

ETSO-C20a

ED Decision 2020/011/R (applicable from 25.7.2020)

COMBUSTION HEATERS AND ACCESSORIES

1 Applicability

This ETSO provides the requirements which combustion heaters and accessories that are designed and manufactured on or after the date of this ETSO, must meet in order to be identified with the applicable ETSO marking.

2 Procedures

2.1 General

The applicable procedures are detailed in CS-ETSO [Subpart A](#).

2.2 Specific

None.

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

The applicable standards are those provided in SAE International's Aerospace Standard AS8040B, Heater, Aircraft, Internal Combustion Heat Exchanger Type, dated 14 February 2013, as amended by Appendices 1 and 2 to this ETSO.

3.1.1.1 Functionality

This standard in this ETSO applies to equipment that is intended to provide heated air for civil aircraft.

Note: For combustion heaters and accessories, the maintenance and inspection items contained in the instructions for continued airworthiness play an important role in preventing failures that result in combustion by-products entering the cabin/flight deck.

3.1.2 Environmental Standard

The required performance under the test procedures in SAE AS8040B, Heater, Aircraft, Internal Combustion Heat Exchanger Type, dated 14 February 2013, as amended by Appendix 1 to this ETSO, using standard environmental conditions and test procedures that are appropriate for airborne equipment, shall be demonstrated.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

(1) A failure of the function defined in paragraph 3.1.1.1 of this ETSO is a

major failure condition.

- (2) A loss of the function defined in paragraph 3.1.1.1 of this ETSO is a *minor* failure condition.
- (3) Design the system to at least fulfil these failure conditions above.

4 Marking

4.1 General

See CS-ETSO, [Subpart A](#), paragraph 1.2.

4.2 Specific

If the article includes software and/or airborne electronic hardware, then the part numbering scheme for the article must identify the configuration of both the software and the airborne electronic hardware. The part numbering scheme can use separate, unique part numbers for the software, the hardware, and the airborne electronic hardware.

If the combustion heater includes a deviation from this ETSO, the marking must include a means to indicate that a deviation was granted.

5 Availability of Referenced Document

See CS-ETSO, [Subpart A](#), paragraph 3.

[Amdt ETSO/16]

Appendix 1 to ETSO-C20a – MPS for Combustion Heater Based on SAE AS8040B

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This Appendix prescribes the MPS for combustion heaters. The applicable standard is SAE International's Aerospace Standard AS8040B, Heater, Aircraft, Internal Combustion Heat Exchanger Type, dated 14 February 2013. EASA has modified it as follows:

Section: 3. Accessories

- 3.2.a. Includes the fuel/air ratio controller, fuel lines and preheater.
- 3.2.b. Rewritten to read 'Ignition System: The ignition system uses an aircraft-supplied energy source to enable the proper functioning of the igniter. Examples of accessory devices that may be utilised in a heater ignition system include but are not limited to:'
 - 3.2.b.2. Replaces the term 'spark plug' with 'igniter'.
 - 3.2.b.3. Removes the statement 'Heaters with output ratings of 11,700 W (40,000 Btu/hour) or less may use an electrically heated resistance wire as an ignition source.'
- 3.2.c. Includes the requirement 'Any component whose failure could lead to an unsafe condition, such as ducting, that is in a fire zone, must be fireproof.'
- 3.2.c. Includes ducting/tubing, the combustion air blower, combustion air flow sensor, ventilation air flow sensor, and air flow/pressure regulator.
- 3.2.d.1. Revised to read 'Cabin temperature controls'.
- 3.2.e. Includes a device to sense differential pressure across the combustion chamber, a device to sense combustion, a device that senses excessive combustion by-products in the ventilation air, a device to shut off the fuel flow when required, and a device to alert the crew that a safety system has engaged.
- 3.3.2. Includes the phrase 'having the capacity to withstand at least as well as .015-inch-thick stainless steel, the heat produced when there is a severe fire of extended duration.'
- 3.5. Includes the service ceiling.
- 3.6. Includes the statement 'It is best practice to set inspection, maintenance and/or replacement intervals based on individual component performance during design qualification testing (such as endurance testing).'

Section: 4. Detailed Requirements

- 4.3.1. Replaces 'gasoline or aviation grade kerosene, or both' with 'fuel'.
- 4.3.4. Adds 'fittings and controls' after 'All fuel lines'.
- 4.3.5. Replaces 'no lead or low lead type gasoline and kerosene' with the word 'applicable'. Adds 'Low starting temperature limits for other types of fuels need to be addressed on a case-by-case basis.' to the end of this paragraph.
- 4.5. Replaces '649 °C (1 200 °F)' with 'material capabilities in this section of the heater'. Adds the sentences 'Best practice is to ensure that the temperature at the point of discharge does not exceed

649 °C (1 200 °F). Consideration should also be given to the impact of heat impingement on the region of the aircraft that surrounds the combustion heater.’ at the end of the paragraph.

4.6.3. Adds at the end of the paragraph the following: ‘or heated solid surface, though it is not considered to be a best practice to use resistance wires as ignition sources for power levels above 11 700 W.’

4.6.8. Adds the statement ‘Other types of fuels need to be addressed on a case-by-case basis.’ at the end of the paragraph.

4.6.9. Adds the statement ‘Other types of fuels need to be addressed on a case-by-case basis.’ at the end of the paragraph.

