THE INTERNATIONAL AIRCRAFT FIRE AND CABIN SAFETY RESEARCH CONFERENCE

SAE A-22 AND AS6826 STATUS

September 2024

A-22 Powerplant Fire Protection and Flammability Testing Committee
Co-Chairs: John Ostic (Boeing) & Daniel Laborie (GE)
Secretary: Brian Stewart (Spirit AeroSystems)

SAE INTERNATIONAL

SAE A-22 Fire Protection and Flammability Testing Committee

Abstract

This presentation will brief the aerospace fire safety community on the activities of SAE A-22 Fire Protection and Flammability Testing Committee.

The A-22 Committee was chartered in 2018 to address the FAA's Tasking Request to develop industry standards to be used as the basis for an updated FAA Advisory Circular AC 20-135. Regulatory and Industry representatives had expressed a need to update the content of the AC, and wide variations in fire test approaches and pass/fail criteria had developed over time across the industry.

The AS6826 Powerplant Fire Test Standard currently nearing initial publication provides fire test methodologies and pass/fail criteria that have been found to be acceptable by the Regulatory Authorities to meet the applicable propulsion system component and powerplant installation fire protection requirements.

The A-22 Committee is also developing additional standards, recommended practices, and informational documents to address fire safety for engine combustor burn-through, engine mounts, and electrical wiring interconnection systems. There are currently six (6) AS, ARP, and AIR documents in work.

SAE A-22: Background and Purpose

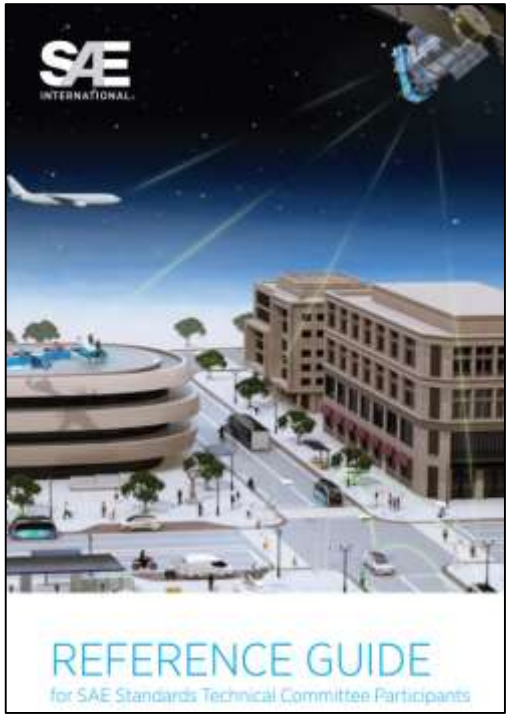
The SAE A-22 Fire Protection and Flammability Testing Committee was initially formed in March 2018 to support the update of FAA AC20-135.

The committee is comprised of individuals from across the industry including aviation certification authorities.

The committee is responsible for creating and maintaining technical standards pertaining to acceptable means of testing aircraft and propulsion system components and their installations (CFR/CS 23, 25, 27, 29, and 33).

The committee works with regulatory authorities to ensure that the standards developed support certification requirements across the globe.

While the initial task was to improve upon the existing AC20-135 powerplant installation fire test standard, the scope has grown to include harmonizing test methodologies, developing recommended practices, and maintaining other test standards.



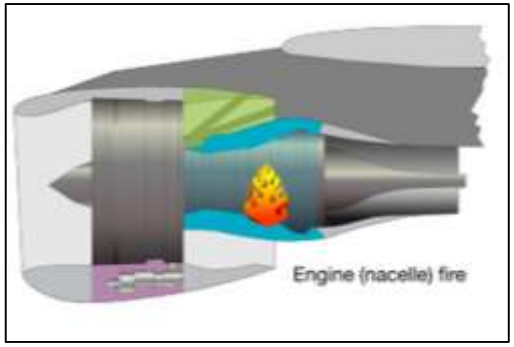


Image Courtesy of Airbus

SAE A-22 Committee Objectives and Initial Program of Work

The objectives of the committee are to:

