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The European Association of Aerospace Industries
AECMA
Gulledelle 94 - b.5, B - 1200 BRUSSELS, Belgium

AIRBUS INDUSTRIE
1, ROND-POINT MAURICE BELLONTE
31707 BLAGNAC CEDEX, FRANCE

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YOUR REFERENCE
OUR REFERENCE AI/EA-A 412.0020/01
DIRECT LINE +33 (0) 5 61 93 38 38
FAX +33 (0) 5 61 93 31 55
E-MAIL jean-francois.petit@airbus.fr

U.S. Department of Transportation Dockets
Docket No. FAA-2000-7909 -32
400 Seventh Street SW
Room Plaza 401
Washington, DC 20590
U.S.A.

SUBJECT: **Docket No. FAA-2000-7909, Notice No. 00-09, Improved Flammability Standards for Thermal/Acoustic Insulation Materials Used in Transport Category Airplanes**

Dear Sir/Madam,

Please find enclosed the comments resulting from the review of NPRM 00-09, prepared on behalf of Airbus Industrie and the European Association of Aerospace Industries (AECMA).

We thank the FAA for this opportunity to comment on this significant rulemaking.

Yours sincerely,

Jean-François Petit
Certification Manager, Cabin Safety
Airbus Industrie

Philippe de Gouttes
Regulations Manager
Airbus Industrie

Comments to NPRM 00-09
Improved Flammability Standards for Thermal/Acoustic Insulation Materials Used in Transport Category Airplanes

Summary

As a summary, the major comments on NPRM 00-09 entitled "Improved flammability standards for thermal/acoustic insulation materials used in transport category aircraft" are listed here below :

Flame propagation

- Approach on new flame propagation requirements for insulation materials in hidden areas is acceptable in principle
- Affected parts need to be defined more clearly
- Practical aspects of the test method still need clarification

Flame penetration

- Validity and benefit of proposed burnthrough rule are questioned; FAA cost/benefit evaluation is based on too optimistic hypothesis
- Proposed burnthrough rule is based on material selection, the test method must be defined accordingly (simplified test rig without frames, stringers, fixations)
- Selection of affected zone of the aircraft must be industrially minded; floor level preferred to lower half of fuselage
- Advisory material on installation aspects significantly impacts design changes, therefore AC is required to be circulated for comments before the final rule and adopted concurrently with the final rule.

Applicability

- Single compliance time for both rules on flame propagation and flame penetration is required for industrial and economical reasons. A compliance time no sooner than 5 years after the effective date of the final rule is proposed for newly built aircraft.

1. General Approach /History

1.1 Flame Propagation Requirement

The problem of flame propagation on insulation blanket films has been identified on aircraft fitted with metalized Mylar® films and is covered by a separate AD procedure in order to remove these particular materials from the aircraft.
Insulation materials installed on Airbus aircraft are not made of metalized Mylar®.
Since 1973, with more than 2000 Airbus aircraft in service now and 35 millions flight hours, only two fire incidents involving insulation materials have been reported, they both showed self-extinguishing of the covering film. Insulation materials installed on Airbus aircraft have never been involved in any fire incident in which evidence of flame propagation has been shown.
However, Airbus recognizes a more stringent requirement concerning flame propagation as a good contribution to an increased level of safety.

1.2 Flame Penetration Requirement (Burnthrough)

Airbus considers that improving fuselage burnthrough protection may significantly prolong the safe environment of the passenger cabin in the event of an external fuel fire. Airbus is also aware that fuselage burnthrough protection did appear in the past as a "solution unlikely to be practicable", refer to RGW Cherry & Associates study "Analysis of Factors Influencing the Survivability of Passengers

