UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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05/14

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SECTION 08 88 58

AIR TRAFFIC CONTROL TOWER CAB GLASS

05/14

****
NOTE: This guide specification covers the requirements for engineered outward sloping low-iron clear annealed tower cab glass for use in military air traffic control towers.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be as a Criteria Change Request (CCR).
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NOTE: The Designer of Record's (DOR) selection of tower cab glass performance and related systems must comply with the UFC including, at a minimum, UFC 1-200-01, General Building Requirements, UFC 3-301-01, , Structural Engineering and UFC 4-133-01N, Navy Air Traffic Control Facilities; if seismic design is required UFC 3-301-01, Structural Engineering; and if antiterrorism protection is required UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings.

Coordinate tower cab glass with supporting glazing

framing system and design performance requirements applicable to the location of the air traffic control tower cab. Selection of framing system and glass units are integral to the performance as a whole and how glazing system is anchored to the structure. Coordinate with glass and framing systems manufacturer's anticipated design thicknesses and the connection between the glass the frame, the "bite", which is how far the glass is imbedded into the frame.

****

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NOTE: On the drawings, show:
1. Locations of each type of tower cab glass unit, using the same terminology as in the specification.
2. Outward slope angle of tower cab glass.
3. Dimension and shape of tower cab glass units.
4. Frame and edge details indicating method of glazing, glass-edge bite requirements, and system anchorage.
5. Wind pressure on tower cab glass.
6. Whether tower cab glass is 'basic' or 'enhanced' per ASTM E1886 or ASTM E1996, as applicable.

In the specifications, show blast pressure and design method: standard air blast, dynamic, or computational, when antiterrorism protection is applicable.

****

PART 1 GENERAL

1.1 SUMMARY

This specification covers engineered tower cab glass for use in military air traffic control towers. Engineering of the tower cab glass is delegated to an approved Glass Engineer. The tower cab glass is used where air traffic is visually controlled and having tower cab glass free of optical distortions or other obstructions that can block or distort vision is critical to air traffic control operations.

1.2 DEFINITIONS

1.2.1 ATCT

Air Traffic Control Tower

1.2.2 Authority Having Jurisdiction (AHJ)

The party that regulates the design and construction process for the project on behalf of the Government.

[1.2.3 Deterioration of Coated Glass

Defects developed from normal use and weather conditions that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to fabricator's directions. Defects include peeling, cracking, and other

indications of deterioration in metallic coating.

]1.2.4 Deterioration of Glass

Defects developed from normal use and weather conditions that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning glass contrary to fabricator's directions. Defects include glass found to be out of compliance with ASTM C1036.

[1.2.5 Deterioration of Insulating Glass

Failure includes, but is not limited to, failure of the hermetic seal under normal use and weather conditions due to causes other than glass breakage and improper practices for maintaining and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, film, or minerals on the surfaces of insulated glass facing the interspace or optical distortions (ghosting or double-images) not due to improper practices for maintaining and cleaning glass not in in compliance with the manufacturer's or fabricator's directions.

]1.2.6 Deterioration of Laminated Glass

Defects developed from normal use and weather conditions that are attributed to the manufacturing process and not to glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's or fabricator's directions. Defects include edge separation, delamination, materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.

1.2.7 Designer of Record (DOR)

Architect or Engineer planning and designing the building and site and preparing the contract documents on behalf of the Government.

1.2.8 Fabricator

Where used in this Section to refer to a firm that fabricates glass units as defined in the referenced glazing standards.

1.2.9 Glass Thickness

Nominal glass thickness indicated by thickness designation per glass ply according to ASTM C1036.

[1.2.10 Interspace

Air- or inert gas-filled space between lites of an insulating-glass unit.

]1.2.11 Manufacturer

Where used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

1.2.12 Tower Cab Glass

Air traffic control tower cab glass as indicated on the Drawings.

1.3 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

****

NOTE: Ensure that the dates of the references are compatible with the version of the building code used for the design of this project.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

ASTM INTERNATIONAL (ASTM)

ASTM C509	(2006; R 2015) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1036	(2016) Standard Specification for Flat Glass
ASTM C1087	(2016) Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1172	(2019) Standard Specification for Laminated Architectural Flat Glass
ASTM D395	(2016; E 2017) Standard Test Methods for Rubber Property - Compression Set

ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E1300	(2016) Standard Practice for Determining Load Resistance of Glass in Buildings
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
ASTM E1996	(2017) Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
ASTM E2129	(2018) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E2190	(2010) Standard Specification for Insulating Glass Unit Performance and Evaluation
ASTM E2461	(2012; R 2017) Standard Practice for Determining the Thickness of Glass in Airport Traffic Control Tower Cabs
ASTM F1642/F1642M	(2017) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
ASTM F2912	(2017) Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2008) Glazing Manual
GANA Laminate Manual	(2009) Laminated Glazing Reference Manual
GANA Sealant Manual	(2008) Sealant Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001	(2001) Guidelines for Sloped Glazing
IGMA TM-3000	(1990; R 2016) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

1.4 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Tower Cab Glass; G[, [_____]]

Submittals which graphically show complete details of the proposed setting methods, mullion details, edge blocking, dimension of glass, dimension of openings, frame details and materials, and

types of thickness of glass, coatings, coating position, laminates, and other aspects of the work.

