

# Daikin Neoflon<sup>®</sup> PFA

## Product Information Guide

Daikin PFA is a copolymer of tetrafluoroethylene (TFE) and perfluoroalkyl vinyl ether. DAIKIN Neoflon<sup>®</sup> PFA melting points range from 295 to 310°C. Compared to FEP, the copolymerization composition ratio of the comonomer content is small, and PFA has a chemical structure that is close to PTFE. Therefore, PFA has a higher melting point and higher heat resistance than FEP. Daikin PFA has excellent mechanical strength at high temperatures, and has excellent moldability for easy processing using extrusion, compression, blow, transfer, and injection molding methods.

Pellets

Daikin PFA pellets have good melt flow characteristics and can be processed in the same manner as other thermoplastic resins. The semiconductor grades (SH Series) have reduced elusion ions, and are used for various components for semiconductor manufacture lines where high purity is essential.

| Property                              | Test Method                                  | AP-201                                                                                          | AP-202                                      | AP-210                                  | AP-230             | AP-201SH                                                                           | AP-211SH                                                                     | AP-231SH            |
|---------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------|--------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------|
| Bulk Density (g/l)                    |                                              | 1200                                                                                            | 1200                                        | 1200                                    | 1200               | 1200                                                                               | 1200                                                                         | 1200                |
| Specific Gravity                      | ASTM D3307                                   | 2.14-2.15                                                                                       | 2.14-2.15                                   | 2.14-2.15                               | 2.14-2.15          | 2.14-2.15                                                                          | 2.14-2.15                                                                    | 2.14-2.15           |
| Melt Flow Rate (g/10min)              | ASTM D3307                                   | 20.0-30.0                                                                                       | 63.0-81.0                                   | 10.0-17.0                               | 1.5-2.5            | 20.0-30.0                                                                          | 10.0-17.0                                                                    | 1.5-2.5             |
| Melting Point °C                      | ASTM D3307                                   | 300-310                                                                                         | 300-310                                     | 300-310                                 | 300.310            | 300.310                                                                            | 300.310                                                                      | 300-310             |
| Continuous Service Temperature (°C)   |                                              | 260                                                                                             | 260                                         | 260                                     | 260                | 260                                                                                | 260                                                                          | 260                 |
| Mechanical                            |                                              |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
| Tensile Strength (MPa), min           | ASTM D3307                                   | 20                                                                                              | 20                                          | 25                                      | 30                 | 20                                                                                 | 25                                                                           | 30                  |
| Elongation (%), min                   | ASTM D3307                                   | 300                                                                                             | 230                                         | 300                                     | 300                | 300                                                                                | 300                                                                          | 300                 |
| Compressive Strength (MPa)            | ASTM D695<br>1% Deformation, 25°C            | 5-6                                                                                             | 5-6                                         | 5-6                                     | 5-6                | 5-6                                                                                | 5-6                                                                          | 5-6                 |
| MIT Flex, cycles                      | ASTM D2176                                   | 11,000                                                                                          | 5,300                                       | 20,000                                  | 600,000            | 11,000                                                                             | 120,000                                                                      | 2,700,000           |
| Electrical                            |                                              |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
| Dielectric Breakdown Strength (V/mil) | ASTM D149<br>Short time<br>1/8 in            | 500-600                                                                                         | 500-600                                     | 500-600                                 | 500-600            | 500-600                                                                            | 500-600                                                                      | 500-600             |
| Volume Resistivity (Ohm-cm)           | ASTM D257                                    | 10 <sup>18</sup>                                                                                | 10 <sup>18</sup>                            | 10 <sup>18</sup>                        | 10 <sup>18</sup>   | 10 <sup>18</sup>                                                                   | 10 <sup>18</sup>                                                             | 10 <sup>18</sup>    |
| Dielectric Constant                   | ASTM D150                                    |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
|                                       | 10 <sup>3</sup>                              | 2.1                                                                                             | 2.1                                         | 2.1                                     | 2.1                | 2.1                                                                                | 2.1                                                                          | 2.1                 |
|                                       | 10 <sup>6</sup>                              | 2.1                                                                                             | 2.1                                         | 2.1                                     | 2.1                | 2.1                                                                                | 2.1                                                                          | 2.1                 |
| Dielectric Dissipation Factor         | ASTM D150                                    |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
|                                       | 10 <sup>3</sup>                              | 1x10 <sup>-5</sup>                                                                              | 1x10 <sup>-5</sup>                          | 1x10 <sup>-5</sup>                      | 1x10 <sup>-5</sup> | 1x10 <sup>-5</sup>                                                                 | 1x10 <sup>-5</sup>                                                           | 1x10 <sup>-5</sup>  |
|                                       | 10 <sup>6</sup>                              | 3x10 <sup>-4</sup>                                                                              | 3x10 <sup>-4</sup>                          | 3x10 <sup>-4</sup>                      | 3x10 <sup>-4</sup> | 3x10 <sup>-4</sup>                                                                 | 3x10 <sup>-4</sup>                                                           | 3x10 <sup>-4</sup>  |
|                                       |                                              |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
| Combustibility(%)                     | ASTM D2863/<br>Oxygen<br>Concentration Index | >95                                                                                             | >95                                         | >95                                     | >95                | >95                                                                                | >95                                                                          | >95                 |
|                                       |                                              |                                                                                                 |                                             |                                         |                    |                                                                                    |                                                                              |                     |
| Process Methods                       |                                              | Extrusion Injection                                                                             | Extrusion                                   | Extrusion Injection                     | Extrusion          | Injection                                                                          | Extrusion Injection                                                          | Extrusion Injection |
| Uses                                  |                                              | Complicated injection molded parts requiring high melt flow to fill, thin wall wire insulations | Good insulation for micro wire applications | Injection molded parts, wire insulation | Linings, tubing    | Good fluidity, suited to making moldings of complex shapes requiring high fluidity | Tubing & injection molded parts requiring high stress crack resistance, etc. | Linings, tubings    |

