Nordel®

Setting new standards
for processing productivity in EPDM
New and innovative technology from DuPont Dow Elastomers is redefining the potential for EPDM products. Nordel® IP products, produced with metallocene catalyst chemistry, set new and higher standards in EPDM performance. Now DuPont Dow has introduced another industry first for EPDM, Nordel® MG. These products are the result of metallocene catalyst chemistry applied to gas phase production of EPDM, resulting in exceptional processing productivity.

**NORDEL® FAMILY OF EPDM PRODUCTS EXPANDS PERFORMANCE BOUNDARIES**

The addition of the Nordel® MG product line complements the proven performance of the Nordel® IP family of products. Nordel® IP improves yield, reduces scrap and provides outstanding polymer cleanliness. Nordel® MG delivers outstanding mixing performance. Together, Nordel® IP and Nordel® MG offer rubber compounders and processors new technology for the next generation of EPDM.

With deep expertise, a broad portfolio of elastomer products and new enabling technologies, DuPont Dow is ushering in a new era of innovation in EPDM. Get ready to reap the benefits of superior performance by putting Nordel® products to work for you!
INSITE™ technology makes control and precision a reality

INSITE™ is the patented metallocene catalyst and process technology, from The Dow Chemical Company, that lies at the heart of Nordel®. INSITE™ makes it possible to control molecular design with precision and predictability. This results in polymers that feature the broad range of Mooney viscosity, crystallinity, and cure characteristics that are in demand in today's competitive marketplace.

PUSHING THE LIMITS

Catalyst stability and geometry  The stability and geometry of the catalyst combined with the flexibility of the DuPont Dow manufacturing processes open new frontiers in molecular design. From very high ethylene-containing polymers to split compositions, DuPont Dow continues to discover new ways to step outside the box of traditional EPDM performance.

Single-site catalyst  The polymerization control offered by single-site catalysts enables polymer designers to produce new grades faster than ever before. This speed enables DuPont Dow to bring products to market more quickly to meet your application needs. The ease of computer modeling with single-site polymerization allows for unprecedented speed from concept to production reality.

Improved quality standards  INSITE™ technology sets new standards for color and appearance through superior catalyst efficiency. This capability enables lower yellowness counts, reduced contamination, and fewer rejects, blemishes or defects, especially in Class A extruded profile applications.

The molecular weight distribution of Nordel® IP is consistent from lot to lot, reducing variability for rubber processors. Rheological consistency achieved via INSITE™ technology enables repeatable processing performance.
REDUCING VARIABILITY
The INSITE™ metallocene catalyst and processes enable DuPont Dow to tightly control molecular architecture. With consistent molecular weight distribution, predictable rheology and uniform, consistent ENB incorporation, Nordel® IP sets the industry standard for product consistency in four ways:

- Consistent polymer reduces set-up times and process profile adjustments
- Smooth, consistent and predictable processing reduces product variability and scrap generation
- Reduced cure variability as a result of consistent ENB incorporation delivers predictable finished part performance
- Repeatable color matching. The lot-to-lot consistency of the base polymer enables standardization of color concentration incorporation for plastic modification applications.

**Nordel IP – Tightly Controlled ENB Content**
Nordel IP 4770

**Nordel IP – Consistent Mooney Viscosity**
Nordel IP 4770

Extraordinary consistency time after time
Nordel® IP delivers **next generation**
predictability and performance

As the first family of commercially available metallocene-based EPDM materials, Nordel® IP can deliver process, performance and product advantages that conventional competitive EPDM materials simply do not match.

- Improved processing for improved performance
- Extraordinary uniformity and lot-to-lot consistency deliver highly reproducible and predictable results
- Outstanding cleanliness for improved part aesthetics
Nordel® IP can save time and money while increasing throughput.

**Nordel® IP** is produced as uniformly sized pellets. The semi-crystalline grades retain this pellet geometry. Compared to conventional EPDM in compacted bale form, Nordel® IP products deliver unique processing advantages – saving time and expense by increasing throughput.

