

# 3M™ Advanced Light Control Film Automotive

ALCF-A2+  
ALCF-A3+  
ALCF-A5+39  
ALCF-A5+39H



## Product Description

3M™ Advanced Light Control Film (ALCF-A2+, ALCF-A3+ and A5+39(H)) constrains light exiting from liquid crystal displays and interior light sources. This effect minimizes reflections on the windscreen or side glass.

## Construction/Performance

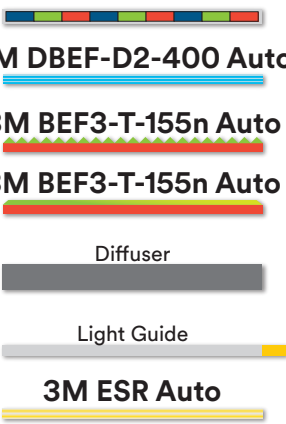
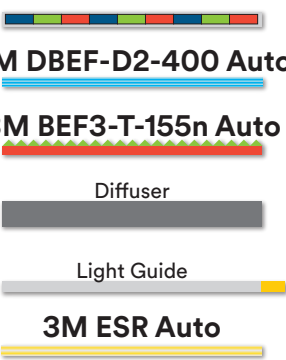

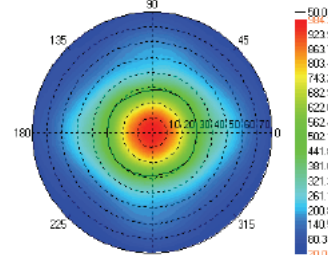
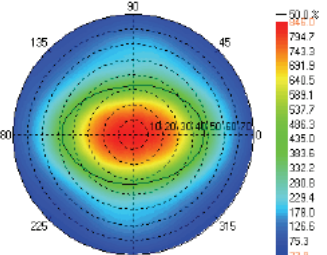
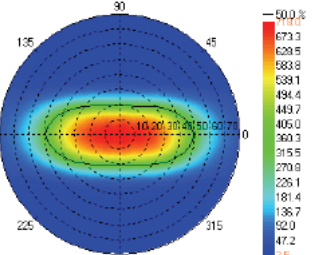
Type	Specification	ALCF-A2+	ALCF-A3+	ALCF-A5+39(H)
Optical	Effective Transmission [Axial Gain; ET(0°,0°)]	≥ 1.13	≥ 1.13	≥ 1.30
	Effective Transmission [Windshield View Gain; ET (90°,45°)]	≤ 0.10	≤ 0.10	≤ 0.18
	Color Shift 0° dx, dy	≤ 0.010, ≤ 0.010		
	Color Shift 30° dx, dy	≤ 0.030, ≤ 0.030		
	Haze, %	21 ± 8	63 ± 10	65(45) ± 10
Physical	Caliper, μm	440 ± 50	380 ± 30	380(390) ± 30
	Louver Pitch, μm	43	43	38.5
	Enhanced Scratch resistance			(✓)

## Automotive Environmental Testing

	Condition	Time
High Temperature	95°C(105°C*)	1000 hours
Low Temperature	-40°C	1000 hours
Temperature/Humidity	65°C/90%RH	1000 hours
Thermal Shock	-40°C to 95°C	1 hour dwell/300 cycles

\*for 3M ALCF-A5+39 and 3M ALCF-A5+39H

## Automotive Display – Recommended Solutions

Partial Instrument Cluster	Full Instrument Cluster	Center Stack
High Axial Brightness	High Efficiency	Minimal Windscreen Reflection
 <p><b>3M DBEF-D2-400 Auto</b>  <b>3M BEF3-T-155n Auto</b>  <b>3M BEF3-T-155n Auto</b>                      Diffuser                      Light Guide  <b>3M ESR Auto</b></p>	 <p><b>3M DBEF-D2-400 Auto</b>  <b>3M BEF3-T-155n Auto</b>                      Diffuser                      Light Guide  <b>3M ESR Auto</b></p>	 <p><b>3M ALCF</b>  <b>3M BEF3-T-155n Auto</b>                      Diffuser                      Light Guide  <b>3M ESR Auto</b></p>
Axial Luminance = 974 nits Axial Gain (ref. Diffuser Only) = 2.8	Axial Luminance = 836 nits Axial Gain (ref. Diffuser Only) = 2.4	Axial Luminance = 706 nits* Axial Gain (ref. Diffuser Only) = 2.1
		

