THE INTERNATIONAL AIRCRAFT FIRE AND CABIN SAFETY RESEARCH CONFERENCE

SAE A-22 AND AS6826 STATUS

October 2023

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

SAE INTERNATIONAL

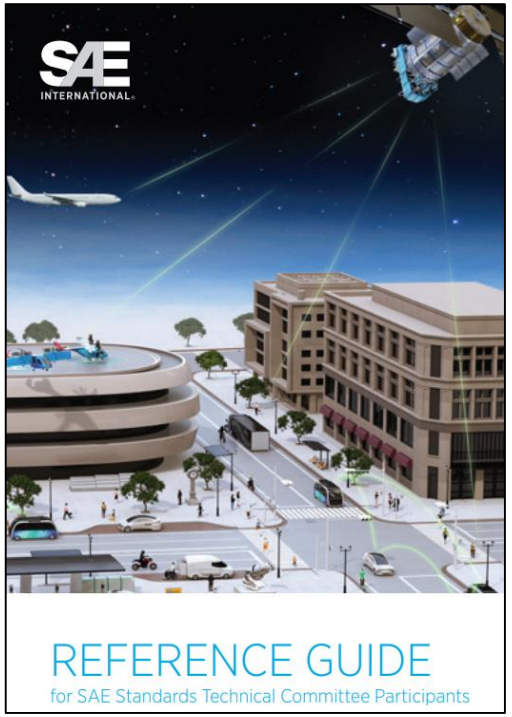
SAE A-22 Fire Protection and Flammability Testing Committee

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 AC20-135. 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 in development will provide 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 standards to address fire safety for engine combustor burn-through, engine mounts, and electrical wiring interconnection systems.

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.



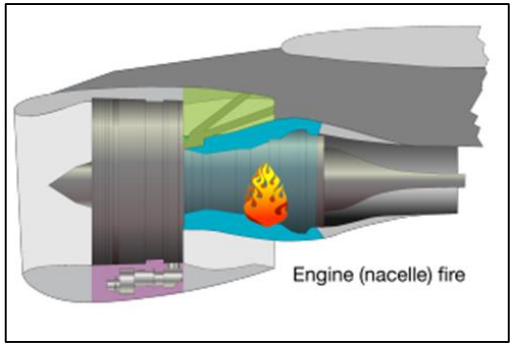


Image Courtesy of Airbus

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 test requirements for aircraft and propulsion systems
- Develop performance standards for 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 update AC20-135, *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.

2016 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 230+ Participants from Industry and Regulatory Authorities

- **Consistent and Meaningful Support from FAA, EASA, TCCA, and ANAC**
- **Recent Additions from other authorities including JCAB, CAA, CAAI, CAAC**
- **Industry Participation has Increased 14% Annually Over Last Five Years**

Airplane Mfg.
Airbus
Boeing
Bombardier
Boom Supersonic
COMAC
Daher
Embraer
Gulfstream
Heart Aerospace
Honda
Mitsubishi
Northrup Grumman
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
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)

