TUFFAK® polycarbonate

A new generation of engineered sheet products for signage

The power of global. The service of local.

Rassolle is one of the leading manufacturers of high-quality polycarbonate products, which are continually leaders in innovation and service. Whether you are a designer, an architect, a manufacturer, or a distributor, we are here to help you find the expertise of the global Rassolle network. Customer focus, innovation, and environmental protection are objectives of equal importance in our corporate policy.

For complete information on TUFFAK signage products, call 800.254.1707 or visit our website www.plaskolite.com

» Code compliance and UL listings
» Product information
» Fabrication and forming guide

TUFFAK SL matte adds a design dimension to high performance signage

- Non-glare finish on UV-protected side
- Serve high performing physical properties as TUFFAK SL

TUFFAK AR transparent sheet expands design and application options

- Durable hard-coated surface on one or two sides offers abrasion resistance for applications that need frequent cleaning and in high traffic areas
- Anti-graffiti protection for indoor and outdoor kiosks/ signs in airports, hotels, and other public facilities
- Enhanced chemical resistance
- UL 972 burglary resistant
- UL 94 HB flammability rating
- UL 94 V-0 > 0.394”

Images and graphs demonstrate TUFFAK LD’s ability to completely eliminate LED hot spots, even when thinned by 50%

Thermochromic polycarbonate domes are photographed with the same backlighting LEDs. Peaks in the light intensity vs. position graph for the competitive PC show strong LED hot spots. No peaks are present in the TUFFAK LD graphs.

**Temperature Resistance (ASTM D 648)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Heat Deflection Temperature (°F) @ 66 psi</th>
<th>Heat Deflection Temperature (°F) @ 264 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUFFAK</td>
<td>280</td>
<td>270</td>
</tr>
<tr>
<td>Acrylic (PMMA)</td>
<td>190</td>
<td>181</td>
</tr>
</tbody>
</table>

**Impact Resistance (ASTM D 3765)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Total Energy (ft·lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUFFAK @ 0.125”</td>
<td>&gt; 46</td>
</tr>
<tr>
<td>Acrylic (PMMA)</td>
<td>2</td>
</tr>
</tbody>
</table>

These suggestions and data are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determine the suitability of our materials and suggestions before adopting them on a commercial scale.
TUFFAK SL and TUFFAK LD

Tradition of delivering the right elements for outstanding electric signage

1) Three-dimensional depth
   » Thermomolding TUFFAK sheet adds dimension to enhance logos, letters, and message
   » Thicker deep draw areas retain strength

2) Versatile sheet and reel sizes
   » Broad inventory of standard sheet and reel speeds delivery and facilitates production planning
   » Custom sizes can minimize material waste in high volume production jobs

3) TUFFAK LD delivers uniform light diffusion for today's LED signage
   » Eliminates LED hot spots even in deep draw thermformed areas that are often problematic for other materials
   » Allows shallow channel letter designs: exceptional light diffusion reduces light intensity variations (shadowing) even at smaller LED-diffuser sheet distances
   » Extensive standard color palette, color match technology consistently satisfies demanding corporate jobs
   » Delivers TUFFAK sheet's recognized performance on impact, temperature, and weather resistance
   » UL recognition: Meets the UL 94 standard for use in electric signs
   » UL 94 V-2 flammability rating 0.043”-0.070”
   » UL 94 V-0 flammability rating 0.125”

Characteristics

- Design versatility and dimensional stability
- Allows closer placement of lighting sources to the sign face for more versatile and cost-effective designs
- UL Listed: TUFFAK sign grades meet UL 94 standard for use in electric signs
- US, 94-V-2 flammability rating

Specifications

- Non-reflective (co-extruded)
- Non-reflective, coated sheet

TUFFAK NR

Non-reflective, co-extruded sheet

Anti-glare surface treatment provides impact resistant solution to current uses of non-glare acrylic
Non-reflective coating is lighter than most matte finishes reducing "pixel" effect

INTENDED MARKETS
- TV enclosures
- Digital displays
- Menu boards
- Graphic panels

TUFFAK NR-C

Non-reflective, coated sheet

Anti-glare surface with abrasion and chemical resistance

INTENDED MARKETS
- Digital displays
- Outdoor menu boards
- Ruggedized electronics for military, aerospace and consumer products

