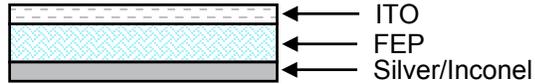


## PRODUCT BULLETIN



## ITO Coated Silver FEP

Sheldahl® Brand Materials of FEP films that are silver coated on one side are used as second surface mirrors to obtain low solar absorptance and high emittance. We then add ITO to the other side to bleed off surface charges without significantly affecting the thermo-optical properties.

This product may be ordered with 0.5, 1, 2, 5, or 10 mil thick FEP that conforms to the requirements of ASTM D-3368. The silver coating is nominally 1500 Å thick. We apply a 275 Å overcoat of Inconel to prevent the silver from oxidizing. Our standard ITO coating has a resistivity between 2K and 10K Ω/square; other values are available upon request. This product is usually manufactured in sheets 4 feet (1.22 m) wide by 10 feet (3 m) long. Roll-to-roll coating is available on a custom basis.

## PRODUCT CHARACTERISTICS

| Parameter (independent of film thickness) | Specified Value                     |
|---|-------------------------------------|
| ITO surface resistivity                   | 2K to 10K Ω/square                  |
| Intermittent temperature range            | -75° C to 65° C (-100° F to 150° F) |
| Continuous temperature range              | -75° C to 65° C (-100° F to 150° F) |

| Standard Item Number | Thickness mil (µm) | Second Surface Mirror Properties |        |        | Typical Weight (g/m <sup>2</sup> ) | Perforation Item Number |
|----------------------|--------------------|----------------------------------|--------|--------|------------------------------------|-------------------------|
|                      |                    | α                                | εN     | εH     |                                    |                         |
| TBD                  | 0.5 (12.5)         | ≤ 0.14                           | ≥ 0.40 | ≥ 0.40 | 28                                 | TBD                     |
| 161038               | 1.0 (25)           | ≤ 0.14                           | ≥ 0.47 | ≥ 0.48 | 54                                 | 164644                  |
| 146648               | 2.0 (51)           | ≤ 0.14                           | ≥ 0.60 | ≥ 0.60 | 109                                | 160077                  |
| 146651               | 5.0 (127)          | ≤ 0.14                           | ≥ 0.75 | ≥ 0.75 | 273                                | 159531                  |
| 146654               | 10.0 (254)         | ≤ 0.15                           | ≥ 0.85 | ≥ 0.85 | 546                                | 174229                  |

ITO/GE



A Multek Brand

## POST PROCESSING - PERFORATION

This product may be processed to enhance its functionality. The film may be Perforation prior to metallization to facilitate air passage during launch or to provide an electrical connection between the silver and ITO coated surfaces. Standard perforation patterns are on pages 14 - 22.

## WARRANTY INFORMATION

Multek warrants that our thermal control materials will meet all acceptance testing criteria for one year from the date of shipment (except Germanium, see product bulletin) if the materials have been stored indoors at standard conditions in their original packaging.

## SHELF LIFE

This product shall meet specified values for a minimum of 12 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures (10° C to 27° C/50° F to 80° F).

The shelf life of the material should be much longer than the warranty period. We recommend retesting any material that is more than one year old (or more than one year since most recent testing) prior to use. This will verify that the material has not been accidentally damaged. Multek offers retest services for a nominal fee.

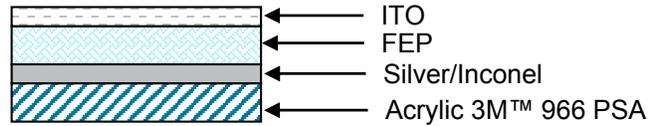
## PART NUMBERS

| STANDARD NUMBERS     |             | Thickness | PERFORATION NUMBERS  |             |
|----------------------|-------------|-----------|----------------------|-------------|
| Multek Specification | Item Number |           | Multek Specification | Item Number |
| G427160              | TBD         | 0.5 mil   | G427164              | TBD         |
| G427110              | 161038      | 1.0 mil   | G427114              | 164644      |
| G427120              | 146648      | 2.0 mil   | G427124              | 160077      |
| G427150              | 146651      | 5.0 mil   | G427154              | 159531      |
| G427200              | 146654      | 10.0 mil  | G427204              | 174229      |

Multek manufactures a broad range of vacuum deposited films, laminates and tapes. Ask for additional product bulletins describing other Sheldahl® Brand Materials.

The information on this product bulletin is based on data obtained by our research and is considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data and the results obtained from the use thereof. This information is furnished upon the condition that the recipient shall conduct tests to determine the suitability of the product for his or her particular application.

