FOAMING TENDENCIES OF OIL TESTS

The Most Complete Line for Apparatus and Accessories Meeting the Foam Testing Requirements of:

- ✓ ASTM D892
- ✓ ASTM D6082
- ✓ IP 146
- ✓ DIN 51-566
- ✓ NF T60-129
- ✓ FTM791c-3213

LAWLER
MANUFACTURING CORP.
7 Kilmer Court
Edison, NJ 08817
Phone: 732-777-2040
Fax: 732-777-4828
Web: www.lawler-mfg.com
Email: lawler@att.net

STATUS OF TESTING FOR FOAMING TENDENCIES OF LUBRICATING OILS

There have been many developments in recent years in the field on foam testing. Of particular note is the establishment of the new ASTM D6082 method for testing at 150°C. This new method replaces what has been previously referred to as Sequence IV test.

The high temperature of ASTM D6082 method raises lots of operator safety issues using oil baths at 150°C. The hot and smoking oil is a fire and health hazard. It also is a housekeeping problem with the operator needing to remove the hot test tube that is dripping hot oil.

The bath oil generally oxidizes and darkens after a few weeks of use, thus making it difficult or impossible for the operator to observe the foam levels.

Due to this problem some laboratories have resorted to using silicone oils as the bath medium. Silicone oil does not darken but even minute contamination (5 ppm or less) in the test oil will produce false results. Regardless of the care taken to clean the test cylinders after they have been immersed in the silicone, silicone contamination of the test oil is nearly impossible to avoid.

Some laboratories accustomed to using the twin jars baths for ASTM D892 increased the bath temperature to 150°C. If the exposed jar breaks the 150°C oil could cause major burns to the operator.

To deal with these issues, Lawler developed air baths for foam testing that operate at 150°C. The test method specifies that the sample must reach test temperature in less than one hour. Since air has a low heat transfer capacity, Lawler developed a unique heating system to accelerate this process.

Air baths for ASTM D6082 have been widely accepted. ASTM D892 was recently modified to allow the use of air baths as well as liquid baths for foam testing.

Additional changes are contemplated for the ASTM D892 test method. The method suffers from old age and as a consequence still specifies antique apparatus such as the wet test meter, etc. Many modern instruments are now available that offer greater ease of use and better precision.

One such item is the electronic mass flow controller to replace the flow meter. The mass flow controller meters air at the precise rate specified and is independent of the air temperature or air pressure.

To improve operator efficiency, automated sequencers are available that precisely time the various events including starting and stopping the air flow. The operator is called when his/hers presence for foam level reading is required.

Many labs have a cavalier attitude towards the diffuser stones, using them untested for years. The diffusers do become partly blocked and regardless of diligence in cleaning will not remove the block. ASTM D6082 method specifies that the diffuser be retested for conformance to specifications after every 10 samples. The testing of diffusers is an arduous procedure. Lawler has developed apparatus that automatically determines the porosity and permeability values.

Lawler also offers a certification service that retests the diffusers.

The current methods specify use of a cumbersome wet test meter to measure the total air volume after it leaves the test cylinder. Lawler offers an electronic totalizing device that digitally displays the total air.

HEATED AIR BATHS FOR FOAM TESTING

Model 323

- ✓ **Meet the requirements of ASTM D892 and D6082 for foaming characteristics**
- ✓ **Operating temperatures from +20°to +160°C**
- ✓ **Digital indicating PID temperature controller, 0.5°C stability**
- ✓ **Rapid sample heat up**
- ✓ **Eliminates liquid bath medium for improved safety and cleanliness**
- ✓ **Two channel, automated mass flow control of air flow**
- ✓ **Automatic, two channel event sequencer**
- ✓ **Two channel exit air totalizer**

Model 323 is a four test position heated **AIR** bath for measuring the foaming tendencies of lubricating oils in the temperature range of +20° to +160°C. The use of heated air for heating test samples improves the overall safety by eliminating the use of the potentially unsafe, smoking, dripping, flammable, hot liquid bath medium. Conventional bath fluids darken and require frequent replacement. Use of silicone oils (strong defoamers) is **not** recommended.

Model 323 uses a digital indicating (0.1°C resolution) PID controller for controlling the air temperature in the chamber, with a stability of better than 0.5°C over the operating range. Novel, sophisticated heating system and control allows the sample to reach test temperature in less than the 60 minutes as specified by the ASTM D6082 method. Long temperature probes are provided for each of the 4 test positions for digital control and test sample temperature display and precise temperature control during the foaming process.