- Develop and publish SAE Technical Reports for testing of fire protection systems, components, and structure
- Define fire test requirements for aircraft and propulsion systems
- Develop performance standards for fire certification testing of aircraft and propulsion systems
- Define the sensitivities and accuracy of equipment used to conduct fire and flammability testing
- Harmonize global testing methodologies

INITIAL PROGRAM OF WORK

Develop SAE standards or recommended practices to address the FAA Tasking Request to develop industry standards to revise **AC 20-135**, *Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria*. The proposed standards will be used to demonstrate compliance with powerplant fire protection requirements. In addition, methods used to calibrate and set-up a new **sonic burner** as an optional replacement for existing fire test burners will be developed.

Original Top 10 Industry Needs	
1	Post-Test Burning & Backside Ignition
2	Burner & Flame Temperature
3	Flame Calibration
4	Definitions: Fireproof, Fire-Resistant, Heat Flux
5	Test Pass/Fail Criteria including TSO hoses
6	Thermocouples (Size, Type, Number)
7	Environment and Operating Conditions
8	Panel Size
9	Materials
10	Harmonize with Other Specifications and References

SAE A-22 Committee Participants

- **Current SAE Roster Includes 250+ Individual Participants from Across the Industry and Regulatory Authorities**
- **Consistent and Meaningful Support from FAA, EASA, TCCA, ANAC , JCAB, CAA, CAAI, and CAAC**

Airplane Mfg.
Airbus
Boeing
Bombardier
Boom Supersonic
COMAC
Daher
Embraer
Gulfstream
Heart Aerospace
Honda
Northrup Grumman
Odys Aviation
Piasecki
Textron/Cessna
Turkish Aerospace

Certification Authorities
Brazil (ANAC)
Canada (TCCA)
China (CAAC)
Europe (EASA)
Israel (CAAI)
Japan (JCAB)
United Kingdom (CAA)
United States (FAA)

Engine Mfg.
GE
Honeywell
Pratt & Whitney
Rolls-Royce
SAFRAN

Helicopter Mfg.
Airbus
Bell/Textron
Sikorsky/Lockheed

Component Mfg.
Air Liquide Tech
Akro Fire
Eaton
JPR Hutchinson
Meggitt
Luxfer MEL Tech.
Parker
Shanghai Aircraft
TA Aerospace
Titeflex
Trelleborg
Triumph
Unison Industries

Testing Facilities
ACES
Accufleet
Aeroblaze
CTA
DGA
Element
Govmark
Lefae-Emitech
NIAR
NTS
Resonate

MRO
Ametek
MHIRJ

Commodity Manufacturers
AIM Altitude
GKN
Safran Nacelles
Spirit AeroSystems
RTC/PW/UTC/Collins
ST Engineering
Zodiac Aerospace

Industry Consultants
Danker Associates
GE Aviation
Marlin Engineering
Nacelle Group
Waldron Aerosystems
Gordon & Gordon Engineering

Government Institutions
FAA Tech Center
Naval Air Systems Command (NAVAIR)
National Research Council (Canada)
ONERA (France)

Standards
NACE
SAE

Academia/Research
Concordia Univ. Montreal
Rescoll (Bordeaux Univ.)
Stanford University
University of Cincinnati
Wichita State University

