

Test Method for Aerospace Firewall Sealant Flame Penetration

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## SAE AS5127/2

### 1. SCOPE:

This SAE Aerospace Standard (AS) describes the procedures for the flammability testing of aircraft firewall sealants in accordance with the requirements of FAR Part 25 Sections 25.865, 25.867, 25.1191, and 25.1193. This test method is intended to determine the capability of sealant materials to control the passage of and effects from fire.

#### 1.1 Purpose:

This test is used to demonstrate compliance with the requirements established by FAA regulations for flammability characteristics of aircraft firewall sealant materials as part of the Type Certification requirements.

### 2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

#### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS401	Propane Burner
AS8028	Powerplant Fire Detection Instruments, Thermal and Flame Contact Types, (Reciprocating and Turbine Engine Powered Aircraft)

#### 2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FAR 25.865	Fire Protection: Flight Controls, Engine Mounts, and Other Flight Structure
FAR 25.867	Fire Protection: Other Components
FAR 25.1191	Powerplant Fire Protection: Firewalls
FAR 25.1193	Powerplant Fire Protection: Cowling and Nacelle Skin

### 3. CLASSIFICATION:

Class A - Fire Resistant - 5 minutes exposure time.

Class B - Fireproof - 15 minutes exposure time.

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### 4. DEFINITIONS:

#### 4.1 Firewall:

A structure designed to prevent a hazardous quantity of air, fluid, or flame from exiting a fire zone and causing hazard to the aircraft. Firewalls shall be fireproof.

#### 4.2 Fire Resistant:

The ability of sealant materials to prevent flame penetration from a fire at least as well as aluminum alloy in dimensions appropriate for their purpose. Sealant materials are demonstrated to be fire resistant by meeting the requirements of this test for an exposure time of 5 minutes.

#### 4.3 Fireproof:

The ability of sealant materials to prevent flame penetration from a severe fire of extended duration at least as well as steel in dimensions appropriate for their purpose. Sealant materials are demonstrated to be fireproof by meeting the requirements of this test for an exposure time of 15 minutes.

#### 4.4 Heat Flux:

The rate of thermal energy transferred per unit area.

#### 4.5 Exposure Time:

The length of time the burner flame is applied to the specimen.

### 5. TEST PANELS:

#### 5.1 Preparation of Test Specimen:

Unless otherwise specified test panels shall be prepared in accordance with AS5127.

#### 5.2 Panel Configuration:

Unless otherwise specified by the specific aircraft configuration, fabricate test panels in accordance with Figure 1 and 2 using 301 CRES sheet conforming to AMS 5517. In smaller panel configurations, the backside of the panel shall be protected from exposure to the flame.

#### 5.3 Flame Penetration Test Configuration:

- 5.3.1 Fillet Sealed Assembly: Fillet seal holes, slots, fasteners, and joint overlaps in accordance with acceptable sealing procedures, see Figure 1. Cure sealant in accordance with manufacturer's instructions or sealing processing procedures. Test sealed panel in accordance with applicable procedure specified in Section 7.

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5.3.2 Wire Bundle Sealed Assembly: Fillet seal fasteners, joint overlaps, and wire bundle penetration in accordance with acceptable sealing procedures, see Figure 2. Cure sealant in accordance with manufacturer's instructions or sealing processing procedures. Test sealed panel in accordance with applicable procedure specified in Section 7.

### 5.4 Test Panel Conditioning:

Unless otherwise specified by the aircraft condition requirements, test panels shall be conditioned at  $77\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$  ( $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ ) and  $50\% \pm 5\%$  relative humidity for a minimum of 24 hours.

## 6. EQUIPMENT/APPARATUS:

### 6.1 Test Burner:

A modified gun-type conversion oil burner such as the Park Model DPL 3400 or an SAE AS8028 Propane Burner shall be used. (See Calibration Procedure 7.1.1 and 7.2.1). The burner used shall be capable of delivering a minimum average flame temperature of  $2000\text{ }^{\circ}\text{F}$  ( $1093\text{ }^{\circ}\text{C}$ ) and a minimum heat flux of  $9.3\text{ BTU/ft}^2\text{ seconds}$  ( $10.6\text{ W/cm}^2$ ) at the specimen location.

