Preparing Activity: USACE Nontechnical Title Revision
(August 2015)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 87 23.13

SAFETY FILMS

08/09

PART 1 GENERAL

1.1 REFERENCES
1.2 SYSTEM DESCRIPTION
1.2.1 General Requirements
1.2.2 Other Submittals Requirements
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
1.5 DELIVERY, STORAGE, AND HANDLING
1.6 WARRANTY

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS
2.2 FRAGMENT RETENTION FILM
2.2.1 Impact Performance
2.2.2 Tensile Strength
2.2.3 Peel Strength
2.2.4 Surface Abrasion
2.2.5 Flame Spread and Smoke Density

PART 3 EXECUTION

3.1 SURFACE PREPARATION
3.2 APPLICATION
3.2.1 Application to New Glass Before Glazing
3.2.2 Application to Existing Glass Involving Dismantlement
3.2.3 Application to Existing Glass Without Dismantlement
3.2.4 Application to Existing Glass and Frame Without Dismantlement
3.2.5 Splicing
3.3 CLEANING

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA **UFGS-08 87 23.13 (August 2009)**

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SECTION 08 87 23.13

SAFETY FILMS
08/09

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NOTE: This guide specification covers the requirements for transparent film at least 0.10 mm 0.004 inch thick (4 mil) applied to the interior side of glass to reduce spalling and fragment dispersal.

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 submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

1.1 REFERENCES

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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.

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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 C1036	(2021) Standard Specification for Flat Glass
ASTM C1048	(2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM D1044	(2019) Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion by the Taber Abraser
ASTM D3330/D3330M	(2004; R 2018) Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2008) Glazing Manual
GANA Sealant Manual	(2008) Sealant Manual

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

1.2 SYSTEM DESCRIPTION

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NOTE: This specification should be used when glass may be subjected to the effects of explosives or

projectiles and when protection of personnel from the resulting glass spalling is required. The film is most effective when installed on the interior surface of the glass. Under low blast pressures or projectile loads, the film may not prevent the glass from breaking but it holds the glass fragments together and reduces the destructive capability of flying glass fragments. Note that testing has shown that fragment retention film will not necessarily hold glass fragments together when subjected to very high blast pressures, and the designer may therefore want to consider alternate methods for protection of personnel. The application of film to glass generally allows projectiles, fragments, or bullets to pass through; however, the film does reduce spalling of the glass associated with a projectile passing through the film.

The application of film to glass provides some resistance against impacts from hammers, rocks, clubs, or thrown objects. An impact on the film reinforced glass creates a hole approximately the size of the impacting object. Therefore, several impacts are needed to make a hole large enough for entry. The use of greater film thickness and/or factory laminated films provides more resistance against these impacts.

Tints and reflective films can improve the thermal energy performance of a building. However, darkly tinted and reflective films can cause internal heat buildup and internal stresses in the glass resulting in a weakened glazing system. If reflective films are used to reduce visibility into a facility, also provide curtains or shades for night use because films are not reflective when the light level on the exterior side of the film is less than that on the interior side.

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1.2.1 General Requirements

Apply clean fragment retention film free of peeling, splitting, scratches, creases, wrinkles, discoloration, and foreign particles. The film application must be free of air bubbles after 30 days. Do not show signs of waviness and distortion at the time the work is accepted. Make this determination by the unaided eye (except for corrective prescription glasses), when the film is viewed from a distance of 3 m 10 feet from the interior room side at angles up to 45 degrees when looking at a clear or uniformly overcast sky. Remove unacceptable fragment retention film applications in accordance with manufacturer's instructions and new film applied.

1.2.2 Other Submittals Requirements

Submit the following for fragment retention film:

a. Manufacturer's data consisting of catalog cuts, brochures, circulars, and a list of glazing compounds and/or gaskets known to be

incompatible with the fragment retention film.

b. Manufacturer's application and cleaning instructions for fragment retention film.

c. A statement that the fragment retention film supplied was manufactured using the same materials and process as the material tested. A statement that the adhesive contains ultraviolet inhibitors which limit ultraviolet transmission to not more than 8 percent of the radiation between 300 and 380 nanometers. A statement that the film manufacturer or manufacturer's representative trained the personnel who will apply the film.

d. A sample consisting of a minimum 200 by 275 mm 8 by 11 inch section of fragment retention film including the adhesive layer.

e. Certified test reports including analysis and interpretation of test results. Identify the manufacturer, the specific product name, the film thickness, the adhesive type and thickness, and the glass type and thickness. Identify the methods used and include the results recorded.

f. On applications where the film will contact the glazing beads or gaskets, a certificate from the Contractor stating that the glazing compounds and gaskets are compatible with the fragment retention film and adhesive.

