

ALUMINUM BEAKER OXIDATION TEST**PART I - APPARATUS AND PROCEDURES****Application**

This procedure is used to determine the oxidation stability of automatic transmission fluids (ATFs) in the presence of some of the materials used in construction of automatic transmissions. It may also be applicable to other fluids whose degradation in service is controlled by time, temperature, and the availability of air.

Summary of the Method

A clean, freshly-etched aluminum beaker is used as the oxidation vessel. This beaker is equipped with a cover from which test strips of various metals can be suspended into the fluid and then withdrawn after different lengths of exposure.

Air is introduced at a prescribed flow rate into the test fluid held at the specified test temperature for the specified time. To assure intimate mixing of air and fluid, the air is introduced directly into a rotating gear pump immersed in the oil; this gear pump also serves to circulate the oil approximately four times per minute and to subject the fluid to a shearing action.

Deterioration of the fluid during the test is determined by analysis of aliquot samples withdrawn periodically and by examination of the test strips at specified times in the test cycle.

A copper and an aluminum strip are rated for corrosion and varnish deposits at the end of the test. Also at the end of the test, the beaker is disassembled and the top surface of the pump housing and inside walls of the beaker are rated for sludge deposits.

Apparatus Required**Aluminum Beaker**

The aluminum beaker (alloy 6061-T6) and associated components may be fabricated from detail drawings available from:

Scientific Research Lab
21500 Oakwood Blvd.
Dearborn, MI 48121

or
Standards Operations
(313) 323-2161

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The assembly is shown in Figure 1.

The inside surfaces of the beaker and pump housing are machined to a 30 – 40 microinch finish.

Bushings

An upper and a lower PTFE (Teflon) bushing are used to align the pump shaft with the stirring mechanism and to serve as bearing.

Gear Pump

Steel Gerotor Gear Pumps, Type 10010

Source: W. H. Nichols Co.
2400 Congress Street
Portland, ME 04102

The gears of these pumps are 25.4 mm O.D. and 7.938 mm thick and have a 9.25 mm diameter bore. A stainless steel shaft of appropriate length is fabricated with a pressed-in key to accommodate the pump rotor. The shaft should slide in and out of the rotor so that the rotor does not fall from the shaft easily.

Gear Pump Base Plates

The pump base plates are fabricated from materials used as thrust washers in automatic transmissions. Two pump plates (B-19319, Bronze Coated) and (B-19318, Lead Coated) are used. B-19319 is SAE 1010 low carbon steel with a 0.25 - 0.41 mm plating of SAE 799 Bronze; total thickness = 1.52 - 1.57 mm. B-19318 is the B-19319 part with an 0.0025 - 0.0102 mm overplate of SAE 190 lead-tin alloy.

Source: Federal Mogul Sealing
Research and Development
3874 Research Park Drive
Ann Arbor, MI 48108

Holes are drilled to attach the pump plates to the bottom of the gear pump. Check base plates for flatness after drilling. New pump base plates are used for each test.

Gear Pump Base Plates Spacers

Stainless steel or aluminum washers 19.1 mm O.D., 7.94 mm I.D. and 3.18 mm thickness.

Air Flow Control System

Air flow into the assembled beaker must be carefully controlled. The following combination has been used satisfactorily:

(a) Flowmeters

- (1) Hastings Mass Flow Meter, Model NALL-10, with transducer, Model HS-105

Source: Teledyne-Hastings Raydist
P.O. Box 1275
Hampton, VA 23661

- (2) Fisher-Porter Precision Flowrater Tube No. 80F-1/16 SA 19808

Source: Fisher-Porter Co.
51 Warminster Road
Warminster, PA 18974

(b) Control Valves

- (1) Hoke Metering Valves #2RB280 with Hoke 280-25 vernier handles

Source: Hoke, Inc.
10 Tenakill Park
Cresskill, NJ 07626

(c) Capillary

A capillary tube located between the air supply and the flowmeters can help stabilize air flow by maintaining a more nearly constant back pressure. Also, if the pressure drop across the capillary is much greater than the pressure drop across the mass flowmeter, the measured flow rate will accurately reflect the actual flow rate when the mass flowmeter is removed. Glass capillary tubes, 0.099 mm I.D. and 76.2 mm long have been successfully employed.

