

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS A-37
		Former Designation: CEMS A-37 & TMS-4117
TITLE: Stainless/Heat Resistant Steels and Finish Requirements		CURRENT REV. No.: 1709
		DATE: Sep. 2017
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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>		

1.0 SCOPE

This specification covers requirements for stainless and heat resistant steels used in the Company's products.

NOTE: Requirements for stainless steel spring wire are covered in MPAPS A-9, Steel Spring Wire. Requirements for stainless steel tubing used for exhaust, coolant, or heater applications can be found in MPAPS F-1058 and MPAPS F-1069.

This specification also defines the mechanical and chemical finish requirements for stainless steel surfaces, including requirements for passivation, electropolished, electropolished with chrome flash, or electrolytically micro-etched, for parts requiring a decorative, color match, corrosion/heat resistant finish, or "paint-ready" stainless steel surface. Such parts might include bright reflective grab handles, sunshades (requiring color match), exhaust pipes which require both corrosion and heat resistance, or passivated stainless steel fasteners.* These finishes are classified according to the following Types (see Appendix for detailed description):

- Type 1 – Electropolish only
- Type 2 – Electropolish plus electrodeposited chrome flash (minimum Cr plating thickness of 0.08 µm or 0.003 mils) – applicable where **color match** is required
- Type 3 – Electropolish plus electrodeposited chrome flash (minimum Cr plating thickness of 0.21 µm or 0.008 mils) – for **high heat** applications
- Type 4 – Micro-etch only
- Type 5 – Chemical passivation*

***NOTE:** All stainless steel fasteners (i.e., bolts, nuts, washers, etc.) will be passivated in accordance with this specification unless otherwise specified on the drawing, purchase order, or in the applicable Engineering Standard Parts (ESP) document. However, passivated fasteners are not required to undergo CASS testing, unless specified.

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2.0 INTRODUCTION

Stainless steels offer good mechanical strength over a wide range of temperatures and provide corrosion resistance superior to all of the common structural steels. Some alloys can be buffed and polished for improved surface appearance. Passivation of stainless steels can be performed to ensure a clean surface, free from iron-bearing contaminants which may result in undesirable rust and degraded surface appearance. However, on bright or polished parts, passivation may somewhat reduce the glossy or polished appearance.

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 – Occupational Safety and Health Standards
NAVISTAR D-13 - Supplier Packing and Shipping Standard
NAVISTAR MPAPS B-50 - Restricted Chemical Substances
NAVISTAR MPAPS A-9 - Steel Spring Wire
NAVISTAR MPAPS A-37 Appendix- Stainless/ Heat Resistant Steels and Finish Requirements
NAVISTAR MPAPS F-1058 - Steel Tubing for Engine Air/Fluid Systems
NAVISTAR MPAPS F-1069 - Steel Tubing for Engine Exhaust Systems
NAVISTAR MPAPS P-9516 - Quality Requirements for Resistance Spot Welds
ASTM A240 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269 - Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276 - Specification for Stainless Steel Bars and Shapes
ASTM A312 - Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A313 – Standard Specification for Stainless Steel Spring Wire
ASTM A370 - Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A380 - Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A480 - Specification for General Requirements for Flat-Rolled Stainless and Heat- Resisting Steel Plate, Sheet, and Strip
ASTM A493 - Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
ASTM A554 - Specification for Welded Stainless Steel Mechanical Tubing
ASTM A555 - Specification for General Requirements for Stainless Steel Wire and Wire Rods

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ASTM A582 - Specification for Free-Machining Stainless Steel Bars
ASTM A751 - Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A967 - Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM B368 – Test Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)
AWS D1.6 – Structural Welding Code – Stainless Steel
AWS D8.8 – Specification for Automotive Weld Quality – Arc Welding of Steel

5.0 MATERIAL CLASSIFICATION AND DESIGNATION

Stainless steels are classified by 1) their chemical composition and resulting room temperature microstructure (e.g., austenitic, ferritic, martensitic, precipitation hardening, and duplex), 2) the American Iron and Steel Institute (AISI) numbering system (e.g., 200, 300, 400 series alloys), and 3) the Unified Numbering System (UNS), developed by ASTM and SAE, to apply to all commercial metals and alloys.

