FSS000663

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ELDON B.NICHOLAS

NATIONAL AVIATION FACILITIES
EXPERIMENTAL CENTER
ATLANTIC CITY, NEW JERSEY 08405

DATE:

IN REPLY REFER TO: ANA-420

SUBJECT: Technical Evaluation of Public Comments to NPRM 75-3, "Smoke Emission from Compartment Interior Materials;" AFS-120 letter dated August 6, 1975

FROM: Aerospace Engineer, ANA-420

TO: Robert Allen, AFS-120

As requested in the subject letter, the following is a technical evaluation of each individual public response to the regulatory notice on smoke emissions. Generally, only arguments or views not having previously been introduced were evaluated for each successive respondent.

1. American Instrument Company (AMINCO)

1.1 The smoke performance criteria derived at NAFEC in 1970 consisted of a specific optical density (D_s) limit of 100 at 90 seconds and 200 at 4 minutes. However, some materials can conceivably exceed a specific optical density of 100 or 200 in the intervals from 0-1.5 minutes or 1.5-4.0 minutes, respectively, without exceeding the limits at each set time. Since these materials would have a smoke production rate in excess of those meeting the set time requirements, it seems obvious they should also be excluded from cabin usage. This would be clear if the proposed wording of 25.853g were changed to read, "(2) 200 within 4 minutes and 100 within 90 seconds after the start of the test." This would be preferred over the redundant wording proposed by AMINCO.

1.2 Our only experience in testing aircraft wiring is from a limited study accomplished about 3 years ago (see NAFEC Data Report No. 98). We, therefore, cannot comment extensively on this subject. For example, we cannot comment on the efficacy of requiring that 12-gage wire be tested in addition to 20 gage, as recommended by AMINCO. Two factors worthy of consideration when deciding on this issue are (1) the likely greater abundance of 20-gage wiring in aircraft as compared to 12 gage, and (2) the desire for the purpose of simplicity of minimizing the number of tests. I must point out that we are confused on how it is intended that testing of wire, other than 20 gage and cable insulation is to be accomplished.

1.3 To our knowledge, AMINCO is correct in stating that the six-tip horizontal burner should be used when testing wiring. This particular burner was used in the experiments on smoke emission from wiring conducted at NAFEC, DuPont, and Raychem (the latter we believe is the primary basis for including wiring in the NPRM).

1.4 We wish to clarify a subtle point with regard to the proposed D_s limit for electrical wiring and cable. It is not clear what constitutes an exposure area for wiring tested in the fixture proposed in NPRM 75-3. The wiring running across the front of the fixture is probably exposed to the greatest amount of heat; however, tested samples exhibit varying degrees of discoloration (indicating differences in smoke emission) for all surface areas on the front and back strands. The calculated D_s values for wiring are based on an assumed exposure area identical to that for flat materials (6.6 in^2). If one assumes that the majority of smoke is produced by the cross-sectional area of the frontal wiring (calculated to be 3.9 in^2 for .078 in O.D. wire), then one must correct the present D_s values for wiring by a factor of 1.7. Conversely, if one assumes the entire surface area of both the front and back strands uniformly emit smoke, this correction factor becomes 0.423.

2. Dale E. Havens

2.1 The respondent who is a consultant to a company developing seat cushions fabricated from glass fibers recommended that the allowable 4-minute specific optical density be reduced to 100 for this category of materials. On the basis of recent testing at NAFEC of wide-bodied cabin materials, this recommendation would exclude polyurethane from usage as a cabin seat cushion material. Without any data to substantiate the respondent's implication that glass fiber can be fabricated to meet the service life, comfort and aesthetic requirements of seat cushions, we feel that exclusion at this time of polyurethane seat cushion would impose an unreasonable design burden on the airlines.

3. Schulte Plastics Engineering

3.1 From an aircraft fire safety and especially smoke and toxic gas emissions standpoint, we do not feel that cargo liners should be considered equally as important as cabin interior materials. Moreover, one may argue that it is inconsistent to regulate cargo liners but not cargo. On the other hand, if cargo liners were required to meet the proposed smoke limits of 25.853(g)(2) (as Mr. Schulte recommends), it is likely that the majority of cargo liners used in wide-bodied aircraft could easily meet these criteria.

