SAFETY-AND-SECURITY FILMS

LLumar® Safety-and-Security Series

Note: Click on “Show/Hide ¶” button to reveal "Specifier Notes" throughout section. Delete this text when editing is complete.

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES

A. Safety-and-security films

B. [Insert item description.]

1.3 RELATED SECTIONS

A. Section 08 80 00 - Glazing: Substrate for application of safety-and-security film.

B. Section [xxxxx] – [Section Title]: [Include brief description of work specified in another section that is related to the work of this section.]

1.4 REFERENCES

A. American National Standards Institute (ANSI):

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

B. ASTM International (ASTM):

1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D3330 - Standard Test Methods for Peel-Adhesion at 180 Degree Angle.
3. ASTM D4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing. Section 7: Puncture Strength.
4. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E903 - Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.

C. Consumer Products Safety Commission (CPSC):

1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

1.5 DEFINITIONS

A. Emissivity: The ability of a surface to absorb far-infrared heat and to reflect it. The lower the emissivity, the lower the far-infrared heat absorption and the greater the far-infrared heat reflectance.

B. Far-Infrared Heat: Heat radiated from objects at temperatures below 1300 degrees F such as heat radiated from: room objects, objects heated by the sun, or a home heating system. Far-infrared heat is different from near-infrared heat that is heat radiated from objects at highly elevated temperatures such as the sun.

C. Neutral Solar Films: Films that allow visible light to pass without distortion of color and that have equal visible light transmission properties at all wavelengths in the visible range from 380 to 780 nanometers.

D. Light to Solar Heat Gain Ratio: Ratio of visible light transmission to Solar Heat Gain Coefficient for a glazing system.

E. Solar Heat Gain Coefficient (SHGC): The fraction of incident solar radiation that actually passes through that window, including solar energy that is both directly transmitted and that which is absorbed and subsequently released inwardly by re-radiation and conduction. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits. This number is the mathematical complement of the Total Solar Energy Rejection (TSER) value: The sum of the TSER (in decimal form) of a glazing system and its SHGC value is 1; therefore, 1 - TSER = SHGC.

1.6 PERFORMANCE REQUIREMENTS

A. Impact Resistance: Provide films that when applied to 1/8-inch annealed glass pass the impact test requirements of ANSI Z97.1 and CPSC 16 CFR 1201.

B. Peel Strength: >2720 (>6) when tested in accordance with ASTM D3330.

C. Puncture Strength: [45] [70] [79] [111] [145] [156] [187] [223] [78] [164] when tested in accordance with ASTM D4830.

D. Surface Burning Characteristics: Provide films that have Class A ratings when tested in accordance with ASTM E84.

E. Tensile Properties: When measured in accordance with ASTM D882.

1. Minimum Tensile Strength of Film: 32,000 psi, average.
2. Minimum Elongation at Break: >100 percent.
3. Break Strength - Average Load: [56][120][135][181]230][266][269][324][472] lbs/in.

F. Ultraviolet Transmission: Provide safety-and-security films with UV absorbing materials that limit the weighted UV Transmission to [6.0][3.0][2.0][1.0][less than 1.0] percent or less when measured according to ASTM E903.

G. Provide safety-and-security films that do not have a masking sheet.

1.7 SUBMITTALS

A. Submit under provisions of Section [01 33 00] [_____].

B. Product Data: Submit for each product specified indicating:

1. Performance properties.
2. Preparation and installation instructions and recommendations.
3. Storage and handling recommendations.

C. Samples: For each type of safety-and-security film specified, two (2) samples, 12 inches square.

D. Qualification Data: Submit documentation indicating qualifications of safety-and-security film manufacturer.

E. Operation and Maintenance Data: Submit for safety-and-security control film to include in maintenance manuals.

F. Warranty: Submit sample special warranty specified in this section.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that has a minimum of 10 years of documented experience manufacturing safety-and-security films similar to be used for this project.

B. Installer Qualifications: A firm that is authorized by safety-and-security film manufacturer to install film in accordance with guidelines set forth by the manufacturer.

C. Source Limitations: Obtain each type of safety-and-security film from same manufacturer.

D. Mock-ups: Build mock-ups to verify selections made under sample submittals and to evaluate surface preparation techniques and application workmanship.

1. Construct mock-ups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Approved mock-ups may become part of the completed work if undisturbed at time of Substantial Completion.

