEMA LE 4.

D. Bulb shape complying with ANSI C79.1.

E. Lamp base complying with **ANSI C81.61**

F. CRI of minimum 80. CCT of 3000 K.

G. Rated lamp life of at least 50,000 hours at L70.

H. Lamps dimmable from 100 percent to 1 percent of maximum light output, unless otherwise noted.

I. Internal driver.

J. Nominal Operating Voltage: Per Fixture Schedule.

K. Housings:
1. Aluminum housing and heat sink.
2. Finished per Fixture Schedule. Final paint after assembly.

L. All fixtures have led lamping unless otherwise noted on fixture schedule.

M. See Light Fixture Schedule on electrical plans for specified basis of design light fixtures. Acceptable alternates are also on the schedule.

N. Confirm color temperature during shop drawing process.

O. Mount as shown on plans.

2.4 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Designed to allow access to all components from below ceiling plane.

C. Diffusers and Globes:
   1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
   1. Aluminum housing and heat sink.
   2. Finished per Fixture Schedule. Final paint after assembly.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label all fixtures with precise LED lamp information to facilitate exact lamp ordering and replacement for 20 years after installation.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, **12 gage**

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.7 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

2.8 TEMPORARY LIGHTING

A. Provide temporary lighting to meet code during construction.

2.9 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:
1. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

2.10 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

2.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
Coordinate "Operational Test" Subparagraph below with requirements in Section 260923 "Lighting Control Devices."

1. Operational Test: After installing luminaires, lighting controls, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

2.12 ADJUSTING

Verify with Owner that adjusting service is required for Project.

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to five visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

SECTION 26 56 00 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps.
2. Luminaire-mounted photoelectric relays.
3. Accessories.
4. Luminaire lowering devices.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

1.4 ACTION SUBMITTALS

A. Product Data: For each luminaire include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

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a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Wiring Diagrams: For power, signal, and control wiring.

B. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
3. Ballasts and Drivers: Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide specified fixture or equal.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. See Light Fixture Schedule on electrical plans for specified basis of design light fixtures. Acceptable alternates also listed.

B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

J. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

K. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

L. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USES ONLY" and include specific lamp type.
b. CCT and CRI for all luminaires.
c. All specific information needed to reorder LED lamping including manufacturer part number and contact information.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

C. Adjust luminaires that require field adjustment or aiming.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source and switchover to emergency power ..

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 56 00

TABLE OF CONTENTS

PART 1 - GENERAL

1. STIPULATIONS
    a. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.
2. RELATED DOCUMENTS
    a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
3. SUMMARY
    a. Section Includes:
        (1) Protecting existing vegetation to remain.
        (2) Removing existing vegetation.
        (3) Clearing and grubbing.
        (4) Stripping and stockpiling topsoil.
        (5) Removing above- and below-grade site improvements.
        (6) Disconnecting, capping or sealing, and removing site utilities.
        (7) Temporary erosion- and sedimentation-control measures.
4. DEFINITIONS
    a. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
    b. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
    c. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
    d. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
    e. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
    f. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings “to remain”.
    g. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.
5. MATERIAL OWNERSHIP
    a. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.
6. INFORMATIONAL SUBMITTALS

a. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   (1) Use sufficiently detailed photographs or videotape.
   (2) Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
b. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

7. QUALITY ASSURANCE
   a. Preinstallation Conference: Conduct conference at Project site.
8. PROJECT CONDITIONS
   a. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
      (1) Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
      (2) Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
   b. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
   c. Utility Locator Service: Notify One Call for area where Project is located before site clearing.
   d. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
   e. The following practices are prohibited within protection zones:
      (1) Storage of construction materials, debris, or excavated material.
      (2) Parking vehicles or equipment.
      (3) Foot traffic.
      (4) Erection of sheds or structures.
      (5) Impoundment of water.
      (6) Excavation or other digging unless otherwise indicated.
      (7) Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
   f. Do not direct vehicle or equipment exhaust towards protection zones.
   g. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
   h. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

1. MATERIALS
   a. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
      (1) Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

1. PREPARATION
    a. Protect and maintain benchmarks and survey control points from disturbance during construction.
    b. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.
    c. Protect existing site improvements to remain from damage during construction.
        (1) Restore damaged improvements to their original condition, as acceptable to Owner.
2. TEMPORARY EROSION AND SEDIMENTATION CONTROL
    a. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
    b. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
    c. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
    d. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
3. TREE AND PLANT PROTECTION
    a. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer.
4. EXISTING UTILITIES
    a. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
        (1) Arrange with utility companies to shut off indicated utilities.
        (2) Owner will arrange to shut off indicated utilities when requested by Contractor.
    b. Locate, identify, and disconnect utilities indicated to be abandoned in place.
    c. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
        (1) Notify Engineer not less than two days in advance of proposed utility interruptions.
        (2) Do not proceed with utility interruptions without Engineer's written permission.
    d. Excavate for and remove underground utilities indicated to be removed.
5. CLEARING AND GRUBBING
    a. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
        (1) Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

(2) Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.