4. General Tire and Rubber Company

4.1 The respondent claims there are not available thermoforming materials that would meet existing flammability and proposed smoke requirements and possess an overall balance of listed properties (i.e., processability, thermoformability, etc.). The data at our disposal seems to indicate the availability of a limited number of materials, although the proposed smoke criteria will admittedly eliminate many currently used thermoplastics. Some grades of polycarbonate used in wide-bodied jets will pass the proposed smoke requirements. We have also tested "self-extinguishing" samples of polysulfone (Union Carbide) and polyethersulfone (ICI America) that easily meet the proposed smoke rule. Paradoxically, we recently tested four material samples provided by this company and found three to be compliant with the proposed rule (viz., polycarbonate, polysulfone and chlorinated PVC).

4.2 Opposition to the use of the NBS chamber on the grounds of poor reproducibility is not justified. A round-robin evaluation of the chamber (see NBS Technical Note 708) indicated that the median coefficient of variation of reproducibility was 7.2 percent under non-flaming exposure and 13 percent under flaming exposure. Primarily as a result of opposition from the wood industry, adoption of the NBS chamber as a standard test has been bogged down in ASTM where presently a third round robin is being conducted. It should be noted that the reproducibility of many standard ASTM fire test methods are far worse than that indicated by previous round robins on the NBS chamber.

4.3 Although attempts have not been made to correlate NBS smoke data "with crash fire conditions," an FAA-funded study by Lockheed established a "fair to good correlation" between the maximum specific optical density (D_m) measured in the NBS chamber with that obtained in an L-1011 mockup (see FAA-RD-73-127). Fire exposure conditions in the mockup were similar to those used in the chamber. A new power law curve fit of the data performed during preparation of an article for the Journal of Fire and Flammability has resulted in an improved correlation coefficient with a value of 0.821 (considered by statisticians as corresponding to a fair correlation).

4.4 We feel the respondents proposed smoke limits for urethane foam (D_s = 300-350 at 4 minutes) are high and not warranted by recent NAFEC testing of urethane seat cushions used in wide-bodied jets. Of seven urethanes we evaluated under flaming exposure conditions, four passed the proposed rule stated in NPRM 75-3. Interestingly, each of the compliant urethanes were produced by a different company.

5. Doug Myers

5.1 No comment needed.

6. California Aviation Safety Council

6.1 No comment needed.

7. Association of Trial Lawyers of America

7.1 No comment needed.

8. International Wool Secretariat

8.1 The straight burner originally used in the NBS chamber was modified, as was the specimen holder with the addition of a trough, to allow for the collection and burning of melted drippings from thermoplastic and foamed materials. The modified burner is now used exclusively when testing all materials except electrical wiring (here the original straight burner must still be used). The respondent's contention that the majority of NBS chamber operators use the original burner is absolutely false. AMINCO, the sole commercial distributor of the NBS chamber, provides "a multi-directional six-tiplet burner (i.e., the modified version) standardized in the ASTM round-robin tests..." Both of the very similar test method descriptions of the NBS chamber currently being voted upon for standardization by ASTM (Subcommittee F-7.06) and NFPA (Test Method 258-T-1974) incorporate the modified burner. Either of these two documents would be a more current and complete description of the test method and operating procedure rather than NBS Technical Note 708 referenced in the NPRM. NBS suggests that NFPA 258-T-1974 be referenced (T designates tentative).

8.2 We feel the respondent has overstated the difficulties and importance of maintaining chamber pressure at 4 $\pm$ 2 inches H_2O. We have never observed any noticeable changes in propane flow rate resulting from fluctuations in chamber pressure. The plastic bag used by the respondent to control pressure is similar to the relief valve installed by NAFEC as an improvision to the test procedure. In any event, a ruggedness (sensitivity) evaluation of the NBS chamber has demonstrated that a departure from the prescribed chamber pressure (a zero pressure differential was maintained) did not indicate any unexpected sensitivity in the measurement of D_m. This insensitivity was also found with regard to the cleanliness of the chamber walls.

8.3 Testing at NAFEC and NBS has never indicated that the reflectivity of the aluminum foil wrapper influences the results. Aluminum foil presently used by NAFEC appears to be equally reflective on each side.

8.4 We concur with the respondent that only tests with the front face or outer surface of the material exposed to the burner are in order. It is difficult to visualize a post-crash fire situation where smoke generated by the back face of a cabin material might affect occupant visibility.