E. Pre-installation Conference: Conduct conference at project site to discuss methods and procedures relating to installation of the safety-and-security films.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials in manufacturer's protective packaging.

B. Store and protect materials according to manufacturer's written recommendations to prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

1.10 SITE CONDITIONS

A. Ambient Conditions: Maintain temperature, humidity, and ventilation within limits recommended by manufacturer.

1.11 LIMITED WARRANTY

A. Manufacturer's Limited Warranty: Certain restrictions apply. The Manufacturer's Limited Warranty can be viewed in full by clicking here.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for safety-and-security films is based on LLumar® Safety-and-Security Films manufactured by an Eastman Chemical Company business: CPFilms Inc., 575 Maryville Centre Drive, St. Louis, Missouri 63141; Telephone: 800-255-8627; Email address: commercialalerts@eastman.com; Web Site: www.llumar.com.

B. Representative: [Insert contact information.]

C. Substitutions will be considered, subject to compliance with requirements of this section, under provisions of Section 01 60 00.

2.2 SAFETY-AND-SECURITY FILMS

A. Safety-and-Security Film: LLumar® SCLSRPS2 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	83
% Total Solar Reflectance	8
% Total Solar Absorptance	9
% Visible Light Transmission	89
% Visible Light Reflection - Exterior	9
% Visible Light Reflection - Interior	9
Winter U-Value	1.07
Shading Coefficient	0.99
% Ultraviolet Ray Protection (280nm-380nm)	94
Emissivity	0.90
Solar Heat Gain Coefficient	0.86
% Total Solar Energy Rejected	14
Light-to-Solar Heat Gain Ratio	1.03
% Summer Solar Heat Reduction	0
% Winter Heat Loss Reduction	-3
% Glare Reduction	1
Thickness without Liner	0.002 inches
Film Color	Clear

B. Safety-and-Security Film: LLumar® SCLSRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	82
% Total Solar Reflectance	8
% Total Solar Absorptance	10
% Visible Light Transmission	90
% Visible Light Reflection - Exterior	9
% Visible Light Reflection - Interior	9
Winter U-Value	1.07
Shading Coefficient	0.98
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.85
% Total Solar Energy Rejected	15
Light-to-Solar Heat Gain Ratio	1.06
% Summer Solar Heat Reduction	1
% Winter Heat Loss Reduction	-3
% Glare Reduction	0
Thickness without Liner	0.004 inches
Film Color	Clear

C. Safety-and-Security Film: LLumar® SCLSRPS6 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	82
% Total Solar Reflectance	9
% Total Solar Absorptance	9
% Visible Light Transmission	89
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	10
Winter U-Value	1.07
Shading Coefficient	0.97
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.85
% Total Solar Energy Rejected	15
Light-to-Solar Heat Gain Ratio	1.05
% Summer Solar Heat Reduction	1
% Winter Heat Loss Reduction	-3
% Glare Reduction	1
Thickness without Liner	0.006 inches
Film Color	Clear

D. Safety-and-Security Film: LLumar® SCLSRPS7 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	82
% Total Solar Reflectance	8
% Total Solar Absorptance	10
% Visible Light Transmission	89
% Visible Light Reflection - Exterior	9
% Visible Light Reflection - Interior	9

Winter U-Value	1.07
Shading Coefficient	0.98
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.85
% Total Solar Energy Rejected	15
Light-to-Solar Heat Gain Ratio	1.05
% Summer Solar Heat Reduction	1
% Winter Heat Loss Reduction	-3
% Glare Reduction	1
Thickness without Liner	0.007 inches
Film Color	Clear

E. Safety-and-Security Film: LLumar® SCLSRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	81
% Total Solar Reflectance	9
% Total Solar Absorptance	10
% Visible Light Transmission	89
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	10
Winter U-Value	1.07
Shading Coefficient	0.97
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.84
% Total Solar Energy Rejected	16
Light-to-Solar Heat Gain Ratio	1.06
% Summer Solar Heat Reduction	2
% Winter Heat Loss Reduction	-3
% Glare Reduction	1
Thickness without Liner	0.008 inches
Film Color	Clear

F. Safety-and-Security Film: LLumar® SCLSRPS11 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	80
% Total Solar Reflectance	9
% Total Solar Absorptance	11
% Visible Light Transmission	87
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	10
Winter U-Value	1.06
Shading Coefficient	0.96
% Ultraviolet Ray Protection (280nm-380nm)	98
Emissivity	0.90
Solar Heat Gain Coefficient	0.84
% Total Solar Energy Rejected	16

