



SECTION 08 87 16

SAFETY AND SECURITY WINDOW FILM

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Safety and security window film.
- B. Anti-graffiti window film.
- C. Film attachment systems.

1.2 RELATED SECTIONS

- A. Section 08 54 13 - Fiberglass Windows.
- B. Section 08 60 00 - Roof Windows and Skylights.
- C. Section 08 83 13 - Mirrored Glass Glazing.
- D. Section 08 44 23 - Structural Sealant Glazed Curtain Wall.

1.3 REFERENCES

- A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.
- B. ASTM International (ASTM):
  1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  2. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
  3. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  4. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
  5. ASTM D1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
  6. ASTM D2240 - Standard Method for Rubber Property - Durometer Hardness.
  7. ASTM D2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.

8. ASTM D5895 - Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders.
  9. ASTM D4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
  10. ASTM E84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
  11. ASTM E903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
  12. ASTM E1886 - 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.
  13. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
  14. ASTM F1642 - Standard Method of Test for Glazing and Glazing Systems Subject to Airblast Loadings.
  15. ASTM F2912 - Standard Specification for Glazing and Glazing Systems Subject to Airblast Loadings.
- C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- D. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.
- E. GSA-TS01-2003 -- Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.
- F. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.
- G. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Safety Glazing Impact Performance:
1. 400 ft-lbs impact resistance, meeting ANSI Z97.1 (Class A, Unlimited) and 16 CFR 1201 (Category 2) impact requirements with film applied on 1/4 inch annealed glass.
  2. Impact Resistance after Aging: 400 ft-lbs, meeting ANSI Z97.1 (Class A, Unlimited) and 16 CFR 1201 (Category 2) impact requirements with film applied on 1/8 inch annealed glass.
  3. 400 ft-lbs impact resistance, meeting 16 CFR 1201 (Category 2) impact requirements with film applied on 1/4 inch annealed glass.
  4. 150 ft-lbs impact resistance, meeting ANSI Z97.1 (Class B, Unlimited) and 16 CFR 1201 (Category 1) impact requirements with film applied on 1/4 inch annealed glass
  5. 400 ft-lbs impact resistance, meeting ANSI Z97.1 (Class A, Unlimited) or 16 CFR 1201 (Category 2) impact requirements with film applied on 1/4 inch annealed glass
  6. 150 ft-lbs impact resistance, meeting ANSI Z97.1 (Class B, Unlimited) and 16 CFR 1201 (Category 1) impact requirements with film applied on 1/4 inch annealed glass
  7. 400 ft-lbs impact resistance, meeting ANSI Z97.1 (Class A, Unlimited) and 16 CFR 1201 (Category 2) impact requirements with film is applied on 1/4 inch annealed glass

- B. Blast Hazard Mitigation Performance:
1. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 7 psi and 43 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  2. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with minimum blast load of 9 psi and 60 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
  3. GSA Rating of "3B" / ASTM F1642 "Very Low Hazard" with minimum blast load of 5 psi and 28 psi\*msec, on 1/4" single pane glass without film attachment system.
  4. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with minimum blast load of 11 psi and 65 psi\*msec, on 1 inch (25 mm) double pane glass without film attachment system.
  5. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 9 psi and 63 psi\*msec, on 1/4" single pane glass and film attachment system.
  6. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with minimum blast load of 10 psi and 89 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
  7. GSA Rating of "3B" / ASTM F1642 "Very Low Hazard" with minimum blast load of 5 psi and 28 psi\*msec, on 1/4" pane glass without film attachment system.
  8. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with blast minimum load of 10 psi and 42 psi\*msec, on 1 inch (25 mm) double pane glass without film attachment system.
  9. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 6 psi and 45 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  10. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 9 psi and 60 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
  11. GSA Rating of "3B" with minimum blast load of 4 psi and 28 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  12. GSA Rating of "3B" with minimum blast load of 10 psi and 89 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
  13. GSA Rating of "3B" / ASTM F1642 "Minimal Hazard" with minimum blast load of 6 psi and 41 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  14. GSA Rating of "2" with minimum blast load of 12 psi and 66 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
  15. GSA Rating of "3B" with minimum blast load of 4 psi and 29 psi\*msec, on 1/4 inch (6 mm) pane glass without film attachment system.
  16. GSA Rating of "3B" with minimum blast load of 8 psi and 44 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  17. GSA Rating of "3B" with minimum blast load of 15 psi and 59 psi\*msec, on 1 inch (25 mm) double pane glass without film attachment system.
  18. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 5 psi and 32 psi\*msec, on 1/4 inch (6 mm) single pane glass and film attachment system.
  19. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 5 psi and 30 psi\*msec, on 1 inch (25 mm) double pane glass and film attachment system.
- C. Impact Resistance and Pressure Cycling:
1. ASTM E1996 / E1886: Small Missile "A", +/- 80 psf Design Pressure.
  2. ASTM E1996 / E1886: Large Missile "C", +/- 75 psf Design Pressure
  3. ASTM E1996 / E1886: Small Missile "A", +/- 70 psf Design Pressure

4. ASTM E1996 / E1886: Small Missile "A", +/- 60 psf Design Pressure
  5. ASTM E1996 / E1886: Large Missile "C", +/- 60 psf Design Pressure
- D. Tear Resistance:
1. Minimum Graves Area Tear Strength of 1,000 lbs% as measured on coated film product, without liner, per ASTM D1004.
  2. Minimum Graves Area Tear Strength of 1,200 lbs% as measured on coated film product, without liner, per ASTM D1004.
  3. Minimum Graves Area Tear Strength of 1,100 lbs% as measured on coated film product, without liner, per ASTM D1004
- E. Adhesion to Glass:
1. Minimum 8 lbs/in peel strength per ASTM D3330 (Method A).
  2. Minimum 6 lbs/in peel strength per ASTM D3330 (Method A).
  3. Minimum 6 lbs/in peel strength per ASTM D3330 (Method A).
  4. Nominal 4 lbs/in peel strength per ASTM D3330 (Method A).
  5. Nominal 5 lbs/in peel strength per ASTM D3330 (Method A).
  6. Minimum 2 lbs/in peel strength per ASTM D3330 (Method A).
  7. Nominal 4 lbs/in peel strength per ASTM D3330 (Method A).
  8. Nominal 4 lbs/in peel strength per ASTM D3330 (Method A).
  9. Nominal 5 lbs/in peel strength per ASTM D3330 (Method A).
  10. Minimum 3 lbs/in peel strength per ASTM D3330 (Method A).
  11. Nominal 1 lbs/in peel strength per ASTM D3330 (Method A).
- F. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
1. Flame Spread Index: no greater than 25.
  2. Smoke Developed Index: no greater than 55.
- G. Abrasion Resistance:
1. Film shall have a surface coating that is resistant to abrasion such that less than 3 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
  2. Film shall have a surface coating that is resistant to abrasion such that less than 3 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
  3. Film shall have a surface coating that is resistant to abrasion such that less than 5 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
  4. Film shall have a surface coating that is resistant to abrasion such that a nominal 5 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
  5. Film shall have a surface coating that is resistant to abrasion such that a nominal 3 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
  6. Film shall have a surface coating that is resistant to abrasion such that less than 2 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.
- H. UV Light Rejection:
1. Minimum of 99.9% UV light rejection (300 - 380 nm), per ASTM E903, as