8.5 It is not necessary to follow exactly the instructions contained in paragraph 8.14 of NBS Technical Note 708 in order to determine the clear beam reading which is used to correct for deposits on the photometer windows. The burners flames probably do not effect the clear beam reading. Furthermore, the number of materials that exhibit the unusual behavior described by the respondent (very gradual reaching of minimum transmittance, double minima) are very small in number.

8.6 For the standard smoke generating materials, the maximum specific optical density that should be measured and referred to in paragraph A1.4 in NBS Technical Note 708 is the corrected value.

8.7 Most of the statements made by the respondent in criticizing the modified burner are valid (see paragraph 8). For example, the modified burner was developed specifically to test thermoplastic and foamed (melting) materials and has been adopted for use with all materials in order to standardize on one burner. Materials that melt and become pyrolyzed in the trough probably produce less smoke under this condition than if they remained exposed to the radiant heater. As a result of this response, we have tested a wool carpet with the original and modified burner and specimen holder. We also are finding the same trends in smoke described by the respondent. Our D_s data is summarized below.

Time (min)	Modified Burner and Holder	Modified Burner and Original Holder	Original Burner and Holder
1.5	37	53	42
4.0	526	505	218
7.0 (D_m)	610	617	372

However, the respondent incorrectly guessed that the increased smoke found with the modified burner/holder was the result of radiation from the trough. We have found no difference between the original and modified (with trough) holder when testing wool carpet with the modified burner. It appears that wool produces less smoke when tested with the original burner than with modified burner because with the former, the combustion is more efficient. We would be opposed to specifying two burners and two holders as the respondent "strongly recommends." The original or straight burner referenced in the earlier NBS reports was developmental in nature. All NBS chamber operators have since "standardized" on the modified burner. This should include the airframe manufacturers whose recently submitted data has formed the basis for the proposed smoke limits. We do not feel that the superior reproducibility of the straight burner demonstrated for wool only is a good argument for returning to using this burner. A very extensive and practically completed round robin under ASTM sponsorship will better specify the repeatability of the modified burner based on testing about 30 different materials.

8.8 We have not analyzed the most recent smoke data submitted by the airframe manufacturers. However, based only on flaming exposure tests that we have recently conducted at NAFEC, it appears the proposed smoke limits are reasonable for fabrics (10 of the 12 fabrics we tested would be compliant) but may be difficult to meet for flooring materials (five of the six flooring materials we tested failed and the only compliant material was an aluminum-faced Nomex honeycomb structure). Therefore, we do agree with the respondent that a relaxation of the requirements for flooring (including carpets) materials may be in order, but it does not appear that there is justification for a similar change for upholstery and drapery fabrics.

9. USIAS

9.1 Since small items were not specifically referred to in the NPRM, I believe it is understood that they would be waived from smoke testing by paragraph 25.853(b-3).

9.2 We concur that it would not be appropriate to require smoke specifications on wiring used outside of the pressurized vessel.

9.3 We have addressed paragraphs 2.5 and 2.7 in paragraph 1.2 and paragraph 2.6 in paragraph 8.4.

10. National Air Carrier Association

10.1 The respondent's main concern is economics and, as an example, refers to the expense required to test three specimens of a material and averaging the results. Since the test procedure (see NFPA 258-T-1974) is very specific on this matter, it would definitely not be appropriate to reduce the number of tests conducted on each material.

11. Man-Made Fiber Producers Association

11.1 The respondent refers to the statement in the Federal Register "...that aircraft interior materials are available that emit appreciably less smoke than currently used materials." In order to support this statement, we are concerned that the respondent was only provided with a NAFEC data report prepared in 1970. We recall claims by AIA at a meeting on February 27, 1974, that much of this data was on materials unsuited for aircraft cabin usage. It was our understanding that subsequent smoke data provided by AIA on currently used cabin materials essentially confirmed that the smoke limits based on the NAFEC data report were reasonable but provided the basis for the limits proposed in NPRM 75-3. We feel this later and more applicable data might have alleviated some of the respondents concerns.

11.2 The respondents statement that the backing material can affect smoke generation is generally valid. However, the test procedure clearly states that the specimen is covered across the back with aluminum foil and backed with a sheet of asbestos millboard. This configuration would tend to minimize heat transfer losses through the back face.