Light-to-Solar Heat Gain Ratio	1.04
% Summer Solar Heat Reduction	2
% Winter Heat Loss Reduction	-2
% Glare Reduction	3
Thickness without Liner	0.011 inches
Film Color	Clear

G. Safety-and-Security Film: LLumar® SCLSRPS13 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	80
% Total Solar Reflectance	9
% Total Solar Absorptance	11
% Visible Light Transmission	88
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	10
Winter U-Value	1.06
Shading Coefficient	0.96
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.84
% Total Solar Energy Rejected	17
Light-to-Solar Heat Gain Ratio	1.06
% Summer Solar Heat Reduction	3
% Winter Heat Loss Reduction	-2
% Glare Reduction	2
Thickness without Liner	0.013 inches
Film Color	Clear

H. Safety-and-Security Film: LLumar® SCLSRPS15 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	80
% Total Solar Reflectance	9
% Total Solar Absorptance	11
% Visible Light Transmission	87
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	10
Winter U-Value	1.06
Shading Coefficient	0.95
% Ultraviolet Ray Protection (280nm-380nm)	99
Emissivity	0.90
Solar Heat Gain Coefficient	0.83
% Total Solar Energy Rejected	17
Light-to-Solar Heat Gain Ratio	1.05
% Summer Solar Heat Reduction	3
% Winter Heat Loss Reduction	-2
% Glare Reduction	3
Thickness without Liner	0.015 inches
Film Color	Clear

I. Safety-and-Security Film: LLumar® R20SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	11
% Total Solar Reflectance	55
% Total Solar Absorptance	34
% Visible Light Transmission	15
% Visible Light Reflection - Exterior	60
% Visible Light Reflection - Interior	64
Winter U-Value	1.02
Shading Coefficient	0.24
% Ultraviolet Ray Protection (280nm-380nm)	>99
Emissivity	0.80
Solar Heat Gain Coefficient	0.21
% Total Solar Energy Rejected	79
Light-to-Solar Heat Gain Ratio	0.71
% Summer Solar Heat Reduction	76
% Winter Heat Loss Reduction	2
% Glare Reduction	83
Thickness without Liner	0.004 inches
Film Color	Clear

J. Safety-and-Security Film: LLumar® R20SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	11
% Total Solar Reflectance	59
% Total Solar Absorptance	30
% Visible Light Transmission	15
% Visible Light Reflection - Exterior	64
% Visible Light Reflection - Interior	64
Winter U-Value	1.06
Shading Coefficient	0.24
% Ultraviolet Rejection	>99
Emissivity	0.87
Solar Heat Gain Coefficient	0.20
% Total Solar Energy Rejected	80
Light-to-Solar Heat Gain Ratio	0.75
% Summer Solar Heat Reduction	77
% Winter Heat Loss Reduction	-2
% Glare Reduction	83
Thickness without Liner	0.008 inches
Film Color	Clear

K. Safety-and-Security Film: LLumar® N1020SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	23
% Total Solar Reflectance	22

% Total Solar Absorptance	55
% Visible Light Transmission	24
% Visible Light Reflection - Exterior	26
% Visible Light Reflection - Interior	27
Winter U-Value	1.06
Shading Coefficient	0.47
% Ultraviolet Rejection	>99
Emissivity	0.88
Solar Heat Gain Coefficient	0.41
% Total Solar Energy Rejected	59
Light-to-Solar Heat Gain Ratio	0.59
% Summer Solar Heat Reduction	52
% Winter Heat Loss Reduction	-2
% Glare Reduction	73
Thickness without Liner	0.004 inches
Film Color	Neutral

L. Safety-and-Security Film: LLumar® N1020SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	23
% Total Solar Reflectance	22
% Total Solar Absorptance	55
% Visible Light Transmission	24
% Visible Light Reflection - Exterior	26
% Visible Light Reflection - Interior	27
Winter U-Value	1.06
Shading Coefficient	0.47
% Ultraviolet Rejection	>99
Emissivity	0.88
Solar Heat Gain Coefficient	0.41
% Total Solar Energy Rejected	59
Light-to-Solar Heat Gain Ratio	0.59
% Summer Solar Heat Reduction	52
% Winter Heat Loss Reduction	-2
% Glare Reduction	73
Thickness without Liner	0.008 inches
Film Color	Neutral

