

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)	NUMBER: MPAPS- A-45, PART II	
	Former Designation: CEMS A-45 PART II	
TITLE: Hydraulic Line Tubing and Tubing Assemblies	CURRENT REV No.: 1506	DATE: June 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: MPAPS Formatting; added references to SAE J356 and SAE J1677; Editorial Changes		

1.0 APPLICATION

Low carbon steel tubing seamless and normalized, electric-resistance welded, flash controlled single-wall pressure tubing intended for use as pressure lines in vehicles.

MPAPS A-45 is in three parts:

- Part I – Automotive Steel Tubing
- Part II – Hydraulic Line Tubing and Tubing Assemblies
- Part III - Diesel Injection Tubing

2.0 SCOPE

Part II of MPAPS A-45 covers the requirements for tubing and tubing assemblies used in the Company's products for hydraulic lines or other applications where fluids are transferred under pressure. It is also suitable for applications requiring flaring and bending.

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 standards, specifications and regulations are referenced in this specification.

Quality System Standard <i>ISO 9001 or TS-16949</i>	ASTM A 370
NAVISTAR Manufacturing Standard MS-K-5	NAVISTAR MPAPS G-1
NAVISTAR Manufacturing Standard MS-D-13	SAE J524
CFR Title 29, Part 1910	SAE J525
NAVISTAR MPAPS G-5 Pt. II	SAE J1677
SAE J356	

4.0 REQUIREMENTS

4.1 Grade Classification

Hydraulic line tubing is produced in three grades which are classified as shown in Table I.

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**TABLE I
GRADE CLASSIFICATION**

NAVISTAR Grade	Approximate SAE Equivalent	Description	Permissible Alternates
NF	J525	No Inside Flash, Drawn Over Mandrel, Electric Resistance Welded, Single Wall	None
S	J524	Seamless	Grade NF
F	J356	Flash Controlled, Electric Resistance Welded, Single Wall	Grade NF

4.2 Chemical Composition

Tubing purchased to this specification will be made from steel conforming to the chemical composition shown in Table II.

**TABLE II
CHEMICAL COMPOSITION**

Element	Ladle (Heat) Analysis, %	Check (Product) Analysis, %
Carbon	0.18 max	0.21 max
Manganese	0.60 max	0.63 max
Phosphorus	0.04 max	0.05 max
Sulfur	0.05 max	0.06 max

4.3 Mechanical Properties

Tubing furnished to this specification will conform to the mechanical property requirements shown in Table III, unless otherwise specified. See "Methods of Test," Section 5.4.

**TABLE III
MECHANICAL PROPERTIES**

Yield Strength 0.2% Offset, min		Tensile Strength, Min		% Elongation in 2 Inches (50 mm), min	Hardness** Rockwell B, max
ksi	MPa	Ksi	MPa		
25	170	45	310	35*	65 **

* Elongation for tubing with nominal outside diameters up to 9.52 mm (0.375 inch) inclusive and/or nominal wall thicknesses of 0.89 mm (0.035 inch) or less is 25%, minimum.

** Not required on tubing with nominal wall thicknesses less than 1.65 mm (0.065 inch) or with inside diameters less than 6.4 mm (0.25 inch).

4.4 Performance Requirements

The finished tubing will meet the following requirements when inspected with an unaided eye. See "Methods of Test," Section 5.4.

4.4.1 Flattening

The tested sample will have no cracks or other flaws. Superficial ruptures resulting from minor surface imperfections will not be cause for rejection. See Section 5.2 for definition of minor surface imperfections.

4.4.2 Reverse Flattening (Grades NF and F Only)

The tested sample will not reveal evidence of cracks, metal flaking, lack of weld penetration or overlaps resulting from flash control or flash removal in the weld.

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4.4.3 Expansion

The tested sample will show no evidence of splitting or other flaws

4.4.4 Hydrostatic Proof Pressure

All tubing supplied to this specification will be hydrostatically tested without showing defects at a pressure equivalent to a fiber stress of 138 MPa (20 ksi). A nondestructive test, such as eddy current, may be substituted for hydrostatic test by agreement between purchaser and supplier.

4.5 Dimensional Tolerances of Tubing

Tubing purchased to this specification will conform to the following requirements for dimensional tolerances. Grades NF and S tubing will be subject to any two of the following dimensional requirements: outside diameter (OD), inside diameter (ID) and wall thickness. Grade F tubing will be specified to only outside diameter and wall thickness.

TABLE IV
DIAMETER TOLERANCES, PLUS OR MINUS

Nominal Outside Diameter, Inches, Incl	Outside and Inside Diameters Tolerances, Inch				Nominal Outside Diameter, mm, Incl	Outside and Inside Diameters Tolerances, mm			
	Grade NF		Grade S	Grade F*		Grade NF		Grade S	Grade F*
Thru 0.375	OD:0.002	ID: 0.005	0.004	0.0025	Thru 9.52	OD: 0.05	ID: 0.013	0.010	0.06
Over 0.375 to 0.625	0.0025		0.004	0.003	Over 9.52 to 15.88	0.06		0.10	0.06
Over 0.625 to 1.000	0.003		0.004	0.0035	Over 15.88 to 25.4	0.08		0.10	0.09
Over 1.000 to 1.125	0.003		0.006	0.0035	Over 25.4 to 28.6	0.08		0.15	0.09
Over 1.125 to 1.500	0.003		0.006	0.005	Over 28.6 to 38.1	0.08		0.15	0.13
Over 1.500 to 2.000	0.003		0.008	0.005	Over 38.1 to 50.8	0.08		0.20	0.13
Over 2.000 to 2.500	0.004		0.010	0.006	Over 50.8 to 63.5	0.10		0.25	0.15
Over 2.500 to 3.000	0.005		0.010	0.008	Over 63.5 to 76.2	0.13		0.25	0.20
Over 3.000 to 3.500	0.006		0.010	0.009	Over 76.2 to 88.9	0.15		0.25	0.23
Over 3.500 to 4.000	0.006		--	0.010	Over 88.9 to 101.6	0.15		--	0.25

* Inside diameter tolerances not applicable to Grade F tubing.

4.5.1 Flash Height

Grade NF: There will be no dimensional indications of the presence of the weld.

Grade F: The outside flash will be removed to provide a smooth surface. The inside flash will conform to the following.

Nominal OD		Nominal Wall Thickness, incl		Height of Flash, Maximum	
Inch	mm	Inch	mm	Inch	mm
Thru 1.000	Thru 25.4	Up to 0.035 Over 0.035 to 0.065 Over 0.065	Up to 0.89 Over 0.8 to 1.65 Over 1.65	0.005 0.008 0.010	0.13 0.20 0.25
Over 1.000	Over 25.4		All	0.010	0.25

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