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

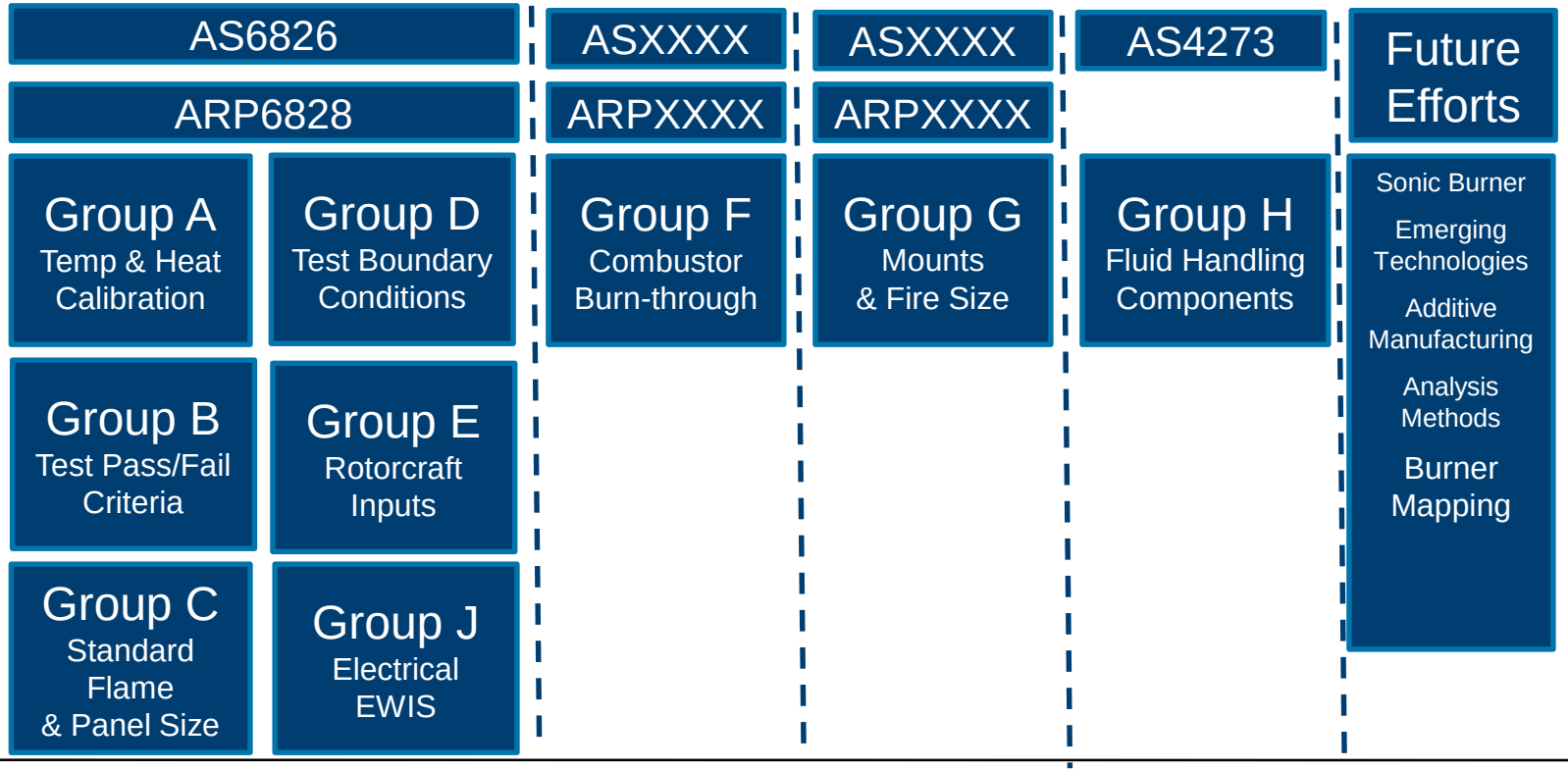
Standards
NACE
SAE

JCAB
ANAC
CAAC
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 Standard
- ARP 6828 – Powerplant Installation Level Fire Safety Assessment
- AS 4273 – Fire Testing of Fluid Handling Components for Aircraft Engines and Installations
- ARP or AS XXXX - Combustor Burn-through Guidance
- ARP or AS XXXX - Protection of Engine Mounts, Flight Controls, and Other Structure



SAE A-22 Group Responsibilities and Efforts

Group A
- Temperature Calibration
- Heat Flux Calibration
- TC and Instrumentation

Group B
- Post Test Burning
- Prescriptive Pass/Fail Criteria
- Industry Examples

Group C
- Standard Flame
- Panel Size
- Burner Position/Orientation

Group D
- Environmental Boundary and Operating Conditions

Group E
- Rotorcraft Input
- Harmonizing Flight Maneuver Loads During Fire Event

Group F
- Combustor Burn-Through Model
- Drafting MoCs for Hole Diameter & Shape, Case Pressure, etc.