- determined with film applied on 1/4 inch clear glass.
- 2. Minimum of 99.9% UV light rejection (300 - 380 nm), per ASTM E903, as determined with film applied on 1/4 inch clear glass.
- 3. Minimum of 99% UV light rejection (300 - 380 nm), per ASTM E903, as determined with film applied on 1/4 inch clear glass.
- 4. Minimum of 99.9% UV light rejection (300 - 380 nm), per ASTM E903, as determined with film applied on 1/4 inch clear glass.
- 5. Minimum of 99% UV light rejection (300 - 380 nm), per ASTM E903, as determined with film applied on 1/4 inch clear glass

## 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's current technical literature on each product to be used, including:
  - 1. Manufacturer's Data Sheets.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods.
- C. 3rd Party Test Report Submittal Requirements. Submit the following 3rd Party test reports indicating compliance with the test values listed in this section.
  - 1. Flammability Testing, ASTM E84.
  - 2. Film Properties Testing, ASTM D882.
  - 3. Abrasion Resistance Testing, ASTM D1044.
  - 4. Peel Strength Testing, ASTM D3330.
  - 5. Tear Resistance Testing, ASTM D1004.
  - 6. Puncture Strength Testing, ASTM D4830.
  - 7. Safety Glazing Impact Testing, ANSI Z97.1 and/or 16 CFR 1201.
  - 8. Flammability Testing, ASTM E84.
  - 9. Film Properties Testing, ASTM D882.
  - 10. Abrasion Resistance Testing, ASTM D1044.
  - 11. Peel Strength Testing, ASTM D3330
  - 12. Safety Glazing Impact Testing, ANSI Z97.1 or 16 CFR 1201.
  - 13. Flammability Testing, ASTM E84.
  - 14. Film Properties Testing, ASTM D882.
  - 15. Abrasion Resistance Testing, ASTM D1044.
  - 16. Peel Strength Testing, ASTM D3330
  - 17. Puncture Strength Testing, ASTM D4830.
  - 18. Safety Glazing Impact Testing, ANSI Z97.1 or 16 CFR 1201.
  - 19. Flammability Testing, ASTM E84.
  - 20. Film Properties Testing, ASTM D882.
  - 21. Abrasion Resistance Testing, ASTM D1044.
  - 22. Peel Strength Testing, ASTM D3330
  - 23. Puncture Strength Testing, ASTM D4830.
  - 24. Burglary Resistance Glazing, UL 972
  - 25. Flammability Testing, ASTM E84.
  - 26. Safety Glazing Impact Testing, ANSI Z97.1 and 16 CFR 1201.
  - 27. Flammability Testing, ASTM E84.
  - 28. Film Properties Testing, ASTM D882.
  - 29. Abrasion Resistance Testing, ASTM D1044.
  - 30. Peel Strength Testing, ASTM D3330.
  - 31. Puncture Strength Testing, ASTM D4830.
  - 32. Impact Resistance and Pressure Cycling, ASTMs E1886 and E1996.
  - 33. Blast Hazard Mitigation Testing, ASTM F1642 / F2912 and/or

GSA-TS01-2003.

- D. Other Product Submittals:
  - 1. Manufacturer's summary of 3rd Party Blast Hazard Mitigation Testing, ASTM F1642 / F2912 and/or GSA-TS01-2003
  - 2. 3rd Party test reports from Forced Entry Resistance evaluations.
- E. Verification Samples: For each film specified, two samples representing actual film color and pattern.
- F. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
  - 1. Provide documentation that the adhesive used on the specified film is a Pressure Sensitive Adhesive (PSA).
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
  - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
  - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
    - a. Name of building.
    - b. The name and telephone number of a management contact.
    - c. Type of glass.
    - d. Type of film and/or film attachment system.
    - e. Amount of film and/or film attachment system installed.
    - f. Date of completion.
  - 3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
  - 4. Provide an EFilm application analysis to determine available energy cost reduction and savings.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Follow Manufacturer's instructions for storage and handling.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of any hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

## 1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

## 1.9 WARRANTY

- A. At project closeout, provide to Owner's Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.
- B. In order to validate warranty, installation must be performed by an Authorized 3M dealer. Verification of Authorized 3M dealer can be confirmed by submission of active 3M dealer code number.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: 3M Commercial Solutions, which is located at: 3M Center Bldg. 220-12-E-04; St. Paul, MN 55144-1000; Toll Free Tel: 888-650-3497; Tel: 651-737-1081; Fax: 651 737 8241; Email: [request info \(tdjohnson3@mmm.com\)](mailto:request info (tdjohnson3@mmm.com)); Web: [www.3m.com/3M/en\\_US/architectural-design-us/?utm\\_medium=redirect&utm\\_source=vanity-url&utm\\_campaign=www.3M.com/AMD](http://www.3m.com/3M/en_US/architectural-design-us/?utm_medium=redirect&utm_source=vanity-url&utm_campaign=www.3M.com/AMD) | [www.3m.com/3M/en\\_US/building-window-solutions-us/](http://www.3m.com/3M/en_US/building-window-solutions-us/)
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

