

SECTION 07562

THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings
- B. Book 1: Project Information, Instructions to Bidders, and Execution Documents
- C. Book 2: Standard Terms and Conditions for Construction Contracts
- D. Book 2A: Standard Terms and Conditions Procedures Manual

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Vapor retarder.
 - 2. Multi-layer roof insulation.
 - 3. Coverboard.
 - 4. Adhered 60 Mil Fleece Back Evaloy: Membrane, baseflashing, accessories and appurtenances for a complete system.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Energy Performance: Provide roofing system with Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.5 SUBMITTALS

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

1. 60 mil fleece backed Evaloy.
2. 60 mil Evaloy membrane.
3. 80 mil vapor retarder and interply.
4. Sheathing / cover board.
5. Polyisocyanurate insulation.
6. Asphalt primer.
7. Hot asphalt.
8. Bonding adhesive.
9. Premolded boots.
10. Cut edge sealant.
11. Water block.
12. Mechanical fasteners.
 - a. Screws.
 - b. Expansion anchors.
13. Walkways.
14. Concrete pavers.
15. Termination bar.
16. Polyurethane sealant.
17. Warranty sample copy.
18. Manufacturer's specifications and instruction manual.

B. Samples:

1. 60 mil fleece backed Evaloy.
2. 60 mil Evaloy membrane.
3. 80 mil base sheet.
4. Sheathing / cover board.
5. Polyisocyanurate insulation.
6. Mechanical fasteners.
 - a. Screws.
 - b. Expansion anchors.
7. Walkways.
8. Concrete pavers.
9. Termination bar.
10. Polyurethane sealant.
11. Premolded corners.
12. Spray foam adhesive.
13. Tee joints patches.

C. LEED Submittals:

1. Product Test Reports for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
- D. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
1. Submit shop drawings to roof system manufacturer for approval, prior to submittal to Architect.
 2. Manufacturer standard details are unacceptable.
 3. Min Scale 3" = 1'-0".
 4. Submit for:
 - a. Baseflashing.
 - b. Parapets.
 - c. Mechanical curbs.
 - d. Roof drains.
 - e. Plumbing vents with extension rings.
 - f. Pipe penetration curb.
 - g. Window sill.
 - h. Electrical lighting cable.
 - i. Roof hatches.
 - j. Roof plan with tapered insulation:
 - 1) Min. scale 1/8" = 1'-0".
 - 2) Show all curbs and penetrations.
 - 3) No flat sumps at roof drains permitted.
- E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install total roofing system.
- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of meeting performance requirements.
- G. Qualification Data: For Installer and manufacturer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Special warranties specified in this Section.
- K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** A qualified firm that has been an approved applicator, under the same name for a minimum of 5 years, by roofing system manufacturer to install manufacturer's 20 year no monetary limit full system warranted roof systems.
- B. **Manufacturer Qualifications:** A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project. Manufacturer of specified for membrane must have a minimum of 5 years experience as a combined system with the insulation manufacturer. Manufacturer of membrane shall have a minimum of 15 years FM approval, and 15 years manufacturing experience.
- C. **Testing Agency Qualifications:** An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. **Source Limitations:** Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.
- E. **Fire-Test-Response Characteristics:** Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. **Exterior Fire-Test Exposure:** Class A; ASTM E 108, for application and roof slopes indicated.
 - 2. **Furnish membrane covering materials bearing UL Classification Marking on bundle, package, or container indicating that materials have been produced under UL's Classification and Follow-up Service.**
- F. **System Design Requirements:** Design all components of the roofing system including vegetation, appurtenances, pavers, gravel, and all other hardscape elements to resist uplift pressures calculated according to ASCE/SEI 7 for the building
 - 1. **Include all restraints and fastening required.**
- G. **Preliminary Roofing Conference:** Before starting roof system construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:
- H. **Preinstallation Conference:** Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. **Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer (Superintendent and Foreman must attend), roofing system manufacturer's representative, deck Installer, and installers whose work interfaces**

- (HVAC, plumbing, masonry, etc.) with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
- I. Concrete: Verify concrete has achieved curing as required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
- E. Deliver materials requiring fire resistance classification packaged with labels attached as required by the labeling service.
- F. Deliver materials in sufficient time and quality to allow continuity of work and compliance with approved construction schedule.
- G. Store rolled goods on end and handle rolled goods in a manner so as to prevent damage to edges or ends.
- H. Remove damaged or defective materials from site.

I. Roof Insulation:

1. Store insulation on clean, raised platforms. Remove manufacturer's wrappings and cover with breathable, waterproof weather protective coverings.
2. Provide continuous protection of the insulation materials against wetting and moisture absorption.
3. Remove moisture contaminated insulation materials from the project site.
4. Once insulation becomes wet, remove it from the site. DO NOT USE. Wet insulation which then dries shall be removed from site, same as wet insulation.

J. No materials shall be stored on any new roofing system.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's full system warranty, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks and moisture intrusion into roof system with interior moisture penetration.

1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, vapor retarder, roof pavers, walkway products, and other components of membrane roofing system. Warranty shall include coverage for damage from grease, oil and chemicals.
2. Cost of exposing the waterproofing membrane, including the removal and replacement of overburden shall be born by the Contractor for the full term of the manufacturer's warranty.
3. Warranty Period: 20 years from date of Substantial Completion.

- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Cost of exposing the waterproofing membrane, including the removal and replacement of overburden shall be born by the Contractor with all warranties.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC ROOFING MEMBRANE

- A. Fabric-Reinforced Thermoplastic Sheet: Uniform, flexible sheet formed from a thermoplastic fleece back Evaloy, internally fabric or scrim reinforced, and as follows:
1. Manufacturers: Manufacturer shall have a record of producing a reinforced sheet system for waterproofing applications for at least 15 years. Subject to compliance with specifications, provide one of the following:
 - a. Flex Membrane International, Inc. – Flex FB.
 2. Thickness: 60 mil min (1.1 mm), nominal.
 3. Exposed Face Color: White.
 4. Physical Properties:
 - a. Breaking Strength: 235 lbf (1 kN); ASTM D 751, grab method.
 - b. Elongation at Break: 100 percent; ASTM D 751.
 - c. Shore “A” Hardness: 83; ASTM D 2240.
 - d. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F (116 deg C); ASTM D 573.
 - e. Resistance to Cold: minus 40°F; ASTM D 2136.
 - f. Vapor Permeability: 3.5 g/m²/day; ASTM E 96.
 - g. Weight Change After Immersion: 1/5% maximum; ASTM D 570.
 - h. Seam Strength: 80%; ASTM D 751.
 - i. Linear Dimension Change: Plus or minus 0.5 percent; ASTM D 1204.
 - j. Accelerated Weathering: 10M hours; ASTM D 2565.
 - k. U.L. Rating: Class A.
 - l. F.M. Rating: Class I-90.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Preformed Penetration Boots:
1. Stainless steel draw bands.
- C. Water Block as manufactured by membrane manufacturer. Provide to sheet metal and wall panel contractor, as required.
- D. Pourable Sealer: By membrane manufacturer.

- E. Provide pourable sealer pockets; split collar: By membrane manufacturer.
- F. Cut Edge Sealant: By membrane manufacturer.
- G. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- I. Geotextile Slip Sheet: By membrane manufacturer; Flex 180N Geotextile Separation Layer

2.3 VAPOR RETARDER/BITUMINOUS INTERPLY

- A. 80-mil asphalt base sheet. Provide products, subject to compliance with specifications, by one of the following:
 - 1. Flex Membrane International, Inc.