6.0 GENERAL REQUIREMENTS

6.1 Chemical Composition

Steels purchased to this specification will meet the requirements of chemical composition shown in Table I for the Type specified. Heat resisting steels and alloys used in high temperature applications requiring wear resistance are listed in Table II, along with the required chemical compositions.

TABLE IA - CHEMICAL COMPOSITION

AISI Type *	UNS No.	Chemical Composition, % (Maximum Unless Otherwise Shown)								
		C	Mn	P	S	Si	Cr	Ni	Mo	Other Elements
AUSTENITIC TYPES										
201	S20100	0.15	5.50-7.50	0.060	0.030	1.00	16.00-18.00	3.50-5.50	--	N 0.25
202	S20200	0.15	7.50-10.0	0.060	0.030	1.00	17.00-19.00	4.00-6.00		N 0.25
***	S20400	0.030	7.0-9.0	0.040	0.030	1.00	15.0-17.0	1.5-3.0		N 0.15-0.30
301	S30100	0.15	2.00	0.045	0.030	1.00	16.00-18.00	6.00-8.00		--
18-8†	--	--	--	--	--	--	--	--	--	--
302	S30200	0.15	2.00	0.045	0.030	1.00	17.00-19.00	8.00-10.00	--	--
302B	S30215	0.15	2.00	0.045	0.030	2.00-3.00	17.00-19.00	8.00-10.00	--	--
302HQ	S30430	0.03	2.00	0.045	0.030	1.0	17.00-19.00	8.00-10.00	--	Cu 3.00-4.00
303	S30300	0.15	2.00	0.20	0.15 min	1.00	17.00-19.00	8.00-10.00	0.60**	--
303Se	S30323	0.15	2.00	0.20	0.060	1.00	17.00-19.00	8.00-10.00	--	Se 0.15 min
304	S30400	0.08	2.00	0.045	0.030	1.00	18.00-20.00	8.00-10.50	--	--
304L	S30403	0.030	2.00	0.045	0.030	1.00	18.00-20.00	8.00-12.00	--	--
305	S30500	0.12	2.00	0.045	0.030	1.00	17.00-19.00	10.50-13.00	--	--
308	S30800	0.08	2.00	0.045	0.030	1.00	19.00-21.00	10.00-12.00	--	--
309	S30900	0.030	2.00	0.045	0.030	1.00	22.00-24.00	12.00-15.00	--	--
309S	S30908	0.08	2.00	0.045	0.030	1.00	22.00-24.00	12.00-15.00	--	--
310	S31000	0.25	2.00	0.045	0.030	1.50	24.00-26.00	19.00-22.00	--	--
316	S31600	0.08	2.00	0.045	0.030	1.00	16.00-18.00	10.00-14.00	2.00-3.00	--
316L	S31603	0.030	2.00	0.045	0.030	1.00	16.00-18.00	10.00-14.00	2.00-3.00	--
321	S32100	0.08	2.00	0.045	0.030	1.00	17.00-19.00	9.00-12.00	--	Ti 5 x C min
347	S34700	0.08	2.00	0.045	0.030	1.00	17.00-19.00	9.00-13.00	--	Cb+Ta 10 x C min

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TABLE IA (cont'd)

