



High Performance Films

# DuPont FEP

fluorocarbon film

## Types A, C, C-20, and L

### Introduction

This specification covers Teflon® FEP fluorocarbon film sold by DuPont Films.

Film types included in this specification meet requirements of fluorocarbon film specified by ASTM D-3368 as follows:

#### ASTM D-3368

|                  |               |
|------------------|---------------|
| Type I           | FEP Type A    |
| Type II, Grade 1 | FEP Type C    |
| Type II, Grade 2 | FEP Type C-20 |
| Type III         | FEP Type L    |

Where minimum or maximum tolerances are given, these represent limiting conditions approached by only a small portion of the film. A majority of the film will have properties falling within a range narrower than that specified.

Current product availability is shown in **Table 1**.

### Manufacturing

#### Material

Copolymer of tetrafluoroethylene and hexafluoropropylene in the form of a film.

#### Color

The color of the film is uniform and ranges from clear to translucent depending on the thickness.

#### Defects

The material shall be uniform in appearance and shall be sufficiently free of contamination, wrinkles, holes, scratches, and other imperfections so as to be functionally acceptable.

#### Cores

Shall be of sufficient strength to prevent collapsing on handling. Sizes 3 in (76.2 mm) or 6 in (152.4 mm) I.D. should be specified on orders.

#### Order Tolerance

The tolerance for under or overrun on pounds ordered is  $\pm 10\%$ .

#### Splices

##### Description

Splices for all gauges are butt type and are made with yellow pressure-sensitive tape. One strip is applied to each side of the splice and shall be 2 in (50.8 mm) wide for 200 gauge and above and 1 in (25.4 mm) wide for below 200 gauge.

##### Frequency

See **Table 2**.

#### Thickness and Coverage

The average thickness is determined by measurement of the average weight of the film. The average unit weight will meet the specifications as shown in **Table 3**, Section A. In addition, no single point will fall outside the minimum and maximum thickness as shown in **Table 3**, Section B. Point thickness is determined through at least ten measurements across the width of the film in accordance with ASTM D-374 Method A or C.

#### Width

The maximum variation in film width from that required on the order varies with the gauge and width of film and is shown in **Table 4**.

## General

### Packaging

DuPont FEP fluorocarbon film is wound on 3-in (76.2-mm) or 6-in (152.4-mm) cores and is overwrapped in polyethylene. The film is then boxed to prevent loss of contents or damage during shipment. Each container is labeled with DuPont and customer's name, purchase order number, film thickness, type, mill roll number, and shipping date.

A label containing similar information is also affixed to the core for roll widths 2 1/8 in (54 mm) and above; for rolls less than 2 1/8 in (54 mm) wide, the core label is in the package.

### Assurance

Statistical sampling techniques are used to ensure specified properties in the following tables are met.

**Table 1**  
**Availability of DuPont FEP Fluorocarbon Film**

| Type | Gauge |     |     |     |     |     |     |      |      |      |      |      |      |      |      |       |       |
|------|-------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|-------|-------|
|      | 50    | 100 | 175 | 200 | 300 | 500 | 750 | 1000 | 1500 | 2000 | 3000 | 4500 | 6000 | 7500 | 9000 | 12500 | 19000 |
| A    | *     | *   | *   | *   | *   | *   | *   | *    | —    | *    | —    | —    | —    | —    | —    | —     | —     |
| C    | *     | *   | *   | *   | *   | *   | —   | *    | —    | —    | —    | —    | —    | —    | —    | —     | —     |
| C-20 | —     | —   | —   | *   | —   | *   | —   | —    | —    | —    | —    | —    | —    | —    | —    | —     | —     |
| L    | —     | —   | —   | —   | —   | *   | —   | *    | *    | *    | *    | *    | *    | *    | *    | *     | *     |

