Designation: D 5000 – 05

An American National Standard

Standard Practice for Evaluating Activity of Clay Elements Using a Side-Stream Sensor[1]

This standard is issued under the fixed designation D 5000; 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.

INTRODUCTION

Calcined clay is a widely used adsorptive medium for removing polar contaminants and additives from petroleum fluids. In refineries, clay is installed in large bed-type vessels to refine products such as lubricants or aviation turbine fuel. In the field, clay is usually used in canister or bag type elements installed as a bank of elements in a vessel to remove traces of contaminants, particularly from non-additive jet fuel immediately before delivery to an airport.

1. Scope*

1.1 This practice describes a field procedure to determine whether the useful life of the clay has been exceeded in canister or bag-type clay elements that are installed in ground filtration units of aviation fuel handling systems.

1.2 The field procedure utilizes the apparatus of Test Method D 3948 to periodically test a small clay capsule installed in a sidestream around a clay treatment vessel that receives a fixed ratio of the same fuel that flows through the clay elements in the vessel.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 3948 Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer

3. Terminology

3.1 *Definitions:*

3.1.1 *surfactants*—surface active molecular species that exhibit both water soluble and oil soluble properties, and affect the physical behavior at the interface between water and oil phases by forming emulsions or changing the wetting characteristics of solid surfaces exposed to water and oil.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *active limit*—the Micro-Separometer (MSEP) rating by Test Method D 3948 of the effluent from a clay monitor that represents low surfactant content and therefore continued activity of the clay for adsorption.

3.2.2 *clay*—a naturally occurring mineral, largely hydrous aluminum silicate, calcined at high temperature to remove water and volatile matter, used in granular form as an adsorptive media for removing polar compounds that are present in many hydrocarbon fluids.

3.2.3 *clay treatment*—a process for exposing fuels and blending components at ambient temperatures to granulated calcined clay in order to remove polar impurities such as surfactants.

3.2.4 *deactivation of clay media*—results when adsorptive surfaces are no longer capable of adsorbing polar species and improving the quality of the feed stream.

3.2.5 *deactive limit*—the MSEP rating by Test Method D 3948 of the effluent from a clay monitor that represents high surfactant content and therefore the deactivation of the clay for adsorption.

[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.J0 on Aviation Fuels.

Current edition approved Nov. 1, 2005. Published November 2005. Originally approved in 1989. Last previous edition approved in 2005 as D 5000–89(2005).

[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.

