

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS F-6016
		Former Designation: TMS-6016
TITLE: Hose, High Temperature, with End Fittings		CURRENT REV No.: 1510
		DATE: OCT. 2015
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<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>		
Change Notice: Updated Table V burst. Released as MPAPS		

1.0 APPLICATION

This specification covers six types of hose, with end-fittings, used in the air brake, engine oil, diesel fuel, transmission oil cooling, low-pressure power steering, and coolant systems. Types I through IV and VI may be used in applications operating between -40° and 150°C (-40° to 302°F) which conform to the pressures and bend radii listed in Table 5. Type V may be used in systems operating between -53° to 232°C (-65° to 450°F) which conform to the pressures and bend radii listed in Table 2. Type V may also be used in applications requiring extra chemical resistance, such as engine oil recirculation lines.

RESTRICTIONS: Hose covered by this specification shall not be used in the following applications:

High-pressure power steering, cab-lift, or hydraulic brake systems.

Air brake jounce/articulating lines - see TMS-6036.

Application in coolant systems is limited to Type VIII and to customer demand option only.

2.0 SCOPE

This specification covers general requirements, property and performance requirements, identification, quality, packing and shipping and source approval and quality control requirements.

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.

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OCTOBER 2015

NUMBER: MPAPS F-6016	TITLE: Hose, High Temperature, With End Fittings	REVISION: 1510
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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>	NAVISTAR Eng. Drw. PT10-53568	ASTM D 792
NAVISTAR Eng. Design Std A-16	NAVISTAR MPAPS A-0, Part II	ASTM D 865
NAVISTAR Manufacturing Std MS-D-13	NAVISTAR MPAPS A-37	ASTM D 1457
NAVISTAR Eng. Procedural Standard EPS-143	NAVISTAR MPAPS G-1	MIL-H-8446
CFR Title 29, Part 1910	NAVISTAR MPAPS G-20	MIL-L-7807
NAVISTAR Eng. Drw. AD 1324	NAVISTAR CEMS C-3	MIL-L-2104E
NAVISTAR Eng. Drw. AD 6466	TMC Recommended Practice 307	SAE J516
NAVISTAR Eng. Drw. AD 6717	NAVISTAR MPAPS B-50	SAE J517
NAVISTAR Eng. Drw. AD 9290	NAVISTAR TMS-6812	ASTM D 412
FMVSS 106	NAVISTAR TMS-6803	SAE J343
SAE J1405	ASTM D 380	ASTM D 622
NAVISTAR MPAPS DT-9	NAVISTAR MPAPS C-10	ASTM B 117
NAVISTAR MPAPS G-22	ASTM D 610	MPAPS G-9009
ASTM D 4895	NAVISTAR MPAPS A-45 Pt I	MPAPS P-9543

4.0 GENERAL REQUIREMENTS

Hose and hose assemblies shall meet SAE, FMVSS, and NAVISTAR requirements as indicated in Tables 2, 3, and 4.

TABLE 1 - DESCRIPTION OF TYPES

MPAPS F-6016	SAE J1402	SAE J517	FMVSS 106	ENG. DR
Type I	Type AI	N/A	YES	AD1324, AD6466, AD6717
Type II	Type AI	N/A	YES	AD1324, AD6466, AD6717
Type III	Type AII	100R5	YES	AD1324, AD6466, AD6717
Type IV	Type AII	100R5	YES	AD1324, AD6466, AD6717
Type V	N/A	100R14	NO	AD9290
Type VI	N/A	100R6	NO	PT10-53568
Type VII				

4.1 Construction

4.1.1 Type I - This hose shall consist of a seamless tube of oil resistant rubber, reinforced with either a single wire braid covered by a textile braid or two textile braids separated by a wire braid. All braids shall be impregnated with a black oil and mildew resistant synthetic rubber compound.

4.1.2 Type II – No longer used. Use type I.

4.1.3 Type III - This hose shall consist of a seamless tube of oil and hydraulic brake fluid resisting rubber reinforced with two textile braids separated by a wire braid. All braids shall be impregnated with an oil and mildew resistant synthetic rubber compound.