SD-03 Product Data

****
NOTE: "Product Data for IEQ credit" Subparagraph below applies to LEED-NC and LEED-CS; coordinate with requirements for glazing sealants.
****

[Laminated Annealed Glass; G[, [_____]]
][Low-E Coated Laminated Annealed Glass; G[, [_____]]
][Insulated Laminated Annealed Glass Units; G[, [_____]]
][Low-E Coated Insulated Laminated Annealed Glass Units; G[, [_____]]
] Setting and Sealing Materials; G[, [_____]]
Glazing Accessories; G[, [_____]]

Submit manufacturer of the glass lites and the fabricator of the insulating units. Submit descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions from both the manufacturer of the glass lites and the fabricator of the insulating and laminated units.

[Product Data for IEQ credit: For field-applied glazing sealants - documentation including declaration of VOC content.

] SD-04 Samples

[Laminated Annealed Glass; G[, [_____]]
][Low-E Coated Laminated Annealed Glass; G[, [_____]]
][Insulated Laminated Annealed Glass Units; G[, [_____]]
[Low-E Coated Insulated Laminated Annealed Glass Units; G[, [_____]]
] Setting and Sealing Materials including color; G[, [_____]]
Glazing Accessories; G[, [_____]]

****
NOTE: Coordinate quantity of glass samples required with the Contracting Officer.
****

Provide [three][_____] 300 mm 12 inch by 300 mm 12 inch samples of tower cab glass units.

SD-05 Design Data

Cab Glazing Design Analysis; G[, [_____]]

Submit design analysis with glass engineering calculations showing that the design of each size and type of glass unit and its attachment to the glazing framing system and surrounding structure conform to project requirements. Indicate the structural performance of each glass unit proposed for use under the given loads as prepared and signed by an approved glass engineer. The size, composition of the glazing units, and details determined by the design analysis must be reflected in the shop drawings of all impacted trades and assemblies.

Glass Wind Load Calculations; G[, [_____]]

SD-06 Test Reports

Compatibility and adhesion test reports
[Standard Airblast Test

] SD-07 Certificates

Glass Engineer Qualifications
Fabricator Qualifications
[Insulating Glass Certification
] Installer Qualifications
Product Certificates
[Local/Regional Materials
][Environmental Data

][Product Certificates for MR credit: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

] SD-10 Operation and Maintenance Data

Maintenance Manuals
[Warranty for insulating glass products]
][Warranty for laminated glass products
][Warranty for coated-glass products

]1.5 SYSTEM PERFORMANCE REQUIREMENTS

Provide glazing systems that are engineered, produced, fabricated, and installed to withstand normal thermal movement,[and] wind loading[, and impact loading] without failure including loss of glass or glass breakage attributable to the following: defective manufacture, fabrication, and installation, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials, visual distortion, blockage of vision, and other defects impacting use or performance. [Provide glazing systems that conform to antiterrorism protection blast pressure and design method or air blast test indicated.]

Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base engineering calculation on materials' actual surface temperatures due to both solar heat gain and nighttime sky heat loss expected for the service life of the tower.

****
NOTE: Verify temperature range at project site with range shown. Provide new data if site specific range is greater than default.
****

Temperature Change (Range): [67 degrees C120 degrees F][_____], ambient; [100 degrees C180 degrees F][_____], material surfaces.

Design, engineering, fabrication, and installation must comply with all applicable requirements.

1.6 QUALITY ASSURANCE

****
NOTE: Determine qualifications required for the Glass Engineer. In the U.S., a registered professional engineer is required; outside the U.S., consider specifying alternate licensing requirements (second set of brackets) where the services of a U.S. registered professional engineer may not be feasible. Alternate requirements must be coordinated with the Contracting Officer. Select requirements and delete items not required.
****

1.6.1 Glass Engineer Qualifications

Glass Engineer must be a registered professional engineer in [a U.S. state or territory][_____] experienced in the design of glass who has successfully completed a minimum of [five][_____] air traffic control tower cab glass projects and possesses no less than [five][_____] years of experience with similar projects in nature, size, and extent to this air traffic control tower; being familiar with special requirements indicated; and having complied with requirements of the AHJ.

1.6.2 Fabricator Qualifications

Provide qualifications for fabricators for glass units who have successfully completed a minimum of five air traffic control tower cab glass projects similar in nature, size, and extent to this air traffic control tower including successful in-service performance [and is a qualified insulating glass fabricator who is approved and certified by the [coated]glass manufacturer.]

[1.6.3 Insulating Glass Certification Program

Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency:

a. Insulating Glass Certification Council (IGCC).

b. Associated Laboratories, Inc. (ALI).

c. National Certified Testing Laboratories (NCTL).

]1.6.4 Installer Qualifications

Engage an experienced installer who has installed similar glazing assemblies in material, design, and extent to the indicated for this Project with a record of successful in-service performance. Installer must be certified under the National Glass Association's certified glass installer program as level Y2 (Senior Glaziers) or level Y3 (Master Glazier). Equivalent or better certification may be considered if acceptable to the Contracting Officer.

1.6.5 Single-Source Responsibility

Obtain all tower cab glass from one source. Obtain glazing accessories from one source for each product and installation method indicated.

