Designation: D3705 – 14

Standard Test Method for Misting Properties of Lubricating Fluids[1]

This standard is issued under the fixed designation D3705; 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 the determination of the misting characteristics of lubricating fluids.

NOTE 1—This test method should not be used to evaluate fluids containing solid additives such as graphite.

1.2 The values stated in SI units are to be regarded as standard.

1.2.1 Inch-pound units are used to describe the various tube fittings shown in Fig. 1.

1.2.2 Inch-pound thread is shown in Fig. 2.

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.* For specific warning statements, see Sections 7 and 8.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D91 Test Method for Precipitation Number of Lubricating Oils

D235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology D4175.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *line condensate, n*—in a mist lubrication system, oil mist which has coalesced in the distribution lines and is not available for lubrication purposes.

3.2.2 *reclassified oil, n*—in a mist lubrication system, lubricant that has coalesced into larger droplets at the points of required lubrication.

3.2.2.1 *Discussion*—Mist lubrication systems are designed so that the oil mist will coalesce in the appropriate area and provide lubrication in the right place.

4. Summary of Test Method

4.1 The mist generator is charged with oil and installed in the mist system. The unit is operated for 19 h; the mist generator, line condensate bottles, and reclassified oil collector are weighed before and after the test. The output from the generator and percentages of reclassified oil, line condensate, and stray mist are determined from changes in weight.

NOTE 2—Line condensate is the commonly accepted term used to describe the oil that coalesces in the mist distribution lines. In this test, the oil that coalesces in the 38 mm (1½ in.) tubing and the diagonal 19 mm (¾ in.) tubing is collected and weighed as line condensate. Oil that coalesces in the vertical 19 mm (¾ in.) tubing becomes part of the reclassified oil.

5. Significance and Use

5.1 This test provides a guide for evaluating the misting characteristics of oils for use in industrial mist lubrication systems. The degree of correlation between this test and service performance has not been fully determined.

6. Apparatus

6.1 The basic system consists of the following:

6.1.1 *Oil Mist Generator,* Alemite No. 383802-B4[3,4] (Fig. 1, item 23) with special ASTM-ASLE mist head 383803–B4 (Fig. 1, item 22). The oil mist generator is attached to the manifold so that it may be easily disconnected in order to determine its mass before and after the test.

6.1.2 *Air Temperature Regulator,* Alemite thermo-aire No. 383808–A4[4,5] (Fig. 1, item 24).

[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.

Current edition approved Oct. 1, 2014. Published November 2014. Originally approved in 1978. Last previous edition approved in 2009 as D3705 – 86 (2009). DOI: 10.1520/D3705-14.

