ANSV AGENZIA NAZIONALE PER LA SICUREZZA DEL VOLO

A. N. S. V.
Prot. USCITA
N.0004853/11
Data 11/08/2011

SAFETY RECOMMENDATION

To: IAC (Interstate Aviation Committee)
119017 Moscow, Russia
Bolshaya Ordynka str. 22/2/1

Copy to: EASA (European Aviation Safety Agency)
Safety Analysis and Research
Postfach 10 12 53
D-50452 Koeln, Germany

UKRAVIATRANS
Ministry of Infrastructure
14, Peremohy str., Kyiv, Ukraine 01135

ENAC
Vicedirettore generale Ing. Benedetto Marasà
Viale del Castro Pretorio, 118
00185 Roma

Subject: serious incident occurred on September 9th 2010 to Antonov An-124-100 registration marks RA-82079 (equipped with Ivchenko Progress D18T engine series), Turin-Caselle airport (Italy).

1. Synopsis.

On September 9th 2010, on Turin-Caselle airport (Torino, Italy), the Antonov An-124-100 (picture 1) registration marks RA-82079 was taking-off from runway 36. During the take-off run, at about 50 kts (confirmed by Flight Data Recorder analysis performed within ANSV laboratory), the crew experienced the engine #4 (outer right) failure with following uncommanded shut down and rejected the take-off. During the application of the thrust reverse, crew experienced an uncommanded shut down of the engine #1 (outer left) too.

The aircraft stopped safely on the runway and the emergency services on the airport approached the aircraft after witnesses saw flames and smoke from the exhaust of the engines affected by shutting down. No aircraft or airport damages and no injuries were reported.

Picture 1: Antonov An-124-100 registration marks RA-82079.

2. Engines investigation.

After technical examination on the engines, included boroscope inspection and shop visit to the Progress Design Bureau facilities in Zaporozhye (Ukraine), under ANSV supervision with the presence of one investigator on site during all analysis performed, the investigation revealed that the engine #1 shut down was due to the application of thrust reverse at a speed lower than the minimum prescribed by the Operational Manual. Such action induced an engine compressor surge.

On the engine #4 has been found a mechanical failure on the HPC 6^{th} stage where it was completely missing one blade and where the fracture at the place of tenon disengagement from groove N° 94 showed presence of fatigue.

The analysis of that engine showed the presence of multiple cracking zone on the HPC 5^{th} stage guide vanes.

ANSV carried out (in Italy) its own fractographic analysis on some specimens coming from the HPC 5th stage guide vanes and ring, and on the fracture at the place of tenon disengagement, on the HPC 6th rotor stage.

All the investigated fracture surfaces of the 5th stage showed a strong contamination. It is worth noting that the fracture surfaces of the vanes are characterized by a degree of surface alteration which is very similar to the one observed on the disc and on the undamaged vanes. An example is shown in figure 1 which refers to the fractured vane labeled as N° 2 (HPC 18T.01.05.050-03, 5th stage vanes, fragment of upper half-ring with vane N° 2 - fracture, attached to the external ring) and figure 2 which is an EDS spectrum of the surface of the disc of the specimen N° 1 (HPC 18T.01.05.050-03, 5th stage guide vanes with vane N° 2 - fracture surface, attached to the internal ring). In figure 1 has to be noted that the morphology of the undamaged disc surface (which has been exposed to operating conditions for a long time) and the one of the fracture surface of a vane are similar.

On the contrary, the stator vanes which have impacted signs appear to be heavily deformed (see figure 3). They show a ductile fracture surface and are contaminated to a lesser extent in comparison with the vanes fractured close to the zone of attachment to the ring. This fracture surface has features which are similar to the ones detected on the ductile fracture surfaces of the specimen of the 6th stage (disk fragment of HPC 18T.01.06.016-01 N° 680I 6th stage with fracture at the place of tenon disengagement from groove N° 94).

