SAE International™

SURFACE VEHICLE STANDARD

SAE J1928

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Devices Providing Backfire Flame Control for Gasoline Engines in Marine Applications

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.

1.2 Relationship of SAE Standard to ISO Standard

This document is similar to ISO 13592 but has some technical differences.

1.3 Rationale

The use of non-metallic materials in flame arrestors and induction systems is becoming more prevalent throughout the Marine Industry. Inclusion of a heat-aging test as proposed in this standard provides a means to insure these materials will meet the requirements of the Marine Environment.

Throttle bodies have been added to the document as they are required by law to have the same flame arresting protection as carburetors and induction systems.

The document's relationship to ISO 13592 has been added to the document.

Tolerances were changed/added to update the document to realistic and current practices.

The UL94 rating was added to provide a current flammability rating for non-metallic materials.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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2.1.1 ASTM PUBLICATION

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Website: www.astm.org. Tel. (610) 832-4585

ASTM B 117—Standard Practice for Operating Salt Spray (Fog) Apparatus

2.1.2 UNDERWRITERS LABRATORIES PUBLICATION

Available from COMM 2000, 1414 Brook Drive. Downers Grove, IL. 60515. Website: comm-2000.com

UL 94—Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

2.2 Related Publication

The following publication is provided for informational purposes only and is not a required part of this document.

2.2.1 ISO PUBLICATION

Available from International Organization for Standardization (ISO), 1 rue de Varembe, Case Postale 56, CH-1211, Geneve 20, Switzerland/Suisse or from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 13592—Small craft—Backfire flame control for petrol engines

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 or throttle body 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.

3.3 Non-Metallic Materials

Rubber, plastics, and adhesives used in the construction of flame arresters and/or induction systems.

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.

4.1.2 A carburetor or throttle body 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 or throttle body that could be left out.

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

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 or throttle body 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 or throttle body 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.

4.1.7 If non-metallic materials are utilized for components critical to the flame arrester or the induction system's function, it is recommended that they have a Limiting Oxygen Index (LOI) of 26% or greater and/or have a UL 94 HB rating.

4.1.7.1 Flame arresters or induction systems containing non-metallic materials must undergo the accelerated aging procedure in 5.4.2.

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, throttle body, 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 ACCELERATED AGING TEST—FLAME ARRESTORS OR INDUCTION SYSTEMS CONTAINING NON-METALIC MATERIALS ONLY

5.4.2.1 The test flame arrester or induction system containing non-metallic components or using adhesives to secure critical components are to be mounted on a carburetor, throttle body, induction system or a representative fixture in the position of intended use and placed in a dry oven for 300 hours at 100 °C +2 (212 °F +4).

5.4.2.2 Non-metallic components which have lost more than 3% of their weight will be considered to have failed. If not the test specimen will proceed to 5.4.3 (Vibration Test).

5.4.3 VIBRATION TEST

5.4.3.1 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, throttle body or induction system or simulated carburetor, throttle body or induction system for the type of assembly intended to be used in service.

5.4.3.2 The carburetor, throttle body 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, throttle body or induction system to simulate a normal installation on a marine engine.

5.4.3.3 The carburetor or throttle body with 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 ± 0.05 mm (0.04 in ± 0.002 in). The test setup shall be automatically cycled at a constant rate from 10 to 60 Hz every 4 min.

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

5.4.4 SHOCK TEST

5.4.4.1 The setup used for the vibration test shall be used for this test including the test fixture, carburetor or throttle body with backfire flame arrester assembly or induction system.

5.4.4.2 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.

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

5.4.5 EXPLOSION CONTAINMENT

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

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

5.4.5.2.1 The backfire flame arrester assembly and carburetor or throttle body, 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 5.4.5.2.3.) Prior to the tests, the carburetor, throttle body 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, throttle body or induction system openings shall be plugged.