3M™ Dual Brightness Enhancement Film (DBEF)  
3M™ Brightness Enhancement Film (BEF)

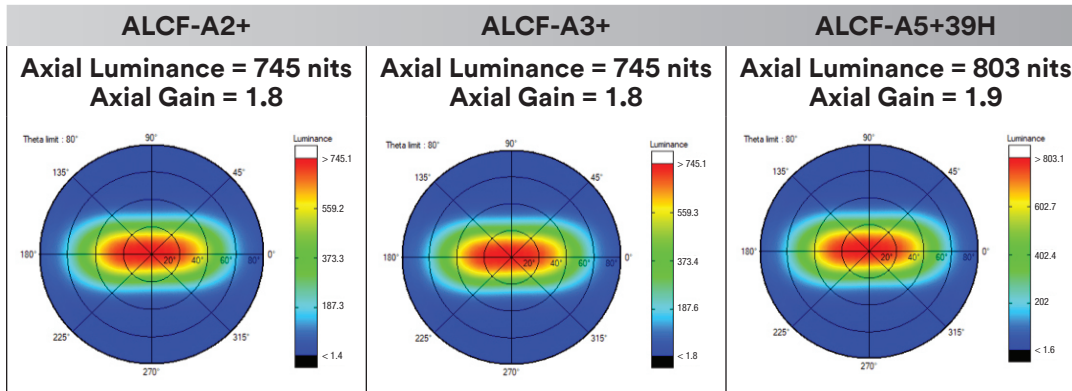
3M™ Enhanced Specular Reflector (ESR)  
3M™ Advanced Light Control Film (ALCF)

\*example data shown in plot from ALCF-A3+

## 3M™ Advanced Light Control Film Comparison

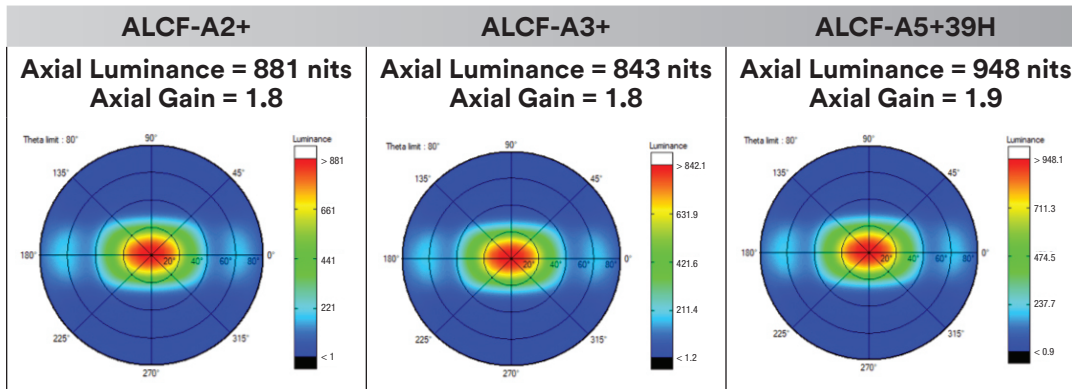
ALCF-A2+	ALCF-A3+	ALCF-A5+39	ALCF-A5+39H
<ul style="list-style-type: none"> <li>• Least amount of off-axis light</li> <li>• Flexibility for reflective polarizer transmission axis oriented at 0° or 90° to louvers</li> </ul>	<ul style="list-style-type: none"> <li>• New reflective polarizer core for improved temperature reliability, reduced color shift over angle and reduced thickness</li> <li>• High haze for improved in-device appearance</li> </ul>	<ul style="list-style-type: none"> <li>• Optimized louver design</li> <li>• New material to allow for a broader output</li> <li>• High Haze for improved in-device appearance</li> </ul>	<ul style="list-style-type: none"> <li>• Optimized louver design</li> <li>• New material to allow for a broader output</li> <li>• Robust surface that reduce scratching between ALCF and adjacent films</li> <li>• Improved environmental stability</li> </ul>

