Heat Treatment and Testing of Carbon, Micro-alloyed, and Low-alloy Steel Wrought and Cast Components

API RECOMMENDED PRACTICE 6HT
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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

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Introduction

Heat treatment is a critical process used to manipulate the microstructures of metallic materials and achieve specific mechanical and metallurgical properties. This document defines heat treatment process and operational controls to produce parts that conform with design requirements.

This document is intended to provide a means for the qualification test coupon (QTC) to represent the properties in the part. The information provided is intended to optimize the heat treatment and heat treatment response of parts with the intent of producing a component that has the required mechanical and metallurgical properties at specified test locations.

This document is recommended for use with the following in consideration:

— API Standard 20H provides additional detailed information for batch-type heat treatment processing and control.

— API Standard 20N provides additional detailed information for continuous-type heat treatment processing and control.

— The properties exhibited by the QTCs can represent the properties of the thermal response of the material comprising the production parts it qualifies, provided material with the proper hardenability is selected.

NOTE The QTC results may not always correspond to the properties of the actual parts at all locations throughout their cross section.

The required mechanical properties as established by the manufacturer may be different from the mechanical properties required by the API equipment specification.

This recommended practice (RP) is not a substitute for sound engineering practices and metallurgical knowledge.

This recommended practice is the result of updating the requirements from API Recommended Practice 6HT, Second Edition. This revision is developed based on input from the technical experts on the API SC06 Valves & Wellhead Equipment subcommittee. The third edition moves this RP to a higher level of guidance for the petroleum and natural gas industry.

Highlights of significant changes between the second and third edition include:

— review and implementation of the RP 6HT ad hoc exploratory group recommendations;

— additional technical information for continuous-type heat treatment processes;

— a change in title and scope;

— improved clarity of document;

— clarified intent and expectation of usage of this RP;

— highlighted alternate furnace calibration frequency provisions per SAE AMS2750;

— new definitions for carbon steel, micro-alloyed steel, and low-alloy steel;

— new definition for qualification test coupon;

— revised definitions of applicable cross sections;

— updated types of furnace temperature monitoring devices;

— provided clear guidance on applicable materials and product forms;

— improved guidance on heat treatment and quench temperature ranges.

Heat Treatment and Testing of Carbon, Micro-alloyed, and Low-alloy Steel Wrought and Cast Components

1 Scope

This document provides recommended practices for batch-type heat treatment, continuous-type heat treatment, and processing of qualification testing coupons for carbon, micro-alloyed, and low-alloy steel wrought and cast components.

This recommended practice is intended:

— for use on components being manufactured for conformance to API product specifications or standards; and

— to supplement the heat treatment and testing requirements found in the API product specifications or standards.

Batch and continuous heat treatment and testing of hot isostatically pressed products or additively manufactured metallic products are outside the scope of this RP.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Standard 20H, *Heat Treatment Services—Batch Type for Equipment Used in the Petroleum and Natural Gas Industry*

API Standard 20N, *Heat Treatment Services—Continuous Line for Equipment Used in the Petroleum and Natural Gas Industry*

ASTM A255,[1] *Standard Test Methods for Determining Hardenability of Steel*

ASTM A991/A991M, *Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products*

ASTM E230/E230M, *Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

IEC 60584-1,[2] *Thermocouples—Part 1: EMF Specifications and Tolerances*

SAE AMSH6875,[3] *Heat Treatment of Steel Raw Materials*

SAE AMS2750, *Pyrometry*

SAE AMS2801, *Heat Treatment of Steel Raw Materials*

[1] ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania 19428, www.astm.org.

[2] International Electrotechnical Commision (IEC), IEC Secretariat, 3 rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland, www.iec.ch.

[3] Society of Automotive Engineers, (SAE), 400 Commonwealth Drive, Warrendale, Pennsylvania 15096-0001, www.sae.org.