ELECTRICAL INSULATING OIL SAMPLING AND TESTING – FLAT GAP

I. General

The dielectric strength of oil is affected by the most minute traces of certain impurities, particularly water. It is important that the greatest care be taken in obtaining the samples and in handling them to avoid contamination. There have been low dielectric test results reported which, upon investigation, have been found to have been largely a matter of carelessness in handling. The following instructions must be followed to assure accurate results. Reference ANSI/IEEE C57.106-1977.

II. Sampling

A. Equipment

Sample bottles - The sample bottle shall be clear glass or approved plastic of at least 16 ounce capacity. It must be clean and dry. The bottle shall be thoroughly rinsed with kerosene or other hydrocarbon solvent. A low boiling point solvent shall not be used as its rapid evaporation may cool the container, causing moisture condensation.

Caution: Do not use natural rubber gaskets or stoppers. The sulfur in the rubber will contaminate the oil.

B. Procedure

Caution: Do not draw samples of oil that are colder than the surrounding air. The oil will condense moisture and contaminate the sample. Do not draw samples in the rain or snow or when the relative humidity exceeds 50%.

1. From drums or shipping containers:

   a. Open the container, insert the thief and quickly empty the thief into the sample bottle. Fill the sample bottle. Reseal the container and the sample bottle. Deliver the sample to the testing area as soon as possible.

   b. Thoroughly clean and dry the sampling thief using the procedure for sample bottles shown in paragraph A., above.

2. From the oil-filled equipment:

   a. Draw enough oil from the chamber to wash any sediment from the drain valve and discard it.

   b. Fill the sample bottle and remove it from the oil stream before closing the valve. Seal the sample bottle and deliver it to the testing area as soon as practical.

      Note: Every precaution should be taken to assure that the sample represents the actual condition of the oil in the chamber and not that in the drain valve.

   c. Visually examine the oil. If the sample contains free water it is not suitable for dielectric test and the sample and bottle should be discarded. A second sample should be taken. If free water still exists in the sample, the oil in the apparatus should be replaced.

III. Testing (ASTM D 877-82)

A. Equipment

The transformer and the source of supply of energy shall not be less than 1/2 kVA. Regulation shall be so controlled that the high tension testing voltage taken from the secondary of the testing transformer can be raised gradually. The rate of rise shall approximate 3,000 volts per second. The voltage may be measured by any approved method which gives root-mean-square values (rms).

Some protection is desirable to prevent excessive flow of current when breakdown of the oil takes place.

The test cup for holding the sample of oil shall be made of a material having a suitable dielectric strength. It must be insoluble in and unattacked by mineral oil and petroleum distillates and nonabsorbent as far as moisture, mineral oil, and petroleum distillates are concerned.

The electrodes in the test cup between which the sample is tested shall be circular discs of polished brass or copper, 1 inch in diameter, with square edges. The electrodes shall be mounted in the test cup with their axes horizontal and coincident, with a gap of 0.100 inch between their adjacent faces, and with tops of electrodes about 1-1/4 inches below the top of the cup. (A suitable test cup is shown in Figure 1 and portable testing outfit in Figure 2.)

B. Adjust and Test the Equipment

1. Check the spacing of the electrodes. Adjust to 0.100 inch and lock in place.
2. Clean the test cup with a dry hydrocarbon solvent such as kerosene or Stoddard solvent.
3. Fill the test cup with new, dry, filtered liquid of the type being tested. Energize the tester and note the breakdown level. If it is less than 25 kV, reclean it.

Caution: Evaporation of the solvent from the electrodes may chill them enough to cause moisture to condense on them.

C. Testing the Oil

Note: The temperature of the test cup and of the oil when tested shall be the same as that of the room, which should be between 20° C and 30° C (68° and 86° F). Testing at lower temperatures is likely to give variable results.

1. Gently invert the sample bottle and swirl four or five times to mix any settled impurities. **DO NOT SHAKE**.
2. Rinse the test cup with the oil to be tested and discard the oil.
3. Fill the test cup immediately with the oil to a level 0.79 inch (20 mm or 25/32 inch) above the electrodes.
4. Gently agitate the oil with a rocking motion of the cup and let set for three minutes.
5. Apply the voltage, increasing uniformly at 3,000 volts per second until breakdown. Disregard any momentary discharges across the gap.
6. Repeat Step 5 for each of five tests of the same sample and record the results.

Note: When oil is tested in considerable quantity, one breakdown test shall be made on each of two fillings of the test cup. If neither breakdown is below the specified value, the oil may be considered satisfactory and no further tests shall be required. If either of the breakdowns is less than the specified value, a breakdown shall be made on each of three additional fillings and test results analyzed in accordance with Section E.

D. Test Reports

1. The test report shall include the following. (See sample form attached.)
   a. Source of oil sample and name of sampler.
   b. Breakdown voltage for each test (5).
   c. Average breakdown voltage.
   d. Temperature of the oil being tested.
   e. Date of the oil test.
   f. Name of tester.
   g. Location of testing area.
   h. Validity of test (see Section E).

E. Validity of Test Data

1. Subtract the lowest kV reading from the highest kV reading and multiply the difference by 3.
2. If the above number is smaller than the next-to-lowest kV reading, the test is valid.
3. If the above number is equal to or larger than the next-to-lowest kV reading, the test is NOT valid.

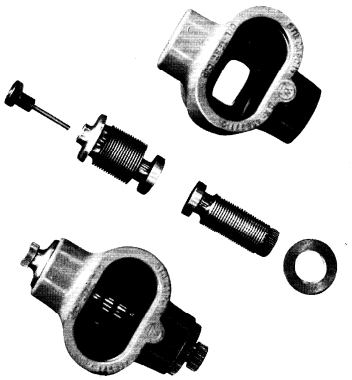

Figure 1. Oil or Fluid Test Cup
for Dielectric Test.

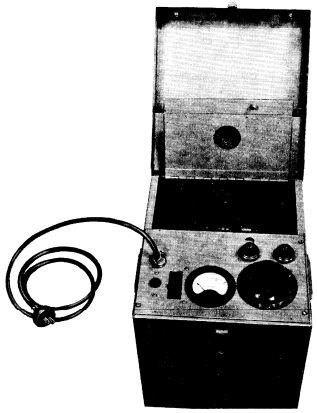

Figure 2. Portable Oil Testing Set
1/2 kVA 35,000 Volts.

OIL TEST REPORT

Oil Sample from _____

_____ by _____

Date _____ Temperature _____

Tested at _____

Tested by _____

_____

Test No. _____ Breakdown kV _____

1 _____

2 _____

3 _____

4 _____

5 _____

Average _____ kV Minimum acceptable avg. is 22 kV (26 kV system)

VALIDITY CHECK

High _____ **minus Low** _____ **=** _____

Multiplied by 3 = _____ *****

Next-to-Low = _____ ******

Test valid? **Yes** **No**

(** must be larger than * for test to be valid)