AEROSPACE STANDARD

AS5127/2	REV. B
Issued 2000-09 Revised 2014-05 Superseding AS5127/2A	

(R) Test Method for Aerospace Firewall Sealant Flame Penetration

RATIONALE

This revision changes the sealing assembly drawing (Figures 1 and 2) back to the original testing configuration in Revision 0 and clarifies the the fabrication procedures in 4.3.1 and 4.3.2. Also, temperature tolerances were corrected and all figures were redrawn with inches (metric) measurements.

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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. REFERENCES

2.1 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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS5517 Steel, Corrosion Resistant, Sheet and Strip, 18Cr - 8Ni (SAE 30301) Cold Rolled, 125 ksi (862 MPa) Tensile Strength

AIR4069 Sealing of Integral Fuel Tanks

AS5127 Aerospace Standard Test Methods for Aerospace Sealants Methods for Preparing Aerospace Sealant Test Specimens

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

AS34501 Connectors, Receptacle, Electrical, Wall Mounting, Rear Release, Crimp Contact, AN Type

2.1.2 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257. For FAA documents, go to www.faa.gov. For FAR documents, go to www.acquisition.gov/far.

FAA AC 20-135 Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria

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

2.2 Definitions

2.2.1 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.

2.2.2 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.

2.2.3 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.

2.2.4 FLAME TOLERANT

The ability of sealant materials to prevent flame penetration from incidental exposure to smaller fires.

2.2.5 HEAT FLUX

The rate of thermal energy transferred per unit area.

2.2.6 EXPOSURE TIME

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

3. CLASSIFICATION

Class A - Fire Resistant - 5 minute exposure time.

Class B - Fireproof - 15 minute exposure time.

Class C - Flame Tolerant - 15 minute exposure time to a Bunsen burner flame

4. TEST PANELS

4.1 Preparation of Test Specimen

Unless otherwise specified test panels shall be prepared in accordance with AS5127. Where not referenced in controlling material specification, test in duplicate.

4.2 Panel Configuration

4.2.1 Unless otherwise specified by the specific aircraft configuration, fabricate test panels for Class A and B materials in accordance with Figure 1 and 2 using 301 CRES sheet conforming to AMS5517, 0.063 inch (1.6 mm) thick and commercially available stainless steel fasteners (bolts, nuts, and washers). The backside of the panel shall be protected from exposure to the flame.

4.2.2 Unless otherwise specified by the specific aircraft configuration, fabricate test panels for Class C materials from 301 CRES sheet conforming to AMS5517, 0.040 x 2.875 x 6 inch (1 x 73 x 152 mm). The center of the panel shall have a 0.25 inch (6 mm) hole, sealed with a 1 inch (25 mm) diameter coating of Class C material to a thickness of 0.125 inch (3 mm).

4.3 Flame Penetration Test Configuration

4.3.1 Sealed Assembly (Figure 1)

Seal all faying surfaces, apply fillet seal (flame side only), seal holes and slots, wet install fasteners, and overcoat fastener heads (flame side only) per Figure 1. AIR4069 paragraphs 11.1.2.4, 11.1.2.5, and 11.1.3 may be used as reference for sealant application techniques. For any variations in dimensions between AIR4069 and this specification, this specification takes precedence. Cure sealant in accordance with manufacturer's instructions and sealing processing procedures. Test sealed panel in accordance with applicable procedure specified in Section 6.

4.3.2 Wire Connector Sealing Assembly (Figure 2)

This panel uses a 2.25 inch x 2.25 inch x 0.125 inch (57 mm x 57 mm x 3 mm) plate of AMS5517 CRES steel to blank off an opening simulating an AS34501 wiring connector penetration. Seal all faying surfaces including the simulating connector plate, apply fillet seal (flame side only) to all panels and connector plate, wet install all fasteners, overcoat all fasteners heads (flame side only) per Figure 2. AIR4069 paragraphs 11.1.2.4, 11.1.2.5, and 11.1.3 may be used as reference for sealant application techniques. For any variations in dimensions between AIR4069 and this specification, this specification takes precedence. Cure sealant in accordance with manufacturer's instructions or sealing processing procedures. Test sealed panel in accordance with applicable procedure specified in Section 6.