AISI Type *	UNS No.	Chemical Composition, % (Maximum Unless Otherwise Shown)								
		C	Mn	P	S	Si	Cr	Ni	Mo	Other Elements
FERRITIC TYPES										
405 409	S40500 S40900	0.08 0.03	1.00 1.00	0.040 0.040	0.030 0.020	1.00 1.00	11.50-14.50 10.50-11.70	— 0.50	—	A1 0.10-0.30 Ti 6 x (C+N) min; 0.75 max; Cb 0.17; N 0.030 max
---	S41050	0.04	1.00	0.045	0.030	1.00	10.5-12.5	0.60-1.10	—	N 0.10 max
409Ni	S40975	0.03	1.00	0.040	0.030	1.00	10.5-11.7	0.50-1.00		Ti 6 x (C+N) min; 0.75 max
--	S41003	0.03	1.50	0.040	0.030	1.00	10.5-12.5	1.50	--	--
430	S43000	0.12	1.00	0.040	0.030	1.00	16.00-18.00	0.75	--	—
430F	S43020	0.12	1.25	0.060	0.15 min	1.00	16.00-18.00	—		—
430FSe 434	S43023 S43400	0.12 0.12	1.25 1.00	0.060 0.040	0.060 0.030	1.00 1.00	16.00-18.00 16.00-18.00	—	— 0.75-1.25	Se 0.15 min
436	S43600	0.12	1.00	0.040	0.030	1.00	16.00-18.00	—	0.75-1.25	Cb+Ta 5 x C min – 0.70 max
439	S43035	0.030	1.00	0.040	0.030	1.00	17.0-19.0	0.50	--	Al 0.15max Ti [0.20 + 4(C+N)] min 1.10max N 0.03 max
	S43932	0.030	1.00	0.040	0.030	1.00	17.0-19.0	0.50		0.2+(C+N) ≤Ti+Nb≤0.75; Al 0.15 max; N 0.030 max
--	S43940	0.030	1.00	0.040	0.015	1.00	17.5-18.5	--		Ti 0.10-0.60; Cb[0.30+(3xC)] min
441	S44100	0.030	1.00	0.040	0.030	1.00	17.5-19.50	1.00	--	Ti 0.10-0.50; Cb [0.3+(9xC)] min to 0.9 max
442 446	S44200 S44600	0.20 0.20	1.00 1.50	0.040 0.040	0.030 0.030	1.00 1.00	18.00-23.00 23.00-27.00	— —	— —	— —
MARTENSITIC TYPES										
410	S41000	0.15	1.00	0.040	0.030	1.00	11.50-13.50	0.75	—	—
414	S41400	0.15	1.00	0.040	0.030	1.00	11.50-13.50	1.25-2.50	—	—
416	S41600	0.15	1.25	0.060	0.15 min	1.00	12.00-14.00	—	0.60**	—
416Se	S41623	0.15	1.25	0.060	0.060	1.00	12.00-14.00	—	—	Se 0.15 min
420	S42000	Over 0.15	1.00	0.040	0.030	1.00	12.00-14.00	—	—	—
431	S43100	0.20	1.00	0.040	0.030	1.00	15.00-17.00	1.25-2.50	—	—
440A	S44002	0.60/ 0.75	1.00	0.040	0.030	1.00	16.00-18.00	—	0.75	—
440B	S44003	0.75/ 0.95	1.00	0.040	0.030	1.00	16.00-18.00	—	0.75	—
440C	S44004	0.95/ 1.20	1.00	0.040	0.030	1.00	16.00-18.00	—	0.75	—
501	S50100	Over 0.10	1.00	0.040	0.030	1.00	4.00-6.00	—	0.40-0.65	—
502	S50200	0.10	1.00	0.040	0.030	1.00	4.00-6.00	—	0.40-0.65	—

*Grade or Type designation originally developed by the American Iron and Steel Institute (AISI)

**May be added at manufacturer's option

***Commercial steel grade described as Nitronic® 30

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†Not an AISI Type; 18-8 is a common designation for types containing approximately 18% Cr and approximately 8% Ni. It is denoted here to allow its usage as a material code for drawings and purchase orders. When specified, 18-8 allows the following stainless steel types: 302, 302B, 302HQ, 303, 304 or 304L.

