NORDEL™ MG Hydrocarbon Rubber

NORDEL™ IP and NORDEL™ MG Handling Guide and FDA Status

A number of different types of NORDEL™ Hydrocarbon Rubber are available commercially. These products are based on ethylene, propylene and ethylidene norbornene and are sold under two designations: NORDEL™ IP and NORDEL™ MG. All are members of the broad family of EPDM polymers. NORDEL IP is made in a solution process and is sold in a bale form or as a free flowing pellet with polyethylene dust as a partitioning agent. NORDEL MG is made in a gas phase process and is sold in granular form. A general purpose high structure furnace carbon black (GPF-HS), also designated as N-650 by ASTM, is incorporated onto the surface of the polymer particles and acts as a partitioning agent.

Raw Polymer Handling

Some types of NORDEL IP are supplied in pelletized form and NORDEL MG in granular form. Pouring or conveying pellets or granular material may cause static ignition hazards. In addition, NORDEL IP pellets are coated with polyethylene dust which is combustible. Use proper grounding when transferring pellets or granules to minimize risk of static ignition. Refer to the National Fire Protection Association (NFPA) RP77 “Recommended Practice on Static Electricity” for guidance in reducing the fire hazards associated with static electricity.

Both NORDEL IP and NORDEL MG are packaged in inclusion bags to allow the product to be added to the mixer without opening the bag if the polymer is mixed at sufficiently high temperature (e.g. >110°C). This innovation allows the elimination of much of the packaging waste and reduces the opportunity for contamination and housekeeping problems. Consult your Dow technical representative to determine the exact characteristics of the packaging available for the product you are interested in.

The other types of NORDEL IP are supplied in compact bales for which static discharge normally is not a factor. Bales are also packaged in inclusion film.

Before use, refer to the most current Material Safety Data Sheet (MSDS), available from your Dow customer service representative.

Acute Oral Toxicity

Oral LD50 has not been determined. Based on tests conducted on similar products, it is currently understood that oral toxicity is very low, on a single dose basis.

Inhalation Toxicity

The polymer contains traces of ethylidene norbornene (ENB) which may be released during storage and processing. ENB is moderately toxic with an LD50 of 732 ppm/4H (inhalation, mouse). Under normal storage and processing conditions with adequate ventilation and exhaust, the ACGIH TLV-C for ENB should not be reached. Exposure to ENB vapors may cause irritation of the respiratory tract, with symptoms such as nasal discomfort and discharge, and coughing possibly accompanied by chest pains, headache or dizziness. Eye contact with ENB vapor may be irritating.

Fumes may evolve during hot processing of compounds of NORDEL IP and NORDEL MG that may irritate eyes, nose and throat. Polymer dust may cause irritation to the upper respiratory tract. Overexposure to carbon black by inhalation may include irritation of the nose, throat and lungs, along with cough, difficulty breathing or shortness of breath.

1Currently the TLV-C value is 5 ppm. Always check the current Dow MSDS for current TLV-C value.
Skin Contact
The polymer could be slightly irritating to skin. Skin absorption is unlikely due to the physical properties of NORDEL™ IP. NORDEL™ MG uses carbon black partitioning agent. The product is not particularly dusty as the carbon black adheres to the polymer but under some circumstances it is possible for carbon black exposure to occur.

If particles from carbon black come in contact with the eye, mechanical irritation with tearing, pain or blurred vision may result.

Carbon Black Toxicology Review and Exposure Guidelines
Significant skin permeation and systemic toxicity appears unlikely. We are currently unaware of any human sensitization reports on carbon black.

Epidemiological studies demonstrate no significant risk of human cancer from exposure to carbon black. While some reports cite an increased incidence of pulmonary abnormalities, such as decreased pulmonary function and radiological changes among carbon black workers, other reports show no correlation between exposure and effects on pulmonary function or disease.

Increased susceptibility to the effects of carbon black may be observed in persons with pre-existing disease of the lungs. Carbon black is listed as an IARC 2B carcinogen.

Exposure guidelines for carbon black are 3.5 mg/m³, 8-hr TWA (OSHA and ACGIH) and 0.5 mg/m³, 8- and 12-hr TWA.

For further details consult the current Dow MSDS.