4.4 Test Panel Conditioning

Unless otherwise specified by the aircraft condition requirements, test panels shall be conditioned at 77 °F ± 5 °F (25 °C ± 3 °C) and 50% ± 5% relative humidity for a minimum of 24 hours.

5. EQUIPMENT/APPARATUS, CLASS A AND B

5.1 Test Burner

A modified gun-type conversion oil burner such as the Park Model DPL 3400 or an AS8028 Propane Burner shall be used (see Calibration Procedure 6.1.1 and 6.2.1). The burner used shall be capable of delivering a minimum flame temperature of 2000 °F (1093 °C) and a minimum heat flux of 9.3 BTU/foot^2 seconds (10.6 W/cm^2) at the specimen location.

5.2 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 5.1. 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.

5.3 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 AS8028 Propane Burner, see Figure 5 for details.

5.4 Thermocouples

A thermocouple rake containing five ungrounded Chromel-Alumel (Type K) nominal 22 to 30 AWG conductor thermocouples sheathed in closed 0.063 inch (1.6 mm) stainless steel or inconel tubes, or equivalent shall be provided. The thermocouples shall be aligned in a row 1.0 inch ± 0.1 inch (25 mm ± 2 mm) apart.

5.5 Heat Flux Measuring Device(s)

A calorimeter capable of measuring heat flux up to 15 BTU/foot^2 second (17 W/cm^2) shall be provided for burner calibration. A Medtherm Corp, Huntsville, Alabama, calorimeter Model #64-10-20, or equivalent, has been found suitable but is not specified as required for this test. FAA circular AC 20-135 describes a suitable flux-tube system.

5.6 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 setup is shown in Figure 6.

5.7 Timer

A stop watch or other device, calibrated and graduated to the nearest 1 second, shall be used to measure the time of application of the burner flame.

6. PROCEDURE, CLASS A AND B

6.1 Conversion Oil Burner Test Method

6.1.1 Calibration Procedure

6.1.1.1 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.

6.1.1.2 Light the burner, allow a 5-minute warm-up, and move the burner into calibration position.

6.1.1.3 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) across the array. Uniformity of the flame should be such that all thermocouples indicate a temperature of 2000 °F ± 150 °F (1093 °C ± 83 °C).

6.1.1.4 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 up for a 5 minute period before resuming testing or calibration measurements.

6.1.1.5 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, if required. Assure that there is water running through the calorimeter prior to taking heat flux measurements.

6.1.1.6 Move the burner into calibration position after a 5-minute warm up.

6.1.1.7 Measure the heat flux continuously or at intervals no greater than 10 seconds. If the heat flux is not at least 9.3 BTU/foot^2 second (10.6 W/cm^2), readjust the burner to achieve the proper heat flux. If burner adjustments are necessary, remove the calorimeter and repeat 6.1.1.1 through 6.1.1.7.

6.1.2 Test Procedure

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

6.1.2.2 Light the burner. Allow a 5-minute warm up and move the burner into test position.

6.1.2.3 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.

6.1.2.4 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.

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

6.1.2.6 Without making adjustments to the burner flame, repeat the temperature measurements described in 6.1.1.1 through 6.1.1.3. If the average temperature has decreased by more than 150 °F (83 °C), readjust the burner and repeat the test. If the average temperature has increased by more than 150 °F (83 °C), note the temperature reading on the test report.

6.2 Propane Burner Test Method

6.2.1 Calibration Procedure

6.2.1.1 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.

6.2.1.2 Light the burner, allow a 5-minute warm up, and move the burner into calibration position.

6.2.1.3 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 °F (1093 °C) across the array. Uniformity of the flame should be such that all thermocouples indicate a temperature of 2000 °F ± 150 °F (1093 °C ± 83 °C).