中国民航 CAAC

JCAB

ANAC

CAAI

EASA

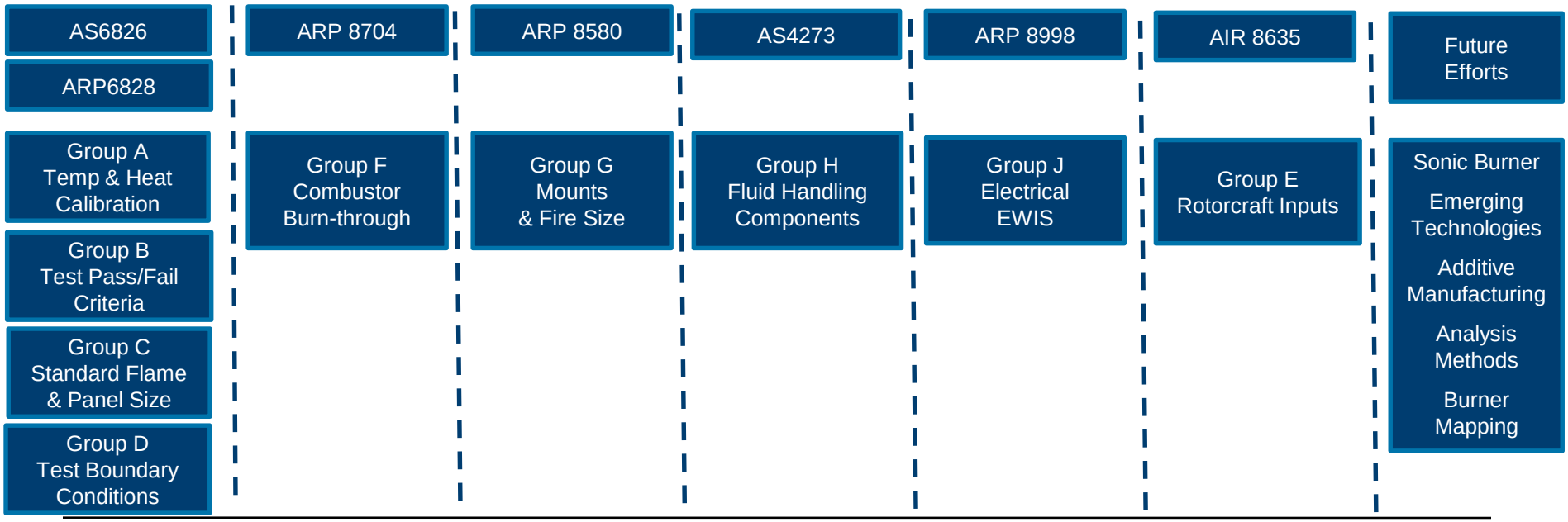
UK Civil Aviation Authority

Transport Canada

SAE A-22 Committee Groups and Documents

Committee is Currently Organized into Groups to develop multiple Standards

- AS 6826 – Powerplant Fire Test Standards
- ARP 6828 – Powerplant Installation Level Fire Safety Assessment
- AS 4273 – Fire Testing of Fluid Handling Components for Aircraft Engines and Installations
- ARP 8704 – Minimizing the Hazards of Engine Combustor Case Burn Through
- ARP 8580 - Protection of Engine Mounts, Flight Controls, and Other Structure
- ARP 8998 - Powerplant EWIS Compliance for Fire Protection
- AIR 8635 – Rotorcraft Fire Test Loading Conditions



2023-2024 Significant Accomplishments

AS6826 Powerplant Fire Test Standard

- 1st ballot - Aug 28 to Sep 24, 2023
- 2nd ballot – Mar 20 to Apr 16, 2024
- 3rd ballot – Aug 26 to Sep 22, 2024; Results pending
- Pending successful 3rd ballot, will publish in 2024

ARP8704 Minimizing the Hazards of Engine Combustor Case Burn Through

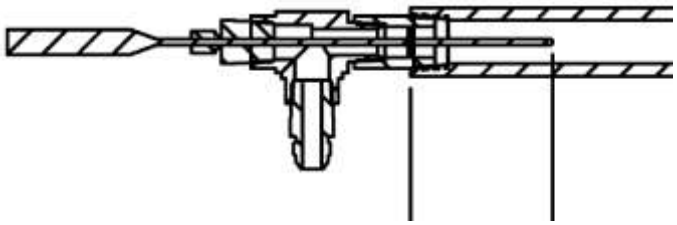
- 1st ballot – Nov 1 to Nov 28, 2023
- Currently preparing for 2nd ballot
- Anticipate publication in 2025

AS6826 Powerplant Fire Test Standard: Significant Changes from AC 20-135 Change 1

- Heat transfer rate calibration uses copper tube water apparatus, similar to FAA Powerplant Report 3A
  - New apparatus design included in AS6826
  - Use of horizontally-installed resistance temperature detector (RTD) or thermistor is most significant change
  - Used with or without the airflow hood (ref. SAE AIR1377)
  - No change to 4500 BTU/hr (1319 W) minimum requirement

