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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1684 | REV. JUN2000

Issued 1994-01
Revised 2000-06

Superseding J1684 JAN1994

Submitted for recognition as an American National Standard

Test Method for Evaluating the Electrochemical Resistance of Coolant System Hoses and Materials

1. Scope—This test method provides a standardized procedure for evaluating the electrochemical resistance of automotive coolant hose and materials. Electrochemical degradation has been determined to be a major cause of EPDM coolant system hose failures. The test method consists of a procedure which induces voltage to a test specimen while it is exposed to a water/coolant solution. Method #1, referred to as a "Brabolyzer" test, is a whole hose test. Method #2, referred to as a "U" tube test, uses cured plate samples or plates prepared from tube material removed from hose (Method No. 2 is intended as a screening test only). Any test parameters other than those specified in this SAE Recommended Practice, are to be agreed to by the tester and the requester.

2. References

2.1 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

R. C. Keller, SAE Technical Paper 900576, February 28, 1990
Harold Schneider, Hal Tucker, Dr. Eddie T. Seo, Rubber Division, ACS Technical Paper 73, May 22, 1992

3. Method #1 "Brabolyzer," Whole Hose Test—Materials and Equipment Required

3.1 12 V DC power supply.

3.2 Multivolt ohmmeter.

3.3 Commercial automotive coolant, ethylene glycol based containing an inorganic anticorrosion protection system, shall be used. These coolants are typically green in appearance.

3.4 End plugs chemically resistant, electrically nonconductive thermoplastic as polyamide, PTFE, or polypropylene suitable for isolating voltage applied to end of hose from the liquid test media inside the hose. Electrical contact surface for applied voltage should be the inside circumference of test hose. See Figures 1A and 1B for end plug assembly components. The end plugs shown are for 31.8 mm ID hose, which is preferred, but other sizes can also be made.

3.5 Glass insulator to isolate electrically the hose samples attached to the negative and positive terminals. See Figure 2.

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3.6 Suitable hose clamps for size of hose used.

3.7 Air-circulating oven configured with wooden or other nonconducting surface for complete electrical isolation of test assembly.

3.8 Suitable electrical leads and clips for connecting power source to end plug.

3.9 Microscope (10X to 20X) for examination of specimens after test. A stereo microscope is best, using a fiber-optic light source that can be adjusted for angle.

3.10 Two 100 mm straight samples for each cell. Curved hose may be used if straight hose is not available.

4. Set-Up Procedure

4.1 Attach one end-plug flush to one end of test hose with appropriate clamp.

4.2 Attach glass insert between the two test hoses with appropriate clamps.

4.3 Fill hose assembly 80% ± 5% by volume with a solution of 50:50 distilled water/coolant.

4.4 Attach second end plug to test specimen with appropriate clamp.

4.5 Mark specimen with pertinent identification and positive or negative polarity. Marking should be on the top side of the hose as it lays in the oven for use as a reference point.

4.6 Make three of the previous completed assemblies per test. See Figure 3.

5. Test Procedure

5.1 Place test hose assemblies in air-circulating oven which has been configured to electrically isolate the assemblies. Attach leads to assemblies at the end plugs, ensuring that polarity is consistent with markings. Use volt/ohmmeter to ensure continuity through all components measured with voltage off. Voltage measurements may vary through each hose assembly.

5.2 Apply 12 V, and measure voltage from plug to plug and record. Also measure voltage at source (before hose circuit) and record. If a significant difference exists, check all leads and connections. Voltage may or may not be the same. However, it is critical to ensure that all connections are properly made.

5.3 Heat oven to 100 °C ± 2 °C. Visually check liquid level through glass insulator each day, replenishing liquid, if it drops below 50%.

5.4 After 168 h ± 0.5 h, detach leads and remove assemblies from oven and allow to cool to room temperature.

5.5 Remove end plugs and drain fluid from hose. Rinse hose interior thoroughly.

5.6 Cut the negative end of the hose approximately 45 mm from hose end. A smooth, straight cut through the hose with a sharp blade instrument is desirable for examination purposes.

5.7 Examine the cross section of the cut end under magnification (10X to 20X) with a bright, low angle light. Make note of striations. The striations may be long and thin, short and thick, branched or unbranched, liquid filled or dry, or any combination of the previous. Do not confuse knife cut marks with striations.