2.4 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Rigid Thermal Insulation
 - 1. Polyisocyanurate Insulation: 25 psi, closed-cell polyisocyanurate foam core laminated to coated glass fiber mat facers.
 - 2. Manufacturers:
 - a. Flex Membrane International, Inc.
 - 3. Polyisocyanurate Foam Panels: HCFC-free; formulated with hydrocarbon blowing agents chemically bonded during the foaming process to facers on the top and bottom surfaces.
 - 4. Insulation: Rigid board conforming to ASTM C 1289-01; Type II, Class II, Grade III; UL 1256, #120 and 123; UL 790, ASTM E 108, Class A; UL 263, ASTM E 119, FM 4450 / 4470, Class I fire rating; polyisocyanurate rigid board, both faces surfaced with fiber reinforced faces, with the following characteristics:
 - a. Board Density: 2.0 lb/cu ft.
 - b. Board Size: 4'-0" x 4'-0".
 - c. Board Thickness: 2".
 - d. Thermal Conductivity: LTTR value of 6.0/inch per ASTM C 1303.
 - e. Board Compressive Resistance: 25 psi min. per ASTM D 1621.
 - f. Board Edges: Square.

C. Substrate Covering Materials

1. Fiberglass Faced Gypsum Roof Board: ½” thickness; Type X; water resistant, zero flame-spread, zero smoke development; ASTM E 84, Non-Combustible; ASTM E 136; DensDeck® Prime, Georgia Pacific, Atlanta, GA.

- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

2.6 ASPHALT MATERIALS

- A. Roofing Asphalt: ASTM D 312, Type III or IV.
1. Provide Trumbull Asphalt.
 2. Asphalt primer.

2.7 ROOF PAVERS

- A. Precast Concrete Pavers: Provide precast pavers as shown on the drawings and as follows:

1. Weight: 15.5 psf (75.68 kg/m²) to 32.5 psf (158.68 kg/m²).
2. Thickness: 1-3/4 inches to 2-3/4 inches.
3. Size:
 - a. 24 inches (610 mm) by 24 inches (610 mm).
 - b. 12 inches (305 mm) by 12 inches (305 mm).
4. Compressive Strength: 7000 psi (48 263 kPa) average, 6500 psi (44 816kPa) minimum, when tested in accordance with ASTM C 140.
5. Water Absorption: 5 percent maximum, in accordance with ASTM C 140.
6. Freeze/Thaw: Comply with ASTM C67, no breakage and 1 percent maximum loss in dry weight in any individual unit when subjected to 50 cycles.
7. Concentrated Loads: Support minimum concentrated load of 1750 pounds (794 kg) at center of paver.
8. Flexural Strength: 60 psi (4137 kPa) minimum, in accordance with ASTM C923.
9. Materials:
 - a. Portland Cement: ASTM C 150.
 - b. Aggregates: ASTM C 33.
 - c. Coloring: Inorganic pigment.

10. Color and Finish: White reflective coating with an initial solar reflectance greater than or equal to 0.65 and a maintained reflectance of 0.50 for three years after installation when tested in accordance with ASTM E408.
11. Product: Subject to compliance with requirements, provide the following product:
 - a. "Terra-Pavers H", American Hydrotech, Inc.
 - b. Cool Pavers, Wausau Tile, Inc.
 - c. Prest Pavers, Hanover Architectural Products.
12. Back: Plain
13. Roof Paver Pedestal: Manufacturer's standard SBR paver supports.

2.8 ACCESSORIES

- A. Tapered Edge Strips: High density wood fiber. Tapered edge strip, manufactured 0 to 1/2" and 0 to 1-1/2" configuration as detailed; provided by the roof membrane manufacturer.
- B. Roofing Nails: Aluminum ring shank; size as required to suit application with 1" plastic washer heads.
- C. Pipe Curbs: Polycarbonate Resin Pipe Stands
- D. Termination Bars: 1/8" thick x 1" wide minimum, as supplied by roofing membrane manufacturer.
- E. Polyurethane Sealant: By roof membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. The roofing contractor shall examine all surfaces to receive the roofing assembly to verify it is acceptable and proper for application of the membrane.
- B. Verify that surfaces and site conditions are ready to receive work.
- C. Verify roof deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.

- D. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set and wood blocking is in place.
 - 1. Notify Architect of all roof deck conditions observed that will affect the performance of the roof system.
- E. Verify work of subcontractors which penetrates roof deck or requires men and equipment to traverse roof deck has been completed prior to commencing roof operations.
- F. Repair any minor sections (2'-0" x 2'-0") of the roof deck which may have been damaged to provide smooth level surface.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Prior to application of the Roof System verify that the concrete topping has met the following requirements.
 - 1. Concrete Hydration (Cure):
 - a. Duration of Cure/Dry:
 - 1) Concrete: recommend 60 days, minimum 28 days, and prior to application of membrane.

3.3 VAPOR-RETARDER INSTALLATION

- A. Concrete Roof Deck:
 - 1. Prime concrete roof deck.
 - 2. Install 80-mil base sheet lapping each sheet 6 inches over preceding sheet. Embed each sheet in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt at a rate of 20 lb/100 sq. ft. (1 kg/sq. m), plus or minus 25 percent.
 - 3. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.4 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with spray foam insulation – trim flush.
 - 1. Fill all joints at nailers, projections, and penetrations with spray foam insulation.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
- G. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
- H. Set tapered insulation sumps at roof drains as detailed, in hot asphalt.
- I. Set substrate cover board in hot asphalt.

3.5 BITUMINOUS INTERPLY

- A. Install 80-mil base sheet lapping each sheet 6 inches over preceding sheet. Embed each sheet in a solid mopping of hot roofing asphalt. Glaze-coat completed surface with hot roofing asphalt. Apply hot roofing asphalt at a rate of 20 lb/100 sq. ft. (1 kg/sq. m), plus or minus 25 percent.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.6 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax a minimum of 30-minutes before installing.
- B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed roofing membrane. Do not apply roofing asphalt to splice area of roofing membrane.
- E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- I. Install tee joint patches at all lap intersections.
- J. Install cut edge sealant.

3.7 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
 - 1. All concrete block walls to receive two coats of bonding adhesive.
- B. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- C. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

- D. Terminate and seal top of sheet flashings.

3.8 PIPE FLASHING PENETRATING THROUGH MEMBRANE

- A. Flash pipe with pre-molded pipe flashings boots where installation is possible.
- B. Where pre-molded pipe flashing boot cannot be installed, use field fabricated flashing techniques on membrane.
- C. Apply membrane sealant at all flashing edges.
- D. Provide water block between the pipe penetration and pre-molded pipe flashing.
- E. Install sealant at top of pipe boot or field flashing.

3.9 WALKWAY INSTALLATION

- A. Roof-Paver Walkways: Install heavyweight walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways as indicated on drawings.

3.10 ROOF MEMBRANE PROTECTION AT VEGETATED ROOF

- A. Fabricate geotextile slipsheet to size of vegetated roof area. Install per manufacturer's instructions overlapping material 6 inches at all seams.
 - 1. Extend geotextile slipsheet beyond extents of vegetated roof area up to roof drains where indicated.
 - 2. At vegetated roof edge restraint, install additional layer of geotextile slipsheet at inside face of edge restraint. Additional layer to overlap base layer by 6 inches and run continuous to top of edge restraint prior to placement of planting modules.

3.11 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION 07562

SECTION 08520

ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings
- B. Book 1: Project Information, Instructions to Bidders, and Execution Documents
- C. Book 2: Standard Terms and Conditions for Construction Contracts
- D. Book 2A: Standard Terms and Conditions Procedures Manual

1.2 SUMMARY

- A. This Section includes Heavy-Commercial Grade aluminum windows of the performance class indicated. Window types required include the following:
 - 1. Casement windows.
 - 2. Projected windows.
 - 3. Fixed windows.