(3) Use only hand methods for grubbing within protection zones.

(4) Chip removed tree branches and dispose of off-site.

b. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

(1) Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

6. TOPSOIL STRIPPING

a. Remove sod and grass before stripping topsoil.

b. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

(1) Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

c. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

(1) Limit height of topsoil stockpiles to 35 feet.

(2) Do not stockpile topsoil within protection zones.

(3) Stockpile surplus topsoil to allow for respreading deeper topsoil.

(4) Straw mulch and seed.

7. SITE IMPROVEMENTS

a. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

b. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

(1) Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

(2) Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

8. DISPOSAL OF SURPLUS AND WASTE MATERIALS

a. Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

b. Excess suitable soil should be taken to existing stockpile on Owner’s property as shown on plans (requires the installation of stone haul road).

c. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Subgrade preparation, excavating, backfilling, and compaction.
B. Contractor shall pay for services of a testing agency.

1.3 REFERENCES

A. Geotechnical Engineering Report – Not available.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3.)).
2. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, and Rock.
3. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408 (PENNDOT 408).

1.4 SUBMITTALS

A. Material Test Reports:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.

1.5 QUALITY CONTROL TESTING

A. The Contractor shall perform all necessary Quality Control tests and procedures for the performance of the work, in accordance with Section 014000 and this section, to produce end results specified. The Contractor's Quality Control Agent shall maintain clear and orderly records of such tests and procedures and make them available for field review and approval of the Professional and the Department. The Contractor's bid shall include the cost of all Quality Control tests and inspections.

B. The Contractor shall submit its plan for Quality Control testing to the Professional and the Department for review and comments. The Professional shall consult with its Quality Assurance Agent in arriving at its opinion.

C. Quality Control tests shall include tests on fill material, optimum moisture content and maximum density and field density tests of fill layers. The Quality Control Agent shall comment on the suitability of all subgrades, and the subgrades shall be acceptable to the Consulting Geotechnical Engineer.

D. Handwritten copies of filed test reports shall be provided to the Contractor. They shall be given to the Contractor and Assistant Project Coordinator (APC) within two (2) hours of completion, but in no event shall the technician leave the site without providing the Contractor and APC with a copy of the test results. This shall include density, % moisture, plan location, elevation, comments and any other relevant data. Comments shall include any condition that might have adverse effect on the operations, including weather, drainage, etc.

E. The Contractor shall request consultation with the Consulting Geotechnical Engineer on any problems that arise during construction. Copies of the daily in-place soil density tests shall be faxed to the consultant by the Contractor through the testing agency within twenty-four (24) hours of the time the tests are made.

F. The Contractor shall approve each subgrade and each fill layer before proceeding to the next layer. Any area which does not meet density, % moisture or other requirements at any time, shall be suitably reworked and retested by the Contractor at his own expense.

G. The Professional and/or the Department will perform all Quality Assurance Testing and Inspection Services deemed necessary for the assurance of the Professional and/or the Department. This does not relieve the Contractor of his responsibilities. The Department will bear the cost of Quality Assurance tests and inspections.

1.6 DEFINITIONS

A. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.

B. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

C. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cubic yard. for bulk excavation or 3/4 cubic yard that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping.

D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.

E. Subbase: Material shown on the Drawings between the pavement base and subgrade.

1.7 REGULATORY COMPLIANCE

A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

1.8 PROJECT CONDITIONS

A. BASIS OF CONTRACT

1. Excavation for this Project shall be considered unclassified and shall include all types of earth and soil, any pebbles, boulders, and bedrock, municipal trash, rubbish and garbage and all types of debris of the construction industry such as wood, stone, concrete, plaster, brick, mortar, steel and iron shapes, pipe, wire, asphaltic materials, paper and glass. Unclassified excavation does not include unforeseen concrete foundations, walls, or slabs. All such materials encountered which are identified by this paragraph as unclassified shall be removed to the required widths and depths to create a finished product as shown and/or noted on the drawings and as written in the specifications. No additional compensation shall be made to the contractor for this unclassified excavation. The materials defined by this paragraph as unclassified will not be considered to be concealed conditions or unknown physical conditions below the surface of the ground for purposes of interpreting the language in the General Conditions of the Construction Contract.

B. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 15 days prior to excavation.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.

1.9 APPROVAL OF BEARING STRATA

A. The Contractor shall furnish adequate advance notification to the Department and the Professional of times when footing excavations or paving subgrades are to be completed, so that the Construction Stage Geotech Quality Assurance Agent can verify that the bearing quality of the soil has been properly inspected and/or tested by the Contractor. Formwork and concreting shall follow only after approval by the Construction Stage Geotech Quality Assurance Agent.

B. Should the bearing at the levels indicated be found by the Professional and the Department to be inadequate, they may order the excavation carried down to sound bearing. Such excavation shall be classed as additional work and payment be made on the basis of an agreed price according to the General Conditions. Should suitable bearing be found at a lesser depth than indicated, the Professional and the Department may order the reduction of exaction specified or shown on the drawings, and the Contractor shall allow a credit for excavation thus omitted on the same basis.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil or suitable backfill materials are not available from excavations. Material must meet the definition of clean fill as defined by the Pennsylvania Department of Environmental Protection (PADEP).

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP and SM or a combination of these group symbols.

1. Low plasticity (plasticity index less than 10).
2. Maximum particles size of 2-inches in any direction for areas of structural fill beneath asphalt paving, concrete sidewalk & slabs, curbs, and equipment pads. Maximum particles size of 6-inches in any direction for areas of fill under all landscaped areas.
3. Less than 2 percent deviation from optimum moisture content, as determined by ASTM D-1557, for areas of structural fill beneath asphalt paving, concrete sidewalk & slabs, curbs, and equipment pads. Less than 5 percent deviation from optimum moisture content, as determined by ASTM D-1557, for areas of fill under all landscaped areas.

C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, CL, ML, OL, CH, MH, OH and PT, or a combination of these group symbols, or materials not conforming to the requirements for satisfactory soils, including:

1. Unsatisfactory soils also include satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction.
2. Debris, waste, frozen materials, vegetation and other deleterious matter.
3. Otherwise not meeting the requirements for satisfactory soil materials.
4. Materials containing excessive amounts of deleterious materials including construction debris, wood, glass, ash, or organic material as determined by the Department or

Professional.

D. Backfill and Fill Materials: Satisfactory soil materials.

E. Structural Fill: Satisfactory soil materials.

F. Base Course: 2A coarse aggregate, Type C or better, as specified in PENNDOT 408, Section 703 - Aggregate. Material must meet the definition of clean fill as defined by PADEP. Recycled crushed concrete or bricks will not be allowed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing utilities, sidewalks, structures, pavements, and other facilities to remain.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust. Refer to Erosion and Sedimentation Control drawings and Pennsylvania Code Chapter 102.

3.2 EXPLOSIVES

A. Explosives: The use of explosives is prohibited on this Project.

3.3 UNAUTHORIZED EXCAVATION

A. Unauthorized excavations shall be filled with satisfactory fill materials and compacted in accordance with the relevant paragraphs of this Section.

B. The Contractor is responsible for furnishing all materials, labor, supervision, tools, equipment, tools associated with unauthorized excavations without additional compensation.

3.4 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

3.5 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material

compacted by heavy compaction equipment (e.g. ten-ton heavy duty roller), and not more than 4 inches in loose depth for material compacted by hand-operated tampers (e.g. jumping jack or walk behind roller).

B. Compact soil to not less than the following percentages of maximum dry unit weight according ASTM D-1557:

1. Under paving, slabs, sidewalks, equipment pads, and foundations, soils shall be compacted to at least 95% of the maximum dry density as determined by ASTM D-1557.
2. Under landscaped areas, soils shall be compacted to 90% of the maximum dry density as determined by ASTM D-1557.

3.6 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes.

3.7 SUBBASE AND BASE COURSES

1. Under pavements and walks outside the right-of-way, place base course on prepared subgrade.

3.8 PROTECTION

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Provide fencing, barricades, and/or protective barriers for all excavation.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.

END OF SECTION 322000

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Concrete sidewalks.
2. Concrete curbs.
3. Concrete testing and inspection.

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408, (PENNDOT 408), except that measurement and payment sections do not apply.

