Hyster-Yale Group, Inc. **Title:** LOW CARBON – HIGH ALLOY STEEL FOR CARBURIZING AND THROUGH HARDENING	**Document Control Number:** **HC-6**
Page 1 of **3** **Document Author:** Caitlin Toohey	**Effective Date:** 01-Mar-2017 **Revision No.** 2017-03

1.0 OBJECTIVE: This specification is established to provide a low carbon – high alloy carburizing grade of steel with high hardenability which is also suitable for through hardening heat treatment to yield strengths of approximately 100 ksi and 125 ksi and still remain readily weldable.

1.1 CITED: See Master Index for a complete list of Citing & Cited Documents

2.0 REQUIREMENTS:

Chemical Composition, % Ladle Analysis (similar to AISI/SAE 9310H & 9315H)

Carbon	0.08 – 0.18
Manganese	0.45 – 0.66
Nickel	3.00 – 3.50
Chromium	1.00 – 1.40
Molybdenum	0.08 – 0.15
Silicon	0.15 – 0.30
Phosphorous	0.025 Maximum
Sulfur	0.025 Maximum

NOTE: Chemical composition is subordinate to hardenability requirements.

Hardenability

At J1 HRC 36-43; J31 = 6/16 in. min.

Quality

Barstock and forgings: Regular quality, fine grain practice as determined by ASTM E112.

Dimensional Tolerances

Barstock: As stated within ASTM A29/A29M.

Forgings: Commercial forging tolerances, unless otherwise specified.

Heat Treatment by Supplier

Forgings and Barstock: Annealed; SHN 241 maximum.

Certification

The supplier shall include with each material or subcontracted lot shipped to Hyster Company a statement certifying compliance with HC-6 requirements signed by an authorized representative of the supplier.

Alternate Specification

British:	BS 970 P1, EN 36A, B or C
German:	DIN EN 10084: 2006/2008: 18CrNiMo7-6
Japanese:	JIS G4052 Grade SNC 815H

Certification

The supplier shall include with each material lot shipped to Hyster-Yale Group a statement certifying compliance with the HC-6 requirements signed by an authorized representative of the supplier. The following information shall be reported for each heat of steel supplied to Hyster-Yale Group:

(1) Chemical Composition
(2) Mechanical Properties

Method of Specifying

HC-6

3.0 ENGINEERING INFORMATION: (Not Part of Requirement)

Engineering

Application

This material is primarily intended for carburized parts machined form barstock or forgings which require a higher core hardness and toughness than can be obtained with HC-2. Core strength and toughness are dependent on section size.

This material as well as HC-2 can be used for non-carburized parts requiring yield strengths of approximately 100 ksi or 125 ksi and which must be readily weldable. The readily weldable requirement generally precludes the use of HC-5 material. The choice between HC-2 and HC-6 to meet these strength requirements is dependent on the mass of the part and the severity of quench; oil, water or brine. Typical parts having these requirements are large ball studs and stub shafts

Mechanical Properties

SPECIFIED HARDNESS ROCKWELL C	EQUIVALENT TENSILE STRENGTH KSI (MPa)	EQUIVALENT YIELD STRENGTH KSI (MPa)	ELONGATION IN 2 INCHES %	REDUCTION OF AREA %
25 – 32	120-145 (827-1000	100-125 (689-862)	20	55
35 – 38	145-170 (1000-1172)	125-150 (862-1034)	16	50

References

"Steel Products Manual, Alloy Steel: Semi finished, Hot Rolled and Cold Finished Bars," American Iron and Steel Institute. New York, February 1964.

ASTM A304 Standard Specification for Alloy Steel Bars to Eng-Quench Hardenability Requirements.

SAE J1268 Hardenability Bands for Alloy H Steels.

Stahlschluschel (Key to Steel), 1971 Edition.

Method of Specifying

Material:	HC-6	---
Heat Treatment:	Carburized Through Hardened	See Section G1

Manufacturing

Certification

Recertification of incoming materials or parts to a planned quality level will be performed, consistent with product classification, vendor performance and total quality cost.

Availability and Options

This material and its options are not always readily available from standard commercial steel service centers. It may be necessary at times to purchase them from steel service centers serving the aircraft industry. AISI/SAE 3310 or E3310 may be substituted for this material without engineering authorization provided it meets the hardenability requirements of this specification.

Heat Treatment

Parts such as stub shafts which specify a Rockwell C hardness of 25-32 or 33-38 are intended to be water quenched. The required strength level with a sufficient depth of martensitic microstructure generally cannot be obtained with oil quenching.

Color Code

Green background. (See color code for strip.)