Performance that protects the image

- Weather resistance
- UV protection technology provides long-lasting outdoor life
- Exceptional toughness properties provide windload and hail impact protection across a broad temperature range
- Unsurpassed durability in production and use
- TUFFAK sheet helps minimize breakage losses for high production yields and ensures on-schedule installation

Specifications

- Non-reflective (co-extruded)
- Non-reflective, coated sheet

- Technology
- Non-reflective (co-extruded)
- Non-reflective, coated sheet

- Thickness range
- 0.040” – 0.100”
- 0.000” – 0.500”

- Maximum width
- 80.70”
- 48.00”

- Maximum length
- 135.00”
- 80.00”

- Gloss level – 60°
- Target 37 ±5
- Target 37 ±5

- Non-glare layer
- One side only
- One side only

- Weathering
- 10,000 hrs. Xenon
- 10,000 hrs. Xenon

- Impact resistance
- 400” thick
- 400” thick

- Light transmission (0.18” thick)
- 88 – 91
- 88 – 91

- Masking (non-reflective side)
- Adhesive-based
- Adhesive-based

INTENDED MARKETS
- Digital displays
- Outdoor menu boards
- Ruggedized electronics for military, aerospace and consumer products
1) Three-dimensional depth
- Thermoforming TUFFAK sheet adds dimension to enhance logos, letters, and message
- Thinner deep draw areas retain strength

2) Versatile sheet and reel sizes
- Broad inventory of standard sheet and reel sizes speeds delivery and facilitates production planning
- Standard sign colors
- Custom sizes can minimize material waste in high volume production jobs

3) TUFFAK LD delivers uniform light diffusion for today’s LED signage
- Eliminates LED hot spots even in deep draw thermoformed areas that are often problematic for other materials
- Allows shallow channel letter designs: exceptional light diffusion reduces light intensity variations (shadowing) even at smaller LED-diffuser sheet distances
- Extensive standard color palette: color match technology consistently satisfies demanding corporate jobs
- Delivers TUFFAK sheet’s recognized performance on impact, temperature, and weather resistance
- UL recognition: Meets the UL 94 V-0 standard for use in electric signs
- UL 94 V-0 flammability rating 0.093˝-0.177˝
- UL 94 V-0 flammability rating 0.236˝

Characteristics

<table>
<thead>
<tr>
<th>#</th>
<th>Specification</th>
<th>NR</th>
<th>NR-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weather resistance</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>UV protection technology provides long-lasting outdoor life</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Exceptional toughness properties provide windward and hail impact protection across a broad temperature range</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Unsurpassed durability in production and use</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>TUFFAK sheet helps minimize breakage losses for high production yields and ensures on-schedule installation</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Performance that protects the image

- Weather resistance
- UV protection technology
- Exceptional toughness properties
- Unsurpassed durability
- TUFFAK sheet helps minimize breakage losses

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<tr>
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</tr>
<tr>
<td>2</td>
<td>Thickness range</td>
<td>0.040˝ - 0.200˝</td>
<td>0.060˝ - 0.500˝</td>
</tr>
<tr>
<td>3</td>
<td>Maximum width</td>
<td>80.70˝</td>
<td>48.00˝</td>
</tr>
<tr>
<td>4</td>
<td>Maximum length</td>
<td>120.00˝</td>
<td>135.00˝</td>
</tr>
<tr>
<td>5</td>
<td>Gloss level - °</td>
<td>Target 37 ±5</td>
<td>Target 37 ±5</td>
</tr>
<tr>
<td>6</td>
<td>Non-glare layer</td>
<td>One side only</td>
<td>One side only</td>
</tr>
<tr>
<td>7</td>
<td>Weathering</td>
<td>OK: &gt;2,000 hrs. Xenon</td>
<td>OK: &gt;2,000 hrs. Xenon</td>
</tr>
<tr>
<td>8</td>
<td>Hold (0°F thick)</td>
<td>10 - 21</td>
<td>19 - 21</td>
</tr>
<tr>
<td>9</td>
<td>Light transmission (0.06” thick)</td>
<td>80 - 91</td>
<td>80 - 91</td>
</tr>
<tr>
<td>10</td>
<td>Masking (non-reflective side)</td>
<td>Adhesive-based</td>
<td>Adhesive-based</td>
</tr>
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invites Center Information

