

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS A-40
		Former Designation: CEMS A-40 Sections A and B
TITLE: Case Hardening Ferrous Materials		CURRENT REV No.: 1508
		DATE: August 2015
WRITTEN/EDITED BY: J. Sponzilli	APPROVED BY: R. Goluch	SUPERSEDES: Rev No, Date 1408, August 2014
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: Revise nitriding requirements. Added section covering core hardness requirements. Editorial changes.		

1.0 APPLICATION

This specification covers diffusion based surface hardening of ferrous parts for the purpose of enhancing their fatigue, wear and/or corrosion resistance properties.

2.0 SCOPE

MPAPS A-40 covers the following case hardening processes for ferrous parts:

- A. Carburizing and Carbonitriding** - thermochemical processes of case hardening that involve the diffusion of carbon or carbon and nitrogen into the surface of ferrous materials at elevated temperatures
- B. Nitriding and Ferritic Nitrocarburizing** - thermochemical processes of case hardening that involve the diffusion of nitrogen or nitrogen and carbon into the surface of ferrous materials at low temperatures between 930°F to 1050°F

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 Specifications, Standards, and Regulations are referenced in this specification.

Quality System Standard ISO 9001 or TS-16949	SAE J1081
CFR Title 29, Part 1910	SAE J864
NAVISTAR Manufacturing Std. MS-D-13	SAE J404
NAVISTAR Engineering Design Std A-16	ASTM A355
NAVISTAR MPAPS B-50	ASTM E384
ASTM E140	

This document is restricted and may not be sent outside Navistar, Inc. or reproduced without permission from Corporate Technical Standards. Suppliers are required to assume all patent liability. ©2015 by Navistar, Inc.

AUGUST 2015



Documents

Page 1 of 8

Document Sharing Hub

NUMBER: MPAPS A-40	TITLE: Case Hardening Ferrous Materials	REVISION: 1508
------------------------------	---	--------------------------

A. CARBURIZING and CARBONITRIDING

The following sections, prefixed with an (A), apply to carburized and carbonitrided components only.

A4.0 CLASSIFICATION

Case hardened steels are classified by the depth of the hardened surface layer. See Tables I and II.

A5.0 GENERAL REQUIREMENTS

A5.1 Light Cases

Light cases have depths of 0.020 inch (0.50 mm) or less. The case depth will be measured by the total case method, unless otherwise specified. Classification, requirements, and case hardening process will be as shown in Table I (refer to Section A5.5 for measurement of case properties).

TABLE I
CLASSIFICATION ⁽¹⁾ AND REQUIREMENTS ^{(2) (3)}
Light Cases

Navistar Class	Total Case Depth		Surface Hardness	Case Hardening Process	Quench
	in	mm			
1A	0.002-0.006	0.05-0.15	File Resistant	Carbonitriding	Oil or Water
1B			File Hard		
2A	0.006-0.010	0.15-0.25	File Resistant	Carbonitriding	Gas
2B			Rockwell 89-93 HR15N or File Hard		Oil or Water
3	0.010-0.020	0.25-0.50	Rockwell 89-93 HR15N	Carbonitriding or Carburizing	Oil or Water
3A			File Resistant		Gas

⁽¹⁾ Where deemed feasible on particular parts and after consultation with the Materials Engineer, more than one Class should be specified. See "Appendix" for further discussion.

⁽²⁾ All case-hardened steels shall be produced using fully-killed, fine-grain practices.

⁽³⁾ Heat treating will be carried out in such a manner as to avoid excessive brittleness in the finished part. Parts which require specific properties will have the requirements and methods of test detailed on the drawing.

A5.2 Heavy Cases

Heavy cases are those with case depths in excess of 0.020 inch (0.51 mm) and will be produced by carburizing. All heavy case carburized parts will be tempered at 350°F (175°C) minimum. The effective case depth method will be used for determination of case depth on the tempered part, unless otherwise specified on the engineering drawing. Classification will be as shown in Table II (refer to Section A5.5 for measurement of case properties).