6.2.1.4 Move the burner out of calibration without turning the flame off, and remove the thermocouple rake.

6.2.1.5 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 if required. Assure that there is water running through the calorimeter prior to taking heat flux measurements.

6.2.1.6 Move the burner into calibration position.

6.2.1.7 Measure the heat flux continuously or at intervals no greater than 20 seconds. If the heat flux is not at least 9.3 BTU/foot^2 second (10.6 W/cm^2), readjust the burner to achieve the proper heat flux. If burner adjustments are necessary, remove the calorimeter and repeat 6.2.1.1 through 6.2.1.7.

6.2.2 Test Procedure

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

6.2.2.2 Move the burner into test position.

6.2.2.3 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.

6.2.2.4 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.

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

6.2.2.6 Without making adjustments to the burner flame, repeat the temperature measurements described in 6.2.1.1 through 6.2.1.3. If the average temperature has decreased by more than 150 °F (83 °C), readjust the burner and repeat the test. If the average temperature has increased by more than 150 °F (83 °C), note the temperature reading on the test report.

7. EQUIPMENT/APPARATUS, CLASS C

7.1 Test Burner

A standard laboratory Bunsen burner shall be used. The burner used shall be capable of delivering a minimum flame temperature of 2000 °F (1093 °C).

7.2 Burner Fuel

Natural gas, methane, or propane shall be used.

7.3 Thermocouple

A Chromel-Alumel (Type K) nominal 22 to 30 AWG conductor thermocouple shall be provided.

7.4 Test Stand

A test stand shall be provided to maintain the position of the thermocouple and test specimen. The test stand shall also include a provision for positioning the thermocouple with the junction centered on the burner. Suitable test setup is shown in Figure 7.

7.5 Timer

A stop watch or other device, calibrated and graduated to the nearest 1 second, shall be used to measure the time of application of the burner flame.

8. PROCEDURE, CLASS C

8.1 Calibration Procedure

8.1.1 Place the thermocouple on the test stand above the centerline of the burner, approximately 1 inch (25 mm) from the burner tip. Connect the thermocouple to a suitable recording device.

8.1.2 Light the burner, allow a 5-minute warm up, and move the burner into calibration position.

8.1.3 Begin monitoring the temperatures indicated by the thermocouple after 2 minutes. Make adjustments as necessary to the air flow to the burner in order to achieve a minimum thermocouple reading of 2000 °F (1093 °C).

8.1.4 Move the burner out of calibration without turning the flame off, and remove the thermocouple.

8.1.5 Heat flux is NOT MEASURED during this test; report heat flux as ‘non-applicable’.

8.2 Test Procedure

8.2.1 Place the test specimen in position at the same distance from the burner the thermocouple was placed during calibration.

8.2.2 Move the burner into test position.

8.2.3 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.

8.2.4 Terminate the test by moving the burner out of test position after a minimum of 15 minutes.

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

8.2.6 Without making adjustments to the burner flame, repeat the temperature measurement described in 8.1.1 through 8.1.3. If the temperature has decreased by more than 150 °F (83 °C), readjust the burner and repeat the test. If the temperature has increased by more than 150 °F (83 °C), note the temperature reading on the test report.

9. REPORTING

9.1 Record the following information for each specimen evaluated.

9.1.1 Full identification of sealant being tested and any conditioning performed.

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

9.1.3 Report the exposure time, and whether the material is fire proof, fire resistant, or flame tolerant.

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

9.2 Report "Pass" or "Fail"

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

9.2.1 No flame penetration shall occur for the duration of the test.

9.2.2 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.

9.2.3 Test specimens shall not continue to burn after withdrawal of the ignition flame.

9.2.4 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.