Restaurants

Lodging

Feeling Stations

Service Center

Outdoors signage

Heavy duty gauges

Fuel dispensers

INTENDED MARKETS

- TV enclosures
- Digital displays
- Menu boards
- Graphic panels

Anti-glare surface treatment provides impact resistant solution to current uses of non-glare acrylic.
Non-reflective coating is lighter than most matte finishes reducing “pixel” effect.

INTENDED MARKETS

- Digital displays
- Outdoor menu boards
- Ruggedized electronics for military, aerospace and consumer products

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<tr>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Non-pixelating</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Economical</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Outdoors suitable</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>2nd surface printing</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>Chemical resistant</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>Abrasion resistant</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>8</td>
<td>Formability</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>Cold bending</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>10</td>
<td>Gloss consistency</td>
<td>✓</td>
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<tr>
<th>#</th>
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<tr>
<td>5</td>
<td>Gloss level - °</td>
<td>Target 37 ±5</td>
<td>Target 37 ±5</td>
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<tr>
<td>6</td>
<td>Non-glare layer</td>
<td>One side only</td>
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<tr>
<td>7</td>
<td>Weathering</td>
<td>OK: &gt;2,000 hrs. Xenon</td>
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INTENDED MARKETS

- TV enclosures
- Digital displays
- Menu boards
- Graphic panels

Anti-glare surface with abrasion and chemical resistance.

INTENDED MARKETS

- Digital displays
- Outdoor menu boards
- Ruggedized electronics for military, aerospace and consumer products

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<td>✓</td>
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TUFFAK SL and TUFFAK LD
Tradition of delivering the right elements for outstanding electric signage

1) Three-dimensional depth
Thermoforming TUFFAK sheet adds dimension to enhance logos, letters, and message
Three-layer deep draws retain their strength

2) Versatile sheet and reel sizes
A broad inventory of standard sheet and reel sizes delivers speed and flexibility to facilitate production planning
Custom sizes can minimize material waste in high-volume production jobs

3) TUFFAK LD delivers uniform light diffusion for today's LED signage
Eliminates LED hot spots even in deep draw thermoformed areas that are often problematic for other materials
Allows shallow channel letter designs: exceptional light diffusion reduces light intensity variations (shadowing) even at smaller LED-diffuser sheet distances
Extensive standard color palette color matching technology consistently satisfies demanding corporate jobs
Delivers TUFFAK sheet's recognized performance on impact, temperature, and weather resistance
UL recognition: Meets the UL 94 standard for use in electric signs
UL 94 V-2 flammability rating 0.093”-0.177”
UL 94 V-0 flammability rating 0.236”

Performance that protects the image
- Weather resistance
- UV protection technology provides long-lasting outdoor life
- Exceptional toughness properties provide wind and hail impact protection across a broad temperature range
- Unsurpassed durability in production and use
- TUFFAK sheet helps minimize breakage losses for high production yields and ensures on-schedule installation

TUFFAK NR
Non-reflective, co-extruded sheet
Anti-glare surface treatment provides impact resistant solution to current uses of non-reflective acrylic
Non-reflective coating is lighter than most matte finishes reducing “pixel” effect

INTENDED MARKETS
- TV enclosures
- Digital displays
- Menu boards
- Graphic panels

Characteristics
NR
NR-C

Anti-glare ✔ ✔
Non-pixelating ✔ ✔
Economical ✔ ✔
Outdoors suitable ✔ ✔
2nd surface printing ✔ ✔
Chemical resistant ✔ ✔
Abrasion resistant ✔ ✔
Formability ✔ ✔
Cold bending ✔ ✔
Gloss consistency ✔ ✔

Specifications
NR non-reflective (coex)
NR-C non-reflective, coated

Technology
Non-reflective co-extruded sheet
Non-reflective coated surface

Thickness range
0.040” - 0.200”
0.060” - 0.500”

Maximum width
80.70”
48.00”

Maximum length
120.00”
13.50”

