European Union Aviation Safety Agency	Special Condition	Doc. No.:M-TS-0000361Issue:Issue:Oate:O7 MAR 2024Proposed□Final ⊠				
SUBJECT	: Turbofan Engine Tak Temperature (TOTH	Turbofan Engine Take-off Thrust at High Ambient Temperature (TOTHAT) rating				
REQUIREMENTS incl. Amdt.	: CS-E 20, CS-E 25, CS-	CS-E 20, CS-E 25, CS-E 30, CS-E 40, CS-E 50, CS-E 60, CS-E 515,				

ASSOCIATED IM/MoC ADVISORY MATERIAL Yes \square / No \boxtimes

CS-E 730, CS-E 740, CS-E 840, CS-E 920

AMC E 20, AMC E 25, AMC E 30, AMC E 40, AMC E 50, AMC E 60, AMC E 515, AMC E 730, AMC E 740, AMC E 840, AMC E 920

IDENTIFICATION OF ISSUE:

This Special Condition is raised to support the approval of an emergency thrust increase for a turbofan engine operating above Take-off (TO) corner point ambient temperature.

The rated TOTHAT thrust is the same as the engine rated TO thrust with extended flat rating corner point.

If operating below the ambient temperature TO corner point, activation of TOTHAT produces TO thrust.

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If operating above the TO corner point, activation of TOTHAT enables the engine to produce TOTHAT thrust (See Fig.1), which corresponds to operating at a higher TGT value.





This Special Condition defines additional requirements for the TOTHAT rating certification of using two periods of ten (10) minutes in a given flight intended in OEI aircraft configuration during takeoff and go-around operations for a turbine engine installed on a multi-engine airplane.

Two periods of five (5) minutes in a given flight in AEO aircraft configuration and by manual pilot activation of TOTHAT rating is possible in case the aircraft function Automatic Take-off Thrust Control System (ATTCS) does not activate TOTHAT.

The TOTHAT rating is intended for emergency use only, providing higher thrust above corner point ambient conditions in the takeoff / go-around envelope.



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For an engine with sufficient turbine gas temperature (TGT) margin, operation to the TOTHAT rated thrust will not result in exceedance of TO TGT limitations. There is no limitation on such operation, except for the time limits that apply to use of thrusts above Maximum Continuous Thrust.

For a deteriorated engine with less TGT margin, TOTHAT operation above TO rated thrust may lead to the TO TGT limitation being exceeded. An increased TOTHAT TGT limit is enabled when TOTHAT is active. TOTHAT operation between TO and TOTHAT TGT limitation is limited to a maximum of 2 usages of 10 minutes per flight, and 3 uses and 25 minutes prior to engine removal. Dispatch is only permitted when 20 minutes or 2 activations of TOTHAT TGT use remains, therefore engine removal is required when more than 5 minutes has been accumulated above the TO TGT limit.

This rating is not currently defined in CS-E 40.

Commission Regulation (EU) No 748/2012 paragraph 21.B.75 Special Conditions must be addressed as the related airworthiness code does not contain adequate or appropriate safety standards for the product.

Considering all the above, the following Special Condition is proposed:





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Special Condition

Turbofan Engine Take-off Thrust at High Ambient Temperature (TOTHAT) rating

1. APPLICABILITY

This SC is applicable to turbofan Engines with Take-off Thrust at High Ambient Temperature (TOTHAT) rating.

2. SPECIAL CONDITION

In addition to the CS(s) CS-E 20, CS-E 25, CS-E 30, CS-E 40, CS-E 50, CS-E 60, CS-E 515, CS-E 730, CS-E 740, CS-E 840, CS-E 920, the actual design shall comply with the following special detailed technical specifications:

(1) CS-E 20 Engine Configuration and Interfaces

(1.1) For TOTHAT rating, data must be provided within the Operating Instructions on Engine performance characteristics and variability to enable the aircraft manufacturer to establish power assurance procedures.

(2) CS-E 25 Instructions for Continued Airworthiness:

(2.1) Operating limitations, instructions for installing and operating the engine, and recording of each usage (time and duration) of the TOTHAT rating must be specified in the Instructions for Continued Airworthiness (ICA).

(2.2) To comply with CS-E 25(b)(1), the Airworthiness Limitation Section (ALS) must include the limitations associated to the usage of the TOTHAT rating above TO TGT up to TOTHAT TGT and prescribe the mandatory post-flight inspections and maintenance actions associated with any use of the TOTHAT rating.

(2.3) The applicant must validate the adequacy of these mandatory post-flight inspections and maintenance actions.

(2.4) An in-service engine evaluation programme must be established to ensure the continued adequacy of the data of CS-E 20(f) pertaining to thrust assurance procedures, instructions for mandatory post-flight inspections and maintenance actions.

(2.5) The in-service engine evaluation programme must include service engine tests or equivalent service engine test experience on engines of similar design and evaluations of service usage of the TOTHAT rating.