TABLE IB - CHEMICAL COMPOSITION

Type **	UNS No.	Chemical Composition, % (Maximum Unless Otherwise Shown)								
		C	Mn	P	S	Si	Cr	Ni	Mo	Other Elements
PFCEPITATION HARDENING TYPES										
13-8PH**	S13800	0.05	0.10	0.01	0.008	0.10	12.25-13.25	7.50-8.00	2.00-2.50	A1 0.90-1.35 N 0.010
15-5PH **	S15500	0.07	1.00	0.040	0.030	1.00	14.00-15.50	3.50-5.00	--	Cu 2.50-4.50 Cb+Ta 0.15-0.45
17-4PH **	S17400	0.07	1.00	0.040	0.030	1.00	15.50-17.50	3.00-5.00	--	Cu 3.00-5.00 Cb+Ta 0.15-0.45
17-7PH **	S17700	0.09	1.00	0.040	0.040	1.00	16.00-18.00	6.50-7.75	--	A1 0.75-1.50

** Common industry nomenclature; not an AISI designation.

NOTE: For some tube-making processes, it is necessary that the nickel content of several of the austenitic grades be slightly higher than that shown in the table. The user and producer should agree on the appropriate nickel ranges for such grades.

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TABLE II - CHEMICAL COMPOSITIONS OF TYPICAL MATERIALS FOR VALVE APPLICATIONS

Designation		Composition, percent (maximum, unless otherwise shown)											
Navistar Grade	SAE	C	Mn	P	S	Si	Cr	Ni	Mo	Fe	Co	Nitrogen	Other
NCR*	EV1	0.37-0.50	1.00	0.035	0.035	1.00	23.00-24.00	4.50-5.00	2.50-3.00	Balance	—	—	—
TXCR*	EV2	0.35-0.40	4.00-4.50	0.030	0.030	0.60-1.00	23.50-24.50	3.50-4.00	1.20-1.50	Balance	—	—	—
21-12N	EV4	0.15-0.25	1.00-1.50	0.030	0.030	0.70-1.25	20.00-22.00	10.50-12.50	—	Balance	—	0.15-0.20	—
21-55N	EV7	0.15-0.25	5.00-8.00	0.040	0.030	1.00	19.00-22.00	3.50-6.00	—	Balance	—	0.20-0.40	—
21-4N	EV8	0.47-0.58	8.00-10.00	0.050	0.090	0.25	20.00-22.00	3.25-4.50	—	Balance	—	0.38-0.50	—
21-2N	EV12	0.50-0.60	7.00-9.50	0.050	0.060	0.25	19.25-21.50	1.50-2.75	—	Balance	—	0.20-0.40	—
SP-3	—	2.25-2.75	—	—	—	1.0	18.00-22.00	37.00-43.00	—	Balance	10.00-14.00	—	Tungsten 5.00-7.00
No. 1*	HNV3	0.40-0.50	0.20-0.60	0.030	0.030	3.00-3.50	8.00-9.00	—	—	Balance	—	—	—
XB*	HNV6	0.76-0.86	0.20-0.60	0.020	0.030	1.90-2.60	19.00-21.00	1.00-1.60	—	Balance	—	—	—
Stellite 6 ^ψ	VF2	0.90-1.40	1.00	—	—	1.50 max	27.00-31.00	3.0 max	1.5	3.0	Balance	—	Tungsten 3.5-5.5
Stellite F	VF3	1.50-2.00	0.05	—	—	0.90-1.50	23.00-27.00	20.50-24.00	0.060	3.0	Balance	—	Tungsten 10.5-13.5 Boron 0.01 max
71360	—	0.50-0.55	0.20-0.40	0.030	0.030	0.20-0.40	3.00-4.00	—	—	Balance	—	—	Tungsten 12.00-15.00
Pyromet® 31V	--	0.045	0.2	--	--	0.2	22.6	56.5	2.0	Balance	1.0	--	1.3 Al, 2.3 Ti, 0.85 Nb, 0.005 B
TRW 25-12NbN	--	0.3	5.0	0.04	0.03	0.30	25.0	11.5	--	Balance	--	0.6	2.2 Nb

* Silchrome alloys ^ψ Haynes Stellite 6

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