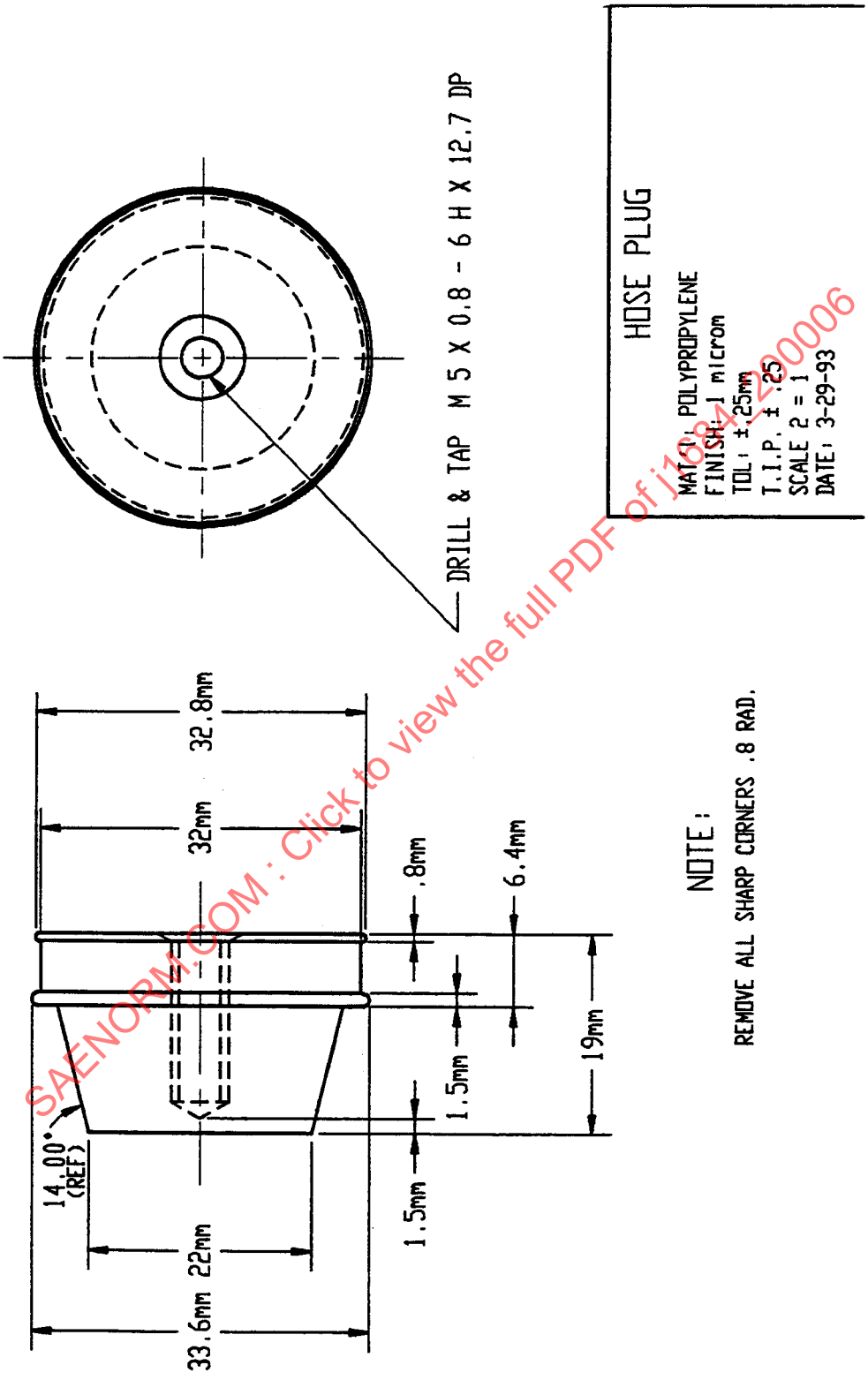

FIGURE 1A—POLYPROPYLENE HOSE PLUG

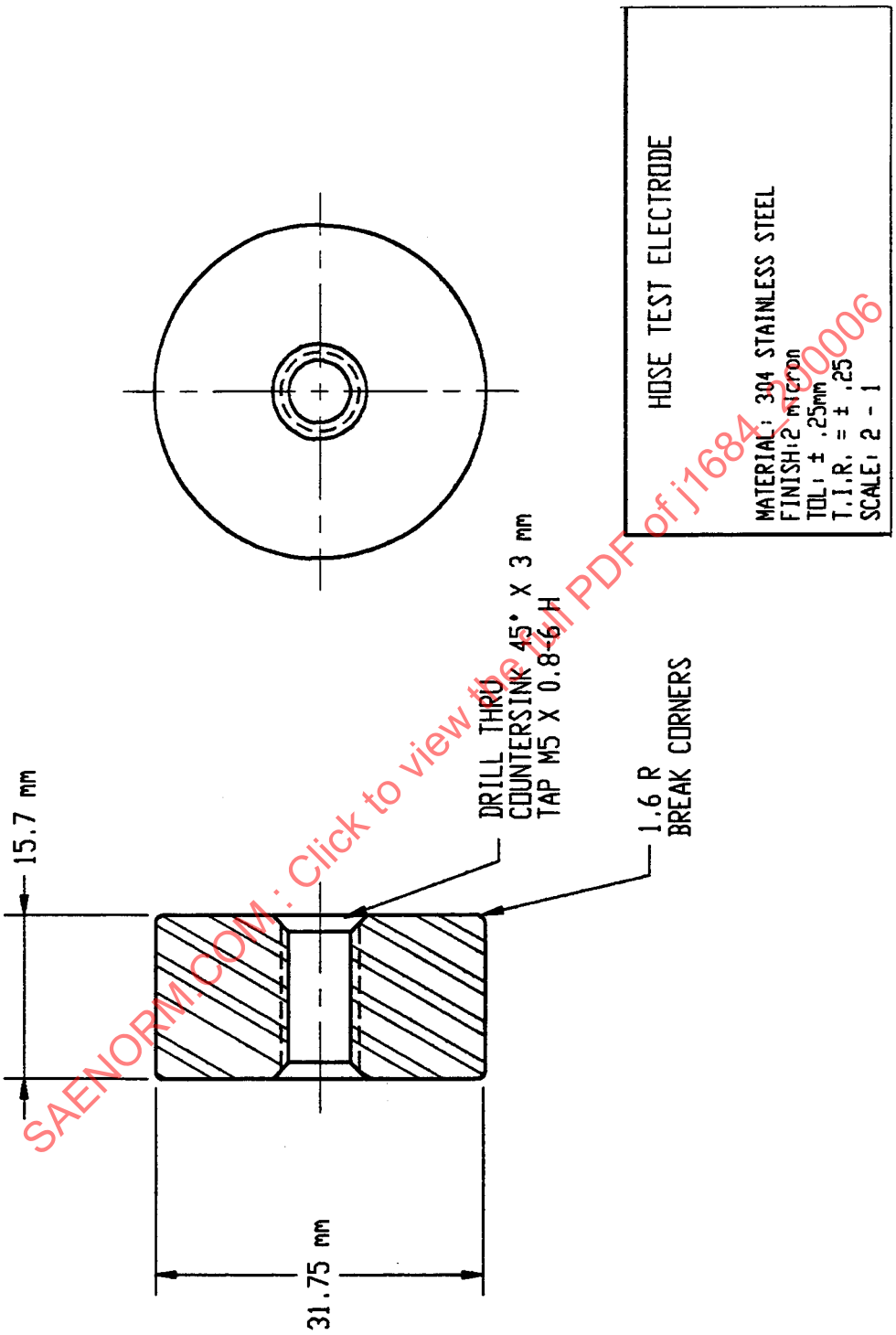

FIGURE 1B—ELECTRODE

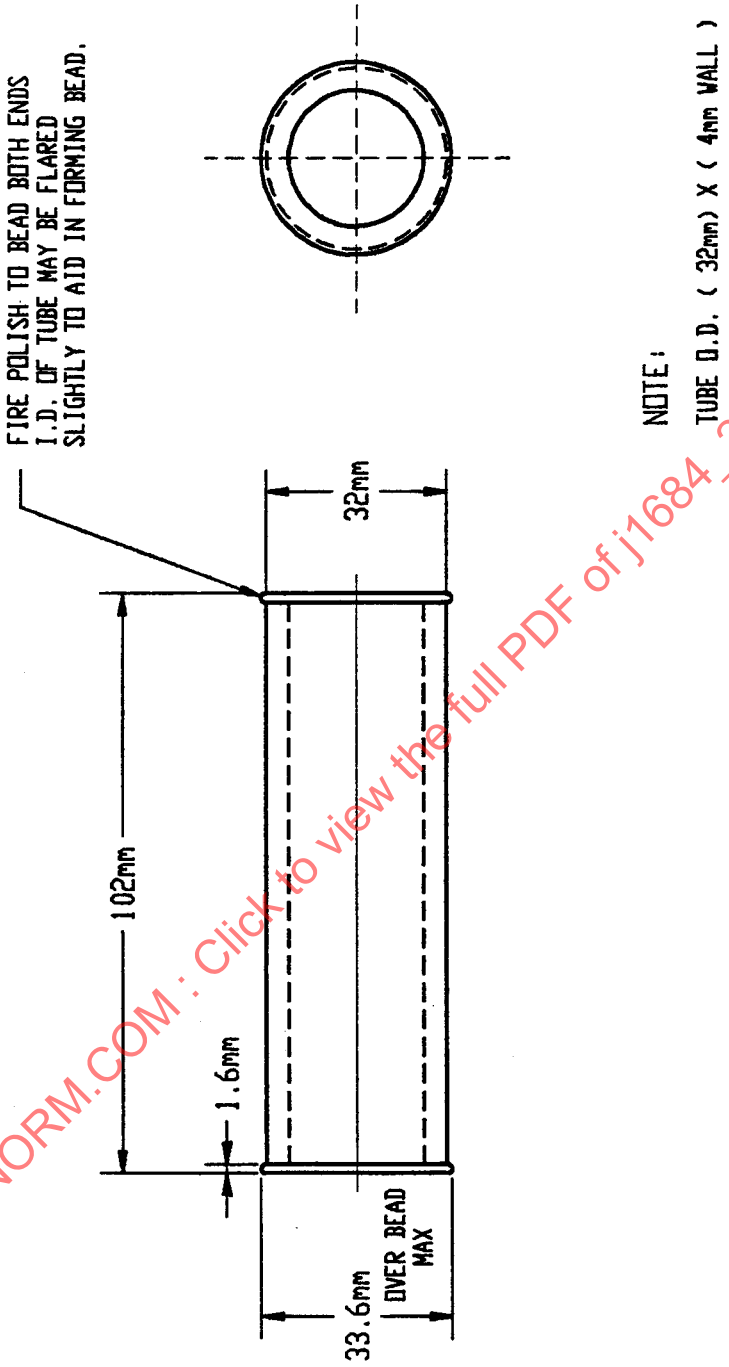

FIGURE 2—GLASS TUBE WITH BEADS ON ENDS

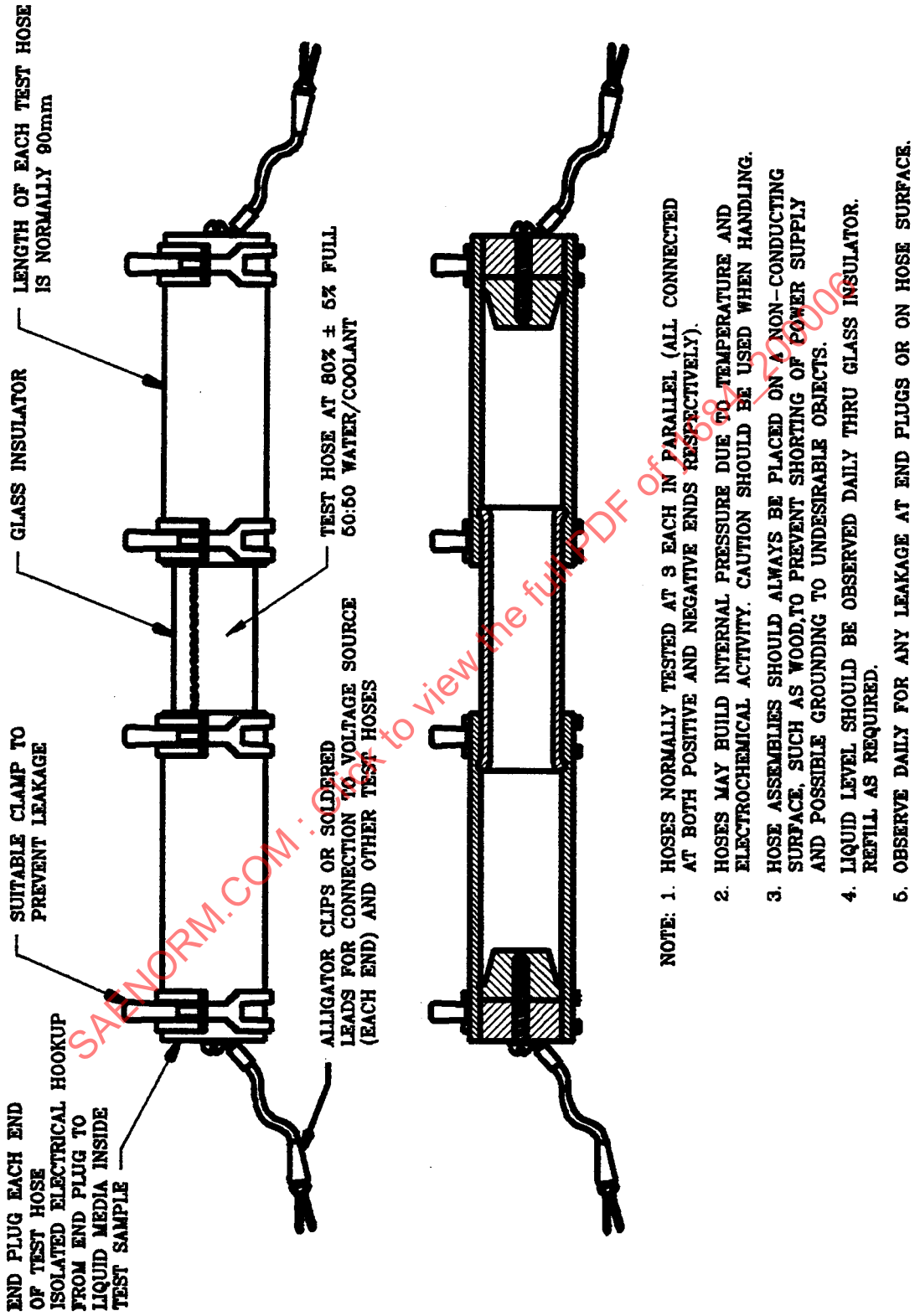

FIGURE 3—BRABOLYZER TEST CONFIGURATION

6. Report

6.1 Report any striations noted during the microscopic examination. Any striations constitute a failure. Additional descriptions such as length, percent