1.4 SUBMITTALS

A. General: Submit each item in accordance with the General Requirements and Conditions of the Contract documents.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete pavement mix and class. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY CONTROL

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

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, type IA.

B. Normal-Weight Aggregates: ASTM C33, Class 4S, uniformly graded. Provide aggregates from a single source.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Water: Potable and complying with ASTM C94/C94M.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A1064, fabricated from as-drawn steel wire into flat sheets.

B. Joint Dowel Bars: ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

C. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

2.3 RELATED MATERIALS

A. Expansion-and-Isolation-Joint-filler-Strips: PENNDOT 408, Section 705.1.

B. Joint Sealer: In accordance with Pennsylvania Department of Transportation Publication 408, Section 705.4.

2.4 CONCRETE MIXES

A. Prepare design mixes, proportioned according to PENNDOT Publication 408, for each type and strength of concrete.

1. Slump Upper / Maximum Limit:
    a. Mix without water reducing admixtures: 5 inches
    b. Mix with water reducing admixtures: 6-1/2 inches
    c. Mix with high range water reducing admixtures (superplasticizers): 8 inches

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Furnish batch certificates for each batch discharged and used in the Work.

B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6 percent plus or minus 1-1/2 percent.

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

2.6 CONCRETE CURB

1. Concrete curb shall be in accordance with PENNDOT Publication 72M, Standards for Roadway Construction, RC-64M, latest edition.

PART 3 - EXECUTION

3.1 PREPARATION

A. Compact subgrade as indicated in Section 312000. Proceed with pavement only after nonconforming conditions have been corrected and subgrade and base course are stable and ready to receive pavement. Subgrade shall be in a moist condition when concrete is placed.

3.2 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendation in CRSI's "Placing Reinforcing bars" for placing and supporting reinforcement.

3.3 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.4 FLOAT FINISHING

B. General: Do not add water to concrete surfaces during finishing operations.

C. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.5 FIELD QUALITY CONTROL TESTING

A. Testing Laboratory: As part of this contract the Contractor shall retain the services of an independent testing and inspection laboratory meeting the qualifications of paragraph 1.5.C to sample materials, perform tests and prepare and submit reports during concrete placement.

B. Testing Services: Testing shall be performed according to the following requirements:

   1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
   2. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

C. Test results shall be reported in writing to the Department and Professional, concrete manufacturer, and Contractor, within 24 hours of testing.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Department and Professional but shall not be used as the sole basis for approval or rejection.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch minus 1/4 inch.
   3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
   4. Joint Spacing: 3 inches.
   5. Contraction Joint Depth: Plus 1/4 inch, no minus.
   6. Joint Width: Plus 1/8 inch, no minus.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet the requirements in this Section. Concrete sections shall be removed to the nearest regularly spaced joint.

B. Repair Surface Defects in accordance with ACI 301.

END OF SECTION 321313

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Manufactured Metal Bollards of the Following Types:

1. C40 crash rated (ASTM F2656): Fixed. (BDS-C40FB-ST)
2. C40 crash rated (ASTM F2656): Removable. (BDS-C40RB-ST)
3. M30 crash rated (ASTM F2656): Fixed. (BDS-M30FB-ST)
4. M30 crash rated (ASTM F2656): Fixed; shallow. (BDS-M30FB-SH)
5. M30 crash rated (ASTM F2656): Removable. (BDS-M30RB-ST)
6. M30 crash rated (ASTM F2656): Removable; shallow. (BDS-M30RB-SH)
7. M50 crash rated (ASTM F2656): Fixed; shallow. (BDS-M50FB-SH)
8. M50 crash rated (ASTM F2656): Removable; shallow. (BDS-M50RB-SH)
9. PU40 crash rated (ASTM F2656): Fixed. (BDS-PU40FB-ST)
10. PU40 crash rated (ASTM F2656): Removable. (BDS-PU40RB-ST)

B. Bollard covers.

1.2. RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications.

1.3. REFERENCES

A. American Welding Society (AWS):

1. AWS D1.1 Structural Welding - Steel.
2. AWS D1.6 Structural Welding - Stainless Steel.

B. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
4. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
6. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
7. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
8. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
9. ASTM F2656 - Standard Test Method for Crash Testing of Vehicle Security Barriers.

1.4. SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data:

1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Verification Samples: Two representative units of each finish.

D. Shop Drawings: Include details of materials, construction and finish. Include anchorage details and relationship with adjacent construction.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

D. Welding: Conform with AWS D1.1 standard.

E. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.

