External Ignition Protection of Marine Electrical Devices—SAE J1171 AUG82

SAE Recommended Practice
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PREPRINT

EXTERNAL IGNITION PROTECTION OF MARINE ELECTRICAL DEVICES—SAE J1171 AUG82

SAE Recommended Practice

Report of the Electrical Systems Subcommittee of the Marine Technical Committee, approved September 1977, revised August 1982. This document incorporates material from SAE J352a, J353, J354a, and J355a which have been discontinued.

1. Scope—This recommended practice covers all electrical devices suitable for use in marine engine compartments and fuel tank spaces.

2. Purpose—To recommend a test procedure for certifying the External Ignition Protection of electrical devices used on boats.

3. General—A device shall not produce combustion by excessive external surface temperature or by an internally generated arc. Reproducible test procedures are necessary to ensure that neither condition can cause external ignition when the particular electrical device is being operated.

In the first case, which involves excessive external surface temperatures, a test procedure includes operation for a minimum time at a higher-than-rated system voltage (or current) level with a limiting external surface temperature value. This should assure that such a device is acceptable for use in an engine compartment or fuel tank space. This test procedure is detailed in Section 4.

In the second case, which involves devices containing parts capable of arcing, two test approaches are necessary since such devices may be either sealed or non-sealed. Those that are sealed are External Ignition Protected by the fact that a combustible mixture cannot enter the void in which the arc occurs. Therefore, the test of sealed devices is a test of the seal integrity. This test is detailed in Section 5.

Non-sealed devices are External Ignition Protected when tests demonstrate that ignition of a combustible mixture within the device does not cause ignition of a combustible mixture surrounding the device. This will be verified by 50 device explosions with the flammability of the mixture within the enclosing chamber being checked by a chamber explosion after each 10 device explosions as detailed in Section 6.

The test sequence for any device is:

1. Section 4—Device Operation
2. Section 5—Sealed Devices
3. Section 6—Non-Sealed Devices

This is to ensure that any deficiency introduced in the device by the Operation Test Procedure, such as seal deterioration, etc., can be detected in the following tests.

4. Continuous Device Operation to Determine External Surface Temperatures

4.1 Electrical devices not rated for continuous operation and wired with manually operated momentary switches are exempt from this test procedure. This includes devices such as engine cranking motors, propulsion unit trim motors, and other intermittently operated devices.

4.2 This test shall be run with the device in an air circulating oven having an initial temperature of 60 ± 2°C (140 ± 4°F).

4.3 The device shall be operated continuously for a minimum of 7 h in the mode in which it draws its maximum current.

4.4 The test voltage supply shall be adjusted to 120% of the nominal system voltage (such as 12 or 115 V).

4.5 The maximum allowable surface temperature is 200°C (392°F) measured at any point on the device's exterior.

5. Method of Test—Sealed Devices

5.1 Equipment Description—Refer to Fig. 3.

5.2 Test Procedure

5.2.1 Submerge the device to be tested in a chamber of water, changing its attitude if necessary so that all possible sources of leaks are at the top and are 355 ± 15 mm (14 ± 0.5 in) below the surface of the water. Submerged time is 15 min for each attitude change.

5.2.2 Observe the device under test carefully during the test duration for a leak as evidenced by the generation of a bubble or stream of bubbles.

5.2.3 If bubbles are observed coming out of the electrical portion of the device, the device shall not be considered a sealed device and shall be tested under Section 6.

5.2.4 If no bubbles are observed, remove the device from the water chamber and dry its exterior.

5.2.5 Disassemble the device for internal inspection.

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

5.2.6 If no water is found inside the device, it shall be accepted as external ignition protected. If water is found, it shall be tested under Section 6.

6. Method of Test—Non-Sealed Devices

6.1 Equipment Description—See Figs. 1 and 2. Special note should be taken of the pressure-relief lid arrangement.

6.2 Device Preparation

6.2.1 Provide means of introducing a combustible mixture of propane and air into the device via 150 mm (6 in) minimum length of rigid or flexible tubing having an I.D. of 1.5–6.35 mm (1/16–1/4 in), the selection to be based on the minimum I.D. that can maintain a test rate which allows a minimum of two device ignitions per minute. The tubing supplying the mixture sample from the device to the analyzer shall have a 1.5 mm (1/16 in) I.D. and a minimum length of 150 mm (6 in). (Utilizing the minimum I.D. minimizes the effect of reducing the combustion pressure within the device at the time of ignition and maximizes the severity of the test.) See Fig. 1.

6.2.2 Devices that do not contain openings large enough to permit the introduction of the mixture at the required rate shall have a vent in the form of a copper tube with a 150 mm (6 in) minimum length installed in the device with the free end open to the chamber. The I.D. of the copper vent tube shall be the same as that required to feed the device. NOTE: The copper material is necessary to assure quenching of the flame before it reaches the end open to the chamber.

6.2.3 Devices which are too small for the direct installation of both the tubing feeding the device and that supplying the device gas analyzer require a tee fitting to join the tubes from which a single 150 mm (6 in) minimum length, 1.5 mm (1/16 in) I.D., rigid or flexible tubing can then enter the device. See Fig. 2.