A5.3 Surface Hardness

Whenever a class from Table II is specified, it is also necessary to specify the desired surface hardness. For gears and splined shafts, the specified hardness is generally Rockwell 57-63 HRC, while roller bearing components are usually specified Rockwell 60 HRC minimum. For certain applications, it may be desirable to specify file hardness. If a surface hardness range with a minimum less than Rockwell 55 HRC is specified, special effective case hardness must be designated on the drawing (see Section 10.0).

This document is restricted and may not be sent outside Navistar, Inc. or reproduced without permission from Corporate Technical Standards. Suppliers are required to assume all patent liability. ©2015 by Navistar, Inc.

AUGUST 2015



Documents

Page 2 of 8

Document Sharing Hub

NUMBER: MPAPS A-40	TITLE: Case Hardening Ferrous Materials	REVISION: 1508
------------------------------	---	--------------------------

A5.4 Microstructure

Surface and near surface microstructures are important to performance. A structure of tempered martensite and retained austenite which results in a surface hardness of not less than 57 HRC or the minimum specified on the drawing is required. Exceptions are noted below. (Note that retention of a sharp edge on the metallographic section is very important for determination of surface microstructures. Use of electroless nickel plating of the case hardened surface is suggested for edge retention.)

TABLE II
CLASSIFICATION ⁽¹⁾ AND REQUIREMENTS ⁽²⁾
Heavy Cases

Navistar Class ⁽⁴⁾	Effective Case Depth ⁽³⁾		Navistar Class ⁽⁴⁾	Effective Case Depth ⁽³⁾	
	inch	mm		inch	mm
25	0.018-0.038	0.40-0.90	60	0.048-0.074	1.25-1.90
30	0.022-0.043	0.50-1.00	70	0.056-0.082	1.50-2.15
35	0.026-0.048	0.65-1.25	80	0.065-0.095	1.65-2.40
40	0.031-0.055	0.75-1.40	90	0.075-0.105	1.90-2.65
45	0.036-0.060	0.90-1.50	110	0.095-0.125	2.40-3.15
50	0.040-0.066	1.00-1.65	130	0.115-0.145	2.90-3.65

- ⁽¹⁾ Where deemed feasible on particular parts and after consultation with Materials Engineering, more than one Class may be specified. See "Appendix" for further discussion.
- ⁽²⁾ All case-hardened steels shall be produced using fully-killed, fine-grain practices.
- ⁽³⁾ Case depth measurements on gear teeth will be made at the pitch line and at the root fillet. At the pitch line, the case depth will conform to the specified class; at the root fillet, it will be not less than 50% of the minimum specified class. On critical parts, it is desirable to specify the location for case depth checks since the case depth may vary from one area to another on a single part.
- ⁽⁴⁾ For obsolete parts with conventional (total) case depth specified on the engineering drawing, the relationships between effective and conventional case depths are approximate. Contact Materials Engineering for conversion of the obsolete case depth to one of the Navistar Classes shown in Table II.

A5.4.1 Only well-distributed globular carbides are permitted.

A5.4.2 Limited amounts of intergranular oxides or associated transformation products are allowed, but to a depth no greater than 0.001 inch (25µm). Where performance requires no intergranular oxides or associated transformation products, a note about it should be put on the part's drawing.

A5.4.3 While bainite in the case is not desired, a small amount is permissible providing the minimum surface hardness of 57 HRC is maintained.

A5.5 Measurement of Case Properties

A5.5.1 Location of Measurement

Measurement will be made on a suitably polished cross section, perpendicular to the one or more significant surface on the finished part, after all grinding has been performed. Case depth measurements

This document is restricted and may not be sent outside Navistar, Inc. or reproduced without permission from Corporate Technical Standards. Suppliers are required to assume all patent liability. ©2015 by Navistar, Inc.

AUGUST 2015



Documents

Page 3 of 8
Document Sharing Hub