11.3 The respondent notes that the NAFEC data report only contains data for the flaming mode of testing. This data was provided by AIA and reflects the conditions chosen for testing. It is believed that an agreement was made to test only under the flaming condition since a prior NBS study (NA-68-36) had demonstrated that most aircraft materials produced more smoke under the flaming rather than non-flaming condition. However, it was also stressed in NA-68-36 that "certain materials produce significantly more smoke in the absence of open flaming."

11.4 The respondent is critical that in the NAFEC data report the only fabrics tested with any degree of frequency were Aramid (20), wools (8), and rayon/cotton (13). We feel this data is a case for supporting the proposed smoke limits. Of these 41 fabrics tested, only two wool materials would not meet the proposed regulation. (However, as was noted in the data submitted by the Wool Secretariat, wool upholstery fabrics could become marginal when evaluated with the modified burner.)

11.5 We would like to clarify a frequent misinterpreted statement made by the respondent that an external fuel fire will burn through the skin of an airplane in 30 seconds. This value is approximately correct for about 30 mils of aluminum, but does not take into consideration the additional protection in an airplane that would be provided by the formers, fiberglas insulation and cabin sidewall panels. A full-scale NASA test simulating the worst conceivable fire condition demonstrated that this protection is more realistically about 1-2 minutes.

12. Air Lines Pilot Association (ALPA)

12.1 This response is identical to that submitted for the advanced notice on toxicity. Please refer to our technical evaluation of ALPA's response to ANPRM 74-38.

13. DuPont (Fluorocarbons Division)

13.1 The respondent addresses only the proposed regulations on insulation for aircraft wiring and cable. His position is based on the presumption that the smoke NPRM is solely directed to the post-crash fire. If this is true, then we believe the respondent has logically developed a good argument for relaxation of the limits. Conversely, if the in-flight fire is also under consideration, then the longer testing times are warranted; however, in this case, the test exposure conditions may not be relevent. For example, an in-flight electrical fire would likely involve low ambient temperature and pressure, possibly an electrical overload, and smouldering combustion with characteristic low heat and deficient oxygen. These factors are not included in the present NBS chamber test procedure.

14. Society of the Plastics Industry (SPI)

14.1 In our technical evaluation of the SPI response to the advanced notice on toxicity, we commented extensively on the relative hazard and interaction of burning aviation fuel and cabin materials. Please refer to our comments on this viewpoint that SPI emphasized again in their response to the smoke notice.

14.2 SPI refers to the NASA Houston 737 fire tests to argue that the use of materials with improved fire resistance will minimize the smoke hazards posed by these products in a fire. This study is used as a case to promote the greater fire safety associated with materials having improved ignition resistance characteristics as compared to low smoke emissions. However, SPI failed to point out that the improved fire resistant materials were also selected on the basis of low smoke emissions in the NBS chamber. A limiting D_s value of 50 was used, which is more stringent than the proposed FAA value of 200.

14.3 SPI briefly outlines several steps of a hazard analysis which could be used to derive rational limiting values for D_s. The need to determine the effect of optical density on evacuation time is stressed. We feel that since the relationship between optical density and visibility (or lack thereof) is fairly well established, some qualitative estimates can be made regarding the effect of smoke density on evacuation. Studies of this type which have been conducted in the past at CAMI could establish the limiting value of optical density that produces severe disorientation and substantially lengthened evacuation times. This information in conjunction with smoke measurements for a wide variety of D_s materials under realistic cabin fire conditions would enable a better appraisal to be made of the relationship between specific optical density (NBS chamber) and evacuation time.

15. Association of European Airlines (AEA)

15.1 No comment needed.

16. I. V. Bouterweck/I. A. Becker

16.1 No comment needed.

17. Monsanto

17.1 In summary, the respondent claims on the basis of NTSB accident investigation reports, there is no evidence to support the FAA view that smoke emissions from burning cabin materials affect survivability. Instead, the presence immediately after the crash of large fuel fires is cited as the primary impediment to safe evacuation. This argument was also espoused by Monsanto in their response to ANPRM 74-38 on toxicity and we refer to our evaluation of this response for an appraisal of this position. We again reference the Salt Lake City (United 727, November 1965) and Los Angeles (TWA 707, January 1974) accidents as examples of post-crash fire not involving large quantities of fuel.

