

Delaware Army National Guard Readiness Center
DEARNG #20017-RRTSRCCONS; NGB #100093

Addendum 4
August 25, 2023

1. Bidder Questions and Answers. (attached)
2. The Project Manual is amended in accordance with Amendment No. 2 (attached)
3. For the drawings indicated in the table below, replace the previous issued drawings with revised drawings. Use this link to access: [DEARNG RRTS Readiness Center Addendum 4 - drawings](#)

Drawing	Title	Rev	Date
G-000	COVER SHEET	2	08/25/23
C-125A	CONSTRUCTION SITE NOTES AND DETAILS	0	08/25/23
C-128	STORMWATER MANAGEMENT PLAN FACILITY #2	2	08/25/23
C-129	STORMWATER MANAGEMENT PLAN FACILITY #3	2	08/25/23
C-130	STORMWATER MANAGEMENT PLAN FACILITY #4	2	08/25/23
A-505	INTERIOR DETAILS	2	08/25/23
A-703	ALTERNATE 7 – FLOOR FINISHES	2	08/25/23
E-201	FLOOR PLAN – POWER	2	08/25/23
E-202	ROOF PLAN - ELECTRICAL	2	08/25/23
E-503	ELECTRICAL DETAILS	2	08/25/23

Attachments:

1. Bidder Questions and Answers.
2. Amendment #2.

John Sclesky, PE



Century Engineering, LLC

DEARNG # 20017-RRTSRCCONS, NGB # 100093

BIDDER QUESTIONS AND ANSWERS

Q1: Please verify that Schluter Dilex are to be installed vertically at Internal corners at all tiled wall locations.

A1: All internal vertical corners shall be per 8/ A-505 – Schluter Dilex AHK - See revised Drawings.

Q2: Clarify that Tile is to be installed over Block walls by others and the TCNA Method to be used.

A2: Tile on Masonry shall be installed per TCNA W211 per specifications. All tile Work is in Contract. No Work is “by others” – See revised Specifications.

Q3: Page 6-line item 3.4 A Interior Floor Installation Lists Six (6) TCNA Methods Please ask what one they want to use exactly since this is a new building on new concrete.

A3 Interior Floor Installation, concrete Subfloor to be TCNA F115: Thinset mortar; epoxy grout – See revised Specifications.

Q4: Line item B, C, D and E up to page Eight (8) same section (Walls) Please ask what methods are to be used.

A4: Interior Tile Wall installation shall be per TCNA W243, TCNA W245, and/or TCNA B419 / TCNA B415– See revised Specifications.

Q5: On A201 Aluminum storefront SF-1 is listed as Kawneer 451UT which is ultra-thermal 4 ½” x 2”. The spec says 451T which is thermal. The details show a 6” deep extrusion. What system are we to provide.

A5: Basis of Design Window System to be Kawneer 451UT Framing System – 4 ½” depth – See revised Specifications.

Q6: The glazing spec states 1” thick laminated insulated glass. The glazing schedule on A601 says 1 5/16” laminated insulated glass. What thickness insulated glass are we to provide.

A6: Exterior glazing to be 1 5/16” laminated insulated blast resistant glass – See revised Specifications.

Q7: Will the owner accept a traditional Franklin lightning protection system?

A7: The ESE system has been removed and a traditional lightning protection system is specified. See revised specification section and drawings.

Q8: Who is the current vendor for controls on this site.

A8: There is specific vendor for controls at the River Road Training Site. The control system is to be an open BacNet/Lonworks/Non-proprietary system.

Q9: On Drawing M-101, in the kitchen Rm. 147, there is an outline for an Ansul Cabinet. I couldn’t find any information about it in the specs. Can you please provide more information.

A9: The requirements for the Ansul system are included in the project manual. Reference Appendix 8, Foodservice Equipment List, item 21A.

DEARNG # 20017-RRTSRCCONS, NGB # 100093

Q10: Who owns the nailable insulation board at the parapet walls?

A10: Means and Methods of Construction is the responsibility of the Contractor. Install as required to obtain roof warranty.

Q11: How is the nailable insulation board, shown on details on sheet A-501, to be attached to the CMU? Adhered, anchored?

A11: Install per nailable insulation board manufacturers written directions. Board may be adhered or anchored.

Q12: The 7/16" OSB nailable insulation board on top of the parapets shown on details on sheet A-501 appear to be installed upside down with 5/8" plywood attached on the insulation side. All of this is attached to 2x wood blocking, is this the intent?

A12: The intent is to install continuous insulation over the top of the parapet wall. The details were designed to allow the system to be connected to the top of wall without crushing the insulation. A/E is open to other configurations of this detail.

Q13: The roof plan, 2/A-104, shows a coverboard AND a 5/8" "thermal barrier underlayment" (substrate board). The roofing spec, section 07 54 23 TPO roofing, 2.5 insulation accessories, B. coverboard, list the coverboard as 5/8" factory primed gyp. board without a spec for the substrate board. Is it the intent to have both a 5/8" gyp. coverboard AND a 5/8" gyp. substrate board? Please clarify.

A13: The roof shall have a 1/2" HDP coverboard and a 5/8" gypsum board thermal Barrier – Per revised specifications.