10. NOTES

10.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

10.2 Dimensions and properties in inch units and the Fahrenheit temperatures are primary. Dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

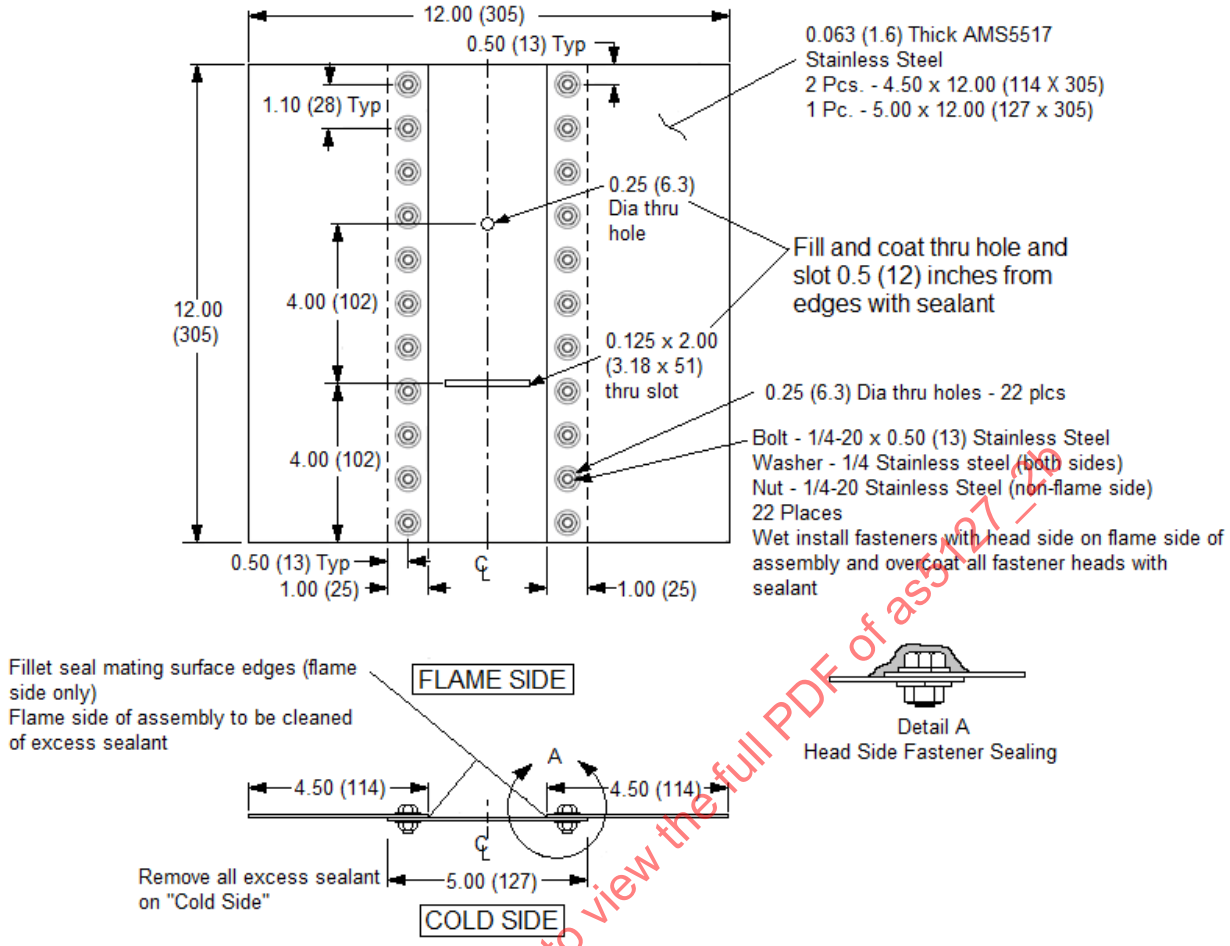

FIGURE 1 - SEALING ASSEMBLY

NOTE: Dimensions in inches (millimeters)

