

INTERNATIONAL TRUCK AND ENGINE CORPORATION		
NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)	NUMBER: MPAPS- A-38	
	Former Designation: CEMS A-38	
TITLE: Structural Steel Tubing	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, Editorial changes; Incorporated previously separate appendix		

1.0 APPLICATION

Structural steel tubing is used where highest strength at low cost is required. Structural tubing is produced in standard sizes, many of which correspond to standard pipe outside diameters. ERW, butt welding and seamless manufacturing methods can be used to produce structural steel tubing.

Corporate Engineering Materials Specifications covering other steel tubular products used by the Company are as follows:

Mechanical Steel Tubing	MPAPS A-10
Welded and Seamless Steel Pipe	MPAPS A-18
Fluid Line Steel Tubing	MPAPS A-45

2.0 SCOPE

This specification covers the requirements for structural steel tubing used in the Company's products.

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 will apply. The following Specifications, Standards, and Regulations are referenced in this specification and constitute a part of this specification to the extent specified herein:

Quality System Standard ISO 9001 or TS-16949	ASTM A 751
CFR Title 29, Part 1910	NAVISTAR MPAPS A-10, Pt I
NAVISTAR Manufacturing Std. MS-D-13	ASTM E 208
NAVISTAR Engineering Design Std A-16	API-5L
NAVISTAR MPAPS B-50	ASTM A 370
ASTM A 500	
ASTM A 618	

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4.0 REQUIREMENTS

4.1 Grade Classification

Structural steel tubing is classified on the basis of yield strength. It is produced in ten grades, as shown in Table I.

TABLE I
GRADE CLASSIFICATION

Designation			Description *	Section **
Navistar Grade	Obsolete International Grade	Approximately Equivalent Specification		
XEW ***	-	-	High Strength – Low Alloy Electric Resistance Welded	Round, Square Rectangular
XBW	-	ASTM A 618	High Strength – Low Alloy Butt Welded	
MCS ***	-	API 5L-X52	Medium Carbon Seamless or Electric Resistance Welded	Round
HMC ***	-	-	Hot Formed Medium Carbon Electric Resistance Welded	Round, Square, Rectangular
MCW	EW	-	Medium Carbon Electric Resistance Welded	
LCW	-	-	Low Carbon Electric Resistance Welded	
XHS	-	-	High Strength – Low Alloy Electric Resistance Welded or Seamless Hot Formed Structural	Square, Rectangular
CHS	HHS	ASTM A 500 Grade B	Electric Resistance Welded or Seamless Cold Formed Structural	
RPA ***	-	-	Electric Resistance Welded or Seamless with Required	
RPS ***	-	-	Low Temperature Impact Properties	

* For a more complete description of the grades, see “Appendix - General Information.”

** Specific size availability for most grades is shown in MPAPS A-10, Part I, “Appendix - General Information.”

*** Most sizes in Grades XEW, MCS, HMC, XHS, RPA and RPS require minimum quantities. See “Appendix - General Information” for details.

4.2 Permissible Alternate

When Grade RPA is specified on a drawing, it is permissible for manufacturing to use Grade RPS to allow for maximum freedom of selection at the manufacturing level.

4.3 Chemical Composition

Tubing purchased to this specification will meet the requirements for chemical composition shown in Table II. For reference analysis use ASTM A 751.

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**TABLE II
CHEMICAL COMPOSITION**

Navistar Grade	Chemical Composition, Percent (Max except where shown as min or range)							
	Carbon		Manganese		Phosphorus		Sulfur	
	Ladle Analysis	Check Analysis	Ladle Analysis	Check Analysis	Ladle Analysis	Check Analysis	Ladle Analysis	Check Analysis
XEW *	0.25	0.29	1.20	1.25	0.035	0.045	0.035	0.043
XBW *	0.25	0.29	1.20	1.25	0.035	0.045	0.035	0.043
MCS **	0.20-0.31	0.17-0.35	1.35	1.45	0.035	0.045	0.035	0.043
HMC	0.35	0.39	1.20	1.25	0.035	0.045	0.035	0.043
MCW	0.35	0.39	1.35	1.40	0.035	0.045	0.035	0.043
LCW	0.15-0.23	0.12-0.27	0.30-0.90	0.26-0.94	0.035	0.045	0.035	0.043
XHS *	0.22	0.26	1.40	1.50	0.035	0.045	0.035	0.043
CHS	0.26	0.30	-	-	0.035	0.045	0.035	0.043
RPA *** RPS ***	0.22	0.26	1.65	1.71	0.035	0.045	0.035	0.043

* Treated with columbium, vanadium or both.

** May be treated with columbium, vanadium or both.

*** Silicon 0.70% maximum ladle analysis. Steel will be fully killed and fine grain. May be treated with Cb, V, N or other alloying elements.