1.3 DEFINITIONS

- A. Combination Windows: Where 2 different types of operating sash or ventilators are included in the same window unit and share a common frame, the unit is considered a "combination window."
- B. Performance class number *according to AAMA/WDMA 101/I.S.2/NAFS*, included as part of the window designation system, is the actual design pressure in pounds force per square foot (pascals) used to determine structural test pressure and water test pressure.
 - 1. Structural test pressure, wind load test, is equivalent to 150 percent of the design pressure.
 - 2. Water-leakage-resistance test pressure is equivalent to **20** percent of *structural load at minimum gateway size*.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows engineered, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading without failure, as demonstrated by testing manufacturer's standard window assemblies representing types, grades, classes, and sizes required for Project according to test methods indicated.
- B. Test Criteria: Testing shall be performed by a qualified independent testing agency based on the following criteria:
1. Design wind *load as required by the Chicago Building Code; 25 lbs/sq.ft. typical and 30 lbs/sq.ft. at corners.*
 2. Heights of window units above grade at window centerline are indicated on or can be determined from the Drawings. Consult with the Architect, if necessary, to confirm required loading and test pressures.
 3. Test Procedures: Test window units according to ASTM E 283 for air infiltration, both ASTM E 331 and ASTM E 547 for water penetration, and ASTM E 330 for structural performance.
- C. Performance Requirements: Testing shall demonstrate compliance with requirements indicated in AAMA 101 for air infiltration, water penetration, and structural performance for type, grade, and performance class of window units required. Where required design pressure exceeds the minimum for the specified window grade, comply with requirements of AAMA 101, Section 3, "Optional Performance Classes," for higher than minimum performance class.
1. Air-Infiltration Rate for Operating Units: Not more than **0.1** cfm/sq. ft. of operable sash joint for an inward test pressure of 6.24 lbf/sq. ft. (299 Pa).
 2. Air-Infiltration Rate for Fixed Windows: Not more than **0.06** cfm/ft. of area for an inward test pressure of 6.24 lbs/sq. ft. (299 Pa).
 3. Water Penetration: No water penetration as defined in the test method at an inward test pressure of 20 percent of the design pressure.
 4. Uniform Load Deflection: No deflection in excess of 1/175 of any member's span during the imposed load, for a positive (inward) and negative (outward) test pressure of 60 lbf/sq. ft. (2873 Pa).
 5. **Structural Performance: No failure or permanent deflection after removing the**

imposed load, for a positive (inward) and negative (outward) test pressure of 30 lbf/sq. ft. (1437 Pa). No failure or permanent deflection in excess of 0.2 percent of any member's span after removing the imposed load, for a positive (inward) and negative (outward) test pressure of 45 lbf/sq.ft. (150% overload test).

6. Condensation Resistance: Where window units are indicated to be "thermally improved," provide units tested for thermal performance according to AAMA 1503.1 showing a condensation resistance factor (CRF) of **55**.
 7. Thermal Transmittance: Provide window units with a U-value maximum of **0.45** Btu/sq. ft. x h x deg F (3.9 W/sq. m x K) at 15-mi./h (24-km/h) exterior wind velocity, when tested according to AAMA 1503.1.
 8. Forced-Entry Resistance: Comply with Performance Level 10 requirements when tested according to ASTM F 588.
 9. Thermal Movements: Provide window units that allow thermal movement resulting from the following maximum change (range) in ambient temperature when engineering, fabricating, and installing aluminum windows to prevent buckling, opening of joints, and overstressing of components, connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 10. *Provide a fully drainable system that transfers all water entering the system back to the exterior through internal gutters and weeps.*
- D. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2/NAFS.
1. Performance Class: AW.
 2. Performance Grade: Minimum **70**

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Specification Sections.
- B. Product Data for each type of window required, including the following:

1. Construction details and fabrication methods.
 2. Profiles and dimensions of individual components.
 3. Data on hardware, accessories, and finishes.
 4. Recommendations for maintaining and cleaning exterior surfaces.
- C. Shop Drawings showing fabrication and installation of each type of window required including information not fully detailed in manufacturer's standard Product Data and the following:
1. Layout and installation details, including anchors.
 2. Elevations at 1/4 inch = 1 foot (1:50) scale and typical window unit elevations at 3/4 inch = 1 foot (1:20) scale.
 3. Full-size section details of typical composite members, including reinforcement and stiffeners.
 4. Location of weep holes.
 5. Panning details.
 6. Hardware, including operators.
 7. Window cleaning provisions.
 8. Glazing details.
 9. Accessories.
 10. ***For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum windows and used to determine the following:***
 - a. ***Structural test pressures and design pressures from wind loads indicated.***
 - b. ***Deflection limitations of glass framing systems.***
 11. ***Window System Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.***
 12. ***Wiring Diagrams: Power, signal, and control wiring.***
- D. Samples: Submit three (3) samples of the specified finish on 6" lengths of window members showing the extreme range of color.
1. The Architect reserves the right to require additional samples, which show fabrication techniques and workmanship, and design of hardware and accessories.
- E. Certification: Provide certification by the manufacturer showing that each type, grade and size of window unit complies with requirements where the manufacturer's standard window units have been tested in accordance with specified tests and meet performance requirements

specified. Where such testing has not been accomplished, perform required tests through a recognized testing laboratory or agency and provide certified test results.

F. Energy Code Certification: Submit written certification, signed by the manufacturer, attesting that system conforms to Title 18 of the Municipal Code of Chicago for Energy Efficiency Requirements as called for in article 1.6 "Quality Assurance".

G. LEED Submittals:

1. Credit MR 4.1 and 4.2: Submit product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Credit MR 5.1 and 5.2: Submit product Data indicating location of material manufacturer for regionally manufactured materials.
 - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
 - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials

H. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installation of aluminum windows similar in material, design, and extent to those required for this Project and with a record of successful in-service performance.

1. ***Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.***
2. ***Engineering Responsibility: Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.***

B. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct

the testing indicated without delaying the Work.

- C. **Single-Source Responsibility:** Obtain aluminum windows from one source and by a single manufacturer.
- D. **Appearance Criteria:** The drawings are based on a specified type and model of aluminum window by a single manufacturer. An equivalent type of window by another listed manufacturer may be accepted provided that deviations in dimensions and profiles are minor and do not materially detract from the design concept or intended performances as judged solely by the Architect.
- E. **Energy Code Certification:** Provide certification of system U-value as determined in accordance with NFRC 100 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Provide certification of solar heat gain coefficient (SHGC) as determined in accordance with NFRC 200 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Provide certification of air infiltration rates as determined in accordance with AAMA/WDMA 101/LS.2 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Reference article 1.4 "Performance Requirements" for U-value and air infiltration requirements. Reference Division 8 Section "Glazing" for SHGC requirements. Such certified and labeled U-values and SHGCs shall be accepted for purposes of determining compliance with the building envelope requirements of Title 18 of the Municipal Code of Chicago for Energy Efficiency Requirements.
- F. ***Professional Engineer Qualifications:*** *A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of glazed aluminum windows that are similar to those indicated for this Project in material, design, and extent.*

1.7 PROJECT CONDITIONS

- A. **Field Measurements:** Check window openings by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
 - e. Failure of insulating glass.
 2. Warranty Period:
 - a. Window: **10** years from date of Substantial Completion.
 - b. Glazing: 10 years from date of Substantial Completion.
 - c. Metal Finish: 15 years 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. Projected / Casement / Fixed Windows:
 - a. Window types 'A', 'B', 'E', 'F', 'G', 'H' and 'K' are based upon Wausau Windows Series 4250 project out, 1" exterior offset.
 - b. Windows of the following manufacturers are also acceptable:
 - 1). EFCO Corporation.
 - 2). Graham Architectural Products Corp.
 2. Fixed Windows:
 - a. Window type 'C' is based upon Wausau Windows Series 4500 DT detention

- series.
- b. Windows of the following manufacturers are also acceptable:
 - 1). EFCO Corporation.
 - 2). Graham Architectural Products Corp.