### 6.2 Burner Extension:

A stainless steel funnel extension fabricated in accordance with Figure 3 shall be used for the gun-type conversion oil burner in accordance with 6.1. The funnel shall have an oblong exit 6 inches (152 mm) high by 11 inches (279 mm) wide. The funnel shall be installed on the gun-type conversion oil burner with the air tube shown in Figure 4.

### 6.3 Burner Fuel:

SAE No. 2 diesel, kerosene, or equivalent shall be used for burner fuel when using the oil burner. Propane shall be used for burner fuel when using the SAE AS401 B Propane Burner, see Figure 5 for details.

### 6.4 Thermocouples:

A thermocouple rake containing five ungrounded Chromel-Alumel (Type K) nominal 22 to 30 AWG conductor thermocouples sheathed in  $1/16\text{ inch}$  (1.6 mm) stainless steel or inconel tubes, or equivalent shall be provided. The thermocouples shall be aligned in a row  $1.0\text{ inch} \pm 0.1$  ( $25\text{ mm} \pm 2$ ) apart.

### 6.5 Heat Flux Measuring Device(s):

A colorimeter capable of measuring heat flux up to  $15\text{ BTU/ft}^2\text{ second}$  ( $17\text{ W/cm}^2$ ) shall be provided for burner calibration. A Hy-Cal model 1300A total heat flux calorimeter with water cooling, available from Hy-Cal Engineering, Santa Fe Springs, CA or equivalent has been found suitable.

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### 6.6 Test Stand:

A test stand shall be provided to maintain the position of the thermocouple rake, calorimeter, and test specimen. The test stand shall also include a provision for positioning the thermocouple rake such that it is parallel to the burner face with the thermocouple junctions on the diameter or major axis of the burner extension. Suitable test setups are shown in Figures 6 and 7.

### 6.7 Timer:

A stop watch or other device, calibrated and graduated to the nearest one second, shall be used to measure the time of application of the burner flame.

## 7. PROCEDURE:

### 7.1 Conversion Oil Burner Test Method:

#### 7.1.1 Calibration Procedure:

- 7.1.1.1 Place the thermocouple rake on the test stand above the centerline of the burner extension. The distance used to position the rake is approximately 4 inches (102 mm) from the burner cone exit. Connect the thermocouples to a suitable recording device.
- 7.1.1.2 Light the burner, allow a 5 minute warm-up, and move the burner into calibration position.
- 7.1.1.3 Begin monitoring the temperatures indicated by the thermocouples after 2 minutes. Make adjustments as necessary to the air flow to the burner in order to achieve a minimum average thermocouple reading of 2000 °F (1093 °C).
- 7.1.1.4 Move it out of calibration position, and remove the thermocouple rake. The burner may be turned off and on, as appropriate, to change specimens and/or calibration equipment. If the burner is turned off, it shall be warmed tip for a 5 minute period before resuming testing or calibration measurements.
- 7.1.1.5 Replace the thermocouple rake with the calorimeter. Place the calorimeter at the same distance as the thermocouple rake, centered over the burner exit. Clean the calorimeter face with a soft tissue or cotton swab dabbed with alcohol. Assure that there is water running through the calorimeter prior to taking heat flux measurements.
- 7.1.1.6 Move the burner into calibration position after a 5-minute warm up.
- 7.1.1.7 Measure the heat flux continuously or at intervals no greater than 10 seconds. If the heat flux is not at least 9.3 BTU/ft<sup>2</sup> second (10.6 W/cm<sup>2</sup>), readjust the burner to achieve the proper heat flux. If burner adjustments are necessary, remove the calorimeter and repeat 7.1.1.1 through 7.1.1.7.

