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LLumar Film-to-Glass Recommendations
Using the Chart

Updated: 1/7/05

Solar Absorption and Thermal Stress - Solar control films are very good at reducing heat discomfort in buildings by lowering the solar energy passing through windows. They work by either reflecting sunlight back outside or absorbing it in the film. Any solar energy absorbed in the film is converted to heat and is transferred to the glass. As the glass warms, it expands in size. If the glass pane expansion is uneven or restricted, stress builds up and, in extreme cases, the glass can crack. It is for this reason there are restrictions on some film and window combinations. As an aid to proper installations, CPFilms has provided a chart of film-to-glass guidelines.

Addition of Contributing Factors - The chart has two sections that cover most factors that may lead to cracked glass. The Film-to-Glass Factor Section contains numbers for each of the various film-to-window combinations. The numbers are proportional to the glass temperature that the combination will reach—the higher the number, the higher the expected glass temperature. The Conditions Factor Section contains a list of additional factors affecting the chances of a window cracking. Numbers are to be taken from this list for as many factors that pertain to the installation. To determine if an application is acceptable, numbers are looked up in the two sections, added together, and compared to the maximum allowed values for the three glass types — annealed, heat strengthened, and tempered. If the total is 10 or below, the installation is recommended for any glass type. If the total is between 11 and 14, the film/glass combo is all right for heat strengthened and tempered. Totals 15 to 18 are acceptable for tempered only. Unlike tempered glass, heat strengthened panes are usually not marked. If you are not sure, assume the glass is annealed.

Solar control film applications are not recommended on any sun-exposed 1) wire-mesh glass or 2) non-tempered glass that is ½ -inch or greater in thickness.

Descriptions of Secondary Conditions

Peak Temperatures refer to normal peak summer air temperatures and correspond roughly to climate zones. The 100ºF (38ºC) peak summer temperature would be true for much of the Midwest. Most of the southern U.S. would use the 110ºF (43ºC) level and the southwest deserts would use 120ºF (49ºC).

Glass Thickness is the thickness of the pane on which the film is mounted.

Shadowing has considerable impact on glass thermal stress because it causes uneven heating. Shadowing in the morning hours will raise stress the most. The three shadow categories are pictorially shown below.

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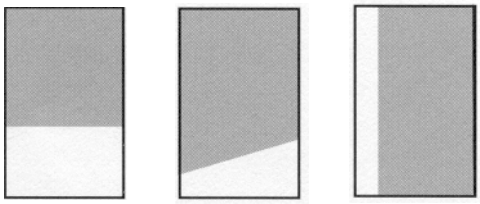
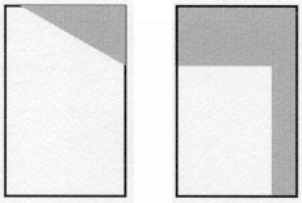
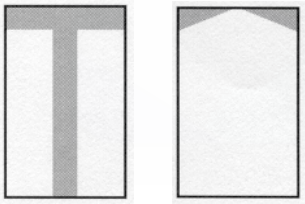
"Straight-shadow" category
1 point



"L-shaped shadow" category
2 points



"T-or V-shaped shadow" category
3 points



Frame Conditions will affect how much restriction there is to glass expansion. Unusually rigid frames or deteriorated gaskets will increase the chances of a cracked pane. Direct metal-to-glass contact, where no gaskets or sealant are present at all, adds considerable stress to a glass pane as it expands.

Glass Condition is the most critical factor affecting a pane's tendency to crack. Chipped edges severely weaken the strength of glass, and unfortunately, these are almost impossible to detect without removing the pane. Windows that break despite application of conservative films are usually due to chipped edges. Remember, curved windows are nearly always chipped or raggedly cut and are, therefore, considerably weaker than straight edged panes.

Altitude Above Sea Level is a temperature related influence. At higher altitudes, nights are cooler and morning sunlight is stronger. This means that in the morning the glass quickly changes from cold to warm and wide temperature difference forms between shadowed and sunlit areas. Wide temperature differences from one spot to another create extra thermal stress.

As **Pane Size** grows, so do the chances of mechanical stress from the weight of the glass. Also, the greater the pane size, the greater will thermal expansion increase the dimensions of the pane, creating greater risk of mechanical stress from rigid framing materials.

Attachments tend to thermally insulate a window and slow the dissipation of heat gained by solar absorption. Closer, darker, interior drapes or blinds mean a higher glass temperature.

FILM TO GLASS RECOMMENDATIONS ADDITIONS
LLumar Products

➢ *Laminated dual pane IG units*

1. Dual pane skylights using laminated, ***annealed*** glass inside and ***tempered*** glass outside, use column for "Clear Dual Pane Laminated" on Film to Glass Chart.
2. Dual pane skylights using laminated, ***tempered*** glass inside and ***tempered*** glass outside, use column for "Clear Dual Pane Laminated" on Film to Glass Chart.
   NOTE: all glass warranties on laminated glass are for glass breakage only. CPFilms will not warrant failure of the laminating interlayer for movement, bubbling, discoloration, or delamination.