1.6.6 Product Certificates

Signed by glazing materials manufacturers certifying that their products comply with specified requirements. Submit certificates to indicate that materials meet specified requirements. Permanent marking safety glass approval on glass lower corner exposed to view is required unless that requirement is waived by the AHJ.

1.6.7 Glazing Accessories

Submit certificates from the manufacturers attesting that the accessories meet the project requirements including requirements set by the glass engineer designing the glass and supports.

Provide compatibility and adhesion test reports from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

1.6.8 Setting and Sealing Materials

ASTM C1087. Submit data from the manufacturer attesting that the sealant used in glazing is compatible with the laminated glass interlayer or primary and secondary sealants in insulated units where applicable. Provide compatibility and adhesion test reports from sealant manufacturer; indicating that glazing materials were tested for compatibility and adhesion with glazing sealant. Include sealant manufacturer's test results relative to sealant performance and recommendations for primers and substrate preparation required for adhesion.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers labeled plainly with manufacturers' names and brands.

Tower cab glass must be boxed, crated, and shipped to the site in a vertical position or as directed by the fabricator. The tower cab glass must be stored in a vertical position against a sturdy support at an angle of approximately 7 degrees from vertical or as directed by the fabricator.

For insulating glass units that will be exposed to substantial altitude changes between location of fabrication and project site or in transit to project site, comply with insulating-glass manufacturer's written recommendations for preventing hermetic seal ruptures at any point or bowing inward or outward of glazing lites when installed due to pressure differentials between interspace air or gas pressure and ambient air pressure at project location.

Tower cab glass and setting materials must be stored in a safe, dry location with adequate ventilation free from heavy dust and must permit easy access for inspection and handling. Unpack glass at time of installation, or as directed by Contracting Officer.

Unpack glass from the front of the case or container and avoid sliding the

glass against itself or any un-cushioned materials. Stack individual lites on edge using clean, cushioned pads placed at the quarter points of the bottom edge. Protect all edges from impact and use a clean dry separating materials.

1.8 ENVIRONMENTAL REQUIREMENTS

Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 5 degrees C40 degrees F.

1.9 SUSTAINABLE DESIGN REQUIREMENTS

[1.9.1 Local/Regional Materials

****
NOTE: Include "Regional Materials" Paragraph below for LEED-NC, or LEED-CS, MR credit; before retaining, verify availability of materials that comply. Coordinate with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Use second option if Contractor is choosing local products in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. First option must not be used for USACE projects. Army projects must include second option only if pursuing this LEED credit.
****

[Regional Materials: Materials must be manufactured within 800 kilometers 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as fabricated, within 800 kilometers 500 miles of Project site, if available from a minimum of [three][_____] sources.][See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total local material requirements. Glazing materials may be locally available.]

****
NOTE: Include following paragraph if required for LEED-NC or LEED-CS IEQ credit.
****

]1.9.2 Sealants VOC Content

Field-applied sealants must have a VOC content of not more than 250 g/L[or lower as required to meet LEED IAQ limits].

[1.9.3 Environmental Data

****
NOTE: ASTM E2129 provides for detailed documentation of the sustainability aspects of products used in the project. This level of detail may be useful to the Contractor, Government,

building occupants, or the public in assessing the sustainability of these products.
****

Submit Table 1 of ASTM E2129 for sealants.

]1.10 WARRANTY

Provide 10-year manufacturer's or, where applicable, fabricator's warranty for tower cab glass.

****
NOTE: Include 10-year warranty for all projects. Select appropriate paragraphs for inclusion based on products specified.
****

[1.10.1 Warranty for Insulating-Glass Products

Provide warranty signed by the [manufacturer][or][fabricator] of insulating-glass units agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" article for Deterioration of Insulating Glass, FOB point of manufacture, freight allowed project site, within 10-years after date of Final Acceptance. Warranty covers only deterioration due to normal conditions of use as defined and not due to handling and installing.

][1.10.2 Warranty for Laminated-Glass Products

Provide warranty signed by glass the [manufacturer][or][fabricator] of laminated-glass agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" article for Deterioration of Laminated Glass, FOB point of manufacture, freight allowed project site, within 10-years after date of Final Acceptance. Warranty covers only deterioration due to normal conditions of use as defined and not due to handling and installing.

][1.10.3 Warranty for Coated-Glass Products

****
NOTE: Verify whether glass manufacturer or glass fabricator applies coating to glass.
****

Provide warranty signed by coated-glass units the [manufacturer][or][fabricator] agreeing to replace coated-glass units that deteriorate as defined in definitions article for Deterioration of Coated Glass, FOB point of manufacture, freight allowed project site, within 10-years after date of Final Acceptance. Warranty covers only deterioration due to normal conditions of use as defined and not due to handling and installing.

]PART 2 PRODUCTS

2.1 SYSTEM DESIGN REQUIREMENTS

****
NOTE: The design of glass should be delegated to the contractor. The contractor is required to assume responsibility for glass engineering and final design and coordination.

****

2.1.1 Cab Glazing Design Analysis

Engage a qualified Glass Engineer to design glazing system as a delegated design. Installed glazing system must withstand normal thermal movement and wind[and][impact][and air blast] loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction. [Delegated design must include antiterrorism protection requirements.]