For improved consistency of results, two digital indicating mass air flow controllers are used for precisely measuring and controlling the amount and rate of air delivered to the air diffuser. The air flow is controlled at a rate of 94 (for ASTM D892) or 200 +/-5 mL/min. (For ASTM D6082).

An automated, two channel sequencer automatically starts the air flow after the 5 minutes diffuser soak time, after 5 minutes stops the air flow and sounds an alarm, and again sounds an alarm after the 10 minutes settling period.

A touch screen allows the operator selection and full adjustment of all test parameters. All key test parameters are displayed during the test. Also displayed is the time remaining to the next test event requiring operator attention.

A multipane insulated window allows full view of the test cylinders for observation of the foam.

A twin pair of fans are provided to accelerate cooling of the air bath to the next lower test temperature. A chilled water/glycol mixture is required to maintain 24°C (75°F) in the air chamber for ASTM D892 Sequence I and III testing. The chilled mixture is also helpful for rapid cool down of the air chamber for the next test. Model **FM-16,** refrigerated chiller suitable for this task is also available.

Model 323-H is identical to Model 323 with the exception that its temperature range is only 90°C to 150°C. It is suitable for ASTM D892 Sequence II only, and D6082 test method.

Model 399-4 is similar to Model 323 but is designed to operate at only 24°C. An internal, fluid free refrigeration system maintains 24°C even in warm laboratory environment.

All models are available for either 115V, 208V, 220V, 50 or 60 Hz operation. Please specify power requirements when ordering.

LIQUID BATHS FOR FOAM TESTING

- ✓ **Meet the requirements of ASTM D892 or D6082 test methods**
- ✓ **Temperature stability better than 0.5°C**
- ✓ **Semi automated sequencer model available**

Model 24 dual foam test bath is the traditional arrangement with two glass jars mounted on a supporting base. Each jar accepts two, 1 liter test cylinders for ASTM D892 testing. One bath is typically controlled at 24 C and the other for 93.5 C. Digital display temperature controllers provide stability of better than ±0.5 C. Four, glass tube flowmeters are provided with micro valves for precision adjustment of air to flow at 94 mL/min ±5 mL/min. Model 24 is provided with a 4 position rack supporting 4 test cylinders when out of the bath. The jar for 93.5 C has a clear plastic protective sleeve to protect the operator from touching the hot surface.

Model 28 is similar to Model 24 but upgraded for semi-automated operation by the addition of Model FM-20 (see page 5). For improved consistency of results, two digital indicating mass air flow controllers are used for precisely measuring and controlling the amount and rate of air delivered to the air diffuser. The air flow is controlled at either a rate of 94 (for ASTM D892) or 200 +/-5 mL/min. (for ASTM D6082).

A two channel sequencer automatically starts the air flow after the 5 minutes diffuser soak time, after 5 minutes stops the air flow and sounds an alarm, and again sounds an alarm after the 10 minutes settling period. A touch screen allows the operator selection and full adjustment of all test parameters. All key test parameters are displayed during the test. Also displayed is the time remaining to the next test event requiring operator attention.

Model 12 single position test bath is same as Model 24 but only a single test jar and only two glass tube flow meters.

Model 296 high temperature foam test liquid bath is a safer way to perform ASTM D892 as well as D6082 test methods. The glass jar holding the heated liquid bath medium is enclosed in an insulated cabinet with a multipane insulated viewing window. The jar enclosure, in part, protects the operator by limiting the hot bath fluid splash in the event of jar breakage.

UPGRADING OF EXISTING FOAM TESTING APPARATUS

AUTOMATED FOAM TEST SEQUENCER:

- ✓ **Conforms to ASTM D892 and D6082**
- ✓ **Automatic, two channel event sequencer**
- ✓ **Two channel, automated mass flow control of air flow**

The currently used foam testing apparatus with two jars can be simply upgraded to improve the precision of the test and improve operator efficiency.


Model FM-20

Model FM-20 has two digital indicating mass air flow controllers for precisely measuring and controlling the amount and rate of air delivered to the diffuser. The air flow is controlled at either a rate of 94 (for ASTM D892) or 200 +/-5 mL/min. (For ASTM D6082). Unpublished data suggests that mass flow controllers may give improved consistency of results. Model FM-20 is enclosed in a small foot print cabinet (10 x 15 X 16 inches).

Model FM-20 has an automated, two channel sequencer that automatically starts the air flow after the 5 minutes diffuser soak time, after 5 minutes stops the air flow and sounds an alarm, and again sounds an alarm after the 10 minutes settling period.