1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
3. Retain mock-up during construction as a standard for comparison with completed work.
4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.6. PRE-INSTALLATION CONFERENCE

A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, and critical path items.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.8. PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9. WARRANTY

A. Manufacturer's Standard Limited Warranty: 1 year. (see "Manufacturer Warranty" for full details)

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturer: Shaw Stainless LLC, which is located at: 3275 Florence Rd.; Powder Springs, GA 30127; Toll Free Tel: 800-282-9694; Tel: 678-290-9211; Email:request info (rob@shawfab.com); Web:https://stainlessandalloy.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2. MANUFACTURED METAL BOLLARDS, FIXED - ASTM C40 CRASH RATED

A. Basis of Design: Standalone Fixed Bollard Assembly, BDS-C40FB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 30 inches (762 mm).
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 bar.
2. Compliance:
    a. ASTM F2656: C40 P1, 2430 lbs (1102.2 kg) at 40 mph (64.4 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 30 inches (762 mm) or 36 inches (914 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.

12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.3. MANUFACTURED METAL BOLLARDS, REMOVABLE - ASTM C40 CRASH RATED

A. Basis of Design: Standalone Removable Bollard Assembly, BDS-C40RB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 30 inches (762 mm).
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 bar.
2. Compliance:
    a. ASTM F2656: C40 P1, 2430 lbs (1102.2 kg) at 40 mph (64.4 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 30 inches (762 mm) or 36 inches (914 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.4. MANUFACTURED METAL BOLLARDS, FIXED - ASTM M30 CRASH RATED

A. Basis of Design: Standalone Fixed Bollard Assembly, BDS-M30FB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 30 inches (762 mm).
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 bar.
2. Compliance:
    a. ASTM F2656: M30 P1, 15000 lbs (6804 kg) at 30 mph (48.3 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 39 inches (991 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.

4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.5. MANUFACTURED METAL BOLLARDS, FIXED, SHALLOW - ASTM M30 CRASH RATED

A. Basis of Design: Standalone Fixed Bollard Assembly, BDS-M30FB-SH; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
   a. Depth: 9 inches (229 mm).
   b. Concrete: 4500 psi (31026.4 kPa) concrete.
   c. Rebar: No. 5 and No.8 bar.
2. Compliance:
   a. ASTM F2656: M30 P1, 15000 lbs (6804 kg) at 30 mph (48.3 kph), less than 39.37 inch (1.0 m) penetration.
   b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 39 inches (991 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.6. MANUFACTURED METAL BOLLARDS, REMOVABLE - ASTM M30 CRASH RATED

A. Basis of Design: Standalone Removable Bollard Assembly, BDS-M30RB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
   a. Depth: 30 inches (762 mm).
   b. Concrete: 4500 psi (31026.4 kPa) concrete.

c. Rebar: No. 5 bar.

2. Compliance:
   a. ASTM F2656: M30 P1, 15000 lbs (6804 kg) at 30 mph (48.3 kph), less than 39.37 inch (1.0 m) penetration.
   b. Welding: Conforms with AWS D1.1 standard.
   c. Bollard Height Above Finished Grade: 39 inches (991 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication..
   d. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
3. Bollard Tops: Flat cap.
4. Bollard Tops: Domed cap.
5. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
6. Bollard Tops: As scheduled and indicated on Drawings.
7. Finish: Standard zinc rich primer.
8. Finish: Hot dip galvanized bollard pipe.
9. Finish: Exterior powder coat, _____.
10. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
11. Finish: Optional decorative cover.

2.7. MANUFACTURED METAL BOLLARDS, REMOVABLE, SHALLOW - ASTM M30 CRASH RATED

A. Basis of Design: Standalone Removable Bollard Assembly, BDS-M30RB-SH; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
   a. Depth: 12 inches (305 mm).
   b. Concrete: 4500 psi (31026.4 kPa) concrete.
   c. Rebar: No. 5 and No. 8 bar.
2. Compliance:
   a. ASTM F2656: M30 P1, 15000 lbs (6804 kg) at 30 mph (48.3 kph), less than 39.37 inch (1.0 m) penetration.
   b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 39 inches (991 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.

