"In the name of God"

Islamic Republic Of Iran

Civil Aviation Organization

Aircraft Accident Investigation Board

Incident Report

Basic Information:

State File Number: I980316TBE

Type of occurrence: Incident

Date of occurrence: 06 Jun 2019

Place of occurrence: Najaf Airport, republic of Iraq

Aircraft Model: McDonnell Douglas MD-88

Registration: EP-TBE

Operator: Taban Air

Date of Issue: 24 June 2019

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SYNOPSIS:

On 08 Jun 2019, CAO IRI aircraft accident investigation board (AAIB) was notified about engine failure incident of Iranian registered MD-88Aircraft; EP-TBE operated by Taban Airlines at Najaf International Airport/Iraq dated on 06 Jun 2019 and aircraft was released from custody by Iraq Civil Aviation Authority and investigation of incident was delegated to Civil Aviation Organization of IR of Iran.

This report has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts in the territory of IR of Iran. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation Organization and under the regulation of Aircraft Accident and Incident Investigation of the IR of Iran government.

The investigation is conducted not to apportion blame or to assess individual or collective responsibility and the sole objective of the investigation is prevention of future accidents or incidents.

1- Factual Information:

- At 05:59 UTC on 06.06.2019 Aircraft MD-88 ; MSN : 53548 with registration EP-TBE operated by Taban Airlines (an AOC holder operator of IR of Iran) experienced engine # 2 failure during take-off roll following abrupt sound and related engine "EGT" was raised. The pilot of the aircraft sensed "compressor surge "and aborted the takeoff at speed of 88 kt (before V1=133 kt) and the flight was canceled. Finally aircraft returned to the ramp and all 157 passengers and 11 crew left the aircraft safely.

- The Aircraft was scheduled for the Flight No; 7258 from AL Najaf International Airport (NJF), republic of Iraq to, Mashhad International Airport (MHD), IR of Iran.

- The Pilot in Command with license No; ATPL-IR-2415 with 3500 flight hours experience was authorized to fly MD-88 aircraft with valid medical license.
  The Pilot monitoring with license No; CPL-IR-3444 with 2400 flight hours experience was authorized to fly MD-88 aircraft with valid medical license.

- The weather condition(METAR) at the time of incident 05:30 UTC was:
  Wind 350/13kts" sky clear " temperature "37/09" ; visibility 10 km or more "QNH 1008".
  The calculation of aircraft performance was made by the cockpit crew based on available weather information. The weather condition had not effect on the incident.

- The aircraft has valid airworthiness certification from CAO.IRI and the Aircraft maintenance is carried out under "PART-145" and the continuity airworthiness of aircraft is maintained under responsibility of Taban Air Continuing Airworthiness Management Organization (CAMO). The aircraft and the airline fleet reliability report during first quarter of the 2019 was reviewed and there were not and abnormal engine reports.

  The airplane was equipped with two Pratt & Whitney JT8D-219 turbofan engines. The JT8D-200 series engine is an axial-flow front turbofan with a 14-stage split compressor, a 9-can combustion chamber, and a split, 4-stage reaction impulse turbine. The failed #2 engine was with P/N; JT8D-219, S/N; P718132. The engine was repaired and tested previously at "AERO THRUST HOLDING" at Miami, U.S.A on the 11 Nov 2015. The latest repair/inspection was made at contracted maintenance organization "VISTA TURBINE" / I.R of Iran on 26 Sep 2018. During repair some due LLP components of engine was changed. The first stage turbine disk (HPT) with P/N; 856601 with limitation of 2390 cycles was installed on the engine. Final operational test and BORESCOPE performed with no discrepancy.

  The engine was operated for 1055 cycles from the last shop inspection. The life limiter parts (LLP) showed that the engine was limited to ***"#2 stage turbine disk"*** within 44 cycles , ***"#1 stage turbine disk***" within 1335 cycles and ***"#4 stage turbine disk***" within 4440 cycles at time of incident.

  The technical history of the aircraft showed that the aircraft ENG # 2 had failure on "EPR" read out indication which was differed (prolonged) according to the aircraft "MEL" dated on 29 May 2019 with " CAT: C" for ten days.
- Following the incident the engine #2 of the aircraft was removed and an operational engine was installed on the aircraft and the aircraft flied back to Tehran Airport (IKA) with no further deficiencies.

  The failed engine was transferred to the approved maintenance organization for detailed investigation and the following results were determined:
  - Fan inlet and fan blades were with no sign of Foreign Object Damage (FOD), the compressor section and combustion chamber had not any discrepancies.
  - The N2 shaft is rotated by Gear Box with no deficiency and the N2 shaft and bearing are normal.
  - The engine magnetic chip detector inspected precisely found no discrepancy.
  - The engine exhaust area is unserviceable due to excessive damages.
  - The high pressure turbine (HPT) , low-pressure turbine stage rotor blades stator vanes (mostly fractured at trailing edge) sustained severe damage and requires close inspection, and needs dismantling turbine section in order to have access to the N1 rotate shaft related subsidiary sections accordingly.