1.3 SUBMITTALS

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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.

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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-03 Product Data

Fragment Retention Film

Cleaning

SD-04 Samples

Fragment Retention Film; G[, [_____]]

SD-06 Test Reports

Fragment Retention Film

SD-07 Certificates

Fragment Retention Film

1.4 QUALITY ASSURANCE

The personnel applying the fragment retention film must be trained by the film manufacturer or manufacturer's representative.

1.5 DELIVERY, STORAGE, AND HANDLING

The Contractor is responsible for delivery of the fragment retention film to the appropriate location for application. Deliver, store, and handle fragment retention film in accordance with the manufacturer's recommendations. Store glass, including glass in windows or doors with factory applied film, in a dry location free of dust, water, and other contaminants. Deliver, store, and handle glass with factory applied film so that the film is not damaged, scratched, or abraded and store in a manner which permits easy access for inspection and handling. Provide each roll of film with a tamperproof label containing full details of the roll, the batch number, and sufficient information to enable the Contracting Officer to ensure that the correct film is supplied.

1.6 WARRANTY

Furnish a 5 year warranty for fragment retention film material, providing for replacement of film if cracking, crazing, peeling, or inadequate adhesion occurs.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide fragment retention film which is the standard product of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 FRAGMENT RETENTION FILM

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NOTE: Indicate windows and doors requiring film on the window and door schedules or window and door elevations of the drawings.

The film is available in 0.05 mm 0.002 in., 0.10 mm 0.004 in., 0.18 mm 0.007 in., 0.20 mm 0.008 in., 0.25 mm 0.010 in., and 0.30 mm 0.012 inch thicknesses. A minimum thickness of 0.10 mm 0.004 inch film is acceptable for fragment retention. The use of greater than 0.10 mm 0.004 inch film thickness and/or factory laminated films of 0.10 mm 0.004 inch or greater may provide more protection for occupants from flying fragments of glass but may not be warranted for low blast pressure. The designer must investigate window frames and building components adjacent to the glazed opening for transfer of the blast load when using 0.18 mm 0.007 inch and thicker films.

The properties of fragment retention film and/or the adhesive may change over time, effecting the film's capacity to retain fragments. Testing has shown the film retains fragments up to 7 years of use.

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Provide fragment retention film consisting of polyester, polyethylene terephthalate, or a composite, optically clear and free of waves, distortions, impurities, and adhesive lines. The film may be a single layer or laminated. Laminate film at the factory of the fragment retention film manufacturer. Include an abrasion resistant coating on the surface that does not receive the film adhesive. Provide [clear] [tinted] [reflective] fragment retention film with a minimum thickness of [0.10] [0.18] [0.25] mm [0.004] [0.007] [0.010] inch. Supply with an optically clear weatherable pressure sensitive adhesive. The adhesive must contain ultraviolet inhibitors to protect the film for its required life and must limit ultraviolet transmission to not more than 8 percent of the radiation between 300 and 380 nanometers. The adhesive must not be water activated. A water soluble detackifier and/or release liner may be incorporated over the adhesive to facilitate film application. The adhesive must be 90 percent cured within 30 days of installation. Provide adhesives that are a minimum of 0.02 mm 0.0008 inch thick on film thicknesses of 0.25 mm 0.010 inch and greater. Perform the following tests to indicate compliance with specified requirements by an independent testing laboratory, and have a responsible official of the laboratory sign the laboratory reports.

2.2.1 Impact Performance

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NOTE: Retain sentences about splices when the film will be applied to sheets of glass with a dimension exceeding 1475 mm 58 inches in both directions.