2.1.2 Structural Performance

Submit signed and sealed glass wind load calculations by the Glass Engineer for all glass installations certifying compliance with wind load[and impact load] requirements below, and as indicated on the drawings [as well as antiterrorism protection blast loads and design methods specified]. The thickness of glass and support requirements must be determined using the most stringent requirements of both ASTM E1300 and ASTM E2461.

[For insulating glass units that will be exposed to substantial altitude changes after fabrication, engineer insulated glass unit lites to maintain parallel alignment to avoid optical distortions (ghosting /double images) when viewing through glass.
]

****

NOTE: The Designer of Record (DOR) is responsible for determining the design wind speed and the resulting design wind pressure on the tower cab glass. The glass manufacturer/fabricator is responsible for determining that glass engineering and fabrication meet the design wind pressure requirements.

The UFC cited International Building Code (IBC) requires that design wind speed and resulting pressure used for design of exterior components and cladding be determined by the DOR and be indicated on the construction drawings.

Verify the current standard for determining wind pressure and antiterrorism protection requirements with UFC 1-200-01. Wind (and impact, hurricane, and tornado) design guidance is found in UFC 3-301-01. If anti-terrorism protection is a factor, coordinate with UFC 4-010-01 and referenced requirements.

The DOR is responsible for determining the antiterrorism protection requirements and for indicating loads, durations, and method of design in the specifications.

****

a. Design Wind Pressure: As indicated on the Drawings.

****

NOTE: Deflection requirements in "Maximum Lateral Deflection" Subparagraph below are examples only and apply only to glass supported on all four edges. The IBC does not contain any deflection limits for glass. ASTM E1300 requires that the deflection not result in loss of edge support. Revise to suit Project.

Modify maximum lateral deflection where insulated glass units are being shipped through, or installed at, substantially different altitudes than place of fabrication to keep inner and outer lite parallel to avoid optical distortions (ghosting/double images).

****

b. Maximum Lateral Deflection: Tower cab glass is supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than [1/50][_____] times the short-side length or 25 mm 1 inch, whichever is less.

2.1.3 Thermal Performance

Glazing must be designed in response to full calendar year project site climatic conditions and sun angles in coordination with tower cab mechanical systems assuring that maximum visibility is afforded while thermal effects that could overwhelm mechanical systems or cause condensation on interior or exterior surfaces of the glass are prevented.

[2.1.4 Antiterrorism Performance

****

NOTE: "Antiterrorism Performance" is optional to designer, and must be omitted or revised as needed to meet project requirements.

****

Minimum Antiterrorism Performance - Glazing must meet the minimum antiterrorism performance criteria specified in the paragraphs below. Conformance to the performance requirements must be validated by[one of] the following method[s].

****

NOTE: The blank in the following paragraph (Computational Design Analysis Method) should be the value of the equivalent 3-second duration design loading obtained from Figure 1 of ASTM F2248 for the explosive weight and standoff distance combination that is being designed for in this project.

****

[a. Computational Design Analysis Method - Cab glazing must be designed to the criteria listed herein. Computational design analysis must include calculations verifying the structural performance of each glazing unit proposed for use, under the given static equivalent loads. Glazing resistance must be greater than equivalent 3-second duration loading of [_____] Pascal [_____] pounds per square foot (psf). The glazing frame bite for the cab frames must be in accordance with ASTM F2248.

]

****

NOTE: The blanks in the following paragraph (Dynamic Design Analysis Method) should be the value of the peak positive pressure and impulse for the explosive weight and standoff distance combination that is being designed for in this project. Choose the first bracketed items, low hazard rating/very low level of protection for inhabited building occupancy as defined in UFC 4-010-01. Choose the second bracketed items, very low hazard rating/low level of protection for primary gathering building occupancy as defined in UFC 4-010-01. The values for input into the blanks in the following paragraph related to 'ductility ratio' and 'maximum support rotation' can be found in Engineering Technical Report (PDC TR-10-02) titled Blast Resistant Design Methodology for Window Systems Designed Statically and Dynamically at USACE Protective Design Center: https://pdc.usace.army.mil/library/tr/10-02)

****

[b. Dynamic Design Analysis Method - Cab glazing must be designed using a dynamic analysis to prove the glazing will provide performance equivalent to or better than a [low][very low] hazard rating in accordance with ASTM F2912 associated with the applicable [very low] [low level] of protection for the peak positive pressure of [_____] kilopascals (kPa) [_____] pounds per square foot (psf) and positive phase impulse of [_____] kilopascal-millisecond (kPa-msec) [_____] pounds per square inch - millisecond (psi-msec). The allowable response limits of aluminum frame elements for low level of protection requirements are as follows: Maximum ductility ratio of [_____] and maximum support rotation of [_____] degrees.

]

****

NOTE: The blanks in the following paragraph (Standard Airblast Test Method) should be the value of the peak positive pressure and impulse for the explosive weight and standoff distance combination that is being designed for in this project. Choose the first bracketed items, low hazard rating/very low level of protection for inhabited building occupancy as defined in UFC 4-010-01. Choose the second bracketed items, very low hazard rating/low level of protection for primary gathering building occupancy as defined in UFC 4-010-01.