### Full Instrument Cluster or Center Stack Sample Performance (Single BEF)



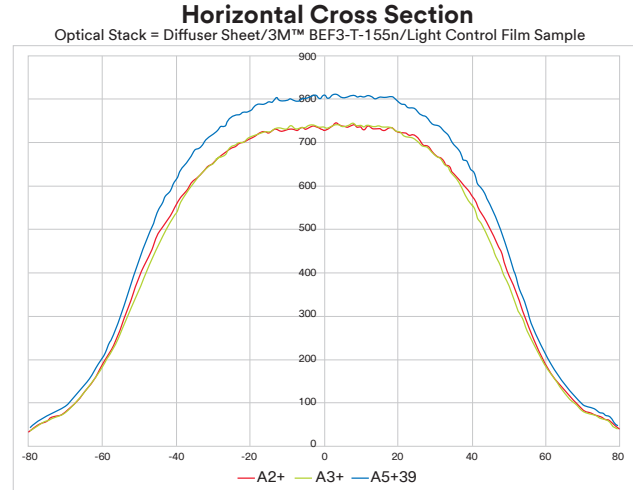
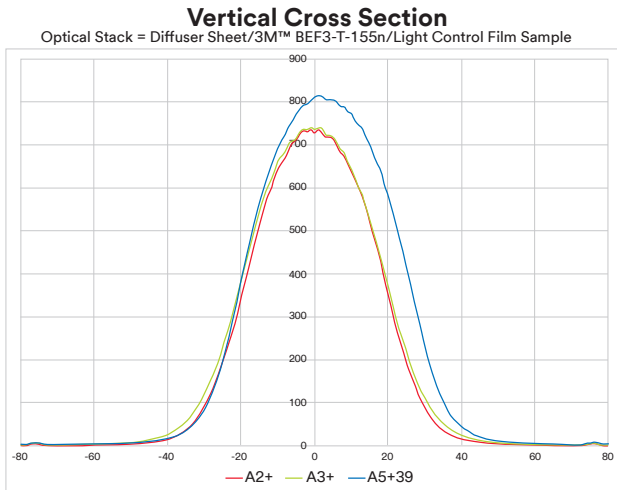
Note: Samples measured on a 12.3" IPS display with White Reflector/Light Guide/Diffuser/BEF3-t-155n/ALCF-AX+ film stack  
Axial Gain with reference diffuser only.

### Partial Instrument Cluster Sample Performance



Note: Samples measured on a 12.3" IPS display with White Reflector/Light Guide/Diffuser/Crossed BEF3-t-155n/ALCF-AX+ film stack  
Axial Gain with reference diffuser only.

