

# Next Generation Fire Test Burner for Powerplant Fire Testing Applications

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# Background

- Numerous FAR's mandate fire protection in aircraft powerplant fire zones
  - Parts 23, 25, 27, 29, 33...
  - FAR Part 1 Section 1.1 – Definitions and Abbreviations
    - Fireproof--
      - (1) With respect to materials and parts used to confine fire in a designated fire zone, means the capacity to withstand at least as well as steel in dimensions appropriate for the purpose for which they are used, the heat produced when there is a severe fire of extended duration in that zone;
      - (2) With respect to other materials and parts, means the capacity to withstand the heat associated with fire at least as well as steel in dimensions appropriate for the purpose for which they are used.
    - Fire resistant--
      - (1) With respect to sheet or structural members means the capacity to withstand the heat associated with fire at least as well as aluminum alloy in dimensions appropriate for the purpose for which they are used; and
      - (2) With respect to fluid-carrying lines, fluid system parts, wiring, air ducts, fittings, and powerplant controls, means the capacity to perform the intended functions under the heat and other conditions likely to occur when there is a fire at the place concerned.
  - No definition of test method, apparatus, or criteria
  - Advisory material has been used to define these test parameters

# Background

- Advisory Circulars and FAA Reports:
  - Power Plant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedure (For Flexible Hose Assemblies), Revised March 1978
    - Acceptable fire test burners listed in Appendix III:
      - Lennox OB-32 (not available)
      - Carlin 200 CRD (not available)
      - Stewart-Warner HPR 250 (not available)
      - Stewart-Warner FR-600 (not available)
  - AC 20-135, Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards, and Criteria, 2/6/90
    - Acceptable fire test burners listed in sec. 6c:
      - Those listed in Appendix III of Powerplant Report 3A
      - SAE 401 Burner adjusted to 9.3 BTU/ft<sup>2</sup>s (propane fueled burner)
      - Propane and oxy-acetylene torch-standard and diverging nozzles

# Background

- Advisory Circulars and FAA Reports (cont.):
  - FAA Aircraft Materials Fire Test Handbook (4/2000)
    - Chapter 11 specifies the oil burners listed above, plus
      - Park DPL 3400 (not available)
    - Chapter 12 specifies the oil burners above, including the Park DPL 3400
      - Chapter 12 Supplement, section 12.3.1 states:
        - SAE AS401B Propane Burner is also acceptable provided the temperature profile and heat flux density conform to the specified requirements
  - AC 33.17-1A, Engine Fire Protection, 8/3/09
    - References Powerplant Report 3A and AC 20-135 for acceptable burners

# Background

- All of the specified oil burners are no longer commercially available
- Industry is left with the propane burner, which can be obtained and is typically preferred due to its consistency and ease of use
  - Propane and jet fuel flames, despite having similar measured temperatures and heat flux, are fundamentally different
  - Propane will provide a less severe flame than a jet fuel flame, due to the transparency of the propane flame vs. the opacity of the jet fuel flame
    - As test components approach the flame temperature, they begin to re-radiate due to the high surface temperature
    - Heat is lost readily from the hot surface through the transparent propane flame
    - Heat is not lost through the opaque jet fuel flame
  - Intent of regulations is to provide protection against an *engine* fire, which is a jet fuel flame, not a propane flame
- FAA Tech Center Fire Safety Branch has been tasked by Transport Airplane Directorate to develop burner performance standards for the next-generation fire test burner for powerplant fire testing

# Current Status – Powerplants Fire Test User Survey

- In conjunction with DGA and EASA, a detailed user survey has been created and has been released on the Powerplants KSN website.
- This survey is aimed at providing authorities better insight as to how the various labs are operating/calibrating their burners and what parts of the test standards need clarification and/or modification.
- As part of the survey, users are asked to conduct a sample test on a 24”x24” sheet of 2024 aluminum with a nut/bolt installation as the initial test in part of a larger round robin test program.
- To date, 8 responses to the survey and one set of test results have been received.

## Current Status – Round Robin Testing

- Round Robin testing to be initiated with various labs and burners (Park DPL 3400, NexGen, and Propane). Materials to be tested include:
  - Slug Calorimeter
    - Sheet of copper with thermal absorptive coating, and thermocouple(s) on back face to determine heat flux
  - 2024 Aluminum Sheet
  - Metallic Firewall (steel)
  - Composite Firewall
- Information will be posted on the Powerplants KSN site as soon as available to request participants.

## Current Status

- New lab space has been built up for powerplants testing. Currently awaiting the finalization of a new compressor installation (est. 4-6 weeks).
- Testing on standardized components (metallic firewall, composite firewall, etc) will be conducted and compared with round robin test results.
- Sensitivity studies will be conducted to examine burner behavior under a variety of fuel and air flow/pressure settings.