****

[c. Standard Airblast Test Method - As an alternative to 'Dynamic Design Analysis Method' indicated above, glazing may be tested for evaluation of hazards generated from airblast loading in accordance with ASTM F1642/F1642Mby an independent testing agency regularly engaged in blast testing. For proposed glazing systems that are of the same type as the tested system but of different size, the test results may be accepted provided the proposed glazing 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. Proposed glazing of a size outside this range must 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. The

test must be performed on the entire proposed glazing system, which must include, but not be limited to, the glazing, its framing/support system, operating devices, and all anchorage devices. Anchorage of the glazing support system must replicate the method of installation to be used for the project. The minimum airblast loading parameters for the test must be as follows: peak positive pressure of [_____]kilopascal (kPa) [_____] pounds per square inch (psi) and positive phase impulse of [_____] kilopascal-millisecond (kPa-msec) [_____] pounds per square inch - millisecond (psi-msec). The hazard rating for the proposed glazing systems, as determined by the rating criteria of ASTM F1642/F1642M, to provide performance equivalent to or better than a [low][very low] hazard rating (i.e. the "No Break", "No Hazard", "Minimal Hazard" and "Very Low Hazard" ratings are acceptable. "Low Hazard" and "High Hazard" ratings are unacceptable) associated with the applicable [very low][low level] of protection. Results of glazing systems previously tested by test protocols other than ASTM F2912 may be accepted provided the required loading, hazard level rating, and size limitations stated herein are met.

]][2.1.5 Windborne-Debris-Impact Performance

****
NOTE: Retain "Windborne-Debris-Impact Resistance" Paragraph if required by Project. The UFC cited IBC defines windborne debris regions. Enhanced protection applies to essential facilities. Verify site specific requirements with the AHJ. Delete items not required.
****

Exterior glazing must comply with indicated basic or enhanced protection testing requirements in ASTM E1996 for [Wind Zone 1] [Wind Zone 2] [Wind Zone 3] [Wind Zone 4] when tested according to ASTM E1886. Test specimens must be no smaller in width and length than glazing indicated for use on Project and must be installed in same manner as glazing indicated for use on Project.

a. Refer to drawings for classification of tower cab requiring basic or enhanced protection.

[b. Large-Missile Test: For glazing located within 9.1 m 30 feet of grade.

][c. Small-Missile Test: For glazing located more than 9.1 m 30 feet above grade.

]]2.1.6 Tower Cab Glass Location and Sizes

Refer to Drawings for location, size intent, and geometry of tower cab glass units.

2.1.7 Tower Cab Glass Slope

Provide outward slope indicated on the drawings for tower cab glass.

2.2 GLASS MATERIALS

****
NOTE: Insulated glass systems should be used where required for thermal insulation or condensation

control. Use air- or inert gas-filled interspace for insulated glass only.
****

Tower cab glass thicknesses shown on the Drawings or specified herein are minimums. Manufacturer must certify that glass can withstand all forces specified.

a. The thickness of the tower cab glass must be determined the Glass Engineer complying with ASTM E2461 for a probability of breakage of 1 lite per 1000.

****
NOTE: "Probability of Breakage for Sloped Glazing" Subparagraph below is more conservative than ASTM E1300 and the IBC, which are based on a probability of breakage of 8 lite per 1000.
****

b. No on-site grinding or buffing of the glass is allowed. Glass edges must be clean cut, undamaged, and flat ground.

c. Probability of Breakage for Sloped Glazing: For glass surfaces sloped from vertical, the thickness of the tower cab glass must be determined by ASTM E2461 for a probability of breakage not greater than 1 lite per 1000 at the first occurrence of the design wind loading.

d. Glass subject to accidental human impact must be glazed with laminated safety glass in accordance with 16 CFR 1201 and ANSI Z97.1.

2.2.1 Annealed Glass

****
NOTE: Tower cab glazing recommended for air traffic control towers is low-iron clear float glass. Standard clear glass is not recommended because of lower visible light transmission compared to low-iron glass. However, where new glass is to match existing adjacent glass that is not low-iron the Contracting Officer may elect to approve standard glass. Tinted glass is not allowed for cab glazing.

Heat strengthened, tempered, and chemically strengthened glass is not allowed for cab glazing because of optical distortions created by the strengthening process. Glass clad polycarbonate is also not allowed.

Coordinate with user and mechanical engineer if a Low-E coating is to be applied to glass to improve the glass unit's thermal properties. The Low-E coating has some affect on the visible light transmission, though this is considered an acceptable trade-off because of the increased comfort levels for the controllers in the tower cab.

Select one of the float glass products below as the tower cab glass. Retain or modify following

sub-paragraphs as required.
****

Low-iron annealed float glass must be ASTM C1036, Type I, Class I (Clear), quality q3; and with visible light transmission of not less than 91 percent and solar heat gain coefficient of not less than 0.90 for 6 mm 1/4 inchthickness with the following quantities:

a. Allowable scratches: None.

****
NOTE: Select one of the following paragraphs below based on consultation with glass manufacturer on recommended glazing for tower cab. Wind design criteria developed by structural engineer, size of glass units, and cab glass framing system will dictate required assembly of cab glass.
****

[2.2.2 Insulated Glass

Insulating-glass components must be as required to factory-assemble glass units with hermetically sealed dehydrated interspace, qualified according to ASTM E2190.

****
NOTE: Base selection of sealing system of insulated glass units on compatibility with other glazing materials. For example, glazing systems installed with silicone glazing sealants generally require the same material for secondary sealing of insulating-glass units.

