

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS- A-10, PART I
		Former Designation: CEMS A-10 PART 1
TITLE: Mechanical Steel Tubing Part I - Electric Resistance Welded Mechanical Steel Tubing		CURRENT REV No.: 1506
		DATE: June 2015
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Change Notice: Reformatted for MPAPS, Editorial Changes		

1.0 APPLICATION

This specification is in three parts:

- Part I - Electrical Resistance Welded Mechanical Steel Tubing
- Part II - Cold Drawn Butt Welded Mechanical Steel Tubing
- Part III - Seamless Mechanical Steel Tubing

NAVISTAR specifications covering other tubular products used by the Company are as follows:

Welded and Seamless Steel Pipe	MPAPS A-18
Structural Steel Tubing	MPAPS A-38
Fluid Line Steel Tubing	MPAPS A-45

2.0 SCOPE

This part of the specification covers the requirements for electric resistance welded (ERW) mechanical tubing used in the Company's products. Unless otherwise specified herein, ASTM A 513 will apply. Several types of coated or galvanized ERW steel tubing are also covered by this specification.

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 CONTENTS

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4.0 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 ISO 9001 or TS-16949
CFR Title 29, Part 1910
NAVISTAR Manufacturing Std. MS-D-13
NAVISTAR Engineering Design Std A-16
NAVISTAR MPAPS B-50

ASTM A 513
ASTM A 1011
ASTM A 370
ASTM B 117

5.0 GRADE CLASSIFICATION

Electric resistance welded tubing can be produced from either hot or cold rolled strip in as-welded, sink drawn or mandrel drawn grades. The as-welded and sink drawn grades can be further processed to control welding flash height. For a more complete description of the grades, see "Appendix – General Information." Table 1 is a summary of the grades available. **For coated steel tubing, see Section 5.3 below.**

TABLE I – GRADE CLASSIFICATION

Designation			Description	General Size Availability *						
Navistar Grade	Obsolete Grade	Approx ASTM A 513 Type		Outside Diameter		Wall Thickness				
				Inch	Mm	Inch	mm			
H-F	1	1	Hot Rolled, Flash In	0.75 thru 8.0	19.0 thru 203	0.065 thru 0.500	1.65 thru 12.70			
H-10	2	1	Hot Rolled, Flash Controlled To 0.010 Inch (0.25 mm)	1.125 thru 8.0	28.6 thru 203					
H-5	3	1	Hot Rolled, Flash Controlled to 0.005 inch (0.13 mm)	0.75 thru 8.0	19.0 thru 203					
C-F	4	2	Cold Rolled, Flash In	0.25 thru 7.0	6.35 thru 178	0.028 thru 0.165	0.71 thru 4.19			
C-10	5	2	Cold Rolled, Flash Controlled To 0.010 Inch (0.25 mm)	1.125 thru 7.0	28.6 thru 178					
C-5	6	2	Cold Rolled, Flash Controlled To 0.005 Inch (0.13 mm)	0.25 thru 7.0	6.35 thru 178					
H-F-SD	--	3	Hot Rolled, Flash IN, Sink Drawn	0.25 thru 7.5	6.35 thru 190	0.65 thru 0.375	1.65 thru 9.52			
H-10-SD	--	3	Hot Rolled, Flash Controlled To 0.010 Inch (0.25 mm), Sink Drawn							
DOM	C-0-MD	5	Hot or Cold Rolled, No Dimensional Evidence Of Flash, Mandrel Drawn	0.125 thru 7.25	3.18 thru 184	0.022 thru 0.344	0.56 thru 8.74			
	C-F-SD									
	C-10-SD									
EBS	--	--	Any Mechanical Steel tubing Grade Covered in MPAPS A-10, Parts I, II, III.							
CDT	--	--	Any Sink or Mandrel Drawn Tubing Grade Covered in MPAPS A-10, Parts I, II, III.							
CDM	--	--	Any Mandrel Drawn Tubing Grade Covered in MPAPS A-10, Parts I, II, III.							

* For specific size availability for each grade, see "Appendix – General Information".

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5.1 Permissible Alternates

When a certain grade of tubing is specified on a drawing, it may be desirable for the manufacturing department to use a better grade. Permissible alternates for each grade of tubing are shown in Table II. See Table IV in “Appendix – General Information” for comparative cost of the different grades.

