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INTERIOR MATERIALS

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1. INTRODUCTION

The paramount concern to an airplane manufacturer is the safety of his product. It is not enough just to be able to prove to regulatory authorities that the product meets the regulations, and is therefore worthy of certification. Just as importantly the ultimate customer for the product -- the passenger -- must also be convinced that the airplane he rides on represents the highest achievements in safety.

It is also fundamental to an airline that its operations be demonstrably safe. The regulatory authorities must be satisfied, of course. The customer passengers must also be satisfied.

What this means is that in the business of commercial air transport, safety plays the governing role. Safety is the cornerstone of this business. It is good business. It is the only way to stay in business.

The sum total of these efforts on the part of the regulatory authorities, the airplane manufacturers, and the operating airlines is that commercial air travel has become by any reasonable measure far safer than any other mode of transportation in history.

Does this mean that our job is done? No, it certainly does not!! Complacency would not improve safety. In fact, it would probably have just the opposite effect. We must and will continue to strive for safety improvements.

2. BACKGROUND

2.1 History Of Regulations

In the United States, the Federal Air Regulations (FARs) govern the certification and operation of aircraft. For the certification of new designs of passenger airplanes, the applicable regulations are in FAR PART 25, "Airworthiness Standards: Transport Category Airplanes". The operation of airplanes by airlines is covered in FAR PART 121, "Certification and Operations: Domestic, Flag, and Supplemental Air Carriers, and Commercial Operators of Large Aircraft".

3. REQUIREMENTS

3.1 Manufacturer Requirements

3.2.1 Criteria Used For the 727 and 737 Programs

Work done at Boeing in the early 1960s showed that a more stringent, and preferred, flammability test involved positioning the material vertically instead of horizontally, as was required in CAR4b. Accordingly, in 1961 Boeing adopted an internal requirement that parts used for commercial transports had to meet both the horizontal test required by the FAA in CAR4b and an additional vertical flammability test. The 727 and 737 were developed according to this requirement.

In 1966, the FAA released a Notice of Proposed Rule Making to incorporate a vertical flammability test in the regulations, and issued a new rule (FAR PART 25 Amendment 15) doing so in 1967.

3.2.2 Criteria Used For the 747 Program

In the development of the 747 program, potential improvements that had been identified in the AIA Crashworthiness Program (1967 - 1968) were taken into account. Criteria involving flame spread, heat release, and smoke emission were adopted, all of which exceeded the applicable regulations in the FAR at that time. Test procedures included the ASTM E84 Steiner Tunnel procedure, the ASTM E162 Radiant Panel procedure, and the NBS smoke chamber. Acceptance criteria were established that were appropriate to the material application (sidewalls, ceilings, etc.).

The upgraded 60-second Bunsen burner tests that had been developed in the AIA Crashworthiness Program were required. These tests were later imposed by the FAA as Special Conditions for 747 certification.

These criteria resulted in an essentially complete new set of materials used for cabin components. The biggest impact was the large-scale introduction of honeycomb core sandwich panels constructed of fiberglass and fire-retardant epoxies.

3.2.3 Criteria Used For the 757 and 767 Programs

The FAA initiated rulemaking activities involving smoke and toxic gas emissions of interior parts in the early 1970s. ANPRM 74-38 addressing toxic gas emissions and NPRM 75-3 addressing smoke emissions were issued. In addition, NPRM 75-31 proposed to amend FAR 121 to require all new production aircraft to meet the

crushed-core sandwich panels constructed of fiberglass and phenolic resins.

3.2.4 D6-51377 Used for the 747-400

In January, 1984, Boeing issued a document -- D6-51377, "Aircraft Fireworthiness Interior Design Criteria" -- which comprised a comprehensive set of interior fireworthiness criteria to be applied to new design aircraft and to guide modifications of current production aircraft. These criteria combined the existing FAR regulations with supplementary Boeing criteria.

The guidelines established in 1977 for the 757 and 767 were included in D6-51377.

In addition, D6-51377 contains unilateral requirements beyond the regulatory mandates for

- additional provisions for fire containment in cargo compartments,
- fire barriers to inhibit fire from entering the passenger cabin for scenarios involving post-crash fuel-fed exterior fires,
- fire barriers/baffles to inhibit the fire spread for scenarios involving interior fires,
- shielding of possible ignition sources such as light ballasts from potential combustibles, and
- protection of electrical systems.

An updated version (Revision B) of this document was issued in 1986 and used for the redesign of the 747 cabin for the 747-400. The major difference between these versions is the replacement of the initial smoke emission guidelines by a set of component-to-component requirements.

3.2.5 ATS 1000.001

AIRBUS Industrie set up a set of criteria similar to the Boeing guidelines in ATS 1000.001, which was released on January 15, 1979. It did not, however, contain a Flame Spread Index criterion. Also, in addition to the unilateral criteria, ATS 1000.001 included a detailed description of the mandatory Bunsen burner tests.

Amendment 25-32 was developed by the Aerospace Industries Association in its Crashworthiness Program in 1967-1968, and recommended to the FAA in that Program's report. Amendments 25-59, 25-61, and 25-66 were upgrades that were recommended by the SAFER committee.

Amendment 25-32 (the seat cushion fire blocking requirement) was a major step forward, and represented an ideal cooperative effort between industry, NASA, and the FAA for improving fire safety. Suitable replacement materials for the polyurethane foam seat cushions were not available. The concept of fire blocking was developed by the materials industry as an alternate means of removing the inherently flammable foam's fuel potential in a fire. Several viable fire blocking materials had been developed and were commercially available by the time the rule was issued.

3.1.3 FAR PART 121: Certification and Operations

FAR PART 121 covers those requirements airplanes must meet, in addition to the certification requirements for their specific type design from FAR PART 25, before the airlines can operate the airplanes in passenger service. By changing FAR PART 121, the FAA can require that all airplanes operated by the airlines be modified to meet new requirements not covered by its type design.

Since the FAA will not allow airlines to use an airplane that does not comply with FAR 121, it follows that Boeing, Douglas, and Airbus have to incorporate new FAR PART 121 requirements into their production airplanes before the airlines will buy them.

FAR PART 121 amendments are issued and treated the same way as FAR 25 amendments. Subsequent amendments to FAR PART 121 that have been issued and that are of particular note for cabin interiors are

Amendment Number	Effective Date	Added Requirement
121-184	1987	seat cushion fire blocking
121-189	1986	Ohio State Univ. heat release test
121-198	1990	NBS smoke release test

4. CHANGES IN INTERIOR MATERIALS

The evolution in regulatory and manufacturer requirements has over the years resulted in several radical changes in cabin interior components. During this period, the engineers who are responsible for the design of these components have put out a blizzard of new drawings and drawing changes. The factory workers who are responsible for building these components have been faced with enormous challenges, for to them it has seemed that as soon as they became comfortable with one design they had to abandon it and work with another.

The biggest impact however has been on the people responsible for planning and financing physical plants and tooling for the manufacturing operations.

5. CONCLUSIONS

The design criteria for interior materials encompass regulatory mandates, manufacturer requirements, and passenger requirements. They are all important, and all must be taken into consideration simultaneously.

In the development of new technology to improve safety and all the more visible aspects of passenger cabins, it is crucial that everyone involved work together. This includes manufacturers, materials suppliers, airlines, regulators, governmental oversight committees, associations representing affected parties such as passengers, pilots, and flight attendants. Only in this way can the optimum progress be made.