M. Safety-and-Security Film: LLumar® N1040SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	38
% Total Solar Reflectance	14
% Total Solar Absorptance	48
% Visible Light Transmission	39
% Visible Light Reflection - Exterior	16
% Visible Light Reflection - Interior	17
Winter U-Value	1.06
Shading Coefficient	0.61

% Ultraviolet Rejection	>99
Emissivity	0.90
Solar Heat Gain Coefficient	0.53
% Total Solar Energy Rejected	47
Light-to-Solar Heat Gain Ratio	0.74
% Summer Solar Heat Reduction	38
% Winter Heat Loss Reduction	-2
% Glare Reduction	57
Thickness without Liner	0.004 inches
Film Color	Neutral

N. Safety-and-Security Film: LLumar® N1040SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	38
% Total Solar Reflectance	14
% Total Solar Absorptance	48
% Visible Light Transmission	39
% Visible Light Reflection - Exterior	16
% Visible Light Reflection - Interior	17
Winter U-Value	1.06
Shading Coefficient	0.61
% Ultraviolet Rejection	>99
Emissivity	0.90
Solar Heat Gain Coefficient	0.53
% Total Solar Energy Rejected	47
Light-to-Solar Heat Gain Ratio	0.74
% Summer Solar Heat Reduction	38
% Winter Heat Loss Reduction	-2
% Glare Reduction	57
Thickness without Liner	0.008 inches
Film Color	Neutral

O. Safety-and-Security Film: LLumar® N1050SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	48
% Total Solar Reflectance	10
% Total Solar Absorptance	42
% Visible Light Transmission	49
% Visible Light Reflection - Exterior	11
% Visible Light Reflection - Interior	14
Winter U-Value	1.07
Shading Coefficient	0.70
% Ultraviolet Rejection	>99
Emissivity	0.90
Solar Heat Gain Coefficient	0.61
% Total Solar Energy Rejected	39
Light-to-Solar Heat Gain Ratio	0.80
% Summer Solar Heat Reduction	29

% Winter Heat Loss Reduction	-3
% Glare Reduction	46
Thickness without Liner	0.004 inches
Film Color	Neutral

P. Safety-and-Security Film: LLumar® N1050SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	48
% Total Solar Reflectance	10
% Total Solar Absorptance	42
% Visible Light Transmission	49
% Visible Light Reflection - Exterior	11
% Visible Light Reflection - Interior	14
Winter U-Value	1.07
Shading Coefficient	0.70
% Ultraviolet Rejection	>99
Emissivity	0.90
Solar Heat Gain Coefficient	0.61
% Total Solar Energy Rejected	39
Light-to-Solar Heat Gain Ratio	0.80
% Summer Solar Heat Reduction	29
% Winter Heat Loss Reduction	-3
% Glare Reduction	46
Thickness without Liner	0.008 inches
Film Color	Neutral

Q. Safety-and-Security Film: LLumar® NUV65SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	64
% Total Solar Reflectance	9
% Total Solar Absorptance	27
% Visible Light Transmission	69
% Visible Light Reflection - Exterior	10
% Visible Light Reflection - Interior	9
Winter U-Value	1.07
Shading Coefficient	0.83
% Ultraviolet Rejection	>99
Emissivity	0.90
Solar Heat Gain Coefficient	0.72
% Total Solar Energy Rejected	28
Light-to-Solar Heat Gain Ratio	0.96
% Summer Solar Heat Reduction	16
% Winter Heat Loss Reduction	-3
% Glare Reduction	23
Thickness without Liner	0.004 inches
Film Color	Neutral

R. Safety-and-Security Film: Vista™ by LLumar® Luminance V28SRPS4 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	23
% Total Solar Reflectance	32
% Total Solar Absorptance	45
% Visible Light Transmission	29
% Visible Light Reflection - Exterior	32
% Visible Light Reflection - Interior	20
Winter U-Value	1.05
Shading Coefficient	0.43
% Ultraviolet Rejection	>99
Emissivity	0.86
Solar Heat Gain Coefficient	0.37
% Total Solar Energy Rejected	63
Light-to-Solar Heat Gain Ratio	0.78
% Summer Solar Heat Reduction	57
% Winter Heat Loss Reduction	0
% Glare Reduction	68
Thickness without Liner	0.004 inches
Film Color	Neutral

S. Safety-and-Security Film: Vista™ by LLumar® Luminance V28SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/8-inch clear glass:

% Total Solar Transmittance	21
% Total Solar Reflectance	34
% Total Solar Absorptance	45
% Visible Light Transmission	27
% Visible Light Reflection - Exterior	35
% Visible Light Reflection - Interior	21
Winter U-Value	1.06
Shading Coefficient	0.41
% Ultraviolet Rejection	>99
Emissivity	0.88
Solar Heat Gain Coefficient	0.35
% Total Solar Energy Rejected	65
Light-to-Solar Heat Gain Ratio	0.77
% Summer Solar Heat Reduction	59
% Winter Heat Loss Reduction	-2
% Glare Reduction	70
Thickness without Liner	0.008 inches
Film Color	Neutral

T. Safety-and-Security Film: Vista™ by LLumar® Mirage V38SRPS8 Safety-and-Security Film with the following performance characteristics when applied to the interior surface of single-pane, 1/4-inch clear glass:

% Total Solar Transmittance	31
% Total Solar Reflectance	25

% Total Solar Absorptance	44
% Visible Light Transmission	39
% Visible Light Reflection - Exterior	25
% Visible Light Reflection - Interior	18
Winter U-Value	1.06
Shading Coefficient	0.52
% Ultraviolet Rejection	>99
Emissivity	0.88
Solar Heat Gain Coefficient	0.45
% Total Solar Energy Rejected	55
Light-to-Solar Heat Gain Ratio	0.87
% Summer Solar Heat Reduction	48
% Winter Heat Loss Reduction	-2
% Glare Reduction	57
Thickness without Liner	0.008 inches
Film Color	Neutral

2.3 SAFETY-AND-SECURITY FILM ACCESSORIES

A. General: Provide accessories either manufactured by or acceptable to safety-and-security film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Adhesive: Pressure sensitive adhesive which is activated by pressure and water. It is characterized by its permanently tacky nature and its installation ease. Protect adhesive from contamination by applying a release liner that will be removed and discarded at installation.

C. Cleaners, Primers, and Sealers: Types recommended by safety-and-security film manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements and for conditions affecting performance of safety-and-security film including glass that is broken, chipped, cracked, abraded, or damaged in any way.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer’s written instructions for surface preparation.

B. Clean substrates thoroughly prior to installation.

C. Prepare substrates using methods recommended by film manufacturer to achieve the best results for the substrate under project conditions.

D. Protect window frames and surrounding surfaces to prevent damage during installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer’s written instructions.

B. Install with no gaps or overlaps.

C. If seamed, make seams non-overlapping.

D. Do not remove release liner from film until just before each piece of film is cut and ready for installation.

E. Custom cut to the glass with neat, square corners and edges to within 1/8-inch of the window frame.

F. Remove air bubbles, blisters, and other defects. Be careful to remove “fingers” to eliminate any contamination or excess water pockets. It is crucial to remove as much water as possible during installation.

3.4 FIELD QUALITY CONTROL

A. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, wrinkles, banding, thin spots or pinholes.

B. If installed film does not meet these criteria, remove and replace with new film.

3.5 CLEANING AND PROTECTION

A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended by safety-and-security film manufacturer.

C. Replace films that cannot be cleaned.

D. Protect installed products until completion of project.

E. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

For inquiries inside the U.S. and Canada

Eastman Chemical Company
Advanced Materials - Performance Films
P.O. Box 5068
Martinsville, Virginia 24115
1-800-2LLUMAR
www.llumar.com

For inquiries outside the U.S. and Canada

Contact your regional technical services representative or visit www.llumar.com.

Definitions of Key Terms

% Solar Transmittance (T-sol): The ratio of the amount of total solar energy in the full solar wavelength range (300-2,500 nanometers) that is allowed to pass directly through a glazing system (e.g., a film/glass combination) to the amount of total solar energy falling on that glazing system. Value is usually expressed as a percent.

Relevance to the consumer or specifier: The smaller this number, the cooler objects will be when directly exposed to sunlight passing through the window, since they will be exposed to less incident solar energy.

% Solar Reflectance (R-sol): The ratio of total solar energy which is reflected outwardly by the glazing system to the amount of total solar energy falling on the glazing system. Value is usually expressed as a percent.

Relevance to the consumer or specifier: This number together with the T-sol determines the solar absorption value of the film. This latter value is most critical in determining what film is suitable for a given glass type & situation. Generally, the higher this number, the better.

% Solar Absorptance (A-sol): The ratio of the amount of total solar energy absorbed by a glazing system to the amount of total solar energy falling on the glazing system. Solar absorption is that portion of total solar energy neither transmitted nor reflected. Since solar transmittance and solar reflectance are measured directly, the following equation should be used in calculating solar absorption. Solar absorption =1.00 - (solar transmittance) - (solar reflectance).

Relevance to the consumer or specifier: Generally, the lower this number, the better. This number is a critical determinant in the potential for thermal stress (how hot the glass gets). Too much solar absorption can excessively warm the glass cause window failure, either though glass breakage or seal failure. Always use the **Film-to-Glass Recommendation Chart** (a web app is available for specifiers) to avoid wrongly specifying a film for a given glazing system.

% Visible Light Transmittance (VLT): The ratio of the amount of total visible solar energy (380-780 nanometers) that is allowed to pass through a glazing system to the amount of total visible solar energy falling on the glazing system. Value is usually expressed as a percent. Glare is influenced by visible light transmittance through a glazing system. Visible light accounts for about 44% of the sun's energy reaching Earth's surface. The VLT value is often weighted or measured in the area of the spectrum most easily sensed by the human eye, around 550nm.

Relevance to the consumer or specifier: The smaller this number, the greater the glare reduction. Of concern to many clients because while they want glare reduction, they often do not want a room "too dark."

% Visible Reflectance-exterior and interior (VLR-ext and VLR-int): The percent of total visible light falling on a glazing system that is reflected by that system. Generally, VLR values are for exterior surfaces, those exposed to sunlight, unless otherwise specified. For dual-

reflectance films, values are often given for each surface, the exterior (usually listed first in specification charts) and the interior (listed second).

Relevance to the consumer or specifier: A guide to how "shiny" a film looks from the exterior of a building relative to other films. Clear glass has a VLR of about 8%. And the lower the ***interior*** reflectance value, the less shiny the window will appear at night from the interior when it is very dark outside but brightly lit inside.

% UV Transmission: The ratio of the amount of total UV solar energy (from 300-380 nanometers) that is allowed to pass through a glazing system to the amount of total UV solar energy falling on the glazing system (little if any UV light from 100-300 penetrates glass). Ultraviolet is one portion of the total solar energy spectrum which greatly contributes to fading and deterioration of fabrics and furnishings. Sometimes UV performance numbers are given in term of how much is "**rejected**," that is, what percentage of incident UV is **prevented** from passing through the glazing system. UV is generally subdivided into 3 smaller bands, progressively smaller in wavelength (therefore higher in frequency): UVA (380-320nm); UVB (320-280); UVC (280-100). Clear glass blocks very little UVA but most UVB. High quality window films can block well over 99% of both UVA and UVB.

Relevance to the consumer or specifier: This parameter is a very important factor in the purchase of window films. Excessive UV is the most dangerous part of the solar spectrum for human health (it's implicated in cataracts and skin cancer, and adversely affects people with Lupus, Xeroderma Pigmentosum, Porphyria, and other such diseases. UV is generally the biggest factor in damage to drapes, carpets, furniture, though shorter wavelengths of visible light (extending into the violet and blue bands) may play an important role as well. UV blocking is also important for the longevity of the window film itself.

U-value: The U-value (sometimes called the "U-Factor") should be understood as the overall heat transfer coefficient of the glazing system. The U-value is a measure of the heat transfer that occurs through the glazing system between its outer and inner surfaces. This value is a function of temperature, and is expressed in BTUs per square foot per hour per degree Fahrenheit (BTU/ ft2/hr/°F or w/m2). The lower the U-value, the better the insulation qualities of the glazing system. Alternative definition: The "coefficient of heat transfer;" a measure of the ability of a material to resist heat transfer. The number is actually the number of BTUs per square foot per hour per °F of temperature difference (or w/m2 per °C) across a barrier. The lower the U-value, the slower heat moves by conduction through the material.

Others in the insulation and construction industry use the measure of "R-Value," which denotes a material's ability to act as an insulator. The higher the R-Value, the slower the heat transfer rate; it is the reciprocal of the U-Value, expressed as R = 1/U. A window with a U-value of 0.25 has an R-value of 4.0 (1 divided by 0.25).