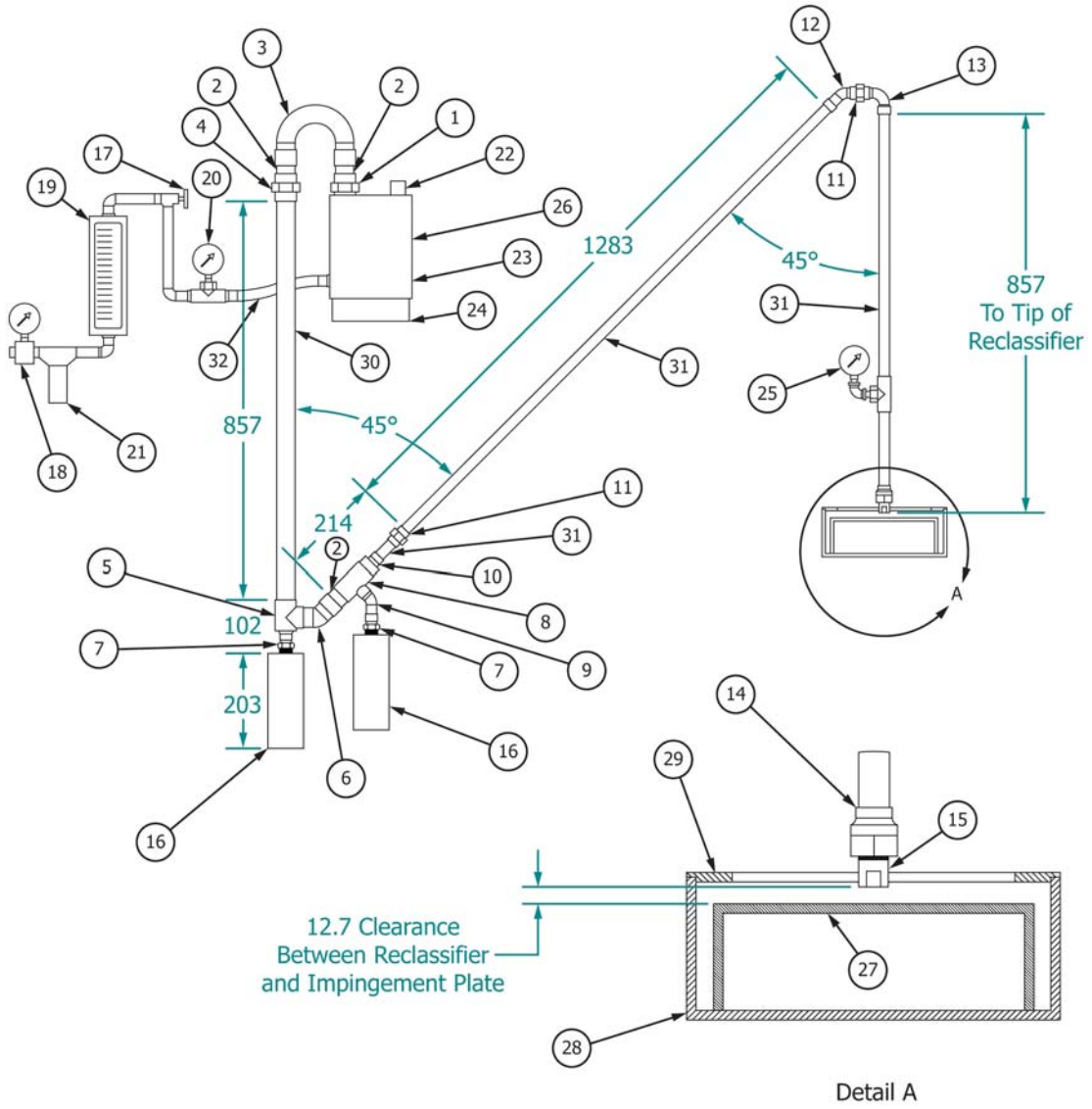
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The sole source of supply of known to the committee at this time is Alemite Co., Stewart Warner, 1826 West Diversey Parkway, Chicago, IL 60614.

[4] 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 committee [1], which you may attend.

[5] The sole source of supply of Alemite thermo-aire unit No. 383808-A4 known to the committee at this time is Alemite Co., Stewart Warner, 1826 West Diversey Parkway, Chicago, IL 60614.

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



(1) 1½ C × 1½ in. MPT union
(2) 1½ in. copper tubing, 3 in. long
(3) 1½ in. C × C Return bend
(4) 1½ in. C Union
(5) 1½ × ¾ × 1½ in. C × C × C tee
(6) 1½ in. C 45 deg ftg Ell (straight ell)
(7) ¾ in. ftg × MPT adapter
(8) 1½ × 1½ × ¾ in. C × C × C tee
(9) ¾ in. C 45 deg ftg ell
(10) 1½ ftg × ¾ in. C extended bushing
(11) ¾ in. C Union
(12) ¾ in. ftg × C 45 deg ftg ell
(13) ¾ in. ftg × C 90 deg ftg ell
(14) ¾ C × ½ in. FPT adapter
(15) ½ in. reclassifier fitting
(16) Collector bottle, 1 L plastic with ¾ female NPT top
(17) Thermometer
(18) Pressure regulator with gage (2 mPa)
(19) Air flow meter (L/s)
(20) Pressure gage, 7 kPa
(21) Air filter
(22) Oil mist head assembly with adjusting screw
(23) Oil mist generator
(24) Thermo-aire unit
(25) Pressure gage, 4 kPa
(26) Thermocouple
(27) Impingement plate
(28) Collection box
(29) Lid for collection box
(30) 1½ in. type “M” hard copper tubing, 41.3 mm O.D. × 38.3 mm I.D.
(31) ¾ in. type “K” hard copper tubing, 22.2 mm O.D. × 18.9 mm. I.D.
(32) Flexible hose

