

RATIONALE

The purpose of this document is to provide the analysis methods, testing, and rationale used to justify changes contained in ARP6199B.

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1. SCOPE

This SAE Aerospace Information Report (AIR) is only applicable to 14 CFR Part 25 transport airplane passenger and flight attendant seats. This document provides the analysis methods, testing, and rationale used to justify changes contained in ARP6199B.

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 +1 724-776-4970 (outside USA), www.sae.org.

ARP6199B Method to Evaluate Passenger and Flight Attendant Seats for the Test Requirements of 14 CFR Part 25 Appendix F, Parts IV and V

2.1.2 Code of Federal Regulations (CFR) Publications

Available from United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

14 CFR Part 25 Airworthiness Standards: Transport Category Airplanes

2.1.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

Advisory Circular 25-17A (AC 25-17A), Change 1, Transport Airplane Cabin Interiors Crashworthiness Handbook.

Aircraft Materials Fire Test Handbook: <https://www.fire.tc.faa.gov/Handbook>.

FAA Policy Statement No. PS-ANM-25.853-1-R2, Flammability Testing of Interior Materials, July 3, 2013.

Technical Standard Order TSO-C127b, ROTORCRAFT, TRANSPORT AIRPLANE, AND SMALL AIRPLANE SEATING SYSTEMS

2.2 Definitions

ARM CAP: A feature (such as foam and leather covering, or elastomeric) that is part of the design of armrests, end bays, or center consoles and is intended to provide support for the passengers' arms.

ARMREST: A feature that provides arm support and may include structural, comfort, and aesthetic components, such as arm caps.

COMPLIANT PANEL: A panel that meets the requirements of 14 CFR Part 25 Appendix F, Parts IV and V. Heat release and smoke density will be referred to as "compliant panel" in this document.

DRESS COVERS: Fabrics (woven or non-woven) and leathers (including synthetic leather) are not panels.

DRESS COVER ASSEMBLIES: Dress covers with padding, foam, batting, or cushioning materials.

EXEMPTED PANEL: The applicant may designate up to and including 1.5 square feet (1394 cm²) of non-traditional, non-metallic panel material per seat place that does not have to comply with 14 CFR Part 25 Appendix F, Parts IV and V. For example, a triple seat assembly may have a total of 4.5 square feet (4181 cm²) excluded on any portion of the assembly, e.g., outboard seat place 1.0 square feet (929 cm²), middle 1.0 square feet (929 cm²), and inboard 2.5 square feet (2323 cm²).

NON-BONDED OVERLAPPING PANELS: Panels that are either touching without a bonding agent or with a gap between them.

RESILIENT PANEL: A panel material is resilient if it is an exposed panel and if during a post-crash fire event it is unlikely to deteriorate and expose underlying materials, thereby preventing them from affecting the likelihood of a flashover event. A resilient panel design must be itself compliant to 14 CFR Part 25 Appendix F, Parts IV and V, and its base substrate must fit one of the following:

- Finished or unfinished metallic construction (less than 10% magnesium).
- Thermoset resin glass or carbon fiber reinforced composite (multi-ply construction or a sandwich panel with honeycomb foam core).
- Materials (such as thermoplastic) shown by test to be resilient as defined in 4.3.

SEAT PLACE: Seat occupied by a passenger.

2.3 Acronyms

AC	advisory circular
A/C	aircraft
AFM	airplane flight manual
ARP	aerospace recommended practice
ATC	amended type certificate
CAD	computer aided design
CFR	Code of Federal Regulations
cm	centimeter
CRI	certification review item
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
HR	heat release
HRR	heat release rate
HRSC	heat release special conditions

IAT	in-arm table
IAV	in-arm video
IFE	in-flight entertainment equipment
KW/m ²	kilowatts per meter squared
MOC	means of compliance
MPS	minimum performance standard
m	meter
mm	millimeter
min	minutes
OEM	original equipment manufacturer
OSU	Ohio State University
PC	personal computer
PCU	passenger control unit
P/N	part number
SC	special conditions
SD	smoke density
STC	supplemental type certificate
TC	type certificate
>	greater than
≤	less than or equal to
“	inches

3. BACKGROUND

In 2007, the Federal Aviation Administration (FAA) released special conditions that held seats to the same heat release and smoke density standard as the rest of the cabin. The European Aviation Safety Agency (EASA) soon followed with similar regulations. The seat heat release special conditions (HRSC) required heat release and smoke density tests for large, exposed, non-metallic, non-traditional panels that are part of the seat design to be performed.