### 2.2 CLEAR MICROLAYERED SAFETY AND SECURITY WINDOW FILM

- A. 3M Scotchshield Ultra S600 Safety and Security Window Film. Optically clear microlayered polyester film, nominally 6 mils (0.006 inch) thick, with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is clear and does not contain dyed polyester. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film is microlayered with both plastic and ductile polyester layers for tear resistance.
  - 1. Physical / Mechanical Performance Properties (nominal):
    - a. Film Color: Clear.
    - b. Film Thickness (excluding coatings or adhesive liner): Nominal 6 mils
    - c. Tensile Strength (ASTM D882):
      - 1) Base Film: 32,000 psi (MD) / 32,000 psi (TD).
      - 2) Coated Film: 32,000 psi (MD) / 32,000 psi (TD).
    - d. Break Strength (ASTM D882):
      - 1) Base Film: 190 lb/in (MD) / 190 lb/in (TD).
      - 2) Coated Film: 210 lb/in (MD) / 210 lb/in (TD).
    - e. Percent Elongation at Break (ASTM D882):
      - 1) Base Film: 110 % (MD) / 100 % (TD).
      - 2) Coated Film: 136 % (MD) / 115 % (TD).
    - f. Yield Strength:
      - 1) Base Film: 12,000 psi (MD).
      - 2) Coated Film: 15,000 psi (MD).

- g. Percent Elongation at Yield (ASTM D882):
  - 1) Base Film: 7% (MD).
  - 2) Coated Film: 9% (MD).
- h. Graves Tear Resistance (ASTM D1004):
  - 1) Maximum Force (lbs):
    - a) Base Film: 28 (MD) / 28 (TD).
    - b) Coated Film: 28 (MD) / 28 (TD).
  - 2) Maximum Extension (in):
    - a) Base Film: 0.45 (MD) / 0.65 (TD).
    - b) Coated Film: 0.55 (MD) / 0.55 (TD).
  - 3) Graves Area Tear Resistance (lbs%):
    - a) Base Film: 900 (MD) / 1,200 (TD).
    - b) Coated Film: 900 (MD) / 1,100 (TD).
- i. Puncture Propagation Tear Resistance (ASTM D2582):
  - 1) Coated Film: 6 lbf (MD) / 7 lbf (TD).
- j. Puncture Strength (ASTM D4830):
  - 1) Coated Film: 140 lbf.
- 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
- 3. Variation in Total Transmission across the width: Less than 2 percent over the average at any portion along the length.
- 4. Identification: Labeled as to Manufacturer as listed in this Section.
- 5. Solar Performance Properties: Film applied to 1/4 inch (6 mm) thick clear glass.
  - a. Visible Light Transmission (ASTM E 903): 87 percent.
  - b. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
- 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
  - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  - b. Safety Rating (ANSI Z97.1): Class A, Unlimited Size.
- 7. Impact Resistance and Pressure Cycling: Film shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 80 psf Design Pressure with use of 3M Impact Protection Adhesive. Film applied to 3/16 inch (4.8 mm) tempered glass.
- 8. Blast Hazard Mitigation:
- 9. Independent testing with results from high explosive arena blast or shock tube testing:
  - a. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 44 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Profile Attachment system.
  - b. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 42 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Profile Attachment system
  - c. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 42 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Adhesive Attachment system
  - d. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 42 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Adhesive Attachment system
  - e. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 8 psi and 60 psi\*msec blast impulse, on 1 inch (25.4 mm) annealed double pane glass and 3M Impact Protection Profile Attachment system
  - f. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure



- of 8 psi and 60 psi\*msec blast impulse, on 1 inch (25.4 mm) annealed double pane glass and 3M Impact Protection Adhesive Attachment system
  - g. GSA Rating of "3B" / ASTM F1642 "Very Low Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass, daylight applied film (no attachment)
  - h. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with blast pressure of 7 psi and 43 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass, daylight applied film (no attachment)
  - i. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with blast pressure of 7 psi and 42 psi\*msec blast impulse, on 1 inch (25.4 mm) annealed double pane glass, daylight applied film (no attachment)
  - j. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with blast pressure of 12 psi and 70 psi\*msec blast impulse, on 1 inch (25.4 mm) tempered double pane glass, daylight applied film (no attachment)
10. Forced Entry Resistance: Product shall have been evaluated for time to resist complete body passage by a qualified 3rd Party test lab.
- B. 3M Scotchshield Ultra S800 Safety and Security Window Film. Optically clear microlayered polyester film, nominally 8 mils (0.008 inch) thick, with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is clear and does not contain dyed polyester. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film is microlayered with both plastic and ductile polyester layers for tear resistance.
1. Physical / Mechanical Performance Properties (nominal):
    - a. Film Color: Clear.
    - b. Film Thickness (excluding coatings or adhesive liner): Nominal 8 mils
    - c. Tensile Strength (ASTM D882):
      - 1) Base Film: 32,000 psi (MD) / 32,000 psi (TD).
      - 2) Coated Film: 32,000 psi (MD) / 32,000 psi (TD).
    - d. Break Strength (ASTM D882):
      - 1) Base Film: 250 lb/in (MD) / 250 lb/in (TD).
      - 2) Coated Film: 245 lb/in (MD) / 265 lb/in (TD).
    - e. Percent Elongation at Break (ASTM D882):
      - 1) Base Film: 115 % (MD) / 115 % (TD).
      - 2) Coated Film: 132 % (MD) / 130 % (TD).
    - f. Yield Strength:
      - 1) Base Film: 12,000 psi (MD).
      - 2) Coated Film: 15,000 psi (MD).
    - g. Percent Elongation at Yield (ASTM D882):
      - 1) Base Film: 7% (MD).
      - 2) Coated Film: 9% (MD).
    - h. Graves Tear Resistance (ASTM D1004):
      - 1) Maximum Force (lbs):
        - a) Base Film: 40 (MD) / 40 (TD).
        - b) Coated Film: 40 (MD) / 40 (TD).
      - 2) Maximum Extension (in):
        - a) Base Film: 0.45 (MD) / 0.65 (TD).
        - b) Coated Film: 0.50 (MD) / 0.57 (TD).
      - 3) Graves Area Tear Resistance (lbs%):
        - a) Base Film: 1,100 (MD) / 1,300 (TD).
        - b) Coated Film: 1,100 (MD) / 1,300 (TD).
    - i. Puncture Propagation Tear Resistance (ASTM D2582):
      - 1) Coated Film: 9 lbf (MD) / 10 lbf (TD).
    - j. Puncture Strength (ASTM D4830):

