



Federal Aviation Administration

Date: November 7, 2008

Subject: Approval Criteria and Test Methods for Evaluating Alternate Methods of Compliance Applicable for Airworthiness Directive, 2008-23-09

Airworthiness Directive (AD) 2008-23-09, paragraph (f) requires the removal and replacement of existing blanket materials manufactured using Orcon Corporation Orcofilm® AN-26 (hereafter "AN-26"), with new material meeting the requirements of Title 14 Code of Federal Regulation (CFR) section 25.856(a). The purpose of this memorandum is to provide information regarding one possible alternative method of compliance (AMOC) to paragraph (f) and to define criteria that may be used to evaluate proposed modifications of existing AN-26 insulation blankets (in-place) as stated in the AMOC section of the AD. We have determined these criteria represent an acceptable level of safety in accordance with 14 CFR 39.19.

As stated in the AD, operators are required to remove AN-26 insulation blankets and replace them with blankets that comply with 14 CFR 25.856(a). The alternative discussed below is an option to allow AN-26 insulation blankets to remain installed in the aircraft, provided they are modified such that they comply with specific criteria defined in this memorandum. It is important to note that testing and the approval criteria contained in this memorandum are only applicable to blankets that have been modified in-place and do not apply to blankets removed from the aircraft for modification and re-installation per paragraph (h) of the AD. We recognize that a blanket that is modified in-place may only be modified on the exposed side of the blanket and that the back side (facing the aircraft fuselage skin) would not be modified. While we expect that blankets removed from the aircraft for modification will be modified on both sides, this memorandum does not apply to modifying removed blankets.

Background

The Federal Aviation Administration (FAA) has issued AD 2008-23-09 for certain Boeing transport category airplanes. The AD requires replacing any insulation blanket constructed of AN-26. The AD is prompted by reports of in-flight and ground fires on certain airplanes manufactured with insulation blankets covered with AN-26, which may contribute to the spread of a fire when ignition occurs from sources such as electrical arcing or sparking.

Test Methods and Approval Criteria

The FAA has developed four tests with approval criteria to be used in evaluating whether a modified in-place AN-26 insulation blanket will eliminate the identified unsafe condition.

1. Backside Burning Test: This test evaluates the effects of a small ignition source originating on the outboard surface of an insulation blanket surface which contacts the exterior fuselage skin.
2. Large Ignition Source (This test involves a comparison between a blanket compliant with 14 CFR 25.856(a) "baseline configuration" and a modified AN-26 insulation blanket installation.): This test evaluates the proposed modified insulation blanket installation using a realistic condition that could exist in an aircraft. This test scenario has been used by the FAA Technical Center to rank insulation blanket materials and later assist in the development of an improved flame propagation test standard, 14 CFR 25.856(a).
3. Flammability and Flame Propagation Test: This test evaluates the flammability and flame propagation characteristics of modified AN-26 insulation blankets when exposed to a radiant heat source and a flame. This test was established in September 2003 for improving the in-flight fire ignition/flame propagation of thermal/acoustic insulation materials and therefore reducing the incidence and severity of cabin fires, particularly those in inaccessible areas where thermal acoustic insulation materials are typically installed.
4. Medium Scale Arc/Spark Test: This test evaluates the ability to ignite insulation blankets using an electrical arcing event. A number of in-flight and ground fires have been reported as a result of electrical arcing or sparking igniting insulation blankets and subsequently the spread of a fire.

Conducting three of the four tests are necessary and the approval criteria must be met for each test conducted. The tests defined in paragraphs b. (baseline and modified blanket installation) and c. of this document are considered similar to one another and one of the two must be performed in addition to the tests defined by paragraphs a. and d. In addition to the tests presented in this memorandum, the design solution must be shown to comply with all applicable requirements of 14 CFR part 25 established under the certification basis for the airplane, including but not limited to environmental effects on modified blankets, endurance of modified blankets, and effect of modification on other commodities.*

* We note that compliance with the criteria in this memorandum may not bring the modified insulation blanket to full compliance with 14 CFR 25.856(a); however, we have determined that meeting these criteria represents an acceptable level of safety when AN-26 insulation blankets are left in place.