Q14: We have reviewed the SWM plans and do not see any plants listed as indicated in the answer to Q7 from the 8/17/23 responses.

A14: Please reference the landscape/planting requirements noted on the SWM drawings C-128, C129 and C130. This is the only landscaping required, which is for the bio-retention ponds.

Q15: Mechanical Scope:

- a. Could you please provide a list of approved alternates for the Little Giant VC Series?
- b. Could you please provide a list of approved alternates for the Daikin VRF system?
- c. Could you please provide a list of approved alternates for the Daikin split systems?
- d. Could you please provide a list of approved alternates for the Arrow Foil/Honeywell automatic temperature controls, or is it only those two manufacturers?

A15: Approved equal will be considered for all items a thru d.

DEARNG # 20017-RRTSRCCONS, NGB # 100093

Q16: Plumbing Scope:

- a. Could you please provide a list of approved alternates for the Bell and Gossett circuit setters?
- b. Could you please provide a list of approved alternates for the Watts flow measuring ball valves?
- c. Could you please provide a list of approved alternates for the Watts thermostatic mixing valve?
- d. Are there any other approved alternates for the backflow preventer other than Watts and Febco, and if so, could you please list them?
- e. Are there any other approved alternates for the expansion tank other than Watts and Febco, and if so, could you please list them?

A16: Approved equal will be considered for all items a thru e.

Q17: What are the pipe sizes for the refrigerant piping that is to be installed for the VRF? There are no sizes listed on the drawings or in the schedules for the equipment connections. Could you also please provide a piping diagram as well?

A17: For a VRF system, the pipe sizes and piping schematic are to be generated by the manufacturer. These items are not part of a typical MEP design and must be produced by the manufacturer.

DEARNG # 20017-RRTSRCCONS, NGB # 100093

AMENDMENT NO. 2

The Project Manual is amended as follows:

1. Specification Section 07 54 23 SF Thermoplastic-Polyolefin (TPO) Roofing. Remove previous specification in its entirety and replace with the revised section. Attached.
2. Specification Section 08 80 00 Glazing. Remove previous specification section in its entirety and replace with the revised section. Attached.
3. Specification Section 08 43 00 Aluminum Framed Storefront System – Blast Resistant. Remove previous specification section in its entirety and replace with the revised section. Attached.
4. Specification Section 09 30 13 SF Ceramic Tiling. Remove previous specification section in its entirety and replace with the revised section. Attached.
5. Specification Section 26 41 13 Lighting Protection System. Remove previous specification section in its entirety and replace the revised section. Attached.

End of Amendment No. 2

SECTION 07 54 23 – THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Roof insulation.
3. Cover board.
4. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples: For the following products:

1. Roof membrane and flashings, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Single source Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.
2. "No dollar limit" full system watertightness.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. Wind Uplift Resistance: Design roofing system to resist wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-90
 - 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.
- E. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
 - 1. Wind Uplift Load Capacity: 90 psf.
- F. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- H. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.
 - 1. Thickness 80 mils , nominal.
 - 2. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction and LEED requirements.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard, water based.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 1. Size: 48 by 48 inches or 48 by 96 inches.
 2. Thickness:
 - a. Base Layer: 1-1/2 inches.
 - b. Upper Layer: As required to achieve R value.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 1. Material: Match roof insulation.
 2. Minimum Thickness: 1/4 inch.
 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

- A. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

- B. ~~Cover Board~~ Thermal Barrier Under Layment: ASTM C1177, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
 - 1. Thickness: 5/8 inch.
 - 2. Surface Finish: Factory primed.
- C. Cover Board: ASTM C1289 Type II, Class 4, Grade 3, High-Density Polyiso (HDP).
 - 1. Thickness: 1/2 inch.
 - 2. Surface Finish: Factory primed.

2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches.
 - 2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.
 - a. Test Frequency: One test probe per each 1000 sq. ft. or portion thereof, of roof deck, with not less than three tests probes.
 - b. Submit test reports within 24 hours after performing tests.
 - 3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - 4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.3 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 - 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - d. Fill gaps exceeding 1/4 inch with insulation.
 - e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - f. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
 - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water flow is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

- g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

3.4 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, 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 roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.5 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 INSTALLATION OF WALKWAYS

A. Flexible Walkways:

1. Install flexible walkways at the following locations:
 - a. Retain one or more subparagraphs below. Revise to suit Project.
 - b. Perimeter of each rooftop unit.
 - c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - e. Top and bottom of each roof access ladder.
 - f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - g. Locations indicated on Drawings.
 - h. As required by roof membrane manufacturer's warranty requirements.
2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system 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 roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Laminated glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

1.2 COORDINATION

- ##### A.
- Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.3 PREINSTALLATION MEETINGS

- ##### A.
- Preinstallation Conference: Conduct conference at:

Delaware Army National Guard Readiness Center
River Road Training Site
1197 River Road
New Castle Delaware

1.4 ACTION SUBMITTALS

- ##### A.
- Product Data: For each type of product.
- ##### B.
- Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1.5 INFORMATIONAL SUBMITTALS

- ##### A.
- Product Certificates: For glass.
- ##### B.
- Product test reports.
- ##### C.
- Preconstruction adhesion and compatibility test report.
- ##### D.
- Sample warranties.