of circumference affected, location, branching, moisture present, as well as pictures are helpful in determining degree and type of damage.

7. Method #2 "U" Tube—Materials and Equipment Required

7.1 12 V DC power supply.

7.2 Multivolt ohmmeter.

7.3 Commercial automotive coolant, ethylene glycol based containing an inorganic anticorrosion protection system, shall be used. These coolants are typically green in appearance.

7.4 Test specimen, die-cut from standard laboratory press cure stock. A die-cut sample from the tube removed from a hose may also be used. Dimensions are 10 mm wide x 100 mm long.

7.5 Glass "U" tube assembly.

7.6 Thermostatically controlled heating bath, using water soluble oil as a heating medium. The temperature of the bath oil shall be set at 80 °C.

7.7 Hook-up wire and crocodile clips.

7.8 Balance capable of weighing to 0.01 g.

8. Set-Up Procedure

8.1 Connect the hook-up wire to the crocodile clip and insert through the glass insulation tube as shown in Figure 4.

8.2 Weigh negative test specimen, bend the strip into a loop and clamp the ends with the crocodile clip.

8.3 Prepare a sufficient quantity of 50:50 coolant:distilled water for all tests.

8.4 Add 100 mL of the liquid prepared in 8.3 to the "U" tube apparatus.

8.5 Place a bent loop test specimen, held in place with the crocodile clip, and glass insulation tube into each arm of the "U" tube.