\*Available

**Note:** Specifications apply to gauges and type available as indicated.

**Table 2**  
**Maximum Allowable Splices/Roll**

| Types: A, C, and C-20 |            |        |       |       |            |       |    | Type: L   |        |   |
|-----------------------|------------|--------|-------|-------|------------|-------|----|-----------|--------|---|
| Gauge                 | Put-Up     |        |       |       |            |       |    | Roll, in  |        |   |
|                       | O.D., in   |        |       |       |            |       |    | 3 × 9 1/2 | 3 × 11 |   |
|                       | 3-in Cores |        |       |       | 6-in Cores |       |    |           |        |   |
|                       | 6          | <7 1/2 | 7 1/2 | 9 1/2 | <9 1/2     | 9 1/2 | 11 |           |        |   |
| 50                    | —          | —      | —     | —     | 3          | 4     | 7  | 500       | 3      | 3 |
| 100                   | 2          | 2      | 3     | 4     | 2          | 3     | 4  | 1000      | —      | 3 |
| 200                   | 1          | 1      | 2     | 3     | 1          | 2     | 3  | 1500      | —      | 3 |
| 300                   | 1          | 1      | 2     | 3     | 1          | 2     | 3  | 2000      | —      | 2 |
| 500                   | 1          | 1      | 2     | 3     | 1          | 2     | 3  | 3000      | —      | 2 |
| 750                   | 1          | 1      | 2     | 3     | 1          | 2     | 3  | 4500      | —      | 2 |
| 1000                  | —          | —      | —     | —     | 1          | 1     | 3  | 6000      | —      | 1 |
| 2000                  | —          | —      | —     | —     | 1          | 1     | 2  | 7500      | —      | 1 |
|                       |            |        |       |       |            |       |    | 9000      | —      | 1 |

**Note:** Minimum distance between splices or between a splice and the end or start of a slit roll shall not be less than 100 ft for film under 2000 gauge and 50 ft for 2000 gauge.

**Note:** Minimum distance between the end of a splice and the end or start of a slit roll shall not be less than 100 ft for 500L, 60 ft for 1000L, 50 ft for 2000L and 3000L, 30 ft for 6000L, and 14 ft for 9000L.

**Table 3**  
**DuPont FEP Fluorocarbon Film Thickness Tolerance**

| Nominal Gauge                | Nominal Thickness, in | A   |         |         |        | B                       |         | C                                |        |        |
|------------------------------|-----------------------|---|---------|---------|--------|-------------------------|---------|----------------------------------|--------|--------|
|                              |                       | Average Thickness Unit Weight, g/m <sup>2</sup> |         |         |        | Single Point Thickness* |         | Area Factor, ft <sup>2</sup> /lb |        |        |
|                              |                       | Nom.  | Min.    | Max.    | % Var. | Min.                    | Max.    | Nom.                             | Min.   | Max.   |
| <b>Types: A, C, and C-20</b> |                       |   |         |         |        |                         |         |                                  |        |        |
| 50                           | 0.0005                | 27.28   | 24.55   | 30.01   | ±10    | 0.00035                 | 0.00065 | 178.97                           | 162.70 | 198.87 |
| 100                          | 0.0010                | 54.56   | 49.10   | 60.02   | ±10    | 0.00070                 | 0.00130 | 89.49                            | 81.35  | 99.43  |
| 175                          | 0.0017                | 95.48   | 85.93   | 105.03  | ±10    | 0.00130                 | 0.00220 | 51.14                            | 46.00  | 56.25  |
| 200                          | 0.0020                | 109.12  | 98.20   | 120.03  | ±10    | 0.00150                 | 0.00250 | 44.74                            | 40.67  | 49.72  |
| 300                          | 0.0030                | 163.68  | 147.31  | 180.05  | ±10    | 0.00225                 | 0.00375 | 29.83                            | 27.11  | 33.14  |
| 500                          | 0.0050                | 272.80  | 253.70  | 291.90  | ±7     | 0.00400                 | 0.00600 | 17.90                            | 16.72  | 19.25  |
| 750                          | 0.0075                | 409.20  | 380.55  | 437.84  | ±7     | 0.00622                 | 0.00877 | 11.93                            | 11.15  | 12.83  |
| 1000                         | 0.0100                | 545.60  | 507.40  | 583.79  | ±7     | 0.00850                 | 0.01150 | 8.95                             | 8.36   | 9.62   |
| 2000                         | 0.0200                | 1091.20   | 1014.82 | 1167.58 | ±7     | 0.01700                 | 0.02300 | 4.47                             | 4.18   | 4.81   |

