

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS- A-44
		Former Designation: CEMS A-44
TITLE: Heat Treated Constructional Steels	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: Reformatted as MPAPS. Editorial Changes		

1.0 APPLICATION

Constructional steels are supplied in the heat treated condition. They have limited formability, but possess high strength and good wear resistance in the as-received condition. They are suitable for use in many applications where their limited formability is acceptable. AR grades are intended for applications where a good combination of abrasion resistance, formability, and weldability is required

2.0 SCOPE

This specification covers the Company's requirements for high strength, heat-treated steel used for constructional or wear resistant applications. These steels are normally supplied in the quenched and tempered condition. Abrasion resistant (AR) steel grades are supplied as through-hardened plate which has been austenitized, water quenched, and tempered.

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 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 514
ASTM A 370

4.0 GENERAL REQUIREMENTS

4.1 Classification

Constructional steels are classified by their yield strength, hardness, and chemical composition

4.2 Chemical Composition

The chemical composition of the material furnished to this specification will fall within the limits shown in Table I (a) or (b). The choice of, and limits for, alloys other than those specified below which are

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JUNE 2015

NUMBER: MPAPS A-44	TITLE: Heat Treated Constructional Steels	CURRENT ISSUE DATE: June 2015
------------------------------	---	---

necessary to produce the required mechanical properties, will be subject to agreement between the supplier and purchaser. The type of alloy combination will not be changed by the producer without the knowledge and consent of the purchaser. Acknowledgement of an order by trade name does not void the chemical requirements herein. However, such acknowledgement does constitute agreement on the alloys to be used and must be approved by the Plant Quality Control Manager involved.

TABLE I (a)
CHEMICAL COMPOSITION
(%max unless otherwise specified)

Steel Type		Carbon				Alloy		
NAVISTAR Type Approx ASTM A514 Equivalent		80	90	100C*	321WRC*	100	321WR	363WR
		All Grades						
Chemical Composition	Carbon	0.20	0.20	0.28	0.21			
	Manganese	1.35	1.50	1.50	1.50			
	Phosphorus	0.04	0.04	0.04	0.04			
	Sulfur	0.05	0.05	0.05	0.05			
	Silicon	0.40	0.40	0.60	0.90			
	Boron **	0.0005 – 0.003				Optional		
	Others	***				Alloys Optional		
Description		Fully Killed Steel Made to Fine Grain Practice						

* When Type 100C or 321WRC are specified on a drawing, it is permissible for manufacturing to use Type 100 for Type 100C or Type 321WRC to allow for maximum freedom of selection at the manufacturing level.

**Boron not required for Type 80 in thicknesses 19 mm (0.75 inch) and under.

***Alloys may be used at the producer's option with or in place of boron.

TABLE I (b)
CHEMICAL COMPOSITION – AR Steel Grades
(%max unless otherwise specified)

Abrasion Resistant Steel Type	C	Mn	P	S	Si	Ni	Cr	Mo	Boron
AR400F	0.18	1.60	0.025	0.01	0.50	0.30	0.30	0.25	0.0005 min
AR500	0.29	1.60	0.025	0.01	0.70	0.50	1.00	0.60	0.004 max

4.3 Mechanical Properties

The mechanical properties of steel purchased to this specification will conform to the requirements shown in Table II. See “Methods of Test,” Section 8.

These properties and nil ductility transition temperature (NDTT) can be affected by welding. NDTT is also affected by increased hardness and thickness. See “Appendix – General Information” section for details.

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NUMBER: MPAPS A-44	TITLE: Heat Treated Constructional Steels	CURRENT ISSUE DATE: June 2015
------------------------------	---	---