Thermal and Oxidative Degradation
NORDEL IP and NORDEL MG products have been stabilized to allow the use of normal operating and curing temperatures. Abnormally high temperatures, particularly in the presence of oxygen can lead to degradation. The main decomposition products are anticipated to be carbon monoxide, carbon dioxide, organic fragments and their oxidation products. Laboratory tests at temperatures of 170°C indicate that exothermic reactions start in approximately 15 minutes. In the absence of oxygen the product is stable to much higher temperatures, but temperatures greater than 200°C should be avoided to prevent thermal decomposition.

Possibility of Fire When Blending EPDM Polymers
EPDM polymers, such as NORDEL IP and NORDEL MG, may evolve low-molecular weight polymer fragments or other volatiles. If ventilation in the mixer is poor, combustible vapor could accumulate in the air space of an internal mixer during mastication or blending. The possibility of fire exists if ventilation in the mixer is poor and higher than recommended temperatures are reached in the mixer. The potential for a fire is minimized by maintaining mixing temperatures below 199°C, by providing good ventilation in the mixer and the processing area, and by maintaining good static control.

Storage and Handling
The quality of EPDM products may be affected by exposure to artificial or natural light that contains UV radiation. These products should be stored indoors in their original packaging and out of direct sunlight. If it is necessary to remove part of the contents of the package, protect the remaining product with a light-blocking material. NORDEL IP and NORDEL MG grades are best stored under low humidity conditions, away from direct sunlight and sources of UV radiation, and at temperatures below 35°C. Extended storage and/or exposure to a source of UV radiation may cause the polymer to cross-link and form gel. When in doubt, Mooney viscosity measurement is a good indicator of storage stability. NORDEL MG is less prone to UV light exposure effects due to the carbon black partitioning agent.
Laboratory testing and formulation of NORDEL™ MG

Due to possible size segregation of NORDEL MG products during shipment, materials for laboratory evaluations should be homogenized or riffled* to ensure that a representative sample is obtained. A representative sample containing all particle sizes is important because, while polymer Mooney and composition are similar for the large and small particles, the carbon black content is not. In general the larger particles have significantly lower carbon black than the smaller ones. Contact your technical representative if you have any questions about using the best techniques to get a representative sample for testing. Laboratory sized quantities are available on request.

The carbon black level in NORDEL MG products varies by grade from 15 to 35 phr (the actual amount is minimized but varies due the inherent “stickiness” of the polymer during production). The carbon black level is reported on the certificate of analysis and must be factored into the formulation. The variability of carbon black in a given lot of material is relatively low as produced with a variability of less than ± 2 phr. Some segregation does occur as the product is packaged but our experience has shown that the variation is low enough that compound properties are slightly affected. The properties of cured compounds are likely to be less than 5% even with extremes in carbon black variations within a lot.

Warehouse Stacking

Various available packaging options have different stacking requirements: Flexible Intermediate Bulk Containers (FIBCs) can be stacked only one high. The free flowing pellet and granular products packaged 40 bags to a pallet and stretch wrapped also can only be stacked one high. Bulk boxes of semi-crystalline NORDEL™ IP can be stacked 3 high. Amorphous products (or pelletized product that is partially compacted) packaged in boxes can be stacked 2 high.

Compounding of NORDEL

The pellet versions of NORDEL IP and NORDEL MG require slightly higher fill factors at the beginning of the mixing cycle, as the effective bulk density of the compound is lower vs. bale rubber. Fill factors in the range of 75–80% are found to be suitable for single pass mixing. Ram pressure is also important, as efficient packing of the material is necessary in the mixing chamber at the beginning of the mixing cycle. A 5 bar ram pressure is found to be suitable. The mixer body temperature should be 70°C or higher to be above the low temperature melting peak (typically 50–60°C) for semi-crystalline polymer. Loading rpm should be low, followed by high rpm for the actual mix cycle. Upside down mixing is recommended for granular rubber mixing.

Faster mixing is possible with the pelletized NORDEL IP product and particularly with the granular form of NORDEL MG. Significant savings in processing costs is possible with NORDEL MG due to the faster and lower energy mixing. Another advantage of the better mixing of the NORDEL MG is the possibility of single pass mixing which could potentially cut processing costs even further.

Compounding Ingredients

Many compounding ingredients and techniques (e.g., mixing time, temperature) are employed during conversion of NORDEL IP and NORDEL MG Hydrocarbon Rubbers to end-products. These may alter the toxicity as well as the handling precautions for the product during intermediate stages or in its finished form. Even when no danger from individual compounding ingredients exists, there is no assurance that a combination of these ingredients will be equally nonhazardous. Consequently, it is the responsibility of each user to determine whether techniques, processes, and additives comply with government regulations and are safe with respect to both employees and customers.