**REACHING THE TARGETED DEGREE OF MIXING FASTER**

Polymer design and the pellet form enable faster mixing cycles compared to mixes made with EPDM in compacted bale form. Customer plant trials using tangential mixers have shown mixer throughputs increased by over 17%. With the intermeshing mixers, throughput benefits comparable to the increase in fill factor have been demonstrated.

**MAKING BULK-HANDING POSSIBLE**

The pellet form of the semicrystalline grades enables bulk material handing and all of the operating efficiencies that these systems deliver.

**INCREASING MIXER LOADING**

The pellet geometry also facilitates increased load factors. More polymer can be added into the mixer on any given run, effectively increasing the batch size. In many operations, this results in increased mixing capacity and higher mixing throughput. In customer plant evaluations, Nordel® IP processed significantly better if the fill factor was increased by 5 - 10% in tangential mixers and by 3 - 7% in intermeshing mixers.

**BALANCING PERFORMANCE AND PROCESSABILITY**

Nordel® IP delivers excellent characteristics beyond the mixer. These characteristics balance the needs of performance and processability, including:

- Better flow for higher yields and better surface finishes
- Improved extrudability for more intricate product shapes; consistent die swell
- Reduced cure variability permitting process conditions to be dialed in and maintained
- A broad processing window, facilitating ease of set-up and continuous production.

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**NORDEL® IP – FASTER MIXING**

<table>
<thead>
<tr>
<th>Black Incorporation Time, seconds</th>
<th>Formulation used:</th>
<th>EPDM 500 phr, Oil 75 phr, N550 150 phr, 125°C, 450 MPA</th>
<th>ML 1+4 at 125°C 20 to 40 MPA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nordel® IP 4640</td>
<td>Competitor #1</td>
<td>Competitor #2</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>100</td>
<td>120</td>
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<tr>
<td></td>
<td>90</td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>120</td>
<td>140</td>
</tr>
</tbody>
</table>

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**Exceptional purity & cleanliness**

**EXCEPTIONAL PURITY**
Nordel® IP sets new standards for purity. Typical features include:

- Extremely low catalyst residues
- Very low metals content
- Very low yellowness index

**EXCEPTIONAL CLEANLINESS**
For polymer modification applications that require both consistent colorability and attractive visual aesthetics, the cleanliness of Nordel IP® enables:

- Reliable color-matching
- Reduced color concentrate costs as a result of the low yellowness of the base polymer
- Deeper, richer colors and improved surface consistency

The desirable traits of cleanliness, low odor and low yellowness index are exhibited by all grades of Nordel® IP so that customers receive an EPDM product that leads the industry in cleanliness and purity.

**LOW GEL AND CONTAMINATION**
The high catalyst efficiency of Nordel® IP production leads to very low catalyst residue and metals content. This yields a clear polymer with very low contamination and gel levels. Polymers made with Nordel® IP can be produced on a consistent basis with a very low gel level. In fact, when the polymer gel count of Nordel® IP is compared to competitive products, Nordel® IP meets best-in-class standards.

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**POLYMER GEL COUNT IN NORDEL® IP 5565 VS COMPETITIVE GRADES**

![Polymer Gel Count Chart](chart.png)
Nordel® MG is the first metalloocene-based, gas phase EPDM rubber

DuPont Dow has expanded its EPDM offerings with Nordel® MG grades that combine the production advantages of the gas phase process with the technical advantages of metallocene catalysts. This advancement in EPDM production technology yields new products with unmatched processing economics. Rubber processors will benefit from:

- Easier and faster mixing
- Reduced compound cost
- Increased productivity and yields
- Higher quality products
- Potential for bulk handling and continuous compounding

**INCREASE PRODUCTIVITY IN MIXING OPERATIONS**

The granular form of Nordel® MG more efficiently fills the mixing volume and allows an increase in fill factor from 5 to 10%. Because bale breakdown is eliminated, and because some of the carbon black is already incorporated into Nordel® MG, the time needed for compound mixing can be reduced by up to 30%. The end result is high quality compounds at substantially higher throughput and reduced energy costs.

**OFFERING VERY HIGH-MOONEY EPDM**

The gas-phase reaction process and granular form of Nordel® MG allows for the creation of polymers with a Mooney viscosity greater than 100 (ML1+4 at 125°C) without oil extension. The presence of carbon black and the granular form facilitate oil absorption. The result is that, unlike oil-extended EPDM, very high viscosity Nordel® MG needs no prior oil extension to facilitate mixing. Custom mixers and parts manufacturers alike will appreciate having the option to use Nordel® MG in the dry form as well as having the flexibility to add their own oil to manipulate processing characteristics and cost.
Thanks to the unique, granular form of Nordel® MG products, compounders can save from 10 to 30% in mixing cycle time. Nordel® MG mixes and handles easier and faster than baled EPDM forms. Testing performed in DuPont Dow laboratories validates that Nordel® MG is faster mixing than competitive EPDM.

The free-flowing granules enable bulk handling in Flexible Intermediate Bulk Containers (FIBC) for easier shipment, storage and usage. The granules are easy to use with automated weighing equipment and batch mixers, which results in lower manpower costs. Nordel® MG also eliminates an entire step in continuous mix compounds because no bale grinding is needed to granulate the rubber.

**MORE MIX FLEXIBILITY**

The granular form of Nordel® MG enables bulk handling and better mixing. The new product line is highly processable, designed to minimize mixer seizure even at the highest Mooney viscosity levels. This translates to increased flexibility for compounders who can take advantage of the ability to lower compound costs with higher filler-to-oil extension.
Nordel® MG

Attributes and Applications

Nordel® MG sets new standards for processing efficiency in EPDM, which expands the window of applications. Finished goods range from hoses and weatherstrip to roofing membranes and TPVs.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-flowing, granular form</td>
<td>• Potential for automated material handling</td>
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<tr>
<td></td>
<td>• Facilitates easier mixing, lower discharge temperatures and single pass mixing</td>
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<tr>
<td></td>
<td>• Better dispersion of compounding ingredients</td>
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<td></td>
<td>• Opens new opportunities for continuous mixing without additional grinding</td>
</tr>
<tr>
<td></td>
<td>• Reduced manpower needs/usage</td>
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<tr>
<td></td>
<td>• Particle size ideal for blending with polyethylene pellets</td>
</tr>
<tr>
<td>High Mooney viscosity</td>
<td>• Outstanding mixing including fast cycle times</td>
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<tr>
<td></td>
<td>• Highly extendable, low cost formulations can replace 60 – 70 Mooney competitive products</td>
</tr>
<tr>
<td></td>
<td>• Can displace oil-extended EPDMs with more favorable compound economics</td>
</tr>
<tr>
<td></td>
<td>• Dry blending possibilities</td>
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<tr>
<td>Consistency</td>
<td>• Lower scrap rate downstream</td>
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<tr>
<td></td>
<td>• Higher production yields without defects</td>
</tr>
<tr>
<td>Packaging in FIBCs and “inclusion” melt bags</td>
<td>• Reduces disposal cost of packaging</td>
</tr>
</tbody>
</table>

**APPLICATIONS**

**Automotive**
- Weatherstrip
  - extruded dense compounds
  - corner moldings
  - window seals
- Hose
  - radiator
  - heater
  - windshield wiper fluid
- Anti-vibration
  - muffler hanger
- Tire (in blends with NR/BR)
  - sidewalls
  - motorcycle treads

**Roofing**
- Membranes

**Other applications**
- bicycle tires
- container seals
- garden hoses
- tarp straps
- air ducts
- electronic condenser caps
- TPVs
TECHNICAL SUPPORT FOR ACHIEVING OPTIMUM RESULTS

Depend on DuPont Dow for the support you need to achieve optimum results in the shortest possible time. Our worldwide TS&D expertise can help you with:

- Process development
- Application testing
- New application development
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