



Standard Test Method for Comparing Metal Removal Fluids Using the Tapping Torque Test Machine¹

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1. Scope

1.1 This test method covers a laboratory technique to evaluate the relative performance of metal removal fluids using a non-matrix test protocol using the tapping torque test machine.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.2.1 *Exception*—Because the equipment used in this test method is available only in inch-pound units, SI units are omitted when referring to the equipment and the test pieces.

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 limitations prior to use.*

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 *build-up edge*—a triangular deposit that forms adjacent to the cutting edge on the face of the tool in a metalworking operation.

2.1.1.1 *Discussion*—The high contact pressure between the cutting edge of the tap and the specimen material results in a high temperature. The high temperature, the wear debris, the high contact pressure, and some of the constituents of the cutting fluid combine at the cutting edge and form a triangular deposit, referred to as a built-up edge (BUE). The BUE is sustained by the chip curl as it is passed over, and as the BUE grows, it is abraded by the rubbing of the chip curl. Since the BUE is located exactly where the curl is generated, it contributes to the size of the curl; the larger the BUE, the larger the

diameter of the chip curl. A small chip curl will flow smoothly up the flute of the tap and will not affect the torque. However, a large curl will drag and jam in the flute and will contribute to the tapping torque.

If a new tap is utilized, it is necessary to run several tests to run-in the tap. This process prepares the cutting edge to receive a characteristic BUE, depending on which cutting fluid is utilized.

If a cutting fluid is changed to another cutting fluid during a test sequence, it is necessary to discard the results from at least the first test of the new fluid since the previous BUE must be abraded or modified with the chemistry of the new fluid to form its own characteristic BUE.

The ideal cutting fluid forms a small, stable BUE that assists in the formation of a small curl.

3. Summary of Test Method

3.1 The torque required to tap a thread in a blank specimen nut while lubricated with a metal removal fluid is measured and compared with the torque required to tap a thread in a blank specimen nut while lubricated with a reference fluid. See Fig. 1. The ratio of the average torque values of the reference oil to the metal removal fluid tested, when using the same tap, is expressed as the percent efficiency of the fluid. The efficiency of two or more fluids can be compared when the average torque values of the reference fluid on different taps are considered to be statistically equivalent.

4. Significance and Use

4.1 The procedures described in this test method can be used to predict more accurately the lubricating properties of a metal removal fluid than previously available laboratory scale tests.

4.2 This test method is designed to allow flexibility in the selection of test specimen metal composition, tap alloy or coatings, and machining speeds.

4.3 Comparison between various types of fluids can be made, including cutting oils, soluble oils, semi-synthetics, or water soluble synthetics.

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.L0.01 on Metal Removal Fluids and Lubricants.

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