4.4 Mechanical Properties

Structural tubing purchased to this specification will conform to the mechanical property requirements shown in Table III unless otherwise specified. See "Methods of Test," Section 5.

**TABLE III
TENSILE PROPERTIES**

Navistar Grade	Wall Thickness incl	Yield Strength, min (Unless Specified as Range)		Tensile Strength, min (Unless Specified as Range)		Elongation in 2 in (50 mm), percent, min
		Psi	MPa	psi	MPa	
XEW	All	50 000	345	70 000	483	18
XBW	All	50 000	345	70 000	483	18
MCS ⁽³⁾	All	52 000	359	66 000	455	22
HMC	All	46 000	317	58 000 ⁽¹⁾	401 ⁽¹⁾	23 ⁽²⁾
MCW *	All	50 000	345	75 000	517	20
LCW	All	50 000 **	345 **	60 000	411	17
XHS	All	50 000	345	65 000	448	22
CHS	All	46 000 ***	317 ***	58 000	401	23
RPA RPS	All	50 000-78 000	345-538	70 000	483	20

* Grade MCW is annealed after welding of the seam by the producer.

** Yield strength will be 40 000 psi (276 MPa), minimum, after arc welding or normalizing at 1650°F (898°C) and air cooling.

*** Yield strength will be 36 000 psi (248 MPa), minimum, after arc welding or normalizing at 1650°F (898°C) and air cooling.

(1) Minimum tensile strength for Grade HMC round tubing will be 52 000 psi (359 MPa).

(2) Minimum elongation for wall thicknesses under 0.180 inch (4.57 mm) will be calculated by the formula: elongation in 2 in = 61 t (inch) + 12 or elongation in 50 mm = 2.4 t (mm) + 12; where t = wall thickness.

(3) The weld seam of electric resistance-welded pipe will be heat treated after welding or processed in such a manner that no untempered martensite remains, RC 35 max.

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4.5 Impact Test Requirements (Grades RPA And RPS Only)

Grades RPA and RPS tubing purchased to this specification will meet the impact test requirements shown in Table IV unless otherwise specified. See "Methods of Test," Section 5.

4.6 Charpy V-Notch

The requirements for standard and subsize Charpy V-Notch specimens are shown in Table IV. The standard size specimen will be used except where the section thickness is less than 11 mm. In such cases, subsize specimens as listed will be used. The largest preferred size as shown in Table IV that the material thickness will permit should be selected.

4.7 Nil Ductility Transition Temperature - Alternate Method

Grade RPS tubing will have a maximum nil ductility transition temperature (NDTT) of -30°F (-34°C). This requirement may be used in lieu of the Charpy V-Notch impact test for material with section thickness of 0.625 inch (15.9 mm) and greater. See "Methods of Test" in Section 5.

TABLE IV
CHARPY V-NOTCH IMPACT TEST REQUIREMENTS

Type of Specimen	Specimen Size, mm	Test Temperature		Impact Value, Minimum			
		deg F	Deg C	Grade RPA		Grade RPS	
				ft lbf	J	ft lbf	J
Standard	10 x 10	-20	-29	8.0	11.0	20.0	27.1
Subsize	10 x 9	-20	-29	7.5	10.0	19.0	25.8
Subsize	10 x 8	-20	-29	7.0	9.5	18.0	24.4
Subsize	10 x 7.5	-20	-29	7.0	9.5	17.0	23.0
Subsize	10 x 7	-20	-29	6.5	9.0	16.5	22.4
Subsize	10 x 6.7	-20	-29	6.5	8.5	16.0	21.7
Subsize	10 x 6	-20	-29	6.0	8.0	15.0	20.3
Subsize	10 x 5	-20	-29	5.5	7.5	13.0	17.6
Subsize	10 x 4	-20	-29	5.0	7.0	11.0	14.9
Subsize	10 x 3.3	-20	-29	4.5	6.0	9.5	12.9
Subsize	10 x 3	-20	-29	4.0	5.5	7.0	9.5

4.8 Dimensional Tolerances

Tubing purchased to this specification will conform to the requirements for dimensional tolerances shown in Tables V, VI, VII and VIII. See "Methods of Test," Section 5. Structural tubing is specified to outside diameter and nominal wall thickness.

TABLE V
STRAIGHTNESS TOLERANCES

International Grade	Section	Straightness Tolerance	
XEW XBW	Round, Square, and Rectangular	0.062 inch in 3 feet 0.125 inch in 5 feet	1.57 mm in 0.91 m 3.18 mm in 1.52 m
MCS	Round	0.120 inch in 5 feet	3.05 mm in 1.52 m
HMC	Round Square, and Rectangular	0.062 inch in 3 feet 0.064 inch in 3 feet	1.57 mm in 0.91 m 1.63 mm in 0.91 m
XHS, CHS, RPA, RPS	Square, Rectangular	0.125 inch in 5 feet	3.18 mm in 1.52 m

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