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

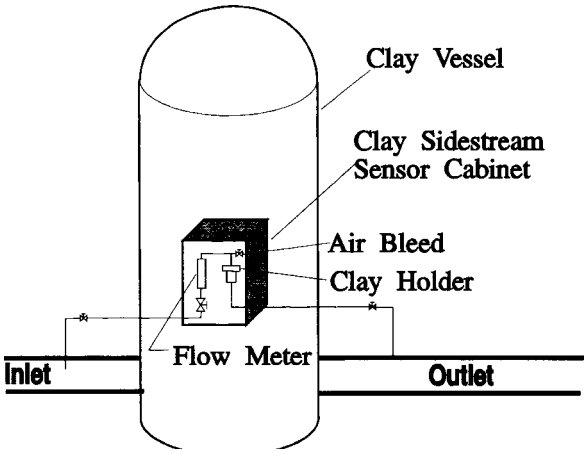


FIG. 1 Schematic of Clay Sidestream Sensor Installation

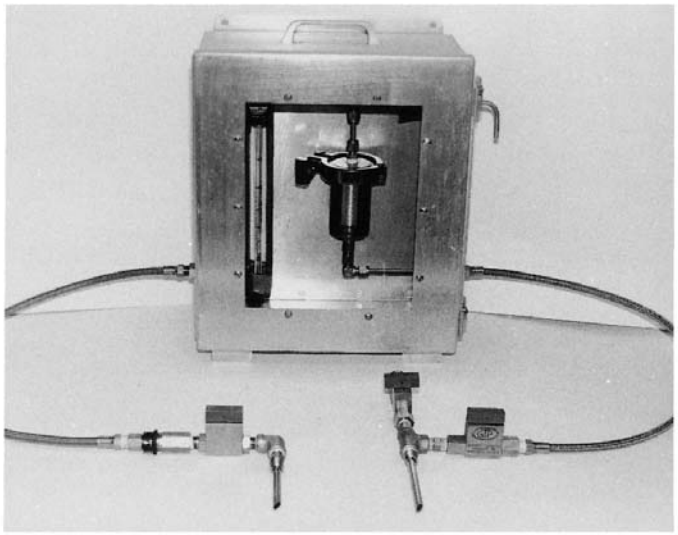


FIG. 2 Clay Side-Stream Sensor

3.2.6 *sidestream*—flow system that parallels the main flow stream into and out of a unit, such as a vessel, holding filter elements but usually operating at a lower flow rate.

4. Summary of Practice

4.1 A sample of the clay from the same model element that is installed in a clay treatment vessel is placed into a clay holder that is then mounted in a sidestream cabinet that receives flow from an inlet probe at a rate proportional to main line flow. After preconditioning to ensure that flow is not bypassing the holder, it is placed on-stream to monitor the clay elements in the main vessel.

4.2 The clay holder is designed to simulate the fuel residence time through an industry standard clay element of 7 in. in diameter by 18 in. long with a center hole of 2¼ in. The holder is designed for downward flow through clay that is poured into the cone-shaped cavity. The diameters of the cone frustum are set to simulate the flow velocities at the OD and the ID of a standard clay element. The depth of the holder cavity is the same as the difference between the OD and ID of the element.

4.3 At intervals of two to eight weeks, depending on surfactant levels experienced in the system, the clay holder is removed and tested twice in the Mark V Deluxe or two-speed[3] Micro-Separometer with reference fuel containing a specified surfactant additive. The rating of the reference fuel from the clay holder by Test Method D 3948 determines whether the clay is deactivated or still capable of adsorbing surfactants. In the latter case, the clay holder is returned to the sidestream cabinet and monitoring continues.

4.4 If the rating suggests that clay is spent, the elements are changed and a fresh clay holder is installed. A plot or record of successive periodic tests is desirable to anticipate the need for changing clay elements or to increase testing frequency. (Fig. 1 is a schematic of a sidestream sensor installation around a clay treating vessel).

5. Significance and Use

5.1 Clay elements are widely used in aviation fuel handling systems to adsorb polar contaminants that are picked up in shipments by tanker, barge, or pipeline from refineries to terminals, airports, or both. Some of these contaminants such as surfactants interfere with efficient operation of filter-separator units that remove water from fuel.

5.2 In order to determine whether the clay elements are spent, it is necessary to test fuel both into and out of clay treatment vessels frequently. Clay elements must be changed when no improvement in quality is noted. Unless carried out frequently, such testing may not disclose a deactivated clay treatment vessel in time to prevent failure of downstream filter/separators.

5.3 To avoid such failures, a small sample of clay in a clay holder contained in a sidestream installation that receives flow proportional to the main stream flow is evaluated periodically using a reference fuel containing a known surfactant. When the rating of the reference fuel by Test Method D 3948 indicates that the capsule clay is becoming spent, the elements in the main filter vessel are ready for change.

6. Apparatus

6.1 *Sidestream Sensor*, consisting of the following components as illustrated in Fig. 2:

6.1.1 *Inlet Probe*, metal-sheathed polytetrafluorethylene tubing and valve to the cabinet,[4]

6.1.2 *Metal–sheathed Tubing and Valve*, from the cabinet,[4]

6.1.3 *Cabinet, Flow Meter*, accurate to ±5 %,[4]

6.1.4 *Clay Holder and Air Bleed*, contained in the sensor cabinet,[4] and

6.1.5 *Clay Cone Insert*, (test capsule).[4]

[3] The Mark V Deluxe or two-speed Micro-Separometer, is available from Emcee Electronics, Inc., 520 Cypress Ave., Venice, FL 34292.

[4] The sole source of supply of the apparatus known to the committee at this time is Gammon Technical Products, P.O. Box 400, 2300 U.S. Highway 34, Manasquan, NJ 08736. 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.

