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| <b>NAVISTAR, INC.</b>                                                                                                                                                                                                                                                                                                                   |                                  |                                             |
| <b>Material, Parts, and Process Specifications<br/>(MPAPS)</b>                                                                                                                                                                                                                                                                          |                                  | NUMBER:<br><b>MPAPS L-6040</b>              |
|                                                                                                                                                                                                                                                                                                                                         |                                  | Former Designation: <b>TMS-6040</b>         |
| <b>TITLE:<br/>Thermoplastic Elastomer Molding Compounds</b>                                                                                                                                                                                                                                                                             |                                  | CURRENT REV No.:<br><b>1606</b>             |
|                                                                                                                                                                                                                                                                                                                                         |                                  | DATE:<br><b>June 2016</b>                   |
| WRITTEN/EDITED BY:<br><b>G. Svidron</b>                                                                                                                                                                                                                                                                                                 | APPROVED BY:<br><b>R. Goluch</b> | SUPERSEDES:<br><b>REV. 1306 – JUNE 2013</b> |
| <b>PRINTED COPIES OF THIS DOCUMENT MUST BE VERIFIED FOR CURRENT REVISION</b>                                                                                                                                                                                                                                                            |                                  |                                             |
| <i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i> |                                  |                                             |

## 1.0 APPLICATION

This specification covers thermoplastic rubber compounds used for various truck applications that may or may not contain recycled rubber materials. For thermoset compounds, see MPAPS L-6039.

### 1.1 Restricted Chemical Substances

Effective January 1, 2007, all product supplied to the requirements of this specification must comply with the requirements of the MPAPS B-50 specification.

## 2.0 SCOPE

This specification covers general requirements, identification, inspection, property and performance requirements, quality plan, and source approval and quality control requirements.

### 2.1 Descriptions

This specification covers several categories of material types with several choices within each category. The choices within each category typically vary by hardness and related physical properties but can apply to similar applications. The following base material designations are available:

#### 2.1.1 TPR

This designates a standard thermoplastic rubber material. It usually consists of thermoplastic olefins (TPO) blended with elastomers, although other polymer bases are available. These materials may contain recycled rubber (post-consumer automotive tire) with prior approval. Typical applications include grommets, bumpers, boots, aero effect seals, body seals, sound dampers, closeouts, air ducts, trim components, valence panels and other interior and exterior applications.

#### 2.1.2 TPU

This designates a thermoplastic urethane material suitable for many of the applications listed above and has its own unique properties.

### 2.2 Descriptions – Suffix

The following suffix modifications are available:

**2.2.1 H** This designates a heat and weather resistant thermoplastic material. Minimal oil resistance is expected for this material.

**2.2.2 Q** This suffix designates a material with good oil and diesel fuel resistance.

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**2.2.3 C** This suffix designates a heat and weather resistant material with resistance to heavy duty diesel coolants. Minimal oil resistance is expected for this material. Typical applications include water seals, air seals, and hoses.

**2.2.4 Compound Variations.** A lower case letter may be used at the end of the compound designation, after the tensile strength number to indicate a specific compound.

### **2.3 Designation on Drawings**

The drawing designation shall consist of the base type of material – TPR – followed by any suffix requirements – H, O, or C – which is then followed by the durometer specified with an “A” or “D” to designate scale. This is followed by a compound identifier to differentiate compound variations. If desired, the specific base polymer may be identified in the specification as well. For example:

**2.3.1** TPR60A-a per MPAPS-6040

**2.3.1.1** This designation identifies a basic elastomer with a durometer of 60 scale A.

**2.3.2** TPO per MPAPS-6040 TPR-H70D-a

**2.3.2.1** This designation identifies a TPO compound meeting the heat resistance requirements with a durometer of 70, scale D. This is also a specific compound variation a designated by the “a.”

**2.3.3** Polyester per MPAPS-6040 TPR-O55D-b

**2.3.3.1** This is an oil resistant polyester elastomer compound with a durometer of 55, scale D. This compound is designated “b.”

**2.3.4** TPR-0020 per MPAPS-6040

**2.3.4.1** An alternate designation, intended primarily for parts still under development that may require material property modifications prior to final production release but after the print geometry has been determined.

## **3.0 REFERENCE DOCUMENTS**

Unless otherwise specified the latest issue of all referenced standards shall apply. The following specifications and standards are referenced in this specification.

|                                                     |             |              |
|-----------------------------------------------------|-------------|--------------|
| Quality System Standard <i>ISO 9001 or TS-16949</i> | ASTM D 412  | ASTM D 395   |
| NAVISTAR Eng. Design Std. A-16                      | ASTM D 624  | ASTM D 865   |
| NAVISTAR Manufacturing Standard MS-D-13             | ASTM D 573  | ASTM D 5992  |
| CFR Title 29, Part 1910                             | ASTM D 1171 | ASTM B 117   |
| NAVISTAR MPAPS B-50                                 | ASTM D 2137 | ASTM D 575   |
| NAVISTAR MPAPS GT-31                                | ASTM D 2240 | MPAPS P-9543 |

## **4.0 GENERAL REQUIREMENTS**

All materials covered by this specification shall meet the following requirements and shall be molded or extruded utilizing good industry practice.

### **4.1 Finish**

Unless otherwise specified on the engineering drawing the part finish for molded parts shall be uniform as produced from a polished steel tool. The mold will be polished to a surface finish of 800 nm or better with small, incidental to part function or appearance, tool marks not polished out. Extruded products shall have a smooth and clean surface finish free from any foreign matter.

### **4.2 Flash**

Unless otherwise specified on the engineering drawing the part shall have a maximum flash allowance of 0.80 mm.

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### 4.3 Dimensional Tolerances

Part tolerances are shown in Tables 1 and 2. These tolerances shall override standard print tolerances unless otherwise stated on the print or unless specific tolerances are designated on the part detail.

**TABLE 1: STANDARD DIMENSIONAL TOLERANCE TABLE**

| <b>Dimension (in)</b> | <b>Tolerance</b> | <b>Dimension (mm)</b> | <b>Tolerance</b> |
|-----------------------|------------------|-----------------------|------------------|
| 0 - 1.00              | .015             | 0 - 25                | <b>.40</b>       |
| 1.00-4.00             | .020             | 25 - 100              | <b>.50</b>       |
| 4.00-6.30             | .032             | 100 - 160             | <b>.80</b>       |
| 6.30 & over           | 0.50%            | 160 & over            | <b>0.50%</b>     |

### 4.4 Property And Performance Requirements – Original Properties

Test samples shall be taken from finish parts whenever possible. The referenced values are minimums unless stated otherwise. See the attached tables for specific requirements referencing the following test methods:

**4.4.1 Hardness** ASTM D 2240 – Type A unless a “D” is listed in the table. All values are  $\pm 3$  points from specified value.

**4.4.2 Tensile Strength** ASTM D 412, Die C. Reported as MPa.

**4.4.3 Elongation** ASTM D 412, Die C. Reported as % elongation.

**4.4.4 Tear Resistance** ASTM D 624, Die B. Reported as kN/m.

**4.4.5 Compression Set** ASTM D 395, Method B, 22 hours. Reported as maximum % set.

**4.4.6 Low Temperature Brittleness** ASTM D 2137, Method A, Non-Brittle at -40°C (-40°F).

### 4.5 Property And Performance Requirements – Aged Properties

Test samples shall be taken from finish parts whenever possible. The referenced values are calculated from the qualified, original, measured, average properties (these are not from the specification minimums!). See the attached tables for specific requirements referencing the following test methods:

**4.5.1 Heat Resistance** ASTM D 573 or ASTM D 865, see Table 2 for the times and temperatures designated.

**4.5.2 Oil Resistance** ASTM D 471, No. 3 oil, see Table 2 for the times and temperatures designated. Note: Use the current, designated replacement for ASTM #3 oil and please note that not all of the listed temperatures are appropriate for this fluid.

**4.5.3 Fuel Resistance** ASTM D 471, No. 2 Diesel - 168 hours at 25°C

**4.5.4 Coolant Resistance** ASTM D 471, 50/50 Ethylene Glycol and water per MPAPS B-1 Type III - 168 hours at boiling point with reflux.

#### 4.5.5 Accelerated Weathering (per MPAPS GT-31)

The listed alternate methods may be used for initial evaluation and tentative approval pending completion of the standard method.

**4.5.5.1 Method:** Exterior parts, per Method B, 2400 kJ.

**4.5.5.2 Alternate Method:** Exterior parts, per Method C, 1000 hrs.

**4.5.5.3 Method:** Interior parts, per Method A, 1200 kJ.

**4.5.5.4 Alternate Method:** Interior parts, per Method F, 500 hrs.

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**4.5.5.5 Required:** Shall have no visible color change greater than  $\Delta E$  of 3.

#### **4.6 Property And Performance Requirements – Mechanical Properties**

Tests shall be performed with finish parts unless otherwise indicated on the engineering print. These methods are only required if specifically specified. See the engineering print or an attached table for specific requirements referencing the following test methods:

**4.6.1 Static Compression Deflection** ASTM D 575 Test Method A except that a finished part shall be used. The direction and amount of deflection shall be indicated on the engineering print.

#### **4.7 Property And Performance Requirements – Recycled Content**

The minimum and maximum amount of post consumer recycled rubber content allowed by weight percent. Postindustrial recycled content shall be indicated if it is a part of the compound.

### **5.0 QUALITY**

All material produced to this specification shall be clean and free of dirt, grease, and contamination. All rubber debris from cutting and processing shall be removed. Parts shall be free of voids.

#### **5.1 Qualification**

Materials submitted for approval to this specification shall include the following:

- 5.1.1.** A detailed, signed test report documenting testing to this specification per MPAPS P-9543.
- 5.1.2.** The complete procedure used for preparing and curing materials for test, especially surface preparation (when appropriate) and condition of the test materials.
- 5.1.3.** A complete description, including engineering prints and pictures, of any non-standard test fixtures used.
- 5.1.4.** Adhesive, substrate and any chemicals used for bonding where appropriate.

**5.2 Submission** The material and test report shall be submitted to:

Manager of Materials Engineering  
Materials Engineering and Technology  
NAVISTAR, Inc.  
10400 W. North Ave  
Melrose Park, IL 60160

**5.3 Approval** A report from NAVISTAR will be issued approving material to this specification. Approval is not granted until this report has been published. Specification changes listing the approval may be delayed from the date of the original approval; this report is authorization of that approval prior to this change.

### **6.0 SOURCE APPROVAL AND QUALITY CONTROL**

#### **6.1 Supplier Requirements**

All suppliers to NAVISTAR are required to be registered to ISO 9001 Quality System Requirements. NAVISTAR will also accept TS-16949 registration as long as the supplier can also fulfill all AIAG PPAP (Production Part Approval Process) documentation and approval requirements. Suppliers must maintain their certification with an accredited registrar and must furnish copies of registration certificates to their NAVISTAR Corporate Buyer upon request.

#### **6.2 Approval**

Parts supplied against contracts or purchase orders citing this specification shall be equivalent in all respects to those samples that were approved by the purchaser. No changes in formulation or processing practices are permitted without approval. In the event that changes in material, properties, processing practices, construction, color, or labeling of the product are required, the supplier shall notify Materials Engineering and Purchasing

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