Insulating glass units inner and outer lites may not remain parallel if fabricated at one elevation level and transported or installed at higher elevations. Provide grade elevation of ATCT above sea level either on drawings or in specifications.
****

a. Sealing System: Units must be double sealed. Primary seal must be polyisobutylene; secondary seal must be silicone.

****
NOTE: Spacer must be stainless steel for the following reasons, stronger and keeping hermetic seals intact during installation, and better thermal performance than other spacer materials.
****

b. Spacer: Stainless steel.

c. Desiccant: Molecular sieve or silica gel, or a blend of both.

****
NOTE: Breather tubes must not be allowed for insulated glass units. Coordinate with manufacturer the need for capillary tubes only if use is approved by the Contracting Officer and only if use does not

limit warranty coverage.

Capillary Tube - Typically 0.25 to 0.50 mm 0.01 to 0.02 inch inside diameter stainless steel tubes, approximately 305 mm 12 inch long, and are left open after installation. Capillary tubes are used in low humidity mountainous areas of the country to equalize pressure. The 305 mm 12 inch long tube minimizes moisture entering unit, but in small glass units, this can still be significant amount of moisture.

Breather Tube - Typically 3 mm 1/8 inch inside diameter aluminum tubes, 75 to 150 mm 3 to 6 inches long that are sealed after installation. Breather tubes are used to allow for pressure differentials during shipping. Concern is will humidity enter dehydrated interspace during manufacturing and shipping. Some manufacturers will not honor warranty if glass unit has breather tube.

****
****

NOTE: Antiterrorism performance rated glass, windborne debris region rated glass, and safety glass are required to be laminated glass. One or all of these requirements may apply to the tower cab glass design.

****

][2.2.3 Laminated Glass Interlayers

Laminated glass must comply with the GANA Laminate Manual and interlayer must comply with 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.

a. Interlayer Material: [Polyvinyl butyral (PVB) interlayer] [Ionomeric polymer interlayer] [or] [Cast-in-place and cured-transparent-resin interlayer] used in compliance with the interlayer manufacturer's written instructions.

b. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with engineered requirements.

c. Interlayer Color: Clear.

][2.2.4 Interspace

The inner and outer lites of insulated glass units must be separated by a 12.7 mm 1/2-inch minimum hermetically sealed interspace. The entrapped air or gas must be dehydrated by a drying agent. Tower cab glass must be fabricated for use at the installation’s elevation above mean sea level (AMSL). Units must be free of any optical distortion at the time of installation.

]2.3 TOWER CAB GLASS ASSEMBLIES

****

NOTE: Requirements for control tower cab glazing are for the sizes and details on the current standard

control tower drawings. Any modification from standard will be made only with the approval of the Contracting Officer.

If spare units are required for a particular project an "Extra Materials" paragraph must be developed for PART 1 which identifies the items, states quantities, and indicates to whom, when and where to be delivered.

For overseas work the following subparagraph will also be added: When units from other than a United States manufacturer are proposed for use, the manufacturer must prove successful use of the insulating glazing units in aircraft control tower cabs to the Contracting Officer.

****

Tolerances and clearances for units must be designed to prevent the transfer of stress in metal frames to the glass under all design conditions. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, glazing sealants, and resilient channels must be of the type recommended in the glass manufacturer's approved written instructions.

****

NOTE: For better thermal performance, a Low-Emissivity (Low-E) coating on glass is recommended for most locations. Low-E coating selection must have minimal impact on the visible light transmittance, as the importance of visible transmittance of light is critical to the cab operation. Coordinate with glass manufacturer, Contracting Officer, and mechanical engineer regarding selection of Low-E coating.

For insulated glass units, Low-E coating should be on one of the glass surfaces facing the interspace; on the interior-side surface in heating-dominated buildings and on the exterior-side surface (inside surface of the exterior pane) in cooling-dominated buildings. (The number one (1) surface of the glass is always the exterior face of the glass assembly; surfaces are counted on each ply of glass with the highest numbered surface facing the interior of the building.

When selecting glass and a coating, verify with manufacturer/fabricator if Low-E coating is either pyrolytic or vacuum applied to glass. Be aware that currently applying Low-E coating to glass thicker than 6 mm 1/4 inch is problematic. If required on glass thicker than 6 mm 1/4 inch consider using laminated glass. Coordinate with glass manufacturer/fabricator.

Pyrolytic coatings (hard coat) are applied by glass manufacturer during the manufacturing process and are integral to the glass. Pyrolytic coatings are more durable than vacuum deposit. Easier to ship,

handle, and install. This Low-E coating is used on single panes of glass where Low-E coating is exposed. (Verify if selecting laminated glass, if low-E is required to be pyrolitically applied.) Vacuum deposit (Sputter) coatings (soft coat) can be applied by either manufacturer, or fabricator of glass. Vacuum deposit coatings require special handling and storage to protect the coating. Typically only used in insulated glass units, as coating requires protection. Vacuum deposit offers more coating options and improved solar, thermal, and light-to-solar gain options than the pyrolitic process.

Coordinate with glass manufacturer's and fabricator's thermal performance of glass assembly.