Group G
- Fire Protection of Engine Mounts, Flight Controls, and Other Structure
- Aligning Fire Protection and Certification Standards to 25.865

Group J
- Electrical/EWIS Regulations
- Fire Testing of Electrical Components

AS6826 Powerplant Fire Test Standard: 2023 Significant Accomplishments

- Document balloting- Aug 28 to Sep 24, 2023
- 23 / 26 Voted
- 1 Approve, 20 Disapprove, 2 Waive

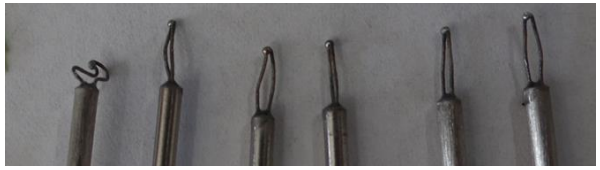
240 Technical Comments under review by the Committee:

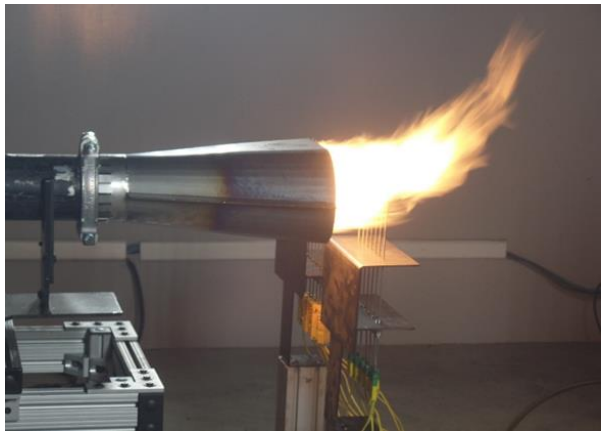
- Some criteria appear to be rulemaking
- Type of fuel for FAA fuel burner
- Burner cone thickness
- Maintain boundary conditions until residual flames extinguish
- Max temp of 2150ºF
- Loads during fire tests
- Consistency with AS1055 (fluid temperature, test set-up)
- Determination by analysis of worst-case boundary conditions
- No back-side ignition for non-firewall assemblies
- Residual flames: Acceptable size; Conflict with AMC E130; Video quality/ 14CFR/CS33; 14 CFR/CS23
- Pass/fail criteria differ from AMC E130
- Test ends at 5/15 minutes mark and residual flames must extinguish within two minutes
- ISO2685 1992 & 1998
- Flammable fluid leakage definition
- Electronic control box: Maintain shutdown for how long/ Safe shutdown
- Criteria for vibration application
- Water flow set-up
- Criteria applicability on multiple components

AS6826 Powerplant Fire Test Standard: Significant Changes

- Pre-test calibration for heat transfer rate will use copper tube water apparatus
  - Apparatus design included in the Standard
  - No change to 4500 BTU/Hr minimum requirement
- Added post-test heat transfer rate validation
  - 4500 BTU/Hr minimum if copper tube can be cleaned
  - 4100 BTU/Hr minimum if copper tube cannot be cleaned
- Pre-test calibration for flame temperature will use rake of 7 thermocouples (TC), 1/16 inch (1.6 mm) nominal dia.
  - 2000±150°F (1093±83°C) for each TC (no change)
- 2000°F (1093°C) minimum for average of 5 center TC (calculation excludes the 2 edge TC)
  - TC construction: ASTM E585/E585M-18 or IEC 61515
  - TC accuracy: IEC/BS EN 60584 or ASTM E230/E230-M12