1.6 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

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

- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

- 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Snow Loads: As indicated on Drawings.
 - 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

- B. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 2 for enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
 2. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
 3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.
- E. Acoustic Performance:
 1. Exterior Glazing: 33 OITC.
 2. Interior Glazing: 37 STC.

2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.
- E. Exterior Glazing: Provide laminated glass with a minimum interlayer thickness of 0.030 in. and a load resistance determined from ASTM E 1300 greater than or equal to the 3-second duration equivalent design load determined from ASTM F 2248.

2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

2.4 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer, ionoplast interlayer, or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions. The 1/4" laminated glass consists of two nominal 1/8 inch glass bonded together.
 - 2. Interlayer Thickness: Provide thickness not less than 0.030 in. and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - 3. For insulated glass units use the laminated glass for the innermost pane as a minimum.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
- C. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

- D. Acid-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
 - 1. EPDM Silicone with Shore A durometer hardness of 85, plus or minus 5.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
 - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Edge Blocks:
 - 1. EPDM Silicone with Shore A durometer hardness per manufacturer's written instructions.
 - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- F. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation, remove non-permanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.6 LAMINATED GLASS SCHEDULE

- A. Laminated Tinted Glass Type : Two plies of fully tempered float glass with outer ply tinted and inner ply clear.
 - 1. Tint Color: Bronze
 - 2. Minimum Thickness of Each Glass Ply: 6 mm.
 - 3. Interlayer Thickness: 0.030 inch min.
- B. Low-E-Coated, Laminated Vision Glass Type: Two plies of clear fully tempered float glass.
 - 1. Minimum Thickness of Each Glass Ply: 6 mm.
 - 2. Interlayer Thickness: 0.030 inch min.
 - 3. Low-E Coating: Pyrolytic or sputtered on second or third surface.

3.7 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Tinted Insulating Glass Type :
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.
 - 3. Outdoor Lite: Tinted fully tempered float glass.
 - 4. Tint Color: Bronze.
 - 5. Interspace Content: Air.
 - 6. Indoor Lite: Clear fully tempered float glass.
 - 7. Low-E Coating: Pyrolytic or sputtered on second or third surface.

3.8 INSULATING-LAMINATED-GLASS SCHEDULE – Blast Resistant

- A. Low-E-Coated, Tinted, Insulating Laminated Glass Type:
 - 1. Overall Unit Thickness: 1 5/16" inch.
 - 2. Minimum Thickness of Outdoor Lite: 3 mm.
 - 3. Outdoor Lite: Tinted fully tempered float glass.
 - 4. Tint Color: ~~Bronze~~: Optigray Tempered w/ Solarban 60 on #2 Surface
 - 5. Interspace Content: Air.
 - 6. Indoor Lite: Clear laminated glass with two plies of fully tempered float 1/8" annealed glass.
 - a. Minimum Thickness of Each Glass Ply: 3 mm.
 - b. Interlayer Thickness: ~~0.030 inch~~-.060 PVB
 - 7. Low-E Coating: Pyrolytic or sputtered on second or third surface.

END OF SECTION 08 80 00

SECTION 08 43 00 – ALUMINUM-FRAMED STOREFRONT SYSTEMS – BLAST RESISTANT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems (Blast Resistant).
2. See Section 08 80 00 – for Glazing

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Blast resistant storefront frame structural anchoring devices locations and details.
3. Show dimensioned details of storefront system, including intended metal and glazing materials. 1: 20 (Three quarter inch equals 1 foot) scaled elevations showing interior and exterior. Indicated how storefront units can be replaced or removed, including replacement of glazing. Shop drawings shall be submitted for review and approval prior to fabrication. The contractor is responsible for all field verification of conditions and dimensions for new construction. The field verification shall be conducted and incorporated in the submitted shop drawings and calculations prior to submission. Blast calculations and or testing data shall be submitted with the shop drawings.
4. Show detailed sections at 1: 5 (3 inch equal 1 foot) scale for members; indicating construction, size, and thickness of components, together with connections, fasteners, and means of separating dissimilar metals.
5. Provide final submittal drawings as DWG AutoCAD files.

- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Calculations: Submit calculations for review and approval prepared by qualified blast consultant, with a minimum of 5 years of experience in design of blast resistant systems, verifying system and glazing assembly including anchors comply with specified blast resistance performance given in this specification. The magnitudes of the design threats W1, W2 and GP1, GP2 are defined in the Physical Security and Resiliency Design Standards Data Definitions which is a document separate from the referenced VA Security and Resiliency Design Manual. The Physical Security and Resiliency Design Standards Data Definitions are provided on a need to know basis by the structural blast specialist performing the blast design on VA projects. It is the responsibility of the delegated engineer responsible for the design of blast resistant storefront to request and obtain the Physical Security and Resiliency Design Data Standard Data Definitions from the VA Office of Construction and Facilities Management (CFM). Any associated delays or increased costs due to failure to obtain this information will be borne by the contractor.
- F. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Manufacturer with project experience list demonstrating a minimum of 5 years of experience manufacturing blast resistant windows.
 - 2. Installer with project experience list demonstrating a minimum of 5 years of experience installing blast resistant windows.