****

****

NOTE: The use of Low-E coating on the glass is recommended for most climates, however caution should be used. It is problematic to apply to glass thicker than 6 mm 1/4 inch. If the glass layup is required to be thicker, then it is possible to use multiple layers of laminated glass (i.e., 6 mm 1/4 inch glass plus 1.52 mm 0.060 inch interlayer plus 12.7 mm 1/2 inch glass plus 1.52 mm 0.060-inch interlayer plus 12.7 mm 1/2 inch glass) with the Low-E on the 6 mm 1/4 inch lite when required.

Use greater interlayer thicknesses for improved impact and blast resistance as determined by the glass engineer. It is not recommended to use thickness less than 1.52 mm 0.060 inch.

****

[**********

NOTE: The assembly of laminated glass can be done a number of different ways. It can be with or without a Low-E coating. It can be assembled in two, three, or more plies of varying glass ply thicknesses or the same thicknesses. Modify following paragraphs as necessary for selection of this cab glazing.

****

][2.3.1 Laminated Annealed Glass Units

Glass Type: Low-iron clear laminated glass with no less than two plies of low-iron annealed float glass.

****

NOTE: Provide overall unit thickness minimum based on concept design and including total glass thickness and interlayer thickness. These will be minimums as delegated glass engineering may increases unit thicknesses.

****

a. Overall Unit Thickness: [_____] mm [_____] inch minimum.

b. Minimum Thickness of Each Glass Ply: 3 mm 1/8 inch.

c. Interlayer Thickness: 1.52 mm 0.060 inch minimum each.

][2.3.2 Low-E Coated Laminated Annealed Glass Units

Glass Type: Low-iron clear Low-E laminated glass with [two] [_____] plies of low-iron annealed float glass.

a. Overall Unit Thickness:[_____] [_____] mm [_____] inch minimum.

b. Minimum Thickness of Each Glass Ply: 3 mm 1/8 inch.

c. Interlayer Thickness: 1.52 mm 0.060 inch minimum each.

****

NOTE: Where low-e coating is required at laminated uninsulated glass, provide pyrolitic hard coat at external surface when approved by the Contracting Officer or on surface approved or provide approved low-e film between two plies of interlayers.

****

d. Low-E Performance: [Pyrolytic hard coat on first surface (out of four surfaces total)] [Pyrolytic hard coat on fourth surface (out of four surfaces total)] [Low-E film between two plies of interlayer].

e. Winter Nighttime U-Factor: [_____] maximum.

f. Summer Daytime U-Factor: [_____] maximum.

g. Visible Light Transmittance: [_____] percent minimum.

h. Solar Heat Gain Coefficient: [_____] maximum.

][2.3.3 Insulated Laminated Annealed Glass Units

Glass Type: Insulating laminated low-iron clear annealed float glass.

a. Overall Unit Thickness: [_____] mm [_____] inch minimum.

b. Outdoor Lite: Low-iron clear laminated glass with two plies of low-iron annealed float glass.

1) Minimum Thickness of Each Glass Ply: 3 mm 1/8 inch.
2) Interlayer Thickness: 1.52 mm 0.060 inch minimum each.

c. Interspace Content: [Air][Argon].

d. Indoor Lite: Low-iron clear laminated glass with two plies of low-iron annealed float glass

Minimum Thickness of Each Glass Ply: 3 mm 1/8 inch.
2) Interlayer Thickness: 1.52 mm 0.060 inch minimum each.

e. Winter Nighttime U-Factor: [_____] maximum.

f. Summer Daytime U-Factor: [_____] maximum.

g. Visible Light Transmittance: [_____] percent minimum.

h. Solar Heat Gain Coefficient: [_____] maximum.

][2.3.4 Low-E Coated Insulated Laminated Annealed Glass Units

Glass Type: Insulating laminated Low-E coated low-iron clear annealed float glass.

a. Overall Unit Thickness: [_____] mm [_____] inch minimum.

b. Outdoor Lite: Low-iron clear laminated glass with two plies of low-iron annealed float glass.

1) Minimum Thickness of Each Glass Ply: 3 mm 1/8 inch.
2) Interlayer Thickness: 1.52 mm 0.060 inch minimum each.

c. Interspace Content: [Air][Argon].

d. Low-E Coating: [Pyrolytic on fourth] [Pyrolytic on fifth] [Sputtered on fourth] [Sputtered on fifth] surface (out of eight surfaces total).

e. Indoor Lite: Low-iron clear laminated glass with two plies of low-iron annealed float glass

1) Minimum Thickness of Each Glass Ply: 3 mm1/8 inch.
2) Interlayer Thickness: 1.52 mm0.060 inch minimum each.

f. Winter Nighttime U-Factor: [_____] maximum.

g. Summer Daytime U-Factor: [_____] maximum.

h. Visible Light Transmittance: [_____] percent minimum.

i. Solar Heat Gain Coefficient: [_____] maximum.

]2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted must be a dark color to match mullions.

2.4.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing sash. Sealant must be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. For laminated glass the sealant must be compatible with interlayer. Sealant color must be as selected from manufacturer's samples.

2.4.2 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the project specific conditions.

2.4.3 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use sealing tape only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes must be chemically compatible with the product being set.

2.4.4 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks must be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer of 90. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be black.

2.4.5 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, water tight, and weather tight.

2.4.6 Glazing Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide anticorrosion metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.5 FABRICATION

Provide glazing units required to fit glazing opening sizes and shapes and outward slope indicated on the construction documents and as verified in the field with edge and face clearances, edge and surface conditions, and bite complying with written instructions manufacturer, fabricator and referenced glazing publications, to comply with system performance requirements.