The tests and approval criteria presented in this memorandum do not identify how one would modify the blankets. The proposed modification to the blanket is the responsibility of the applicant seeking the AMOC. It is imperative that before tests are conducted per this memorandum, the applicant will have developed a reliable and repeatable method to modify AN-26 insulation on the aircraft without removing it. We acknowledge that in order to perform the tests defined by this memorandum on AN-26 insulation, blankets fabricated using AN-26 insulation will need to be obtained which may involve removing them from an airplane.

Refer to FAA Technical Report DOT/FAA/AR-99/44, "Development of Improved Flammability Criteria for Aircraft Thermal Acoustic Insulation", available on <http://www.fire.tc.faa.gov/>, for the following test set-up examples. Thermocouples must be installed at various locations throughout the test sections. Typically four thermocouples are installed (two at each end of the fuselage test section) to provide an estimate of the material's energy release rate; however, additional thermocouples may be necessary to adequately generate a representative thermal profile during the tests specified by paragraphs a. and b. Using the four thermocouple arrangement, an estimate of the energy release rate (ERR) can be found by using the following formula:

$$\text{ERR} = \frac{(T_1 + T_2)}{2} + \frac{(T_3 + T_4)}{2}$$

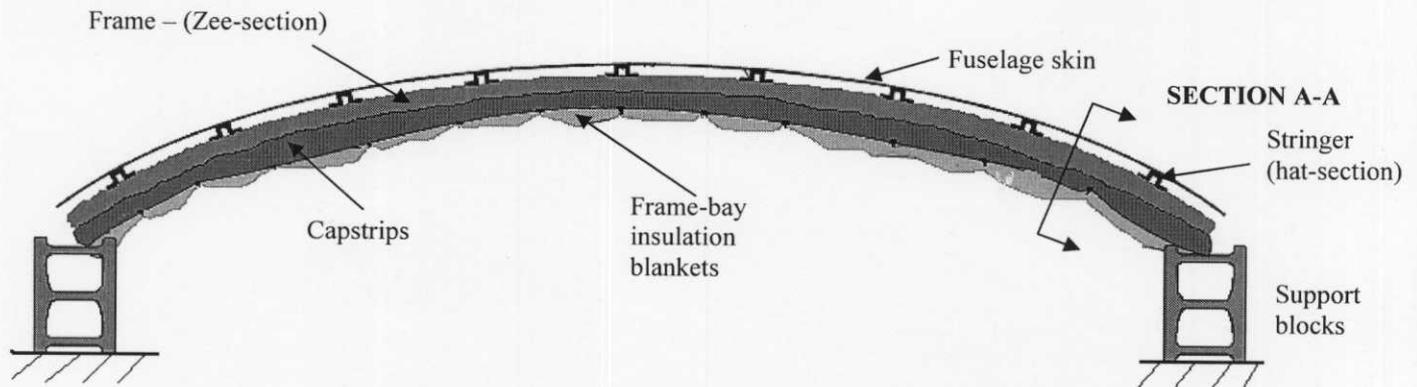
a. Backside Burning Test (see Figure 1): This test involves installing modified AN-26 insulation blankets into a test fixture to evaluate performance of the blankets' backside (the unmodified side adjacent to the aircraft fuselage) when exposed to a small ignition source. The ignition source must be a small flame, such as a cotton swab saturated with alcohol or a typical barbecue lighter. Ignition must be initiated through a small hole in the test fixture, measuring approximately 0.75 inches in diameter at three unique locations. Each test must be performed separately with only one hole open at any time. The remaining two holes in the fuselage test section should be plugged so as to not influence the test. The test set-up must consist of the modified insulation blankets installed in a test fixture conforming to Figure 1 and representing the installation on the airplane. The test fixture should be approximately 8-feet by 8-feet and be representative of a fuselage section similar to that of an affected airplane. The tests must be performed in a suitable chamber to reduce or eliminate the possibility of test fluctuation due to air movement. One method that has been used with desired results is to drape a fire proof blanket (e.g., Kaowool®) along the edges of the test fixture leaving only the ends open.