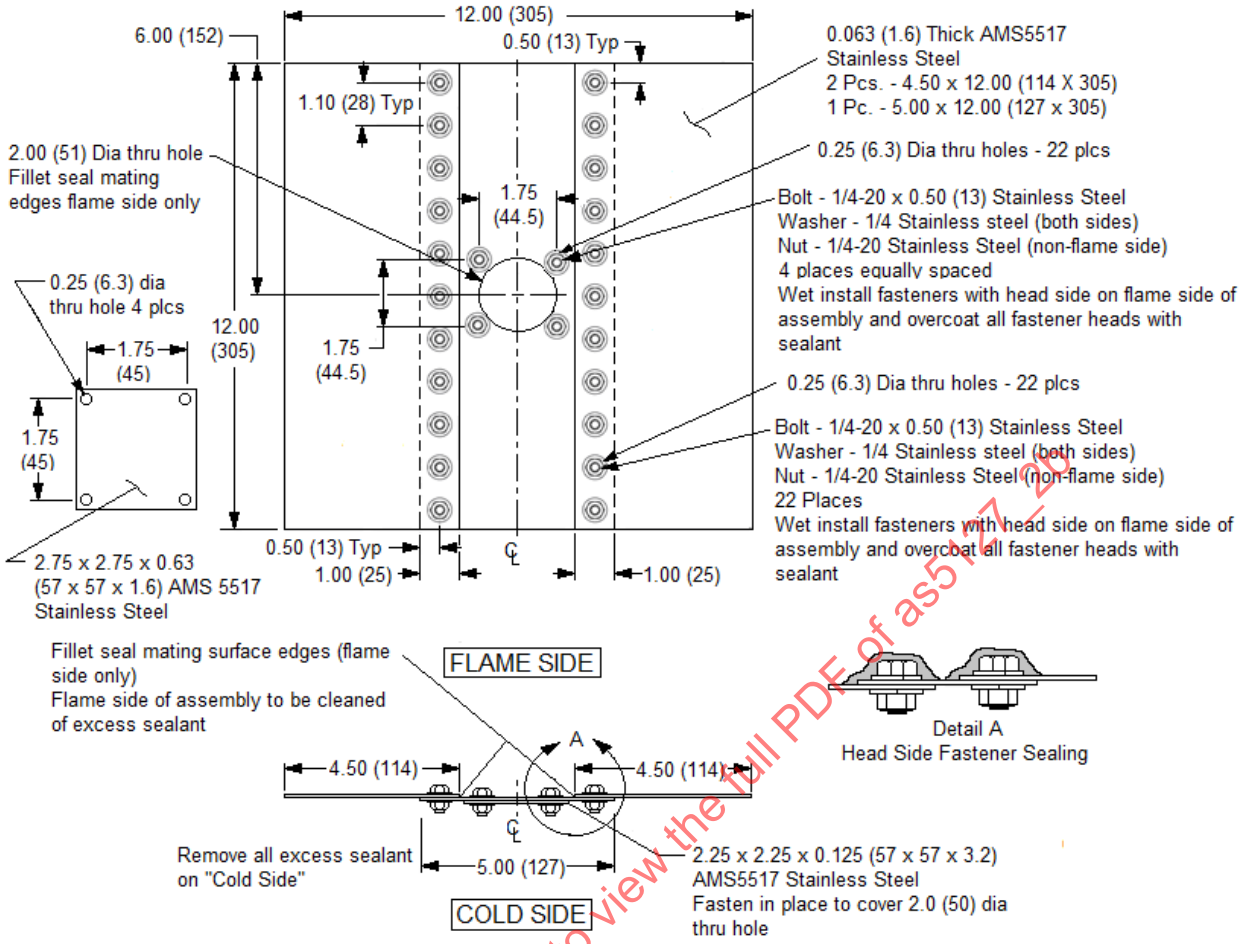

FIGURE 2 - WIRE BUNDLE CONNECTOR SEALING ASSEMBLY

NOTE: Dimensions in inches (millimeters)