- 1) Material Properties (as supplied).
- 2) Coated Film: 185 lbf.
2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
3. Variation in Total Transmission across the width: Less than 2 percent over the average at any portion along the length.
4. Identification: Labeled as to Manufacturer as listed in this Section.
5. Solar Performance Properties: Film applied to 1/4 inch (6 mm) thick clear glass.
  - a. Visible Light Transmission (ASTM E 903): 87 percent.
  - b. Visible Reflection (ASTM E 903): Not more than 10 percent.
  - c. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
  - d. Solar Heat Gain Coefficient (ASTM E 903): 0.79
6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
  - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  - b. Safety Rating (ANSI Z97.1): Class A, Unlimited Size.
7. Impact Resistance and Pressure Cycling: Film shall pass impact of Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E1996 and E1886) at +/- 75 psf Design Pressure with use of 3M Impact Protection Adhesive. Film applied to 1/4-inch tempered glass.
8. Blast Hazard Mitigation:
  - a. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 44 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Profile Attachment system
  - b. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 7 psi and 43 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Profile Attachment system
  - c. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 9 psi and 62 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Adhesive Attachment system
  - d. GSA Rating of "2" / ASTM F1642 "No Hazard" with blast pressure of 9 psi and 63 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Adhesive Attachment system
  - e. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 9 psi and 60 psi\*msec blast impulse, on 1 inch (25 mm) annealed double pane glass and 3M Impact Protection Profile Attachment system
  - f. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 10 psi and 89 psi\*msec blast impulse, on 1 inch (25 mm) annealed double pane glass and 3M Impact Protection Adhesive Attachment system
  - g. GSA Rating of "3B" / ASTM F1642 "Very Low Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass, daylight applied film (no attachment)
  - h. GSA Rating of "3B" / ASTM F1642 "Very Low Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass, daylight applied film (no attachment)
  - i. GSA Rating of "3B" / ASTM F1642 "Low Hazard" with blast pressure of 7 psi and 42 psi\*msec blast impulse, on 1 inch (25 mm) annealed double pane glass, daylight applied film (no attachment)
9. Forced Entry Resistance: Product shall have been evaluated for time to resist complete body passage by a qualified 3rd Party test lab.

## 2.3 MICROLAYERED SAFETY AND SECURITY WINDOW FILM WITH SUN CONTROL

- A. 3M Scotchshield Ultra Prestige S70: Optically clear micro-layered polyester, laminated to an optically clear multi-layered polyester film containing at least 220 layers with a pressure sensitive adhesive on one side and durable acrylic abrasion resistant coating on the other side. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. Films contain no metals, but so contain infrared-absorbing carbon, metal oxide particles, or both.
1. Physical / Mechanical Performance Properties:
    - a. Film Color: Virtually clear with at least 220 layers.
    - b. Thickness: Nominal 8.0 mils
    - c. Tensile Strength (ASTM D 882): 24,000 psi (MD) / 26,000 psi (TD)
    - d. Break Strength (ASTM D 882): 200 lbs/in (MD) / 215 lbs/in (TD)
    - e. Percent Elongation at Break (ASTM D882): 104% (MD) / 118% (TD)
    - f. Yield Strength (ASTM D882): 16,000 psi (MD)
    - g. Percent Elongation at Yield (ASTM D882): 8% (MD)
    - h. Graves Tear Resistance (ASTM D1004):
      - 1) Maximum Force: 35 lbs (MD) / 36 lbs (TD)
      - 2) Maximum Strain: 56% (MD) / 50% (TD)
      - 3) Graves Area Tear Resistance: 1,100 lbs% (MD) / 1,100 lbs% (TD)
    - i. Puncture Propagation Tear (ASTM D 2582): 10 lbf
  2. Solar Performance Properties: Film applied to 1/4 Inch thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 68 percent.
    - b. Visible Reflection (ASTM E 903): Not more than 10 percent.
    - c. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
    - d. Solar Heat Gain Coefficient (ASTM E 903): 0.51
    - e. Total Solar Energy Rejected: 50%
  3. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  4. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  5. Identification: Labeled as to Manufacturer as listed in this Section.
  6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  7. Impact Resistance and Pressure Cycling:
    - a. Safety film component shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 80 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
  8. Blast Hazard Mitigation: Independent testing with results from high explosive arena blast testing.
    - a. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 6 psi and 45 psi\*msec, on 1/4 inch (6 mm) single pane tempered glass and 3M Impact Protection Adhesive film attachment system.
    - b. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 9 psi and 60 psi\*msec, on 1 inch (25 mm) double pane tempered glass and 3M Impact Protection Adhesive film attachment system.
- B. 3M Scotchshield Ultra Prestige S50: Optically clear micro-layered polyester, laminated to an optically clear multi-layered polyester film containing at least 220 layers with a pressure sensitive adhesive on one side and durable acrylic abrasion resistant coating on the other side. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. Films contain no metals, but so contain infrared-absorbing carbon, metal oxide particles, or both.

