Designation: ~~D7752 – 11~~ D7752 – 18

Standard Practice for Evaluating Compatibility of Mixtures of Hydraulic Fluids[1]

This standard is issued under the fixed designation D7752; 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~~ Scope*

1.1 This practice covers the compatibility of mixtures of hydraulic fluids as defined by Specifications D6158, DIN 51524, ISO 11158, and ISO 15380.

1.2 This practice can be used to evaluate new (unused) lubricant compatibility or the effects of combining new (replacement) lubricant with in-service (original) lubricant in the system.

1.3 To evaluate primary compatibility using this method, the replacement fluid must pass the ISO 13357-1 Stage II filterability test. The original fluid is not required to pass ISO 13357-1 filterability test, Stage I or II.

1.4 Primary testing is conducted on fluid mixtures in 2:98, 10:90, and 50:50 ratios using the ISO 13357-1 Filterability Test, Stage II.

1.5 Secondary testing is suggested when circumstances indicate the need for additional testing.

1.6 This practice does not evaluate the wear prevention characteristics, load carrying capacity, or the mechanical shear stability of lubricant mixtures while in service. If anti-wear (AW), extreme pressure (EP), or shear stability are to be evaluated, further testing of these parameters may be required.

1.7 This practice does not purport to cover all test methods that could be employed.

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

1.9 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.N0 on Hydraulic Fluids.

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

1.10 *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]

D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration
D665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water
D892 Test Method for Foaming Characteristics of Lubricating Oils
D974 Test Method for Acid and Base Number by Color-Indicator Titration
D1401 Test Method for Water Separability of Petroleum Oils and Synthetic Fluids
D2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 °C and 100 °C
D3427 Test Method for Air Release Properties of Hydrocarbon Based Oils
D6158 Specification for Mineral Hydraulic Oils
D7042 Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)

2.2 *ISO Standards:*[3]

~~11158:1997~~11158:2009 Lubricants, industrial oils and related products (class L)—Family H (hydraulic systems)—Specifications for categories HH, HL, HM, HR, HV and HG
13357-1:2002(E) Petroleum Products—Determination of the filterability of lubricating oils—Part 1: Procedure for oils in the presence of water
13357-2:2005(E) Petroleum Products—Determination of the filterability of lubricating oils—Part 2: Procedure for dry oils
~~15380:2002~~15380:2011 Lubricants, industrial oils and related products (class L)—Family H (Hydraulic systems)—Specifications for categories HETG, HEPG, HEES, and HEPR
4788 Laboratory glassware—Graduated measuring cylinders

2.3 *DIN Standards:*[4]

DIN 51524 Pressure fluids—Hydraulic oils—Parts 1–3

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *2:98 mixture, n*—a uniform blend of 2 % by weight of original fluid with 98 % by weight of replacement fluid.

3.1.2 *10:90 mixture, n*—a uniform blend of 10 % by weight of original fluid with 90 % by weight of replacement fluid.

3.1.3 *50:50 mixture, n*—a uniform blend of 50 % by weight of each of two component fluids.

3.1.4 *compatibility, n*—of hydraulic fluids, the ability of hydraulic fluids to mix together without significant degradation of properties or performance.

3.1.4.1 *Discussion*—

Compatibility will be determined using the ISO 13357-1 filterability test. When a mixture passes the Stage II filterability designation as specified in the ISO 13357-1 test, the mixture is considered compatible at the tested ratio by the primary testing procedure. If this practice is to be used for adding new (replacement) to in-service (original) and the system is not drained (for example, top-up), two additional ratios will be required, 10:90 and 2:98. Depending on the ratios that have passed the test, flush quantities are given in Annex A1.

3.1.5 *fail, n—in secondary compatibility testing of hydraulic fluid mixtures*, a test result that is inferior to that of the poorer of the two constituent fluids.

3.1.6 *original fluid, n*—fluid that the system is being converted from.

3.1.7 *pass, n—in secondary compatibility testing of hydraulic fluid mixtures*, a test result that is equal to or better than that of the poorer of the two constituent fluids.

[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] Available from ~~International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.~~American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Deutsches Institut ~~fur~~für Normung e.V.(DIN), Am DIN-Platz, Burggrafenstrasse 6, 10787 Berlin, Germany, http://www.din.de.

