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SURFACE VEHICLE STANDARD

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An American National Standard

(R) DEVICES PROVIDING BACKFIRE FLAME CONTROL FOR GASOLINE ENGINES IN MARINE APPLICATIONS

***Foreword*—**This Document has also changed to comply with the new SAE Technical Standards Board format.

***1. Scope*—**This SAE Standard covers the minimum requirements for design, construction, and testing of devices to prevent the propagation of backfire flame from within the gasoline engine to the surrounding atmosphere.

1.1 Purpose—The purpose of this document is to recommend a procedure for testing and establishing acceptable flame arresting characteristics of the devices.

2. References

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein.

2.1.1 ASTM PUBLICATION—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM B 117—Method of Salt Spray (Fog) Testing

3. Definitions

3.1 Flame Arrester—An assembly, consisting of one or more component parts, designed and constructed as to prevent the propagation of backfire flame from within the carburetor and engine air intake system to the surrounding atmosphere.

3.2 Engine Air and Fuel Induction System—Either a particular method of introducing fuel into the engine or a design of air intake passages to the cylinders that provides protection equivalent to that of an effective backfire flame arrester.

4. General

4.1 Flame Arrester

4.1.1 The flame arrester assembly shall include a permanent and prominent means of identification as described in Section 7.

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4.1.2 A carburetor adaptor, if required, shall be attached permanently to the flame arrester. Examples of permanent attachment would be: bond, weld, rivet, or threaded fastener with thread upset after assembly. No loose pieces shall be used between the flame arrester and the carburetor that could be left out.

4.1.2.1 The adaptor assembly shall provide for direct attachment to the carburetor.

4.1.3 The construction of the flame arrester shall provide access for inspection and cleaning.

4.1.4 There shall be no openings in the arrester or its connection to the carburetor, through which a backfire flame can pass.

4.1.5 The construction for the flame arrester shall provide means of securely fastening both the flame arrester to the carburetor air intake and the component parts to each other. When clamps are used, they shall be affixed to one of the major component parts in such a manner that they cannot be easily removed. No springs shall be used for the purpose of clamping.

4.1.6 Construction of the flame arrester shall be such that component parts cannot be misaligned during assembly or installation to an extent that will impair its effectiveness.

4.2 Engine Air and Fuel Induction System

4.2.1 The engine air and fuel induction system shall be designed and constructed to provide protection equivalent to that of an effective backfire flame arrester designed and constructed in accordance with this document.

5. Method of Test

5.1 Each design of the flame arrester shall be tested to determine conformance to this document.

5.1.1 Where a particular design consists of various combinations of parts, only a sufficient number of sample assemblies need to be tested that will be representative of the flame arresting performance of the cross section of assemblies of the design.

5.1.2 The test of the samples representative of each design shall conclusively indicate that, when such backfire flame arresters are subjected to the test procedures of 5.4, the design prevents propagation of the backfire flame to the surrounding atmosphere without failure, damage, or permanent deformation.

5.1.3 A change in the design or construction of an arrester that has passed qualification tests requires that the arrester be retested if the change cannot be considered and accepted under 5.1.1.

5.2 Each design of an engine incorporating a backfire flame control air and fuel induction system shall be tested and shall conform to this document.

5.2.1 Where a particular design of the engine air and fuel induction system consists of variations so that it may be utilized in similar engines of a particular manufacturer, only a sufficient number of engines need to be tested that will be representative of the backfire flame control performance of the cross section of engines.

5.2.2 The tests conducted according to the procedures of 5.4 shall conclusively indicate that the engine air and fuel induction system, when installed on a representative engine, will prevent the propagation of backfire flame to the surrounding atmosphere.

5.2.3 The tests performed in accordance with this document, and adapted as necessary to an air and fuel induction system, will satisfy the testing requirement of this section.

5.2.4 A change in the design or construction of an engine air and fuel induction system that has passed qualification tests requires that the system be retested if the change cannot be considered and accepted under 5.2.1.