Compounding ingredients, including peroxides, solvents, talc, carbon black and lead-based curing agents, used with NORDEL IP and NORDEL MG to prepare finished products, may present hazards in handling and use. Before proceeding with any compounding work, always consult and follow all label directions, handling precautions and MSDS from the suppliers of all ingredients.
Lead-containing compounding chemicals used with NORDELM™ IP and NORDELM™ MG can have a toxic effect on the human blood, kidneys, and nervous and reproductive systems. Effective March 1, 1979, the Occupational Safety and Health Administration (OSHA) promulgated a new standard for occupational exposure to lead, 29 CFR 1910.1025 which includes in its coverage metallic lead, inorganic lead compounds, and organic lead soaps. This standard establishes a permissible exposure level for lead of 50 µg/m³ (8-hr time-weighted average) in the workplace.

Be sure to review the current Material Safety Data Sheet (MSDS) for the specific product you are using before starting any work.

NORDELM IP and NORDELM MG in Applications Regulated By The Food and Drug Administration (FDA)

FDA overview information in this section is provided as a convenience to the reader. The current Code of Federal Regulations should be consulted to ensure that all requirements for pertinent food contact application(s) are met. It is the responsibility of the article manufacturer to establish FDA compliance of the article to be used in Food Contact Service.

Many of the NORDELM IP products are compliant with one or more of the following FDA Regulations with use restrictions as defined in the Regulations (see Table 1):

- 21 CFR 177.2600—“Rubber Articles Intended for Repeated Use”
- 21 CFR 177.1520—“Olefin Polymers”
- 21 CFR 175.105—“Adhesives”
- 21 CFR 177.1210—“Closures with Sealing Gaskets for Food Containers”

### Table 1

**Summary of NORDELM IP and NORDELM MG Hydrocarbon Rubbers Complying with FDA Regulations**

<table>
<thead>
<tr>
<th>NORDELM IP Product</th>
<th>21 CFR 177.2600</th>
<th>21 CFR 177.1520</th>
<th>21 CFR 175.105</th>
<th>21 CFR 177.1210</th>
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<td>5565</td>
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<table>
<thead>
<tr>
<th>NORDELM MG Product</th>
<th>21 CFR 177.2600</th>
<th>21 CFR 177.1520</th>
<th>21 CFR 175.105</th>
<th>21 CFR 177.1210</th>
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</tr>
</tbody>
</table>

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Form No. 042-00086-1105
Technical Information

1 Review current code of Federal Regulations for specific details pertaining to food contact requirements.

2 Can be used in contact with all foods except water in oil emulsions, high or low fat, and low moisture fats and oil (See Table 2).

3 Adhesives Only

4 Compliant as a blend component in compliant polymers at levels up to 25% for conditions of use E through G.

5 Polymer as sold excludes use in contact with milk or edible oil. Finished goods made with NDR 47085.03 or NDR 46140.01 may be formulated to comply with use in contact with milk or edible oil, provided they meet the conditions outlined in 21 CFR177.2600.

If you have a food contact application, please consult your technical representative regarding the FDA compliance status of the NORDEL™ IP product for your application.

Articles Intended to Food Contact
Reference: 21 CFR 177.2600 Rubber Articles
Intended for Repeated Use

This regulation defines the polymers and compounding ingredients that can be used in vulcanized rubber articles intended for repeated use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food subject to provisions of the regulations.

There are limitations on the amount of certain compounding ingredients, as follows:

- **Accelerators**—Total is not to exceed 1.5% by weight of rubber product.
- **Retarders**—Total is not to exceed 10% by weight of rubber product.
- **Activators**—Total is not to exceed 5% by weight of rubber products, except magnesium oxide, which may be used at higher levels.
- **Antioxidants and Antiozonants**—Total is not to exceed 5% by weight of rubber product.
- **Plasticizers**—Total is not to exceed 30% by weight of rubber product unless otherwise specified.
- **Filler**—No maximum is given except for carbon black. Channel process or furnace combustion process, total carbon black is not to exceed 50% by weight of rubber product; furnace combustion black content is not to exceed 10% by weight of rubber products intended for use in contact with milk or edible oils.
- **Colorants**—Are to be used in accordance with 21 CFR 178.3297.
- **Lubricants**—Total is not to exceed 2% by weight of rubber product.
- **Emulsifiers**—No maximum is given.
- **Sulfur**—No maximum is given.