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### 7.1.2 Test Procedure:

- 7.1.2.1 Unless otherwise specified, test shall be conducted at  $77\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$  ( $25\text{ }^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ) and  $50\% \pm 10\%$  RH.
- 7.1.2.2 Place the test specimen in position at the same distance from the burner as the thermocouple rake and calorimeter were placed during calibration.
- 7.1.2.3 Light the burner. Allow a 5-minute warm up and move the burner into test position.
- 7.1.2.4 Start the timer when the burner is positioned with the test specimen. The critical area of the test specimen shall be over the center of the burner.
- 7.1.2.5 Terminate the test by turning off the burner after a minimum of 15 minutes as required for fireproof materials, or after a minimum of 5 minutes as required for fire resistant materials.
- 7.1.2.6 Note the condition of both faces of the test specimen.
- 7.1.2.7 Without making adjustments to the burner flame, repeat the temperature measurements described in 7.1.1.1 through 7.1.1.3. If the average temperature has decreased by more than  $150\text{ }^{\circ}\text{F}$  ( $65\text{ }^{\circ}\text{C}$ ), readjust the burner and repeat the test. If the average temperature has increased by more than  $150\text{ }^{\circ}\text{F}$  ( $65\text{ }^{\circ}\text{C}$ ), note the temperature reading on the test report.

### 7.2 Propane Burner Test Method:

#### 7.2.1 Calibration Procedure:

- 7.2.1.1 Place the thermocouple rake on the test stand above the centerline of the burner extension. The distance used to position the rake approximately 2 inches (51 mm) from the burner cone exit. Connect the thermocouples to a suitable recording device.
- 7.2.1.2 Light the burner, allow a 5-minute warm up, and move the burner into calibration position.
- 7.2.1.3 Begin monitoring the temperatures indicated by the thermocouples after 2 minutes. Make adjustments as necessary to the air flow to the burner in order to achieve a minimum average thermocouple reading of  $2000\text{ }^{\circ}\text{F}$  ( $1093\text{ }^{\circ}\text{C}$ ).
- 7.2.1.4 Move the burner out of calibration without turning the flame off, and remove the thermocouple rake.
- 7.2.1.5 Replace the thermocouple rake with the calorimeter. Place the calorimeter at the same distance as the thermocouple rake, centered over the burner exit. Clean the calorimeter face with a soft tissue or cotton swab dabbed with alcohol. Assure that there is water running through the calorimeter prior to taking heat flux measurements.
- 7.2.1.6 Move the burner into calibration position.

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7.2.1.7 Measure the heat flux continuously or at intervals no greater than 20 seconds. If the heat flux  $W/cm^2$ ) is not at least 9.3 BTU/ft<sup>2</sup> second (10.6 W/cm<sup>2</sup>), readjust the burner to achieve the proper heat flux. If burner adjustments are necessary, remove the calorimeter and repeat 7.2.1.1 through 7.2.1.7.

### 7.2.2 Test Procedure:

7.2.2.1 Unless otherwise specified, test shall be conducted at 77 °F ± 10 °F (25 °C ± 5 °C) and 50% ± 10% RH.

7.2.2.2 Place the test specimen in position at the same distance from the burner the thermocouple rake and calorimeter were placed during calibration.

7.2.2.3 Move the burner into test position.

7.2.2.4 Start the timer when the burner is positioned with the test specimen. The critical area of the test specimen shall be over the center of the burner.

7.2.2.5 Terminate the test by moving the burner out of test position after a minimum of 15 minutes as required for fireproof materials, or after a minimum of 5 minutes as required for fire resistant materials.

7.2.2.6 Note the condition of both faces of the test specimen.

7.2.2.7 Without making adjustments to the burner flame, repeat the temperature measurements described in 7.2.1.1 through 7.2.1.3. If the average temperature has decreased by more than 150 °F (65 °C), readjust the burner and repeat the test. If the average temperature has increased by more than 150 °F (65 °C), note the temperature reading on the test report.

### 8. REPORTING:

8.1 Record the following information for each specimen evaluated.

8.1.1 Full identification of part construction being tested and its use.

8.1.2 Include the average flame temperature and heat flux data for pre-test calibration, and the average temperature for post-test calibration.