1. Physical / Mechanical Performance Properties:
    - a. Film Color: Lightly tinted with at least 220 layers.
    - b. Thickness: Nominal 8.0 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi (MD) / 26,000 psi (TD)
    - d. Break Strength (ASTM D 882): 210 lbs/in (MD) / 220 lbs/in (TD)
    - e. Percent Elongation at Break (ASTM D882): 111% (MD) / 102% (TD)
    - f. Yield Strength (ASTM D882): 16,000 psi (MD)
    - g. Percent Elongation at Yield (ASTM D882): 8% (MD)
    - h. Graves Tear Resistance (ASTM D1004):
      - 1) Maximum Force: 36 lbs (MD) / 36 lbs (TD)
      - 2) Maximum Strain: 50% (MD) / 50% (TD)
      - 3) Graves Area Tear Resistance: 1,100 lbs% (MD) / 1,100 lbs% (TD)
    - i. Puncture Propagation Tear (ASTM D 2582): 10 lbf
  2. Solar Performance Properties: Film applied to 1/4 Inch thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 48 percent.
    - b. Visible Reflection (ASTM E 903): Not more than 10 percent.
    - c. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
    - d. Solar Heat Gain Coefficient (ASTM E 903): 0.44
    - e. Total Solar Energy Rejected: 56%
  3. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  4. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  5. Identification: Labeled as to Manufacturer as listed in this Section.
  6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  7. Impact Resistance and Pressure Cycling:
    - a. Safety film component shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 80 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
  8. Blast Hazard Mitigation: Independent testing with results from high explosive arena blast testing.
    - a. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 6 psi and 45 psi\*msec, on 1/4 inch (6 mm) single pane tempered glass and 3M Impact Protection Adhesive film attachment system.
    - b. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 9 psi and 60 psi\*msec, on 1 inch (25 mm) double pane tempered glass and 3M Impact Protection Adhesive film attachment system.
- C. 3M Scotchshield Ultra Night Vision S25: Optically clear polyester film comprised of co-extruded micro-layers, laminated to a metalized polyester film. Additional film layer is added for color and performance, with a durable abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film color is derived from the metal coating and the product will not contain dyed polyester.
1. Physical / Mechanical Performance Properties:
    - a. Film Color: Moderately tinted.
    - b. Thickness: Nominal 8.0 mils
    - c. Tensile Strength (ASTM D 882): 28,000 psi (MD) / 27,000 psi (TD)
    - d. Break Strength (ASTM D 882): 235 lbs/in (MD) / 230 lbs/in (TD)
    - e. Percent Elongation at Break (ASTM D882): 120% (MD) / 85% (TD)
    - f. Yield Strength (ASTM D882): 17,000 psi (MD)

- g. Percent Elongation at Yield (ASTM D882): 8% (MD)
- h. Graves Tear Resistance (ASTM D1004):
  - 1) Maximum Force: 37 lbs (MD) / 38 lbs (TD)
  - 2) Maximum Strain: 49% (MD) / 46% (TD)
  - 3) Graves Area Tear Resistance: 1,100 lbs% (MD) / 900 lbs% TD)
- i. Puncture Propagation Tear (ASTM D 2582): 10 lbf
- 2. Solar Performance Properties: Film applied to 1/4 Inch thick clear glass.
  - a. Visible Light Transmission (ASTM E 903): 24 percent.
  - b. Visible Reflection (ASTM E 903): Not more than 20 percent exterior / 7% interior.
  - c. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
  - d. Solar Heat Gain Coefficient (ASTM E 903): 0.40
  - e. Total Solar Energy Rejected: 60%
- 3. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
- 4. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
- 5. Identification: Labeled as to Manufacturer as listed in this Section.
- 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
  - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  - b. Safety Rating (ANSI Z97.1): Class A, Unlimited Size.
- 7. Impact and Pressure Cycling:
  - a. Safety film component shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 80 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
- 8. Blast Hazard Mitigation: Independent testing with results from high explosive arena blast testing.
  - a. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 6 psi and 43 psi\*msec, on 1/4 inch (6 mm) single pane annealed glass and 3M Impact Protection Adhesive film attachment system.
  - b. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 6 psi and 45 psi\*msec, on 1/4 inch (6 mm) single pane tempered glass and 3M Impact Protection Adhesive film attachment system.
  - c. GSA Rating of "3B" / ASTM F1642 "Minimal Hazard" with minimum blast load of 5 psi and 32 psi\*msec, on 1/4 inch (6 mm) single pane tempered glass and 3M Impact Protection Profile film attachment system.
  - d. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 5 psi and 35 psi\*msec, on 1 inch (25 mm) double pane annealed glass and 3M Impact Protection Profile film attachment system
  - e. GSA Rating of "2" / ASTM F1642 "No Hazard" with minimum blast load of 9 psi and 61 psi\*msec, on 1 inch (25 mm) double pane tempered glass and 3M Impact Protection Adhesive film attachment system

## 2.4 CLEAR SAFETY AND SECURITY WINDOW FILM

- A. 3M Safety S40 (SH4CLARL): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass.
  - 1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 4.0 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.

- d. Elongation: 130 percent.
  - e. Break Strength (ASTM D 882): 100 lbs/in
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  - 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  - 4. Identification: Labeled as to Manufacturer as listed in this Section.
  - 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 87 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
  - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category I (150 ft.-lbs).
    - b. Safety Rating (ANSI Z97.1): Class B, Unlimited Size.
- B. 3M Safety S70 (SH7CLARL): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
- 1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 7.0 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Break Strength (ASTM D 882): 175 lbs/in.
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  - 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  - 4. Identification: Labeled as to Manufacturer as listed in this Section.
  - 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 87 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
  - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category I (150 ft.-lbs).
  - 7. Blast Hazard Mitigation: Independent testing with results from high explosive arena blast testing.
    - a. GSA Rating of "3B" with minimum blast load of 4 psi and 28 psi\*msec, on 1/4 inch single pane annealed glass and 3M Impact Protection Adhesive film attachment system.
    - b. GSA Rating of "3B" with minimum blast load of 10 psi and 89 psi\*msec, on 1 inch (25 mm) double pane annealed glass and 3M Impact Protection Adhesive film attachment system.
- C. 3M Safety S80 (SH8CLARL): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.
- 1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 8 mils.
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Break Strength (ASTM D 882): 200 lbs/in
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or

- other optical defects.
    - 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
    - 4. Identification: Labeled as to Manufacturer as listed in this Section.
    - 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
      - a. Visible Light Transmission (ASTM E 903): 87 percent.
      - b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
    - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
      - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
      - b. Safety Rating (ANSI Z97.1): Class A, Unlimited Size.
    - 7. Blast Hazard Mitigation:
      - a. GSA Rating of "3B" / ASTM F1642 "Minimal Hazard" with minimum blast load of 6 psi and 41 psi\*msec, on 1/4 inch (6 mm) single pane annealed glass and 3M Impact Protection Adhesive film attachment system.
      - b. GSA Rating of "3B" with minimum blast load of 7 psi and 41 psi\*msec, on 1/4 inch single pane annealed glass and 3M Impact Protection Profile film attachment system.
      - c. GSA Rating of "3B" with minimum blast load of 4 psi and 29 psi\*msec, on 1/4 inch single pane annealed or tempered glass without use of film attachment system.
      - d. GSA Rating of "2" with minimum blast load of 12 psi and 66 psi\*msec, on 1 inch double pane annealed glass and 3M Impact Protection Adhesive film attachment system.
      - e. GSA Rating of "3B" with minimum blast load of 14 psi and 63 psi\*msec, on 1 inch double pane annealed glass and 3M Impact Protection Profile film attachment system.
- D. 3M Safety S140 (SH14CLARL): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.
- 1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 14 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Break Strength (ASTM D 882) (Per Inch Width): 350 lbs.
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  - 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  - 4. Identification: Labeled as to Manufacturer as listed in this Section.
  - 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 85 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
  - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category II (400 ft.-lbs).
  - 7. Impact Resistance and Pressure Cycling:
    - a. Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 50 psf Design Pressure with use of 3M Impact Protection Adhesive