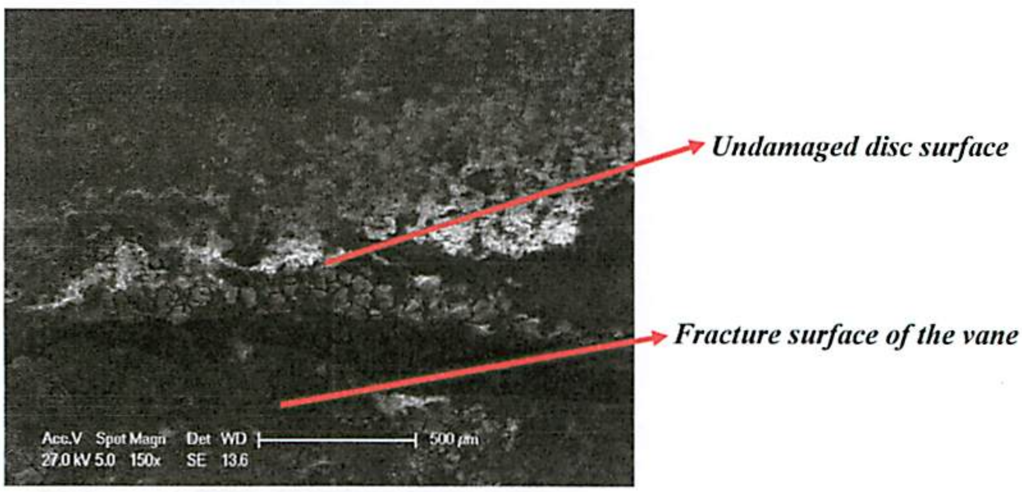

Figure 1: SEM micrograph of fracture surface of specimen N° 2.

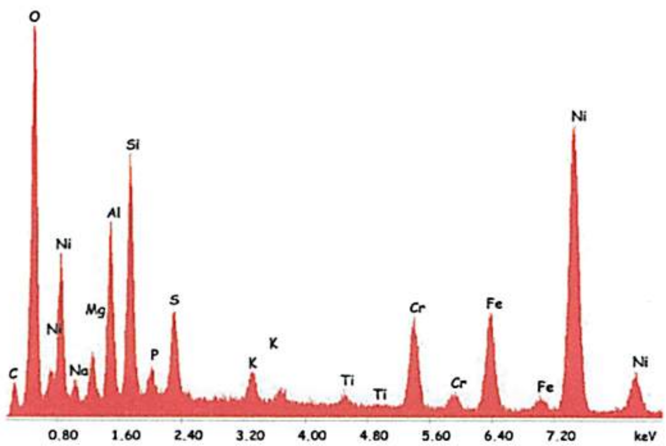

Figure 2: EDS spectrum of the disc surface for the specimen N° 1.

The low level of contamination characteristic of the fracture surfaces of both the impacted 5th stage vanes and 6th stage is therefore consistent with a short exposure time to high temperature and operating conditions of the compressor. Moreover, it was noted that the fracture surfaces of the 5th stage did not show a ductile behavior (at least when taking into account the morphology of the surface which is almost completely covered by thick deposits) and that a concentration gradient of the contaminants exists which is strictly correlated with the fatigue crack growth path. In fact, it was noted that the concentration of contaminants is higher where the crack originated (figure 4) and is lower in close proximity to the ultimate failure region where the EDS spectrum is comparable with one of the virgin alloy.

Figure 3: fragment of upper half-ring 5th stage with vane N° 1 - external ring.