in Aircraft Accidents" Volume 3 Issue 2 "Assessment of Factors Influencing Survivability". Report presented to the European Communities-Directorate General for Transport on January 1995.
The proposed new rule covers burnthrough protection via insulation blankets only, based on the hypothesis that improved insulation blankets alone can delay the entry of an external fire by several minutes.
However, internal Airbus burnthrough full-scale tests with improved insulation blankets have shown that the aluminum frames collapse under real fire conditions and thus cannot hold in place the improved insulation blankets, as a consequence, the fuselage is no longer protected against flame penetration.
Therefore, we question the validity and benefit of the proposed burnthrough requirement.
In addition, Airbus would like to draw FAA's attention to the fact that an equivalent level of fuselage burnthrough protection could be achieved by the introduction of new burnthrough resistant skin materials (e.g.GLARE®). In that specific case the installation of burnthrough resistant insulation blankets would not be beneficial and thus should not be required.
As a general remark, we consider that an "objective orientated" requirement should be preferred to a "design orientated" requirement.

2. Test method / test equipment

2.1 Flame Propagation Requirement

General

In the paragraph "Discussion of the Proposal" (Federal Register page 56995 column 3), the FAA states that proposed section 25.856 "would address thermal/acoustic insulation materials wherever installed". We understand that, consistent with § 25.853, the proposed new requirement would apply to areas within the pressurized section of the aircraft. The words "installed in the pressurized section of the fuselage", or equivalent, should be added to § 25.856 as follows "Thermal/acoustic insulation material *installed in the pressurized section of the fuselage* must meet... ".

One objective of the new proposed requirements is to take into account heating of the material in a confined zone in combination with a flame source. The proposed test method introduces more realistic test conditions and will replace the Bunsen burner test for insulation materials. Only the test conditions of the Bunsen burner test are questioned in the NPRM explanation (FR page 56994 column 2). There is no documented evidence that the associated pass/fail criteria (burn length, after flame time) are inappropriate. Thus, the known acceptable limits in burn length and after flame time associated to the formerly applicable Bunsen burner test should have been kept for the new test method.

Definition of the burn length

In the vertical Bunsen burner test method, the definition of the burn length is given in Appendix F, Part I as:
"Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source"

We consider that the same definition also applies to Appendix F part VI.

Pilot burner

In the paragraph "Incidents Involving Insulation Materials" (FR page 56993 column 3, it appears that almost all fires in hidden area were initiated by electrical problems. We understand that the test intends to test for the likelihood of fire spread from an open flame but the testing conditions with the proposed gas burner are not representative of this kind of event. The gas pressure in the burner is too high and it produces a flame looking like a torch.

Test specimen construction

In the radiant panel test method, the numerous ways of preparing the insulation blanket samples can lead to various stresses in the film covers. Consequently, the flammability behavior of the film covers can be influenced.
Guidance material should be added in proposed Appendix F part VI, comparable to what is mentioned in Appendix F part I on flammability testing of fabrics.

Test procedure: timing

In appendix F part VI, paragraphs (f)(5) and (f)(6), it should be clearly indicated that ignition with the pilot burner must be simultaneous with introduction of the test specimen since a delay could have a significant influence on the results. It should be easily feasible to fit the test equipment with an ad hoc combined system. This would limit variations in test results.

Small insulation parts

We suggest that, as for existing fire test methods (§ 25.853 (d)) there should be a list of small parts that need not to be tested. Also, for some particular materials, it may appear difficult to provide test specimen in the required dimensions. The test equipment and protocol should take into account these cases.

Equivalence between air-gas and electric radiant panels

For equivalence demonstration, it is required that:
"An equivalent panel must [...] produce test results equivalent to the air-gas panel, for any material tested" (FR page 57004 column 3)

This sentence needs to be clarified and a procedure for showing equivalence needs to be specified.
Moreover, the electric radiant panel should be considered equivalent since several labs are already equipped, have developed skill and the equipment produces reliable and repeatable results.

Units, conversions

All unit conversions should be checked. For example, the following ones need to be corrected:
FR Page 57005, Figure 4: should read 11.1 mm instead of 0.43 mm
FR Page 57006, Figure 5: should read 200 mm instead of 140 mm
FR Page 57010: should read 1.7 Watts/cm2 instead of 1.8 W/cm2

2.2 Flame Penetration Requirement (Burnthrough)

General

The new proposed test method is defined as a material test for the assessment of the resistance to flame penetration of insulation blankets under realistic post crash fire conditions.