## PRODUCT BULLETIN



## ITO Coated Silver FEP Tape with 3M™ 966 Acrylic Adhesive

Sheldahl® Brand Materials ITO coated silver FEP tapes with acrylic 3M™ 966 adhesive are used whenever charge dissipation, high emittance, and low solar absorptance are needed. The acrylic 3M™ 966 adhesive is nominally 2.3 mils thick, provides a strong bond with low outgassing, and can be used over a moderate temperature range. These tapes may be bonded to structures to control radiative heat transfer or used on multilayer insulation blankets to close the edges or repair rips in the outer layers.

This product may be ordered with 1, 2, 5, or 10 mil thick FEP that conforms to ASTM D-3368. The silver coating is nominally 1500 Å thick. We apply a 275 Å overcoat of Inconel to prevent the silver from oxidizing. Although the standard widths for this tape are 1, 2, 3, and 4 inches, it may be ordered in any width needed. Each roll is 108 feet (33 m) long.

## PRODUCT CHARACTERISTICS

| Parameter (independent of film thickness) | Specified Value                                  |
|---|--|
| ITO Surface Resistivity                   | 2K to 10K Ω/square                               |
| Adhesion to stainless steel               | ≥ 20 oz./inch of width                           |
| Intermittent temperature range            | -75° C to 65° C (-100° F to 150° F) <sup>A</sup> |
| Continuous temperature range              | -60° C to 65° C (-75° F to 150° F) <sup>A</sup>  |

<sup>A</sup> Zero peel strength of acrylic pressure sensitive adhesive is at about -45°C (-50°F).

| Standard Item Number | Thickness mil (μm) | Second Surface Mirror Properties |                |                | Typical Weight (g/m <sup>2</sup> ) | Perforation Item Number |
|----------------------|--------------------|----------------------------------|----------------|----------------|------------------------------------|-------------------------|
|                      |                    | α                                | ε <sub>N</sub> | ε <sub>H</sub> |                                    |                         |
| TBD                  | 1.0 (25)           | ≤ 0.14                           | ≥ 0.47         | ≥ 0.48         | 115                                | TBD                     |
| 146655               | 2.0 (51)           | ≤ 0.14                           | ≥ 0.60         | ≥ 0.60         | 169                                | TBD                     |
| 146656               | 5.0 (127)          | ≤ 0.14                           | ≥ 0.75         | ≥ 0.75         | 333                                | 146657                  |
| 147449               | 10.0 (254)         | ≤ 0.15                           | ≥ 0.85         | ≥ 0.85         | 606                                | 171898                  |



A Multek Brand

## POST PROCESSING – PERFORATION & EMBOSSING

This product may be processed after metalizing and combining the film to the adhesive to enhance its functionality. We offer a standard perforation pattern with 0.76 mm (0.03 in.) diameter holes on 6.35 mm (0.25 in.) centers, with a nominal 1.1% open area.

The raw material for these tapes may be embossed prior to coating to provide a more diffuse reflection pattern.

## WARRANTY INFORMATION

Multek warrants that our thermal control materials will meet all acceptance testing criteria for one year from the date of shipment (except Germanium, see product bulletin) if the materials have been stored indoors at standard conditions in their original packaging.

## SHELF LIFE

This product shall meet specified values for a minimum of 12 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures (10° C to 27° C/50° F to 80° F).

The shelf life of the material should be much longer than the warranty period. We recommend retesting any material that is more than one year old (or more than one year since most recent testing) prior to use. This will verify that the material has not been accidentally damaged. Multek offers retest services for a nominal fee.

## SPECIFICATION AND ITEM NUMBERS

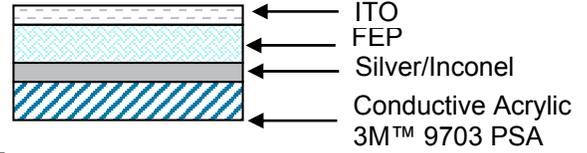
| STANDARD NUMBERS     |             | Thickness | PERFORATION NUMBERS  |             |
|----------------------|-------------|-----------|----------------------|-------------|
| Multek Specification | Item Number |           | Multek Specification | Item Number |
| G427410              | TBD         | 1.0 mil   | G427411              | TBD         |
| G427420              | 146655      | 2.0 mil   | G427421              | TBD         |
| G427450              | 146656      | 5.0 mil   | G427451              | 146657      |
| G4274X0              | 147449      | 10.0 mil  | G4274X1              | 171898      |

Multek manufactures a broad range of vacuum deposited films, laminates and tapes. Ask for additional product bulletins describing other Sheldahl® Brand Materials.

The information on this product bulletin is based on data obtained by our research and is considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data and the results obtained from the use thereof. This information is furnished upon the condition that the recipient shall conduct tests to determine the suitability of the product for his or her particular application.