17.2 To support the above argument, Monsanto and other respondents refer to the NASA Houston test (No. 4) where smoke from one quart of JP-4 fuel masked the low smoke emission characteristics of advanced cabin materials passing the proposed FAA smoke limits. Please note that the use of a small ignition source which prevented the attainment of a self-sustaining fire and the small cabin volume (1,100 cubic feet) were two selected test parameters that had an important bearing on the results. If both of these parameters were increased, the relative importance of smoke emissions by fuel and cabin materials could conceivably shift. For example, in a larger volume, the smoke density produced by the fuel would decrease and, if the fuel area is large enough to allow the cabin materials to burn on their own, the smoke production from the cabin materials will continuously increase as the fire spreads. At some point in time, the generation of smoke by cabin materials could surpass or even mask that of the burning fuel.

17.3 Monsanto states they can find only one NTSB accident report (Anchorage DC-8, November 1970) in which concern is expressed regarding the flammability of interior materials. We would like to point out that the measurement of elevated cyanide levels in the bloodstream of victims from this and subsequent accidents indicate the probable ingestion of large quantities of combustion products produced by cabin materials (if the measurements are accurate and divorced from the possible contribution to body cyanide levels by burned or decayed tissue and bacteria).

17.4 We concur with Monsanto (Wright) that the referenced science article on the acute combustion toxicity of a laboratory-formulated urethane foam should not be considered as indicative of the behavior of any commercial foams.

18. Mohasco

18.1 We concur with the respondent that only the top side of the carpet should be exposed in the NBS chamber test. We agree that exposure of the bottom side does not simulate any realistic crash fire situation.

18.2 Mohasco proposes testing under the flaming condition only. We feel that materials should be tested under both standard exposure conditions as proposed in the NPRM, although we recognize that acceptability limits were apparently derived from a data base on flamming exposure only. Examination of smoke data found in NBS and CSIRO reports on aircraft carpets indicates that higher smoke (D_m) levels were experienced during the flaming mode for only 8 of 13 carpets tested. Other aircraft cabin materials (e.g., urethane seat cushions, acrylic sheets, etc.) should be expected to produce more smoke under the non-flaming test condition than under the flaming condition (see paragraph 11.3).

18.3 Without having extensive D_s versus time profiles for both flaming and non-flaming conditions for a wide variety of aircraft carpets, we cannot comment authoritatively on the advisability of slackening the acceptability limits for carpets. However, we have examined the data referred to above and surprisingly found that 5 of the 13 carpets would be compliant with the D_s = 200 limit at 4 minutes. The compliant carpets include three wool mixtures, a polypropylene and a Nomex. However, only the Nomex and one of the wool carpets would pass current FAA flammability criteria.

19. Aerospace Industries Association of America (AIA)

19.1 We do not feel that AIA's proposed replacement of the words "smoke emission" by "visibility" serves any useful purpose and could be confusing. This play with semantics would tend to discredit the importance of visibility vis-a-vis smoke in survivability during a cabin fire.

19.2 AIA refers to report FAA-RD-73-127 as indicating that for four major material categories evaluated, the least smokey materials available for cabin design exceeded the NPRM smoke limits. This statement does not correctly state the selection criteria for materials tested in this study. Basically, two materials were selected for each of 10 usage categories, one representative of low smoke emission (and not necessarily the lowest) and one of high smoke emission.

19.3 AIA provides a list of asterisked items they claim cannot be replaced by materials or constructions passing the NPRM smoke limits. We would like to see some qualification for citing these materials or constructions. For example, why must some panels be constructed of ABS and not some other thermoplastic having significantly lower smoke emissions? Why cannot polycarbonate passenger service units be replaced by polysulfone units fabricated in the past? Is it necessary to make seat trays only from ABS? Qualifications statements are needed to fairly evaluate whether the AIA claims are reasonable.

19.4 AIA uses Report FAA-RD-73-127 to indicate that specific optical densities of 280 to 350 permit a degree of useful visibility. We would like to emphasize that visibility is not explicitly related to specific optical density. This relationship also depends on the volume to area ratio (arbitrary).

19.5 AIA proposes that certain materials be excluded from consideration for compliance with smoke limits. In order to remain consistent with the original basis for selecting performance limits, it would be more proper to relax the limits for a particular usage category found only to contain materials consistently producing high smoke emissions.