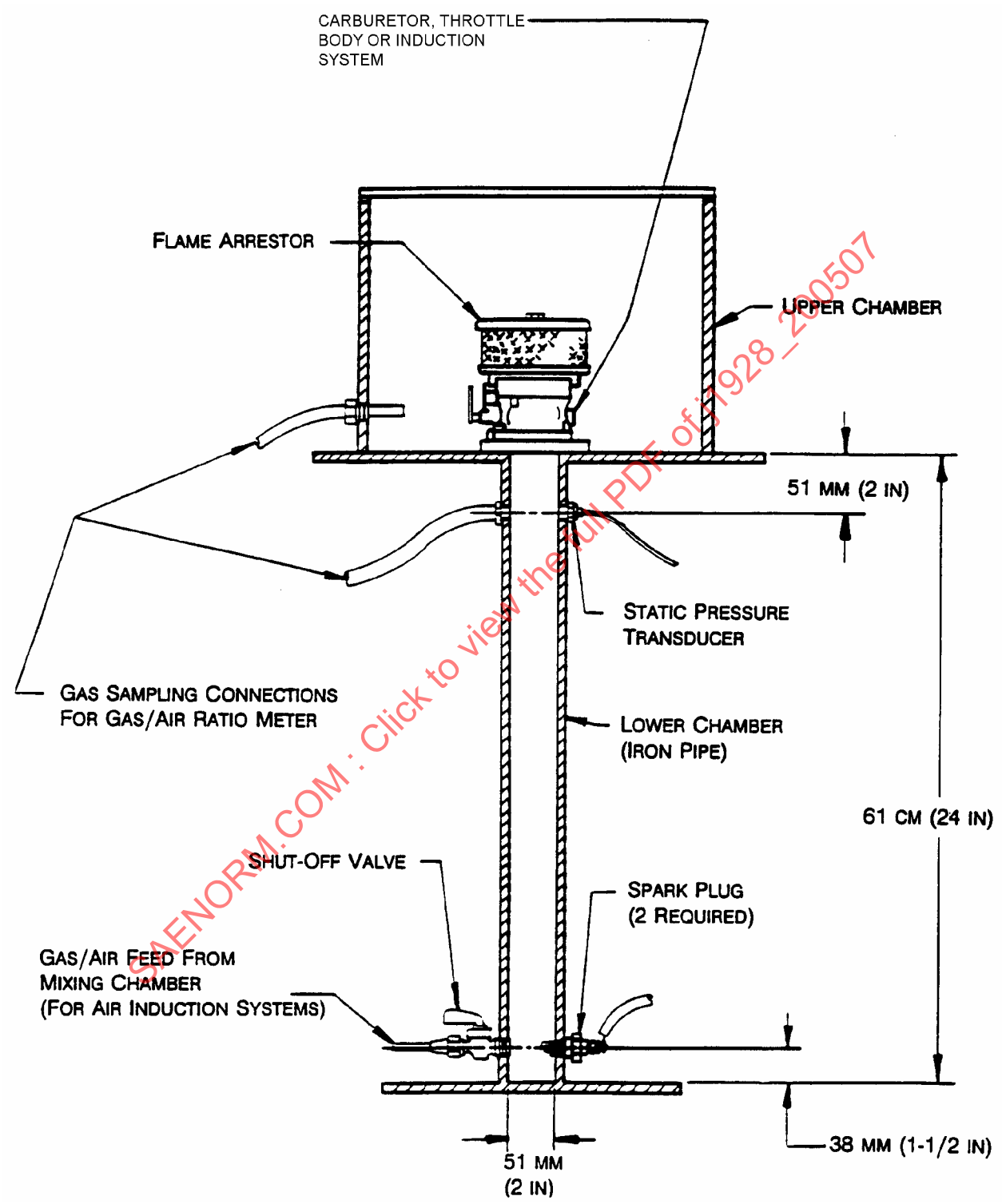

FIGURE 1—EXPLOSION CONTAINMENT TEST SETUP

5.4.5.2.2 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.

5.4.5.2.3 Using whatever adaptor that may be required, the carburetor or throttle body 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, throttle body 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.

5.4.5.2.4 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.

5.4.5.2.5 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.

5.4.5.2.6 Two spark plugs, set with a gap of 0.76 mm ± 0.05 mm (0.030 in ± 0.002 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.

5.4.5.2.7 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.

5.4.5.2.8 The instrumentation shall include the following:

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

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

5.4.5.2.8.3 Flowmeters to monitor the gas and air flow rates.