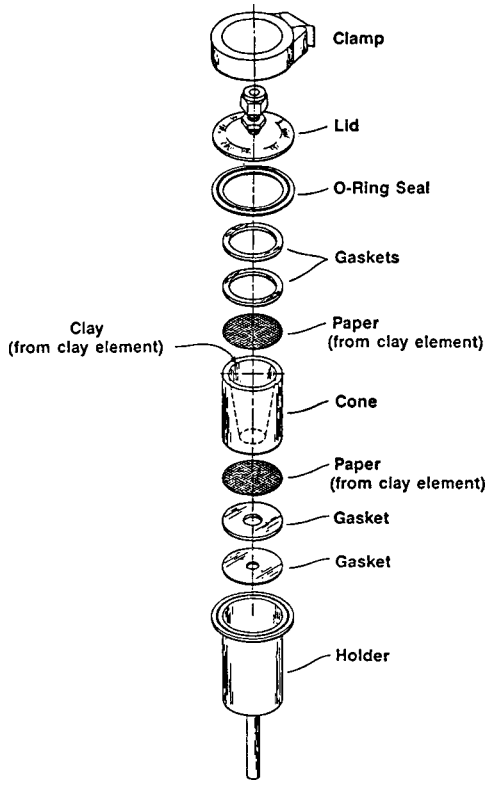


FIG. 3 Clay Holder (Exploded View)

6.2 *Micro-Separometer*, Mark V[3] Deluxe.

6.3 *Clay Holder Bracket*, and tubing assembly.

NOTE 1—The sensor cabinet and probes are installed across the inlet and outlet of the clay treating vessel being monitored. The inlet probe may consist of a short 7.9 mm (5/16 in.) diameter tube that protrudes into the moving stream of fluid.[4]

7. Reagents and Materials

7.1 *Reference Fluid Base*, is fuel from the fuel supply system under evaluation. In the event the fuel contains additives or has a MSEP rating less than 96, the fuel should be clay treated as described in Test Method D 3948.

7.2 *Dispersing Agent*, is a toluene solution containing 1 mg of solid (100 % dry) bis 2 ethyl hexyl sodium sulfosuccinate per mL of toluene.

7.3 *Reference Fuel*—consists of dispersing agent in reference fluid base. To produce a MSEP rating by Test Method D 3948 of 51 to 77 about 0.8 mL/L of dispersing agent is required in the base.

8. Preparation of Clay Holder

8.1 Clay to fill the clay holder is obtained from a new clay element (canister or bag type) at the time all elements in a clay treatment vessel are changed. About 100 mL of clay should be placed in a clean jar. The cover of the jar should be screwed on tightly. A portion of resin treated filter paper from the center tube of the element or media migration barrier of the bag type element should also be removed and saved.

8.2 Insert components in the clay holder in the following order as illustrated in Fig. 3:

NOTE—Insert cone spacer, (large end of cone on top). Pour clay into cavity. Repeatedly, tap holder and add clay until level with top of cone.

FIG. 4 Clay Cone Spacer

8.2.1 *Gasket*—(An additional gasket, as shown, may be added to ensure a leak-tight fit. The gasket hole should be of approximately the same size as the bottom of the cone.)

8.2.2 Filter paper, or media migration barrier from the clay element.

8.2.3 *Cone Spacer*—Insert cone spacer into holder (large end on top) and pour clay into cavity, (See Fig. 4). Tap holder to settle clay. Alternately add make-up clay and tap until clay does not settle below the top of cone section. Place section of filter paper (media migration barrier) on top of clay in cone. Insert gasket(s) to give firm compression of all components when top is clamped in place. Install holder lid, o-ring seal, lid, and clamp. Tighten clamp firmly.

NOTE 2—Use of a bench vise will aid in compressing gaskets, positioning the lid to holder body and installing the lid clamp.

8.2.4 *Filter Paper* or *Media Migration Barrier* from Clay Element.

8.2.5 *Gasket*—(An additional gasket, as shown, may be added to assure a leak tight fit. The gasket hole should be of approximately the same size as the top of the cone insert.)

8.2.6 *O-Ring Seal*.