5.3 Certification test reports shall be retained by the manufacturer so long as the device covered by the report is marketed, and shall include the following:

5.3.1 Detailed drawings (provided by the manufacturer) of the device, including a complete bill of materials.

5.3.2 Types of tests conducted and results obtained.

5.3.3 A record of all markings found on the devices tested.

5.3.4 A record of assemblies actually tested and all assemblies to which the results apply, see 5.1.1 and 5.2.1.

5.3.5 A report number, date of test, name, and address of test laboratory.

5.4 Test Procedure—The devices or systems shall withstand the effects of each of the following tests without failure.

5.4.1 BENCH EXAMINATION—The backfire flame arrester assembly, together with a stock carburetor designed to be used, or the engine air and fuel induction system, shall be examined for compliance with the requirements of this document.

The following specific points of design and construction shall be examined as part of the bench examination.

5.4.1.1 *Workmanship*—Visually inspect all submitted samples for evidence of imperfections and consistency with production drawings.

5.4.1.2 *Inspection and Cleaning*—Visually inspect the assembly to confirm that the flame arrester or induction system can be inspected and cleaned in service.

5.4.1.3 *Other Openings*—Visually inspect the assembly as installed for the existence of any of the following openings.

5.4.1.3.1 Engine oil breather connections shall be subject to the backfire tests in 6.4.4 as installed on the engine.

5.4.1.3.2 All clamps and joints shall be examined specifically for any possible bypass openings.

5.4.1.3.3 Fuel pump vent/sight hose, connected to a flame arrester vent tube passing through the elements, can be capped if the hose opening is dead ended at the fuel pump.

5.4.1.4 *Assembly*—Visually inspect the provisions made for securing the assembly or system and the method of fastening the components to each other. Determine that the clamps are permanently fastened to a major assembly component.

5.4.1.5 *Component Misalignment*—Determine that the component parts can be assembled properly by following instructions provided with the device.

5.4.2 VIBRATION TEST

5.4.2.1 A stock model or prototype backfire flame arrester or system assembly shall be used for this test and shall be mounted on a stock carburetor or induction system or simulated carburetor or induction system for the type of assembly intended to be used in service.

5.4.2.2 The carburetor or induction system shall be secured by the means of a rigid adaptor directly to the surface of the vibration table in its normal operating position. The backfire flame arrester or system assembly shall then be secured to the carburetor or induction system to simulate a normal installation on a marine engine.

5.4.2.3 The carburetor and backfire flame arrester or induction system shall be subject to 24 h of vibration with 8 h in each of the x, y, and z planes at a peak-to-peak amplitude of 1.02 mm ± 0.025 mm (0.04 in ± 0.001 in). The test setup shall be automatically cycled at a constant rate from 10 to 60 Hz every 4 min.

5.4.2.4 The backfire flame arrester assembly or induction system shall not fail in a way that would prevent it from functioning as intended.

5.4.3 SHOCK TEST

5.4.3.1 The setup used for the vibration test shall be used for this test including the test fixture, carburetor, and backfire flame arrester assembly or induction system.

5.4.3.2 The test setup shall be secured to the surface of a shock machine and subjected to 5000 vertical impacts of 10 G rms having a shock duration of 20 ms ± 2 ms measured at the 0 reference line of a half-sine shock pulse.

5.4.3.3 The backfire flame arrester assembly or induction system shall not fail in a way that would prevent it from functioning as intended.

5.4.4 EXPLOSION CONTAINMENT

5.4.4.1 The backfire flame arrester assembly and carburetor or the engine air and fuel induction system used for the vibration and shock tests shall be used for this test.

5.4.4.2 The test setup for conducting the explosion containment tests shall be in accordance with the following conditions:

5.4.4.2.1 The backfire flame arrester assembly and carburetor or induction system shall be attached to the test stand in Figure 1 in a manner simulating a normal installation. An engine may be used in place of the test stand for testing induction systems (see 5.4.4.7.3.) Prior to the tests, the carburetor or induction system shall be carefully checked for any openings that could permit flame passage and all throttle and choke butterflies shall be locked in the full open position. Fuel line, vacuum advance, and other carburetor or induction system openings shall be plugged.

5.4.4.2.2 Where provisions are made on the backfire flame arrester or induction system for the connection of oil breather tubing or for any other purpose, such lines shall be left disconnected during the tests.