## PRODUCT BULLETIN

### ITO Coated Silver FEP Tape with Conductive Acrylic 3M™9703 Adhesive



Sheldahl® Brand Materials ITO coated silver FEP tapes with conductive acrylic 3M™9703 adhesive are used whenever charge dissipation, high emittance, low solar absorptance, and electrical connection between the tape and the spacecraft are needed. The conductive acrylic 3M™9703 adhesive is nominally 2 mils thick, provides a strong bond with low outgassing, and can be used over a moderate temperature range. These tapes may be bonded to structures to control radiative heat transfer or used on multilayer insulation blankets to close the edges or repair rips in the outer layers.

This product may be ordered with 1, 2, 5, or 10 mil thick FEP that conforms to ASTM D-3368. The silver coating is nominally 1500 Å thick. We apply a 275 Å overcoat of Inconel to prevent the silver from oxidizing. Although the standard widths for this tape are 1, 2, 3, and 4 inches, it may be ordered in any width needed. Each roll is 108 feet (33 m) long.

## PRODUCT CHARACTERISTICS

| Parameter (independent of film thickness) | Specified Value                                  |
|---|--|
| ITO Surface Resistivity                   | 2K to 10K Ω/square                               |
| Adhesion to stainless steel               | ≥ 15 oz./inch of width                           |
| Intermittent temperature range            | -75° C to 65° C (-100° F to 150° F) <sup>A</sup> |
| Continuous temperature range              | -60° C to 65° C (-75° F to 150° F) <sup>A</sup>  |

<sup>A</sup> Zero peel strength of acrylic pressure sensitive adhesive is at about -45°C (-50°F).

| Standard Item Number | Thickness mil (μm) | Second Surface Mirror Properties |                |                | Typical Weight (g/m <sup>2</sup> ) | Perforation Item Number |
|----------------------|--------------------|----------------------------------|----------------|----------------|------------------------------------|-------------------------|
|                      |                    | α                                | ε <sub>N</sub> | ε <sub>H</sub> |                                    |                         |
| TBD                  | 1.0 (25)           | ≤ 0.14                           | ≥ 0.47         | ≥ 0.48         | 115                                | TBD                     |
| 146669               | 2.0 (51)           | ≤ 0.14                           | ≥ 0.60         | ≥ 0.60         | 169                                | 160550                  |
| 155410               | 5.0 (127)          | ≤ 0.14                           | ≥ 0.75         | ≥ 0.75         | 333                                | 149598                  |
| 166724               | 10.0 (254)         | ≤ 0.15                           | ≥ 0.85         | ≥ 0.85         | 606                                | 165790                  |



A Multek Brand

## POST PROCESSING – PERFORATION & EMBOSSING

This product may be processed either before or after metalizing and combining the film to the adhesive to enhance its functionality. By perforating first, there will be an electrical connection from the ITO through the holes to the silver and the conductive adhesive. We offer a standard perforation pattern with 0.76 mm (0.03 in.) diameter holes on 6.35 mm (0.25 in.) centers, with a nominal 1.1% open area.

The raw material for these tapes may be embossed prior to coating to provide a more diffuse reflection pattern.

## WARRANTY INFORMATION

Multek warrants that our thermal control materials will meet all acceptance testing criteria for one year from the date of shipment (except Germanium, see product bulletin) if the materials have been stored indoors at standard conditions in their original packaging.

## SHELF LIFE

This product shall meet specified values for a minimum of 12 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures (10° C to 27° C/50° F to 80° F).

The shelf life of the material should be much longer than the warranty period. We recommend retesting any material that is more than one year old (or more than one year since most recent testing) prior to use. This will verify that the material has not been accidentally damaged. Multek offers retest services for a nominal fee.

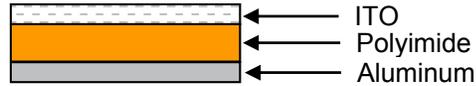
## SPECIFICATION AND ITEM NUMBERS

| STANDARD NUMBERS     |             | THICKNESS | PERFORATION NUMBERS  |             |
|----------------------|-------------|-----------|----------------------|-------------|
| Multek Specification | Item Number |           | Multek Specification | Item Number |
| G430010              | TBD         | 1.0 mil   | G430011              | TBD         |
| G430020              | 146669      | 2.0 mil   | G430021              | 160550      |
| G430050              | 155410      | 5.0 mil   | G430051              | 149598      |

Multek manufactures a broad range of vacuum deposited films, laminates and tapes. Ask for additional product bulletins describing other Sheldahl® Brand Materials.