First Stage Turbine Disk (HPT) ***4th Low Pressure Turbine Disk***

- This aircraft has been equipped with DFDR and CVR. Condition of the Recorders was serviceable with no damaged. While the aircraft flied back to Tehran, The CVR was engaged and the recorded cockpit voices at the time of the incident were lost.
  The DFDR was downloaded and analyzed in Tehran successfully. The flight was not became completed so no event was registered in flight data monitoring system so detail analysis of recorded parameters was focused as:

UTC	Recorded data	Remarks
05:45:53	#1 EGT=437 #2 EGT=90 #1 N_1=25 #2 N_1=0.3 #1 N_2=52 #2 N_2=0.3 #1 EPR=1.031 #2 EPR=1.01	The aircraft started ENG #1
05:50:00	1 EGT=484 #2 EGT=442 #1 N_1=66 #2 N_1=26 #1 N_2=81 #2 N_2=53 #1 EPR=1.22 #2 EPR=1.11	The aircraft started ENG #2
05:59:44	1 EGT=614 #2 EGT=612 #1 N_1=95 #2 N_1=96 #1 N_2=95 #2 N_2=97 #1 EPR=1.98 #2 EPR=1.11	The aircraft begun take off roll Right Engine EPR indication was faulty based on MEL

05:59:57	1 EGT=618 #2 EGT=618 #1 N_1=94 #2 N_1=87 #1 N_2=95 #2 N_2=92 #1 EPR=1.95 #2 EPR=1.01 Indicated Speed=88 kt	Failure in #2 Engine
05:59:59	1 EGT=576 #2 EGT=673 #1 N_1=81 #2 N_1=39 #1 N_2=87 #2 N_2=61 #1 EPR=1.8 #2 EPR=1.0	Aborting Take off The engine is limited with EGT 625 ^{0} C
06:00:16	1 EGT=481 #2 EGT=768 #1 N_1=28 #2 N_1=8 #1 N_2=56 #2 N_2=23 #1 EPR=1.047 #2 EPR=1.07	#2 Engine over temperature engine was shut down

2- Analysis:

The engine was operated with in time limit that determined by authorized engine maintenance organization. Based on aircraft performance chart, the maximum take-off weight for this flight calculated by flight crew was 141000 pounds thus take-off weight of 134482 pound was within limit.

The MD fleets with supporting JT8D engine types have been operating in high elevated/temperature airports and the crew should make certain about operation performance of the aircraft and time limit for engine cool down after landing incorporating thrust reveres. Also engine maintenance based on the manufacturer manuals is another key point. The exceedance of engine operation limitation on the long time would cause fatigue on the parts of engine hot section.

- *Note: On engines equipped with thrust reversers when an engine has been operated at high power levels for periods of time, a cool down time should be allowed before shut down. The engine should be operated at below a low power setting; preferably at idle for a period of some minutes to prevent possible seizure of the rotors. This applies, in particular, to prolonged operation at high rpm on the ground, such as during engine trimming. The turbine case and the turbine wheels operate at approximately the same temperature when the engine is running. The turbine case is exposed to cooling air from both inside and outside the engine. Consequently, the case and the wheels lose their residual heat at different rates after the engine has been shut down and cause engine damage on long period time. Some aircraft manufacturer define time limit for the crew for cooling down the engines. MD Aircraft FCOM and airline SOP have not mentioned limitation about the subject.* Only a precautionary note is available in JT8D engine maintenance manual for the engine testing .

Damage observed in the turbine section was consistent with a disruption in airflow from the compressor resulting in increased exhaust temperatures beyond the limits of the turbine components. Due to the mechanical damage to the engine, the origin of the engine failure and an accurate assessment of the engine condition prior to the occurrence could not be established with certainty but probably by considering effects of above factors, engine compressor stall occurred with high EGT and Vibration exponentially until they reach above their allowable limits. Engine hot zone parts was on exposure to high temperature leaded to fracture of low-pressure turbine 4th stage rotor blades at root which had been creep and elongated before. The number of turbine rotor airfoils that exhibited fatigue is consistent with significant vibratory excitement of turbine stages. Prior to the engine failure, a liberated piece of material, either just preceding or just following from HPT, could travel aft, inducing damage to subsequent turbine stages and resulting in reduced N_1 and the subsequent engine failure.

3- Conclusions :

There was an internal damage in the turbine rotors, as a result of fatigue and possible back pressure resulting from stall and engine "**Surged**". The damage led to subsequent failures of airstream and a general failure of engine failure.

4- Safety Actions and Recommendations:

On 12 June 2019, CAO IRI asked the operators of MD aircraft and maintenance organizations of JT8D engine to attend in the general meeting to advise some safety alerts about the operation of this type engines. The following recommendations were issued:

SR I980316TBE-1;

The MD operators should research about engine cool down after landing and revise Standards Operating Procedure (SOP) of the aircrafts.

SR I980316TBE-2;

The MD operator airlines should improve flight data monitoring of the fleet based on CAOIRI Air Operations Regulation ORO.AOC.130 to follow engine events and also related engine cool down.

SR I980316TBE-3;

The CAMO mangers of The MD operator airlines should extend Engine Condition Trend Monitoring (ECTM) to identify engine performance deterioration and malfunction of engine components and accessories.

SR I980316TBE-4;

Purchasing of aircraft components/parts in the airlines should be limited/matched with subpart M.A .501 CAO IRI Part M regulation for continuing aircraft airworthiness.