Approval criteria: When the backside surface of the modified insulation blanket is exposed to the ignition source of paragraph a., the flame must not propagate more than 24 inches in length along the blanket measured from the ignition source at any location. The flame propagation must also be confined to the same fuselage frame bay (measured from frame (Zee-section) to frame (Zee-section)) of the airplane as the ignition source.

Note 1: Some airplanes have multiple types of insulation blanket constructions, installation methods, and cross-sections throughout the airplane. To substantiate an airplane's insulation

blanket installation, it may be necessary to run multiple tests represented by the set-up in Figure 1 with the ignition source applied in multiple locations unless a single test can be shown to substantiate all configurations.

Figure 1.



SECTION A-A

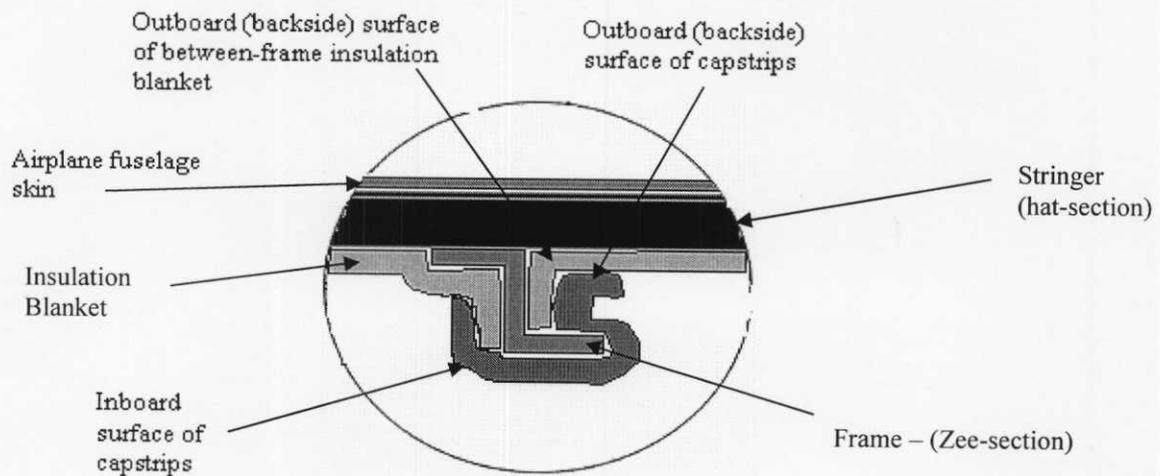


Figure 2.

Thermocouples (T_3 and T_4)

Thermocouples (T_1 and T_2)

DETAIL B

Insulation blankets per installed configuration to include capstrips and between-frame blankets

0.75-inch diameter hole in fuselage skin to allow ignition access to the backside of the blanket