12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.8. MANUFACTURED METAL BOLLARDS, FIXED, SHALLOW - ASTM M50 CRASH RATED

A. Basis of Design: Standalone Fixed Bollard Assembly, BDS-M50FB-SH; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 9 inches (229 mm).
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 and No.8 bar.
2. Compliance:
    a. ASTM F2656: M50 P1, 15000 lbs (6804 kg) at 50 mph (80.5 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 39.5 inches (1003 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 58 inches (1473 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.9. MANUFACTURED METAL BOLLARDS, REMOVABLE, SHALLOW - ASTM M50 CRASH RATED

A. Basis of Design: Standalone Removable Bollard Assembly, BDS-M50RB-SH; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 14 inches (356 mm)
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 and No. 8 bar.
2. Compliance:
    a. ASTM F2656: M50 P1, 15000 lbs (6804 kg) at 50 mph (80.5 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
3. Bollard Height Above Finished Grade: 39.5 inches (1003 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.

4. Maximum Bollard Spacing: 58 inches (1473 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.10. MANUFACTURED METAL BOLLARDS, FIXED - ASTM PU40 CRASH RATED

A. Basis of Design: Standalone Fixed Bollard Assembly, BDS-PU40FB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 30 inches (762 mm).
    b. Concrete: 4500 psi (31026.4 kPa) concrete.
    c. Rebar: No. 5 bar.
2. Compliance:
    a. ASTM F2656: PU40 P1, 5070 lbs (2299.7 kg) at 40 mph (64.37 kph), less than 39.37 inch (1.0 m) penetration.
    b. Welding: Conforms with AWS D1.1 standard.
    c. Bollard Height Above Finished Grade: 36 inches (914 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication .
    d. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
3. Bollard Tops: Flat cap.
4. Bollard Tops: Domed cap.
5. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
6. Bollard Tops: As scheduled and indicated on Drawings.
7. Finish: Standard zinc rich primer.
8. Finish: Hot dip galvanized bollard pipe.
9. Finish: Exterior powder coat, _____.
10. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
11. Finish: Optional decorative cover.

2.11. MANUFACTURED METAL BOLLARDS, REMOVABLE - ASTM PU40 CRASH RATED

A. Basis of Design: Standalone Removable Bollard Assembly, BDS-PU40RB-ST; as manufactured by Barrier Defense Systems, a Shaw Stainless Company.

1. Foundation Requirements:
    a. Depth: 30 inches (762 mm).

b. Concrete: 4500 psi (31026.4 kPa) concrete.

c. Rebar: No. 5 bar.

2. Compliance:

a. ASTM F2656: PU40 P1, 5070 lbs (2299.7 kg) at 40 mph (64.37 kph), less than 39.37 inch (1.0 m) penetration.

b. Welding: Conforms with AWS D1.1 standard.

3. Bollard Height Above Finished Grade: 36 inches (914 mm); pavers or other concrete topper is acceptable up to an additional 4 inches (102 mm). Notify manufacturer of requirement in advance prior to fabrication.
4. Maximum Bollard Spacing: 48 inches (1219 mm) on center; meeting ADA handicap accessibility provision after decorative covers are installed.
5. Bollard Tops: Flat cap.
6. Bollard Tops: Domed cap.
7. Bollard Tops: Custom, decorative tops as scheduled and indicated on Drawings.
8. Bollard Tops: As scheduled and indicated on Drawings.
9. Finish: Standard zinc rich primer.
10. Finish: Hot dip galvanized bollard pipe.
11. Finish: Exterior powder coat, _____.
12. Finish: Exterior powder coat, color as scheduled and indicated on Drawings.
13. Finish: Optional decorative cover.

2.12. BOLLARD COVERS

A. Basis of Design: Bollard covers as manufactured by Barrier Defense Systems, a Shaw Stainless Company:

1. Compliance: Welding conforms with AWS D1.1 standard.
2. Materials: Type 304/304L stainless steel.

a. Finish: No. 4 circumferential brush finish.

b. Finish: No. 6 circumferential brush finish.

c. Finish: As scheduled and indicated on Drawings.

3. Materials: Type 316/316L stainless steel.

a. Finish: No. 4 circumferential brush finish.

b. Finish: No. 6 circumferential brush finish.

c. Finish: As scheduled and indicated on Drawings.

4. Materials: 6061-T6 grade aluminum.

a. Finish: Powder Coat: RAL _____.

b. Finish: As scheduled and indicated on Drawings.

5. Materials: As scheduled and indicated on Drawings.
6. Bollard Tops: Flat.
7. Bollard Tops: Domed.
8. Bollard Tops: Slanted.
9. Bollard Tops: As scheduled and indicated on Drawings.
10. Bollard Cover Height: 30 inches (762 mm).
11. Bollard Cover Height: 36 inches (914 mm).