In January 2010, the industry and regulators began meeting to develop common criteria that can be used to determine which panels on a seat require heat release and smoke density substantiation. This activity was concluded in December 2010, and the final criteria were subsequently distributed via a white paper to all the industry and regulatory participants.

The SAE Aircraft Seat Committee subsequently published ARP6199 in 2012. However, the guidance in this revision of the ARP was not fully harmonized and/or accepted throughout the seat industry, and therefore it was not widely used. As a result, ARP6199A was published in 2017 to address the most important issues. The goal of ARP6199A was to clarify the available guidance and harmonize the requirements across the industry and to the TSO-C127 elective minimum performance standard (MPS) coextensive with seat HRSC. The SAE working group also chose to focus on the remaining issues that were not addressed in ARP6199A (due to time and scope constraints) in ARP6199B.

ARP6199B was released in February 2022 and included the changes documented in this AIR. In addition, this AIR contains the testing and analyses that were conducted and supported by the seat industry. The goal of this AIR is to ensure that all the testing data, analyses, and rationale that led to the creation of ARP6199B is documented for reference purposes.

4. LIST OF ARP6199B CHANGES AND SUPPORTING DATA/ANALYSIS (COMPARED TO ARP6199A)

4.1 New Criteria for Evaluating Overlapping Panels/Engineering Gaps/Resilient Materials

If a gap of less than or equal to 0.25 inch exists between two panels, the underlying panel is exposed, and compliance must be shown according to Table 1. If the gap is greater than 0.25 inch, the underlying panel is not exposed.

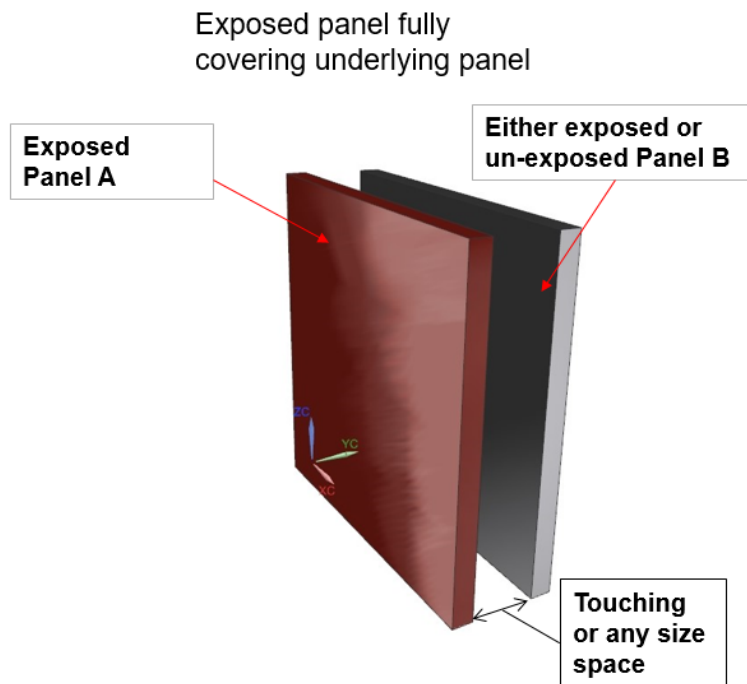


Figure 1 - Example of exposed panel fully covering underlying panel

4.2 Evaluating Overlapping Panels

Table 1 - Criteria for evaluating overlapping panels

Gap ≤ 0.25 Inch (6.35 mm) Including Touching Non-Bonded Substrates Exposed Panel	Gap > 0.25 Inch (6.35 mm) Unexposed Panel
Choose any of the following options*: 1. Test the exposed panel, and if it is resilient then the underlying panel does not need to be evaluated for HRSC. 2. Test each panel independently. 3. Test the panels as a stack-up per type design (may be tested with zero gap). * If option 1 or 2 is used and fails, then another option may be used. Once option 3 is used and fails, then the design must be changed.	Only the exposed Panel A must be evaluated to HRSC.

4.3 Test Method to Show Material Resilience

A material may be shown to be resilient by meeting the Ohio State University (OSU) heat release requirements evaluated per the test configuration shown in Figure 2.