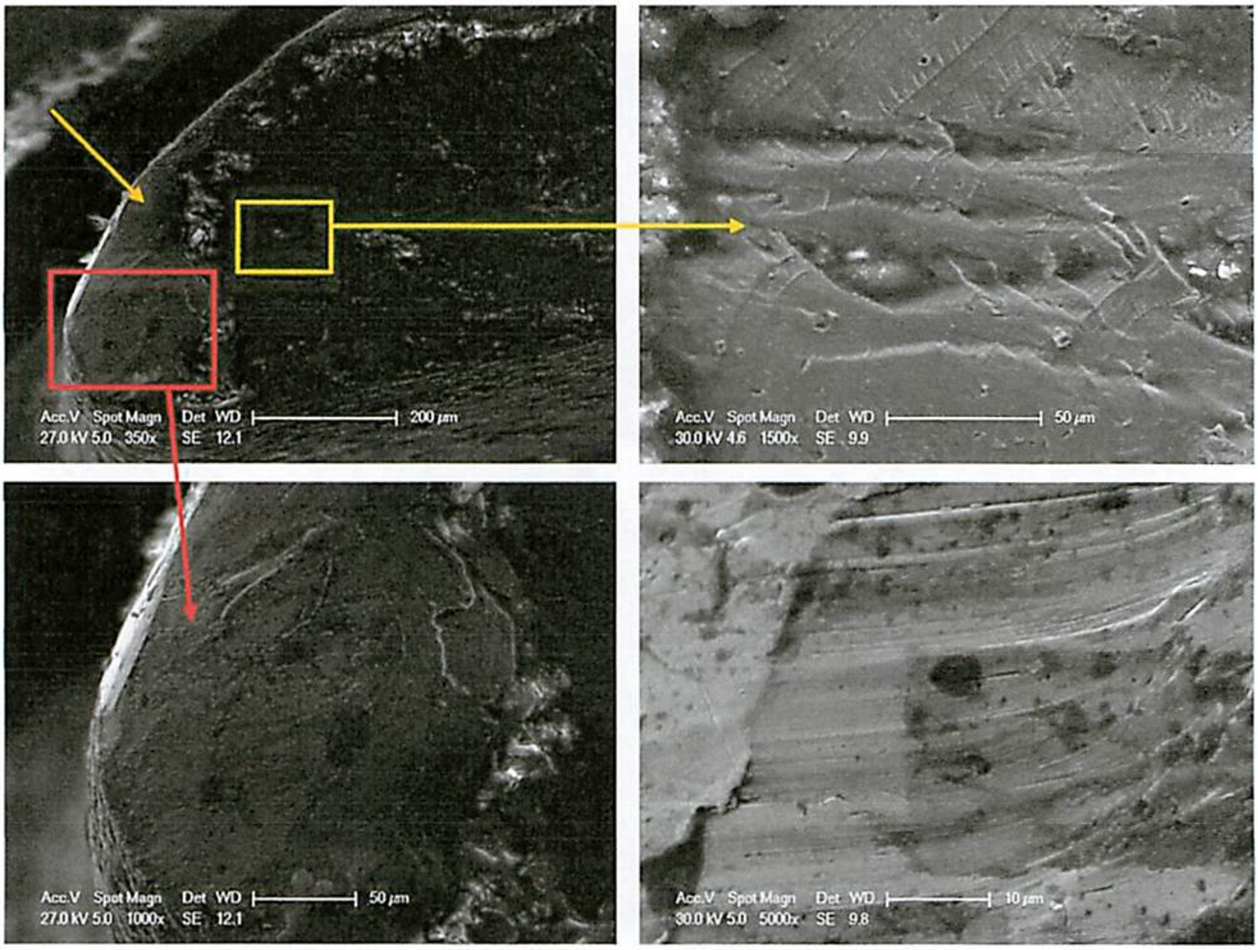

Figure 4: SEM micrographs of the fracture surface of specimen N° 2 showing fatigue striations.

This is likely to suggest that the fracture surfaces of the 5th stage have been subjected to the operating conditions for a longer period than those of the 6th stage. From the fractographic analysis it can be supposed that the fracture of the vanes of specimens N° 1 - 2 occurred prior to the catastrophic failure of the 6th stage.

3. Conclusion.

The cracks on the HPC 5th stage guide vanes induce a rotation on the longitudinal axis of the vanes with following variation of the angle of attack of the air flow on the 6th rotor stage. This kind of variation induces fatigue phenomena, found on the HPC 6th stage.

The engine Designer stated that the problem on the 5th stage is already known and that it issued the modification document D18T-1567 and 18T25446 on October 2007 to solve it during the scheduled engine shop visit, on each engine.

The engine Designer guarantees the engine failsafe operation till the completion of modification. On August of this year the engines modified (related to the Operator involved in the serious incident only) were 43 of 51 (as stated by Russian Accredited Representative in the ANSV investigation). After the incident, the Operator involved in the event in subject issued an additional boroscope inspection (every 250 fh) and the Designer considered that action (Temporary Change 559) sufficient.

4. Recommendation.

Addressee: IAC (Interstate Aviation Committee), 119017 Moscow, Russia, Bolshaya Ordynka str. 22/2/1.

Text.

The serious incident occurred on Turin-Caselle airport demonstrates that engine failsafe operation on model D18T series is not guaranteed at all on the ones not yet modified.

ANSV - considering the very high MTOW of the aircraft on which D18T engine series are installed, considering the safety level of an uncommanded engine shut down during take-off on those aircraft, considering the Temporary Change 559 that is not supported by analysis related to the "fatigue progression" on HPC 5th stage (the document was issued by the Operator) - recommends Interstate Aviation Committee that the modification stated on the engine Designer documents (D18T-1567 and 18T25446) must be completely carried out on each engine installed onboard an aircraft before it could be airworthy. The solution adopted by engine Designer (modification to the successive scheduled shop visit) appears to be not acceptable and not sufficient at all **(ANSV-13/1687-10/1/I/11).**

President of ANSV
(Prof. Bruno Franchi)