**Type: L**

|       |        |          |         |          |     |        |        |       |       |       |
|-------|--------|----------|---------|----------|-----|--------|--------|-------|-------|-------|
| 500   | 0.0050 | 272.80   | 245.52  | 300.08   | ±10 | 0.0040 | 0.0060 | 17.90 | 16.27 | 19.89 |
| 1000  | 0.0010 | 545.60   | 491.04  | 600.16   | ±10 | 0.0085 | 0.0115 | 8.95  | 8.13  | 9.94  |
| 1500  | 0.0015 | 818.40   | 736.56  | 900.24   | ±10 | 0.0128 | 0.0173 | 5.97  | 5.42  | 6.63  |
| 2000  | 0.0200 | 1091.20  | 982.08  | 1200.32  | ±10 | 0.0170 | 0.0230 | 4.47  | 4.06  | 4.97  |
| 3000  | 0.0300 | 1636.80  | 1473.12 | 1800.48  | ±10 | 0.0255 | 0.0345 | 2.98  | 2.71  | 3.31  |
| 4500  | 0.0400 | 2455.20  | 2209.68 | 2700.72  | ±10 | 0.0383 | 0.0518 | 1.99  | 1.80  | 2.20  |
| 6000  | 0.0600 | 3273.60  | 2946.24 | 3600.24  | ±10 | 0.0540 | 0.0660 | 1.49  | 1.35  | 1.66  |
| 7500  | 0.0750 | 4092.00  | 368.28  | 4501.20  | ±10 | 0.0638 | 0.0863 | 1.19  | 1.07  | 1.31  |
| 9000  | 0.0900 | 4910.40  | 4419.36 | 5401.44  | ±10 | 0.0810 | 0.0990 | 0.99  | 0.90  | 1.10  |
| 12500 | 0.125  | 6820.00  | 6480.00 | 7160.00  | ±10 | 0.106  | 0.144  | 0.72  | 0.68  | 0.76  |
| 19000 | 0.190  | 10366.00 | 9885.00 | 10847.00 | ±10 | 0.161  | 0.218  | 0.47  | 0.45  | 0.49  |

Determined by using lowest and highest thickness readings of ten measurements across the film per ASTM D-374 Method A or C.

**Table 4**  
**Roll Width Tolerance, in**

| Gauge            | Web Width, in |       |        |
|------------------|---------------|-------|--------|
|                  | 1/2-15/16     | 1-6   | Over 6 |
| 50 and 100       | ±1/16         | ±1/16 | ±1/16  |
| 200 through 400  | ±1/16         | ±1/16 | ±1/16  |
| 500 through 1500 | ±1/16         | ±1/32 | ±1/16  |
| 2000             | ±1/16         | ±1/16 | ±1/16  |
| Over 2000        | ±1/8          | ±1/8  | ±1/8   |