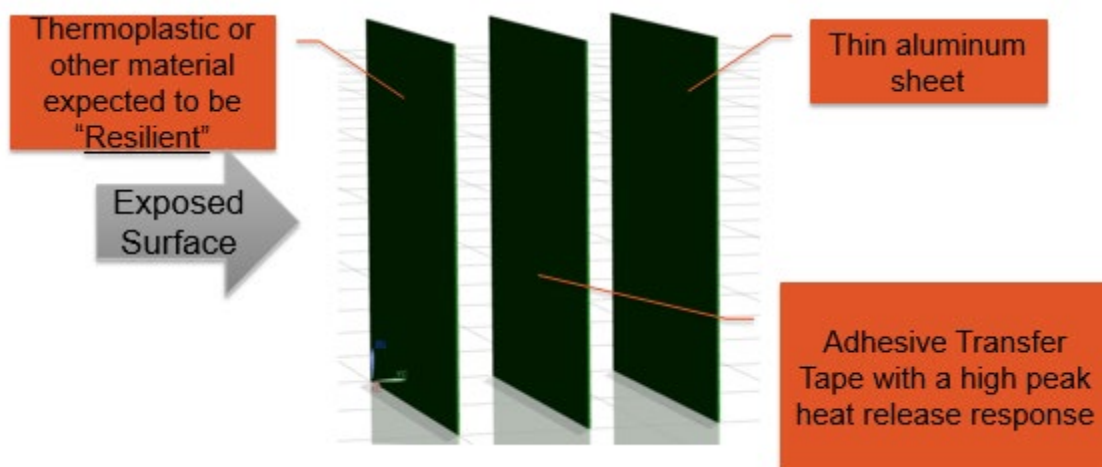


Figure 2 - Test configuration to determine resilient material

4.3.1 Test Requirements

The covering material shall be equivalent to the proposed panel thickness.

The aluminum sheet shall be no greater than 0.063 inch (1.60 mm) in thickness. Aluminum grade 6061 is recommended.

For the test to properly demonstrate resiliency, the underlying adhesive must be of a type that produces a high peak heat release (HR) value when exposed to the OSU test.

Tape characteristics shall meet the following when tested to the requirements of 14 CFR Part 25 Appendix F, Part IV:

- Peak heat release rate (HRR) value shall be at least 100 KW/m².
- The time to peak shall be less than 60 seconds.
- The peak event shall be greater than 30 seconds. The duration of the peak event is comprised of two inflection points: It begins approximately when the test curve crosses the zero HRR line and ends approximately when the downward slope of the test curve begins to level off. See Figure 3 for example.

NOTE: 3M (manufacturer) 9473 (part number) 0.010-inch (0.25-mm) thick has been shown to meet these requirements. Figure 3 shows the test data for a specimen set (three samples) using this tape.

4.3.2 Tape Performance Parameters (3M 9473 Example)

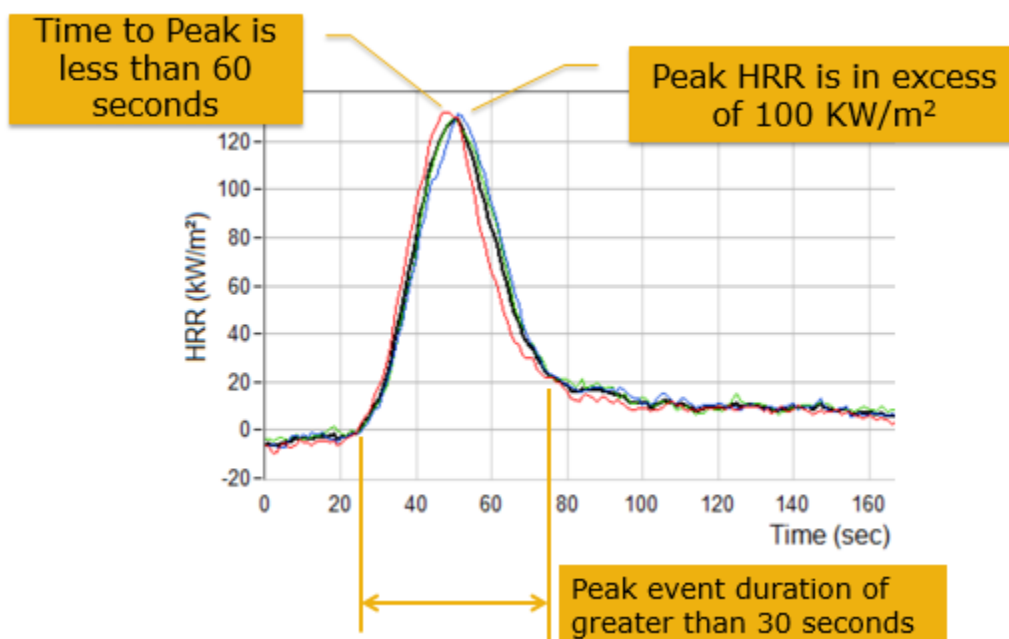


Figure 3 - Tape performance parameters (set of three specimens shown)