Source: Labcrest Scientific Glass Company
County Line Road
Warminster, PA 18974

(d) Air Inlet Tube

The air inlet tube is made from 4.8 mm outside diameter aluminum or stainless steel and is inserted into the top of the aluminum pump housing. A 2.4 mm hole, 25 +/- 2 mm above the entry to the housing allows oil to enter the air inlet tube for recirculation through the pump. A new air inlet tube is used in each test.

The Mass Flow Meter is used as the primary flow standard to establish the position of the ball in the flowrater tube for the prescribed flow rate. The Mass Flow Meter is used at least once each day but is disconnected during interim periods; the flowraters are connected throughout the test to provide an instantaneous indication of flow rate.

The air from the laboratory compressed air supply or bottled compressed air is dried by passage through a tower of fresh anhydrous calcium sulfate. Dry compressed air does not require a drying tower.

Constant Temperature Block

An aluminum block with built-in heaters and with wells to accommodate the aluminum beakers has proved satisfactory. Any block can be used that is capable of continuous operation at the test temperatures. Liquid baths are not recommended at high temperatures for reasons of safety.

Temperature Control

A stainless steel sheathed thermocouple immersed in the oil is used to sense the temperature. The heat input into the constant temperature block may be controlled using the output from this thermocouple. In that case, it may be connected at a temperature controller to maintain temperatures at the required $\pm 1^\circ\text{C}$. Love Model 149 controllers have been found to be adequate.

Source: Love Controls Corporation
1475 S. Wheeling Road
Wheeling, IL 60090

Temperature Recorder

A temperature recorder capable of continuous recording of the fluid temperature within $\pm 1^\circ\text{C}$ throughout the test cycle is used. A multi-channel recorder such as YEW Model 4156, 6-Point Model 100 mm Micro Recorder was found to be satisfactory.

Source: Great Lakes Controls, Inc.
23373 Commerce Drive, Suite A5
Farmington Hills, MI 48024

Metal Strips

Metal strips are suspended into the fluid from the aluminum strip holders. These strips are used to examine interactions between fluid and different metals and to collect deposits such as varnish which can then be rated by standard techniques.

One aluminum and one copper strip are suspended into the fluid. The aluminum strip is fabricated from No. 1100 alloy and the copper strip from CA 110 alloy; both are manually wet polished with No. 000 steel wool before use.

Note: Stoddard solvent is used in wetting the strips for polishing.

Conax Fittings

No. MPG-125-A-T and 187-A-T stainless steel or equivalent.

Source: Conax Corp.
2300 Walden Avenue
Buffalo, NY 14225

Millipore Filter

0.45 micron filter with 47 mm diameter.

Source: Millipore Corp.
Bedford, MA 01730

Drive Mechanism

Any suitable mechanism capable of driving the gear pump at 1100 +/- 100 RPM may be used provided it is designed to prevent axial loading which could cause wear of the gear pump base plate.

Materials Required

Sodium Hydroxide

2 - 4 wt % NaOH (Reagent grade) in water. Caution: Corrosive.

Nitric Acid

50 vol % nitric acid (Reagent grade) in water. Caution: Corrosive.

Trichloroethane

Caution: TLV = 350 PPM.

N-Pentane

Caution: - 50.6 °C flash point. Also avoid inhalation.

Acetone

Caution: - 9 °C flash point. Also avoid inhalation.

Conditioning and Test Conditions

All test values indicated herein are based on material conditioned in a controlled atmosphere of 23 +/- 2 °C and 50 +/- 5 % relative humidity for not less than 24 h prior to testing and tested under the same conditions unless otherwise specified.