



Designation: D 3520 – 04

An American National Standard

Standard Test Method for Quenching Time of Heat-Treating Fluids (Magnetic Quenchometer Method)¹

This standard is issued under the fixed designation D 3520; 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 covers a procedure for making a comparative evaluation of the quenching speed characteristics of petroleum fluids used in the quenching of metals by means of the Magnetic Quenchometer.

NOTE 1—A comparison method for testing the hardenability of steel is Test Method A 255.

NOTE 2—An additional comparison method for evaluation of the quenching speed characteristics of petroleum fluids used in the quenching of metals is Test Method D 6200.

1.2 This test method provides a measure of changes in oil chemistry due to contamination, base oil degradation, and additive drag-out during use. This test measures changes in the quenching speed characteristics of petroleum fluids at the high temperature (>354°C). This test method does not reliably predict metallurgical performance.

1.3 *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 and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- A 255 Test Method for End-Quench Test for Hardenability of Steel
- D 91 Test Method for Precipitation Number of Lubricating Oils
- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- D 97 Test Method for Pour Point of Petroleum Products
- D 287 Test Method for API Gravity of Crude Petroleum and

Petroleum Products (Hydrometer Method)

- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)
- D 484 Specification for Hydrocarbon Drycleaning Solvents³
- D 1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids
- D 1744 Test Method for Water in Liquid Petroleum Products by Karl Fischer Reagent³
- D 6200 Test Method for Determining Cooling Characteristics of Quench Oils by Cooling Curve Analysis

3. Summary of Test Method

3.1 This test method determines the time for cooling a chromized nickel ball from approximately 885°C (1625°F) to approximately 354°C (670°F) when quenched in 200 mL of test fluid in a metal beaker at 21 to 27°C (70 to 81°F). The quenching time is recorded by a digital timer which is energized by a photoelectric cell from light produced by the ball at 885°C (1625°F) and which is stopped when the ball becomes magnetic (Curie Point, approximately 354°C) and is attracted by a magnet to the side of the beaker, tripping a relay to stop the timer.

4. Significance and Use

4.1 The results obtained by the test method described are useful as guides in selecting fluids with respect to quenching speed characteristics desired for metal quenching applications.

NOTE 3—Although this test method has been found useful for some water-based fluids, the statistical significance of the test has been established only by round-robin testing of petroleum-based fluids.

4.2 These results will provide a measure of quenching speed (cooling rate) from approximately 885°C (1625°F) to 354°C (670°F) and are not directly proportional to hardness obtainable on metals quenched therein as many other factors are involved in the quenching process in actual plant operation with production parts.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.L0 on Industrial Lubricants.

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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 Withdrawn.