FIG. 1 Mist Distribution Manifold

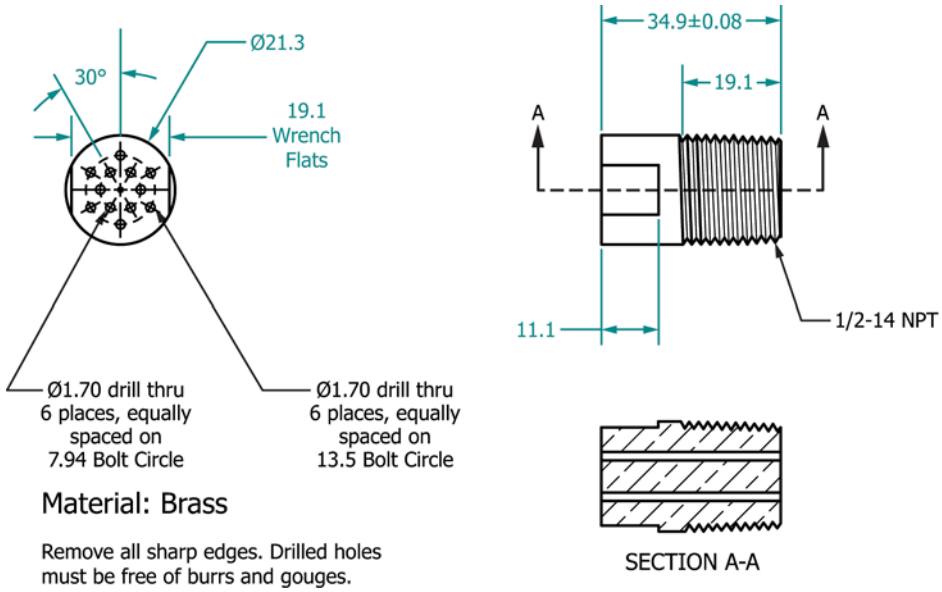


FIG. 2 Mist Reclassifier Fitting

6.1.3 *Mist Distribution Manifold,* as shown in Fig. 1.

6.1.4 *Mist Reclassifier Fitting,* (Fig. 1, item 15; Fig. 2). The fitting must be drilled exactly as shown in Fig. 2. Any deviations from the given hole size and pattern will negate the test.

6.1.5 *Reclassified Oil Collector and Lid,* as shown in Fig. 3 and Fig. 4.

6.2 *Impingement Plate,* as shown in Fig. 5.

6.3 *Balance,* 20 kg capacity open pan, with 1 g sensitivity.

6.4 *Air Supply,* from a source capable of maintaining an air flow rate up to 2 dm^3/s. The air should be dry, oil-free, and filtered through a 1 µm filter. In order to ensure the driest and cleanest air possible, it is recommended that a drying element and filtering system such as a desicant cartridge be added to the apparatus. The device chosen should maintain a flow rate of 14 dm^3/s and provide air with a dew point not in excess of –40 °C.

NOTE 3—The oil mist generator head and mist reclassifier fitting are available from the Alemite Co. Orders should specify Special ASTM-ASLE mist head and reclassifier fitting.

NOTE 4—While not required, the addition of an oil bath temperature regulator (Alemite 383807–A4) is recommended. Results will be more consistent if the oil is kept at a constant temperature.

7. Reagents

7.1 *Stoddard Solvent,* as specified in Specification D235 (Type 1). (**Warning—**Flammable.)

7.2 *Precipitation Naphtha,* as specified in Test Method D91. (**Warning—**Flammable.)