1.4 DESIGN ANALYSIS

- A. Submit structural calculations for deflection to substantiate compliance with requirements and Antiterrorism Performance Requirements. A registered Professional Engineer must provide calculations. Submit design analysis with calculations showing that the design of each different size and type of aluminum storefront unit and its anchorage to the structure meets the requirements of paragraph ANTITERRORISM PERFORMANCE REQUIREMENTS. Calculations verifying the structural performance of each system proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the storefront components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.
- B. Submit test reports for each type of system attesting that identical systems have been tested and meet the requirements specified herein for conformance to AAMA/WDMA/CSA 101/I.S.2/A440 including test size, and minimum condensation resistance factor, and resistance to forced entry. For Antiterrorism storefront system, in lieu of a Design Analysis, results of airblast testing, whether by arena test or shock tube, must be included in a test report, providing information in accordance with ASTM F1642/F1642M, as prepared by the independent testing agency performing the test. The test results must demonstrate the ability of each system proposed for use to withstand the airblast loading parameters and achieve the hazard level rating specified in paragraph STANDARD AIRBLAST TEST METHOD.
- C. As an alternative to the 'Computational Design Analysis Method' and 'Dynamic Design Analysis Method' indicated above, window assembly may be tested for evaluation of hazards

generated from airblast loading in accordance with ASTM F1642/F1642M by an independent testing agency regularly engaged in blast testing. For proposed systems that are of the same type as the tested system but of different size, the test results may be accepted provided the proposed window size is within the range from 25 percent smaller to 10 percent larger in area and aspect ratio of the original qualified tested glazing systems in accordance with ASTM F2912. Proposed system/assembly of a size outside this range will require testing to evaluate their hazard rating or are certified by the 'Dynamic Design Analysis Method' indicated above. Testing may be by shock tube or arena test. Perform the test on the entire proposed system/assembly, including, the glazing, its framing/support system, operating devices, and all anchorage devices. Support system replicate anchorage of the support system with the method of installation to be used for the project. The hazard rating for the proposed systems, as determined by the rating criteria of ASTM F2912, to provide performance equivalent to or better than a very low hazard rating (i.e. the "No Break", "No Hazard", "Minimal Hazard", "Very Low Hazard" and "Low Hazard" ratings are acceptable. "High Hazard" ratings are unacceptable. Results of window systems previously tested by test protocols other than ASTM F1642/F1642M may be accepted provided the required loading, hazard level rating, and size limitations stated herein are met.

1.5 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated

by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- D. All blast design calculations must be performed by or under the direct supervision of a registered engineer with a minimum of 5 years experience performing blast design. The engineer performing the blast design must be able to demonstrate experience on similar size projects using similar design methods to meet the requirements outlined in this specification.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

1.9 REFERENCES

- A. ASTM E1300 (2016) Standard Practice for Determining Load Resistance of Glass in Buildings
- B. ASTM E1886 (2019) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
- C. ASTM F1642/F1642M (2017) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
- D. ASTM F2248 (2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
- E. ASTM F2912 (2017) Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings

- F. UFC 4-010-01 (2018; with Change 2, 2022) DoD Minimum Antiterrorism Standards for Buildings

1.10 STRUCTURAL PERFORMANCE

- A. Structural test pressures on storefront units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage. There must be no permanent deformation of any storefront frame excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440.
- B. System must meet the antiterrorism performance criteria as specified in the paragraphs below in accordance with UFC 4-010-01. Conformance to the performance requirements must be validated by one of the following methods.
 - 1. Design assembly to the criteria listed herein. Include computational design analysis calculations verifying the structural performance of each assembly proposed for use, under the given static equivalent loads.
 - 2. Design assembly using a dynamic analysis to prove the system will provide performance equivalent to or better than a very low; hazard rating in accordance with ASTM F2912. Use a triangular blast load using the applicable pressure and impulse indicated above.

1.11 ANTITERRORISM PERFORMANCE REQUIREMENTS

- A. System must meet the antiterrorism performance criteria as specified in the paragraphs below in accordance with UFC 4-010-01. Conformance to the performance requirements must be validated by one of the following methods.
 - 1. Design assembly to the criteria listed herein. Include computational design analysis calculations verifying the structural performance of each window assembly proposed for use, under the given static equivalent loads.
 - 2. Design storefront system frames and glazing to the criteria listed herein. Include computational design analysis calculations verifying the structural performance of each system proposed for use.
 - 3. Design Aluminum framing members to restrict deflections of the edges of glazing they support to $L/60$ under two times (2X) the glazing resistance per the requirements of ASTM F2248 and ASTM E1300.