## 3M Demo – Example Angular Luminance Data



## Measurement

Item	Description
Thickness	<p><b>Equipment:</b> Calibrated caliper capable of measuring to the nearest 0.001 mm.</p> <p><b>Procedure:</b> Allow sample to come to equilibrium in a constant temperature and humidity (CTH) room, controlled to room temperature conditions. Measure at least three evenly spaced locations across the converted sample in a direction perpendicular to the louver direction (“across louvers”). Average the three or more readings.</p>
Part Size	<p><b>Equipment:</b> Calibrated ruler capable of measuring to the nearest 0.5 mm.</p> <p><b>Procedure:</b> Allow sample to reach equilibrium in a constant temperature and humidity (CTH) room, controlled to room temperature conditions. Measure the distance between adjacent corners along the short and long dimensions of the converted sample. Average the two long and short side measurements.</p>
Curl	<p><b>Equipment:</b> Flat working surface and calibrated ruler capable of measuring to the nearest 0.5 mm.</p> <p><b>Procedure:</b> Lay sample on flat surface and measure the distance from the table top to the underside of the sample at all four corners. Flip the sample over and repeat same measurements. The sample curl is the value of the largest measured value.</p>
Effective Transmission	<p><b>Equipment:</b> 3M Effective Transmission tester. PR-650 Spectrophotometer. Fostec DCR II or III halogen light source with fiber optic cable (minimum luminance of 50 footLamberts). Light box with Melles Griot polarizer.</p> <p><b>Procedure:</b> Align test equipment absorbing polarizer pass axis parallel with louver direction. Effective transmission = <math>L_d / L_n</math>. <math>L_n</math>: measured luminance at normal axis of polarizer without sample on backlight. <math>L_d</math>: measured luminance with sample between the backlight and polarizer. For horizontal ET, orient the film so that the louvers are perpendicular to the tilt axis of the light source. For vertical ET, orient the film so that the louvers are parallel to the tilt axis of the light source. For 0° ET, orient the light source such that its front surface is normal to the inspection camera (light table protractor should read 0°). For ET 30° and 45°, orient the light source so that the protractor reads 30° and 45° respectively.</p>

## Measurement (continued)

Item	Description
Color Shift	<p><b>Equipment:</b> 3M Color Shift tester. Photo Research, Inc., SpectraColorimeter, Model PR-650 SpectraScan. Absorbing Polarizer (adjustable angle) Backlight System. Normally white, no-electrical driving, edge lit backlight or LED advanced illuminations backlight.</p> <p><b>Procedure:</b> Using Y, x, y color coordinate measurements, measure and record the x and y values for the color of the backlight with and without a test piece at both 0° and 30° orientation. For 0° Color Shift, orient the light source such that it is normal to the inspection camera. For 30° Color Shift, orient the light source such that it is 30° to the inspection camera. Color Shift =  Color (without louver film on backlight) – Color (with louver film on backlight) . <math>\Delta x</math> = Color Shift of the x color coordinate. <math>\Delta y</math> = Color Shift of the y color coordinate.</p>
Haze	<p><b>Equipment:</b> BYK-Gardner HazeGard Plus 4725.</p> <p><b>Procedure:</b> Place the front surface of the louver film flat against the haze port and capture reading.</p>
Color Change, Delta E*	<p><b>Equipment:</b> BYK Color Sphere (equivalent to Minolta Co., Ltd., Spectrophotometers cm-3500).</p> <p><b>Procedure:</b> ASTM E 1164. Light source: D65/10. Measurement: Transmission. Measure color (L*a*b*) of transmitted light through louver film before and after environmental weathering. Color change, DeltaE*, is calculated as follows: <math display="block">\Delta E^* = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}</math></p>

### Storage and Handling

Product must be stored flat, in its original 3M packaging, out of sunlight, and in a clean, dry (relative humidity between 30% and 60%) area that is maintained at a temperature between 10°C and 30°C. Avoid applying pressure to, or resting objects on, the product to prevent marking, denting or deforming. Hold product by the edges to prevent soiling of the view area and wear gloves to prevent fingerprints or nail marks. Do not slide the product.

### Limited Warranty

3M warrants that each Product will conform to our Customer Quality Standard (the “3M Warranty”) for 12 months after 3M’s Product shipment (“Warranty Period”). Any engineering or technical information, recommendations, installation instructions, jumbo delivery standards, certificates of analysis, and other information or materials relating to Products (“Other Product Information”) is provided for the Product buyer’s convenience and is not warranted. 3M will have no obligations under the 3M Warranty with respect to any Product that has been: (a) not stored, handled, or transported in accordance with this Warranty or Other Product Information; or (b) modified or damaged by anyone other than 3M.



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