DuPont™ Teflon® AF

Amorphous Fluoroplastic Resin

Adhesion Information

Typical Procedure

Teflon® AF is a family of amorphous copolymers of perfluoro (2,2-dimethyl-1,3-dioxole) (PDD) and tetrafluoroethylene (TFE). The perfluorinated Teflon® AF polymers possess the same outstanding chemical resistance, thermal stability, electrical, and mechanical properties as other Teflon® fluoroplastics. In addition, because they are amorphous, Teflon® AF fluoroplastics possess outstanding optical properties, have high gas permeability, and are soluble at room temperature in selected perfl uorinated solvents. This combination of properties makes Teflon® AF well suited for use in optics, electronics, chemical protection, membrane separation process, and semiconductor processing applications. Typical properties are shown in Table 1.

Adhesion

Teflon® AF perfluorodioxole copolymers are essentially nonpolar, contain no reactive chemical functionality, and are highly resistant to chemical attack. Thus, adhesion to various substrates depends primarily on physical, rather than chemical, interactions. Specific strategies for adhering Teflon® AF depends on three factors:

- The nature of the substrate;
- The degree to which the substrate can be modified; and
- The degree of adhesion required.

Metals

Teflon® AF adheres relatively well to metals, such as titanium, aluminum, and electrolytic copper. Before attempting to adhere Teflon® AF to metal, either from solution or by melting under pressure, verify that the metal surface is free of dirt, weakly adhering oxide layers, grease, or other organic contaminants. Surface roughening of the metal, such as by grit blasting or chemical etching, increases surface area and enhances adhesion. If Teflon® AF is applied from solution, post-application baking (described later in this document) will improve adhesion.

Glass or Silicon

Adhesion of Teflon® AF to glass or silicon is more difficult because it is usually undesirable to etch these substrates. However, studies have shown that adhesion can be improved by first treating the glass or silicon surface with a fluorosilane,* then coating with Teflon® AF, and finally baking using the procedure described below.

Plastics

Adhesion of Teflon® AF to plastics depends primarily on the type of plastic, whether or not it can be surface roughened, and whether or not it can withstand the baking procedure described below. Functionalization of the plastic surface with fluorine-containing groups, when possible, should enhance adhesion.

Baking Procedure to Improve Adhesion

WARNING!
VAPORS CAN BE LIBERATED THAT MAY BE HAZARDOUS IF INHALED.

Before using Teflon® AF amorphous fluoroplastic, read the Material Safety Data Sheet and the information in the "Guide to the Safe Handling of Fluoropolymer Resins," latest edition published by the Fluoropolymers Division of The Society of the Plastics Industry (www.fluoropolymers.org); copies may be obtained from your DuPont representative.

Handling Practices

Teflon® AF resins contain parts per million of residual hexafluoroacetone (HFA). Because HFA hydrates are readily absorbed through the skin it is necessary to avoid skin contact with the resin during processing. DuPont recommends the use of protective gloves when handling resin during manufacturing operations.

Residual gases (including HF, COF_2, CO, and HFA) that diffuse from Teflon® AF resins even at room temperature may be harmful. To avoid exposure, all resin containers should be opened and used only in well-ventilated areas using local exhaust ventilation (LEV).

1. When applying Teflon® AF from solution, air dry the coated substrate for 5 to 10 min at 25 to 50°C (77 to 122°F) to remove most of the solvent. The time required for this solvent removal will increase with the thickness of the coated layer and the boiling point of the solvent. Thick layers may require longer times at lower temperatures to avoid skinning and bubble formation.
2. Bake the coated substrate at 10°C (18°F) above the boiling point of the solvent for 5 to 10 min. At this point, less than 1% of the solvent remains.
3. Because Teflon® AF is a high molecular weight polymer, complete removal of solvent can take a long time, unless the polymer is heated above its glass transition temperature (Tg). To remove the last trace of solvent, heat the coated substrate to 5°C (9°F) above the Tg of the polymer (i.e., 165°C (329°F) for Teflon® AF 1600; 245°C (473°F) for Teflon® AF 2400) for 5 min.
4. For maximum uniformity of coating thickness and enhanced adhesion, heat the coated substrate to 330°C (626°F) for 10 to 15 min. This permits the polymer to spread uniformly over the substrate and level any hills or valleys formed during the drying process.

Note: Although this step can be used for most metals, glass, and silicon, it is probably not feasible for use with most plastics.

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Table 1
Typical Property Data for DuPont™ Teflon® AF Resins

Property	ASTM Test Method	Unit	Value
Optical			
Effective Transmission, IR-UV	—	%	>95
Transmission	D1003	%	>95
Refractive Index	D542	—	1.29–1.31
Mechanical			
Tensile Modulus	D638	MPa	950–2,150
Elongation at Break	D638	%	3–40
Tensile Strength	D638	MPa	25–27
Water Absorption	D570	%	<0.01
Electrical			
Dielectric Constant	D150	—	1.89–1.93
Dissipation Factor	D150	—	0.000073–0.00035
Thermal			
Linear Thermal Expansion Coefficient	E831	ppm/°C	80–100
Thermal Stability	—	°C (°F)	360 (680)
Glass Transition Exposure	D3418	°C	Up to 240°C

This product is manufactured with technology that meets the goals of the U.S. Environmental Protection Agency (EPA) 2010/15 PFOA stewardship program. See www.fluoropolymers.dupont.com for more details.

For more information, visit www.teflon.com/industrial

For sales and technical support contacts, visit www.teflon.com/industrialglobalsupport

HOW TO USE THE DUPONT™ TEFLON® BRAND NAME WITH YOUR PRODUCT

Teflon® is a registered trademark of DuPont for our brand of fluoroplastic resins. Customer use of the Teflon® brand name must be licensed by DuPont in association with approved applications. Without a license, customers may not identify their product with the DuPont™ Teflon® brand name.

Unlicensed customers may refer to the DuPont product offering when used as an ingredient in their products by the DuPont product code number and generic descriptor. In this instance, when the product offering is to be sold and used without a license, the customer may refer to the ingredient as **DUPONT™ AF** resin.

If you are interested in applying for a trademark licensing agreement for the DuPont™ Teflon® brand, please contact us at (800) 207-0756 in the US or (302) 996-7906 (outside of the US).

CAUTION: Do not use DuPont materials in medical applications involving permanent implantation in the human body or contact with bodily fluids or tissues unless the material has been provided from DuPont under a written contract that is consistent with DuPont policy regarding medical applications and expressly acknowledges the contemplated use. For further information, please contact your DuPont representative. You may also visit www.teflon.com/industrial to download a copy of the "DuPont POLICY Regarding Medical Applications" H-50103 and "DuPont CAUTION Regarding Medical Applications" H-50102.

For medical emergencies, spills, or other critical situations, call (800) 441-7515 within the United States. For those outside of the United States, call (302) 774-1000.

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