PART 2 - PRODUCTS

2.1 MANUFACTURERS – Provide blast resistant storefront system from one manufacturer.

- A. Kawneer: TriFab ~~VersaGlaze 451/451F~~ 451UT Framing System - 4 ½” depth
- B. Oldcastle: BRW-500 BlastMax – 5” depth
- C. YKK Corporation: YHS 50 ~~FS~~ FI – 5” depth
- D. Approved Equal

2.2 SYSTEM PERFORMANCE

- A. Design windows complying with specified performance:
 - 1. Comply with VA Physical Security and Resiliency Design Manual
 - a. Standoff Distance: 28 feet
 - b. Design Threat W1 at the standoff distance not to exceed pressure and impulse associated with GP1 threat for Life Safety Protected Buildings W1 at the standoff not to exceed pressure and impulse associated with GP2 threat for Mission Critical Protected Buildings.
 - c. Mullion deformation not to exceed deformation limits shown in Table 6-4 of the referenced Physical Security and Resiliency Design Manual.
 - d. Glazing performance condition shall not exceed those shown in Table 6-3 of the referenced Physical Security and Resiliency Design Manual.
 - e. Glass shall be restrained within the mullions with min ½” bite and min 3/8” wide continuous bead of structural silicone adhesive attaching the inner lite of the glass to the frame.
 - f. ASTM F1642, ASTM F1233 and AAMA/WDMA/CSA 101/I.S.2/A440.
 - 2. Provide indicated levels of resistance for forced entry and blast resistances storefront assemblies. Resistance level applies to anchorages, interfaces with adjoining substrates, glass retention, and hardware.
 - 3. Would be attackers cannot penetrate through secure closed storefront assembly.
 - 4. Provide combined performances within rating limitations knowing certain attacks can result in severe damage to unit and require replacement.
- B. Forced Entry (FE) Resistant Assemblies: Manufacturer's storefront assembled with panels, inserts, hardware, glazing and framing.
 - 1. Resistance of 5 minutes for forced entry, using basic hand tools.
- C. Blast Resistant (BR) Assemblies: Manufacturer's storefront unit assembled with panels, inserts, glazing and framing.
 - 1. As required to meet the blast performance requirements listed in this specification
- D. Thermal Movement: Assembly capable of withstanding thermal movements resulting from ambient range of 67 degrees C to 82 degrees C.
- E. Design Performance: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA/WDMA/CSA 101/I.S.2/A440 for AW Class.

1. Wind Load Resistance: ASCE/SEI 7; Design criteria as indicated on Drawings.
2. Water Infiltration: ASTM E331; no uncontrolled penetration at 300 Pa minimum, pressure differential.
3. Air Infiltration: ASTM E283; Maximum 6 liter/second/square meter at static pressure difference of 300 Pa.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: Blast Requirements – 55 lbs TNT at 28 ft.
- D. Deflection of Framing Members Supporting Glass: At design wind load (negative and positive), as follows:
 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
 1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- G. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 2. Solar Heat Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.35 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283.
 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
- H. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 2 for enhanced protection.
1. Large-Missile Test: For glazing located within 30 feet of grade.
 2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.4 ALUMINUM-FRAMED STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken.
 2. Interior Vestibule Framing Construction: Nonthermal.
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Glazing Plane: Front.

5. Finish: Anodic Finish.
 6. Fabrication Method: Field-fabricated stick system.
 7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 8. Steel Reinforcement: As required by manufacturer.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
 - C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components. Anchor storefront frames to the supporting structure with anchors designed to resist two times (2X the glazing resistance in accordance with ASTM F2248 and ASTM E1300.

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B221.
 1. Framing Members: Alloy 6063 T5, T6, or T52, or alloy 6061 T6; 5 mm (3/16 inch) minimum thickness.
 2. Trim and Stops not exposed to forced entry attack: Alloy 6063 T5, T6, or T52; 1.5 mm (1/16 inch) minimum thickness.
- B. Bolts and Fasteners: ASTM A320/A320M; Type 300 series stainless steel screws, bolts, nuts, and washers. Non removable type where accessible from attack side.
- C. Sheet and Plate: ASTM B209 (ASTM B209M).
- D. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- E. Structural Profiles: ASTM B308/B308M.
- F. Steel Reinforcement:
 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- G. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. 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.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.
- F. Unit Anchorages: Fabricate metal anchorage system complying with performance requirements.

2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Dark bronze, as selected by Architect from full range of industry colors and color densities to match storefront at adjacent building.

PART 3 - EXECUTION

3.1 DELIVERY

- A. Deliver storefront in manufacturer's original sealed packaging.
- B. Mark packaging, legibly. Indicate manufacturer's name or brand, unit type, and manufacture date.
- C. Before installation, return or dispose of products within distorted, damaged, wet, or opened packaging.

3.2 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.

ALUMINUM-FRAMED STOREFRONTS – BLAST-RESISTANT

- B. Protect products from damage during handling and construction operations.

3.3 FIELD CONDITIONS

- A. Field Measurements: Verify field conditions affecting storefront fabrication and installation. The field verification shall be conducted and incorporated in the submitted shop drawings and calculations prior to submission. Show field measurements on Submittal Drawings

3.4 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.
- K. Anchorage to Existing Building:
 - 1. Spacing: Maximum 300 mm (12 inch) on center through pre drilled bolt holes in structural frame. Install anchorage per reviewed and approved shop drawings.
 - 2. Anchor Diameter: 10 mm (3/8 inch) minimum.
 - 3. Minimum Embedment and Edge Distances:
 - a. Embedment in Solid Masonry: 150 mm (6 inches).
 - b. Edge Distance: 75 mm (3 inches).
 - c. Do not cut rebar during anchor installation without approval of the Architect.