Paragraph 5.1.3 (2) of ANSI Z97.1 and paragraph 1204.4 (e) (1) (ii) of 16 CFR 1201 will not be an accepted form of testing glazing failure after the impact test because these paragraphs allow complete disintegration if fragment particles are small enough. Complete disintegration of the glazing is unacceptable under blast loading because the particles would be propelled into the building and could seriously injure or kill the occupants. Designers specifying fragment retention film for use in other countries may substitute impact test reports in accordance with British Standard (BS) BS 6206 Class B and German Standard DIN 5237, which use similar testing methods to the impact tests specified. The designer should accept but not specify films tested and receiving an A1 impact resistance under DIN 52290 or film which has tested positively in accordance with BS 5544. Do not specify the film to be tested in accordance with DIN 52290 or BS 5544 because relatively few films can pass these more stringent impact tests.

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Test fragment retention film for impact in accordance with ANSI Z97.1 or 16 CFR 1201. Conduct tests on fragment retention film applied to 3.1 to 6.4 mm 1/8 to 1/4 inch-thick annealed flat glass which conforms to the requirements of ASTM C1036, Type I, Class 1, Quality q3. Apply the tested film to the glass with a splice located at the midpoint of the specimen. Include sketches showing location and configuration of splice in submitted certified test reports. After the impact portion of the test is conducted, determine satisfactory performance of the test specimens using ANSI Z97.1, paragraph 5.1.3 or 16 CFR 1201, paragraph 1201.4 (e)--INTERPRETATION OF RESULTS. To be qualified for use under this specification, provide a report that the fragment retention film satisfactorily performed in accordance with ANSI Z97.1, paragraph 5.1.3 (1), (3), or (4) or with 16 CFR 1201, paragraph 1204.4 (e) (1) (i), (iv), or (v). ANSI Z97.1, paragraph 5.1.3 (2) or 16 CFR 1201, paragraph 1204.4 (e) (1) (ii) does not constitute passing criteria.

2.2.2 Tensile Strength

The fragment retention film samples tested must exhibit a minimum tensile strength at break of 172.4 MPa 25,000 psi when tested in accordance with ASTM D882. Use Method A, Static Weighing, Constant Rate of Grip Separation Test, to conduct this test. Rate of grip separation exceeding 0.2 mm/s 1/2 inch per minute is not permitted.

2.2.3 Peel Strength

Conduct testing following 1,200 hours accelerated weathering exposure. The fragment retention film must exhibit a minimum peel strength of 930 N/m 5.3 pounds/inch for 0.10 mm 0.004 inch thick film and 790 N/m 4.5

pounds/inch for 0.18 mm 0.007 inch thick and thicker film when tested in accordance with ASTM D3330/D3330M. Use Method A to conduct the tests. Use a glass substrate and a maximum dwell time of 45 days is permitted.

2.2.4 Surface Abrasion

Exhibit a change in haze not to exceed 3.2 percent following 100 turns, using 500-gram weights on a CS 10F abrasive wheel when tested in accordance with ASTM D1044.

2.2.5 Flame Spread and Smoke Density

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Note: The designer may delete the requirement for flame spread and smoke density index if not required by the project.

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Exhibit a flame spread index not exceeding 25 and a smoke density index not exceeding 100 when tested in accordance with ASTM E84. For the test, mount the specimen to 6.4 mm 1/4 inch thick tempered glass which conforms to the requirements of ASTM C1048, Kind FT, Type I, Class 1, Quality q3.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean the glass surface, to which the fragment retention film is to be applied, of paint, foreign compounds, smears, and spatters. After the initial cleaning, further clean the surface to receive the film in accordance with the film manufacturer's instructions.

3.2 APPLICATION

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NOTE: Greater protection for occupants from flying glass caused by blast loads is achieved by applying film such that it extends edge to edge of the sheet and into the bite of the frame. Some gaskets and compounds can dissolve the film surface, the adhesive, or the metallic coating interlayer of reflective or tinted films. For insulated glass units, apply film to the interior (room) side only. Other applications have not been tested. Tests show that film applications to insulated glass units offer more protection for occupants than applications on single sheets of glass. When more than one type of film application is used for a project, indicate the application to be used on the door and window schedules or elevations.

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Provide fragment retention film on window and door glass where indicated. After surface preparation, apply the fragment retention film in accordance with the manufacturer's recommendations and instructions. Apply film to the interior (room) side of the glass for both single and double glazed sheets, unless otherwise indicated. Multiple applications of film to achieve specified thicknesses is not allowed. Do not apply film if there are visible dust particles in the air, if there is frost on the glazing,

or if any room condition such as temperature and humidity do not meet the manufacturer's instructions. After film application, maintain room conditions as required by the manufacturer's instructions to allow for proper curing of the adhesive.