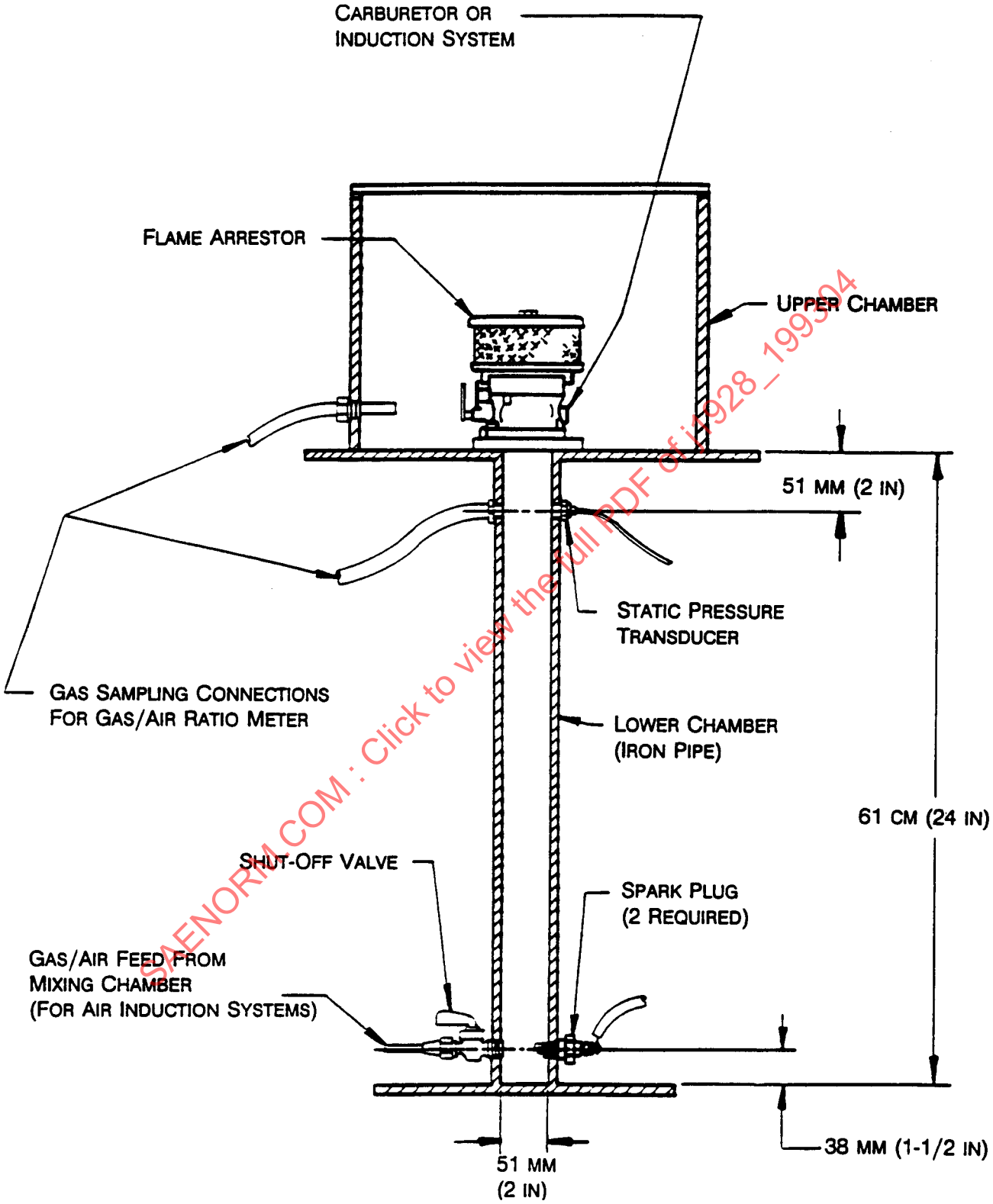

FIGURE 1—EXPLOSION CONTAINMENT TEST SETUP

5.4.4.2.3 Using whatever adaptor that may be required, the carburetor with the attached backfire flame arrester assembly or the induction system shall be secured directly to the upper end of a chamber, to be referred to as the lower chamber with an internal bore of 51 mm (2 in) and a length of 61 cm (24 in). The lower chamber shall be closed at the lower end. See Figure 1. The method of attachment shall be that all joints are gas-tight and the carburetor or induction system is directly and fully open to the lower chamber with no restriction to gas flow. For evaluation of induction systems an engine can be used in place of the lower chamber, with alterations to introduce the combustible mixture and ignition source.

5.4.4.2.4 In accordance with Figure 1, a provision shall be made at the base of the lower and upper chambers for the introduction of a premixed propane gas/air mixture. The mixing of the propane and air shall not be accomplished within the chamber.