3.5 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - 3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
- C. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 08 43 13

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quarry tile.
 - 2. Porcelain tile.
 - 3. Glazed wall tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Each type and composition of tile and for each color and finish required.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Square-Edged Quarry Tile Type: Unglazed.
 - 1. Daltile Quarry Tile, QT-1 (or approved equal)
 - 2. Face Size: 6 by 6 inches
 - 3. Thickness: 1/2 inch
 - 4. Wearing Surface: Abrasive
 - 5. Dynamic Coefficient of Friction: Not less than 0.42.
 - 6. Finish: Mat, opaque
 - 7. Tile Color and Pattern: OQ42Arid Gray
 - 8. Grout Color: As indicated by manufacturer's designations.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base, B-3: Coved with round bottom and all required coordinating corner pieces, face size 5 by 6 inches (127 by 152 mm)
- B. Porcelain Tile Type:
 - 1. Daltile Reminiscent (or approved equal)
 - 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
 - 3. Face Size: 12 by 24 inches
 - 4. Face Size Variation: Rectified.
 - 5. Thickness: 5/16" (7.8 mm)
 - 6. Face: Plain with square or cushion edges
 - 7. Dynamic Coefficient of Friction: Not less than 0.42.
 - 8. Tile Color, Glaze, and Pattern: Aged Beige RM21 (CT-1), 33% Offset
 - 9. Grout Color: Bostik Mobe Pearl H145
- C. Glazed Wall Tile Type:
 - 1. Daltile Color Wheel Classic (or approved equal)
 - 2. Module Size: 6 by 6 inches (152 by 152 mm)
 - 3. Face Size Variation: Rectified.
 - 4. Thickness: 5/16 inch (8 mm).

5. Face: Pattern of design indicated on drawings, with manufacturer's standard edges
6. Finish: Mat, opaque
7. Tile Color and Pattern: Urban Putty 0761 (CT-3), Artisan Brown 0744 (CT-4)
8. Grout Color: Bostik Mobe Pearl H145
9. Trim Units
 - a. At GWB partitions: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes
 - 1) Base (CT-2): Bullnose with rounded top and all required coordinating corner pieces, face size 6 by 6 inches
 - b. At Tiled Partitions: Schluter trim as indicated on drawings.
- D. Internal Corners: Schluter trim as indicated on drawings.

2.3 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
 1. For wall applications, provide nonsagging mortar.
- C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
 3. For wall applications, provide nonsagging mortar.
- D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
 1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
 3. For wall applications, provide nonsagging mortar.
- E. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
- F. Organic Adhesive: ANSI A136.1, Type I.

2.4 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
- C. High-Performance Tile Grout: ANSI A118.7.
 1. Polymer Type:
 - a. Dry, redispersible form, prepackaged with other dry ingredients.
 - b. Liquid-latex form for addition to prepackaged dry-grout mix.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

2.5 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Transitions: Schluter transitions as indicated on drawings.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the

ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Quarry Tile: 1/4 inch
 2. Glazed Wall Tile: 1/16 inch
 3. Porcelain Tile: 1/4 inch
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Metal Edge Strips: Install at locations indicated. **Install at all internal corners.**
- J. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- K. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- L. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

~~1. TCNA F112 and ANSI A108.1A: Cement mortar bed (thickset) bonded to concrete.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Bond Coat for Cured-Bed Method: Standard dry-set mortar.~~
- ~~c. Grout: Sand portland cement grout.~~

~~2. TCNA F113: Thinset mortar.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Thinset Mortar: Standard dry-set mortar.~~
- ~~c. Grout: Sand portland cement grout.~~

3. TCNA F115 : Thinset mortar; epoxy grout.

- a. Ceramic Tile Type: As indicated on Drawings.
- b. Thinset Mortar: Standard dry-set mortar.
- c. Grout: Water-cleanable epoxy grout.

~~4. TCNA F116 : Organic adhesive.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Grout: Sand portland cement grout.~~

~~5. TCNA F131 : Water cleanable, tile setting epoxy; epoxy grout.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Grout: Water cleanable epoxy grout.~~

~~6. TCNA F132 : Water cleanable, tile setting epoxy on cured cement mortar bed bonded to concrete subfloor; epoxy grout.~~

- ~~a. Ceramic Tile Type: As indicated on drawings.~~
- ~~b. Grout: Water cleanable epoxy grout.~~

B. Interior Wall Installations, Masonry or Concrete:

~~1. TCNA W202: Thinset mortar.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Thinset Mortar: Standard dry-set mortar.~~
- ~~c. Grout: Sand portland cement grout.~~

2. TCNA W211 and ANSI A108.1A: Cement mortar bed (thickset) bonded to substrate.

- a. Ceramic Tile Type: As indicated on Drawings.
- b. Bond Coat for Wet-Set Method: Standard dry-set mortar.
- ~~c. Bond Coat for Cured-Bed Method: Standard dry-set mortar.~~
- d. Grout: ~~Sand portland cement~~ Water cleanable epoxy grout.