A touch screen panel allows the operator selection and full adjustment of all test parameters including calibration. All key test parameters are displayed during the test. Also displayed is the time remaining to the next test event requiring operator attention.

DIGITAL DISPLAY EXIT AIR TOTALIZER

- ✓ **Two and one channel digital totalizer of exit air**
- ✓ **Eliminates the use of the wet test meter**

To make certain there are no air leaks in the foam testing system, ASTM D892 specifies the need to measure the total air exiting the foam test assembly. Lawler offers a simple electronic digital display device that replaces the wet test meter. Installation is simple, only requiring a connection to the test tube exit tube.


Model FM-21

Model FM-21-1, a single channel electronic totalizer digitally displays the total air that is exiting the test tube. The cabinet size is a small 8 x 11 x 8 inches high.

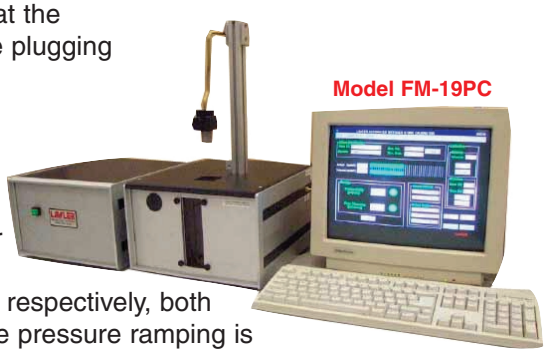
Model FM-21-2 is the same as Model FM-21-2 but has two sets of digital display totalizers.

DIFFUSER CALIBRATION APPARATUS FOR FOAM TESTING OF LUBRICATING OILS

- ✓ **Fully automated and manual apparatus**
- ✓ **Calibrate diffusers used in ASTM D892 and D6082**
- ✓ **Determine permeability and maximum pore diameter**

The measurement of Foaming Characteristics of Lubricating Oils per ASTM D892 foam testing, and ASTM D6082 High Temperature Foam Testing, is dependent upon the gas diffuser stone used in the test. Calibration of the diffuser stone involves the determination of critical parameters including PORE DIAMETER and PERMEABILITY for either spherical ceramic (Norton stone) or cylindrical metal (Mott) diffusers.

ASTM D892 recommends that the diffusers be tested when new and periodically thereafter, preferably after each use. It is, however, strongly recommended that the recalibration of the diffuser be done every 10 tests since plugging occurs after use even with diligent cleaning.



Model FM-19PC

Model FM-19PC Digital Diffuser Calibration Apparatus **automatically** determines both diffuser PORE DIAMETER and PERMEABILITY in accordance with ASTM D892 and D6082. The traditional manometer and water test meter are replaced by a high precision digital pressure controller and a digital mass flow meter, respectively, both controlled by the PC. The first bubble is detected and the pressure ramping is automatically controlled.

The proprietary Windows software manages the testing operation, the required calculations, and all the data. The results are displayed on the screen and can be printed and/or stored on the PC hard drive for ISO 9000 tractability.

Model FM-18PC is identical to Model FM-19PC, above, but required visual observation for the appearance of the first bubble.

Model FM-18D is a manual apparatus, also conforming to ASTM D892 and D6082 for measurement of pore diameter. It consists of a certified (NIST traceable) U-tube manometer capable of reading 1000 mm of water installed on a wall mountable panel, a 250 mL graduated cylinder, a precision regulating valve and a 1 meter length of 8 mm plastic tubing.

Model FM-18

Mounted on the same panel is the apparatus for the determination of permeability, which consists of a digital indicating mass flow meter capable of measuring 6000 mL/min. air flow while generating a low back pressure, and an Erlenmeyer flask with a rubber stopper. Model FM-18D eliminates the need for the clumsy and difficult to use water test meter.

Lawler also offers the calibration service to certify that the users diffusers conform to the specifications for pore diameter and porosity (see page 8).

All models are available for 115V, 208V, 220V, 50 or 60Hz. Please specify power requirements when ordering.

AUTOMATED APPARATUS FOR CLEANING FOAM TESTING CYLINDERS

- ✓ **Meets The Requirements of ASTM D892 and D6082**
- ✓ **Cleans 4 Foam Test Cylinders Simultaneously**
- ✓ **Each Solvent Flushing Time is Operator Adjustable via Touch Panel**
- ✓ **Improved Safety with Minimum Operator Contact with Solvents**
- ✓ **Significant Time Savings to the Operator**

Lawler Model 406 is specifically designed for automated cleaning of 4 foam testing cylinders simultaneously. The cleaning process fully conforms to ASTM D892 and D6082 using the specified solvents and drying procedure. The automation of the foam test cylinder cleaning chore releases the operator to more productive activity.