Isometric View of the Test

Frame bay

Capstrips

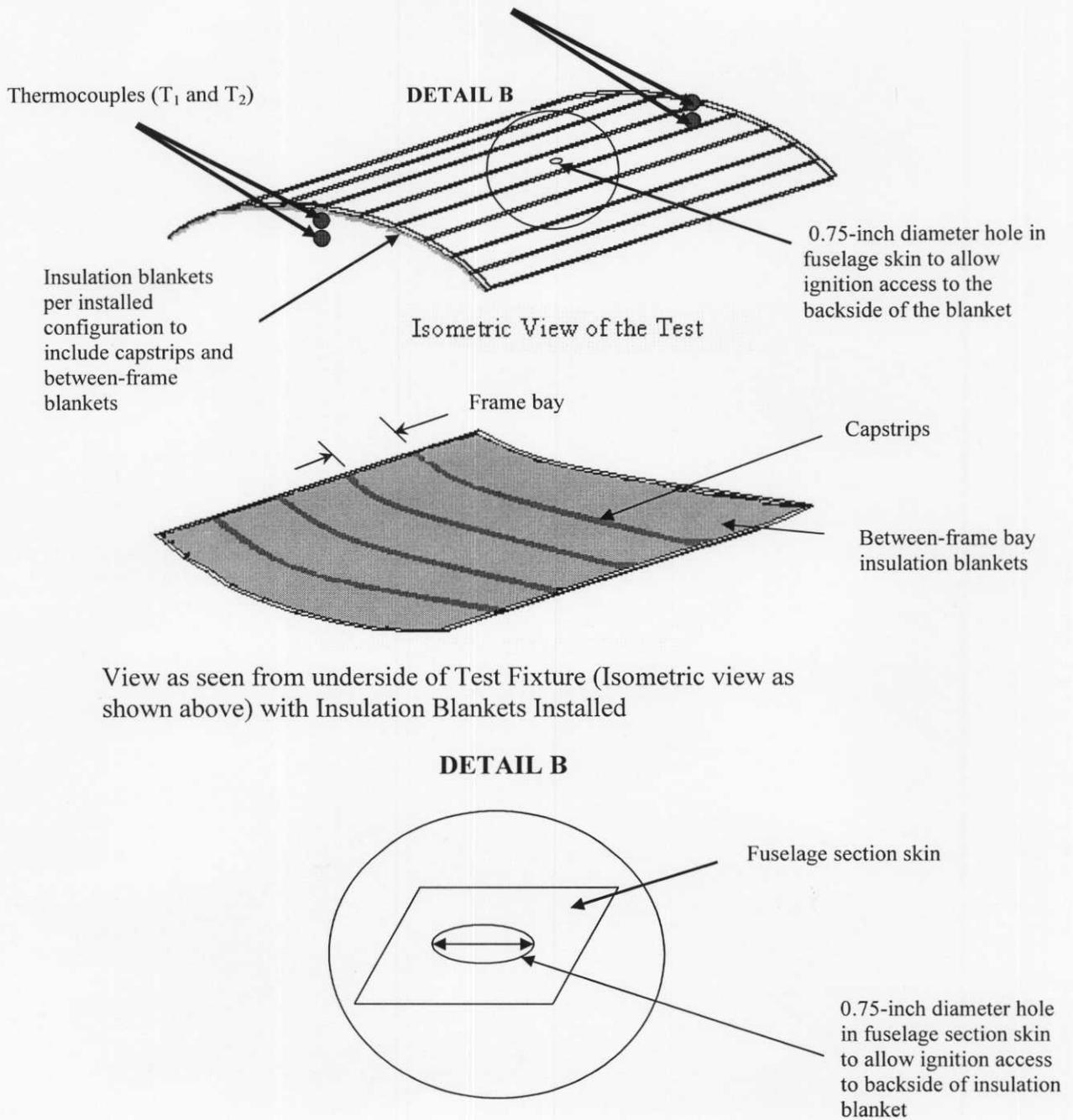
Between-frame bay insulation blankets

View as seen from underside of Test Fixture (Isometric view as shown above) with Insulation Blankets Installed

DETAIL B

Fuselage section skin

0.75-inch diameter hole in fuselage section skin to allow ignition access to backside of insulation blanket



b. Large Ignition Source Baseline Configuration Test (see Figure 3): This test involves installing insulation blankets previously shown to comply with 14 CFR 25.856(a) and Part VI of Appendix F into a test fixture to establish a baseline configuration for the test fixture. Based on previous studies conducted by the FAA Technical Center, establishing a baseline configuration is essential in order to determine specific parameters, such as the distance from the ducts to the top of the fuselage test section and the volume under the test section. A consistent test set-up is critical in determining acceptable insulation blanket installations. A proper test set-up will yield some effect to the insulation materials as a result of the ignition source (i.e., material that has shrunk, or melted away from the flame or areas sooted, stained, or discolored). For typical post-test results, reference FAA data report DOT/FAA/AR-06/4, dated February 2006, "Results of Intermediate-Scale Flammability Tests Performed on Hypalon™ RB71 Aircraft Duct Insulation," Test 8, Figure 33 available on <http://www.fire.tc.faa.gov/>. If excessive or minimal burning behavior results from the baseline configuration, the test must be repeated until the baseline burning behavior is achieved. This may result in changing the height of the ducts and/or height of the horizontal honeycomb panel in relation to the fuselage skin. The ignition source must be a 4-inch by 4-inch by 9-inch polyurethane foam block placed in a dish with 10 milliliters (ml) of Heptane. The test fixture should be approximately 8-feet by 8-feet and be representative of a fuselage section similar to that of an affected airplane. The tests must be performed in a suitable chamber to reduce or eliminate the possibility of test fluctuation due to air movement. One method that has been used with desired results is to drape a fire-proof blanket (e.g., Kaowool®) along the edges of the test fixture leaving only the ends open (See Figure 4). A horizontal panel such as an aircraft style honeycomb panel must be installed below the suspended ducts to enclose the attic space. The test must be performed within two-minutes of preparing the heptane spiked foam block to ensure the heptane has not evaporated before igniting the block.