2.2 MATERIALS

- A. Aluminum Extrusions: Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength.
 - 1. Minimum window member wall thickness: not less than 0.125 inch (1.6 mm) thick at any location for main frame and sash members.
 - 2. Detention windows minimum member wall thickness: not less than 0.188 inch thick at any location for main frame and sash members.
- B. Preglazed Fabrication: Provide preglazed window units at the factory using glazing methods tested with units as required for window grade and performance requirements specified.
 - 1. Provide insulated laminated glass as specified in Part 3 of Division 8 Section "Glazing".
 - 2. In security windows provide 7/8" laminated security glass.
- C. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.
 - 1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard, noncorrosive, pressed-in, splined grommet nuts.
 - 2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- D. Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel or iron complying with requirements of ASTM B 633; provide sufficient strength to withstand design pressure indicated.
- E. Compression-Type Glazing Strips and Weatherstripping: Unless otherwise indicated, and at manufacturer's option, provide compressible stripping for glazing and weatherstripping such as molded EPDM or neoprene gaskets complying with ASTM D 2000 Designation 2BC415

to 3BC620, or molded PVC gaskets complying with ASTM D 2287, or molded expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.

- F. Sealant: For sealants required within fabricated window units, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating. Comply with Division 7 Section "Joint Sealants" of these Specifications for selection and installation of sealants.
- G. Wire-Fabric Insect Screen: 18-by-18 (1.2-by-1.2-mm), 18-by-16 (1.2-by-1.4-mm), or 18-by-14 (1.2-by-1.6-mm) mesh of 0.009-inch- (0.2-mm-) diameter, stainless-steel wire, complying with FS RR-W-365, Type VI.

2.3 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.
- B. Four-Bar Friction Hinges: Comply with AAMA 904.1.
 - 1. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.
- C. Concealed Gear-Type Rotary Operators: Comply with AAMA 901.1 for rotary operators. Comply with ASTM E 405, Method A, when subjected to operating moments and closing torques indicated in AAMA 101.
 - 1. Operator shall operate all ventilators simultaneously, securely closing them at both jambs without using additional manually controlled locking devices.
- D. Limit Device: Provide manufacturer's standard, concealed support arms with adjustable, limited, hold-open limit device designed to restrict ventilator opening. Limit opening to 6 inches. Sash stops to match finish.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessories that comply with indicated standards.
- B. Insect Screens: Provide insect screens for each operable exterior sash or ventilator. Locate screens on inside or outside of window sash or ventilator, depending on window type.

Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches.

1. Wickets: Provide sliding or hinged-type wickets, framed and trimmed for a tight fit and durability during handling.
2. Screen Frames: Fabricate frames of tubular-shaped, extruded- or formed-aluminum members of 0.040-inch- (1-mm-) minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match window units.
 - a. Provide removable PVC spline-anchor concealing edge of screen frame.
- C. Weatherstripping: Provide sliding-type weatherstripping where sash rails slide horizontally or vertically along unit frame. Provide compression-type weatherstripping at perimeter of each operating sash where sliding type is inappropriate.
 1. Provide weatherstripping locked into extruded grooves in sash.

2.5 CASEMENT WINDOWS

- A. Window Grade and Class: Comply with requirements of AAMA Grade and Performance Class **AW** Grade **70**. Window units shall successfully pass vertical deflection, hardware load, and torsion test performance requirements specified in AAMA 101.
- B. Hardware: Provide the following equipment and operating hardware:
 1. Operating Device: Concealed gear-type rotary operator located on jamb at sill.
 2. Hinges: Heavy-duty, 3-knuckle butt hinges with nylon bushings.
 3. Lock: Concealed multipoint lock operated by single lever handle or lift-type throw.
 4. Limit Device: Concealed friction adjustor, adjustable stay bar limit device.

2.6 FIXED WINDOWS

- A. Window Grade and Class: Comply with requirements of AAMA Grade and Performance Class **AW** Grade **70**.

2.7 FABRICATION

- A. General: Fabricate aluminum window units to comply with indicated standards. Include a
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12TH DISTRICT POLICE STATION
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- complete system for assembly of components and anchorage of window units.
1. Provide units that are reglazable without dismantling sash or ventilator framing.
 2. Prepare window sash or ventilators for glazing, except where preglazing at the factory is indicated.
- B. Thermally Improved Construction: Fabricate window units with an integral, concealed, low-conductance, thermal barrier, located between exterior materials and window members exposed on interior, in a manner that eliminates direct metal-to-metal contact.
1. Provide thermal-break construction that has been in use for not less than 3 years, has been tested to demonstrate resistance to thermal conductance and condensation, and has been tested to show adequate strength and security of glass retention.
 2. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.
 3. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
 4. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
 5. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.
 6. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated.
 7. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish to match window units.
- C. Preglazed Fabrication: Preglaze window units at the factory where possible and practical for applications indicated. Comply with glass and glazing requirements of Division 8 Section "Glazing" of these Specifications and AAMA 101.

2.8 FINISHES

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

- C. Finish aluminum windows to match other aluminum components of curtain wall system. Refer to Division 8 Section "Glazed Aluminum Curtain Walls" for finish requirements.
- D. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match PPG No. 5VMN93388P Anodic Bronze.

2.9 WINDOW OPERATING SYSTEMS

- A. Provide window operating system of the type and in groups as indicated. Coordinate operating system design with window fabrication and hardware selection to ensure smooth, durable operation of ventilators.
- B. Rack-and-Pinion or Screw-Type Operating System: Complete with shafts, brackets, levers, rods, oil-encased gear boxes, and standard fittings and accessories for operation indicated.
- C. Operation: Electric, with factory-assembled electric operator designed for operating windows of type, size, weight, construction, use, and operating frequency indicated.
 - 1. Electric Operator: Provide operating system complying with NFPA 70; of size and capacity and with features, characteristics, and accessories suitable for Project conditions, recommended in writing by window manufacturer; complete with operating system indicated, electric motor and factory-prewired motor controls with limit switches, remote-control stations, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation. Include wiring from motor controls to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Clearline Inc., North Wales, PA; Sleekline 24 VDC Actuator.

- 2)
 - b. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
 - c. Electric Motor: Comply with NEMA MG 1; with thermal-overload protection; sized to start and operate size and weight of window sash ventilators under any conditions; one per each gear box shaft.
 - 1) Motor Characteristics: Single phase, sized by electric operator manufacturer,, 60 Hz.
 - 2)
 - d. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure and three-position, push-button-operated control with open, close, and stop functions.
 - e. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop sash ventilators at fully opened and fully closed positions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect openings before installation. Verify that rough or masonry opening is correct and sill plate is level.
 1. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.
 2. Metal surfaces shall be dry; clean; free of grease, oil, dirt, rust and corrosion, and welding slag; without sharp edges or offsets at joints.

3.2 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for installing window units, hardware, operators, and other components of the Work.
- B. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.
 1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified under "Dissimilar Materials" Paragraph in appendix to AAMA 101.