- e. ~~Bond Coat for Wet Set Method: Standard dry set mortar.~~
- f. ~~Bond Coat for Cured Bed Method: Standard dry set mortar.~~
- g. ~~Grout: Sand portland cement grout.~~
- h. ~~Bond Coat for Wet Set Method: Standard dry set mortar.~~
- i. ~~Bond Coat for Cured Bed Method: Standard dry set mortar.~~
- j. ~~Grout: Sand portland cement grout.~~

3. ~~TCNA W223 : Organic adhesive.~~

- a. ~~Ceramic Tile Type: As Indicated on the Drawings.~~
- b. ~~Grout: Sand portland cement grout.~~

C. Interior Wall Installations, Wood or Metal Studs or Furring:

1. ~~TCNA W221 and ANSI A108.1A: Cement mortar bed (thickset) on solid backing.~~

- a. ~~Ceramic Tile Type: As indicated on Drawings~~
- b. ~~Bond Coat for Wet Set Method: Standard dry set mortar.~~
- c. ~~Bond Coat for Cured Bed Method: Standard dry set mortar.~~
- d. ~~Grout: Sand portland cement grout.~~

2. ~~TCNA W222 and ANSI A108.1A: One coat cement mortar bed (thickset) on solid backing.~~

- a. ~~Ceramic Tile Type: As indicated on Drawings.~~
- b. ~~Bond Coat for Wet Set Method: Standard dry set mortar.~~
- c. ~~Bond Coat for Cured Bed Method: Standard dry set mortar.~~
- d. ~~Grout: Sand portland cement grout.~~

3. ~~TCNA W223: Organic adhesive on solid backing.~~

- a. ~~Ceramic Tile Type: As indicated on Drawings.~~
- b. ~~Grout: Sand portland cement grout.~~

4. ~~TCNA W231/W241 and ANSI A108.1A: Cement mortar bed (thickset).~~

- a. ~~Ceramic Tile Type: As indicated on drawings.~~
- b. ~~Bond Coat for Wet Set Method: Standard dry set mortar.~~
- c. ~~Bond Coat for Cured Bed Method: Standard dry set mortar.~~
- d. ~~Grout: Sand portland cement grout.~~

5. ~~TCNA W242: Organic adhesive on gypsum board.~~

- a. ~~Ceramic Tile Type: As indicated on Drawings.~~
- b. ~~Grout: Sand portland cement grout.~~

6. TCNA W243 : Thinset mortar on gypsum board.

- a. Ceramic Tile Type: As indicated on Drawings.
- b. Thinset Mortar: Standard dry-set mortar.
- c. Grout: ~~Sand portland cement~~ Water cleanable epoxy grout.

7. TCNA W245 or TCNA W248: Thinset mortar on glass-mat, water-resistant gypsum backer board.

- a. Ceramic Tile Type: As indicated on Drawings.
- b. Thinset Mortar: Standard dry-set mortar.
- c. Grout: ~~Sand-portland-cement~~ Water cleanable epoxy grout.

D. Shower Wall Installations, Wood or Metal Studs or Furring:

- ~~1. TCNA B411 and ANSI A108.1A: Cement mortar bed (thickset) over vapor-retarder membrane.~~

- ~~a. Ceramic Tile Type: As indicated on Drawings.~~
- ~~b. Bond Coat for Wet Set Method: Standard dry-set mortar.~~
- ~~c. Bond Coat for Cured Bed Method: Standard dry-set mortar.~~
- ~~d. Grout: Sand-portland-cement grout.~~

2. TCNA B419: Thinset mortar on coated glass-mat, water-resistant gypsum backer board.

- a. Ceramic Tile Type: As indicated on the Drawings.
- b. Thinset Mortar: Modified dry-set mortar.
- c. Grout: ~~Sand-portland-cement~~ Water cleanable epoxy grout.

E. Shower Receptor ~~and Wall~~ Installations:

- ~~1. TCNA B414 and ANSI A108.1A: Cement mortar bed (thickset) over vapor-retarder membrane.~~

- ~~a. Ceramic Tile Type: As indicated on the Drawings.~~
- ~~b. Bond Coat for Wet Set Method: Standard dry-set mortar.~~
- ~~c. Bond Coat for Cured Bed Method: Standard dry-set mortar.~~
- ~~d. Grout: Sand-portland-cement grout.~~

2. TCNA B415: Thinset mortar.

- a. Ceramic Tile Type: As indicated on Drawings.
- b. Thinset Mortar: Standard dry-set mortar.
- c. Grout: ~~Sand-portland-cement~~ Water cleanable epoxy grout.

END OF SECTION 09 30 13

SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 NOTE

- A. The requirements of Section 26 00 00 apply to work performed under this Section.
- B. The requirements of this Section of the Specifications apply to and form a part of the individual Electrical Sections of the Specifications.

1.2 SCOPE

- A. The work under this Section of the Specifications includes the furnishing of labor, materials, and equipment for the installation of a complete lightning protection system.

1.3 GENERAL DESCRIPTION

- A. System shall consist of air terminals, roof conductors, down conductors, ground connections, grounds, etc. and shall be interconnected to form the shortest distance to ground without passing through any non-conducting parts of the structure. Secondary conductors shall interconnect with grounded parts within the building. The system furnished shall consist of standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design.
- B. The lightning protection system shall conform to NFPA 70 and 780, UL 96 and 96A.
- C. Become familiar with structures requiring such systems and coordinate the installation with that of other trades. Installation shall meet the requirements of UL Master Label for such systems.
- D. System shall bear a UL Master Label.