4.1.4 Type IV – No longer used. Use Type III.

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OCTOBER 2015

NUMBER: MPAPS F-6016	TITLE: Hose, High Temperature, With End Fittings	REVISION: 1510
--------------------------------	--	--------------------------

4.1.5 Type V - This hose shall consist of a seamless smooth bore extrusion of Teflon meeting the requirements of Type III resin per ASTM D1457, except suitable additives (up of 2% max) are permissible. The reinforcement shall consist of a 300 series stainless steel wire braid of sufficient strength to insure the hose will meet requirements of this specification.

4.1.6 Type VI - This hose shall consist of a seamless tube of oil resistant rubber reinforced and covered with textile.

4.1.7 Type VII - This hose shall consist of a seamless tube of virgin PTFE reinforced with 90% electrical grade continuous filament glass fibers blended with 10% aramid fibers having minimum 9000 yarn denier for 5/16 inch nominal inside diameter, 14000 yarn denier for 3/8 inch, and 14000 for 1/2 inch hose bonded to tube by means of Teflon coating with weaving construction of two over and two under such that a minimum 90% coverage is achieved.

4.1.8 Type VIII – This hose shall have the same construction requirements as Type VII hose but is intended for water and glycol based coolant applications. In addition to the requirements of this specification this hose must also satisfy the requirements of MPAPS F-30 Sections: 6.2.4 For Oven Aged Burst Strength, 6.2.6 Electrochemical Resistance, Section 6.2.9 Chemical Interaction, and Section 8.6 Immersions. Use the performance criteria for MPAPS F-30 Grade 1 tube material for the Oven Aged Burst Strength and Immersions testing.

4.2 General Requirements for Fittings and Tubing

4.2.1 Fittings

4.2.1.1 Types I, II, III, and IV Hose Fittings

Shall comply with requirements of SAE J1402 and SAE J516. Fittings may be permanent (crimped) or reusable as indicated on the Engineering drawing and/or purchase order. Reusable end fittings used in air brake applications shall have a brass or stainless steel inner, the outer nut and collar may be brass, stainless steel or plated steel (see Section 4.2.1.3 for material requirements). In some cases, the print may require the inner to be phosphate coated. Reusable end fittings used in fluid (non air) applications may use a coated steel liner. Such applications are not interchangeable with air applications.

4.2.1.2 Type V, VI, VII, Type VIII Hose Fittings

Fittings are permanent (crimp). Reusable fittings are not recommended. Material requirements are the same as Types I through IV for air applications except that only stainless steel or brass are allowed on Type V. Fittings shall comply with SAE J516 except as indicated on the engineering drawing.

4.2.1.3 Fitting Materials

NOTE - Fittings are not interchangeable between types; each material has its own type and style of fitting that does not work with other types of hose. Applications between Types I and III may be interchanged based on economics or availability, with prior engineering approval. Types I and III may also be used for Type VI with prior approval. As outside diameters change between hose style, care must be taken to ensure that assembly issues do not arise due to substitutions.

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OCTOBER 2015

NUMBER: MPAPS F-6016	TITLE: Hose, High Temperature, With End Fittings	REVISION: 1510
--------------------------------	--	--------------------------

Fittings shall meet the following requirements, or as specified on engineering drawing:

Brass	UNS C36000, C34500, C35000, or C37700 per CEMS C-3
Steel	0-100, 0-115 or 0-201 per MPAPS A-0, Part II
Finish for steel fittings	Unless otherwise specified: a) Zinc Plating (trivalent), Class 6A, per MPAPS G-20 b) Zinc-Nickel Plating (trivalent) Class ZNi-C3, per MPAPS G-22 (for use w/oil centrifuge lines) c) For inner when specified: phosphate coating, Class B-2, per MPAPS G-1
Stainless Steel	Austenitic (18-8) Stainless Steel per MPAPS A-37; Passivated per MPAPS A-37, Type 5.
Aluminum	6061-T6 aluminum per MPAPS C-10 (for use with aluminum tubing only)

4.2.2 Tubing Material

4.2.2.1 Steel - Steel tubing will be single-wall, electric-resistance welded (ERW) low carbon steel, Grade F, per MPAPS A-45 Part II with flash height controlled to 380 m (0.015 inch) max. For lower pressure applications, such as transmission oil cooler hose assemblies, single-wall, electric-resistance welded (ERW) low carbon steel, Grade 5, per MPAPS A-45 Part I with flash height controlled to 380 m (0.015 inch) max, is acceptable when designated on the drawing.