19.6 We concur with the proposed AIA rewording of Appendix F(2)(i).

20. Air Transport Association (ATA)

20.1 ATA's statement that the cabin materials in use before 1967 and 1972 emitted less smoke and toxic gases than the new materials is absolutely false. The older airplane interiors were primarily lined with plasticized PVC and ABS materials which produce copious amounts of smoke and toxic gases. In fact, the airframe manufacturers have tried to replace these materials where possible because of this recognized problem.

20.2 ATA should be advised that the planning of the NASA FIREMAN program is unrelated to FAA's regulatory notices.

20.3 ATA states "there is sufficient useful visibility at higher smoke numbers" without qualifying the basis for such a strong assertion. We must emphasize that this statement simply is not true. It takes a relatively small area of material meeting the proposed criteria to generate sufficient quantities of smoke to seriously reduce visibility in a wide-bodied cabin (see NAFEC Data Report No. 105).

21. Flight Engineers' International Association

21.1 The respondent expresses concern that the smoke limits proposed in the DuPont petition to the FAA in 1968 are considerably more stringent than recommended by FAA in NPRM 75-3. Some assurance can be given to the respondent by noting that DuPont now endorses the new smoke limits proposed by FAA which are based on the state of the art of available materials (see comment No. 25).

22. General Electric

22.1 An interesting, well-written and positive discussion on smoke and other aspects of fire safety.

23. California Aviation Safety Council

23.1 This is a petition to "consider broadening the requirements for Emergency Locator Transmitters" and does not address the smoke NPRM.

24. JAR Committee

24.1 The respondent states that the "most probable cause of smoke emission from cables is not external fire as for furnishing materials but internal overheating due to electrical overloading which is more probable." If this is a valid statement, it appears the proposed test procedure for wiring may not be the most relevent (see paragraph 13.1); i.e., the wiring insulation should be pyrolyzed by passing an electrical overload through the conductor (see NAFEC Data Report No. 98).

24.2 For the purpose of clarity, we agree that a statement is needed to the effect that materials not listed in paragraph 25.853 (g) (1) and (2) are not to be submitted to the smoke test.

24.3 For the purpose of clarity, paragraph (1) (iv) in Appendix F should be reworded, "At least three speciments of a material must be tested for each exposure condition and the results..."

24.4 We do not feel any special consideration should be given to the maximum permissible scatter between replicate tests. No such provisions exist in the "standard" test procedure (see NFPA 258-T-1974). However, we approve of the present NPRM wording that "at least three specimens must be tested" since this provides the latitude of "averaging out" an unrepresentative test result.

24.5 Although the NPRM does not specify the sample thickness, the standard test procedure (see NFPA 258-T-1974) clearly states that the thickness must correspond to the end-use value.

24.6 We disagree with the respondent's emphasis on the importance of insulation and insulation covering as compared to cabin interior surface materials in realistic post-crash fire scenarios.

25. DuPont (Product Services and Technology)

25.1 We believe the wording used in the NPRM clearly states that textiles are tested under paragraph (g) (1) and carpets under (g) (2).

25.2 We concur with the respondent's analysis of the possible implication of the present wording used in paragraph (g) (2) and have already recommended a change (see paragraph 1.1) which has the same meaning as that proposed by the respondent.

26. National Electrical Manufacturers Association

26.1 This is a request for an extension of the closing date for submitting a response.

27. National Transportation Safety Board

27.1 No comment.

28. B. F. Goodrich

28.1 We appreciate the importance of sample thickness on the rate of smoke emission. Basically, the thinner a material is the faster the rate of increase in surface temperature and resulting emission rate of smoke. However, we do not agree with the respondent that by using thick materials you would be increasing the life safety hazard, apparently because a greater ultimate quantity of smoke could be produced. If a material should continue generating smoke beyond the time available for safe evacuation (approximately 5 minutes), this will not affect life safety. Therefore, it would be inconsistent to also place a limit on D_m as proposed by the respondent.

28.2 We concur with the respondent concerning two important points: (1) generally, melting materials will tend to produce less smoke than non-melting materials when tested currently in the NBS chamber because the former melt away from the radiant heat source and are collected and pyrolyzed in a small trough; and (2) the relative "flammability" of materials tested in the present FAA vertical test apparatus does not provide a true indication of the relative flame spread across materials under realistic and intense fire conditions. With regard to the first point, in a real fire situation, a material that melts onto the floor may or may not then become exposed to a more severe fire condition.

29. International Air Transport Association (IATA)

29.1 This response is identical to that submitted for the ANPRM on toxicity. Please refer to our technical evaluation of IATA's response to ANPRM 74-38.