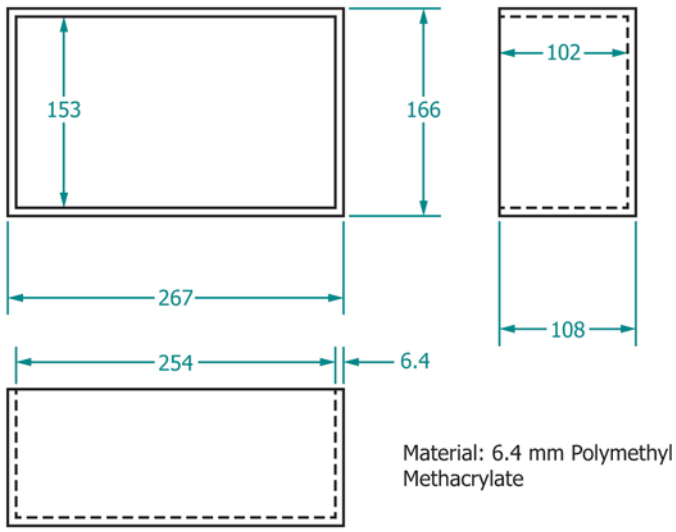


FIG. 3 Reclassified Oil Collector

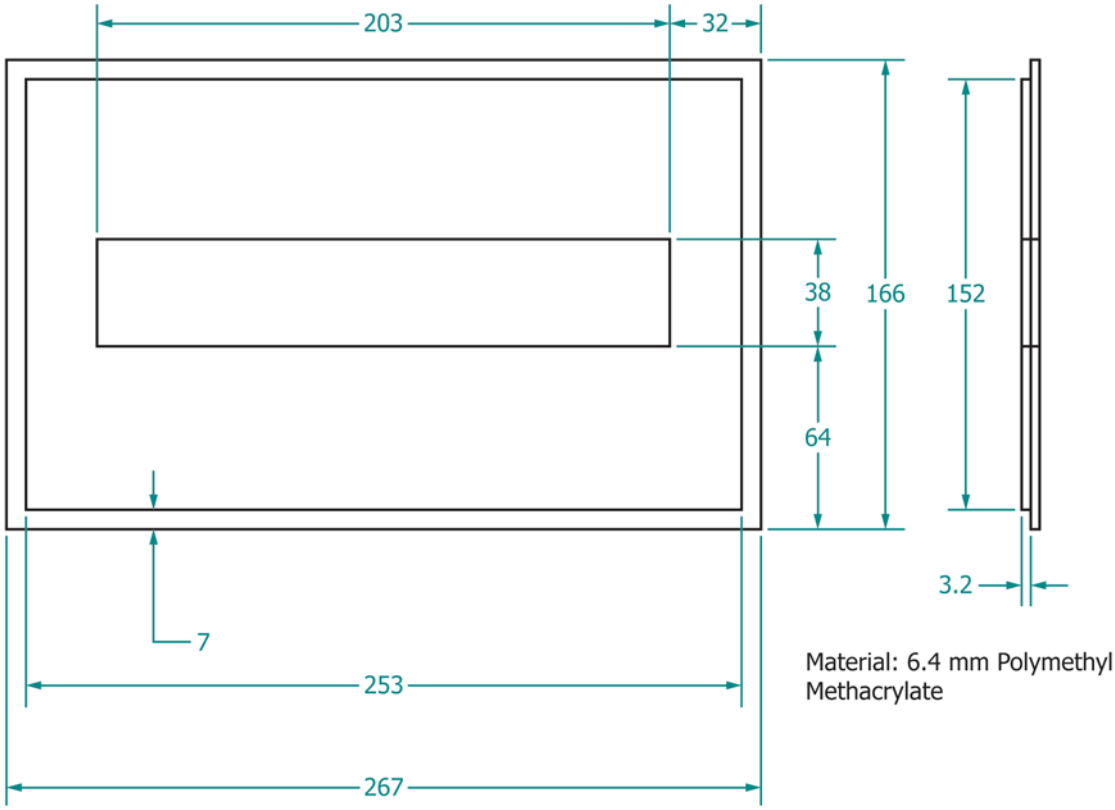


FIG. 4 Reclassified Oil Collector Lid

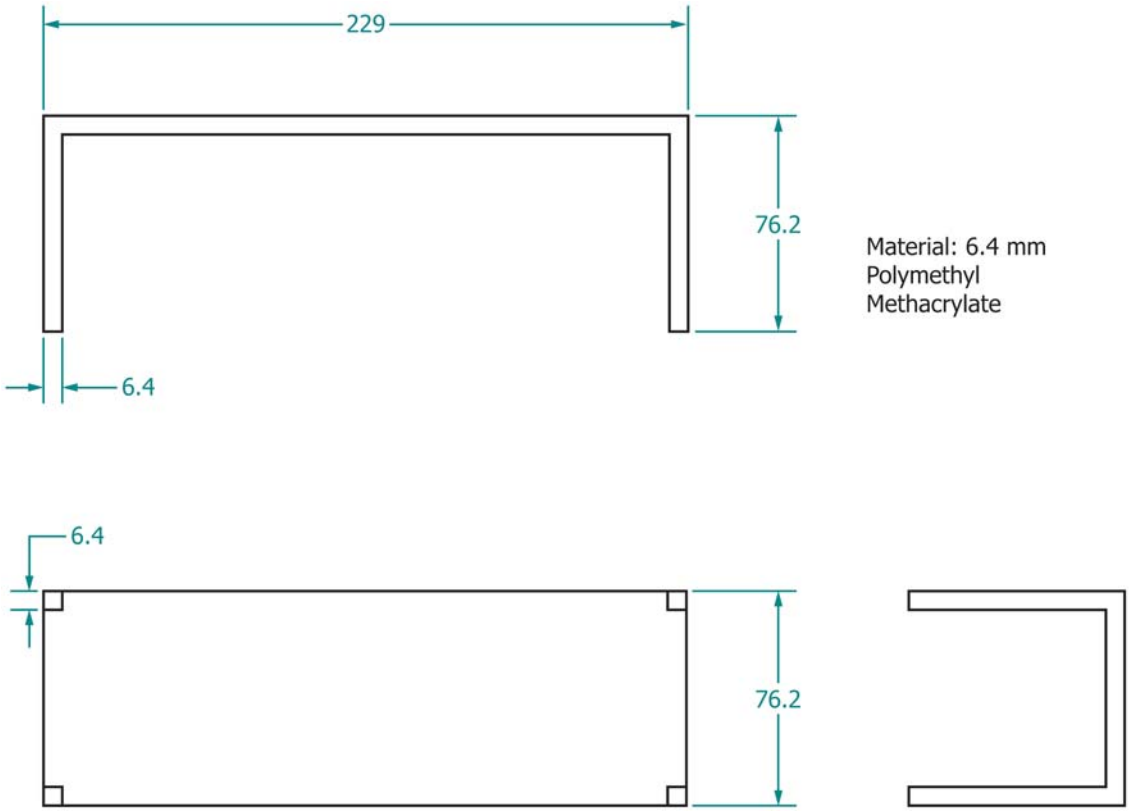


FIG. 5 Impingement Plate

8. Preparation of Apparatus

8.1 Thorough cleaning of the apparatus with solvent is required prior to initiating a test on a new oil. For a duplicate test on the same oil, the mist generator should be thoroughly drained but the apparatus need not be cleaned with solvent.

8.2 Drain the oil thoroughly and rinse the generator with Stoddard solvent. (**Warning—**Combustible. Vapor harmful.)

8.3 Charge the generator with 2 L of clean Stoddard solvent and mist the Stoddard solvent through the manifold for 30 min. (**Warning—**Do not use the air heater while misting the Stoddard solvent.)

8.4 Drain the Stoddard solvent from the generator, rinse the generator with naphtha, and blow dry with compressed air. (**Warning—**Extremely flammable. Harmful if inhaled. Vapors may cause flash fire.)

8.5 Disconnect the mist head and remove the oil adjustment screw; rinse the head and screw with naphtha and blow dry.

8.6 Remove the reclassifier fitting and rinse it with naphtha; examine the orifices for deposits or buildup. If necessary, the orifices may be cleaned with a fine pipe cleaner.

9. Procedure

9.1 *Break-In Period:*

9.1.1 Charge the mist generator with 4 L ± 0.1 L of test oil. Assemble the test apparatus.

9.1.2 Turn the oil flow adjusting screw clockwise to a fully closed position and then open the screw by turning it counterclockwise to a full open position.