(2.6) All limitations must be included in the engine Type Certificate Data Sheet (TCDS).

(2.7) Any usage of the TOTHAT rating must be assessed to identify the need of mandatory engine inspection and maintenance action.

(2.8) Any mandatory engine inspection must be defined in the ICA.



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(2.9) The applicant must specify within the Installation Instructions the TOTHAT rating in OEI configuration during the takeoff and go-around, and the TOTHAT rating in AEO configuration under specific altitudes and temperatures.

(2.10) The rated TOTHAT thrust rotational speed limits are the same as those associated with the engine rated TO thrust.

(3) CS-E 30 Assumptions:

(3.1) The assumed rate of TOTHAT usage should be included as an Assumption under CS-E 30, included in the Installation Manual, and compared with the actual rate determined by in-service monitoring.

(4) CS-E 40 Ratings

(4.1) In addition to the ratings already listed in CS-E 40, a new TOTHAT rating is created and defined as follows:

(4.1.1) The rated TOTHAT thrust is the same as the engine rated TO thrust with extended flat rating corner point.

(4.1.2) This rating is intended to be limited in use:

- for continuation of the takeoff and go-around to a maximum usage after failure or shutdown of one engine (OEI) of two periods no longer than ten (10) minutes each in any one flight during the takeoff or go-around, or
- for two times of five (5) minutes in all engines operating (AEO) in multi-engine airplane configuration in any one flight.

(4.1.3) The maximum accumulated usage time of the TOTHAT rating in any one flight is not to exceed twenty (20) minutes.

(5) CS-E 50 Engine Control Systems

(5.1) The engine control system managing the rated TOTHAT thrust for all ambient conditions must assure that:

(5.1.1) The approved rated TO thrust is available to the pilot at all times by throttle selection.

(5.1.2) The TOTHAT rating in OEI configuration is automatically available at specified altitudes and temperatures.

(5.1.3) The TOTHAT rating in AEO configuration is on pilot demand available at specified altitudes and temperatures.

(5.2) The TOTHAT rating should be controlled by an automatic means within its operating limitations (excluding time). Such means for automatic control should be effective during normal and abnormal operations.

(6) CS-E 60 Provision for Instruments

(6.1) Engines must have means or provision for means:

(6.1.1) To alert the pilot when the engine TOTHAT rating is in use, when the event begins and when the time interval expires.





(6.1.2) Which cannot be reset in flight, to:

- Automatically record each usage, associated TGT and duration of thrust at TOTHAT rating.
- Alert maintenance personnel in a positive manner, that the engine has been operated at TOTHAT rating and permit retrieval of recorded data.

(6.1.3) To enable routine verification of the proper operation of the above means.

(7) CS-E 515 Engine Critical Parts

(7.1) A representative usage of the TOTHAT rating must be included in the Engine Flight Cycle used for the establishment of the Approved Life of the Engine Critical Parts.

(7.2) Actual TOTHAT usage must be evaluated to confirm that assumptions made in the Engineering Plan remain valid.

(8) CS-E 730 Engine Calibration Test

(8.1) The applicant must base the calibration test on the thrust check at the end of the endurance test required by paragraph (9) of the special conditions.

(9) CS-E 740 Endurance Tests

(9.1) The following two tests must be performed:

(9.1.1) To run an endurance test schedule as defined in CS-E 740, modified to include in Part 2 (stages 16 to 25, each of thirty (30) minutes duration), five (5) minutes at TOTHAT thrust (corresponding to TOTHAT EGT redline) after one (1) minute at TO thrust, the remaining twenty four (24) minutes have to run at TO thrust.

(9.1.2) To run an additional 26th cycle. The following test sequence must be performed for a total time not less than 120 minutes:

Part 1: Ten (10) minutes at rated TOTHAT thrust

Part 2: Eighty-eight (88) minutes at Maximum Continuous Thrust

Part 3: One (1) minute at 50 percent of rated TO thrust

Part 4: Ten (10) minutes at rated TOTHAT thrust

Part 5: Ten (10) minutes at Maximum Continuous Thrust

Part 6: One (1) minute at Flight Idle

(9.2) After completion of the whole endurance test sequences (8.1.1 and 8.1.2), the engine must be subject to a strip inspection, and dimensions measured in accordance with CS-E 740(b)(5) must be remeasured and recorded. Compliance with CS-E 740(h)(1) must be demonstrated.

(10) CS-E 840 Rotor Integrity

(10.1) The demonstration for CS-E 840(b)(3)(ii) should include consideration of operation at TOTHAT rating.



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(11) CS-E 920 Over-temperature Test

(11.1) The demonstration for CS-E 920 should include consideration of operation at TOTHAT rating.

Any other method proposed by the applicant shall be justified and will be subject to the acceptance of the Agency.