3.1.8 *primary testing, n*—Two constituent fluids are combined at 2:98, 10:90, and 50:50 ratios by weight. The fluid mixtures are prepared, aged, and evaluated for changes in filterability using the procedure described in ISO 13357-1.

3.1.9 *replacement fluid, n*—fluid that the system is being converted to.

3.1.10 *secondary testing, n*—Mixtures of the fluids are prepared following ISO 13357-1 samples and sampling section and evaluated for changes in the parameters detailed in 7.4.

3.1.11 *type, n*—type refers to lubricant base stock and additive composition. For example, Rust and Oxidation Inhibited fluid (R & O) versus antiwear (AW).

4. Summary of Practice

4.1 *Option 1*—Prepare a 2:98 mixture of two fluids to be evaluated for compatibility. This mixture and the two neat, constituent fluids are tested using the primary compatibility test. If the 2:98 does not pass ISO 13357-1 Stage II requirement, secondary tests may be run or a different replacement fluid should be considered. If the 2:98 mixture passes, the 10:90 and 50:50 ratios should be tested.

4.2 *Option 2*—Instead of testing mixtures in sequential order, 50:50 and 10:90 mixtures are tested at the same time the 2:98 mixture is evaluated. Such tests can be run concurrently, if desired. If all mixtures pass the primary ISO 13357-1 test, no further testing is required. If the 2:98 mixture does not pass, or the application requires the evaluation of specific properties, secondary compatibility tests can be employed for further evaluation.

5. Significance and Use

5.1 Hydraulic fluid compatibility is important to hydraulic equipment users because a mixture of incompatible fluids may produce a substance that is markedly inferior to its constituents. Even in identical base stocks, the formation of a precipitate may occur as a result of additive interactions. In this practice, compatibility will be determined using ISO 13357-1 filterability test method. Since hydraulic systems utilize fine-filtration to protect components from wear, incompatibility often exhibits itself as premature filter plugging.

5.2 Because of such occurrences, suppliers recommend evaluating the compatibility of hydraulic fluids prior to mixing. A flowchart is provided in Annex A1 to aid in interpretation of the test results and hydraulic system conversion.

5.3 Although new hydraulic fluids may be compatible, in-service fluid of the same type may be degraded or contaminated to such an extent that the new fluid added may not be compatible with the system fluid. In-service fluid compatibility with new fluid additions should be evaluated on a case by case basis.

5.4 The oxidation resistance and wear protection of different fluids of the same type can vary widely, and compatibility does not imply equivalent performance.

6. Apparatus

6.1 The equipment and materials required for this practice shall be those required by the test methods used to evaluate compatibility.

6.1.1 *Laboratory Oven,* static-air or stirred-air type, capable of maintaining the test temperature within ±2 °C and equipped with one or more grill-type wire shelves.

6.1.2 *Filtration Apparatus,* stainless steel, consisting of a lidded funnel of at least 350 mL capacity and a funnel base with filter support, such that a membrane filter (6.1.3) can be clamped between the sealing surfaces of the funnel and the base by means of a metal clamp or other suitable gas-tight closure. The apparatus shall be grounded (earthed), and suitable electrical bonding of the parts shall be provided. The effective filtration area shall be 1130 mm^2 ± 60 mm^2. A suitable schematic may be found in the ISO 13357 standard.

6.1.3 *Membrane Filters,* of mixed cellulose esters, diameter 47 mm and mean pore size 0.8 µm. Membranes of an equivalent specification to Millipore filter membranes, catalogue number AAWP 04700, have been found satisfactory.

6.1.4 *Measuring Cylinders,* of 250 mL capacity, of borosilicate glass, conforming to the requirements of ISO 4788. This cylinder shall be permanently marked with further graduation marks at 10 mL and 300 mL. A second cylinder, capable of measuring 330 mL ± 5 mL, is also required for sample transfer. The procedure for adding extra graduations to a cylinder can be found in ISO 13357, Annex A.

NOTE 1—The 250 mL measuring cylinder has a capacity in excess of 300 mL, allowing the extra graduations to be added. The use of a larger measuring cylinder for the filtration process would not give adequate precision for the test.

6.1.5 *Pressure Gauge,* dial or digital type, capable of reading the required delivery pressure ±5 kPa.

6.1.6 *Forceps,* spade-ended.

6.1.7 *Timing Device,* electronic or mechanical, capable of reading to the nearest 0.2 s, and fitted with a dual-stop facility.

6.1.8 *Petri Dishes,* loosely covered.