5.4.4.2.5 The propane/air explosive mixture used for these tests shall be generated through the use of flow meters and a suitable premixing chamber so designed and arranged that a controlled homogeneous explosive mixture is fed up to the lower chamber for a flame arrester and to the upper and lower chamber for air induction system during all tests. A suitable control valve shall be provided at the gas/air inlet fitting to permit immediate extinguishment of the mixture, should it continue to burn after ignition. Flame arresters shall be provided in all connecting fittings between the explosion chamber and mixing chamber to prevent effective flame propagation through the lines to the mixing chamber.

5.4.4.2.6 Two spark plugs, set with a gap of 0.76 mm (0.030 in), shall be provided at the base of the lower chamber directly adjacent to the gas/air inlet fitting. A dual ignition system capable of simultaneously firing both spark plugs with a minimum peak voltage of 25 000 V shall be provided.

5.4.4.2.7 An upper chamber shall be provided around the flame arrester or engine air and fuel induction system to maintain an explosive mixture around the flame arrester or induction system during all the tests.

At least one side of the upper chamber shall be made of transparent plastic to permit good observation of the backfire flame arrester or induction system at the time of ignition.

5.4.4.2.8 The instrumentation shall include the following:

5.4.4.2.8.1 Meters for monitoring the propane/air mixture in the upper and lower chambers.

5.4.4.2.8.2 A pressure transducer in the lower chamber with an amplifier and oscilloscope to monitor the relative severity of each test explosion.

5.4.4.2.8.3 Flowmeters to monitor the gas and air flow rates.

5.4.4.2.9 When testing air and fuel induction systems with reed valves on similar devices which will close when pressure is applied, a pressure relief opening or valve with a flame arresting device may be required in the lower chamber to prevent damage to the chamber. Design of the chamber and relief provision must not reduce the severity of the backfire from that produced in an engine application.

5.4.4.3 The tests shall be conducted in accordance with the following procedure:

5.4.4.3.1 The individual propane and air supply pressure and flow rates shall be adjusted to provide a stoichiometric mixture in both the upper and lower chambers at a flow rate of at least 477 cm^3/s (1 ft^3/min).

5.4.4.3.2 When the instrumentation indicates that a proper mixture is present in both the upper and lower chambers, the mixture in the lower chamber shall be ignited by the means of the dual-plug, single-shot ignition system. The intensity of the explosion in the lower chamber shall be observed and the relative pressure in the lower chamber recorded. Following each test, the upper and lower chambers shall be purged of all burned gases and the test repeated. During the initial tests, the gas flow shall be adjusted so as to provide first a mixture that is rich, and then back through the stoichiometric mixture to a lean mixture, to determine the mixture that produces the maximum explosive condition. At least 50 test explosions shall be conducted at, or very close to, this maximum explosive condition. All test explosions of low intensity (less than 80% of maximum pressure) shall be discounted.

5.4.4.3.3 There shall be no ignition of the gas/air mixture in the upper chamber as a result of any of the tests due to flame passage through the flame arrester or induction system or any connections, including oil breather connections and attachment to the carburetor.

5.4.5 CORROSION TEST

5.4.5.1 The backfire flame arrester assembly or air and fuel induction system shall be exposed to a salt spray test in accordance with ASTM B 117 for a period of 240 h.

5.4.5.2 The backfire flame arrester assembly or induction system must not fail in any way that would prevent it from functioning as intended.

6. Certification

6.1 The certification shall be furnished with the device or system stating that the device or system has been manufactured, tested, and inspected in accordance with this document and the requirements have been met. A report of the test results shall be available on request.

6.1.1 Each manufacturer shall certify that a device or system has been constructed in accordance with this document.

6.2 The technical manual shall include:

6.2.1 Installation instructions

6.2.2 Operating instructions

6.2.3 Maintenance requirements including instruction on how to determine when cleaning is required and the method of cleaning.

6.2.4 A technical data brochure of a type typically used for marketing will satisfy the requirements for a technical manual if it includes the information cited.

7. Marking

7.1 Evidence of compliance with the document shall be indicated by the marking 'SAE J1928' together with the word MARINE arranged in any suitable manner.

7.2 The marking shall be permanent in nature, and shall include the manufacturer's name or trademark, identification by style, type, or model number, and SAE J1928 together with the word "MARINE."