Figure 3.

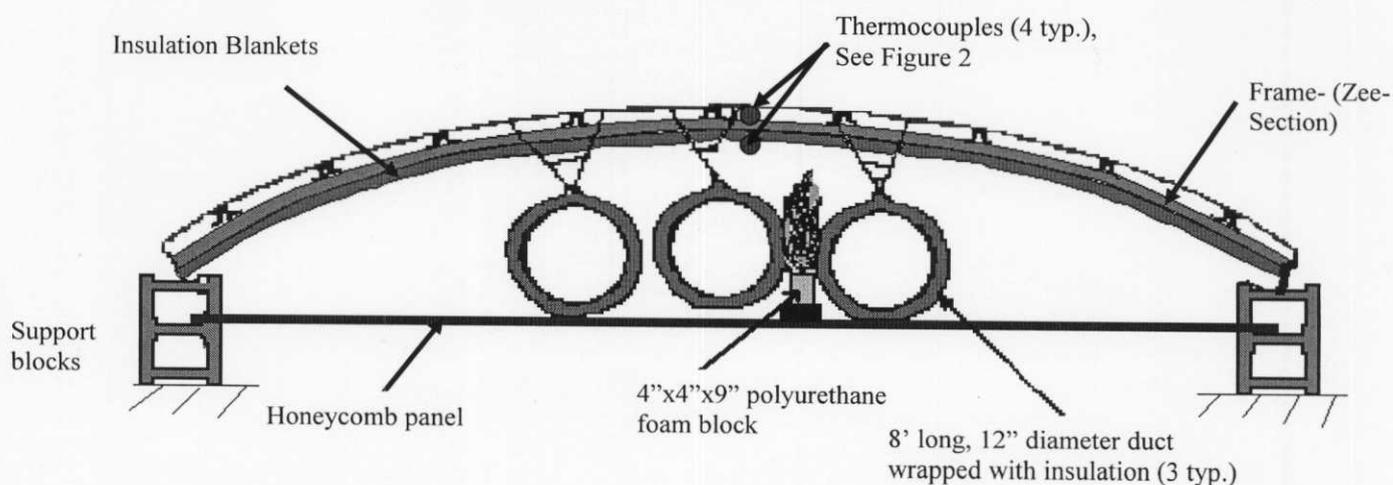


Figure 4.



Subsequent to conducting the test defined above as the “Large Ignition Source Baseline”, an additional large ignition source test (see Figure 3) must be conducted. This test involves installing modified AN-26 insulation blankets into a test fixture to evaluate the blankets’ performance when exposed to a large ignition source near the exposed side of the blanket. With the exception of the type of insulation materials installed, the test fixture set-up must be identical to that established by the baseline test configuration. The ignition source must be a 4-inch by 4-inch by 9-inch polyurethane foam block saturated with 10ml of Heptane. The test set-up must consist of the modified insulation blankets installed in a test fixture conforming to Figures 2 and 3 and representing the installation on the airplane with placement of the foam block representing the most critical location(s). The test fixture should be approximately 8-feet by 8-feet and be representative of a fuselage section similar to that of an affected airplane. The tests must be performed in a suitable chamber to reduce or eliminate the possibility of test fluctuation due to air movement. One method that has been used with desired results is to drape a fire-proof blanket (e.g., Kaowool®) along the edges of the test fixture leaving only the ends open (See Figure 4). A horizontal panel such as an aircraft style honeycomb panel must be installed below the suspended ducts to enclose the attic space.