- attachment system.
8. Blast Hazard Mitigation: Independent testing with results from high explosive arena blast testing.
    - a. GSA Rating of "3B" with minimum blast load of 8 psi and 44 psi\*msec, on 1/4 inch single pane annealed glass and 3M Impact Protection Profile film attachment system.
    - b. GSA level 3B rating with minimum blast load of 15 psi overpressure and 58 psi\*msec blast impulse on 1 inch double pane annealed glass without use of film attachment system.
  9. Forced Entry Protection: Independent lab testing according to UL 972 protocol (Multiple Impact Test).
    - a. Annealed Glass (1/4 inch) - Pass
    - b. Tempered Glass (1/4 inch) - Pass
- E. 3M Safety Exterior S20: Optically clear polyester film with an exterior durable abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 2 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Elongation: 88 percent.
    - e. Break Strength (ASTM D 882): 50 lbs/in
  2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  4. Identification: Labeled as to Manufacturer as listed in this Section.
  5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 88 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
  6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category I (150 ft.-lbs).
    - b. Safety Rating (ANSI Z97.1): Class B, Unlimited Size.
- F. 3M Safety Exterior S40. Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 4 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Break Strength (ASTM D 882): 100 lbs/in.
  2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  4. Identification: Labeled as to Manufacturer as listed in this Section.
  5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 89 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
  6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category I (150 ft.-lbs).



- G. 3M Safety Exterior S70. Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
  - 1. Physical / Mechanical Performance Properties:
    - a. Film Color: Clear.
    - b. Thickness: Nominal 7 mils
    - c. Tensile Strength (ASTM D 882): 25,000 psi.
    - d. Break Strength (ASTM D 882): 140 lbs/in.
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  - 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
  - 4. Identification: Labeled as to Manufacturer as listed in this Section.
  - 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
    - a. Visible Light Transmission (ASTM E 903): 88 percent.
    - b. Ultraviolet Transmission (ASTM E 903): Less than 0.5 percent.
  - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category I (150 ft.-lbs).

## 2.5 SAFETY AND SECURITY WINDOW FILM WITH SUN CONTROL

- A. 3M Safety Neutral S35. Dual reflective polyester film, nominally 8 mils (0.008") thick, with a durable abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is comprised of an optically clear safety film laminated to a metallized film layer for reflective and sun control properties. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass.
  - 1. Physical / Mechanical Performance Properties (nominal):
    - a. Film Color: Neutral
    - b. Film Thickness (excluding coatings or adhesive liner): Nominal 8 mils
    - c. Tensile Strength 33,000 psi (MD) / 23,000 psi (TD)
    - d. Break Strength: 170 lb/in (MD) / 280 lb/in (TD)
    - e. Percent Elongation at Break: 100 % (MD) / 80 % (TD)
    - f. Yield Strength: 23,000 psi
    - g. Percent Elongation at Yield: 80%
  - 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  - 3. Variation in Total Transmission across the width: Less than 2 percent over the average at any portion along the length.
  - 4. Identification: Labeled as to Manufacturer as listed in this Section.
  - 5. Solar Performance Properties: Film applied to 1/4 inch (6 mm) thick clear glass (NFRC 100/200).
    - a. Visible Light Transmission: 39%
    - b. Visible Reflection: 23% exterior / 13% interior
    - c. Ultraviolet Transmission: Not more than 1%.
    - d. Solar Heat Gain Coefficient: 0.43
  - 6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category 2 (400 ft.-lbs).
    - b. Safety Rating (ANSI Z97.1): Class A, Unlimited (400 ft.-lbs).
  - 7. Impact Resistance and Pressure Cycling
    - a. Film shall pass impact of Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E1996 and E1886) at +/- 60 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system. Tested on 1/4 inch (6 mm) tempered glass.

8. Blast Hazard Mitigation:
  - a. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Profile Attachment system
  - b. GSA Rating of "2"/ ASTM F1642 "Minimal Hazard" with blast pressure of 6 psi and 42 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Adhesive Attachment system
  - c. GSA Rating of "2" / ASTM F1642 "No Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Adhesive Attachment system
  - d. GSA Rating of "2" / ASTM F1642 "No Hazard" with blast pressure of 6 psi and 42 psi\*msec blast impulse, on 1 inch (25 mm) double pane tempered glass and 3M Impact Protection Adhesive Attachment system
  