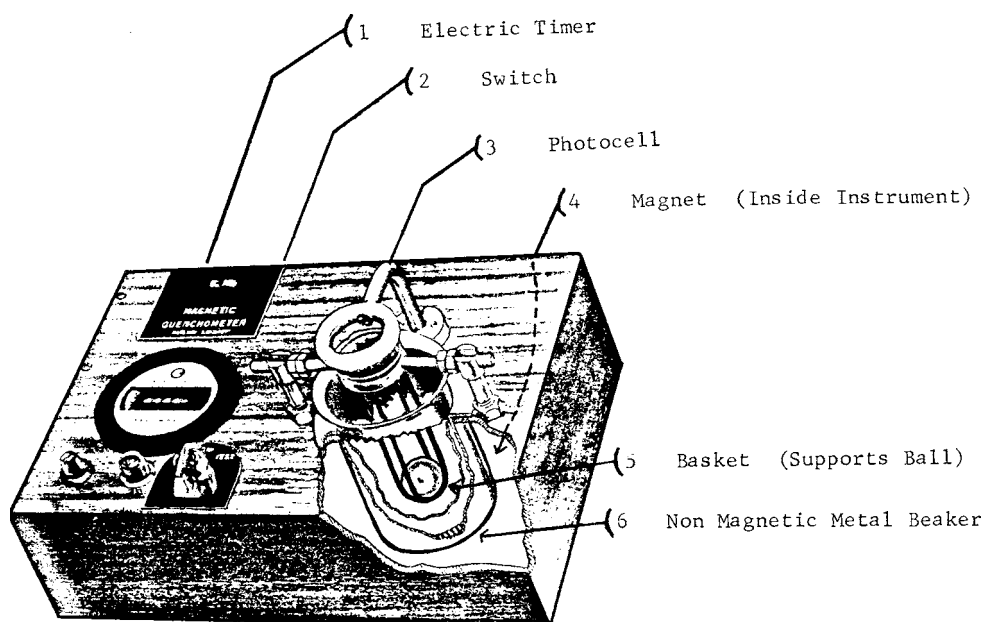


FIG. 1 Magnetic Quenchometer

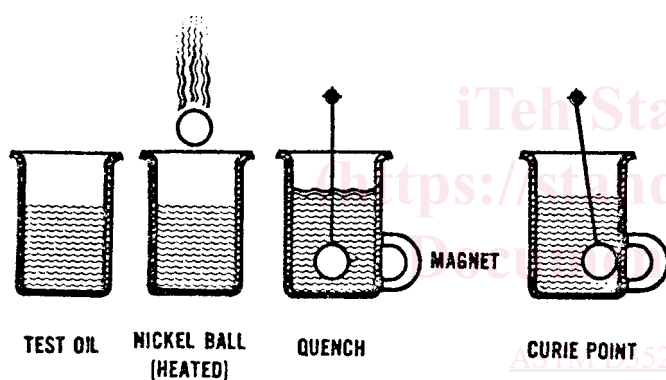


FIG. 2 Test Sequence in Beaker

NOTE 4—Test Method D 6200 describes the equipment and procedure for characterizing the time-temperature performance of a quenching oil through the entire cooling process.

5. Apparatus

5.1 *Magnetic Quenchometer*,⁴ as shown in Figs. 1 and 2.

5.2 *Furnace, Electric Muffle*, with air atmosphere, capable of maintaining a temperature of $885 \pm 5^\circ\text{C}$ ($1625 \pm 9^\circ\text{F}$), as measured at the ball by the thermocouple prior to quenching, and fitted with (1) a clean ceramic base plate, for supporting the test ball, and (2) a No. 14 B&S gage Chromel-Alumel thermocouple probe (without a protection tube) inserted through a hole in a wall of the furnace, and positioned to contact the test ball.

NOTE 5—A rheostat on the power supply may be used to provide a closer control of furnace temperature, or a separate thermocouple-

connected controller near the heating elements can be used to minimize temperature overrides, or both may be used. Further, 1 by 2 by 3-in. heat sinks can be placed next to the area where the ball is to be placed to act as heat shields and provide a more uniform temperature in this particular area.

6. Materials

6.1 *Ball, Chromized Nickel*,⁴ having a diameter of 22.22 ± 0.13 mm (0.875 ± 0.005 in.), a weight of 50 ± 2 g, and surface finish from 0.38 to $0.76 \mu\text{m}$ (15 to 30 $\mu\text{in.}$).

6.2 *Reference Fluid*.

NOTE 6—Fluids used in cooperative testing covered in Annex A2 are suitable. Reference fluids TDL-VI-1 (35) the primary reference fluid and TDL-VI-1 (100X) the secondary standard are suitable.⁴

NOTE 7—The use of non-chromized nickel balls is not included in this test method and is not recommended since the results obtained are commonly more scattered and may be inconsistent with data properly obtained with chromized nickel balls. It is also recommended that chromized nickel balls be used with a final initialization value of 29.0 to 32.0 seconds to obtain optimal repeatability.

6.3 *Stoddard Solvent*, conforming to Specification D 484. (**Warning**—Combustible, skin irritant on repeated contact, aspiration hazard.)

6.4 *Precipitation Naphtha*, conforming to the requirement for precipitation naphtha in Test Method D 91. (**Warning**—Extremely flammable, skin irritant on repeated contact, aspiration hazard.)

6.5 *Forceps*, approximately 450 mm (18 in.) long. Weld two 20 mm ($\frac{3}{4}$ in.) stainless steel washers to the tips of the forceps for greater safety in transporting the hot nickel balls.

6.6 *Tissue*, lintless.

7. Preparation of Apparatus

7.1 Tester:

7.1.1 Place the instrument near the furnace and where lighting does not activate the photo cell.

7.1.2 Connect to 110 V ac.

⁴ The sole source of supply of the apparatus known to the committee at this time is Testron Corp., 34153 Industrial Rd., Livonia, MI 48150. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee¹, which you may attend.