- C. Set sill members and other members in a bed of sealant or with joint fillers or gaskets, as shown on Shop Drawings, to provide weathertight construction. Refer to Division 7 Section "Joint Sealants" for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the Work.
 - 1. Sealants, joint fillers, and gaskets to be installed after installation of window units are specified in another Division 7 Section.
- D. Connect operators to the building electrical system.

3.3 ADJUSTING

- C. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.

3.4 CLEANING

- C. Clean aluminum surfaces promptly after installing windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.
- D. Clean glass of preglazed units promptly after installing windows. Comply with requirements of Division 8 Section "Glazing" for cleaning and maintenance.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to aluminum window manufacturer, that ensure window units are without damage or deterioration at the time of Substantial Completion.

3.6 FIELD TESTING

- A. Field Tests: Contractor shall perform and pay for onsite tests of selected installed windows or window system components. Test newly installed Aluminum Window products as directed by the Commission's Representative for air leakage and water penetration resistance.

1. ***Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.***
 - a. ***Test Area: A minimum area of 75 feet (23 m) by-2-story minimum area of glazed aluminum curtain wall system, test system for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.***
2. Costs for all tests, both original and retests shall be paid for by the responsible Contractor. All unsuccessful tests, both original and retest, shall be paid for by the responsible Contractor.
3. ***Testing Quantity: Test three (3) Aluminum Window products of each type and size, or three (3%) percent of each type of Aluminum Window product installations, whichever is greater.***
4. All work on Aluminum Windows that fail the field tests shall be re-executed until the installation passes the field testing. Modify methods of installation of subsequent work to incorporate required corrections identified by the testing process.

END OF SECTION 08520

SECTION 08920

GLAZED ALUMINUM CURTAIN WALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings
- B. Book 1: Project Information, Instructions to Bidders, and Execution Documents
- C. Book 2: Standard Terms and Conditions for Construction Contracts
- D. Book 2A: Standard Terms and Conditions Procedures Manual

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Glazed aluminum curtain wall, unit system installation.
 - 2. Aluminum entrance systems, interior and exterior.
 - 3. Aluminum entrance doors.

1.3 SYSTEM DESCRIPTION

- A. General: Provide glazed aluminum curtain wall system that has the following capabilities based on preconstruction testing:
 - 1. Withstands loads and thermal and structural movement requirements indicated without failure. Failure includes the following:
 - a. Air infiltration and water penetration exceeding specified limits.
 - b. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing is physically and thermally isolated from framing members.
- C. System is pressure equalized at its interior face.
- D. System is reglazable from the exterior.
- E. Wind Loads: Provide glazed aluminum curtain wall system, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever are more stringent.

1. Deflection of framing members in a direction normal to wall plane is limited *to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.*
 2. Deflection of framing members overhanging an anchor point is limited to 2 times the length of the cantilevered member, divided by 175.
 3. Test Performance: Provide glazed aluminum curtain wall system that does not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.
 4. ***Design wind loads as required by Chicago Building Code: 25 lbs/sq.ft. typical and 30 lbs/sq.ft. at corners.***
- F. Dead Loads: Provide glazed aluminum curtain wall system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load. Provide a minimum 1/8-inch (3.18-mm) clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum 1/16-inch (1.59-mm) clearance between members and operable windows and doors.
- G. Live Loads: Provide glazed aluminum curtain wall system, including anchorage, that accommodates supporting structure's deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- H. Air Infiltration: Provide glazed aluminum curtain wall system with permanent resistance to air leakage through system of not more than 0.06 cfm/sq. ft. (0.3 L/s/sq. m) of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (299 Pa).
- I. Water Penetration: Provide glazed aluminum curtain wall system that does not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than **10** lbf/sq. ft. (479 Pa).
- J. Water Penetration: Provide glazed aluminum curtain wall system that does not evidence water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 10 lbf/sq. ft. (479 Pa). Water leakage is defined as follows:
1. According to AAMA 501.1.
 2. Uncontrolled water infiltrating system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not

water leakage.

- K. Thermal Movements: Provide glazed aluminum curtain wall system, including anchorage, that accommodates thermal movements of system and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, noise or vibration, and other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- L. Structural Support Movement: Provide glazed aluminum curtain wall system that accommodates structural movements including, but not limited to, sway, twist, column shortening, long-term creep, and deflection.
- M. Condensation Resistance: Provide glazed thermal-break aluminum curtain wall system with condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.98 with 0 degrees outside and 25% relative humidity inside.
- N. Average Thermal Conductance: Provide glazed aluminum curtain wall system with an average U-value of not more than 0.45 Btu/sq. ft. x h x deg F (3.75 W/sq. m x K) when tested according to AAMA 1503.1.
- O. Dimensional Tolerances: Provide glazed aluminum curtain wall system, including anchorage, that accommodates dimensional tolerances of building frame and other adjacent construction.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Specification Sections.
- B. Product Data for each product specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Shop Drawings showing fabrication and installation of glazed aluminum curtain wall system including plans, elevations, sections, details of components, and attachments to other units of Work.
 - 1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for verification of each type of exposed finish required in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. The right is reserved to require samples of typical fabricated sections, showing joints, exposed fastenings if any, quality of workmanship, hardware and accessory items, before fabrication of the Work proceeds.

- E. Welder certificates indicating that welders comply with requirements specified in "Quality Assurance" Article.
- F. Installer certificates signed by manufacturer certifying that installers comply with requirements in "Quality Assurance" Article.
- G. Certification: Submit written certification, signed by window wall manufacturer, attesting that system conforms to "Quality Assurance" requirements of this Specification where the manufacturer's standard system has been tested in accordance with specified tests and meets performance requirements specified. Where such testing has not been accomplished, perform required tests through a recognized testing laboratory or agency and provide certified test results.
- H. Energy Code Certification: Submit written certification, signed by the manufacturer, attesting that system conforms to Title 18 of the Municipal Code of Chicago for Energy Efficiency Requirements as called for in article 1.5 "Quality Assurance".
- I. LEED Submittals:
 - 1. Credit MR 4.1 and 4.2: Submit product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
 - 2. Credit MR 5.1 and 5.2: Submit product Data indicating location of material manufacturer for regionally manufactured materials.
 - a. Include statement indicating cost and distance from manufacturer to Project for each regionally manufactured material.
 - b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.
- J. ***Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for glazed aluminum curtain walls, indicating full compliance with performance requirements on an equivalent system.***

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of glazed aluminum curtain wall systems that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Engage an experienced installer to assume engineering responsibility

- and perform work of this Section who has specialized in installing glazed aluminum curtain wall systems similar to those required for this Project and who is acceptable to manufacturer.
1. **Engineering Responsibility:** Engage a qualified professional engineer to prepare or supervise the preparation of data for glazed aluminum curtain wall systems, including drawings, testing program development, test-result interpretation, and comprehensive engineering analysis that shows systems' compliance with specified requirements.
- D. **Source Limitations:** Obtain each type of glazed aluminum curtain wall system from one source and by a single manufacturer.
- E. **Product Options:** Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sight lines and relationships to one another and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- F. **Welding Standards:** Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."
1. Engage welders who have satisfactorily passed AWS qualification tests for welding processes involved and who are currently certified for these processes.
- J. **Energy Code Certification:** Provide certification of system U-value as determined in accordance with NFRC 100 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Provide certification of solar heat gain coefficient (SHGC) as determined in accordance with NFRC 200 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Provide certification of air infiltration rates as determined in accordance with AAMA/WDMA 101/LS.2 by an accredited, independent testing laboratory, and labeled and certified by the manufacturer. Reference article 1.3 "System Description" for U-value and air infiltration requirements. Reference Division 8 Section "Glazing" for SHGC requirements. Such certified and labeled U-values and SHGCs shall be accepted for purposes of determining compliance with the building envelope requirements of Title 18 of the Municipal Code of Chicago for Energy Efficiency Requirements.