8.1.3 Report the exposure time, and whether the material or part is fire proof or fire resistant.

8.1.4 Describe the condition of both the flame side and the non-flame side of the test specimen after test.

8.2 Report "Pass" or "Fail":

The following criteria will be used for judging the acceptability of the design. These criteria are not necessarily all inclusive; other criteria may be required by the approving agency or documents which reference this test method specification.

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- 8.2.1 No flame penetration shall occur for the duration of the test.
- 8.2.2 Burning on the backside of the specimen is not acceptable. Significant burning on the side of the flame impingement shall be investigated to determine if a potential increase in hazard exists. Minor flashing on the side of flame impingement is acceptable.
- 8.2.3 Test specimens shall not continue to burn after withdrawal of the ignition flame.
- 8.2.4 Ultimate determination of acceptability shall be based on the ability of the sealant material to withstand exposure to the flame without resulting in a condition that will further increase hazard to the aircraft. Any additional acceptance criteria will be found in documents referencing this test method specification.

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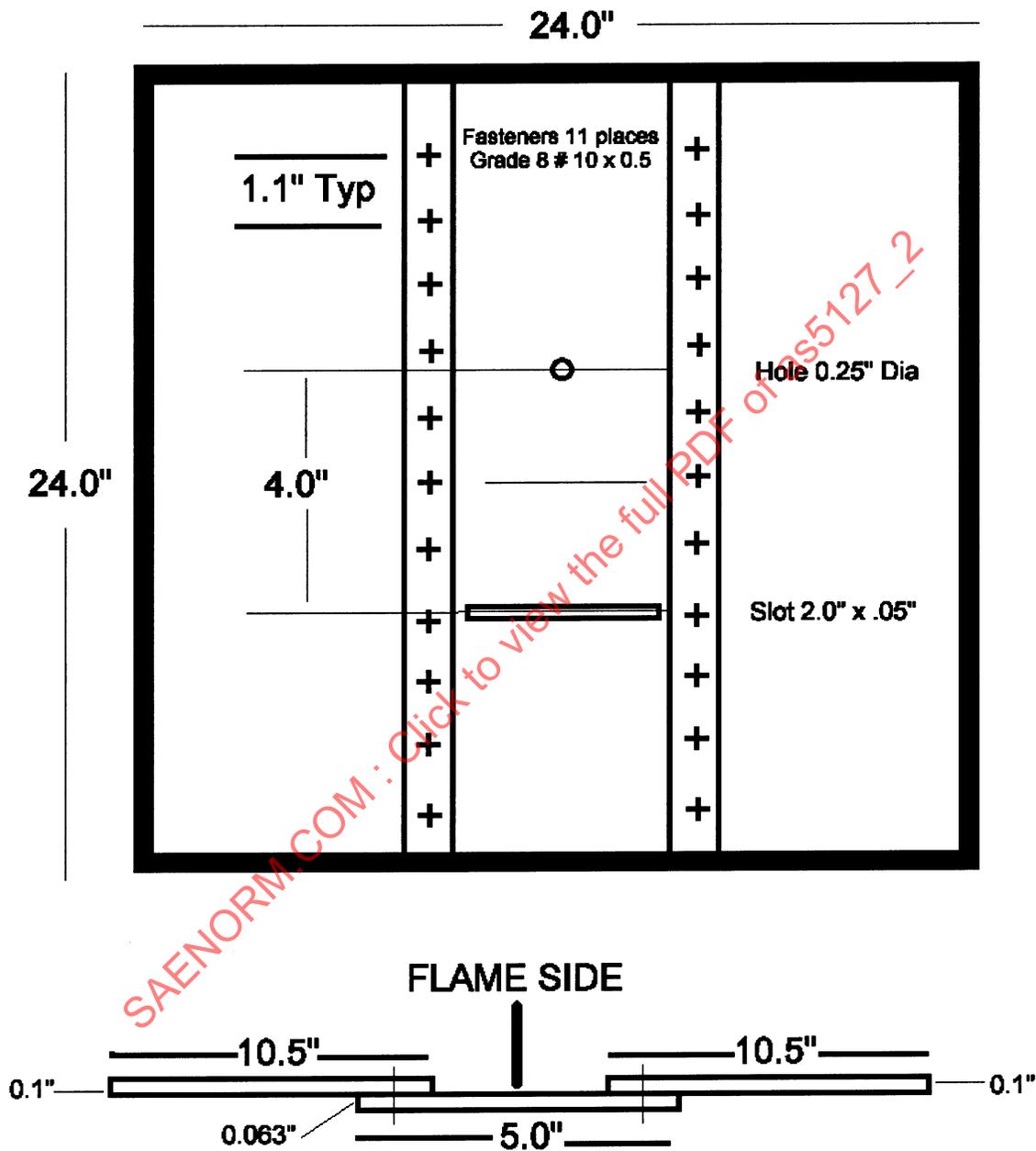