9.1.3 Open the air regulator until a pressure of 3.7 kPa is obtained on the manifold gage (Fig. 1, item 25).

9.1.4 Activate the oil heater and inlet air heater and adjust both to 40 °C ± 1 °C.

9.1.5 Allow the unit to run for 1 h to stabilize.

NOTE 5—The full open position for the oil flow adjusting screw, that is, the position beyond which further opening of the adjusting screw does not increase oil output from the mist generator, should be determined for each mist test unit. The full open position on most test units is attained by turning the adjusting screw counterclockwise 2-½ turns from the fully closed position.

9.2 *Test Start-Up:*

9.2.1 Following the 1 h break-in, deactivate the air and oil heaters and turn off the air supply.

9.2.2 Disconnect and determine the mass of the mist generator (W_1) and install clean, tared line condensate bottles (LC_1) and reclassified oil collector (RC_1).

9.2.3 Reassemble the apparatus. Turn on the inlet air and activate the air and oil heaters to start the test.

9.2.4 Record the air flow rate in dm^3/s.

9.2.5 Check the inlet air temperature, oil reservoir temperature and manifold temperature. Make adjustments, if necessary, 30 min after starting the test to bring the manifold pressure to 3.7 kPa ± 0.1 kPa and the inlet air temperature to 40 °C.

9.2.6 At the end of the 19 h test, deactivate the heaters and turn off the air supply. Disconnect and determine the mass of the mist generator (W_2), line condensate bottles (LC_2), and reclassified oil collector (RC_2) within 15 min.

10. Calculation and Report

10.1 Calculate and report the oil output from the mist generator after break-in in grams per hour as follows:

$$\text{oil output} = \frac{W_1 - W_2}{19} \quad (1)$$

where:

W_1 = mass of the mist generator at the start of the test, g, and
W_2 = mass of the mist generator after 19 h, g.

10.2 Calculate and report the percent of reclassified oil as follows:

$$\%\ \text{reclassified oil} = \frac{RC_2 - RC_1}{W_1 - W_2} \times 100 \quad (2)$$

where:

RC_1 = mass of the reclassified oil collector at the start of the test, g,
RC_2 = mass of the reclassified oil collector at the end of the test, g.

10.3 Calculate and report the percent of line condensate as follows:

$$\%\ \text{line condensate} = \frac{LC_2 - LC_1}{W_1 - W_2} \times 100 \quad (3)$$

where:

LC_1 = mass of the line condensate bottles at the start of the test, g, and
LC_2 = mass of the line condensate bottles at the end of the test, g.

10.4 Calculate and report the percent of stray mist as follows:

$$\%\ \text{stray mist} = 100 - (\%\ \text{reclassified oil} + \%\ \text{line condensate}) \quad (4)$$

NOTE 6—For design considerations, it may be desirable to calculate the output oil mist density or effective oil mist density, or both. These calculations are made as follows:

$$\text{Oil output mist density, mg/m}^3 = \frac{\text{oil output (g/h)} \times 1000}{\text{air flow rate (dm}^3\text{/s)} \times 3.6} \quad (5)$$

$$\text{effective oil mist density, mg/m}^3 = \frac{\text{reclassified oil } (RC_2 - RC_1) \times 1000}{\text{air flow rate (dm}^3\text{/s)} \times 68.4} \quad (6)$$

11. Precision and Bias[6]

11.1 The precision of this test method as determined by statistical examination of interlaboratory results is as follows:

11.1.1 *Repeatability*—The difference between successive results obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

[6] Supporting data (derived from results of the cooperative tests on oils L-II-3-M, N, O, P, Q, R, S, T, U, V, W, and X) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1056.

Oil output, g/h	8 %
Percent reclassified oil	6 %
Percent line condensate	22 %

11.1.2 *Reproducibility*—The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would, in the long run, exceed the following values only in one case in twenty:

Oil output, g/h	41 %
Percent reclassified oil	57 %
Percent line condensate	73 %

11.2 *Bias*—The procedure in this test method has no bias because the values of Oil Output, percent Reclassified Oil, and percent Line Condensate can be defined only in terms of a test method.

NOTE 7—The percent of stray mist is obtained by calculation rather than by a direct determination. Therefore, no precision data are included for percent of stray mist.