PART 3 EXECUTION

3.1 GLAZING, GENERAL

Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

Install tower cab glass at outward slope indicated on the drawings.

Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

Protect glass from edge damage during handling and installation as follows:

a. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal

edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

b. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

Provide spacers for glass as follows:

a. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.

b. Provide manufacturer's recommended minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer. Prevent shifting of glass units within the mullion rabbets which could cause loss of required bite.

3.2 PREPARATION

Preparation, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

****

NOTE: Retain following paragraph if the speed of construction of the air traffic control tower is not of the essence. The cab glazing and structural framing system dimensions can sometimes be distorted by weight of cab roof assembly or temperature/ solar heat gain where radiant energy of the sun causes some opening sizes to vary during installation process.

****

[Where tower cab glass mullions also structurally support the tower cab

roof and penthouse, the full dead load of the tower cab roof, not including the tower cab ceiling grid and panels, must be applied before taking final measurements of the tower cab glazing openings. The tower cab glass must then be fabricated to fit those actual dimensions.

] Inspect glazing units to locate exterior and interior surfaces. Temporarily label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not specified as permanently bonded to substrates.

Ensure that glazing framing weep system must not be obstructed during installation of glazing. Coordinate installation with glazing frame manufacturer's instructions, and requirements.

3.3 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, must conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.3.1 Manufacturer's Instructions

Comply with the manufacturer's warranty and written instructions. Confirm that additional specified requirements are accepted by the manufacturer in writing. Secure glass in place with bolts and spring clips. The minimum clearance between bolts and edge of glass unit must be 5 mm 3/16 inch. The glass must be edged, top and bottom, with 5 mm 3/16 inch thick continuous neoprene, vinyl, or other approved material. Trim edging after installation. The channel shapes or strips must be firmly held against the glass by the spring action of the extruded metal moldings or metal bars. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, applicable glazing compound, and resilient channels or cemented-on materials must be as recommended in the written instructions of the glass manufacturer which must be submitted and approved prior to shipping the tower cab glass.

3.3.2 Tolerances and Clearances of Units

Design to prevent the transfer of stress in the setting frames to the glass. Springing, twisting, or forcing of units during setting is not permitted.

[3.3.3 Insulating Glass Units

****
NOTE: Delete following paragraph if cab glass units are not insulated glass units.
****

Springing, forcing, or twisting of units during setting is not permitted.

Handle units so as not to strike frames or other objects. Installation mustconform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

][3.3.4 Seismic Installation

****
NOTE: Delete following paragraph if cab glass units are not being installed in high seismic area.
****

Comply with the following requirements for seismic installation.

a. Glass Corner and Edge Cushioning: Padding consisting of 50-70 shore durometer hardness material should be placed in the glazing channel or on the glass edges/corners to avoid any glass to frame contact.

b. Gasket Performance: Gasket should have a positive lock-in method so that gasket will not disengage from metal framing system during up and down and side-to-side movement.

c. Setting Blocks and Supports: Permanently mount setting block and supports to frame using a compatible sealant. Use anti-walk blocks.

]3.3.5 Laminated Glass Units

****
NOTE: Delete following paragraph if cab glass units are not laminated glass.
****

Frames which are to receive laminated glass must be weeped to the outside to prevent water collection in channels or rabbets.

3.4 CLEANING

Follow recommendations of GANA Glazing Manual and the glass manufacturer. Clean glass and metal frequently during construction. Clean glass surfaces and remove labels, paint spots, and other defacement as required to prevent staining. Glass must be cleaned with a soft, clean, grit-free cloth, mild soap, detergent, or slightly acidic cleaning solution. Rinse immediately after cleaning with water and promptly remove excess rinse water with a clean squeegee. Razor blades or other sharp objects must not be used to clean glass surfaces. Glass must be clean at the time the Work is accepted.

3.4.1 Cleaning Prior to Final Inspection

Clean glass at least one day prior to final inspection. Final inspection will be performed during the day and at night. Inspection at night is required verifying that the glass does not have optical distortions that causes ghosting/double images. No additional work will be performed in tower cab by the contractor after final inspection without permission of contracting officer.

3.5 PROTECTION

Glass work must be protected immediately after installation. Glazed openings must be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protective material must be

placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities must be removed and replaced with new units.

Follow recommendations of GANA Glazing Manual and the glass manufacturer. Protect the glass from weld splatter by using plywood or heavy tarpaulins. Do not place insulation over the glass for protection or keep shading material on the glass because excess thermal buildup could result in glass breakage. Do not allow materials to be stored or placed in contact with the glass.

3.6 WASTE MANAGEMENT

****

NOTE: Float glass cannot be recycled with beverage-container glass. Diverting waste from the landfill contributes to the required LEED MR credit. Coordinate with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Designer must verify that items are able to be disposed of as specified.

****

Disposal and recycling of waste materials, including corrugated cardboard recycling, must be in accordance with the Waste Management Plan. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

3.7 MAINTENANCE MANUALS

Provide product manufacturer's published and written instructions for both the maintenance and cleaning of the tower cab glass assemblies as installed in the format compliant with the project requirements and as approved by the Contracting Officer.

-- End of Section --