12. Bollard Cover Height: 40 inches (1016 mm).
13. Bollard Cover Height: 42 inches (1067 mm).
14. Bollard Cover Height: Custom, _____.
15. Bollard Cover Height: Custom, as scheduled and indicated on Drawings.
16. Bollard Cover Height: From manufacturer's standard range, as scheduled and indicated on Drawings.
17. Outer Dimensions: 12-3/4 inches (324 mm), fits up to a 10-3/4 inches (273 mm) pipe bollard.
18. Outer Dimensions: 10-3/4 inches (273 mm), fits up to 8-5/8 inches (219 mm) pipe bollard.
19. Outer Dimensions: 8-5/8 inches (219 mm), fits up to 6-5/8 inches (168 mm) pipe bollard.
20. Outer Dimensions: 6-5/8 inches (168 mm), fits up to nominal 4 inch pipe bollard.
21. Outer Dimensions: As scheduled and indicated on Drawings.
22. Bollard Cover Retention: Set screws located 3 inches (76 mm) from bottom of cover.
23. Spacers: Factory welded.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Do not begin installation until substrates have been properly constructed and prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction. Protect all surfaces from concrete pour, debris, etc. during installation

3.4. CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturers recommendations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 323913

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of

analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.5 INFORMATIONAL SUBMITTALS

A. Soils Testing results for imported topsoil and samples obtained from the site with recommendations

from the testing agency for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable turf lawn indicated.

B. Field quality-control reports.

1.6 QUALITY CONTROL

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.7 REGULATORY COMPLIANCE

A. Compliance with the following laws and regulations: Pennsylvania Agricultural Liming Materials Act of 1978, P.L. 15, No.9, as amended, Agricultural Liming Materials Rules & Regulations (7 Pa. Code, Part V. Chapter 108), Pennsylvania Soil Conditioner and Plant Growth Substance Law, Act of December 1, 1977, Pl. 258, No. 86 (3P.S.68.2) as amended.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

2.2 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

B. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

C. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Department's property unless otherwise indicated.

END OF SECTION 329113

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.

1.3 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed
   1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.4 QUALITY CONTROL

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1.5 REGULATORY COMPLIANCE

A. Comply with specifications of NPDES permit as primary, then follow 'B.' for other areas.

B. Compliance with the following laws and regulations: Pennsylvania Seed Act of 1965 (Act No. 187), Regulations of the Pennsylvania Department of Agriculture, Bureau of Plant Industry, Pennsylvania Soil Conditioner and Plant Growth Substance Law, Act of December 1, 1977, P.L. 258, No. 86 (3P.S.68.2) as amended.

PART 2 - PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Temporary Seeding:

a. 100% Annual Rye Grass

3. Sun and Partial Shade: Proportioned by weight as follows:

a. 70 percent perennial ryegrass (Lolium perenne).
b. 30 percent red fescue (Festuca rubra variety).

4. Shade: Proportioned by weight as follows:

a. 35 percent chewings red fescue (Festuca rubra variety).
b. 35 percent hard fescue (Festuca longifolia or duriuscula).
c. 30 percent creeping red fescue ((Festuca rubra subp. rubra).

PART 3 - EXECUTION

3.01 EXAMINATION

A. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Professional and replace with new planting soil.

3.02 TURF AREA PREPARATION

A. Before planting, obtain the Professionals acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.03 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
3. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at a total rate of:

1. Temporary Seeding: 10 lb/1000 sq. ft.
2. Sun and Partial Shade: 2.5 lb/1000 sq. ft.
3. Shade: 5 lb/1000 sq. ft

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas from hot, dry weather or drying winds by applying mushroom manure within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly at a rate of 2-4 cubic yards per 1000 sq. ft. and rake lightly.