1.4 SUBMITTALS

- A. Shop drawings shall be submitted for components and for the proposed installation and shall consist of manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Shop drawings shall contain details to demonstrate that the system has been coordinated and will function as one unit. Drawings shall show proposed layout, including relationship to other parts of work.
- B. Where materials are specified to comply with UL requirements, proof of compliance is required. Written certification from a nationally recognized testing laboratory will be accepted in place of UL Listing or Labeling. Report shall state that items have been tested and conform to the requirements and methods of UL.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. No combination of materials shall be used which form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the union of such metals. Where conditions exist which would cause corrosion of conductors, protective coatings shall be used.
- B. Where a mechanical hazard exists, conductors shall be oversized to compensate for the

hazard or the conductors shall be protected by coverings of molding or tubing made of nonmagnetic materials. Where metallic conduit is used, conductors shall be bonded to the conduit at upper and lower ends.

2.2 CONDUCTORS

- A. Copper conductors shall be in accordance with NFPA 78 and UL 96 as applicable for materials specified.
- B. Copper conductors shall weigh not less than 375 pounds per thousand feet and no conductor shall be less than No. 12 AWG. The thickness of any copper webbing or braid shall not be less than No. 12 AWG. Ground ring and counterpoise shall consist of copper conductors not less than No. 1/0 AWG.

2.3 AIR TERMINALS

- A. Terminals shall be in accordance with UL 96 and NFPA 78. Air terminals shall be a minimum 18 inches in length and shall be supported by suitable braces, with guides not less than one half the height of the terminal.

2.4 GROUND RODS

- A. Ground rods shall conform to UL 467 and shall be made of copper-clad steel. Rods shall be one piece, 5/8 inch diameter, and 10 feet in length. All connections to ground rods shall be by exothermic weld.

2.5 CONNECTORS

- A. Connectors for splicing components shall conform to UL 96, class as applicable. Connectors shall be of the compression clamp type.

2.6 MISCELLANEOUS COMPONENTS

- A. Other components required for a complete lightning protection system such as bonding plates, terminal supports, clip, fasteners, etc. shall conform to UL 96 for applicable classes.

PART 3 - EXECUTION

3.1 AIR TERMINALS

- A. Terminals shall be rigidly connected to and made electrically continuous with roof conductors by means of pressure connectors or crimped joints. Air terminals at the end of structures shall be set not more than 2 feet from the end of the ridge or edges and corners of roof. Spacing shall not exceed 25 feet. Terminals shall be secured against overturning by means of substantial tripod or braces permanently and rigidly attached to structure.

3.2 ROOF CONDUCTORS

- A. Roof conductors shall be connected directly to the roof or ridge. Sharp bends or turns shall not be made. Necessary turns shall have a minimum radius of 8 inches. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 4 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets and edges and where necessary, over flat surfaces, in such a way as to join each air terminal to all others.

3.3 DOWN CONDUCTORS

- A. Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Conceal down conductors within building elements in coordination with Architect. Each building shall have not less than two down conductors located as widely separated as possible, at diagonally opposite corners. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet, or fraction thereof. Down conductors shall be protected where necessary, to prevent mechanical damage to the conductor.

3.4 INTERCONNECTION OF METAL PARTS

- A. Metal doors, windows and gutters shall be connected directly to the grounds or down conductors using minimum No. 6 copper conductor, or equivalent. Conductors shall be installed so as to avoid corrosion, mechanical injury or wear. If these conditions exist where installed, then conductors shall be increased in size or protected. Ground connections to metal doors and windows shall be by mechanical ties under pressure, or equivalent.
- B. Metal bodies of conductance shall be protected if not within the zone of protection of the air terminals. All metal bodies having equal to, or greater than, 400 square inches shall be bonded to the lightning protection system using main size conductors and a bonding plate of not less than 3 square inches. Provisions shall be made to guard against corrosion due to joining of dissimilar metals.

3.5 GROUND CONNECTIONS

- A. Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical damage.

3.6 GROUND LOOP

- A. Install ground-level, potential equalization conductor and extend around the perimeter of structure.
 - 1. Bury ground ring not less than 24 inches from building foundation.
 - 2. Bond ground terminals to the ground loop.
 - 3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.
 - 4. Each down conductor shall terminated in a ground test to facilitate ground resistance testing.

3.7 STEEL FRAME BUILDINGS

- A. The steel framework shall be made electrically continuous. Electrical continuity shall be made by bolting, riveting or welding frame unless another method is specified in another section. Air terminals shall be connected to the structural steel framework at the ridge. Short runs of conductors shall be used to join air terminals to the metal framework so as to maintain proper terminal placement. Where metal water service enters the building, the structural steel shall be bonded at the point of entrance by a ground conductor. Connections to pipes shall be by means of ground clamps with lugs. Connections to steel work shall be

by means of nut and bolt or welding. Column to ground connections shall be made at the bottom of steel columns. At least half of steel columns shall have ground connections, spaced equally around perimeter. Metal doors, windows, gutters, etc. shall be bonded to the steel of the structure.

3.8 INSTALLATION AND COORDINATION

- A. Coordinate the installation of the lightning protection system with the work of other trades and contractors prior to laying out system or beginning work.

3.9 FIELD QUALITY CONTROL

- A. Notify Engineer at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 26 41 13