➢ *Suspended film and Gas-Filled IG units:*

3. Heat Mirror suspended-film type windows: use column for "Low-E Dual Pane" on Film to Glass Chart.

   NOTE: Remember that these are expensive glass units and the $500 maximum still applies. Make sure the dealers do not oversell this warranty.

➢ *Triple pane windows:*

4. The following LLumar films are approved for clear, triple pane applications ***in mild climates only*** (maximum summer temperature below 95°F or 35°C) with additional restrictions described below.

RK-20 (exterior)
R-50 SR CDF
N-1065 SR CDF
N-1050 SR CDF
N-1050 SR PS4
N-1050B SR CDF
NUV65 SR PS4

5. Application restrictions for triple pane windows also include:
   a. Windows must be less than 50 square feet (4.6 square meters) in size
   b. Rectangular and square windows only. (No curved edges, no polygons, no triangular windows).
   c. Absolutely no overhangs, side extensions, or recessed windows that could cause harmful shading of the glass surface.
   d. Triple pane unit must not contain low-e coatings, reflective coatings, or be OEM tinted.
   e. Glazing must be protected from the frame with by a pliable rubber or neoprene gasket or soft caulking (glazing tape alone is not sufficient). Non-pliable gaskets or hardened caulking is not permitted.
   f. Use of close fitting blinds within 4 inches (10cm) of window is prohibited.
   g. No visible chips or scratches on the window.

   Any deviation form these limitations will void the optional LLumar glass breakage and seal failure warranty.

6. The following (clear) LLumar films are approved for all triple pane applications in all situations:

SCL SR PS4
SCL SR PS7
SCL SR PS11
SCL SR PS15
UV CL SR PS

LLUMAR FILM-TO-GLASS RECOMMENDATION CHART

Film-to-Glass Factor + Condition Factors = Recommended Applications

FILM TYPE	Clear Single Pane	Clear Dual Pane (6)	Tinted Single Pane (7)	Tinted Dual Pane (6) (7)	Low-E Dual Pane (6) (8)	High Performance Low-E Dual Pane (6)	Clear Single Pane Laminated	Clear Dual Pane Laminated (1)(6)	Tinted Single Pane Laminated (2) (7)	Tinted Dual Pane Laminated (3)(6)(7)
Deluxe Series										
DL-05GR	9	**NR**	10	**NR**	**NR**	5	11	12	12	**NR**
DL-15B	8	11	10	8	11	5	11	12	12	8
DL-15G	8	11	10	11	12	5	11	12	12	11
DL-30GR	7	10	8	9	11	4	10	12	12	9
Dyed-Reflectives										
R-15B	8	12	10	**NR**	12	5	11	12	12	**NR**
R-15G	8	11	10	**NR**	**NR**	5	11	12	12	**NR**
R-15BL	7	11	9	**NR**	11	4	11	12	12	**NR**
R-15GO	5	6	8	8	8	3	8	10	12	8
R-30B	7	11	9	5	12	4	11	12	12	5
R-30G	7	11	9	5	12	4	11	12	12	5
PCR-15BL	8	11	10	6	12	4	11	12	12	6
PCR-35GN	6	9	7	5	9	4	10	11	12	8
Reflectives										
R-20	5	6	8	9	7	3	7	8	12	8
R-35	4	5	7	7	7	3	7	8	12	7
R-50	4	4	6	6	6	3	7	8	12	6
Dual-Reflectives										
DR-15	6	9	7	8	9	4	10	10	12	8
DR-25	6	10	8	5	10	4	11	11	12	5
DR-35	6	8	6	5	8	4	8	9	12	5
Sputtered Neutrals										
N-1020	7	11	8	8	11	4	11	12	12	9
N-1040	6	9	7	8	9	4	10	11	12	8
N-1050	5	5	6	5	7	3	8	10	12	5
N-1065	3	4	4	4	5	3	7	9	12	4
Sputtered Bronzes										
N-1020B	5	7	7	7	9	4	9	11	12	7
N-1035B	5	6	6	7	7	3	8	9	12	7
N-1050B	4	5	5	6	6	3	7	7	12	6
Low-E Series										
E-1220	6	7	8	9	7	3	8	10	12	8