**Note:** Variation in film width shall not exceed these limits.

**Table 5**  
**Property Value, Types A, C, C-20, and L**

| Property   | Film Gauge           |      |      |      |      |      |      |      |      | Method  |
|--|----------------------|------|------|------|------|------|------|------|------|---|
|  | 50                   | 100  | 200  | 300  | 500  | 750  | 1000 | 1500 | 2000 |   |
| Dielectric Strength, V/mil, AC                           | 4000                 | 4000 | 3500 | 3000 | 2500 | 2000 | 1800 | 1500 | 1400 | Average of ten samples tested per ASTM D-149 Method A. Flat sheets in air placed between 1/4 in diameter brass electrodes with 1/32 in edge radius and subjected to 60 Hz AC voltage rise at 500 V/sec to the break-down voltage. |
| Dielectric Constant (at 25°C, 1000 Hz) Max.              | 2.15                 |      |      |      |      |      |      |      |      | ASTM D-150. Result is average of five tests using measured sample thickness.  |
| Dissipation Factor (at 25°C, 1000 Hz) Max.               | 0.0003               |      |      |      |      |      |      |      |      | ASTM D-150, same as above.  |
| Volume Resistivity, ohm-cm at 170°C, Min.                | 1 × 10 <sup>17</sup> |      |      |      |      |      |      |      |      | ASTM D-257.   |
| Surface Resistivity, ohm (per sq.) at 23°C, 38% RH, Min. | 1 × 10 <sup>15</sup> |      |      |      |      |      |      |      |      | ASTM D-257.   |

**Table 6**  
**Property Value, Types A, C, and C-20**

| Property  | Film Gauge |      |      |      |      |      |      |      | Method  |
|---|------------|------|------|------|------|------|------|------|---|
|   | 50         | 100  | 200  | 300  | 500  | 750  | 1000 | 2000 |   |
| Tensile Strength, psi, 25°C, Min.                                     | 2000       | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | ASTM D-882 for ≤10 mil thickness. ASTM D-638 for >10 mil thickness. 2 in/min testing speed.   |
| Elongation at Break, %, Min.  | 175        | 200  | 250  | 250  | 250  | 250  | 250  | 250  | Same as above method.   |
| Shrinkage, %, Max. at 200°C   |            |      |      |      |      |      |      |      | Average of five measurements on room temperature samples before and after each test. Each specimen, 4 in × 4 in freely suspended in an oven controlled to 200°C ±1°C. Exposure time 0.5 hr. |
| MD  | ±5         | ±5   | ±3   | ±2   | ±2   | ±2   | ±2   | ±2   |   |
| TD  | ±5         | ±5   | ±3   | ±2   | ±2   | ±2   | ±2   | ±2   |   |
| Cementability (Type C film only), Min. peel strength in g/in of width | 170        | 300  | 750  | 800  | 2000 | 2000 | 3000 | —    | Use DuPont adhesive #68040 on Aldine #1200 aluminum sheet (0.019 in thickness). Peel Test at 180° angle at peel rate 12 in/min.   |
| Melt Temperature, Melting Endotherm Peak, °C                          | 260–280    |      |      |      |      |      |      |      | ASTM D-3418 (DTA).  |
| Density, g/cm <sup>3</sup> , 23°C                                     | 2.13–2.17  |      |      |      |      |      |      |      | ASTM D-1505.  |

**Table 7**  
**Property Value, Type L**

| Property                                     | Film Gauge |      |      |      |      |      |      |      |      |       | Method             |   |
|--|------------|------|------|------|------|------|------|------|------|-------|--------------------|---|
|  | 500        | 1000 | 1500 | 2000 | 3000 | 4500 | 6000 | 7500 | 9000 | 12500 |                    |   |
| Tensile Strength, psi, 25°C                  | 2500       | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 | 2500  | 2500               | ASTM D-882 for ≤10 mil thickness.<br>ASTM D-638 for >10 mil thickness.<br>2 in/min testing speed.   |
| Elongation, %, Min.                          | 250        | 250  | 250  | 250  | 250  | 250  | 250  | 250  | 250  | 250   | 250                | Same as above method.   |
| Shrinkage, %, Max. at 200°C                  |            |      |      |      |      |      |      |      |      |       |                    | Average of five measurements on room temperature samples before and after each test. Each specimen, 4 in × 4 in freely suspended in an oven controlled to 200°C ±1°C. Exposure time 0.5 hr. |
| MD   | ±2         | ±2   | ±2   | ±2   | ±4   | ±4   | ±4   | ±4   | ±5   | ±5    |                    |   |
| TD   | ±2         | ±2   | ±2   | ±2   | ±4   | ±4   | ±4   | ±4   | ±5   | ±5    |                    |   |
| Melt Temperature, Melting Endotherm Peak, °C | 260–280    |      |      |      |      |      |      |      |      |       | ASTM D-3418 (DTA). |   |
| Density, g/cm <sup>3</sup> , 23°C            | 2.13–2.17  |      |      |      |      |      |      |      |      |       | ASTM D-1505.       |   |