U-Value and R-Value measurements are similar—but reciprocal—in nature. They quantify the rate at which heat is transferred through a material due to temperature differences between its opposing surfaces. The window films industry uses two standards of measurement to determine U-values for glazing systems:

Winter U-value: With (a) the outside temperature set at -0.4°F (-18°C), (b) the inside temperature set at 69.8°F (21°C), (c) no sunlight illuminating the glass, and (d) the outside wind speed set at 12.3 mph (5.5 m/s). The "Winter U-value" can be measured in terms of the number of BTU's per square foot per hour (w/m2) lost through the glass.

Summer U-value: With (a) the outside temperature set at 89.6°F (32°C), (b) the inside temperature set at 75.2°F (24°C), (c) sunlight illuminating the exterior of the glass at the intensity of 248.2 BTUs per square foot per hour (783 w/m2), and (d) the outside wind speed set at 6.2 mph (2.8 m/s), the "Summer U-value" can be measured in terms of the number of BTUs per square foot per hour (w/m2) gained through the glass by conduction and re-radiation.

Relevance to the consumer or specifier: U-values of glass are not much affected by most films, although newer classes of low-e films offer significant heat loss reduction in winter, and improved heat rejection in summer by reflecting re-radiated far-infrared energy.

Shading Coefficient (SC): The ratio of the solar heat gain through a given glazing system to the solar heat gain under the same conditions for clear, unshaded double strength window glass (DSA). Shading coefficient defines the sun control capability or efficiency of the glazing system relative to a standard window.

Relevance to customer or specifier: The smaller the number, the greater the solar heat reduction. This term is a standard measure in the glass industry; used to rate the relative effectiveness of a glazing system compared to a "standard window." However, the glazing industry is moving away from use of the term since a "standard window" is no longer a single pane clear window with double strength glass. SHGC is a better term for quantifying glazing performance because it allows for easy comparison of the solar performance of a given window to any other.

% Total Solar Energy Rejected (TSER): The percent of incident solar energy rejected by a glazing system. This value equals solar reflectance plus the part of solar absorption that is both re-radiated and conducted/convected outwardly.

Relevance to the consumer or specifier: The higher this number, the better. Like "shading coefficient" in the glass industry, this term historically has been a standard one in the film industry. The number is a good way to compare relative performance of various film products. (Remember that this number is measured for a film on clear, 3mm glass, unless otherwise stated.)

Solar Heat Gain Coefficient (SHGC): Also known as the g-value, the SHGC is the fraction of incident solar radiation that actually passes through that window, including solar energy that is both directly transmitted and that which is absorbed and subsequently released inwardly by re-radiation and conduction. SHGC is expressed as a number between 0 and 1. The lower a window's solar heat gain coefficient, the less solar heat enters a room space. This number is the mathematical complement of the TSER value. In other words, the sum of the TSER (Total Solar Energy Rejection, in decimal form) of a glazing system and its SHGC value is 1; therefore,

1 - TSER = SHGC
Thus, if the TSER of a specified film/glass combination is 58%, then 1 - .58 = .42, which is the SHGC of the window.

Note: This term is being increasingly used in the window film industry because it is a central term in the window glazing industry which does not use the term “TSER.”

Relevance to the consumer or specifier: This is the industry's standard number for comparing the solar performance of a window. The lower this number, the better.

Emissivity: *Short definition:* the measure of a surface's ability of reflect or emit heat in the form of *radiation* (wavelengths from 2500-60,000 nm).

Long definition/discussion: Emissivity is a measure of a surface's ability to *emit* radiation. When heated, a low-E surface will radiate less electromagnetic energy than a high-E surface at the same temperature. The "E" (Emissivity) value is actually the ratio of the amount of radiation emitted from a given surface to the amount of radiation emitted by an ideal "black body" at the same temperature. Thus, emissivity values must be between 0 and 1. (Emissivity simply answers the question: How good does this object radiate heat as compared to a black body?) In the process of emission (re-radiation), the surface is shedding radiant energy to the environment, thus cooling itself. A low-E surface cools itself more slowly than a highly emissive surface. Therefore, installers and sales reps should be aware that sun-exposed Low-E glass with film, all other factors being equal, will tend to remain at a higher temperature than a regular filmed glass. This fact is taken into consideration in the film-to-glass recommendations calculations.