CONDITION FACTORS	
Peak Temperatures	
109° F (42° C) or below	0
110 to 119° F (43 to 48° C)	1
120 to 129° F (49 to 53° C)	2
130 to 140° F (54 to 60° C)	3
Glass Thickness	
1/4 inch (6mm) or less	0
3/8 inch (9mm)	1
1/2 inch (12mm)	Note 4
Greater than 1/2 inch (12mm)	NR
Shadowing	
"straight shadow"	1
"L-shaped" shadow	2
"T or V-shaped" shadow	3
Frame Condition	
steel or concrete frame	1
deteriorated rubber gasket	1
no rubber gasket	2
Glass Conditions	
Scratches -	
Visible from 5 to 10ft (1.5-3.0m)	1
Visible from 11-20ft (3.3-6m)	2
Visible from beyond 20ft (6m)	NR
Glass visibly chipped (from any distance)	NR
Altitude Above Sea Level	
2,000 to 5,000 ft (600-1,525m)	1
5,000 to 10,000ft (1,525-3,050m)	2
above 10,000ft (above 3,050m)	3
Pane Size	
50 to 100 sq ft (4.6-9.3 sq m)	1
greater than 100 sq ft (9.3 sq m)	Note 5
Attachments	
close fitting curtains or blinds (within 4 inches (10cm) of window)	1

APPLICATION LIMITS

Annealed Glass
10 or less

Heat Strengthened
14 or less

Tempered
18 or less

NR
Not recommended

For **any glass type not listed here**, contact CPFilms Technical Services (276) 627-3366

Additional films shown on page 2

LLUMAR FILM-TO-GLASS RECOMMENDATION CHART

Film-to-Glass Factor + Condition Factors = Recommended Applications

FILM TYPE	Clear Single Pane	Clear Dual Pane (6)	Tinted Single Pane (7)	Tinted Dual Pane (6) (7)	Low-E Dual Pane (6) (8)	High Performance Low-E Dual Pane (6)	Clear Single Pane Laminated	Clear Dual Pane Laminated (1)(6)	Tinted Single Pane Laminated (2) (7)	Tinted Dual Pane Laminated (3)(6)(7)
Magnum Safety Films										
SCL SR PS4, 7, 11, 15	1	2	3	3	2	2	1	2	8	3
R-30GR SR PS4	7	11	9	5	12	4	11	12	12	5
R-30BR SR PS4	7	11	9	5	12	4	11	12	12	5
R-20 SR PS4 & PS8	5	6	8	9	7	3	7	8	12	8
R-35 SR PS4	4	5	7	7	7	3	7	8	12	7
N-1020 SR PS4 & PS8	7	11	8	8	11	4	11	12	12	9
N-1040 SR PS4 & PS8	6	9	7	8	9	4	10	11	12	8
N-1050 SR PS4 & PS8	5	5	6	5	7	3	8	10	12	5
NUV-65 SR PS4	3	4	4	4	5	3	7	9	12	4
Non-Reflective Series										
NRM PS2 Frosty	3	4	4	4	5	2	3	4	12	4
NRMB PS2 Bronze	5	5	6	5	7	5	5	8	12	5
NRMM PS3 Black	15	NR	15	NR	NR	NR	NR	NR	12	NR
NRMW PS3 White	6	8	8	8	9	7	8	10	12	8
NRMS PS2 Silver	5	6	8	8	8	5	8	10	12	8
RICE PAPER	3	4	4	4	5	2	3	4	12	4
UV CL SR PS Clear	1	2	3	3	2	2	2	2	8	3
Exterior Series										
RK20 PS	3	3	3	3	4	4	3	3	3	3

Notes:

(1) Chart assumes inner pane is clear laminated glass and exterior pane is clear non-laminated glass. If exterior pane is laminated glass or if both panes are laminated glass, contact CPFilms Inc. Technical Services (276) 627-3366 for recommendation.

(2) Use of LLumar films on tinted, single-pane, laminated glass is allowed only if all glass layers in laminated glass pane are tempered or heat-strengthened.

(3) Inner pane clear laminated glass, outer pane is tinted, non-laminated glass. If inner pane is tinted laminated glass, then application of LLumar film is allowed only if all glass layers in laminated glass pane are tempered or heat-strengthened.

CONDITION FACTORS | **APPLICATION LIMITS**

See previous page for Condition Factors and Application Limits

For **any glass type not listed here**, contact CPFilms Technical Services (276) 627-3366 for recommendation.

(4) LLumar film may be applied to 1/2 inch (12 mm) thick glass only if glass is heat-strengthened or tempered. If glass is laminated, all layers must be tempered or heat-strengthened.

(5) Film application to windows over 100 sqft (10 sq m) not recommended UNLESS window is single-pane heat-strengthened or tempered glass.

(6) If dual pane unit is gas-filled (argon, krypton, etc.), the film-to-glass recommendation is not affected.

(7) Chart values based on medium gray, medium bronze, or light green (PPG Solex) glass . For dark gray (PPG Optigray or Graylite, or LOF/Pilkington Supergray), or medium green glass (PPG Solargreen or LOF Evergreen), or medium blue glass (PPG Azurlite or LOF Arctic Blue) **ADD 2 points.**

(8) Chart values based on low-e coating on inner pane (number 3 surface). For low-e coating on OUTER pane (#2 surface), **SUBTRACT 1 point.**