- B. 3M Safety Silver S20. Highly reflective polyester film, nominally 8 mils (0.008") thick, with a durable abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The film is comprised of an optically clear safety film laminated to a metallized film layer for reflective and sun control properties. The adhesive is pressure-activated, not water-activated, and forms a physical bond, not chemical bond, to the glass.
  1. Physical / Mechanical Performance Properties (nominal):
    - a. Film Color: Silver reflective
    - b. Film Thickness (excluding coatings or adhesive liner): Nominal 8 mils
    - c. Tensile Strength: 20,000 psi (MD) / 30,000 psi (TD)
    - d. Break Strength: 160 lb/in (MD) / 247 lb/in (TD)
    - e. Percent Elongation at Break: 95 % (MD) / 76 % (TD)
    - f. Yield Strength: 15,000 psi
    - g. Percent Elongation at Yield: 7%
  2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
  3. Variation in Total Transmission across the width: Less than 2 percent over the average at any portion along the length.
  4. Identification: Labeled as to Manufacturer as listed in this Section.
  5. Solar Performance Properties: Film applied to 1/4 inch (6 mm) thick clear glass (NFRC 100/200).
    - a. Visible Light Transmission: 18%
    - b. Visible Reflection: 61%
    - c. Ultraviolet Transmission: Not more than 1%.
    - d. Solar Heat Gain Coefficient: 0.25
  6. Impact Resistance for Safety Glazing: Tested on 1/4 inch (6 mm) annealed glass.
    - a. Safety Rating (CPSC 16 CFR, Part 1201): Category 2 (400 ft-lbs).
    - b. Safety Rating (ANSI Z97.1): Class A, Unlimited (400 ft-lbs).
  7. Impact Resistance and Pressure Cycling
    - a. Film shall pass impact of Small Missile "A" and withstand subsequent pressure cycling (per ASTMs E1996 and E1886) at +/- 60 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system. Tested on 1/4 inch (6 mm) tempered glass.
  8. Blast Hazard Mitigation:
    - a. GSA Rating of "2" / ASTM F1642 "Minimal Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed single pane glass and 3M Impact Protection Profile Attachment system
    - b. GSA Rating of "2"/ ASTM F1642 "Minimal Hazard" with blast pressure of 6 psi and 42 psi\*msec blast impulse, on 1/4 inch (6 mm) annealed

single pane glass and 3M Impact Protection Adhesive Attachment system

- c. GSA Rating of "2" / ASTM F1642 "No Hazard" with blast pressure of 4 psi and 28 psi\*msec blast impulse, on 1/4 inch (6 mm) tempered single pane glass and 3M Impact Protection Adhesive Attachment system
- d. GSA Rating of "2" / ASTM F1642 "No Hazard" with blast pressure of 6 psi and 42 psi\*msec blast impulse, on 1 inch (25 mm) double pane tempered glass and 3M Impact Protection Adhesive Attachment system

## 2.6 ANTI-GRAFFITI WINDOW FILM

A. 3M Anti-Graffiti 4 (AG-4): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.

- 1. Physical / Mechanical Performance Properties:
  - a. Film Color: Clear.
  - b. Thickness: Nominal 4.0 mils
  - c. Tensile Strength (ASTM D 882): 25,000 psi.
  - d. Break Strength (ASTM D 882) (Per Inch Width): 136 lbs.
  - e. Elongation at Break (ASTM D 882): >100 percent.
  - f. Peel Strength: 1 lb/inch.
  - g. Puncture Strength (ASTM D 4830): 90 lbs.
  - h. Abrasion Resistance (ASTM D1044): < 2 percent increase in haze.
- 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
- 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
- 4. Identification: Labeled as to Manufacturer as listed in this Section.
- 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
  - a. Visible Light Transmission (ASTM E 903): 81 percent.
  - b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.

B. 3M Anti-Graffiti 6 (AG-6): Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other. The film may be laminated to other clear polyester film layers to achieve the desired thickness of the film.

- 1. Physical / Mechanical Performance Properties:
  - a. Film Color: Clear.
  - b. Thickness: Nominal 6.0 mils
  - c. Tensile Strength (ASTM D 882): 25,000 psi.
  - d. Break Strength (ASTM D 882): 150 lbs/in
  - e. Elongation at Break (ASTM D 882): >100 percent.
  - f. Peel Strength: 1 lb/inch.
  - g. Puncture Strength (ASTM D 4830): 125 lbs.
  - h. Abrasion Resistance (ASTM D 1044): < 2 percent increase in haze.
- 2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
- 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
- 4. Identification: Labeled as to Manufacturer as listed in this Section.
- 5. Solar Performance Properties: Film applied to 1/4 Inch (6 mm) thick clear glass.
  - a. Visible Light Transmission (ASTM E 903): 87 percent.

- b. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.

## 2.7 3M IMPACT PROTECTION FILM ATTACHMENT SYSTEMS

- A. 3M Impact Protection Adhesive (IPA): Weatherable, UV-resistant, moisture curable structural sealant wet glaze.
  - 1. Color:
    - a. Black.
    - b. White.
  - 2. Material Properties (as supplied):
    - a. Typical Cure Time: 3 - 7 days (25 degrees C, 50% RH)
    - b. Full Adhesion: 7 - 14 days
    - c. Tack-Free Time (ASTM D 5895): 21 minutes (25 degrees C, 50% RH)
    - d. Flow, Sag or Slump (ASTM D 2202): 0 inches
    - e. Specific Gravity: 1.4
    - f. Working Time: 10 - 20 minutes (25 degrees C, 50% RH)
    - g. VOC Content: 16 g/L
  - 3. Material Properties (as cured - 21 days at 25 degrees C, 50% RH):
    - a. Ultimate Tensile Strength (ASTM D412): 380 psi (2.62 MPa)
    - b. Ultimate Elongation (ASTM D412): 640 psi
    - c. Durometer Hardness, Shore A (ASTM D2240): 38-39 points
    - d. Tear Strength, Die B (ASTM D624): 72 ppi
  - 4. Uniformity: Product shall have uniform consistency and appearance, with no clumping.
  - 5. Impact Resistance and Pressure Cycling:
    - a. As part of a filmed glass system, film attachment shall demonstrate ability to withstand Medium Large Missile C and Small Missile A impact, with subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 75 psf design pressure.
    - b. As part of a filmed glass system, film attachment shall demonstrate ability withstand structural load requirements of ASTM E330 when tested at +/- 100 psf design pressure.
  - 6. Blast Hazard Mitigation:
    - a. GSA level "2" rating (minimal hazard) of "2" with minimum blast load of 11 psi overpressure and 55 psi\*msec blast impulse.
    - b. GSA level "3B" rating (low hazard) with minimum blast load of 10 psi overpressure and 89 psi\*msec blast impulse.
    - c. ASTM F1642 rating of "Low Hazard" with minimum blast load of 8 psi overpressure and 42 psi\*msec blast impulse.
- B. 3M Impact Protection Profile (IPP): Weatherable, flexible-mechanical style film attachment made of extruded rubber profile with two strips of double coated foam tape: one strip for bonding to applied film and the other strip for bonding to the window frame.
  - 1. 3M Impact Protection Profile, BP-700.
    - a. Total width: 1.0 inches.
    - b. Tape width: 0.5 inches.
  - 2. 3M Impact Protection Profile, BP-950.
    - a. Total width: 1.3 inches.
    - b. Tape width: 0.625 inches.
  - 3. 3M Impact Protection Profile, BP-950 XL.
    - a. Total width: 1.3 inches.
    - b. Tape width: 0.38 inches.
  - 4. Material Properties:
    - a. Full Adhesion: 1 - 2 days (25 degrees C, 50% RH)
    - b. Ultimate Tensile Strength (ASTM D412): > 20,500 psi