8.6 Loosen the screw cap on the Teflon® ball joint and slide the glass tube up or down to adjust the immersion depth of the specimen. The test sample should be marked 12.5 mm from each end, and the looped specimen immersed in the test fluid to those marks. This ensures that 75% of the specimen is immersed in the fluid. Repeat the process, placing another test specimen in the other arm of the "U" tube.

8.7 Place each "U" tube into the heating bath and clamp so that the coolant solution in the apparatus is just below the level of the heating oil liquid in the bath.

NOTE—The bath should be at the desired temperature before placing the "U" tube in it.

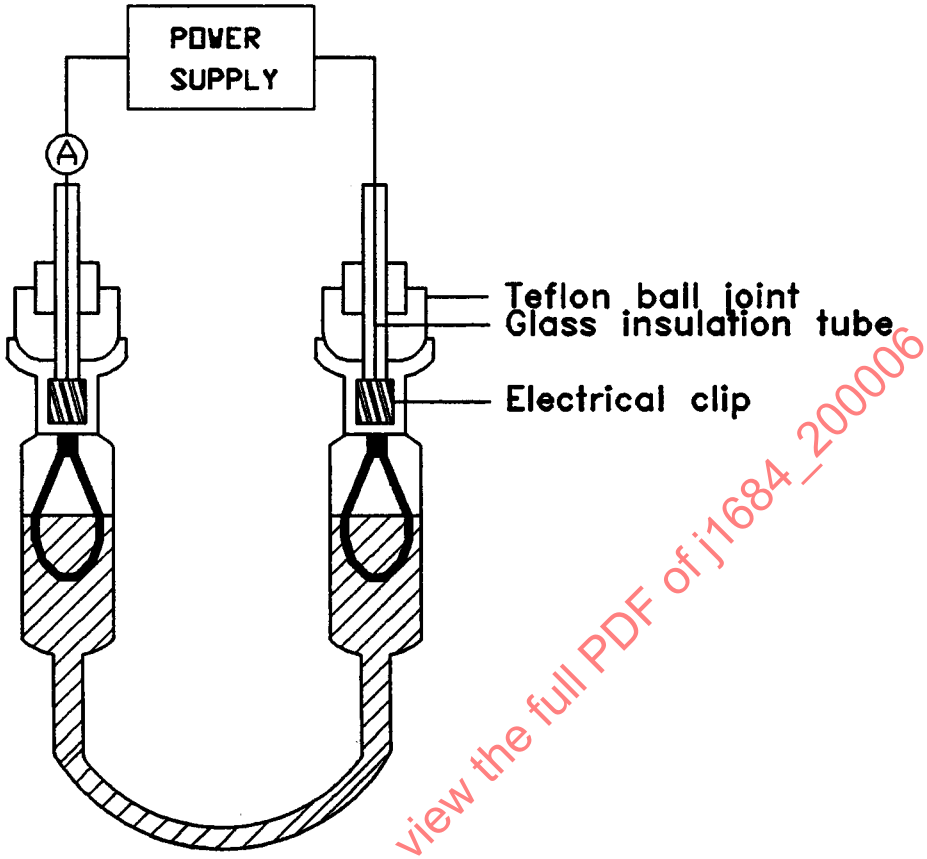

FIGURE 4—"U" TUBE APPARATUS TO DETERMINE ELECTROCHEMICAL RESISTANCE

8.8 Connect each "U" tube to the power supply.

NOTE—Label the positive and negative polarity of each of the connections and label the polarity on each arm of the "U" tube.

8.9 Make three of the previous assemblies per test, see Figure 4.

9. Test Procedure

9.1 Turn on the power supply and adjust the voltage to 12 V. Turn on each circuit as required. The current may be monitored, and recorded if desired.

9.2 After the test period, 168 h ± 0.5 h, is completed, turn off power to each circuit. Carefully loosen the Teflon® ball joint from the "U" tube and remove the ball joint from the crocodile clip. Note the polarity of each sample. Rinse sample in water, blot, and weigh immediately. Record the weight of the negative sample only.

9.3 Calculate the percent weight increase as follows in Equation 1:

$$100 \times \left(\frac{\text{Final wt.} - \text{Initial wt.}}{\text{Initial wt.}} \right) \qquad \text{(Eq. 1)}$$