30. See No. 24

31. John Schneller and Associates

31.1 This response is identical to that submitted for the ANPRM on toxicity. Please refer to our technical evaluation of Schneller's response to ANPRM 74-38.

32. Missing

33. Missing

34. ICORE International

34.1 ICORE and NTSB both state that electrical wire or cable are replaced more often than one might anticipate and recommend that the installation of the upgraded insulated wire and cable should be required by FAA regulations. We tend to agree with this proposal which would improve the level of safety without imposing an unreasonable economic burden (approximately 20 percent cost increase).

35. Rohm and Haas

35.1 This response is identical after changing a few words (i.e., toxicity to smoke, etc.) to that submitted for the ANPRM on toxicity. Refer to our reaction to Rohm and Haas' response to ANPRM 74-38.

36. Aviation Consumer Action Project (ACAP)

36.1 We have commented previously that specific optical density is not explicitly related to visibility (paragraph 19.4). Considering D_s = 16 "critical" for L = 10 ft., A = 10 ft.^{2}, and V = 2000 ft^3 was meant to indicate that the visibility through smoke at these conditions is about 10 ft. The commonly used parameter optical density is directly related to visibility.

36.2 We agree to the necessity for changing the wording of paragraph (g)(2) as recommended by this respondent and also others previously (see paragraph 1.1).

36.3 We do not see the importance of placing stringent requirements on structural flooring, when it is the carpet or covering that produces the smoke in a real fire. Testing of structural flooring is meaningless unless the covering is attached.

36.4 ACAP proposes more stringent requirements (D_s = 50 at 4 minutes) for seat cushions, drapery and upholstery. FAA must decide what constitutes providing adequate design flexibility to the airplane manufacturers and airlines. We do not believe that leaving the designer to use polyethylene for seat cushions, which is an unheard of material for this application (it is not resilient), and eliminating all urethane foam formulations is reasonable. It may be possible to lower the performance limits for drapery and upholstery fabrics and still provide two or three materials or blends to select from.

37. General Aviation Manufacturers Association

37.1 We are not sufficiently familiar with the safety considerations in general aviation aircraft certified under Part 25 to properly evaluate this response.

38. Allied Chemical

38.1 We would not be surprised if the relative ordering of materials in terms of smoke generation in the NBS chamber depends on the incident radiant heat flux. To be rigorous, a material should be tested over the range of possible energy levels that can exist in a cabin fire to properly appraise its smoke generation characteristics. Studies on this effect have been conducted at the University of Utah.

38.2 We have contacted NBS and learned that they do not intend to revise the test procedure for the NBS chamber. However, if they had to do it all over again, a horizontal specimen holder to retain melted material in the heating zone and to provide uniform pyrolysis they admit would have been a substantial improvement over the present method.

39. British Aircraft Corporation

39.1 We concur that only electrical wiring and cable located within the pressurized cabin should be required to meet smoke emission criteria.

39.2 BAC expresses concern that the smoke limits proposed in NPRM 75-3 are more stringent than anticipated based on NAFEC Data Report 76. We feel this concern is unjustified since the limits have only been tightened for textiles, air ducting and insulation, and there is a sufficient variety of these materials available that will pass the new smoke limits (D_s = 100 at 4 minutes).

39.3 We do not recall any smoke data on air ducting to use as a basis for selecting performance limits; however, we believe the motive may have been to eliminate the insulating of air ducting with rigid urethane foam.

39.4 Of the three differences listed by BAC between the original and latest NBS chamber test procedure, we have only found an effect on smoke emission values from the different burners (i.e., straight horizontal and modified types). Nevertheless, we believe the latest test procedure only should be specified in any smoke regulation (see paragraph 8.7). It is unfortunate that some of the overseas facilities (e.g., BAC, Wool Secretariat, etc.) have had difficulties remaining apprised of the developmental changes in the NBS chamber test procedure.

39.5 To our knowledge, there has never been an interlaboratory evaluation of the smoke test procedure for wiring to assess the reproducibility of this method.

39.6 As described in the proposed ASTM F-7.06 standard test description of the NBS chamber, the "wire holding fixture" for airframe wire is constructed of low carbon, 300 series stainless steel.

An evaluation was not made of the agency responses.

Constantine P. Sarkos
CONSTANTINE P. SARKOS