TABLE II – PERMISSIBLE ALTERNATES

Grades	Permissible Alternate Grades
EBS	All Grades in MPAPS A-10, Parts I, II, and III
H-F	All Other Grades in MPAPS A-10, Part I, except EBS, CDT, and CDM
H-10	H-5, C-10, C-5, H-10-SD, DOM
H-5	C-5, DOM
CDT	All SD and MD Grades in MPAPS A-10, Parts I, II, and III
CDM	All MD Grades in MPAPS A-10, Parts I, II, and III
C-F	C-10, C-5, DOM
C-10	C-5, DOM
C-5	DOM
H-F-SD	H-10-SD, DOM
H-10-SD	DOM
DOM	--

5.2 Grades EBS, CDT, and CDM

5.2.1 Grades EBS, CDT, and CDM are codes which allow manufacturing to select a tubing grade covered in Parts I, II, or III, e.g., Grade H-F, Part I, which will satisfy both engineering and manufacturing requirements. See “Dimensional Tolerances,” Part III, for diameter and wall thickness tolerances and “Appendix – General Information,” Part III, for discussion of these grades.

5.2.2 When a coded grade is specified on the engineering drawing, the selection of the appropriate tubing within that code should be made by the quality control manager of the ordering plant. The quality control manager should consult the various departments involved from the standpoint of cost, inventory, processing, and so forth, to determine which tubing grade can be used to best advantage. The drawings and engineering specifications for individual parts should show only the coded grade.

5.2.3 When more than one plant is involved in the production of a part, it is the responsibility of the quality control manager of the originating plant to obtain the approval from other fabricating plants on the selection of tubing. In general, it should be the plant having the most critical operation who should decide upon the tubing which is most suitable for his operation.

5.2.4 Outside suppliers furnishing finished parts may use any tubing grade covered within the coded grade shown on the drawing.

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5.2.5 Outside suppliers of semi-finished parts requiring welding, heat treating, or machining in NAVISTAR plants must obtain approval of the specific tubing grade and steel from the NAVISTAR plant quality control manager of the purchasing plant.

5.3 Coated Steel Tubing

Mechanical steel tubing is also available as zinc-coated or galvanized ERW tubing of several types, as defined below.

Type G – standard galvanized steel tubing fabricated from hot- or cold-rolled pre-galvanized steel sheet. Galvanize coating defined by MPAPS A-6 Part II, with coating weight on outer and inner tubing walls assumed to be 60G60GU, unless otherwise specified on the drawing.

Type F – ERW steel tubing made from flat strip steel, then cold formed and welded. Coating consists of three layers: zinc coating, conversion coating, and clear polymer topcoat. Interior tubing surfaces are coated with zinc organic coating for corrosion protection.

Type GS – coated tubing similar to Grade F, but with 50% more pure zinc to provide higher corrosion resistance. Interior tubing surfaces are coated with zinc organic coating for corrosion protection.

5.3.1 Base Metal and Strength Requirements

Type G - required tubing grade should be specified on the drawing, based on Navistar grades in Table 1 above.

Types F or GS - 1008-1010 steel per ASTM A1011 will be supplied unless otherwise specified on drawing. Minimum yield strength to be 50 ksi, tensile strength 55 ksi, and elongation 23%. This type of tubing is also available in a higher strength steel, with minimum 65 ksi yield/70 ksi tensile, but must be specified on the drawing.

5.3.2 Corrosion Resistance

When salt spray (fog) tested per ASTM B117, Type F tubing shall withstand min 840 hrs to red rust, and Type GS, 2000 hrs minimum.

5.3.3 Tolerances for Coated Tubing

For O.D. up to 1.5 in = ± 0.005 in

Up to 2.0 in = ± 0.010 in

Over 2.0 in = ± 0.015 in

Wall thickness tolerance = 10% nominal

6.0 GENERAL REQUIREMENTS

6.1 Chemical Composition

When no steel designation is specified, the plant quality control manager of the originating plant will select the grade of steel from those listed in Tables, III, III-A, IV, and IV-A. Tubing purchased will meet the requirements for chemical composition shown in the latest issue of ASTM A 513. The most commonly used steels are shown in "Appendix – General Information."

6.2 Mechanical Properties

6.2.1 Expected minimum mechanical properties are shown in Tables III, III-A, IV, and IV-A. They can be specified as minimum requirements by the purchaser.

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6.2.2 As-drawn tubing subject to additional cold working after drawing such as bending, upsetting, or ballizing will be ordered stress relieved at 800° F (425° C) min. This is the responsibility of the using manufacturing plant. If there is no cold work after drawing, stress relieving is not required unless specified on the engineering drawing. When cold drawn tubing requires hot forming, hot bending, or other thermal treatment, mechanical properties may be significantly reduced. In such cases, the tubing supplier should be consulted. See “Appendix – General Information” under “Grades.”