Gloss level - 60°
Target 37 ±3
Target 37 ±5

Non-glare layer
One side only
One side only

Weathering
OK 11,000 hrs. Xenon
OK 13,000 hrs. Xenon

Haze (0.18” thick)
18 - 21
19 - 21

Light transmission (0.18” thick)
88 - 91
88 - 91

Masking (non-reflective side)
Adhesive-based
Adhesive-based

TUFFAK NR-C
Non-reflective, coated sheet
Anti-glare surface with abrasion and chemical resistance

INTENDED MARKETS
- Digital displays
- Outdoor menu boards
- Ruggedized electronics for military, aerospace and consumer applications

Characteristics
NR
NR-C

Anti-glare ✔ ✔
Non-pixelating ✔ ✔
Economical ✔ ✔
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TUFFAK NR and TUFFAK LD
Non-reflective sheet applications

INTENDED MARKETS
- TV enclosures
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Anti-glare ✔ ✔
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Cold bending ✔ ✔
Gloss consistency ✔ ✔

Specifications
NR non-reflective (coex)
NR-C non-reflective, coated

Technology
Co-extruded sheet

Thickness range
0.040” - 0.200”

Maximum width
80.70”

Maximum length
120.00”

Gloss level - 60°
Target 37 ±3
Target 37 ±5

Non-glare layer
One side only
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Weathering
OK 11,000 hrs. Xenon
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Masking (non-reflective side)
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Adhesive-based
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For complete information on TUFFAK signage products, call 800.254.1707 or visit our website www.plaskolite.com

- Code compliance and UL listings
- Product information
- Fabrication and forming guide

The power of global.
The service of local.

Rearranged content:

TUFFAK® is a registered trademark of Plaskolite LLC

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A new generation of engineered sheet products for signage

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- Non-gloss finish on UV-protected side
- Serve high performing physical properties as TUFFAK SL

TUFFAK AR transparent sheet expands design and application options
- Durable hard-coated surface on one or two sides offers abrasion resistance for applications that need frequent cleaning and in high traffic areas
- Anti-graffiti protection for indoor and outdoor kiosks, signs in airports, hotels, and other public facilities
- Enhanced chemical resistance
- UL 972 burglary resistant
- UL 94 HB flammability rating
- UL 94 V-0 > 0.394"*

The service of local.

Temperature Resistance (ASTM D 648)

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<thead>
<tr>
<th>Material</th>
<th>Heat Deflection Temperature (°F) @ 66 psi</th>
<th>Heat Deflection Temperature (°F) @ 264 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUFFAK</td>
<td>280</td>
<td>270</td>
</tr>
<tr>
<td>Acrylic (PMMA)</td>
<td>190</td>
<td>181</td>
</tr>
</tbody>
</table>

Impact Resistance (ASTM D 3763)

<table>
<thead>
<tr>
<th>Material</th>
<th>Total Energy (ft·lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUFFAK 0.125&quot;</td>
<td>66</td>
</tr>
<tr>
<td>Acrylic (PMMA)</td>
<td>2</td>
</tr>
</tbody>
</table>

Images and graphs demonstrate TUFFAK LD’s ability to completely eliminate LED hot spots, even when thinned by 50%.

Temperature (°F)

<table>
<thead>
<tr>
<th>Material</th>
<th>Total Energy (ft·lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUFFAK</td>
<td>&gt; 46</td>
</tr>
<tr>
<td>Acrylic (PMMA)</td>
<td>2</td>
</tr>
</tbody>
</table>

For complete information on TUFFAK signage products, call 800.254.1707 or visit our website www.plaskolite.com
- Code compliance and UL listings
- Product information
- Fabrication and forming guide

Plaskolite is one of the leading manufacturers of high-quality polycarbonate products, which are continually leaders in global markets. Behind the technologically sophisticated solutions you’ll find the expertise of the global Plaskolite network. Customer focus, innovation and environmental protection are objectives of equal importance in our corporate policy.

These suggestions and data are based on information we believe to be reliable. They are offered in good faith, but without guarantee, as conditions and methods of use are beyond our control. We recommend that the prospective user determine the suitability of our materials and suggestions before adopting them on a commercial scale.