- c. Ultimate Elongation (ASTM D412): 400%
- d. Break Strength, Die B (ASTM D624): > 71 ppi
- e. Durometer Hardness, Shore A: (ASTM D2240): 70 pts
- 5. Uniformity: Product shall have uniform consistency and appearance.
- 6. Impact Resistance and Pressure Cycling:
  - a. As part of a filmed glass system, film attachment shall demonstrate ability to withstand Small Missile A impact, with subsequent pressure cycling (per ASTMs E 1996 and E 1886) at +/- 50 psf design pressure.
- 7. Blast Hazard Mitigation:
  - a. GSA level "2" rating (minimal hazard) with minimum blast load of 4 psi overpressure and 28 psi\*msec blast impulse.
  - b. GSA level "3B" rating (low hazard) with minimum blast load of 10 psi overpressure and 89 psi\*msec blast impulse.
  - c. ASTM F1642 rating of "Low Hazard" with minimum blast load of 4 psi overpressure and 28 psi\*msec blast impulse.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Film Examination:
  - 1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
  - 2. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
  - 3. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
  - 4. Commencement of installation constitutes acceptance of conditions.
- B. Impact Protection Adhesive Examination:
  - 1. If application of window film is/was the responsibility of another installer, notification in writing shall be made of deviations from manufacturer's recommended installation tolerances and conditions.
  - 2. Filmed glass surfaces receiving new attachment should first be examined to verify that they are free from defects and imperfections, and that the film edges extend sufficiently to the frame edges.
  - 3. Do not proceed with installation until film and frame surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
  - 4. Conduct an adhesion test to the frame surface may be conducted by applying a 4 - 6 inch long bead, approximately 0.5 - 1 inch in width, masking one side of the frame surface underneath the strip with tape. Allow the Impact Protection Adhesive to cure for 7 days and test adhesion by pulling up on the masked end and a 90 degree angle. If cohesive failure is observed (adhesive residue left behind on the frame surface), adhesion is acceptable; if adhesive failure is observed (clean peel from the frame), adhesion is unacceptable and product is not recommended.
- C. Impact Protection Profile Examination:
  - 1. If application of window film is/was the responsibility of another installer, notification in writing shall be made of deviations from manufacturer's recommended installation tolerances and conditions.
  - 2. Windows and frames must be examined to ensure that they are fit to receive

- the Impact Protection Profile in a manner such that the two profile adhesive strips will be perpendicularly opposed to each other and that they will not contact glazing stops or frame gaskets without stretching the profile.
3. Filmed glass surfaces receiving new attachment should first be examined to verify that they are free from defects and imperfections, and that the film edges extend sufficiently to the frame edges.
  4. Do not proceed with installation until film and frame surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
  5. Conduct an adhesion test to the frame surface may be conducted by applying a 4 - 6 inch long strip on the frame surface, using the sufficient pressure to achieve good adhesive wet-out. Allow the Impact Protection Profile to cure for 1-2 days and test adhesion by removing the test strip. If cohesive failure is observed (adhesive residue left behind on the frame surface), adhesion is acceptable; if adhesive failure is observed (clean peel from the frame), adhesion is unacceptable and product is either not recommended, or an adhesion promoter, such as 3M Primer 94, must be used.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

### 3.3 INSTALLATION

- A. Film Installation:
  1. Install in accordance with manufacturer's instructions.
  2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
  3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
  4. Apply film to glass and lightly spray film with slip solution.
  5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
  6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
  7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- B. Impact Protection Adhesive Installation:
  1. The film attachment system shall be applied according to the specifications of the Manufacturer by an Authorized Dealer/Applicator. Refer to 3M publication, 70-0709-0322-7, 3M Impact Protection Adhesive Attachment System Installation Instructions.
    - a. For blast hazard mitigation: minimum 1/2 inch bead overlap on both frame and film (excluding glazing stops or compression gaskets).
    - b. For impact resistance and building envelope protection: minimum 3/8 inch bead overlap on both frame and film (excluding glazing stops or compression gaskets).
  2. To ensure a straight and consistent bead width is achieved, masking tape

- may be applied to film and frame surfaces prior to application.
3. With prior approval of the building owner or property manager, existing compression gaskets may be partially removed or trimmed to allow for a thinner bead and stronger anchorage. If removing the gaskets, sections shall be trimmed approximately 3 inches in length and inserted with appropriate spacing along all sides of the window to help secure the glazing during application and curing of the Impact Protection Adhesive.
  4. The Impact Protection Adhesive shall be dispensed with a caulk gun with nozzle opening diameter sized to match the approximate size of the desired bead width.
  5. A plastic putty knife or other tool with a clean straight edge shall be used to trowel and smooth out the adhesive. The completed adhesive bead shall be relatively triangular in shape.
  6. Any masking tape used shall be carefully removed within 10 minutes after applying the wet glaze.
- C. Impact Protection Profile Installation:
1. The film attachment system shall be applied according to the specifications of the Manufacturer by an Authorized Dealer/Applicator trained to install 3M Impact Protection Profile. Refer to 3M publication, 3M Impact Protection Profile Installation Systems Instructions.
  2. Each profile piece must span continuously to both sides of the window, within 1/8 inch to the frame edge. Splicing the profile between frame edges is prohibited.
  3. Profile must be aligned and applied by 3M recommended or approved methods and tools to ensure a quality installation.
  4. Corner joints must be fabricated by 3M recommended and approved methods. No part of the profile adhesive shall make contact with an adjacent profile.
  5. Sufficient pressure must be evenly applied along the entire length of the profile to ensure full adhesion from both adhesive strips. A roller tool is required to minimize entrapment of air in the adhesive.
- 3.4 CLEANING AND PROTECTION
- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
  - B. Touch-up, repair or replace damaged products before Substantial Completion.
  - C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION