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| <b>NAVISTAR, INC.</b>                                                                                                                                                                                                                                                                                                                   |                                  |                                           |
| <b>Material, Parts, and Process Specifications<br/>(MPAPS)</b>                                                                                                                                                                                                                                                                          |                                  | NUMBER:<br><b>MPAPS F-1045</b>            |
|                                                                                                                                                                                                                                                                                                                                         |                                  | Former Designation: <b>TMS-1045</b>       |
| <b>TITLE:<br/>Corrosion Resistant Steel Tubing</b>                                                                                                                                                                                                                                                                                      |                                  | CURRENT REV No.:<br><b>1609</b>           |
|                                                                                                                                                                                                                                                                                                                                         |                                  | DATE:<br><b>Sept. 2016</b>                |
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| <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 three types of double wall, furnace brazed steel tubing, with corrosion resistant coatings, suitable for use in hydraulic brake lines or other applications where improved corrosion resistance is required. Type 1 tubing (hot dip terne coating overlaid with a zinc rich organic topcoat) is obsolete, and not to be used in Navistar products. Type 2 uses a hot dip zinc-aluminum coating overlaid with an aluminum rich organic (epoxy) topcoat. Type 3 tubing is Type 2 tubing with a nylon/polyamide covering.

## 2.0 SCOPE

This specification covers the performance requirements of the tubing and tube assemblies, including coating thickness, corrosion resistance, dimensional tolerances, quality, and source approval. The control of the corrosion protective properties of the tubing is the responsibility of the manufacturer.

## 2.1 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.

## 3.0 REFERENCE DOCUMENTS

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

|                                                  |                             |           |
|--------------------------------------------------|-----------------------------|-----------|
| Quality System Standard ISO 9001 or TS-16949     | NAVISTAR MPAPS B-50         | GMW14124  |
| CFR Title 29, Part 1910                          | NAVISTAR MPAPS A-45, Part I | SAE J400  |
| NAVISTAR Supplier Packing and Shipping Std. D-13 | ASTM A254                   | SAE J527  |
| NAVISTAR Engineering Design Std A-16             | ASTM B117                   | SAE J2334 |

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|--------------------------------|---------------------------------------------------|--------------------------|

## **4.0 REQUIREMENTS**

### **4.1 Description of Tubing Types**

#### **4.1.1 Type 1 Tube**

***NOT TO BE USED FOR NEW DESIGN***

#### **4.1.2 Type 2 Tube**

This tubing is standard double wall brazed steel tubing (SAE J527) that meets the *performance* requirements of Grade 1 of MPAPS A-45, Part I. The hot dip coating consists of 95% zinc and 5% aluminum with minor trace elements. Minimum coating weight is 39 g/m<sup>2</sup> (0.13 oz/ft<sup>2</sup>). The tubing is coated with epoxy paint containing uniformly dispersed aluminum flakes or platelets, then baked.

#### **4.1.3 Type 3 Tube**

Type 3 tubing is Type 2 tubing with an adhesive primer layer and a polyamide 12 topcoat.

### **4.2 Coating Thickness**

#### **4.2.1 Type 2 Tube**

When examined metallographically, the zinc-aluminum metal coating and the aluminum rich epoxy dry film coating will each exhibit a minimum thickness of 3µm as measured at any point on the circumference of the tube.

#### **4.2.2 Type 3 Tube**

Type 3 tubing will meet the coating requirements for Type 2 tubing above. In addition, the polyamide 12 coating will have a film thickness of 150 µm minimum.

### **4.3 Environmental Resistance Evaluation**

#### **4.3.1 General**

Required testing will be performed using production representative tubing samples and fittings. In order to allow fittings to remain functional when pressure testing is required after corrosion testing, the system should be protected during exposure (such as inserting tube fittings into a solid block of aluminum, or placing wax into openings to protect interior tubing surfaces).

#### **4.3.2 Gravelometer/Salt Spray Testing**

##### **4.3.2.1 Type 2 Tubing**

A minimum of 2 samples representative of production tubing will be subjected to 1000 hour salt spray exposure per ASTM B117.

##### **4.3.2.1.1 Requirements**

Tested tubes will not exhibit more than 1.5 mm creepback from scribes placed longitudinally along the tubing. No other loss of adhesion will be evident after testing.

##### **4.3.2.2 Type 3 Tubing**

A minimum of 2 samples representative of production tubing will be conditioned at -40°C for a minimum of 4 hours prior to performing gravelometer testing per SAE J400 using 5 pints of gravel. Tubing should be impacted with gravel within 30 seconds of removal from freezer. Within 24 hour of gravelometer exposure, the specimens will be placed in salt spray per ASTM B117 for 2000 hr.

##### **4.3.2.2.1 Requirements**

Tested samples will show no red rust in non-gravel impacted areas; red rust is allowed up to 1 mm from impacted areas. No peeling or delamination (i.e., splitting or separation of the nylon into layers) of coating is allowed after testing.