Olefin Polymers
Reference: 21 CFR 177.1520 Olefin Polymers

Olefin copolymers complying with this regulation may be used as articles, or components of articles, intended for use in contact with food subject to provisions of the regulations.

NORDEL IP products containing not more than 5 wt% of total polymer units derived by copolymerization with 5-ethylidene-2-norbornene, with a minimum viscosity average molecular weight of 120,000, with a minimum Mooney viscosity of 35 and density of .85–.90 (see Table 1), may contact foods of types identified in 21 CFR 176.170(C), Table 1 under types I, II, III, IV -B, VI, VII, VIII and IX. (See Table 2 for types of raw and process foods that can come into contact with NORDEL IP grades compliant with 21 CFR 177.1520.)
## Table 2  
**NORDEL™ IP—Polyolefin Blends:**  
**Contact With Raw and Processed Foods***

<table>
<thead>
<tr>
<th>Types of Foods</th>
<th>Description</th>
<th>Contact Permitted?</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Non-acid, aqueous product; may contain salt or sugar or both (pH above 5.0)</td>
<td>Yes</td>
</tr>
<tr>
<td>II</td>
<td>Acid, aqueous products; may contain salt or sugar or both, and including oil-in-water emulsions of low-fat or high-fat content</td>
<td>Yes</td>
</tr>
<tr>
<td>III</td>
<td>Aqueous, acid or non-acid products containing free oil or fat; may contain salt, and including water-in-oil emulsions of low-fat or high-fat content</td>
<td>Yes</td>
</tr>
</tbody>
</table>
| IV             | Dairy Products and modifications  
|                | A. Water-in-oil emulsions, high or low fat | No |
|                | B. Oil-in-water emulsions, high or low fat | Yes |
| V              | Low moisture fats and oils | No |
| VI             | Beverages:  
|                | A. Containing up to 8% of alcohol | Yes |
|                | B. Non-alcoholic | Yes |
|                | C. Containing more than 8% of alcohol | Yes |
| VII            | Bakery products other than those included under types VIII and IX of this table:  
|                | A. Moist bakery products with surface containing free fat or oil | Yes |
|                | B. Moist bakery products with surface containing no free fat or oil | Yes |
| VIII           | Dry solids with surface containing no free fat or oil (no end test required) | Yes |
| IX             | Dry solids with surface containing free fat or oil | Yes |

*Food classification from 21 CFR 176.170(c), Table 1

### Components of Adhesives

*Reference: 21 CFR 175.105 Adhesives*

This regulation includes substances that may be used as components of adhesives which may be used as components of articles intended for packaging, transporting, or holding food. In such uses, the adhesive must either be separated from the food by a functional barrier or be subject to the additional limitations outlined in 21 CFR 175.105 (a) 2 (i-ii). The NORDEL IP Hydrocarbon Rubber products that may be used as components of adhesives in compliance with this regulation are listed in Table 1.

### Closures

*Reference: 21 CFR 177.1210 Closures with Sealing Gaskets for Food Containers*

This regulation includes substances that may be used as closure sealing gaskets on containers intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting or holding food subject to provisions of the regulation. NORDEL IP products containing not more than 5 wt% of total polymer units derived by copolymerization with 5-ethylidene-2-norbornene, with a minimum viscosity average molecular weight of 120,000 and with a minimum Mooney viscosity of 35 (see Table 1, “Summary of NORDEL IP Hydrocarbon Rubbers Complying with FDA Regulations”) may be used in contact with food as a closure sealing gasket subject to provisions of 21 CFR 177.1210.

**Note:** Information in this section provides an overview of the FDA Regulations pertaining to food contact. For specifics, refer to the actual, current Code of Federal Regulations.
Product Stewardship

The Dow Chemical Company and its subsidiaries (Dow) has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our Product Stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our Product Stewardship program rests with each and every individual involved with Dow products—from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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b. use in cardiac prosthetic devices regardless of the length of time involved; (Cardiac prosthetic devices include, but are not limited to, pacemaker leads and devices, artificial hearts, heart valves, intra-aortic balloons and control systems, and ventricular bypass assisted devices);

c. use as a critical component in medical devices that support or sustain human life; or

d. use specifically by pregnant women or in applications designed specifically to promote or interfere with human reproduction.

Additionally, all Products intended for use in pharmaceutical applications, other than pharmaceutical packaging, must pass the current Pharmaceutical Liability Guidelines.

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