Photo Courtesy of ACES

- Calibration process standardized
  - Begin gathering data when heat transfer rate reaches 4500 BTU/hr (1319 W) or 2 minutes minimum
  - Data recorded for 3 minutes
  - 3-minute average value compared to 4500 BTU/hr (1319 W) requirement

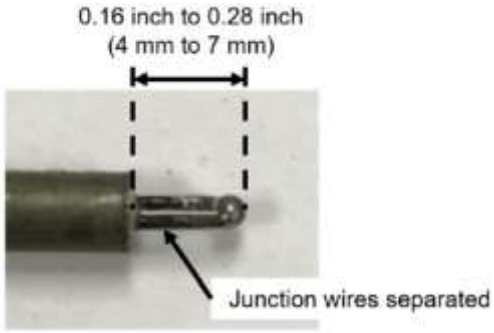


- New post-test validation for heat transfer rate
  - 4500 BTU/hr (1319 W) minimum if copper tube cleaned
  - 4100 BTU/hr (1202 W) minimum if copper tube not be cleaned
  - No post-test validation for flame temperature

AS6826 Powerplant Fire Test Standard: Significant Changes from AC 20-135 Change 1 (continued)

- Flame temperature calibration uses 7 thermocouple rake
  - Exposed junction, chromel-alumel, Type K, 1/16 inch (1.6 mm) nominal dia.
  - 2000±150ºF (1093±83ºC) required for each TC (no change)
  - New 2000ºF (1093ºC) minimum requirement for the average of 5 center TC (excludes the 2 edge TC)
  - Used with or without the airflow hood (ref. SAE AIR1377)

- Calibration process standardized
  - Begin gathering data after 2 minutes
  - Data recorded for 3 minutes
  - 3-minute average value for each of the 7 TC compared to the 2000±150ºF (1093±83ºC) requirement
  - 3-minute combined average value for the center 5 TC compared to the 2000ºF (1093ºC) minimum average requirement