Polymer Processing of Daikin PFA Pellets

Molding

PFA can generate traces of highly corrosive gas when it decomposes at the molding temperature, requiring materials of construction with outstanding corrosion and heat resistance for extrusion and injection-molding equipment used for molding.

Extrusion Molding

In extrusion, covered electrical wire, pipe, tubing, monofilament, film, etc. can be formed by extrusion. Extruders with a cylinder diameter from 30 to 65 mm are most commonly used. A rapid compression type screw with an L/D ratio of 20 to 24 and compression ratio of 2.5 to 3.0 is also used.

Injection Molding

DAIKIN PFA has good injection moldability and can easily mold complicated profiles, such as semiconductor manufacturing jigs, electrical and electronic components. A screw-type molding machine is generally used, and the spool, runner, and gate must be made slightly thicker than normal, as short as possible, and have the cross section nearly circular to reduce molding strain. Hard chromium-plated dies are generally used.

Transfer Molding

Pipe, valves, joints, and other linings for the chemical industry, brewing industry, etc. can be formed by transfer molding PFA. Components subject to lining processing, such as pipes and valves, are used for the outer die or inner die, and are heated to temperatures that exceed the melting point. PFA resin that has been separately melted inside the cylinder is pressure-fed into the components and cooled while under pressure. Components can be molded at die temperatures of 350 to 370°C and resin temperatures of 350 to 390°C.

Dispersions

Neoflon PFA dispersions are water-based coatings with bases of co-polymers of tetrafluoroethylene and perfluoroalkylvinylether.

| Product No. | Color        | Viscosity (Cp) | pH     | Solid Content (%) | Uses                                                                                               |
|-------------|--------------|----------------|--------|-------------------|----------------------------------------------------------------------------------------------------|
| AD-2CRER    | White, milky | 140-260        | 8-10   | 50                | Dispersion makes pinhole free films with non-stick properties                                      |
| AW-5000R    | White, milky | 15-65          | 7.5-11 | 47                | Films with excellent abrasion resistance and non-stick properties. Used in printers and copy rolls |

Coating Powders

| Product No. | Color | Bulk Density | Description                                 | Processing Methods                                    |
|-------------|-------|--------------|---------------------------------------------|-------------------------------------------------------|
| AC-5600     | White | 500          | Up to a thickness of 100 μm per single coat | Electro-static spray coating<br>Fluidized bed coating |
| AC-5539     | Gray  | 500          | Multiple coats, up to 1,000 μm              | Roto molding, Roto lining                             |
| AC-5820     | White | 830          | 0.5-5.0mm thickness                         | Roto lining                                           |
| AC-5830     | Gray  | 850          | 0.5-5.0mm thickness                         | Roto lining                                           |
| ACX-31      | White | 750          | 30-80 μm thickness                          | Electro-static spray coating                          |
| ACX-34      | White | 700          | 30-80 μm thickness                          | Electro-static spray coating                          |

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## Daikin Neoflon® PFA Properties

### Thermal Properties:

Due to the high bonding strength of the carbon, fluorine, and oxygen atoms, PFA demonstrates nearly the same outstanding capabilities as PTFE in temperatures ranging from -200°C to 260°C. From 200°C to 260°C, PFA maintains its flexibility without a loss of toughness. The maximum continuous use temperature for PFA is 260°C (500°F). This is the highest temperature for continuous use of any fluoropolymer resin.

### Chemical Properties:

Daikin PFA provides excellent chemical resistance.

### Electrical Properties:

A low dielectric constant and dissipation factor exist along with high dielectric breakdown strength over a wide range of frequencies and temperatures.

### Low Friction:

Daikin PFA is inherently non-cohesive and it is extremely repellent of water, oil and other substances. Furthermore, its surface is characteristically slippery.

### Quality/Regulatory:

Daikin PFA pellets comply with the requirements set forth in FDA specification 21 CFR.177.1550. Daikin America's manufacturing facility is registered to ISO-9001 (Quality System), ISO-1400 (Environmental System) and Responsible Care 14001 (Safety, Health, Environment and Security).

### Safety:

When PFA resins are heated to temperatures above 300°C, some decomposition products may be given off. These decomposition products may be harmful, and inhalation of these fumes must be avoided. Ovens, process equipment and working area must be adequately ventilated. For further information, please refer to the material safety data sheet for these products and the *Guide to the Safe Handling of Fluoropolymer Resins* published by SPI Inc., The Society of Plastics Industry, Inc., 1801 K Street, NW, Suite 600K, Washington, DC, 20006-1301 (202-972-5200).

### Medical Use:

These products are not specifically designed or manufactured for use in implantable medical and/or dental devices. They have not been tested for such applications and will only be sold for such use pursuant to contract containing specific terms and conditions required by us.