- With regard to the threat coming from a post crash fire, the burner flame parameters, Heat Flux 16.0 + 0.8 Btu/ft²sec (18.2 + 0.9 W/cm²) and Temperature 1900 + 100 °F (1038 + 56 °C) are representative of realistic fire conditions.

As a material performance test, the proposed burnthrough test is meant to address the insulation material alone but it is also stated that it would apply to the insulation as installed in the aircraft.

- With regard to the test installation, it appears that compared to current (and future) fuselage parts, the test rig (made of steel) and the blanket installation procedure (using metal clamps) is not representative of the established installation of thermal/acoustic insulation material in the airplane.

Conclusion:

- Proposed burnthrough test method does not reflect real aircraft design scenario in terms of insulation blanket installation thus the configuration of the test method should be changed to a pure material test. To be consistent with the above, the test rig should be a simple specimen holder without stringer, middle frame and steel clamps.

In any case, the installation aspects must be addressed separately in an AC (refer to section 3.1 below).

Applicability

Burnthrough protection is proposed for the lower half of the fuselage. Lower half of fuselage is different on various aircraft types and may lead to different interpretations (e.g. for A380 or B747).
A less ambiguous and more industrially minded definition would be "below main passenger floor".

Test procedure (Experiences from the Round Robin Tests)

1. All parameters, dimensions etc. in the description and in the figures should also be specified in SI-Units.
2. For all particular items the acceptable tolerances should be indicated (also in the figures)
3. Page 57018
(5) Back face Calorimeter
Complete the information with "...appropriate range such as 0-5 Btu/ft²sec (0-5.7 W/cm²), accurate to + 3 % of the indicated reading" (see page 57015 (3) (ii))
4. Page 57019
(3) Construction
What means "...and assembly processes" (representative seams and closures) ?
5. Page 57019
(iv) Installation on test frame
Missing information (dimensions) about the steel spring type clamps
No sufficient specification also in figure 7
6. Page 57020
(e) Calibration
(1) It is not practicable to "Secure the calibration rig to the test specimen frame". The testrig heats up during the calibration process and a burnthrough test directly after the calibration procedure is not practicable.
This information is in contradiction to the information of Page 57015 (3) (i) "Individual calibration rigs are also acceptable".
7. Page 57020 and Page 57021
(e) Calibration
(2) The adjustment of the air intake velocity to a level of 2150 ft/ min (11 m/sec) is necessary by using the Omega HH 30 vane-type air velocity meter (dia. 70 mm)

The application of other vane-type air velocity meters with other diameters should be permitted. Consequently therefore the volumetric airflow should be specified.
8. Page 57021
(5) average temperature
(4) average heat flux
The Round Robin Tests have shown that it is difficult to get average temperatures for each of the 7 thermocouples in a range of 1900 + 100 °F (1038 + 56 °C).
Therefore the requirements should be fixed in the same way as in other FAA-Regulations (or some parts of the Aircraft Materials Fire Test Handbook):
- The minimum average temperature of each of the 7 thermocouples should be 1800 °F (982 °C).
- The minimum average heat flux should be 15.2 Btu/ft²sec (17.3 W/cm²)

3. Implementation on existing and new programs

3.1 Fastening

Due to the fact that the burnthrough resistance of the insulation will only work if the insulation blankets 'stay in place' the installation method and fasteners are major items. Internal Airbus full-scale tests with insulation blankets complying with the new burnthrough requirements, have shown that the supporting structure (where the insulation usually is fixed to) in case of a post crash fire will disappear in less than 90 seconds. So there is a gap of at least 150 seconds after the structure is lost in which the insulation has to 'stay in place' to fulfill the 4 minutes burn through resistance. Therefore new design would be needed to keep the blankets together after the loss of structure integrity.
It is stated in the NPRM § "Installation Details" (FR page 56996 column 2), that "the FAA is still developing advisory material concerning the installation of insulation that would enable the installer to avoid a specific test on the fastener, etc.". Taking into account that new design is required for a realistic burn through protection with insulation blankets, the rule should not be made effective before acceptable design solutions are described in the related final AC.