6.2.4 The device contacts or a separately mounted spark plug or spark-plug-like item is required to provide a gap across which a spark can jump. The gap size need only be large enough to ignite consistently the specified mixture. However, where possible, a 2.54 mm (0.100 in) gap is preferred. The spark gap provided must be installed as close as possible to that part in the device from which the arc would normally originate. Electric motors, for example, must have a spark plug mounted at the commutator end of the motor since it is at this end that sparks between the brushes and commutator can occur. The test chamber ignition system shall be a single-shot system to insure that the surrounding mixture is easily ignitable.

6.2.5 Confirmation of ignition within the device can usually be detected by the noise produced. If the *pop* or *bang* is not clearly audible, make provisions to check the pressure rise in the device or utilize the observed flash of combustion seen through a 19 mm (3/4 in) maximum length, 6.35 mm (1/4 in) maximum I.D. supply tubing. See Fig. 2. The transparent tube must connect to the device through a hole large enough to transmit the combustion into the transparent tube without being quenched.

6.3 Test Procedure

6.3.1 With the device in the test chamber, fill the device and chamber with mixtures as follows:

6.3.1.1 *Test Chamber*—Fill the test chamber with a mixture of 4.75% ± 0.25% propane to air by volume. This test chamber mixture ratio is to be maintained during all testing cycles.

6.3.1.2 *Device*—Fill the device with a mixture ratio determined by varying the ratio to produce a maximum pressure rise as indicated by the pressure transducer. This mixture ratio shall then be used throughout the device testing procedure. Where the smallest practicable pressure transducer cannot be installed due to the limited space available, a mixture ratio of 4.25% ± 0.25% propane to air by volume shall be used and combustion determined by the flash of combustion seen through the transparent tubing supplying the propane-air mixture to the device. See Fig. 2.

6.3.2 After establishing the proper mixture, stop the filling process and ignite the device mixture with the spark. NOTE: If any attempt to ignite the device mixture fails, purge the device and chamber by returning to step 6.3.1 and rerun only that cycle. Do not rerun the entire test.

