

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS C-2
		Former Designation: CEMS C-2
TITLE: Brass and Bronze Castings		CURRENT REV No.: 1412
		DATE: Dec. 2014
WRITTEN/EDITED BY: Materials Engineering	APPROVED BY: Materials Engineering	SUPERSEDES: CEMS C-2 - December 2001
PRINTED COPIES OF THIS DOCUMENT MUST BE VERIFIED FOR CURRENT REVISION		
<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: Changed to new MPAPS format; editorial changes.		

1.0 SCOPE

This specification covers the requirements for copper-base castings used in the Company's products.

1.1 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.

2.0 REFERENCE DOCUMENTS

Unless otherwise specified, the latest issue of all referenced standards shall apply. The following Specifications, Standards, and Regulations are referenced in this specification.

Quality System Standard ISO 9001 or TS-16949	SAE HS-1086
CFR Title 29, Part 1910	ASTM DS-56
NAVISTAR Manufacturing Std. MS-D-13	ASTM B 208
NAVISTAR Engineering Design Std A-16	ASTM E 8
NAVISTAR MPAPS B-50	ASTM E-10
NAVISTAR EPS-143	

3.0 REQUIREMENTS

3.1 Chemical Composition Requirements

Copper-base castings purchased to this specification will meet the requirements of chemical composition shown in Table I.

3.2 Mechanical Properties

Copper-base alloys purchased to this specification will conform to the requirements shown in Table II.

3.2.1 The tensile data given in Table II represents the minimum requirements for test coupons and specimens prepared in accordance with standard procedures. These properties are not necessarily the same as the corresponding properties of the casting because of the effect of varying size, section and design.

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DECEMBER 2014



Documents

Page 1 of 5
Document Sharing Hub

NUMBER: MPAPS C-2	TITLE: Brass and Bronze Castings	REVISION: 1412
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TABLE I - CHEMICAL COMPOSITION

Designation		Composition, Percent (Max Except Where Shown Otherwise)									
UNS No.	Obsolete International	Copper	Zinc	Tin	Lead	Aluminum	Manganese	Iron	Nickel	Phosphorus	Other
C83600	BC-26-05	84.0-86.0 ***	4.0-6.0	4.0-6.0	4.0-6.0	-	-	0.30	1.0 ***	0.5 *	-
C85400	BC-11-33	65.0-70.0	balance	1.5	1.5-3.8	0.35	-	-0.7	-	-	-
C86300	BC-41-30	60.0-66.0	balance	0.20	0.20	5.0-7.5	2.5-5.0	2.0-4.0	-	-	-
C86500	BC-41-40	55.0-60.0	balance	1.0	0.40	0.50-1.5	1.5	0.40-2.0	0.50	-	-
C90500	BC-22-10	86.0-89.0	1.0-3.0	9.0-11.0	0.30	-	-	0.20	1.0	0.05 *	-
C90700	BC-22-11	88.0-90.0	0.50 **	10.0-12.0	0.50 **	0.005	-	0.15	**	0.10-0.30	-
C92200	BC-22-06	86.0-90.0	3.0-5.0	5.5-6.5	1.0-2.0	-	-	0.25	1.0	0.05 *	-
C92700	BC-26-02	balance	0.7	9.0-11.0	1.0-2.5	0.005	-	0.20	1.0	0.25	-
C93200	BC-26-07	81.0-85.0 ***	1.0-4.0	6.3-7.5	6.0-8.0	-	-	0.20	1.0 ***	0.15 *	antimony 0.35
C93700	BC-26-10	78.0-82.0	0.8	9.0-11.0	8.0-11.0	-	-	0.7	0.5 ***	* 0.1	antimony 0.50
C95200	BC-33-09	86.0 min	-	-	-	8.5-9.5	-	2.5-4.0	-	-	1.0 total
C95300	BC-33-11	86.0 min	-	-	-	9.0-11.0	-	0.8-1.5	-	-	1.0 total
C95400	-	83.0 min	-	-	-	10.0-11.5	0.50	3.0-5.0	1.5	-	0.50 total

* For continuous castings, phosphorus will be 1.5% max.

** Total lead, zinc and nickel will be 1.0 percent, max.

*** In determining copper minimum, copper may be calculated as copper and nickel.

3.2.2 When the strength of a casting is critical, the purchaser and supplier will agree on the minimum tensile properties acceptable in a critical location of the casting. Specimens will be machined from the critical section to check these requirements.

4.0 QUALITY

Castings will conform to drawings within commercial standards or to the patterns supplied by the purchaser. The castings will be free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects. Castings will be cleared of all extraneous cast-on parts; the surfaces will be free from burned-on sand and will be reasonably smooth. Repair welding will be permitted only by agreement between purchaser and supplier. Welded castings will be free from excessive stresses, warping or hard spots in or near the weld.

5.0 METHODS OF TEST

5.1 Chemical Test

Samples for checking conformity to Table I, will be taken by drilling or cutting the test coupon or sprue, or the casting in case of purchaser's quality control checks, in such a manner as to be representative of the entire cross section.

5.2 Mechanical Tests

Unless otherwise agreed, the test coupons and specimens for tension tests will be prepared in accordance with ASTM B 208. If the castings are heat treated, the test bars representing the castings will be similarly heat treated.

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DECEMBER 2014



Documents

Page 2 of 5
Document Sharing Hub

NUMBER: MPAPS C-2	TITLE: Brass and Bronze Castings	REVISION: 1412
-----------------------------	--	--------------------------

TABLE II - MECHANICAL PROPERTY REQUIREMENTS

UNS No.	Type of Casting	Test Bar Values, Min (Except Where Shown As Range)						
		Tensile Strength		Yield Strength *		elongation in 2 in (50 mm), %	Brinell Hardness Number	
		psi	MPa	psi	MPa		500 kgf load	3000 kgf load
C83600	sand	30 000	207	14 000	97	20	55-65	-
	continuous	36 000	248	19 000	131	15	60	-
C85400	sand	30 000	207	11 000	76	20	50-60	-
C86300	sand	110 000	758	60 000	414	12	-	217-269
C86500	sand	65 000	448	25 000	172	20	-	100-120
C90500	sand	40 000	276	18 000	124	20	66	-
	centrifugal	44 000	303	22 000	152	15	75	-
	continuous	40 000	276	25 000	172	10	80	-
C90700	sand	35 000	241	18 000	124	10	60-80	-
	continuous	40 000	276	25 000	172	10	80	-
C92200	sand	34 000	234	16 000	110	22	60-80	-
C92700	sand	35 000	241	18 000	124	10	60-75	-
C93200	sand	30 000	207	14 000	97	12	55-65	-
	continuous	35 000	241	20 000	138	10	60	-
C93700	sand	25 000	172	12 000	83	8	55-65	-
	continuous	35 000	241	24 000	138	6	60	-
C95200	sand	65 000	448	25 000	172	20	-	110-140
C95300	sand, heat treated	80 000	552	40 000	276	12	-	160-225
C95400	sand	75 000	517	30 000	207	12	-	-
	sand, heat treated	90 000	621	45 000	310	6	-	-

* Stress producing an elongation under load of 0.5 percent; i.e., 0.01 inch (0.25 mm) in a gage length of 2 inches (50 mm).

5.2.1 The following ASTM methods will be used to test properties required in this specification:

Test	ASTM Method
Tension	E 8
Hardness Brinell	E 10
Rockwell	E 18

6.0 SOURCE APPROVAL AND QUALITY CONTROL

6.1 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.

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DECEMBER 2014



Documents

Page 3 of 5

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