

# New Grades of Polyvinylidene Fluoride for Wire & Cable Applications

by:

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**These PVDF resins are used to insulate and jacket both copper and fiber cables as well as for tubes and other structural members that are inside cable constructions.**

Polyvinylidene Fluoride (PVDF) is a thermoplastic material in the fluoropolymer family that is generally used in applications requiring high purity, high strength, excellent solvent and chemical resistance and exceptionally low smoke and flame properties. Kynar® and Kynar Flex® resins are polyvinylidene fluoride homopolymers and copolymers that are used in many wire and cable applications. Kynar and Kynar Flex resins are used to insulate and jacket both copper and fiber cables as well as for tubes and other structural members inside cable constructions.

Kynar PVDF and Kynar Flex PVDF inherently are self-extinguishing, exhibit low-smoke properties, have high limiting oxygen index (LOI), have excellent electrical properties and provide exceptional abrasion and chemical resistance making them well suited for high-performance cables. Kynar and Kynar Flex resins can be crosslinked by e-beam for producing cables used in high-temperature environments and when cold flow resistance is important.

The Kynar and Kynar Flex PVDF line has grown along with the wire and cable market with over 50% of all products offered specifically tailored for wire and cable markets. Arkema Inc. continues to support the wire and cable industry by updating its portfolio of products to ensure that the ever-changing needs of this industry are addressed.

## Kynar® PVDF and Life Safety – Foaming Technology

The wire and cable market is a dynamic market with new products being developed continuously. To support these new requirements, it has been necessary to produce Kynar PVDF grades with tailored properties to meet these changing requirements.

A historically large application for Kynar grades has been with fire alarm cables or more specifically, fire alarm cables meeting the requirements for New York City, known as “Local Law 5” or “LL5” cables.

LL5 fire alarm cables are typically produced using only fluoropolymers to meet the 150°C minimum temperature rating required under the specification. Over the years, this market has become quite competitive, with producers of fire alarm cables focused on cost reduction. To allow manufacturers to make LL5-compliant cables at a reduced cost, Arkema Inc. has developed new foam concentrates to reduce the material used in these cables.

KYNAR® Fluoropolymer Physical Property Data*								
Property**	Superflex® 2500-20	Flex® 2750-01 2950-05	Flex® 2800-20 2900-04	Flex® 2800-00 2850-02 2850-07	Flex® 3120-10 3120-15 3120-50	450 460	710 720 740	Ultraflex® B
Notched Izod Impact Strength (ft-lbs/in)	No break	No break	No break	>2.0	>8.0	>2.0	>1.8	No break
Tensile Strength @ yield (MPa)	12-19	14-21	20-34	31-41	24-34	34-52	45-55	5-7
Tensile Stress @ break (MPa)	14-31	20-27	17-34	27-48	34-48	31-48	38-55	20-30
Elongation @ break (%)	500-800	200-400	100-300	30-200	300-550	50-250	20-100	>600
Flexural Modulus (MPa)	190-280	280-420	620-830	1030-1240	620-830	1380-1790	1660-2310	70-90
Melting Point (C)	117-125	130-138	140-147	155-160	161-168	155-160	165-172	97-104
Specific Gravity	1.80	1.79	1.78	1.78	1.78	1.77	1.77	1.81

\* - Values are general properties and vary according to sample preparation.

\*\* - Type IV tensile coupons were tested according to ASTM D 638 with a crosshead travel of 2.0 in/min, and elongation was tested using a high-resolution digital extensometer. Flexural modulus was tested according to ASTM D 790 using ¼ inch specimens and a crosshead travel of 0.1 in/min. Impact strength was tested according to ASTM D 256 using ¼ inch specimens

The foaming process developed uses a foamed masterbatch capable of 20% to 30% weight reduction with a 3% to 4% concentrate addition. Beyond cost reduction, additional benefits of foaming include better flexibility and weight reduction while maintaining good abrasion resistance. The use of foaming technologies is useful in markets outside of LL5, with interest in fiber optics where again, increased flexibility is desired.

Other markets including coaxial cables, shielded category cables and other nonplenum wire and cable applications, could find foaming to be useful as a cost reduction measure in the future.

## Continued Innovation

Industrial cable markets asked for a flexible grade with a high melting point that could achieve a true 150°C UL temperature rating. In response, Arkema Inc. introduced the copolymer version of the popular Kynar 700 series homopolymer, which has led to the introduction of the Kynar Flex 3120 series.

There are three grades within the Kynar Flex 3120 family. These include Kynar Flex 3120-50, which is a high-viscosity grade recommended for compounding and applications requiring E-beam radiation cross-linking; Kynar Flex 3120-15, which is a low-viscosity, flame-retardant grade for high-speed primary and jacket material for plenum applications requiring a 150°C temperature rating; and Kynar Flex 3120-10, which is a grade similar to Kynarflex 3120-15, but without the flame-retardant package while useful for nonplenum wire

and cable applications.

The capability for Kynar resins to be cross-linked through the use of e-beam radiation is an important attribute for the wire and cable industry. The Kynar Flex 3120-50 grade as well as other higher-viscosity grades have found favor as materials of choice for high-temperature cross-linked cables. Kynar Flex 3120-50 provides the benefits of a higher melting point typical of homopolymers while also providing the flexibility of a copolymer. Temperature ratings as high as 175°C have been obtained with Kynar Flex 3120-50 after cross-linking.

Additionally, Arkema's Kynar Flex 3120-50 grade has been found to be useful for the production of heat-shrink tubing, cathodic protection cable, industrial cable and automotive wiring.

The evolution of Kynar resins has continued to grow over the years. Arkema has expanded the product line to include Kynar Superflex® and Kynar Ultraflex® resins, which are suitable for wire and cable applications requiring the softest jacket properties.

The Kynar Superflex 2500 resin offers a flexural modulus of 31 Kpsi and the Kynar Ultraflex has the softest properties with a flexural modulus of 12 Kpsi. Both of these products can be used individually to produce ultra-flexible cables or can be melt blended with other Kynar grades to combine useful properties such as higher melting point and increased flexibility.

## Final Thoughts

By listening to the needs of wire and cable producers, the end users of the various cable products available and the regulatory community, a polymer supplier can continue to introduce product advancements. Cost reduction, increased productivity and physical property improvements are the key targets, but innovation is not limited to these areas.

What started as one PVDF product (Kynar 460) has evolved into a series of copolymers designed to increase wire flexibility, foaming technology that reduces product cost and weight and elastomeric technology that allows blending to reach a combination of properties that otherwise would not be available or affordable in previous product offerings.

To receive additional technical specifications on the Kynar and Kynar Flex lines, visit the website listed below.

[www.kynar.com](http://www.kynar.com)

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### Company Profile:

*Arkema of France is a world-class producer of industrial chemicals including acrylic monomers, emulsion systems, fluorochemicals, functional additives, hydrogen peroxide, PMMA, technical polymers and thiochemicals. In North America, Arkema Inc., a subsidiary of Arkema, employs 2400 people and operates 32 facilities in the USA, Canada, Mexico and Brazil.*

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