



General Product Information



Nucrel®

ethylene acid copolymer resin

Description

Nucrel® resins from DuPont are tough, light-weight, easily processible ethylene copolymers. *Nucrel*® is inherently flexible without plasticizers. *Nucrel*® offers the flexibility of ethylene-vinyl acetate (EVA) copolymers, plus performance advantages over EVA resins of similar flex modulus. They can be pigmented, painted or plated, and can be UV-stabilized for exterior applications.

Applications/Grades

Nucrel® resins are used in molded or extruded parts requiring unique combinations of flexibility and tensile strength, low temperature impact and adhesion. They are also useful as modifiers and concentrate carriers. A variety of *Nucrel*® grades are available with varying methacrylic acid contents and melt indices.

Chemistry

Nucrel® acid copolymers are produced chemically by the high-pressure polymerization of ethylene and methacrylic acid in the presence of free radical initiators. This method of polymerization produces a branched, random ethylene methacrylic acid copolymer (EMAA).

The carboxyl groups on adjacent molecules interact and form a weak cross-linked network through hydrogen bonding. This produces copolymers with excellent toughness whose total property package is dependent on the acid content, molecular weight and the extent of short and long chain branching.

Properties

The carboxyl groups disrupt the linearity of the polyethylene backbone. This interferes with chain alignment and reduces the total crystallinity, as in the case of other ethylene copolymers, such as ethylene-vinyl acetate or ethylene methyl acrylate copolymers. *Nucrel*® copolymers have, as a result, lower melting points, stiffness and tensile yield strength in proportion to the acid comonomer content. In addition, the carboxyl functionality contributes to improved adhesion and toughness, with good adhesion to foil, paper, glass, aluminum, and other metals. The degree of adhesion is related to the acid comonomer content. The acid functionality allows the polymers to form very strong bonds to polar substrates. These bonds withstand a variety of aggressive environments. In addition to its excellent adhesion properties, *Nucrel*® has good mold flow and a molding cycle time slightly longer than polyethylene.

Toughness, measured by impact resistance, is outstanding compared with LDPE. This increases with acid content and is maintained at low temperatures.

Environmental stress crack resistance of *Nucrel*® copolymers increases with increasing acid content and is superior to LDPE of equivalent molecular weight. Adding the polar comonomer improves resistance to grease and oils.

Nucrel® offers tensile strength as high as 25 MPa (3,600 psi); and it performs well at low temperatures, exhibiting tensile impact up to 945 kJ/m² (450 ft·lb/in² at -40°C (-40°F)).

Lightweight *Nucrel*® is up to 30 percent lighter than polyvinyl chloride (PVC) compounds. In its natural state it has a low specific gravity of 0.94 g/cm³, but *Nucrel*® resins can be foamed for even greater weight savings.

In summary, *Nucrel*® copolymers offer a unique combination of properties:

- Flexibility, eliminating the need for plasticizers. No migration problems, no embrittlement
- Excellent durability and weatherability
- Excellent low temperature impact
- Low resin specific gravity
- Direct adhesion to treated glass eliminates the need for an adhesive
- Lightweight
- Can be painted and pigmented
- Foamable

Processing

Processing conditions for *Nucrel*® copolymers are generally similar to those used with low density polyethylenes. However, the presence of the acid function in the copolymer differs specifically from LDPE. The polymeric acids are somewhat corrosive to metals, particularly mild steels. Because of the presence of the methyl group, EMAA resins are more thermally stable than the more common acrylic acid copolymers. All are more subject to cross-linking and gel formation than LDPE because reaction of the carboxyl groups forms anhydrides at elevated temperatures. The degree of corrosion and gel formation increases with increasing acid content, higher processing temperature, and longer residence time in the processing equipment. Consequently, process equipment exposed to acid copolymers should be constructed of corrosion resistant metals or protected from corrosion by chrome or nickel plating. Melt temperature should be as low as possible consistent with the production of a quality product. Melt temperature may be varied over the range of 150°C to 260°C (302°F to 446°F). Typical processing ranges are shown in Table 1.

Nucrel® copolymers usually will be introduced into processing equipment behind low density polyethylenes. It is preferable to transition from a higher melt index LDPE to a lower melt index acid copolymer. Conversely, an acid copolymer should be purged with LDPE of a lower melt index than the copolymer. Because of the long heat history involved in shutdown and heat-up procedures, processing equipment should never be shut down on acid copolymers.

Safe Handling

A Product Safety Bulletin and Material Safety Data Sheet are available by calling our toll-free number, or by contacting a DuPont Regional Sales Office.

FDA Status

Please be advised that EMAA and EAA are not covered by the same regulation. Ethylene methacrylic acid resins conform to the U.S. Code of Federal Regulations, Title 21, paragraph 177.1330, covering their use as a food contact surface subject to the extractives limitations on the finished food contact articles as described in the regulation.

Ethylene acrylic acid resins conform to the U.S. Code of Federal Regulations, Title 21, paragraph 177.1310, covering their use as a food contact surface subject to the extractive limitations on the finished food contact articles as described in the regulation.

Europe: *Nucrel*® resins are in compliance with all European food contact regulations and hence can freely be used for the manufacture of material and articles intended to come into contact with food-stuffs subject to the migration and organoleptics limitations given.

Nucrel® resins containing additives have to be examined on a case-by-case basis. Please contact your DuPont representative, who can supply to you the necessary regulation statement.

Table 1
Barrel Melt Temperature Range for Extruding *Nucrel*® Resins, °C (°F)

Barrel Zones				Front	Head and Adaptor	Die	Desired Nominal Melt Temperature
Rear*	Rear Center	Center	Front Center				
150 (302)	150 (302)	150 (302)	150 (302)	150 (302)	150 (302)	150 (302)	150 (302)
150 (302)	175 (347)	150 (302)	175 (347)	175 (347)	175 (347)	175 (347)	175 (347)
150 (302)	175 (347)	200 (392)	200 (392)	200 (392)	200 (392)	200 (392)	200 (392)
150 (302)	200 (392)	230 (446)	230 (446)	230 (446)	230 (446)	230 (446)	230 (446)



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We welcome and respond promptly to [e-mail](#).

The technical data contained herein are guides to the use of DuPont resins. The advice contained herein is based upon tests and information believed to be reliable, but users should not rely upon it absolutely for specific applications because performance properties will vary with processing conditions. It is given and accepted at user's risk and confirmation of its validity and suitability in particular cases should be obtained independently. The DuPont Company makes no guarantees of results and assumes no obligations or liability in connection with its advice. This publication is not to be taken as a license to operate under, or recommendation to infringe, any patents.

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.