Approval criteria: *When the exposed side (the modified side) of the modified insulation blanket is exposed to the ignition source of paragraph b, the flame must not propagate more than that which was allowed to propagate during the baseline configuration test when measured from the ignition source on the exposed side and/or backside surfaces of the insulation blanket.*

Note 2: Flame propagation is strictly an assessment of the propagation of flame from the point of application of the ignition source. Since this test utilizes a relatively large ignition source, the burned area may be large. This may include areas where the insulation blanket charred, shrunk, or melted away from the ignition source. This type of damage should not be taken into consideration when assessing flame propagation as it is different from an assessment of material burn length. Flame propagation strictly means the furthest distance of the propagation of visible flame from the ignition source towards the edges of the fuselage section.

c. Flammability and Flame Propagation Test (See 14 CFR 25.856(a) and Part VI of Appendix F): This test involves evaluating the flammability and flame propagation characteristics of modified AN-26 insulation blankets when exposed to a radiant heat source and a flame. This test must be performed at a facility with a radiant panel test chamber that has been accepted by the FAA.

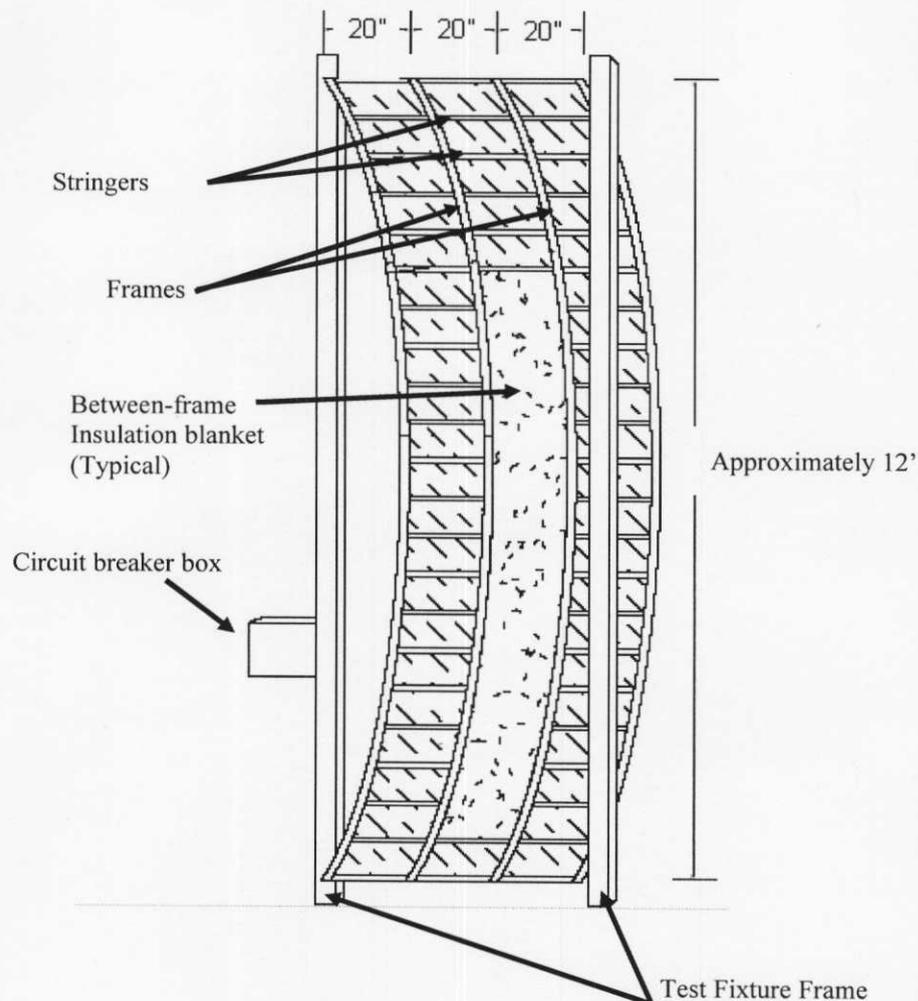
Approval criteria: When tested in accordance with paragraph c., the modified insulation blankets must meet the requirements specified by Part VI of Appendix F, paragraph (h)(1)(2). The unmodified side must also meet the requirements specified by this same standard if, as a result of being tested from the modified side, flames burn-through to, propagate to, or occur on the unmodified side of the insulation blanket. For the purposes of this AMOC criteria, the unmodified side of the insulation blanket is not required to be tested by exposing this surface directly to the ignition and radiant panel heat source.