APPENDIX

(Nonmandatory Information)

X1. METHOD FOR HANDLING STRAY MIST

X1.1 Fig. X1.1 shows a container that has been found satisfactory for handling the stray mist generated during the test.

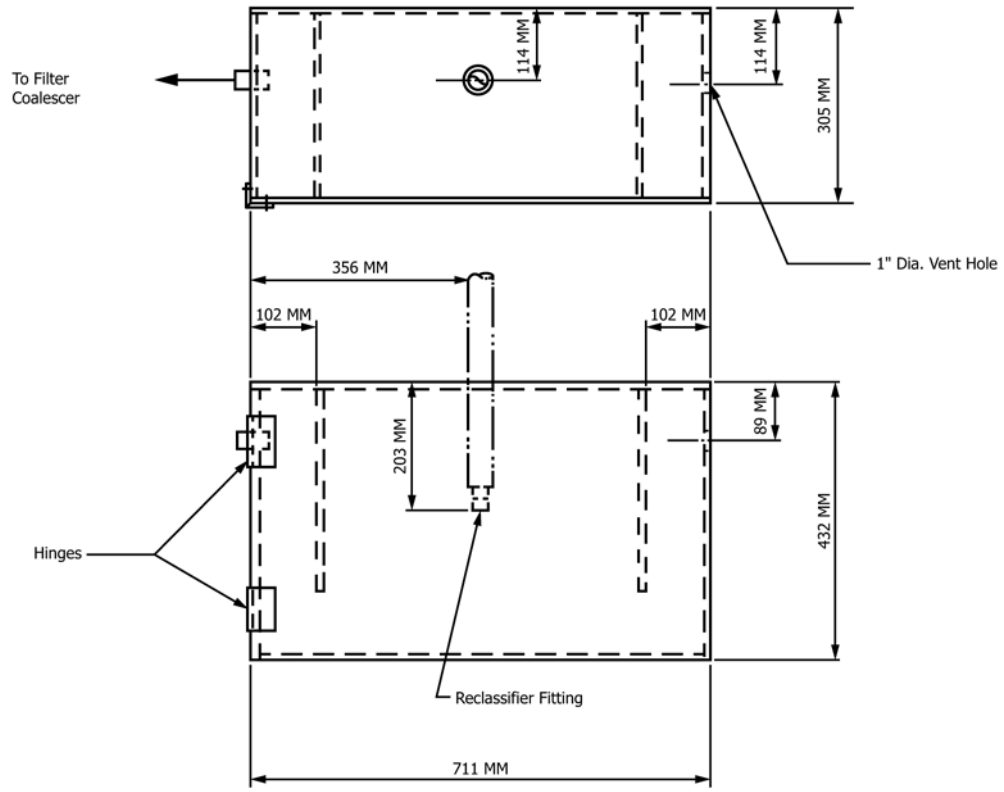
X1.2 The stray mist is sucked from the container through a filter-coalescer unit which removes approximately 99 % of the oil. The suction is obtained using an air jet exhauster or other suitable means; the exhaust can be fed into the laboratory exhaust system.

X1.3 The exhaust system should be started after a mist test has been initiated and must not affect the manifold pressure. If a decrease in manifold pressure is noted when the exhaust system is started, the vent hole should be enlarged or disconnect the exhaust system drop leg from the container exhaust port and place it within an inch or two of the exhaust port.

X1.4 The baffles must be included as an integral part of the container to prevent air flow directly across the top of the reclassified oil collector.

X1.5 It is recommended that the container be placed in an area with a non-slip floor.

X1.6 Provisions such as gasketing must be used to seal the door so that the air flow to the exhaust port will not be disturbed by air entering from other sources.



Mat'l.:

6.4 MM Polymethyl Methacrylate

FIG. X1.1 Apparatus For Removing Stray Mist

SUMMARY OF CHANGES

Subcommittee D02.L0 has identified the location of selected changes to this standard since the last issue (D3705 – 86 (2009)) that may impact the use of this standard. (Approved Oct. 1, 2014.)

(1) Revised subsection 1.2, Section 6, and Appendix X1.
(2) Added new Section 3, Terminology.
(3) Revised/updated all figures.