1.6 PROJECT CONDITIONS

- A. **Field Measurements:** Verify dimensions by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication without field measurements. Coordinate

construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.7 WARRANTY

A. **Special Assembly Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Noise or vibration caused by thermal movements.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- d. Water leakage.
- e. Failure of operating components to function normally.

2. Warranty Period: **Three** years from date of Substantial Completion.

B. Special Finish Warranty: *Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.*

1. *Deterioration includes, but is not limited to, the following:*

- a. *Color fading more than 5 Hunter units when tested according to ASTM D 2244.*
- b. *Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.*
- c. *Cracking, checking, peeling, or failure of paint to adhere to bare metal.*

2. **Warranty Period:** *20 years 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. Profiles and dimensions are based upon Wausau Windows and Wall Systems Superwall Series 8250. Provide exact profiles and dimensions (2" face dimension).
2. EFCO Corporation.

2.2 MATERIALS

A. **Aluminum:** Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: ASTM A 36 (ASTM A 36M) for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 (ASTM A 570M) for hot-rolled sheet and strip.
- C. Glazing as specified in Division 8 Section "Glazing."
- D. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers; in hardness recommended by manufacturer.
- E. Glazing sealants and fillers as specified in Division 8 Section "Glazing."
- F. Framing system gaskets and joint fillers as recommended by manufacturer for joint type.
- G. Sealants and joint fillers for joints within glazed aluminum curtain wall system as specified in Division 7 Section "Joint Sealants."
- H. Firesafing materials as specified in Division 7 Section "Building Insulation."
- I. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.3 COMPONENTS

- A. Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide nonstaining, nonferrous shims for aligning system components.
- B. Exterior Closures and Trim: Minimum 0.125 inch thick sheet aluminum finished to match curtain wall and in profiles indicated. Provide aluminum aluminum stiffeners as required to eliminate distortion or oil canning. Provide aluminum clips as required for secure concealed fastening. Provide 1 inch return at joints for sealant.
- C. Interior Closures and Trim: Minimum 0.060 inch thick sheet aluminum finished to match curtain wall and in profiles indicated. Provide aluminum aluminum stiffeners as required to eliminate distortion or oil canning. Provide aluminum clips as required for secure concealed fastening. Provide 1 inch return at joints for sealant.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Finish exposed portions to match glazed aluminum curtain wall.
1. At movement joints, use slip-joint linings, spacers, and sleeves of material and type

- recommended by manufacturer.
 - 2. Where fasteners anchor into aluminum less than 0.125 inch (3.2 mm) thick, provide reinforcement to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads finished to match framing members, unless otherwise indicated.
- E. Anchors: 3-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- F. Concealed Flashing: Dead-soft, 26-gauge 0.018-inch- (0.457-mm-) thick stainless steel, complying with ASTM A 666, of type selected by manufacturer for compatibility with system.
- G. ***Foil-Faced-Slag-Wool-Fiber Board Safing Insulation: Semirigid boards designed for use as fire stop at openings between edge of slab and exterior wall panels, produced by combining slag-wool fibers with thermosetting resin binders to comply with ASTM C 612, Type IA and IB; nominal density of 4 lb/cu. ft. (64 kg/cu. m); passing ASTM E 136 for combustion characteristics; thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).***
- H. Doors: Provide manufacturer's standard 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
- 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
 - 2. Stile Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
- I. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
- 1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.

2.4 HARDWARE

- A. General: provide hardware as specified under specification Section 08710 Hardware, unless otherwise indicated. Hardware templates shall be furnished to the manufacturer for the fabrication of door and frames to receive hardware.

2.5 FABRICATION

- A. General: Fabricate glazed aluminum curtain wall system according to Shop Drawings. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.
- E. Welding: Weld components to comply with referenced standard and Shop Drawings, unless otherwise indicated. Weld before finishing components. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- F. Glazing Pockets: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Frame Units: Factory assemble frame units according to Shop Drawings to greatest extent possible. Rigidly secure nonmovement joints. Seal joints watertight, unless otherwise indicated. Assemble components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.
 - 1. Install glazing according to Shop Drawings. Comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.
- I. Thermal Break:
 - 1. Wall system isolator to be a special dual durometer rigid/flexible PVC providing minimum 3/8" thermal separation and sealing against water infiltration.
 - 2. Pressure plate retaining screw head and shank to integral molded nylon or other suitable low conductivity material.
 - 3. Zone dams at framing intersections to be foam neoprene or other suitable low conductivity compressible material compatible with sealants employed.
- J. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. Interior Doors: Provide ANSI/BHMA A156.16 silencers at stops to prevent metal to metal contact. Provide 3 silencers on strike jamb of single-door frames and 2 silencers on head

of double-door frames.

- K. Internally reinforce the Work as necessary for performance requirements, and for support to the structure. Separate metal surfaces at moving joints with nonmetallic separators to prevent "freeze-up" of joints.

2.6 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- 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 the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and 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.
 - 1. Color and Gloss: Match PPG No. 5VMN93388P Anodic Bronze.

2.7 STEEL PRIMING

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.
- B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.
- C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of glazed aluminum curtain wall system.

Do not proceed with installation until unsatisfactory conditions have been corrected or accommodations acceptable to Architect have been made.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing glazed aluminum curtain wall system. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight, unless otherwise indicated. Provide means to drain water to the exterior to produce a permanently weatherproof system.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.
- D. Install framing members plumb and true in alignment with established lines and grades.
- E. Install factory-assembled frame units plumb and true in alignment with established lines and grades.
- F. Anchorage: After system components are positioned, fix connections to building structure as indicated on Shop Drawings.
 - 1. Provide separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- G. Welding: Weld components to comply with referenced standard and Shop Drawings, unless otherwise indicated. Weld in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- H. Install glazing according to Shop Drawings. Comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.
- I. Install sealant according to Shop Drawings. Comply with requirements of Division 7 Section "Joint Sealants," unless otherwise indicated.
- J. Install firesafing in locations indicated. Comply with requirements of Division 7 Section "Building Insulation," unless otherwise indicated.
- K. Erection Tolerances: Install glazed aluminum curtain wall system to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
 - 2. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).

3. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm); where a reveal or protruding element separates aligned surfaces by less than 2 inches (50.8 mm), limit offset to 1/2 inch (12.7 mm).
 4. Location: Limit variation from plane or location shown on Shop Drawings to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.
- L. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
 2. Cut, reinforce, drill and tap frames and doors as required to receive hardware, except do not drill and tap for surface-mounted items until the time of installation at the Project Site. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
 3. Install all hardware, except surface-mounted hardware, at the fabrication plant. Remove only as required for final finishing operations, and for delivery and installation of the Work at the Project Site.

3.3 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensures glazed aluminum curtain wall system is without damage or deterioration at the time of Substantial Completion.

3.4 FIELD QUALITY CONTROL

- A. Field Tests: Contractor shall perform and pay for onsite tests of selected installed Curtain Wall System components. Test newly installed Aluminum Curtain Wall System products as directed by the Commission's Representative for air leakage and water penetration resistance.
1. ***Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.***
 - a. ***Test Area: A minimum area of 75 feet (23 m) by-2-story minimum area of glazed aluminum curtain wall system, test system for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.***
 2. Costs for all tests, both original and retest shall be paid for by the responsible Contractor. All unsuccessful tests, both original and retest, shall be paid for by the responsible Contractor.
 6. All work on Aluminum Curtain Wall System that fails the field tests shall be re-executed until the installation passes the field testing. Modify methods of installation of subsequent work to incorporate required corrections identified by the testing process.