**TABLE II
MECHANICAL PROPERTIES**

Navistar Type	Thickness		Yield Strength, min		Tensile Strength		Min % Elongation in 2 inches (50 mm)	Brinell Hardness (HBW)	180° Bend Test **
	inches (incl)	mm (incl)	ksi	MPa	ksi	MPa			
80	To 1.000	To 25.4	80	552	95 to 115	655 to 792	18	197 to 235*	D = 2T
	1.001 - 1.500	25.5 - 38.0							D = 3T
90	To 1.000	To 25.4	90	621	100 to 120	689 to 827	18	212 to 248*	D = 2T
	1.001 - 1.500	25.5 - 38.0							D = 3T
100C	To 1.000	To 25.4	100	689	110 to 130	758 to 896	18	229 to 269*	D = 2T
	1.001 - 1.250	25.5 - 31.5							D = 3T
100	To 1.000	To 25.4	90	689	115 to 135 ^{ψψ}	792 to 931 ^{ψψ}	18***	235 to 277*	D = 2T
	1.001 - 2.500	25.5 - 63.5							D = 3T
	2.501 - 4.000	63.6 - 101.6		621	105 to 135 ^{ψψ}	724 to 931 ^{ψψ}	17	217 to 277*	D = 4T
321WR ^ψ	To 1.500	To 38.0	137*	945*	171 *	1179*	14*	321 to 363	--
321WRC ^ψ	To 1.250	To 31.8	137*	945*	171 *	1179*	14*	321 to 363	--
363WR ^ψ	To 1.500	To 38.0	145*	1000*	184 *	1269*	13*	363 min	--
AR400F	0.188 - 1.50	4.8-38.1	150*	1030*	184*	1270*	23*	360-444	--
AR500	0.236-2.5	6.0-63.5	200*	1378*	225*	1551*	12*	477-550	--

* Typical value; not a requirement.

** This is an acceptance test per ASTM A370 where D = the inside diameter of bend and T= thickness. The ratios shown in Table II apply to the bending performance of a test specimen only. This specimen is always taken parallel to the rolling direction with the bend axis perpendicular to the rolling direction and usually has some edge preparation. Where plates are to be bent in a fabricating operation, more liberal bend radii must be used, particularly if the bend axis is parallel to the direction of grain flow. For recommended fabricating bend radii, see "Appendix – General Information."

*** Elongation for plates under 6.4 mm (0.250 inch) thick is 15% min and 10% min for sheet and strip.

^ψ Type 321 WRC, 321WR, and 363WR are furnished to minimum hardness and all other published mechanical properties are waived. 288 HBW max permitted for bar products for Types 321WR and 321WRC.

^{ψψ} 965 MPa (140 ksi) max tensile strength permitted for structural shapes.

5.0 QUALITY

All product supplied shall be clean and free from dirt, oils, sharp edges, or defects harmful to product performance.

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JUNE 2015

NUMBER: MPAPS A-44	TITLE: <i>Heat Treated Constructional Steels</i>	CURRENT ISSUE DATE: June 2015
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5.1 METHODS OF TEST

For tensile, bending, and hardness tests, refer to ASTM A370. Machined surfaces of tensile test specimens will have a roughness no greater than 1.5×10^{-6} m (6.3×10^{-6} inches) which is normally produced by finish milling.

6.0 QUALIFICATION

Engineering qualification of sources is required in advance of production shipments. Samples shall be accompanied by test data certifying that all requirements of the specification have been met.

6.1 Quality Control Plan

A Quality Control Plan for products supplied to the requirements of this specification will be established by mutual agreement between NAVISTAR and the supplier. Unless specific exception is noted, the following characteristics, where applicable*, shall be included in the plan as features for management by statistical process control.**



Thickness

- * Other characteristics for inclusion in the control plan may be specified on the engineering drawing and/or purchase order.
- ** See NAVISTAR Engineering Design Standard A-16

7.0 SOURCE APPROVAL AND QUALITY CONTROL

7.1 Supplier Requirements

All suppliers to NAVISTAR are required to be registered to ISO 9001 Quality System Requirements. NAVISTAR will also accept TS-16949 registration as long as the supplier can also fulfill all AIAG PPAP (Production Part Approval Process) documentation and approval requirements. Suppliers must maintain their certification with an accredited registrar and must furnish copies of registration certificates to their Corporate Buyer upon request.

7.2 Approval

Parts supplied against contracts or purchase orders citing this specification shall be equivalent in all respects to those samples which were approved by the purchaser. No changes in formulation or processing practices are permitted without approval. In the event that changes in material, properties, processing practices, construction, color, or labeling of the product are required, the supplier shall notify NAVISTAR Materials Engineering and Purchasing and Supplier Development of the proposed change(s). Test data indicating conformance to all requirements of this specification, test samples, and new or amended or updated Material Safety Data Sheet(s) (MSDS), in accordance with CFR Title 29, Part 1910 shall be submitted with the request for change.

7.3 Process Control

The supplier shall either perform and report results of tests on specific lots of parts produced using ISO 9001 or TS-16949 guidelines, or provide statistical evidence of the lot having been produced in a state of statistical control and with a process capable of providing all required properties. The part supplier and the quality control manager of the using NAVISTAR plant may determine testing and reporting requirements on specific products.

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JUNE 2015