FIGURE 1 - Fillet Sealing Assembly

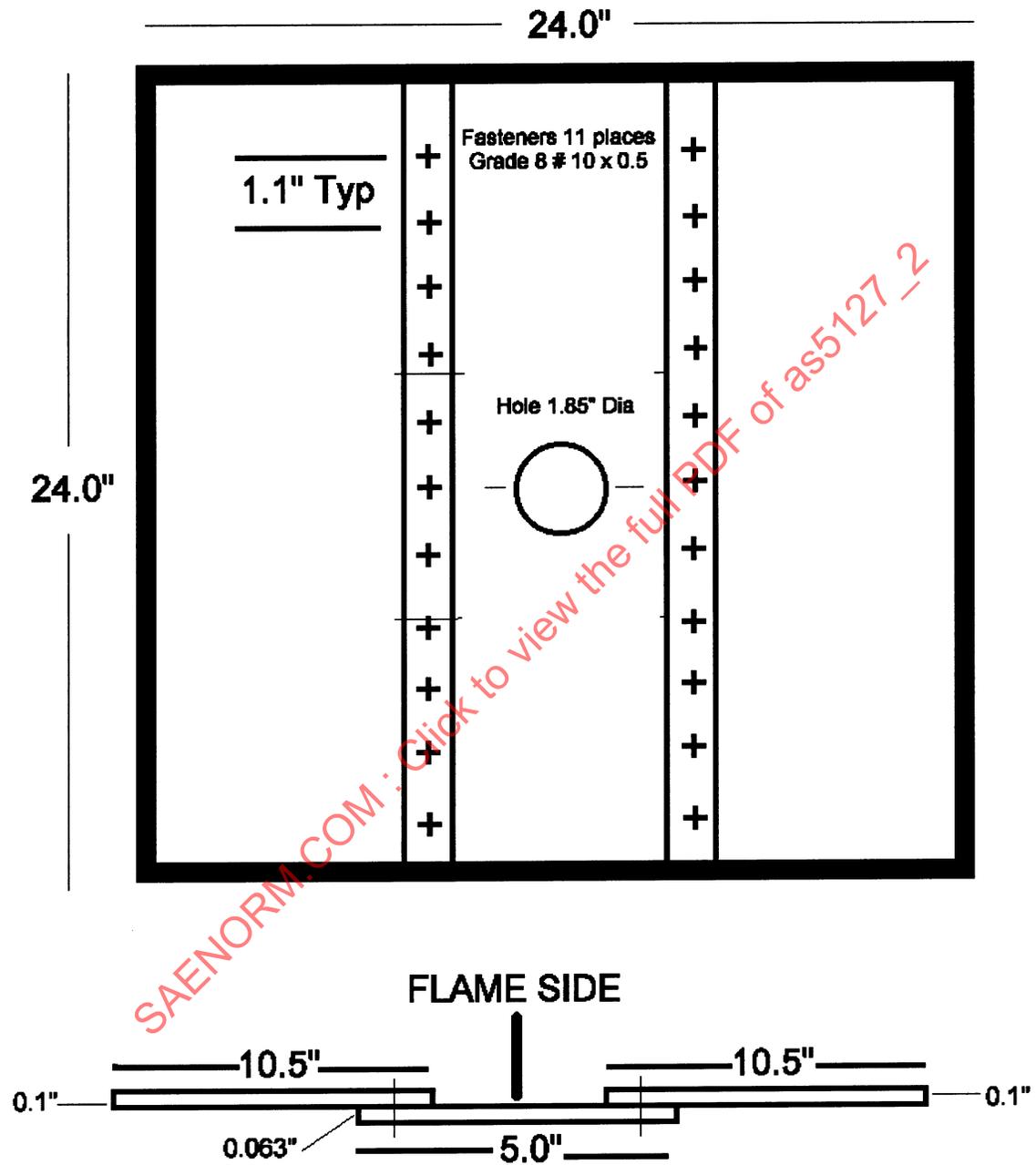


FIGURE 2 - Wire Bundle Sealing Assembly

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