4.3.3 Resilient Test Guidelines

- The tests shall be run according to the guidelines in chapter 5 of the Aircraft Materials Fire Test Handbook.
- The test to show resilience is a separate test than those used to demonstrate compliance to 14 CFR Part 25 Appendix F, Parts IV and V.
- The test to show that a thermoplastic is resilient shall be conducted with a test article that is designed as shown in Figure 2.
- If the heat release test is passing for the construction, the thermoplastic material at the prescribed thickness is considered resilient for purposes of evaluating overlapping panels (see 4.1).
- For a given thermoplastic material and thickness, the color and texture do not affect resilience; therefore, only a single test set per material brand/grade would be needed.

- If the material is coated with paint or a laminate film, and the base thermoplastic is tested for HR and smoke density (SD) and passes, the passing test results of the base thermoplastic will be acceptable to show resilience. A test of the coated panel must demonstrate compliance to 14 CFR Part 25 Appendix F, Parts IV and V.

4.3.4 Resilient Test Data Presentation

The data necessary to show resilience shall be accompanied with:

- OSU/HR test results showing the performance of the adhesive transfer tape used on aluminum.
 - A minimum of three tape samples shall be tested, and each sample HR peak shall exceed 100 KW/m². In addition, time under peak shall be greater than 30 seconds and time to peak shall be less than 60 seconds. In the Figure 3 example, the 3M 9473 tape has been shown to meet the tape criteria. However, all applicants must generate data for the tape they intend to use to determine the exposed substrate's resiliency.
- OSU/HR test results of the resilient panel configuration to be qualified.
 - The average peak test result shall not exceed 65 KW/m².

4.3.5 Data from Resilience Testing

The second peak is a result of adhesive exposure and results in a predictable Peak Heat Release Failure