4.7.d. replaced with this paragraph: ‘These safety controls shall be independent of the controls that are normally used to control the operation of the heater. The shut-off of ignition and fuel shall occur at a point that is remote from the heater itself. The combustion heater shall have a means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means. The requirement to shut off ignition and fuel at a point that is remote from the heater until restarted by the crew, may require a safety interlock relay and an additional fuel shut-off device to be supplied in addition to the valve that is usually supplied with the heater as an accessory. The relay and valve are the responsibility of the installer. See 5.2.10.6 for the tests to be conducted on safety controls.’

4.9. Adds at the end of the first paragraph: ‘Use electrical load analysis to show that the heater is safe to operate in the worst-case situation.’

4.12. Adds a new paragraph:

Radio Interference

4.12.1 If the manufacturer elects to demonstrate compliance with the standard radio interference requirements, it is considered to be a best practice to test the combustion heat exchanger per:

- (a) EUROCAE/RTCA, ‘Environmental conditions and test procedures for airborne equipment’, ED-14D/DO-160D Change 3 (or later revisions), Section 21, Category M, for operation in the passenger compartment and the flight crew compartment; and
- (b) EUROCAE ED-14D/RTCA document DO-160D Change 3 (or later revisions), Section 21, Category H, for operation in areas not accessible during the flight, and report the result in the aircraft flight manual supplement.

4.12.2 If the manufacturer elects not to demonstrate compliance with the radio interference requirements, the manufacturer shall include the following statement in the aircraft flight manual supplement for the combustion heat exchanger:

‘This combustion heat exchanger assembly does not include protection against radio and/or avionics interference, and has not been tested against it.’

Section: 5 Required Testing

The initial paragraph includes the statement ‘Test plans and reports shall be generated and retained for the life of the design.’

5.2.2.2. Revised to include ‘A suitable instrument with a resolution of 5 ppm or better, calibrated against a known standard, will be used to determine CO concentration.’

5.2.2.3. Adds the statement ‘A pressure decay test may alternatively be used, provided that the decay rate can be determined to be equivalent to the requirements listed above.’ at the end of the paragraph.

5.2.3. Replaces:

‘The service ceiling determined by this test shall meet the requirement specified by the purchaser.’

with:

‘It is typical for the service ceiling of a combustion heater to be at least 6 100 m (20 000 ft), and in order to ensure that there is an adequate margin with this test being performed on only one heater, a safety margin of 5 % shall be applied. Therefore, in order to set a service ceiling of 6 100 m (20 000 ft), the peak of the ignition characteristics curve shall be no lower than 6 405 m (21 000 ft).’

5.2.4. The text is replaced by the following:

‘Install the test unit into the test set-up used in 5.2.2.1 and cold soak the combustion heater assembly to - 54 °C (- 65 °F) for gasoline type heaters, and - 29 °C (- 20 °F) for kerosene type heaters (for other fuel types, the applicable temperature will be determined on a case-by-case basis). The valve leakage in the closed position with either the rated fuel pressure or the minimum practical fuel pressure shall not exceed 0.068 fluid ounces (2 mL) of fuel in 10 minutes. Supply combustion air and ventilating air to the heater at sea-level pressure and a temperature of - 54 °C (- 65 °F). The temperature of the fuel supplied to the heater shall be - 54 °C (- 65 °F) for gasoline-type heaters and - 29 °C (- 20 °F) for kerosene-type heaters. The combustion and ventilating air pressure levels and the mass flow rates shall be the same as in 5.2.2.1. Glow plug ignited heaters shall ignite within 200 seconds. Spark ignited heaters shall ignite within 15 seconds when burning gasoline-type fuels, and within 60 seconds when burning kerosene-type fuels. Measure and record the parameters specified in 5.2.2.1.’

5.2.10.6.2.1. This includes the following statement after the first sentence in the second paragraph: ‘Leakage through the fuel valve shall then be measured, and shall not exceed 0.068 fluid ounces (2 mL) in 10 minutes.’

Section: 6 Desirable Features

6.1.2 This includes the statement ‘Other types of fuels need to be addressed on a case-by-case basis.’

[Amdt ETSO/16]

Appendix 2 to ETSO-C20a – Instructions for Continued Airworthiness of the Aircraft Combustion Heater and Accessories

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- 1.0 The following information contained in this Appendix must be included in the manual to ensure that the combustion heater and its accessories continue to comply with the ETSO once it is installed in a product:
 - 1.1 Scheduling information for each part of the combustion heater, stating the inspection criteria and service limits. Necessary cross-references to the Airworthiness Limitations section must also be included.
 - 1.2 Troubleshooting information that describes the probable malfunctions, and how to recognise and resolve those malfunctions.
 - 1.3 Information that describes the order and method for removing and replacing parts, the order and method for disassembly and assembly, with any necessary precautions to be taken.
 - 1.4 Cleaning and inspection instructions that cover the material and apparatus to be used and the methods and precautions to be taken. Methods of inspection must also be included.
 - 1.5 Details of repair methods for worn or otherwise substandard parts and components, along with the information necessary to determine when a replacement is necessary.
 - 1.6 Instructions for testing, including the use of the test equipment and instrumentation.
 - 1.7 A list of the tools and equipment that are necessary for maintenance, and guidance for their use.
 - 1.8 Instructions on how to ensure that the combustion heater assembly is fit to return to service after maintenance and prior to installation (for example, procedures for a pressure decay test).

[Amdt ETSO/16]