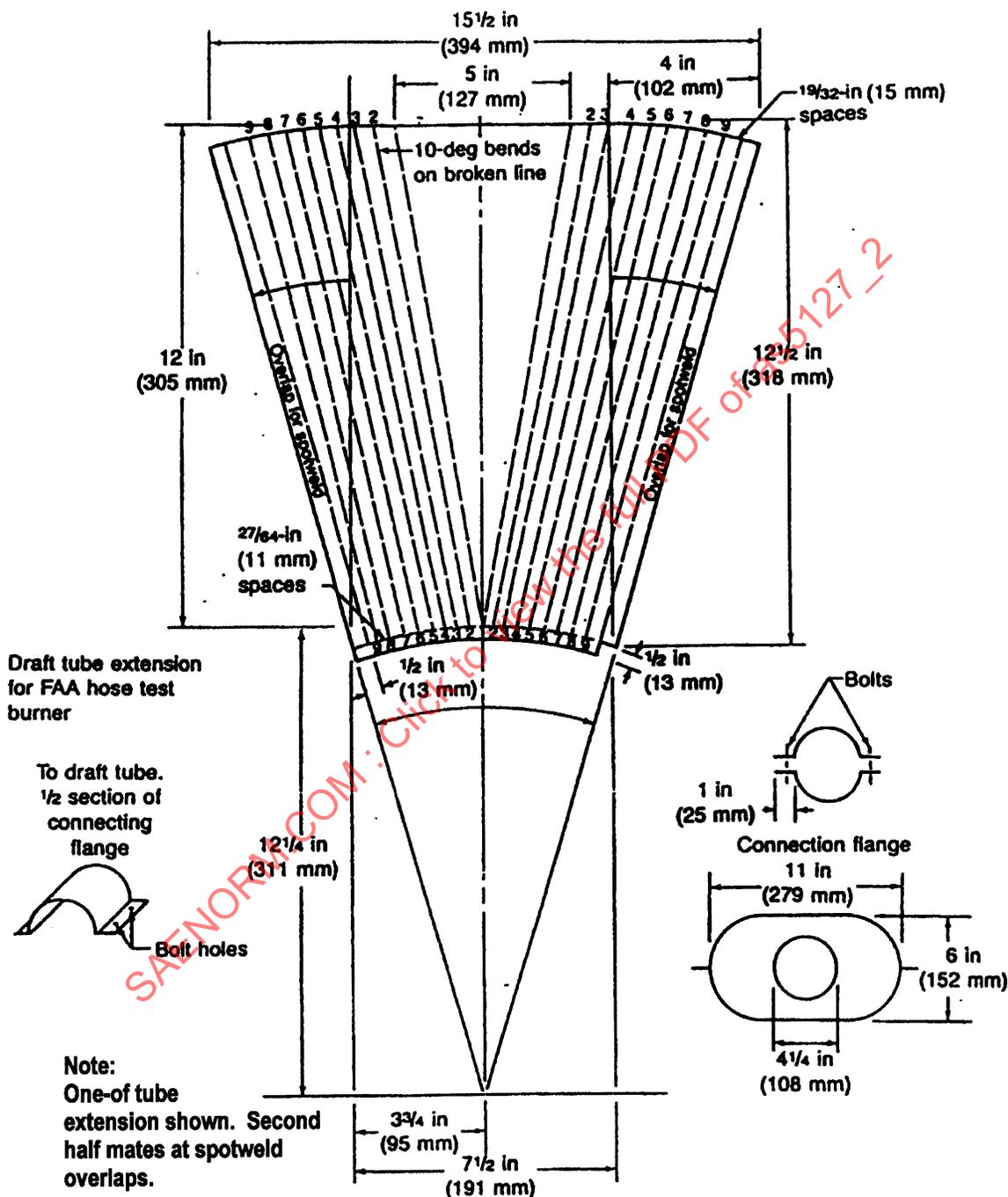
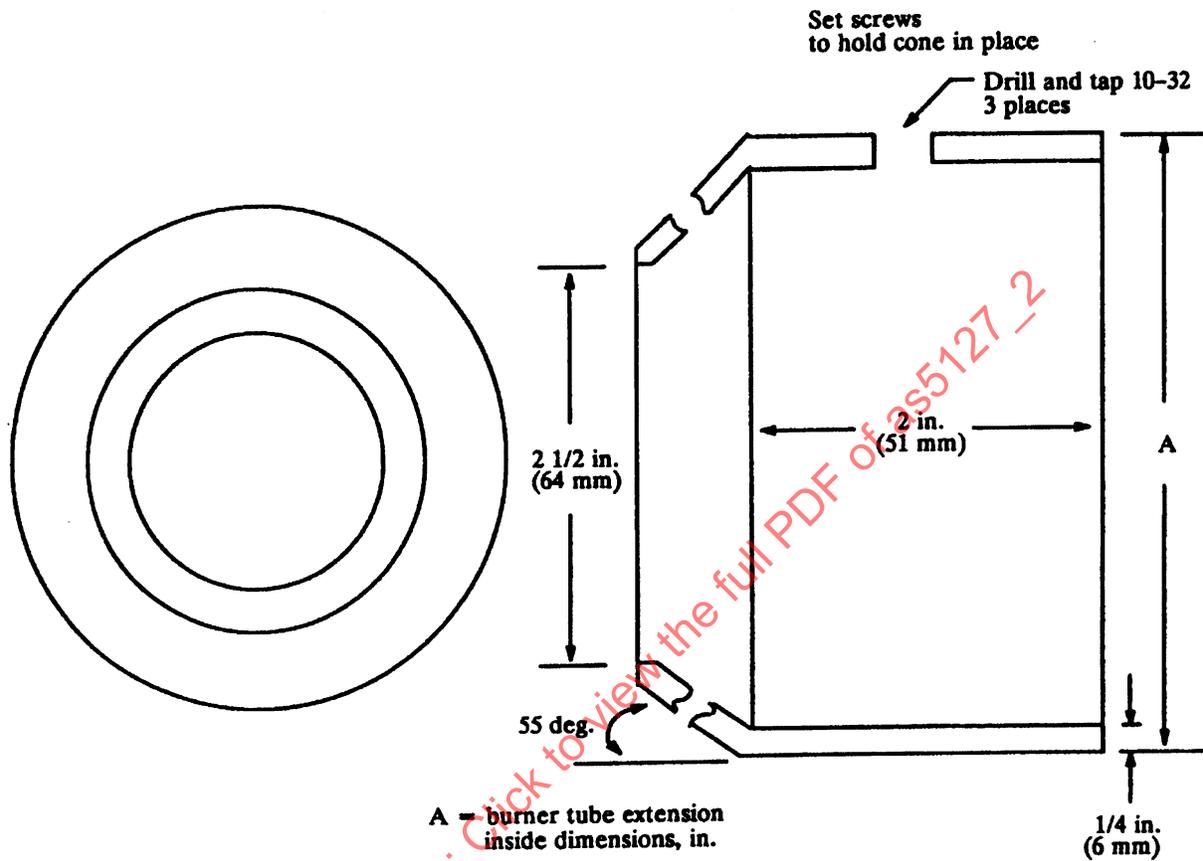


FIGURE 3 - Oil Burner Cone Details

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Material: mild steel

Tolerance on dimensions: +/- 0.010 inches (+/- 0.25 mm)

FIGURE 4 - Air Tube Reducing Cone