Photos Courtesy of Aeroblaze Labs

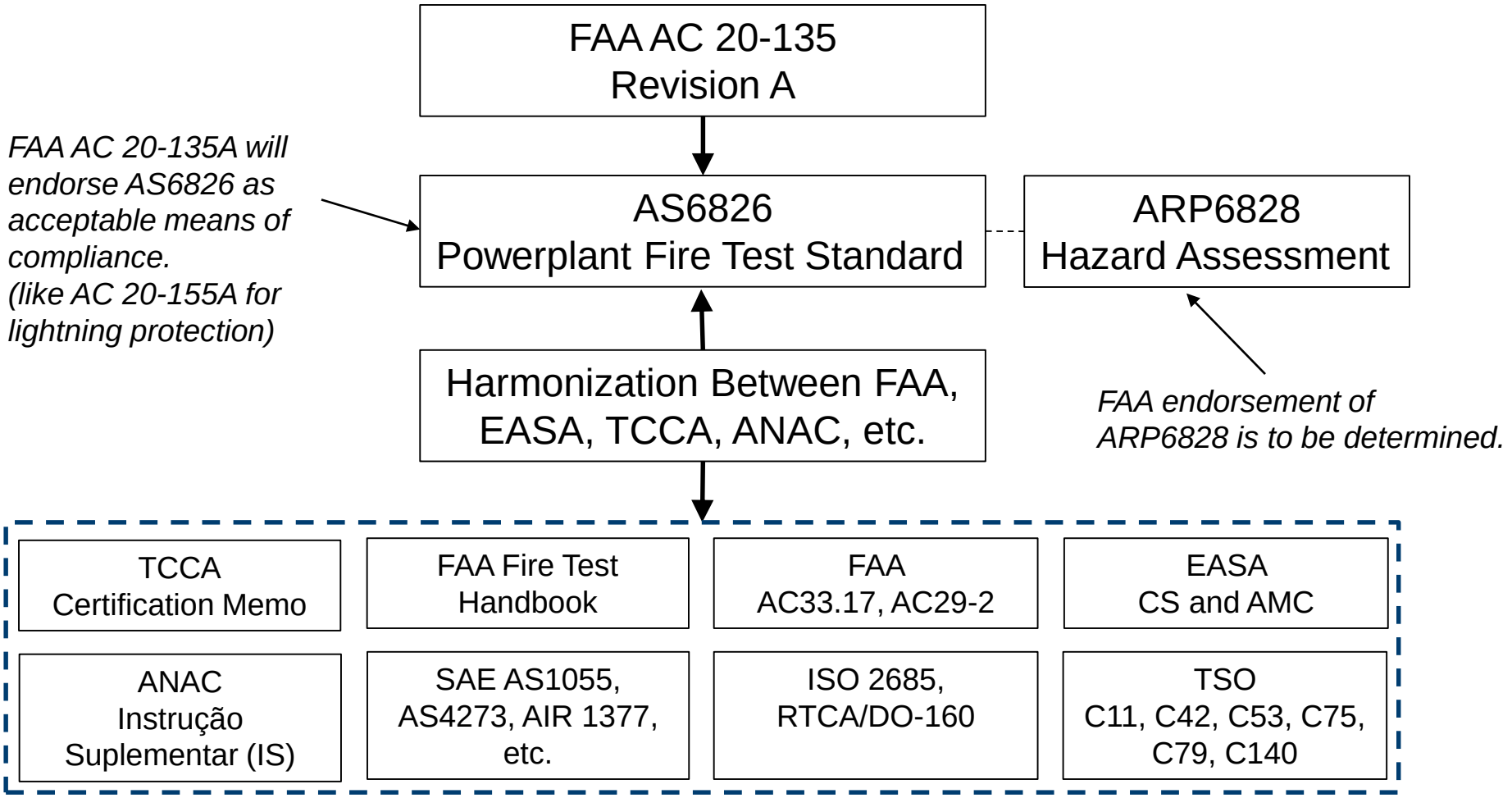
AS6826 Powerplant Fire Test Standard: Significant Changes from AC20-135 Change 1 (continued)

- Legacy liquid fuel burners used, consistent with AC20-135 Change 1; gas burner not allowed (e.g. ISO 2685, SAE 401)
- Sonic burner (DOT/FAA/TC-13/38) allowed, but must be calibrated the same as legacy burners
- New guidance for defining boundary conditions
  - Loads, vibration, pressure, flow, etc.
  - Ground and flight conditions
- Pass/Fail criteria comprehensively defined
  - Prescriptive: can be assessed at the laboratory
  - Perform/maintain the fire-intended function
  - No burn-through, backside ignition, flame penetration
  - Residual flames must self-extinguish within 2 minutes; size and characteristics assessed
  - No flammable fluid leakage greater than weepage insufficient to form a drop

Photo Courtesy of Eaton Aerospace

Photo Courtesy of Resonate

AS6826 Fire Test Standard Implementation: AC20-135 and Other Updates



SAE A-22 Documents – Roadmap & General Timelines

AS 6826

Powerplant Fire Test Standard
- 3rd ballot: In Progress
- Publication: Q3/Q4 2024
- FAA AC 20-135A and other Regulatory Authority document revisions: 2025+

AS 4273

Fire Testing of Fluid Handling Components
- Initiate revision or stabilize document: Q4 2024

ARP 8704

Minimizing the Hazards of Engine Combustor Case Burn Through
- 1st ballot: Completed 4th quarter 2023
- Publication: 2025

ARP 6828

Powerplant Installation Level Fire Safety Assessment
- Draft completion: 2025
- Publication: 2025/2026

ARP 8580

Fire Protection of Aircraft Engine Mounts, Flight Controls, and Other Flight Structures
- Publication: 2025/2026

AIR 8635

Rotorcraft Fire Test Loading Conditions
- Publication: 2025-2026

ARP 8998

Powerplant EWIS Compliance for Fire Protection
- Publication: 2025/2026

…Plus future efforts – Sonic burner development, burner mapping ARP, emerging technologies…