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Project Rev D_06/30/10

END OF SECTION 08920

SECTION 15450

PLUMBING EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings
- B. Book 1: Project Information, Instructions to Bidders, and Execution Documents
- C. Book 2: Standard Terms and Conditions for Construction Contracts
- D. Book 2A: Standard Terms and Conditions Procedures Manual

1.2 SUMMARY

- A. This section includes plumbing equipment for the following:
 - 1. Domestic Water Booster Systems.
 - 2. Domestic Hot Water Circulating Pumps.
 - 3. Elevator Pit Pump.
 - 4. Domestic Water Heat Exchangers.
- B. The Contractor and all Sub-Contractors shall be required to submit documentation to substantiate compliance with all LEED requirements for this project. Final Acceptance is dependent upon the successful submittal of all LEED documentation as required by the contract documents. In addition to the LEED submittal requirements contained within this Section, refer to Section 01352 for LEED submittal requirements and LEED project requirements.
- C. This Section specifies equipment or systems, which will be commissioned as part of the construction process. The contractor will be required to provide documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel. The Commissioning Authority will work in cooperation with the contractor to ensure compliance. Final Acceptance is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Sections 01810 and 15995 for detailed commissioning requirements

1.3 SUBMITTALS

- A. Product Data: For each plumbing equipment indicated, include rated capacities of selected equipment and shipping, installed and operating weights. Include trade coordinated layouts that indicate dimensions, required clearances and method of assembly of components, piping and wiring connections for the following equipment:
 - 1. Domestic Water Booster Systems.
 - 2. Domestic Hot Water Circulating Pumps.
 - 3. Elevator Pit Pump.
 - 4. Domestic Water Heat Exchangers.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing equipment and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled.
 - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- D. Comply with NFPA 70, "National Electrical Code," for electrical components.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Refer to drawings for additional product information.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Domestic Water Booster System:
 - a. AMT
 - b. Metropolitan Pump Co.
 - c. Bell and Gossett.
 - 2. Domestic Hot Water Circulating Pump:
 - a. Bell and Gossett
 - b. Taco, Inc.
 - c. Grundfos.
 - 3. Elevator Pit Pump
 - a. Zoeller Pump Co.
 - b. Weil Pump Co.
 - c. Stancor Pump Co.
 - 4. Domestic Water Heat Exchangers and Water Heaters
 - a. PVI Industries
 - b. Lochinvar Co.
 - c. A.O. Smith Co.
 - d. Teledyne Laars.
 - e. Armstrong Co.

2.2 DOMESTIC WATER BOOSTER SYSTEM

- A. Furnish and install factory prefabricated variable speed duplex water pressure booster systems. Systems shall be of size and capacity as indicated on the Drawings.
1. PUMPS: Provide close-coupled, bronze fitted, end suction centrifugal pumps with lead free bronze impellers statically and dynamically balanced.
 2. MOTORS: Motors shall be; 3450 RPM, High Efficiency, Class F insulated definite purpose inverter rated as defined by NEMA MG 1, Part 31. Motors shall be in accordance with the values listed in Water Pressure Booster Schedule.
 3. STRUCTURAL ELEMENTS: The entire system shall be factory skid mounted on a 304-welded S.S. structural square tube supported frame, with in-shear molded rubber vibration isolators.
 4. VALVES: All valves shall be full port bronze ball valves for valve size 2" and smaller, and cast iron, lever operated, lug type butterfly valves, or mechanical grooved end valves with Aluminum/Bronze alloy disc, and Stainless Steel shaft, for valve sizes 2 ½ and larger. Valves must be rated for maximum pressure service for the system.
 5. CONTROL PANEL AND TOUCH SCREEN INTERFACE: The pumping system control panel shall incorporate the following elements, and criteria:
 - a. The pump controller, and all its components shall be housed in a Type 12, UL listed, ventilated, control enclosure unless specified otherwise. The controller shall have a NFPA 79 compliant main power disconnect switch, with enclosure door interlock, which shall require opening the disconnect switch before the control cabinet may be opened. The system shall provide for a single point electrical connection, with all power, both primary, and secondary to be de-activated by opening the main disconnect switch.
 - b. The entire controller shall be UL 508a listed for Industrial Control Panels, and have all UL listed devices of "Touch-Safe" design, which shall eliminate any bare handed shock hazard while the controller is energized. All primary branch and control circuits shall include circuit breakers (fuses are unacceptable) compliant with UL 489. All secondary control circuit wiring shall be 24 volts, AC/DC and the cabinet door front shall feature an Allen Bradley 256 color, 192 touch point, 5.7" minimum size LCD interface. The screen shall feature a field-replaceable, backlit display, 2 MB of memory with alarm logging and real-time clock. The interface shall meet UL 1604 for hazardous locations with an operating temperature range of 0-50 C.
 - c. The controller shall utilize an Allen Bradley 24 colt programmable logic controller with 14 digital inputs, 4 analog inputs, and 10 outputs, which shall provide all pump staging, and timing functions. All alarm conditions shall have audible, and visual indicators, with timed delayed proof of condition automatic reset and automatic alarm condition and recovery logging accessible through the LCD user interface. The PLC shall provide for automatic alternation between equal pumps. Pressure-based pump sequencing is unacceptable since a change in suction pressure can skew the sequencing point. Pump sequencing must be accomplished through electronic mean either by measuring KW, amperage or frequency as a reference to pump flow. There shall be no failure of any one system component which will render the system incapable of maintaining system flow to the building. All controls must be 100% fail-safe including failure of the PLC.

- d. The controller panel shall have the following features:
 - 1) Provide three phase lighting protection for entire control panel.
 - 2) Main power UL nonfused NFPA 79 compliant door interlocked disconnect switch.
 - 3) Individual suction and discharge pressure transducers.
 - 4) 5.7" LCD, 256 color touch screen with backlit display.
 - 5) Suction pressure historical trending with display.
 - 6) Automatic Alarm Logging feature with time stamp and recovery log.
 - 7) Automatic pump alternation between equal split pumps.
 - 8) Digital thermal probe.
 - 9) Integral freeze protection for outdoor systems.
 - 10) All control components shall be UL Listed devices.
 - 11) The controller shall be UL 508a Listed, and in accordance with the National Electric Code, (NEC).

Note: All components shall be of Allen Bradley manufacture. All components shall bear the manufacturer's original nameplate data, and source, such that repair parts may be readily available at reasonable cost to the owner.

6. PUMP SEQUENCING: All pump sequencing shall be initiated, and controlled via the programmable logic controller automatically to include the following features; lead pump alternation after every cycle, sequential alternation of lag pumps, sequence shifting that adjusts the program if any pump is disabled, "empty building start" which reduces surges on power loss auto restarts and field adjustable parameter settings.
7. PUMP THERMAL RELIEF: Provide electrically actuated, thermal sensing, recirculation, and pressure relief assembly to prevent pumps from overheating due to deadheading condition. The protective device shall actuate at 140 degrees F.
8. BLADDER TANK: A bladder tank is recommended for this system.
9. PRESSURE REGULATION: Pressure regulation is provided by individual Allen Bradley variable frequency drive controller with PID control. No other pressure regulators are required. In the event of drive failure, next drive in sequence shall start automatically and failed drive shall indicate a fault condition. In the event of a loss of transducer signal, the system shall be pre-programmed to a "fail-safe mode" which will ramp pumps to a safe-speed and maintain positive pressure on the system piping without shutting the system down. There will be no failure of the major control components which will compromise the building pipe pressure ratings.
10. FABRICATION: All headers, nipples, and welded attachments to the headers shall be type 304 stainless steel materials. All welding shall be in accordance with section IX of the ASME Boiler and Pressure Vessel code, all welding on stainless steel piping shall be back-purged with inert gas during the entire welding procedure, and shall be performed by welders qualified under that standard. The completed system shall be hydrostatically tested after all appurtenances have been installed to a minimum of 1.5 times the specified system working pressure. Each pump shall have an individual resilient seated non-slam type check valve on each pump immediately downstream of the pump discharge. A main system discharge valve is required on the plumbing system for proper system set-up. A high capacity air vent is also to be installed on the plumbing system.