6.2.3 Tensile properties are based on tubing specimens pulled in full section. For longitudinal strip tests, the width of the gage section will be 1 inch (25.4 mm) and a deduction of 0.5 percent from the basic minimum elongation for each 0.031 inch (0.79 mm) decrease in wall thickness under 0.312 inch (7.94 mm) in wall thickness will be permitted.

6.2.4 See “Methods of Test,” also “Appendix – General Information” for availability of specific grades and sizes.

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TABLE III
EXPECTED MINIMUM MECHANICAL PROPERTIES*
AS-WELDED AND NORMALIZED TUBING

SAE Steel Designation	Outside Diameter, Inch	Wall Thickness, Inch	Yield Strength, psi, min	Tensile Strength, psi, min	Elongation, ** % In 2 Inch, Min	Hardness Rockwell B
As-Welded Grades H-F, H10, H-5, C-F, C-10, C-5						
1008	0.750 and Smaller Over 0.750 Over 0.750	Up to 0.065, incl. Up to 0.083, incl. 0.095 and Heavier	37 000	45 000	15	55
			32 000	45 000	15	55
			30 000	42 000	15	50
1010	0.750 and Smaller Over 0.750 Over 0.750	Up to 0.065, incl. Up to 0.083, incl. 0.095 and Heavier	40 000	48 000	15	58
			35 000	48 000	15	58
			32 000	45 000	15	55
1015	0.750 and Smaller Over 0.750 Over 0.750	Up to 0.065, incl. Up to 0.083, incl. 0.095 and Heavier	40 000	50 000	15	60
			36 000	48 000	15	58
			35 000	48 000	15	58
1020	0.750 and Smaller Over 0.750 Over 0.750	Up to 0.065, incl. Up to 0.083, incl. 0.095 and Heavier	40 000	55 000	12	65
			38 000	52 000	12	62
			38 000	52 000	12	60
1025	0.750 and Smaller Over 0.750	Up to 0.065, incl. All	45 000	58 000	12	67
			40 000	56 000	12	65
1026	0.750 and Smaller Over 0.750	Up to 0.065, incl. All	50 000	65 000	12	74
			45 000	62 000	12	68
1030	0.750 and Smaller Over 0.750	Up to 0.065, incl. All	50 000 45 000	65 000 62 000	10 10	74 68
Normalized – All Grades						
1008	0.750 and Smaller Over 0.750	All	24 000	38 000	25	65 max
			23 000	38 000	30	65 max
1010	0.750 and Smaller Over 0.750	All	27 000	45 000	25	65 max
			25 000	40 000	30	65 max
1015	0.750 and Smaller Over 0.750	All	32 000	50 000	25	70 max
			30 000	45 000	30	70 max
1020	0.750 and Smaller Over 0.750	All	35 000	50 000	25	75 max
			35 000	50 000	30	75 max
1025	0.750 and Smaller Over 0.750	All	37 000	55 000	25	80 max
			37 000	55 000	25	80 max
1026	0.750 and Smaller Over 0.750	All	40 000	60 000	25	85 max
			40 000	60 000	25	85 max
1030	0.750 and Smaller Over 0.750	All	40 000	60 000	20	85 max
			40 000	60 000	25	85 max

* The expected minimum mechanical properties can be specified as minimum requirements by the purchaser. See "Appendix – General Information," under "Grades."

** As-welded tubing with 0.028 inch wall thickness and under will have 5% lower elongation than shown.

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TABLE III-A
EXPECTED MINIMUM MECHANICAL PROPERTIES*
AS-WELDED AND NORMALIZED TUBING