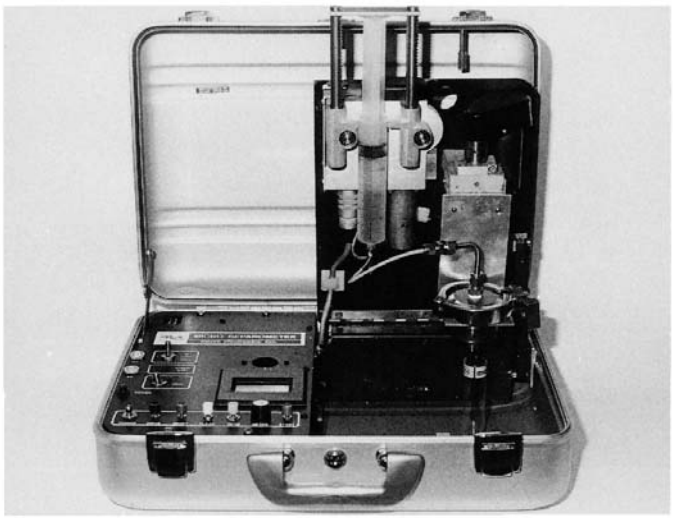
9. Pre-Conditioning the Clay Holder

9.1 The clay holder is tested to ensure that flow will not by-pass the clay or components. The Test Method D 3948 Mark V[3] Deluxe Micro-Separometer is used to perform this test as follows:

9.2 After turning the apparatus ON, the switch marked "F'' initiates the automatic program for clay holder testing. The annunciator lamps in the SYRINGE section will indicate that manual control of the drive mechanism can be initiated.

9.3 Depress the UP switch and the drive mechanism will move to the upper limit. The annunciator lamp in the PROGRAM section will indicate that the turbidimeter can be manually activated.

9.4 Remove plunger from the plastic syringe and pour 50 mL of reference fuel into the syringe barrel. Replace plunger using the wire aid.



NOTE—Bracket is held in slot above stirrer. The bracket fits in the same way for all versions of the Micro-Separometer, but there is no gear change mechanism in Mark V[A] Deluxe because the drive is pre-programmed.

FIG. 5 Holder Bracket

9.5 Insert the holder bracket on the microseparometer in the slot above the stirrer. See Fig. 5.

9.6 Place the clay holder in the bracket and connect the tubing from the holder top to the syringe.

9.7 Move the UP/AUTO/DOWN switch to the DOWN position. The syringe will immediately start down.

9.8 Collect the effluent from the clay holder and discard.

9.9 Immediately repeat 9.4-9.7 by passing through two additional 50 mL samples of reference fuel through the holder in succession.

9.10 Collect the entire effluent from each pass separately into marked 50 mL flasks.

NOTE 3—Because of minor hold-up of fuel, less than 50 mL of effluent may be collected. Do not add reference fuel to effluents.

9.11 Run the standard Test Method D 3948 test on each of the two test method effluent samples collected.

9.12 Record results on the data sheet described in Table 1.

9.13 If either of the two MSEP results are less than 96, flow through the clay holder may be by-passing the clay. The holder should be dismantled, additional clay or gaskets, or both, installed, the holder reassembled and retested. A MSEP reading of 97 or better must be obtained before the clay holder can be installed in the sidestream cabinet for field operation.

10. Field Installation of Clay Holder

10.1 After preconditioning and testing the clay holder is installed in the cabinet and air from the tubing is bled through the vent valve at the top of the cabinet.

10.2 The flow rate through the clay holder in mL/minute is established by reference to Fig. 6 in order to adjust the flow meter. The clay filter vessel must be operated at its normal flow rate when the sidestream sensor flow meter is adjusted.

NOTE 4—Normal flow rate is the maximum rate that will occur in the system. It may not be the rated flow of the vessel itself. Both the sensor and main flow rates should be checked and recorded weekly, readjusting if necessary.

11. Periodic Clay Holder Testing

11.1 At periodic intervals the clay holder is removed from the sidestream cabinet and evaluated in the assembled condition with the Mark V Deluxe Micro-Separometer. Testing intervals are a function of estimated clay life. If clay life is less than 6 months, two week testing intervals may be appropriate. For longer clay lives, monthly testing may be sufficient.

NOTE 5—When the results are obtained by testing of fuel for surfactants by Test Method D 3948.

11.2 To remove the clay holder for evaluation, close valves in the inlet and outlet sampling probe lines. Do not touch the valve that controls the flow meter.