Low-E surfaces also tend to reflect longer wave far-infrared radiation, the kind of radiation emitted by objects at room temperature, indeed by all objects cooler than about 1300°F (705°C). Many low-E coatings on window glass may be *excellent* reflectors of far-infrared (thus reducing winter heat loss through a home's windows) but very *poor* reflectors/absorbers of UV, visible, and near infrared wavelengths found in *solar* radiation, and thus may not be sufficient for solar control purposes without additional coatings (such as high-performance window films). There is some advantage in low-e coatings in summer since such glazing can reduce the transmission of far-infrared energy emitted by objects warmed by the sun outside a home (sidewalks, rocks, pavement, outside adjacent walls, etc.).

Relevance to the consumer or specifier: The lower the emissivity value, the lower the heat gain in summer and the lower the heat loss in winter, including those times when the sun is not shining on the window.

> Emissivity is a measure of how much heat is emitted from an object by radiation. Heat is transferred to and from objects through three processes: conduction, convection, and radiation. For instance, on a hot night, heat will be conducted through a window from the outside, causing the inside pane to become warm. Convection, or natural circulation, of the air in the room past the window will transfer some of that heat into the room. But the window will also radiate heat as infrared waves, which will warm objects throughout the room. This radiative heating is why you can feel the heat of a red-hot piece of metal (for instance, a heating element on an electric stove) from several feet away.
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> Low-emissivity, or low-e, coatings are put on window panes to reduce the amount of heat they give off through radiation. In hot climates, where the outside of the window will typically be hotter than the inside, low-e coatings work best on the interior of the outside window pane. In cold climates, where the inside of the window is typically hotter than the outside, the low-e coatings work best on the inside window pane, on the side that faces toward the outside. To learn more about window coatings, see "Advances in Glazing Materials for Windows," prepared by the U.S. Department of Energy's Energy Efficiency and Renewable Energy Clearinghouse." Quoted from the following Department of Energy web site: http://www.eren.doe.gov/consumerinfo/energy_savers/glossary.html)

Light to Solar Heat Gain Ratio (LSG): the ratio of the amount of visible light to the amount of solar heat that is allowed to pass through a glazing system. If this ratio is greater than 1.00, it means that the glazing system (a window system with film installed on it, for example) blocks more heat than light, which requires the selective blocking of more infrared

radiation than visible light. This term is replacing "LE" (luminous efficacy) because of the gradual extinction of the term "shading coefficient." The higher the LSG ratio, the better the glazing is at reducing unwanted solar heat gain and maximizing desirable natural light transmittance. This term is replacing "luminous efficacy" in the industry. VLT / SHGC = LSG.

Relevance to the consumer or specifier: The higher this number, the more efficient the film product is at reducing solar heat gain rather than visible light.

% Summer Solar Heat Gain Reduction (Summer SHGR): The percent by which incoming solar heat energy is reduced by the addition of a filtering material. For example, if a clear glass pane has solar heat gain of 86% (a solar heat gain coefficient of .86), and the addition of a window film yields a new solar heat gain of only 40%, then the HEAT GAIN REDUCTION is from .86 to .40. We compare the difference in heat gain to the original heat gain to get the percentage of heat gain reduction. The calculation runs as follows: (.86 - .40)/.86 = 0.535, or 53.5%.

Relevance to the consumer or specifier: The higher this number, the greater heat gain is reduced. This is an accurate way to directly compare the difference in heat gain before and after a film installation.

% Winter Heat Loss Reduction: The percentage by which heat energy loss (via conduction, convection, and radiation) through a given glazing system is reduced by the addition of an insulating material. For example, if a clear glass pane has heat loss value of .9 BTUs per square foot per hour per degree F, and the addition of an insulating window film reduces the heat loss to .5 BTUs per square foot per hour per degree F, then the HEAT LOSS REDUCTION is from .9 to .5. We compare the difference in heat loss to the original heat loss to get the percentage of heat loss reduction. The calculation runs as follows: (.9 - .5) / .9 = 0.44, or 44%.

Relevance to the consumer or specifier: The greater this number, the better. This value is a way to compare the (non-solar) insulation of a film, irrespective of its solar performance.

% Glare Reduction: The percent by which visible light transmission is reduced by the addition of a filtering material. For example, if a clear glass pane has a VLT of 90%, and the addition of a window film yields a new VLT of 50%, then the GLARE REDUCTION is from 90 to 50. We compare the difference in light transmission to the original transmission to get the percentage of glare reduction. The calculation runs as follows: (.90 - .50)/.90 = 44.4%

Relevance to the consumer or specifier: The greater this number, the better (in terms of reducing harsh or excessive light).