Photo Courtesy of ACES





Photos Courtesy of Aeroblaze Labs

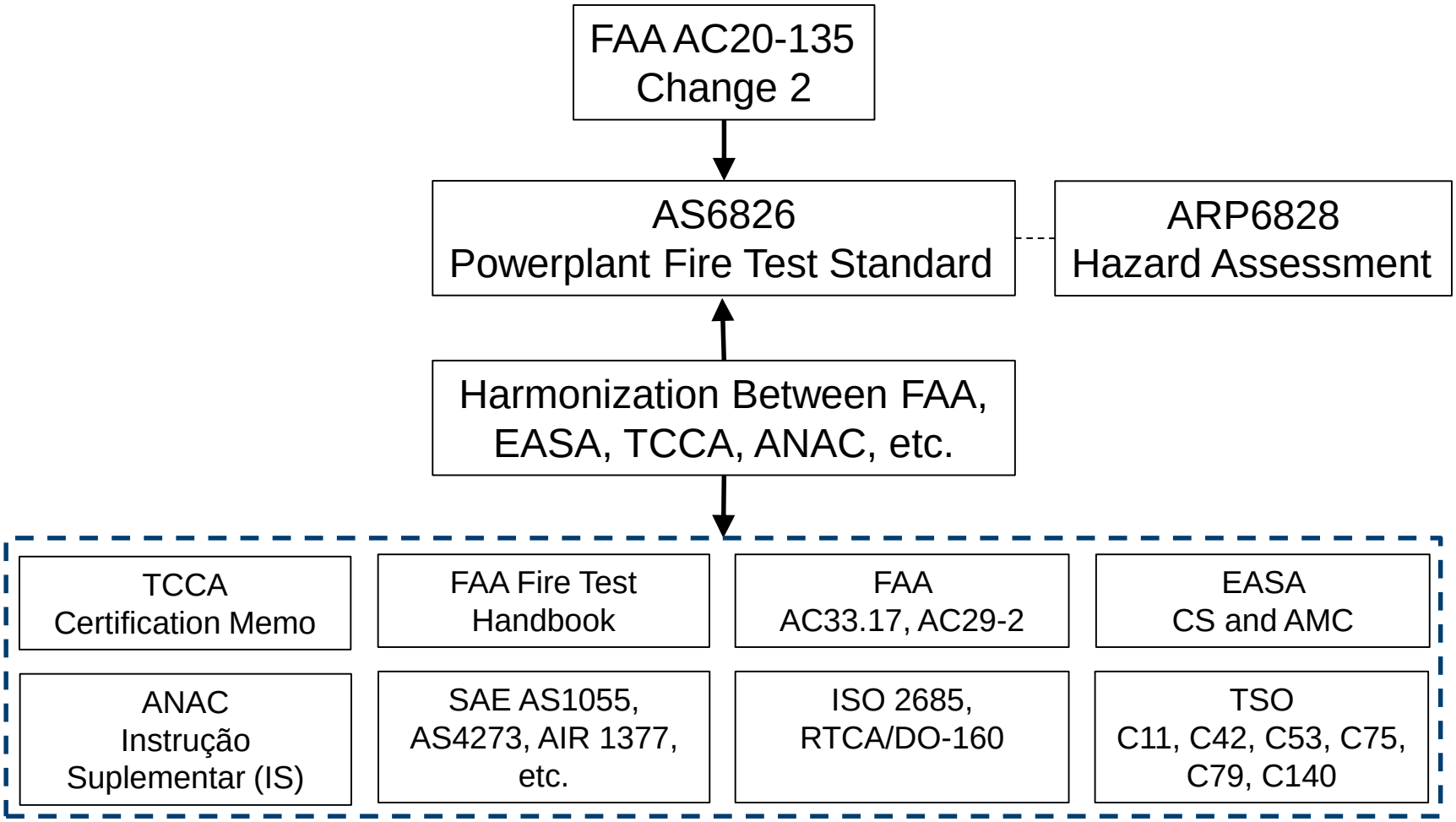
AS6826 Powerplant Fire Test Standard: Significant Changes

- Existing legacy burners allowed, consistent with AC20-135 Change 1
- Sonic burner allowed if calibrated same as legacy burners
- Added instructions for defining boundary conditions
  - Loads, vibration, pressure, flow, etc.
  - Ground and flight conditions
- Pass/Fail criteria defined
  - Perform/maintain the fire-intended function
  - No burn-through, backside ignition, flame penetration
  - Residual flames on fire must be recorded and justified for acceptance; size and duration assessed
  - No flammable fluid leakage

Photo Courtesy of Eaton Aerospace

Photo Courtesy of Resonate

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



Note, the new AS6826 fire test standard is intended to provide acceptable means of compliance to be recognized by FAA AC20-135 (for example, similar to AC20-155A for Lightning Protection)

SAE A-22 Fire Test Document – Roadmap & General Timelines

Are we there yet? Almost on AS6826…

AS 6826

- **AS6826 initial balloting: *3rd Quarter 2023; 2nd ballot 4th Quarter 2023***
- **AS6826 document publication: *1st Quarter 2024***
- **FAA AC20-135 and other Regulatory Authority document revisions to reflect AS6826: *2024 – 2025?***

AS 4273

- **AS4273: *2nd Quarter 2024***
- **Revise or stabilize document**

ARP 6828

- **ARP 6828 completion: *2024***
- **ARP 6828 balloting and publication: *2024***

AS/ARP XXXX

- **Combustor burn-through ARP should be ready for ballot soon**
- **Engine mount ballot in a few months**
- **EWIS in work**

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