3.04 TURF RENOVATION

A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

3.05 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by the Professional:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off the Department's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

PART 1 - GENERAL

1. STIPULATIONS
    a. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.
2. RELATED DOCUMENTS
    a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
3. SUMMARY
    a. Section Includes:
        (1) Pipe and fittings.
        (2) Nonpressure transition couplings.
        (3) Expansion joints and deflection fittings.
        (4) Drains.
        (5) Encasement for piping.
        (6) Catch basins.
        (7) Stormwater inlets.
        (8) Stormwater disposal systems.
4. ACTION SUBMITTALS
    a. Product Data: For each type of product indicated.
    b. Shop Drawings:
        (1) Stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
5. DELIVERY, STORAGE, AND HANDLING
    a. Do not store plastic manholes, pipe, and fittings in direct sunlight.
    b. Protect pipe, pipe fittings, and seals from dirt and damage.
    c. Handle stormwater inlets according to manufacturer's written rigging instructions.
6. PROJECT CONDITIONS
    a. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
        (1) Notify Owner no fewer than 15 days in advance of proposed interruption of service.
        (2) Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

1. PE PIPE AND FITTINGS

a. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
   (1) Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
   (2) Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

b. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
   (1) Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
   (2) Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2. NONPRESSURE TRANSITION COUPLINGS
   a. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   b. Sleeve Materials:
      (1) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      (2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   c. Unshielded, Flexible Couplings:
      (1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      (2) Basis-of-Design Product: Subject to compliance with requirements, provide the following:
         (a) Fernco Inc.
      (3) Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Ring-Type, Flexible Couplings:
      (1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      (2) Basis-of-Design Product: Subject to compliance with requirements, provide the following:
         (a) Fernco Inc.
      (3) Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

3. CONCRETE
   a. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
      (1) Cement: ASTM C 150, Type II.
      (2) Fine Aggregate: ASTM C 33, sand.

(3) Coarse Aggregate: ASTM C 33, crushed gravel.

(4) Water: Potable.

b. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

(1) Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

(2) Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

c. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

(1) Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

(a) Invert Slope: 2 percent through manhole.

(2) Benches: Concrete, sloped to drain into channel.

(a) Slope: 4 percent.

d. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

(1) Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

(2) Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

4. STORMWATER INLETS

a. Yard Inlets: Include heavy duty frames and gates.

b. Frames and Grates: Heavy duty, according to utility standards.

5. GROUT

a. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

(1) Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

(2) Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

(3) Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

1. EARTHWORK

a. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

2. PIPING INSTALLATION

a. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

b. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

c. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

d. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

e. Install gravity-flow, nonpressure drainage piping according to the following:

(1) Install piping pitched down in direction of flow.

(2) Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

(3) Install piping with 12 inch minimum cover.

(4) Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

(5) Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3. PIPE JOINT CONSTRUCTION

a. Join gravity-flow, nonpressure drainage piping according to the following:

(1) Join corrugated PE piping according to ASTM D 3212 for push-on joints.

(2) ASTM F 794 for gasketed joints.

(3) Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.

(4) Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

(5) Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

(6) Join dissimilar pipe materials with nonpressure-type flexible couplings.

4. MANHOLE INSTALLATION

a. General: Install inlets, complete with appurtenances and accessories indicated.

b. Install precast concrete inlet sections with sealants according to ASTM C 891.

c. Where specific inlet construction is not indicated, follow inlet manufacturer's written instructions.

d. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops flush with finished surface elsewhere unless otherwise indicated.

5. CONCRETE PLACEMENT

a. Place cast-in-place concrete according to ACI 318.

6. CONNECTIONS

a. Make connections to existing piping and underground manholes.

(1) Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

(2) Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

(3) Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

(a) Use concrete that will attain a minimum 28-day compressive strength of 4000 psi unless otherwise indicated.

(b) Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

(4) Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

b. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

(1) Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

(a) Unshielded flexible couplings for same or minor difference OD pipes.

(b) Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

(c) Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

(2) Use pressure-type pipe couplings for force-main joints.

7. IDENTIFICATION

a. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

(1) Use detectable warning tape over ferrous piping.

(2) Use detectable warning tape over nonferrous piping and over edges of underground structures.

8. FIELD QUALITY CONTROL

a. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   (1) Submit separate reports for each system inspection.
   (2) Defects requiring correction include the following:
      (a) Alignment: Less than full diameter of inside of pipe is visible between structures.
      (b) Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      (c) Damage: Crushed, broken, cracked, or otherwise damaged piping.
      (d) Infiltration: Water leakage into piping.
      (e) Exfiltration: Water leakage from or around piping.
   (3) Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   (4) Reinspect and repeat procedure until results are satisfactory.

b. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   (1) Do not enclose, cover, or put into service before inspection and approval.
   (2) Test completed piping systems according to requirements of authorities having jurisdiction.
   (3) Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   (4) Submit separate report for each test.
   (5) Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      (a) Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
      (b) Option: Test plastic piping according to ASTM F 1417.
      (c) Option: Test concrete piping according to ASTM C 924.

9. CLEANING
   a. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION **334200**