## **United States**

DuPont High Performance Films  
P.O. Box 89  
Route 23 South and DuPont Road  
Circleville, OH 43113  
Ordering Information:  
800-967-5607  
Product Information:  
800-237-4357  
Fax: 800-879-4481

## **Canada**

DuPont Canada, Inc.  
P.O. Box 2200, Streetsville  
Mississauga, Ontario, Canada  
L5M 2H3  
Inquiries: 905-821-5603  
Customer Service: 800-263-2742  
Fax: 905-821-5230

## **Latin America**

### ***Argentina***

DuPont Argentina  
Av. Mitre y Calle 5  
CP 1884, Berazategui, Argentina  
Pcia de Buenos Aires  
54-1-256-2435  
Fax: 54-1-319-4451

### ***Brazil***

DuPont do Brasil  
Al. Itapeturu, 506  
06454-080, Alphaville  
Barueri, Sao Paulo  
55-11-421-8689  
Fax: 55-11-421-8686

### ***Mexico***

DuPont S.A. de C.V.  
Homero 206  
Col. Chapultepec Morales  
Mexico, D.F. 11570  
525-722-1184  
Fax: 525-722-1370

## **Venezuela**

DuPont Venezuela  
Edificio "Los Frailes"  
Calle la Guarita  
Urbanization Chuao  
CP 1060, Caracas, Venezuela  
58-2-92-8547  
Fax: 58-2-91-5638

## **Europe**

DuPont de Nemours  
(Luxembourg) S.A.  
Contern  
L-2984 Luxembourg  
Grand Duchy of Luxembourg  
352-3666-5575  
352-3666-5000

## **Asia Pacific**

### ***Japan***

DuPont Kabushiki Katsha  
Arco Tower  
8-1, Shimomeguro 1-chome  
Meguro-ku, Tokyo 153  
Japan  
81-3-5434-6139  
Fax: 81-3-5434-6193

### ***ASEAN***

DuPont Singapore PTE Ltd.  
1 Maritime Square  
#07-01 World Trade Centre  
Singapore 099253  
65-279-3434  
Fax: 65-279-3456

## **Hong Kong/China**

DuPont China Ltd.  
1122 New World Office Bldg.  
East Wing  
Salisbury Road, Kowloon  
Hong Kong  
852-2734-5401  
Fax: 852-2721-4117

## **India**

DuPont South Asia Ltd.  
503-505, Madhava  
Bandra Kurla Commercial Complex  
Bandra (E)  
Bombay 400 051  
India  
91-22-6438255/6438256  
Fax: 91-22-6438297

## **Korea**

DuPont Korea Ltd.  
4/5th Floor, Asia Tower  
#726, Yeoksam-dong,  
Kangnam-ku  
Seoul 135-082, Korea  
82-2-222-5398  
Fax: 82-2-222-5476

## **Taiwan**

DuPont Taiwan Ltd.  
7, Tsu-Chiang 1st Road  
Chungli, Taoyuan  
Taiwan, ROC  
866-3-4549204  
Fax: 866-3-4620676



---

The information set forth herein is based on data believed to be reliable, but the DuPont Company makes no warranties express or implied as to its accuracy and assumes no liability arising out of its use by others. This publication is not to be taken as a license to operate under, or recommendation to infringe, any patent.

**Caution:** Do not use in medical applications involving permanent implantation in the human body. For other medical applications, see "DuPont Medical Caution Statement," H-50102.

