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DEPARTMENT OF CIVIL AVIATION

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AIR SAFETY CIRCULAR

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'HOT START' - TURBINE ENGINES

1. Incidents have occurred in the past where turbine engines have been prematurely removed as result of over temperature experienced during start, commonly known as 'HOT START'. In case of some Rolls Royce Dart 531 engines installed on HS-748 aircraft, instances were observed where Turbine Gas Temperature (TGT) had shot up beyond limits during starting. The engines were later found stiff to turn and in some cases seized. Similarly in case of Garrett TPE 331-5 engines installed on Dornier 228 aircraft, Inter-stage Turbine Temperature (ITT) was found shooting up during start in two cases and the engines starts were aborted by the pilots. Subsequently the AMEs on duty found the engines stiff to turn and the engines wer prematurely removed.
2. Strip investigation of both the failed Garrett TPE 331-5 engines, in one case by the manufactures and in the second case by their approved Overhauling Agency had revealed evidence of Hot Section distress attributed to 'Hot Start'. In the first case all the three turbine wheel assemblies and in the latter case I and III stage turbine wheels along with other associated parts were replaced. The premature replacement of the major lifed components of the engine, besides adding to the financial costs of operations, had disrupted scheduled operations of the airline.
3. It may be pertinent to mention that modern engines are highly optimized propulsion units and have to be operated as per laid down limitations. Gas Turbine engines, in particular, are sensitive to over temperature. Should the temperature be exceeded, necessary action as stipulated in the Pilot's Operating Handbook/Maintenance Manual has to be followed. The margin between the normal starting ITT and the maximum limit in case of Garrett TPE 331-5 engines is small and is of the same order as in case of many other engines.
4. It needs to be stressed that the temperature rise during a poor start or poor handling of an engine either due to an operational lapse or engineering deficiencies, is always at a high rate requiring agile monitoring and shut-down of fuel supplied in time to prevent over temperature. The time for preventing the limitations of exceeding would be of the order of a second and hence, the rate of temperature rise has to be anticipated by the operating crew/AMEs. This holds good for all gas turbine engines.

5. In case of Dornier 228 aircraft, the Pilot's Operating Handbook clearly describes the procedures of starting the engines and recommends aborting start of the engines immediately if any of the conditions stated therein is observed.
6. 'HOT STARTS' are normally caused by one of the following factors:
 - a) Mis-rigging of the engine / controls.
 - b) Over-fuelling either due to FCU or mismanagement of the manual fuel.
 - c) Excessive tail wind component.
 - d) Low batteries /GPU.
 - e) Improper power lever position.
 - f) Mechanical problems.
7. The **cause of the failures** of two Garrett TPE 331-5 engines as a result of 'HOT STARTS' mentioned in para 2 above was established as a result of investigation to low battery voltage and non-availability of the Ground Power Unit (GPU) at the operating station.
8. The use of Ground Power Unit for engine starting is a healthy engineering practice and the use of aircraft batteries is resorted to at times when GPU is not available or unserviceable. The use of aircraft batteries for engine starting on a regular and routine basis is neither recommended nor conducive to the health of the engine in the long run.
9.
 - a) All turbine engine Operators in the Maldives are, therefore, advised to ensure that the Ground Support infrastructure including Ground Power Unit or a ground battery cart is available at all airports / helipads they are operating and where grounds starts are undertaken on a regular basis. This requirements shall be accomplished not later than 60 days from the date of issue of the circular.
 - b) Operators are further advised to strictly adhere to the starting procedures laid down in the Pilot's Operating Handbook.



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