The information on this product bulletin is based on data obtained by our research and is considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data and the results obtained from the use thereof. This information is furnished upon the condition that the recipient shall conduct tests to determine the suitability of the product for his or her particular application.

## PRODUCT BULLETIN



## ITO Coated Aluminized Polyimide

Sheldahl® Brand Materials of polyimide films that are aluminized on one side and have an indium tin oxide (ITO) coating on the other are often used as outer layers in multi-layer insulation (MLI) blankets. The ITO coating provides a way to bleed off any electrical charge that may accumulate on the outer surface without significantly affecting the emittance or solar absorptance of the second surface mirror. The aluminum side of these products provides low emittance and low solar absorptance. The ITO side of these products has moderate solar absorptance and emittance (as determined by the polyimide film thickness). This product may be produced economically in small quantities using a batch process to manufacture sheets, or in large quantities using a roll to roll coating process. The product may be PERFORATION prior to coating to provide an electrical connection between the ITO and aluminum coatings.

This product may be ordered with 0.5, 1, 2, 3, or 5 mil thick polyimide that conforms to the requirements of ASTM D-5213. The aluminum coating is nominally 1000 Å thick, and the most common width is 48 inches (1.22 m). Sheets are 48 inches (1.22 m) wide and 10 feet (3 m) wide.

## PRODUCT CHARACTERISTICS

| Parameter (independent of film thickness) | Specified Value                       |
|---|---------------------------------------|
| ITO surface resistivity                   | 2,000 to 10,000 Ω/square*             |
| Intermittent temperature range            | -185° C to 260° C (-300° F to 500° F) |
| Continuous temperature range              | -185° C to 150° C (-300° F to 300° F) |

\* Custom resistance ranges are available upon request

| Standard Item Number | Thickness mil (µm) | Second Surface Mirror Properties |                |                | Typical Weight (g/m <sup>2</sup> ) | Perforation Item Number |
|----------------------|--------------------|----------------------------------|----------------|----------------|------------------------------------|-------------------------|
|                      |                    | α                                | ε <sub>N</sub> | ε <sub>H</sub> |                                    |                         |
| 146638               | 0.5 (12.5)         | ≤ 0.41                           | ≥ 0.50         | ≥ 0.52         | 19                                 | TBD                     |
| 146631               | 1.0 (25)           | ≤ 0.44                           | ≥ 0.62         | ≥ 0.64         | 36                                 | 160075                  |
| 146633               | 2.0 (51)           | ≤ 0.49                           | ≥ 0.71         | ≥ 0.71         | 71                                 | 159972                  |
| 146635               | 3.0 (76)           | ≤ 0.51                           | ≥ 0.77         | ≥ 0.77         | 109                                | 161050                  |
| 146637               | 5.0(127)           | ≤ 0.54                           | ≥ 0.81         | ≥ 0.81         | 181                                | TBD                     |



A Multek Brand

## POST PROCESSING - PERFORATION

This product may be perforated prior to metalizing to enhance its functionality. Perforated films facilitate air passage during launch and provide a through hole electrical connection from the ITO to the aluminum surface. Standard perforation patterns are on pages 14 - 22.

## WARRANTY INFORMATION

Multek warrants that our thermal control materials will meet all acceptance testing criteria for one year from the date of shipment (except Germanium, see product bulletin) if the materials have been stored indoors at standard conditions in their original packaging.

## SHELF LIFE

This product shall meet specified values for a minimum of 12 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures (10° C to 27° C/50° F to 80° F).

The shelf life of the material should be much longer than the warranty period. We recommend retesting any material that is more than one year old (or more than one year since most recent testing) prior to use. This will verify that the material has not been accidentally damaged. Multek offers retest services for a nominal fee.

## SPECIFICATION AND ITEM NUMBERS

| STANDARD NUMBERS     |             | Thickness | PERFORATION NUMBERS  |             |
|----------------------|-------------|-----------|----------------------|-------------|
| Multek Specification | Item Number |           | Multek Specification | Item Number |
| G425160              | 146638      | 0.5 mil   | G425164              | TBD         |
| G425110              | 146631      | 1.0 mil   | G425114              | 160075      |
| G425120              | 146633      | 2.0 mil   | G425124              | 159972      |
| G425130              | 146635      | 3.0 mil   | G425134              | 161050      |
| G425150              | 146637      | 5.0 mil   | G425154              | TBD         |

Multek manufactures a broad range of vacuum deposited films, laminates and tapes. Ask for additional product bulletins describing other Sheldahl® Brand Materials.

The information on this product bulletin is based on data obtained by our research and is considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data and the results obtained from the use thereof. This information is furnished upon the condition that the recipient shall conduct tests to determine the suitability of the product for his or her particular application.