3.2 Date of compliance for newly manufactured aircraft

Burn through and fire propagation

For industrial and economic reasons, it is not satisfactory to have different time schedules for showing compliance with the new regulation for flame propagation and burn through.
Therefore, a single compliance time for both, flame propagation and burnthrough rules is required.

It has to be pointed out that new material and new insulation design has to be integrated into the aircraft and that all aircraft programs are affected by these modifications.

The modifications consist of :
- identification of suppliers and materials
- procurement of new testing facilities
- validation of new testing facilities
- testing of the materials
- qualification of new materials (acoustics, thermal requirements, water accumulation, aging, toxicity etc.)
- identification of blanket design and fixation (is not yet defined by the AC)
- testing the blanket design and fixation for 4 minutes burn through
- identification of production process for new materials and blankets
- design work (production drawings, part lists and installation drawings)
- production of new blankets

- test installation of the new insulation system
- certification
- procurement & installation on production a/c

Due to that development process for new insulation systems addressing both requirements, the minimum acceptable and realistic lead-time is 5 years. In addition, considering that the AC is necessary to complement the rulemaking process and that its content will have significant impact on design definition (fastening, overlapping,...), the AC is required to be circulated for comments before publication of the final rule and adopted concurrently with the final rule.

4. Cost / benefit

4.1 Flame Propagation Requirement

In paragraph "Insulation Materials Unit Costs and Weights" (FR page 56998 column 2) the FAA indicates that "some materials that would meet the proposed test requirements cost and weigh no more than materials currently being installed in newly produced aircraft". We consider however that the installation of envelope film materials such as PVF will introduce additional weight and cost penalties, because they are more expensive and weigh more than currently installed PET films. Nevertheless, we believe that the introduction of the new flame propagation requirements brings a significant benefit in terms of fire safety.

4.2 Flame Penetration Requirement (Burnthrough)

The proposed benefit analysis for the introduction of a burnthrough requirement does not take into consideration the time period from 1993 to 2000. During this interval, no accident showing evidence of burnthrough was reported. We believe that the cost/benefit analysis is less favorable if these figures are accounted for.

The estimated costs and weight penalties of the proposed rule are based on optimistic assumptions that are not shared by Airbus:
Curlon® cannot be used because of corrosion risks associated to this material. Moreover, the replacement of 1 inch or fiberglass by 1 inch of Curlon® would reduce the thermal and acoustic performances of the insulation blankets. As a general remark, we believe that Curlon® as a trademark should be removed from the text of the NPRM.
To keep the same thermal and acoustical performances, the only reasonable option is to add a fire barrier inside the insulation blankets. These materials weigh 80 g/m^2 and cost 15 $\$/m^2$ approximately.
According to FAA, over the 20 years period, 8781 airplanes will be concerned by burnthrough protection. On this basis, calculation of weight and cost penalties, taking into consideration fire barrier materials showing optimized weight/performance ratio, leads to an averaged overall cost of $177.7 million. This figure includes purchasing costs of new materials and costs generated by additional weight. Engineering costs are not included as well as the uncertainty linked to the awaited proposed means of compliance.
In addition, considering the case when Curlon® would be used, the estimated costs on a per aircraft basis are $18,500 for a single aisle and $64,000 for a twin aisle. This calculation includes lower half of fuselage burn through protection with Curlon® (blanket filling combined between glass wool and Curlon®) and replacement of covering film by PVF film.
The total costs of the proposed rule as indicated in the NPRM (FR page 56999 column 2) on a per airplane basis between $6,200 and $9,400 appear to be underestimated.

We therefore believe that the complete cost/benefit analysis should be re-evaluated taking into account these realistic figures.