



Designation: D6200 – 21

Standard Test Method for Determination of Cooling Characteristics of Quench Oils by Cooling Curve Analysis¹

This standard is issued under the fixed designation D6200; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This test method describes the equipment and the procedure for evaluation of a quenching oil's quenching characteristics by cooling rate determination.

1.2 This test is designed to evaluate quenching oils in a non-agitated system. There is no correlation between these test results and the results obtained in agitated systems.

1.3 The values in SI units are to be regarded as the standard.

1.3.1 *Exception*—The values in parentheses are provided for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D1744 Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent (Withdrawn 2016)³

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

E220 Test Method for Calibration of Thermocouples By

Comparison Techniques

E230 Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

2.2 SAE Standards:⁴

AMS 5665 Nickel Alloy Corrosion and Heat Resistant Bars, Forgings and Rings

2.3 Japanese Industrial Standards (JIS):⁵

JIS K 2242 - 1980 Heat Treating Oil

JIS K 6753 - 1977 Di-2-ethylhexyl Phthalate

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 For definitions of terms used in this guide, refer to Terminology D4175.

3.1.2 *cooling curve, n*—the cooling curve is a graphical representation of the cooling time (t) - temperature (T) response of the probe (see 7.3). An example is illustrated in Part B of Fig. 1.

3.1.3 *cooling curve analysis, n*—the process of quantifying the cooling characteristics of a heat treating oil based on the temperature versus time profile obtained by cooling a pre-heated metal probe assembly (see Fig. 2) under standard conditions.

3.1.4 *cooling rate curve, n*—The cooling rate curve is obtained by calculating the first derivative (dT/dt) of the cooling time - temperature curve. An example is illustrated in Part B of Fig. 1.

3.1.5 *heat treating oil, n*—a hydrocarbon containing product, often derived from petroleum base stock, that is used to mediate heat transfer between heated metal, such as austenitized steel, to control the microstructure that is formed upon cooling and also control distortion and minimize cracking which may accompany the cooling process.

3.1.6 *quench severity, n*—the ability of a quenching medium to extract heat from a hot metal.⁶

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.L0.06 on Non-Lubricating Process Fluids.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

⁵ Available from Japanese Standards Organization (JSA), 4-1-24 Akasaka Minato-Ku, Tokyo, 107-8440, Japan, <http://www.jsa.or.jp>.

⁶ Boyer, H. E. and Cary, P. R., *Quenching and Distortion Control*, ASM International, Materials Park, OH, 1988, p. 162.

*A Summary of Changes section appears at the end of this standard

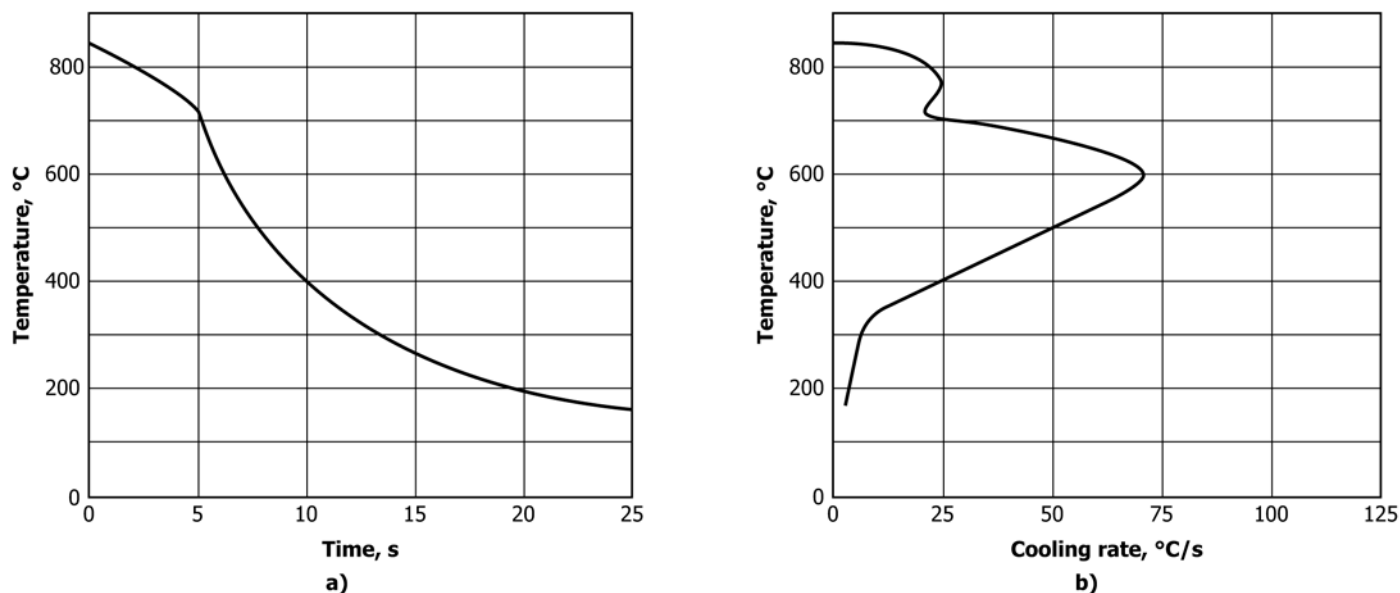


FIG. 1 Typical Temperature/Time and Temperature/Cooling Rate Plots For Test Probe Cooled in a Quenching Oil

4. Summary of Test Method

4.1 Determine the nickel alloy probe assembly's cooling time versus temperature after placing the assembly in a furnace and heating to 850 °C (1562 °F) and then quenching in a heat treating oil. The temperature inside the probe assembly and the cooling times are recorded at selected time intervals to estab-

lish a cooling temperature versus time curve. The resulting cooling curve may be used to evaluate quench severity (see Note 1).

NOTE 1—For production testing, the furnace temperature of 815 °C to 857 °C (1500 °F to 1575 °F) may be used.