6.3.3 Confirm combustion in the device.

6.3.4 Repeat steps 6.3.1–6.3.3 nine additional times in succession.

6.3.5 Ignite the test chamber mixture with the single-shot spark after

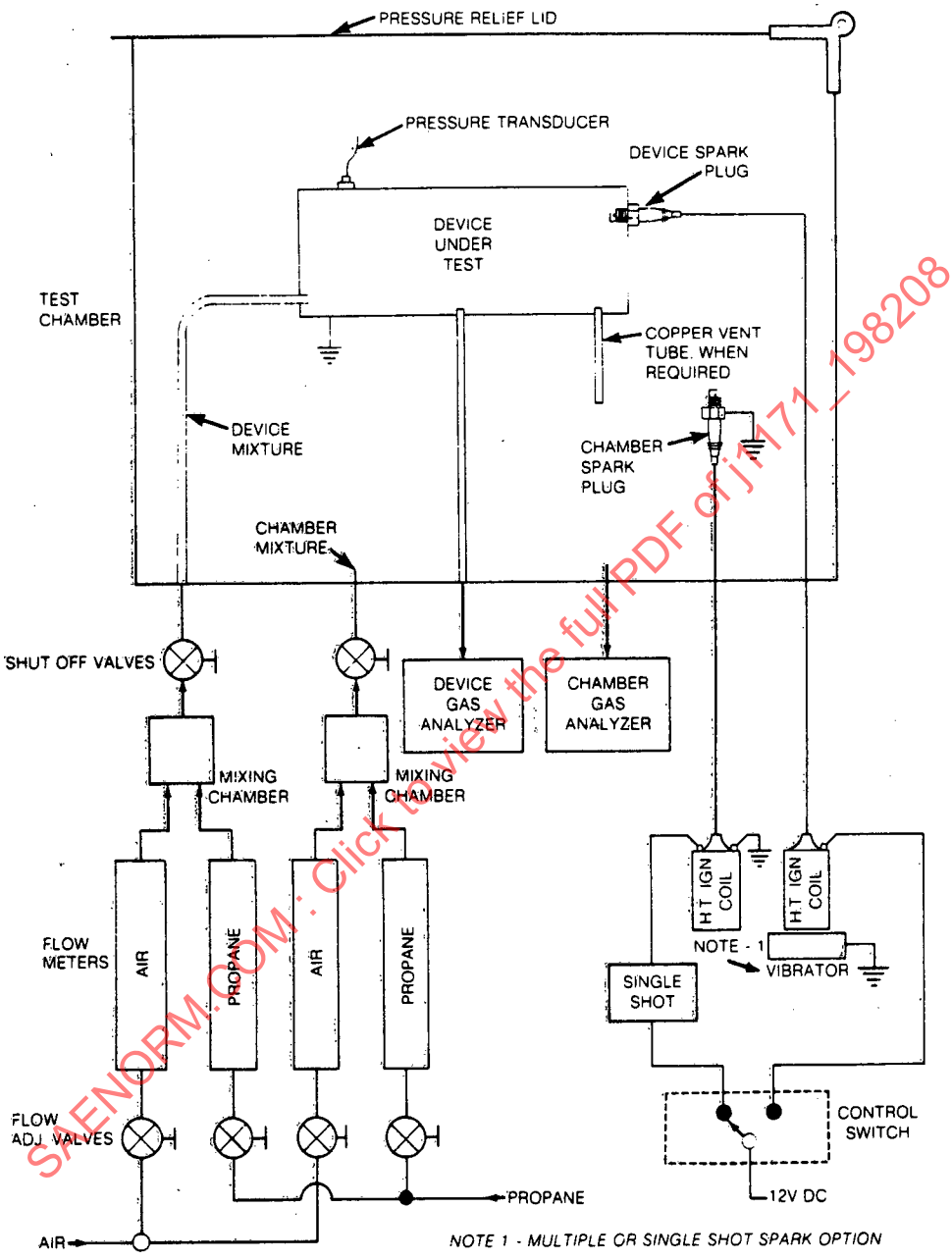

FIG. 1—TEST ASSEMBLY (LARGE NON-SEALED DEVICES)

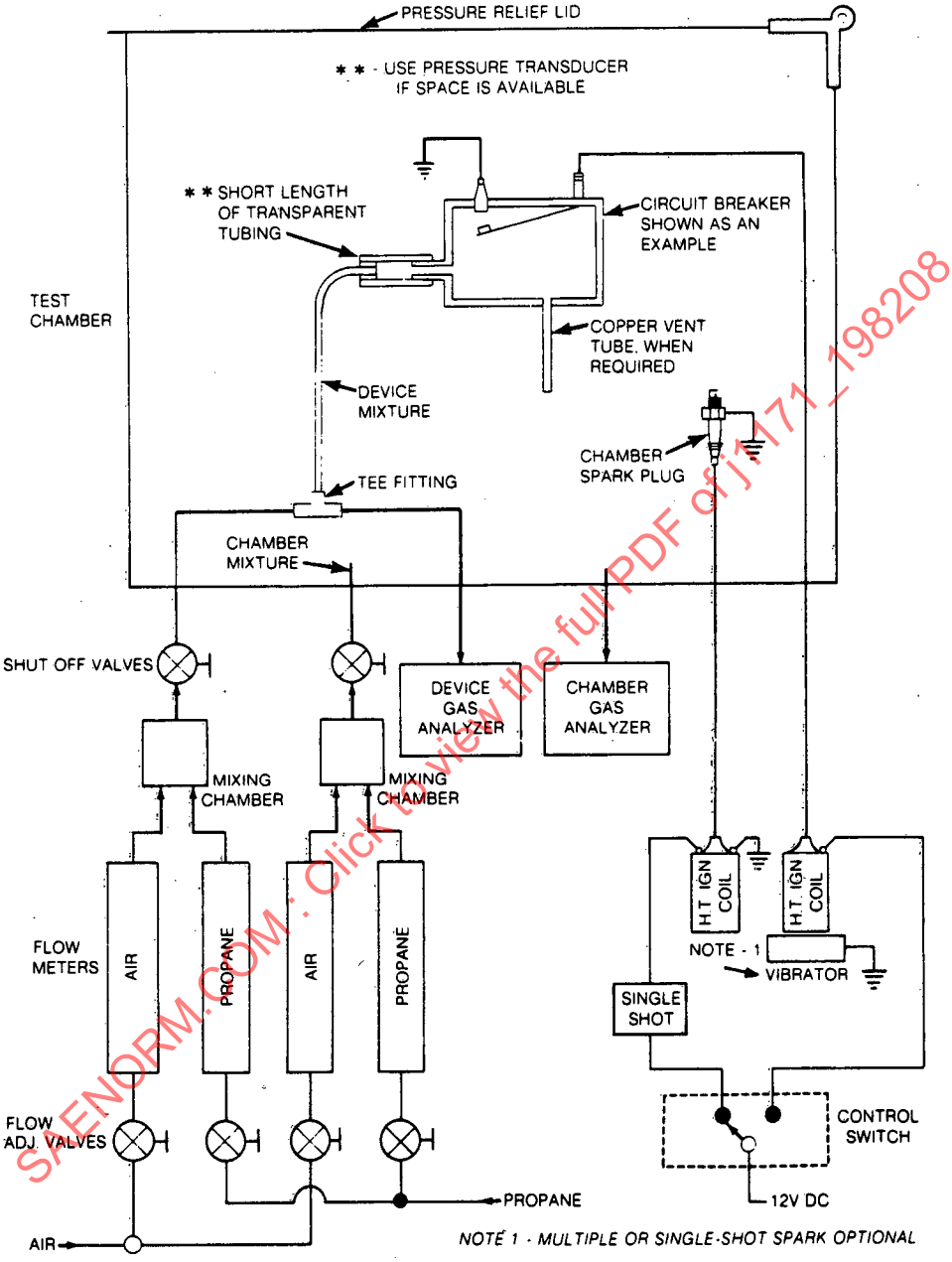

FIG. 2—TEST ASSEMBLY (SMALL NON-SEALED DEVICES)