4.2.2.1.2 Tubing Finish – unless otherwise specified, steel tubing will have one of the following finishes and meet the performance requirements as specified in the applicable specification:

- Zinc plating (trivalent), Class 6A, per MPAPS G-20
- Paint, Class II, per MPAPS G-9009
- Hot-dipped zinc-aluminum coating (95% zinc, 5% aluminum) (Galfan)
(Must provide ASTM B117 salt spray performance of 360 hr to red rust, with no more than 1% red rust per ASTM D610, Plate #6)
- Zinc-nickel plating (trivalent), Class ZNi-C3, per MPAPS G-22 (**esp. for oil centrifuge lines**)

4.2.2.2 Aluminum – 3003-H14 per MPAPS C-10. Aluminum tubing will be plain (no finish).

4.3 Dimensions and Tolerances

All types shall comply with standards indicated in Table 1 and 3. See Table 6 for common tolerances. Types I thru IV and VI inside diameter and outside diameter shall be concentric within the following limits:

Size	Concentricity - T.I.R.	
	<u>Mm</u>	<u>in</u>
-3 through -20	0.8	0.030

4.3.1 Concentricity shall be measured over the finished O.D. The readings shall be taken at 90° intervals around the hose and acceptance shall be based on the total variations of the readings.

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OCTOBER 2015

NUMBER: MPAPS F-6016	TITLE: <i>Hose, High Temperature, With End Fittings</i>	REVISION: 1510
--------------------------------	---	--------------------------

Dimensional measurements shall be made at a minimum distance of 13 mm (0.50 in) from the cut ends of the hose. Type V shall meet the concentricity requirements of SAE 100R14 per SAE J517.

4.4 Performance Requirements

4.4.1 Hose and Hose Assemblies

Hose and hose assemblies furnished will meet required tests per SAE J1402, SAE J517 and FMVSS-106 and any additional requirements of this specification or TMC Recommended Practice 307. Unless otherwise indicated, all tests shall be performed in accordance with SAE J343, ASTM D 380 or D 622.

4.4.1.1 Burst Pressure (Assemblies)

Hose shall not burst or indicate failure at a hydrostatic pressure below the minimum specified burst pressure in Table 5. The assemblies shall be brought to minimum burst pressure at a constant rate within a period of 15-30 seconds and then continue to failure at the same rate.

4.4.1.2 Proof Pressure

Hose assemblies shall not leak when proof pressure tested at the minimum pressure specified in Table 5. Hose assemblies shall be subjected to the required pressure for a period of 30-60 seconds.

4.4.1.3 Cold Flexibility

Hose assemblies shall show no leakage or visible cracking after being exposed to a cold environment, bent over a mandrel, and proof pressure tested after returning to room temperature. The assemblies shall be subjected to -40°C (-40°F) for Types I, II, III, IV and VI; and -53° C (-65° F) for Type V and Type VIII for 24 hours in a straight position. While still at the specified temperature, the sample shall be evenly and uniformly bent over a mandrel having a diameter equal to twice the specified minimum bend radius in Table 5. The mandrel shall be cooled to the specified test temperature. Bending shall be to the indicated angle within 8-12 seconds.

I.D. of Hose	Angle
Less than 2.5 cm (less than 1 in)	180°
25 mm and greater (1 in and greater)	90°

For Type VI hose, an alternate strip method per ASTM D 380 or SAE J30R7 may be used.

4.4.1.4 Burst Strength, Elevated Temperature

4.4.1.4.1 Method: Similar to room temperature burst, except media shall be an appropriate fluid such as:

MIL-H-8446	Oronite Chemical #8200	Dow Chemical F-60
General Electric F-50	MIL-L-7807	ASTM Service Fluid 101
Dexron II		

4.4.1.4.2 Procedure: The assembly, filled with the test fluid, shall be heat aged for 1 hour at 150° C (302° F), or at 232° C (450° F) for Type V (1-hour period doesn't include time for oven or assembly

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OCTOBER 2015