SAE Steel Designation	Outside Diameter, Mm	Wall Thickness, Mm	Yield Strength, MPa, min	Tensile Strength, MPa, min	Elongation, ** % In 50 mm, min.	Hardness Rockwell B
As-Welded Grades H-F, H10, H-5, C-F, C-10, C-5						
1008	19.05 and Smaller	Up to 1.65, incl.	255	310	15	55
	Over 19.05	Up to 2.11, incl.	221	310	15	55
	Over 19.05	2.41 and Heavier	207	290	15	50
1010	19.05 and Smaller	Up to 1.65, incl.	276	331	15	58
	Over 19.05	Up to 2.11, incl.	241	331	15	58
	Over 19.05	2.41 and Heavier	221	310	15	55
1015	19.05 and Smaller	Up to 1.65, incl.	276	345	15	60
	Over 19.05	Up to 2.11, incl.	248	331	15	58
	Over 19.05	2.41 and Heavier	241	331	15	58
1020	19.05 and Smaller	Up to 1.65, incl.	276	379	12	65
	Over 19.05	Up to 2.11, incl.	262	359	12	62
	Over 19.05	2.41 and Heavier	262	359	12	60
1025	19.05 and Smaller	Up to 1.65, incl.	310	400	12	67
	Over 19.05	All	276	386	12	65
1026	19.05 and Smaller	Up to 1.65, incl.	345	448	12	74
	Over 19.05	All	310	427	12	68
1030	19.05 and Smaller	Up to 1.65, incl.	345	448	10	74
	Over 19.05	All	310	427	10	68
Normalized – All Grades						
1008	19.05 and Smaller	All	165	262	25	65 max
	Over 19.05		159	262	30	65 max
1010	19.05 and Smaller	All	186	310	25	65 max
	Over 19.05		172	276	30	65 max
1015	19.05 and Smaller	All	221	345	25	70 max
	Over 19.05		207	310	30	70 max
1020	19.05 and Smaller	All	241	345	25	75 max
	Over 19.05		241	345	30	75 max
1025	19.05 and Smaller	All	255	379	25	80 max
	Over 19.05		255	379	25	80 max
1026	19.05 and Smaller	All	276	414	25	85 max
	Over 19.05		276	414	25	85 max
1030	19.05 and Smaller	All	276	414	20	85 max
	Over 19.05		276	414	25	85 max

* The expected minimum mechanical properties can be specified as minimum requirements by the purchaser. See "Appendix – General Information," under "Grades."

** As-welded tubing with 0.71 mm wall thickness and under will have 5% lower elongation than shown.

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TABLE IV – EXPECTED MINIMUM MECHANICAL PROPERTIES *
SINK DRAWN AND MANDREL DRAWN TUBING

SAE Steel Designation	Outside Diameter, Inch	Wall Thickness, Inch	Yield Strength, psi, min	Tensile Strength, psi, min	Elongation, ** % In 2 Inch, Min	Hardness Rockwell B
Sink Drawn Grades H-F-SD and H-10-SD						
1008	All	All	38 000	48 000	8	65
1010	All	All	40 000	50 000	8	65
1015	All	All	45 000	55 000	8	67
1020	All	All	50 000	60 000	8	70
1025	All	All	55 000	65 000	7	72
1026	All	All	55 000	70 000	7	77
1030	All	All	62 000	70 000	7	78
1035	All	All	70 000	80 000	7	82
Mandrel Drawn Grade DOM						
1008	Thru 2.750 Over 2.750	Thru 0.120	53 000	63 000	5	73
		Over 0.120	48 000	58 000	5	73
		All	48 000	58 000	5	73
1010	Thru 2.750 Over 2.750	Thru 0.120	55 000	65 000	5	73
		Over 0.120	50 000	60 000	5	73
		All	50 000	60 000	5	73
1015	Thru 2.750 Over 2.750	Thru 0.120	60 000	70 000	5	77
		Over 0.120	55 000	65 000	5	77
		All	55 000	65 000	5	77
1020	Thru 2.750 Over 2.750	Thru 0.120	65 000	75 000	5	80
		Over 0.120	60 000	70 000	5	80
		All	60 000	70 000	5	80
1025	Thru 2.750 Over 2.750	Thru 0.120	70 000	80 000	5	82
		Over 0.120	65 000	75 000	5	82
		All	65 000	75 000	5	82
1026	Thru 2.750 Over 2.750	Thru 0.120	75 000	85 000	5	85
		Over 0.120	70 000	80 000	5	85
		All	70 000	80 000	5	85
1030	Thru 2.750 Over 2.750	Thru 0.120	75 000	85 000	5	87
		Over 0.120	75 000	85 000	5	87
		All	75 000	85 000	5	87
1035***	All	All	75 000	85 000	10	85

* The expected minimum mechanical properties can be specified as minimum requirements by the purchaser. See "Appendix – General Information," under "Grades."

** When additional cold work is to be performed such as bending, expanding, and so forth, it may be necessary to thermally treat the cold drawn tubing at a temperature which may reduce mechanical properties. In such cases, the tubing supplier should be consulted.

*** Stress relieved tubing required

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