MERITOR®
2135 West Maple Road
Troy, MI 48084-7121

Material Specification

Specification: 15
Revision Date: 12/07/2015
Revision Level: N

GENERAL SPECIFICATION FOR QUENCH & TEMPER OF WROUGHT STEEL

Caution: Former process specification 15 (called out on drawings released prior to 7/15/86) was withdrawn from production and replaced by P.S. 30-CO on 7/15/86.
Current process specification 15 (called out on drawings released after 7/15/86) is active and is defined in the information below.

1.0 GENERAL SPECIFICATION: Process Specification 1. All the requirements for the general specifications apply unless superseded by the requirements within this specification.

2.0 SCOPE: Description of the metallurgical requirements and code development for specification of the quench and temper (Q&T) processes.

3.0 DEVELOPMENT OF THE SPECIFICATION CODE:

Example: 22-EO-1

3.1 First Three Positions in the Specification Number:

Two numbers followed by a letter identify the process as a quench & temper operation. The value of the first two numbers dictate the minimum Brinell hardness of the heat treated component. The hardness range is specified by the letter in the third position. The first two numbers in the example, "22" specify that the minimum hardness is between 220 and 230 HB. The exact hardness range is shown in the individual specification. The letter code for the third position gives an approximate value of difference between the maximum and minimum range, as shown in Table 1.

Table 1: Third Position Hardness Difference Between Minimum and Maximum Range

Letter Code	Brinell Hardness Range(BHW)
A	10 - 19
B	20 - 29
C	30 - 39
D	40 - 49
E	50 - 59
F	60 - 69
G	70 - 79
H	80 - 89
I	90 - 99
J	100 - 109
K	110 - 119
L	120 - 129
M	Max.
N	Min.

EXAMPLE 22-EO-1: Actual HB RANGE per the individual specification is 223-277. The difference between maximum and minimum is 52 points which corresponds to E (50-59).

3.2 Fourth Position in the Specification Number:

The letter in the fourth position designates the specified quench media as listed in Table 2. The "O" in the example designates that oil should be used as the quench media.

Table 2: Quench Specifications

Letter Code	Quenching Media
A	As required
C	Caustic
H	Hot oil (200°F minimum)
M	Molten salt (700°F)
O	Oil (200°F maximum)
S	Synthetic (Polymer)
W	Water

3.3 Fifth Position in the Specification Number:

Any number in the fifth position indicates that modifications to the process are described in individual sheets.

4.0 HARDNESS REQUIREMENTS:

4.1 Hardnesses:

All hardness ranges listed within the quench and temper specifications are after tempering unless otherwise specified.

Individual specifications may require as-quenched hardnesses. These hardnesses are to be measured in-process.

4.2 Hardness Measurement Location:

Unless otherwise specified, hardness shall be measured at the surface of the heaviest and thinnest cross sections and in the core. Core hardness is applicable only if the specified material has sufficient hardenability to satisfy the specification, when processed according to the applicable ARM Process Standard. The core hardness shall be measured at half radius for shafts and parts with circular cross section unless otherwise specified. The appropriate hardness scale should be selected according to the requirements presented in SAE J417.

5.0 MICROSTRUCTURAL REQUIREMENTS:

The core (center) will be a minimum of 90% martensite when adequate steel hardenability is specified. Where microstructure is a factor in processing (machining or forming) microstructure will be subject to negotiations between the producer and consumer.

6.0 AUSTENITIZING TEMPERATURE:

Recommended normalizing and austenitizing temperatures are given in Table 3 and 4 for steel in order to meet end-quench hardenability requirements. A variation of ±10°F (±5°C) from the temperatures listed within Tables 3 and 4 is permissible.

Table 3: Normalizing and Austenitizing Temperatures Applicable To Steel Ordered To End-Quench Hardenability Requirements.

Applicable Steel Series	1000, 1300, 1500, 4000, 4100, 4300, 4600, 5000, 5100, 6100, 8600, 8700, 9400	
Max Ordered Carbon Content %	**Normalizing Temperature, °F (°C)**	**Austenitizing Temperature, °F (°C)**
Up to 0.25 incl.	1700 (925)	1700 (925)
0.26 to 0.36 incl.	1650 (900)	1600 (870)
0.37 and over	1600 (870)	1550 (845)

Table 4: Normalizing and Austenitizing Temperatures Applicable To Steel Ordered To End-Quench Hardenability Requirements.

Applicable Steel Series	4800, 9200	
Max Ordered Carbon Content %	**Normalizing Temperature, °F (°C)**	**Austenitizing Temperature, °F (°C)**
Up to 0.25 incl.	1700 (925)	1550 (845)
0.26 to 0.36 incl.	1650 (900)	1550 (845)
0.37 and over	1600 (870)	1475 (800)
0.50 and over (9200)	1650 (900)	16000)

7.0 TEMPERING TEMPERATURE:

All hardened parts must be furnace tempered for at least one hour at the minimum tempering temperature of 800°F; unless lower tempering temperature is required to obtain the specified hardness and mechanical properties.

8.0 REFERENCE SPECIFICATIONS:

Industry Affiliation	Standard Number and revision Date	Title of Standard
Meritor	1	CONTROL OF HEAT TREATING PROCESSES, FURNACES, AND AUXILIARY EQUIPMENT

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Date	Change
12/07/2015 Level N PR-03301	Revised format. Changed Letter Code D from 40 – 39 to 40 – 49 in Table 1. Added Section 8.0 REFERENCE SPECIFICATIONS.
5/05/2008 Level M Request 30626-2	Added "(Polymer)" after "Synthetic" in Table 2.
12/05/2007 Level L Request 30272-6	Added hardness section (3.1). Editorial changes to sections 2, 3 and 5.
9/15/2002 Level K Request 22450-1	Added core hardness location requirement in section 3.
8/15/2001 Level J Request 21331-1	Removed section 3: "when a Rockwell hardness scale is also listed, it is the preferred measurement scale", along with Table 1 reference. Expanded core hardness requirements. Added SAE J417 hardness testing reference.
6/15/2001 Level H Request 21206-5	Added caution note and replacement for former P.S. 15.
1/15/2001 Level G Request 20717-1	Section 6 was "Tempering temperature: All hardened parts must be furnace tempered for one hour min. unless otherwise specified at appropriate tempering temperature (800°F minimum) to give required hardness and mechanical properties.
11/16/98 Level F	Deleted the index portion of Table 1 and moved details to individual specifications PS 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 46, 48, 51, 53, 55, and 65.
9/8/98 Level E	Added 48-NW to Table 1
11/15/96 Level D	Update Table 1 -Added 16-NO,21-CW,22-EO, 26-CA, 26-ES, 30-EA, 30-EO-2, 32-DS, 35-LM 40-DH-3,41-DO, 41-DM-1, 43-HA, 51-HS

10/15/94 Level C	Added 24-CW, 24-EO, 24-FO, 44-FO-1
7/15/93 Level B	Added 18-CO, 21-EO-2, 28-EO-1.
8/15/92 Level A	Added 28-DA, 28-EA-1 to Table 1.
4/15/91	Added 28-EA, 32-EH, 36-EO to Table 1.
12/15/91	Added 24-GA, 32-EO, 37-FM-1, 37-FO-1, 37-KO to Table 1.
5/15/91	Added P.S. 24-CA-1, 24-DO, 30-GO-1, 40-DH, 40-DH-2, 48-FO-1, 53-HO, 53-HO-1, to Table 1.
7/15/90	Added P.S. 25-LO-1, 32-JM, 37-JO, 41-KO to Table 1.

Approved By: S. Doyle
Director – Product Validation and Materials Engineering