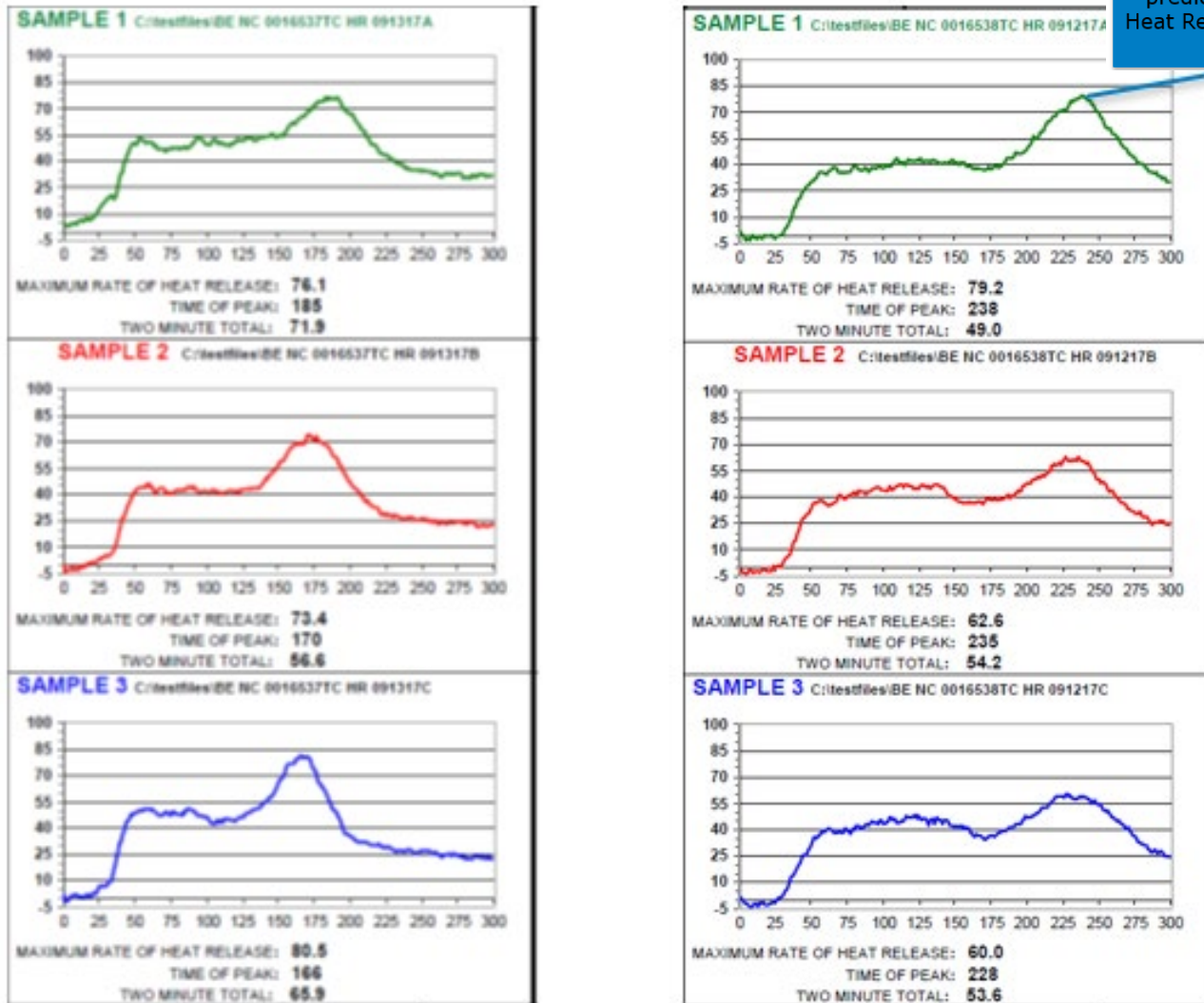
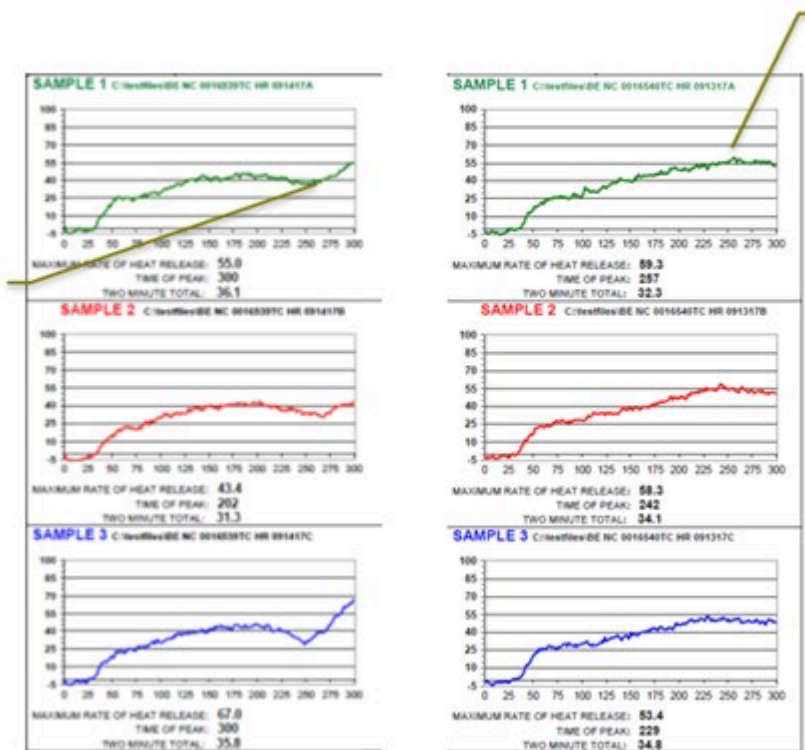


Figure 4 - Resilience test graphs for 0.05-inch (left) and 0.065-inch (right) thick thermoplastic

The .090 thick material moves the engagement of the underlying adhesive to the end of the test. Although a slight increase can be seen the data is still passing.



The .125 thick material prevents the adhesive from becoming engaged at all during the 5 min test.

Figure 5 - Resilience test graphs for 0.09-inch (left) and 0.125-inch (right) thick thermoplastic

Table 2 - Results of resilience testing

Thermoplastic Thickness		Peak Test Result (Avg KW/m ²)	Resilient (Yes/No)
(inches)	(millimeters)		
0.050	1.27	71.1	No
0.065	1.65	66.5	No
0.090	2.29	54.9	Yes
0.125	3.18	54.7	Yes