d. Medium Scale Arc/Spark Test (see Figure 5): This test involves installing modified AN-26 insulation blankets into a test fixture to evaluate the blankets' performance when exposed to arcing and sparking near the exposed surface of the blanket. The electrical arc/spark ignition source must consist of a 400 cycle, 115-volt phase-to-ground generator with each phase connected to a 15-amp circuit breaker typically used in aircraft installations. A 22-gauge wire must be connected to the load side of each breaker, and the ends of each wire must be stripped and used for arc initiation. The test fixture must be grounded to the power supply. One of the hot wires must be brought into contact with the grounded test fixture in the vicinity of the edges of the modified insulation blankets. The contact of wire with the structure must be made in a manner as to create ticking faults. Ticking faults are intermittent metal-to-metal events, such as conductor-to-conductor or conductor-to-structure that result in the discharge of sparks and arcing events. The test set-up shall consist of the modified between-frame insulation blanket installed in a test fixture conforming to Figure 5 and representing the installation on the airplane. The tests must be performed in a suitable chamber to reduce or eliminate the possibility of test fluctuation due to air movement.

Approval criteria: When exposed to arcing and sparking, the exposed side (the modified side) of the insulation blanket must not ignite and flames must not propagate. Furthermore, flame propagation on the backside surface (the unmodified side adjacent to the aircraft fuselage) of the insulation blanket must be less than 16 inches, measured from the ignition source and confined to the same fuselage frame bay of the airplane as the ignition source.

NOTE 3: For a video of this test, see the following URL created by the FAA Technical Center. File: http://www.fire.tc.faa.gov/ppt/materials/Flammability_test.zip, See column labeled "Electric Arc Test."

Figure 5.



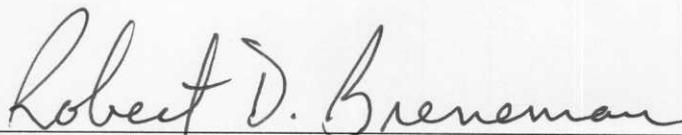
There is currently no approved method for modifying AN-26 blankets in-place; however, The Boeing Company and other parties are researching and developing potential modifications. The potential modifications may result in a reduction of the estimated labor hours identified in the AD.

This approach for modifying blankets in-place (without removal from the airplane) does not represent full compliance with 14 CFR 25.856(a) as the fuselage-side of the insulation blankets is not being modified and it is known that AN-26 will not meet this standard unless modified. This approach has been determined to represent an acceptable level of safety to correct the existing unsafe condition because such an approach may minimize the need to disconnect and reconnect many critical airplane systems that would potentially be disturbed by a remove-and-replace approach.

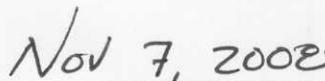
This approach is not considered to be an equivalent level of safety to 14 CFR 25.856(a) per 14 CFR 21.21(b)(1) as both sides of an insulation blanket would need to be shown to meet the test criteria of 14 CFR part 25, Appendix F, Part VI to be considered compliant with 14 CFR 25.856(a). For this reason, and to be consistent with the requirements of 14 CFR 121.312(e) for replacement blankets, insulation blankets constructed of AN-26 that are removed from the aircraft for modification and new blankets that are intended as replacements must be shown to meet the test criteria of 14 CFR part 25, Appendix F, Part VI on both sides prior to installation in order to comply with 14 CFR 25.856(a).

The criteria stated in this document do not constitute a new regulation or create what the courts refer to as a "binding norm."

Applicants should expect that the FAA Seattle Aircraft Certification Office (ACO) will consider this information when evaluating and approving proposed AMOCs to paragraph (f) of AD 2008-23-09. These criteria are one means, but not the only means of compliance. Details pertaining to specific proposals should be submitted to the Seattle ACO for consideration as soon as they become available to enable the FAA to effectively support operator compliance with the AD.



Manager, Seattle Aircraft Certification Office



Date