3.2.1 Application to New Glass Before Glazing

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NOTE: Retain this paragraph when film will be applied to the glass before glazing. This may occur at the window or door manufacturer's shop or in the field. Designer will insert a coordinating note into Section 08 81 00 GLAZING, indicating that fragment retention film application is a requirement.

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Apply fragment retention film so that it extends edge to edge of the glass sheet. Then set the film reinforced glass into the frame with glazing compounds or gaskets as specified in Section 08 81 00 GLAZING. Ensure compatibility when contact between the glazing compounds and/or gaskets and the film occurs. Coordinate fragment retention film application and curing with the glass supplier and window or door manufacturer prior to glazing installation.

3.2.2 Application to Existing Glass Involving Dismantlement

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NOTE: Retain this paragraph when film is to be applied to existing glazing where the stops, compounds, and/or gaskets must be removed to apply the film edge to edge of the glass sheet. Dismantlement is recommended for glazed openings with removable stops and removable reusable gaskets. Removable gaskets include vinyl and rubber channels or beads and extruded aluminum beads. Dismantlement may be too expensive for openings glazed with compounds. This expense is due to the increased labor, increased risk of breakage, and increased cost of replacing compounds because most compounds are not reusable. Compounds include wet applied or semi-soft compounds such as sealant, putty, butyl, hypalon, silicone, acrylic, polyurethane, polysulfide, and preformed semi-solid tapes. Although existing gaskets are readily identifiable, determining the composition of existing compounds to check compatibility with the film is more difficult and could add expense to the project.

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Remove the existing glazing compound, gaskets, and/or stops as required to expose the existing glass pane. If necessary, remove the glass so that the film can be applied extending edge to edge of the glass sheet. Install existing gaskets and/or stops and replace any removed glazing compounds with new glazing compounds. Scrap removed glazing compounds and do not reuse. Provide glazing compounds in accordance with GANA Sealant Manual. Perform glazing in accordance with GANA Glazing Manual. Ensure compatibility when contact between the glazing compounds and/or gaskets and the film occurs. Replace damaged or

broken glazing and gaskets and reinstall in kind.

3.2.3 Application to Existing Glass Without Dismantlement

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NOTE: Retain this paragraph for application where dismantlement is not possible or is too expensive. When exposed to the effects of explosives, films that stop close to the frame but do not extend into the bite tend to break along the weak edge and disengage completely from the frame. Because the disengaged film reinforced glass is held together as a unit, protection is provided for building occupants. This application is simplest and the least costly. Also, coordination and compatibility of the film with the compounds and gaskets is not necessary because they do not contact. If the edges of the existing glazing compounds are particularly irregular, the designer may specify the film application to be within a maximum of 5 mm 3/16 inch, although the 3 mm 1/8 inch maximum is recommended.
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Apply fragment retention film so that it extends to within 1.6 mm 1/16 inch, with a maximum of [3] [5] mm [1/8] [3/16] inch, of the edge of the visible glass area.

3.2.4 Application to Existing Glass and Frame Without Dismantlement

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NOTE: Retain this paragraph for application where dismantlement is not possible or is too expensive. Although this application has not been tested under blast loads, several manufacturers recommend it. In this application, the film is likely to contact the existing gaskets and compounds. Trim or a batten may be indicated on the drawings and/or added to this paragraph to hide the film edge.
****

Apply fragment retention film past the edge of the visible glass and extend onto the frame. Provide amount of film overlap, edge connection to the frame, and adhesive for adhering film to frame as recommended by the film manufacturer. Ensure compatibility when contact between the glazing compounds and/or gaskets and the film occurs.

3.2.5 Splicing

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NOTE: Overlaps of 0.25 mm 0.010 inch thick and thicker film are highly visible and are not recommended. If no glazing has a dimension exceeding 1475 mm 58 inches in both directions, specify that the film may not be spliced.
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[Splices or seams in fragment retention film are not permitted.] [Splices or seams in fragment retention film are permitted only when a sheet of glass has a dimension exceeding 1.475 m 58 inches in both directions.

Apply all seams with a minimum overlap of 6 mm 1/4 inch unless submitted test reports indicate impact performance is not diminished when seam is applied with a different overlap or a gap.]

3.3 CLEANING

Clean the fragment retention film in accordance with the manufacturer's instructions.

-- End of Section --