11. **START-UP:** A qualified factory trained technician shall perform initial factory start-up, and owner training. A factory certified start-up report must be provided to the owner, dated and signed by the factory technician.
12. **PARTS:** A complete listing of all parts, and equipment for the system shall be listed using the original manufacturer's model, serial numbers.
13. **OWNER TRAINING:** The owner instruction and training shall include, but not be limited to the following:
 - a. Training in the replacement of the motor, mechanical seals pump impeller.
 - b. Proper operation of the system, troubleshooting, alarm, and reset features.
14. **SERVICE:** Provide 24/7/365 factory certified field service during the warranty period, and make the same service available, to the Owner after the warranty period is concluded.
15. **WARRANTY, AND FACTORY AUTHORIZED SERVICE:** Provide 24 hour, 7 days per week, factory authorized field warranty service for a period of (12) months after the factory start-up service, or (18) months from the date of shipment whichever occurs first. Make available to the owner factory authorized field service after the warranty period.

2.3 HOT WATER CIRCULATING PUMP

- A. Provide in-line circulation pumps where indicated and of sizes, capacities and types indicated.
 1. Pumps to be all bronze construction. Impellers to be statically, dynamically, and hydraulically balanced with shafts of stainless steel and lubricated type bearings. Provide mechanical seals for continuous operation at the temperatures encountered. Seals to be guaranteed by the pump manufacturer. Pumps to be connected to NEMA non-overloading motors as specified in Section 15170.
 2. Each individual pump installation to be provided with the following:
 - a. A shut-off valve and gauge in pump suction and discharge piping.
 - b. A check valve, balancing valve and gauge in pump discharge piping.

2.4 ELEVATOR PIT PUMP

- A. Provide oil minder pit pump in elevator shaft pit, of capacity as indicated on drawings.
- B. Unit shall be submersible type, cast iron shell, cast iron impeller, stainless steel shaft, oil-filled capacitor start with built-in overload protection.
- C. Unit shall be installed in 18" diameter x 30" deep concrete sump pit.

2.5 DOMESTIC HEAT EXCHANGERS AND WATER HEATERS

- A. The entire system shall comply with section 18-29-501 of the Chicago Building Code.
- B. The domestic heat exchangers and storage tank shall be constructed with ASME code steel and stamped in accordance with Section IV, Part HLW of the ASME code. The domestic heat exchangers will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure. All tank and storage tank connections will be nonferrous.

- C. The heat exchanger coil shall be a double-wall, copper or copper-alloy, plate and frame with appropriate nonferrous waterside baffles and tie rods. Standard heat exchanger will be constructed to ASME code and rated for 150 psi and 300 °F service.
- D. Tank lining and storage tank shall be polymer complying with NSF 61. The entire lining will be applied only after the tanks are completely fabricated and all welding is completed. The lining shall consist of multiple applications creating a continuous and nonporous barrier with no interruptions or discontinuities, particularly at the tank-to-fitting transitions.
- E. Provide with adjustable temperature aqua-stat and all controls and specialties necessary for the operation of the domestic water and boiler water systems. As a minimum, the domestic heat exchanger shall be equipped with immersion upper and lower operating thermostats, an immersion temperature limiting device, and an ASME-rated temperature and pressure relief valve.
- F. Heater exchanger and storage tanks shall have a five-year warranty covering manufacturing or material defects of the storage tank, heat exchanger, controls and other components, and/or the production of rusty water. Warranty shall cover, but is not limited to, the following failures:
 - 1. Structural failures including storage tank and supports.
 - 2. Faulty operations of controls
 - 3. Deterioration of metals, finishes, and other materials beyond normal use.
- G. The domestic heat exchangers and storage tank shall be completely factory packaged, requiring only job site hookup to utilities and domestic water piping. The domestic heat exchangers and storage tank shall be insulated to meet current ASHRAE standards and will be jacketed in coated steel panels. The domestic heat exchangers and storage tank shall fit properly in the space provided and installation shall conform to all local, state, and national codes.
- H. The Water Heater shall bear the ASME “H” stamp and shall be National Board listed for inputs in excess of 200,000 Btu/Hr. there shall be no banding material, bolts, gaskets, or “O” rings in the header configuration. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a five (5) year limited warranty.
 - 1. The Water Heater shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The Water Heater shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating Water Heater firing rates for maximum efficiency. The Water Heater shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column.

2. The Water Heater shall be installed and vented with a Direct Vent Vertical system with a vertical roof top termination of both the vent and combustion air. The flue shall be Stainless Steel sealed vent material terminating at the roof top with the manufacturers specified vent termination. A separate pipe shall supply combustion air directly to the Water Heater from the outside. The air inlet pipe shall be Stainless Steel sealed pipe. The air inlet shall terminate on the roof top with the Manufacturer's specified air inlet cap. The Water Heater's total combined air intake length shall not exceed 100 equivalent feet. The Water Heater's total combined exhaust venting length shall not exceed 100 equivalent feet. *Foam core pipe is not an approved material for exhaust piping.*
3. The Water Heater's firing control system shall be M9 Direct Spark Ignition with Electronic Supervision.

PART 3 – EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. All equipment shall be installed in locations indicated on the Drawings, as detailed, and/or in accordance with manufacturers' recommendations.
- B. Equipment installations shall be made with provisions for ease of future maintenance and replacement of equipment.
- C. Floor mounted equipment shall be provided with a concrete housekeeping pad. Pad shall be 4-inch thickness and shall extend 4-inches beyond footprint of equipment.
- D. Domestic Booster Pump shall have full size bypass with isolation valve (normally closed).

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install piping connections between plumbing equipment and piping specified in other Division 15 Sections.
 2. Install piping connections indicated between equipment specified in other Sections; connect directly to plumbing piping systems.
- B. Install hoses between plumbing specialties and appliances as required for connections.
- C. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power is specified in Division 16 Sections.
- D. Ground electric-powered plumbing specialties.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise the field assembly of components and installation of grease recovery units, including piping and electrical connections, and to report results in writing.
 - 1. Test and adjust plumbing equipment controls and safeties. Replace damaged and malfunctioning controls and components.

3.4 FIELD QUALITY CONTROL

- A. Before startup, perform the following checks:
 - 1. Tests are complete.
 - 2. Damaged and defective specialties and accessories have been replaced or repaired.
 - 3. Clear space is provided for servicing equipment.
- B. Before operating systems, perform the following steps:
 - 1. Close drain valves.
 - 2. Open general-duty valves to fully open position.
 - 3. Remove and clean strainers.
- C. Startup Procedures: Follow manufacturer's written instructions. If no procedures are prescribed by manufacturer, proceed as follows:
 - 1. Energize circuits for electrically operated units. Start and run units through complete sequence of operations.
- D. Adjust operation and correct deficiencies discovered during commissioning.

3.5 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing interceptors.
 - 2. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing grease recovery units.
 - 3. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."

END OF SECTION 15450