The automated cleaning apparatus enclosed in a front opening cabinet consists of a holder for 4 foam test tubes that are inverted on it (after draining of the test oil). A powerful, air driven pump sends a pulsating spray of solvents in the sequence as specified by the test methods (i.e., heptane, detergent water, distilled water, acetone, and finally drying air). The solvent spray impinges on the bottom of the test tube and then flows along the sides of the tubes for a total cleaning.

Model 406

To conserve solvents a small amount of clean solvent is introduced into the cylinder and recirculated for an adjustable period of time. This is followed by a clean solvent rinse, and then proceeding to the next cleaning process.

The operation is controlled by a PLC and can be accessed by the operator via a touch panel screen. He/she can select (and store in memory) the times of each step of the sequence. This option gives the operator the flexibility to adjust the flow of each cleaning step to balance time and material use vs satisfactory cleaning.

Non-sparking, low voltage solenoid valves operate the valves controlling the flow of materials. The PLC and all electrical components are in a separate, nitrogen purged cabinet. Although precautions have been taken to reduce the fire hazard of this apparatus, Model 406 is neither explosion nor fire proof.

The solvents are contained within the test tubes and plumbing. This closed system keeps the operator from exposure to the solvents.

Each test position has a manual shutoff valve, thus allowing the cleaning of less than 4 tubes at a time.

The dimensions of this model are 31 x 15 x 35 inches high.

OPTIONS AND ACCESSORIES FOR FOAM TESTING

Part No.	Description
FM-1	Flat bottomed glass 1000 mL test cylinder graduated at each 10 mL.
FM-3	Mott Cylindrical Metal Gas Diffuser (Mott diffusers offer more uniform air bubbles and greater precision over the Norton stones). Not certified.
FM-3MC	Certified Mott Cylindrical Metal Gas Diffuser
FM-3NC	Certified Spherical Norton Gas Diffuser
FM-4	Test Assembly includes 1 each graduated 1000 mL test cylinder (FM-1), Mott cylindrical metal gas diffuser (FM-3), with air-inlet tube, sealing washer, and two hole rubber stopper, and with air-outlet tube.
FM-14	Air Drying Tower packed with color indicating drying agent, as per section 6.3 of D892
FM-15	Air Supply Pump
FM-14/15	Air Supply Assembly mounted on a base with an air supply pump (FM-15) and with an air drying tower (FM-14). Overall dimensions are 9 x 10 x 14 inches high.
FM-16	Mechanically Refrigerated Bath (12 liters) with a digital indicating controller. Operating temperature range is +10° to -35°C. Designed for pumping cold liquid to Model 323 foam air bath allowing Model 323 to operate at 24°C as well as to rapidly cool the air chamber to the next test lower test temperature. Overall dimensions are 14 x 23 x 33 inches.
FM-17	20 liters (5 gallons) of Polyalphaolefin (PAO) bath medium oil, containing no silicones. PAO fluid has longer useful life at higher temperatures than conventional bath medium oils. 27 liters (7 gallons) needed to fill each liquid bath. Replaces silicones as heated bath medium. Silicone fluids are not recommended. Even low levels (5 ppm) of silicone contamination interfere with test results.
FM-20	Retrofit of existing twin jar foam apparatus for improved precision. Two mass flow controllers and two channel event sequencer. See page 5.
FM-21-1	Single Channel Totalizer for the exit air. See page 5.
FM-21-2	Twin Channel Totalizer for the exit air. See page 5.

DIFFUSER RE-CERTIFICATION SERVICE

- ✓ **Used Mott or Norton Diffuser Re-Certification Service to ASTM D892 and D6082**
- ✓ **Quick Turn Around, Economical**

ASTM D6082 method specifies that the diffuser be re-tested to confirm it is within the specification every 10 samples. ASTM D892 specifies that the diffuser be re-tested periodically and preferably after every use.

Lawler offers a convenient and economical service to certify with NIST traceability your used (cleaned) diffusers to meet the ASTM D892 and D6082 specifications. The service includes engraving the diffuser with a unique number accompanied by a certificate stating the measured pore diameter and permeability.

If the diffuser is outside of the specifications, Lawler offers a 50% credit(for the service) towards the purchase of a certified replacement diffuser.