11.3 Remove the clay holder from the cabinet by loosening the tubing fittings on top and bottom.

11.4 Evaluate the clay holder by following the procedure of 9.2. Two separate samples of reference fuel should be used for the two evaluations.

11.5 Clay holder evaluation results and clay vessel cumulative through-put data should be noted in Table 1.

12. Evaluation of Results

12.1 If MSEP readings from both evaluations are greater than the active limit the clay in the vessel is considered still active and the clay holder should be reinstalled.

12.2 If either MSEP reading is below the deactive limit the clay in the vessel has become deactivated. Elements should be changed immediately and a fresh clay holder prepared and installed.

NOTE 6—Field evaluation of clay systems cited in the CRC Report No. 552[5] suggests that the active limit is 93 MSEP or higher while the deactive limit is 90 MSEP or lower. If one of the two evaluations is between 90 and 93 MSEP deactivation is considered imminent and evaluation frequency should be increased three-fold. Users of this practice may select different MSEP criteria for clay element change-out depending on experience with the particular system being monitored.

13. Reinstallation of the Clay Holder

13.1 The syringe adapter should be removed from the clay holder that is to be returned to the cabinet. Tube fittings should be tightened and valves opened to the sampling probes.

13.2 Air should be bled from the tubing using the vent valve and the flow setting of the flow meter should be checked.

14. Report

14.1 A data log, such as Table 1, is the best method for reporting both clay holder evaluations and other significant data. Tests of the fuel itself as well as flow rate and pressure drop data should also be recorded.

15. Keywords

15.1 aviation turbine fuel; filtration; jet fuel; side-stream sensor; surfactants; water separation

[5] CRC Report No. 552, "Field Evaluation of the Sidestream Sensors for Filter/Separators and Clay Filters," February 1987.

TABLE 1 Clay Sidestream Sensor Data Log

INFORMATION

Normal Vessel Flow: _____ USGPM
Clay Holder (CSS) Flow Rate: _____ Ml/min[A]
Start Date:_____

Location: _____
Vessel Model: _____
Element Model: _____
Quantity Elements: _____
Reference Fuel MSEP:

Sensor Information					Supplementary System Date, (if available)				
Date	Cumulative Throughput USGPM	Sensor MSEP Ratings (Refer 9.1) Sample #1	Sample #2	Remarks	MSEP in	MSEP out	Aqua-Glo (ppm)	Pressure Drop psi	Pressure Drop gpm	Corrected Pressure Drop for Normal Flow Rate

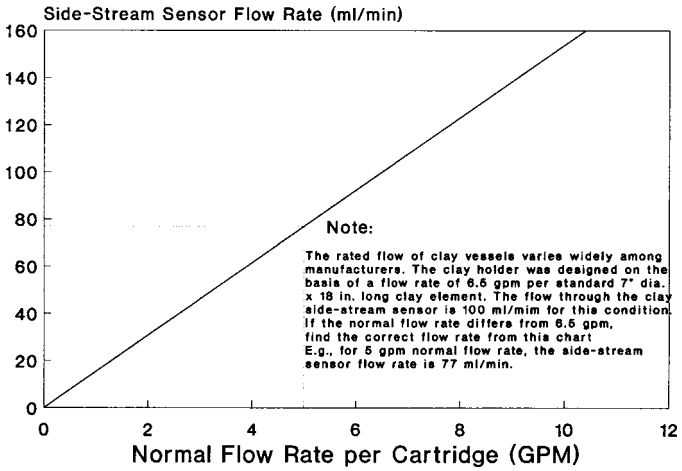


FIG. 6 Clay Side-Stream Sensor Flow Calibration

SUMMARY OF CHANGES

Subcommittee D02.J0 has identified the location of selected changes to this standard since the last issue (D 5000–89(2005)) that may impact the use of this standard.

(*1*) Deleted Test Methods D 2550 and D 3602 from the text and Referenced Documents.
(*2*) Added 4.2, 9.2, and 9.3.
(*3*) Updated and reorganized Section 9.
(*4*) Deleted syringe gear drive figure.
(*5*) Revised Note 5.
(*6*) Revised 3.2.1 and Sections 4, 6, 7, 8, 13, and 14.