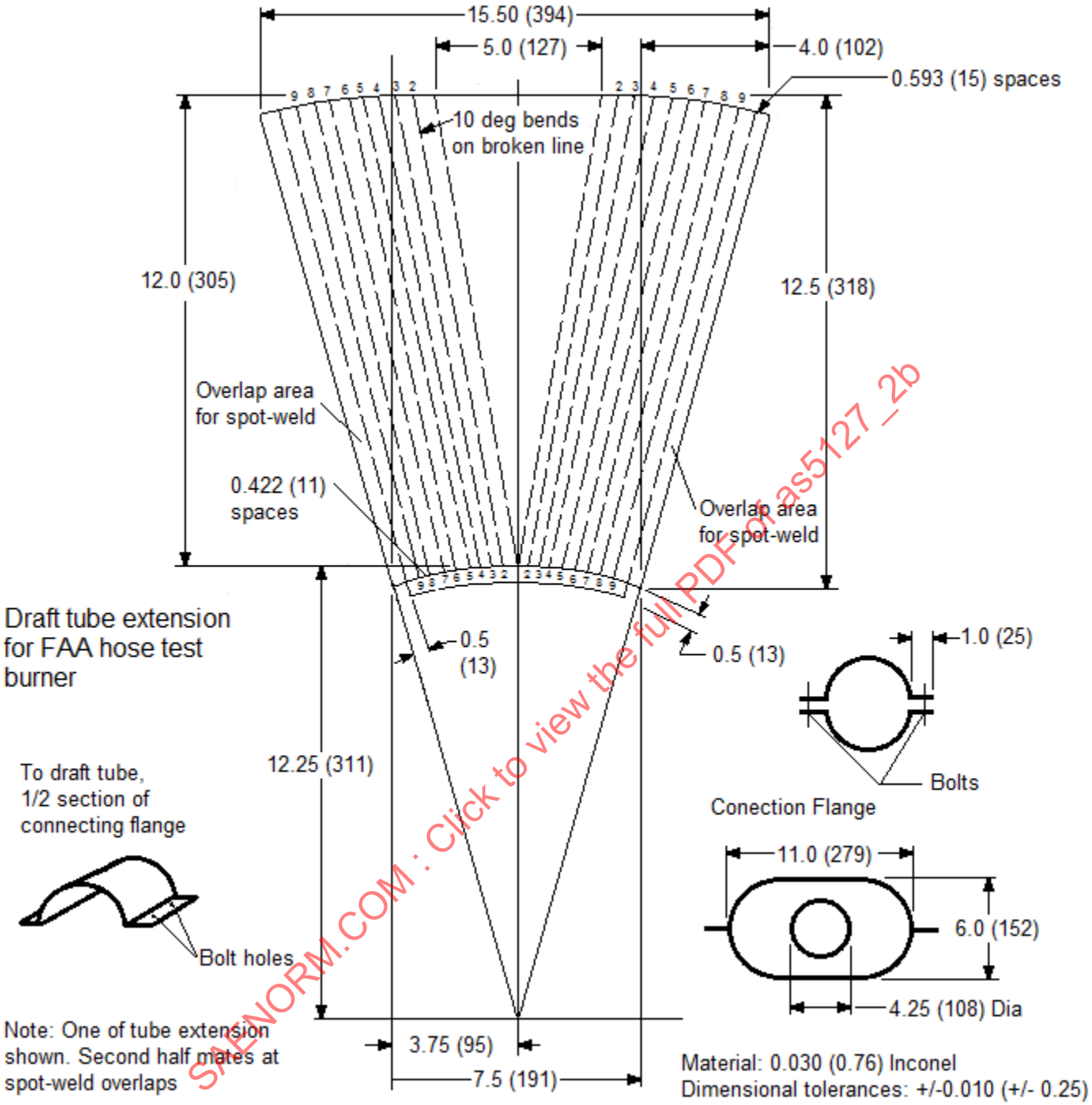

FIGURE 3 - OIL BURNER CONE DETAILS

NOTE: Dimensions in inches (millimeters)