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ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Technical Analysis Investigation Report – 200601133
Final

Turbopropeller engine output shaft examination
Allied-Signal (Honeywell) TPE331-12

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Abstract

A rigid propeller shaft (part number 3102572-2) from an Allied-Signal (Honeywell) TPE331-12 turboprop engine, was received and examined by the ATSB in order to characterise and assess the nature of an unusual and irregularly finished surface at the end of the forward main bearing/seal journal. The anomalous area had been originally identified during inspection by the engine maintenance provider, who subsequently referred the matter to the Civil Aviation Safety Authority (CASA) through their service difficulty reporting (SDR) system.

The ATSB laboratory examination identified the features associated with the ends of the journal surface as being characteristic of surfaces that had been manually dressed following the application of a plasma/metal sprayed coating to re-build the journal surfaces. Subsequent reference to the inspection/repair manual for the propeller shaft, confirmed that plasma spraying was an approved process for journal repair, and that hand-finishing and deburring was specified for post-spray dressing.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

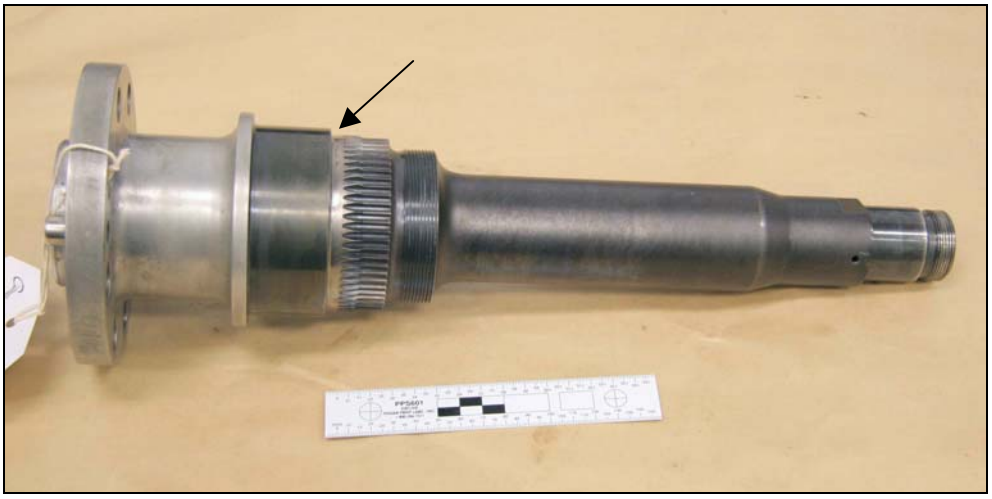
FACTUAL INFORMATION

Safety issue

On 9 February 2006, representatives from the Civil Aviation Safety Authority (CASA) requested the Australian Transport Safety Bureau (ATSB) to assist in the technical evaluation of a possible unsafe condition identified within a Honeywell TPE331-12 turbopropeller engine propeller shaft. The condition related to the potential existence of a material flaw, anomaly or defect around the inboard edge of the forward bearing/seal seat (see figure 1).

The propeller shaft was identified as part number 3102572-2, serial number 1-16436-426 and had originated from a TPE331-12 engine, serial number P-70117.

Figure 1: Part no. 3102572-2 propeller shaft as-received, with anomalous area indicated



Examination

As received, the propeller shaft appeared to be in sound general condition, with no outward evidence of mechanical damage or thermal distress. On inspection, the shaft presented evidence of irregular and coarse abrasive dressing around the full periphery of the shaft, at the inboard end of the forward bearing/seal seat (see figure 2). The uneven and variable nature of the surface was characteristic of a manual dressing, or similar abrasive process. Low-power stereomicroscopic examination of the dressed surface, revealed intermittent, patchy areas of metallic material that had been deposited over the underlying surface, which had a rough, dimpled appearance of an abrasive blasted or sprayed surface (see figure 3). There was no evidence of cracking, undercutting, or other intrusive defects, nor were there any areas of metal loss, other than a small number of shallow corner features that resembled small chips in the edge profile. At the opposite (forward) end of the bearing/seal seat, the radiussed flange transition showed a clear demarcation between seat surface material and the roughened end face material (see figure 4). Such a feature was considered entirely typical of the profiling/dressing process used, following the application of a thermal surface reclamation coating.

Figure 2: Irregular abrasive work noted around edge of journal surface (arrowed)

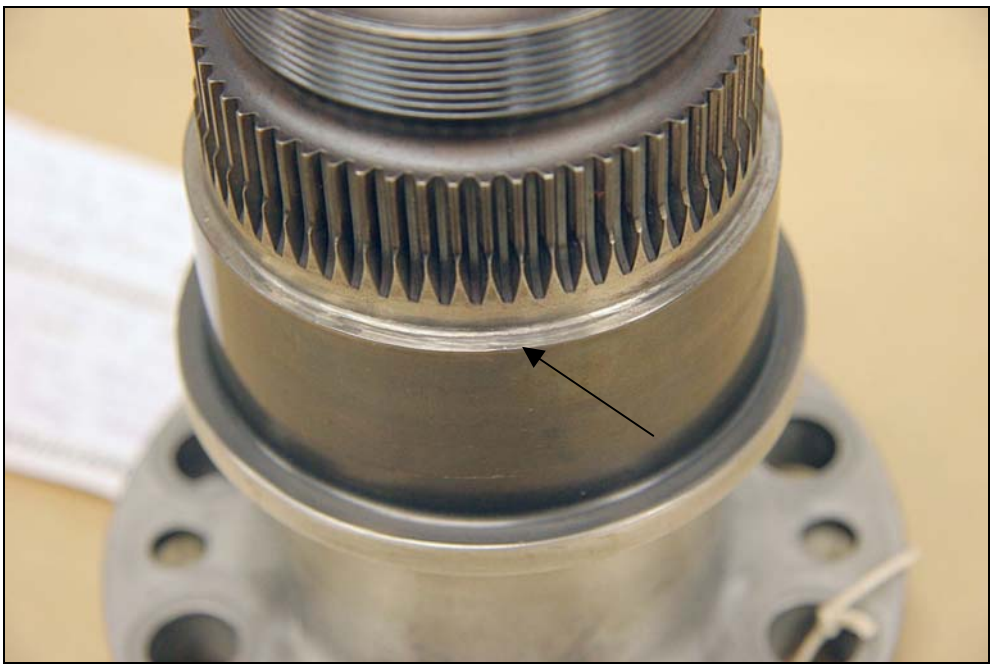


Figure 3: Journal edge area showing an irregular build-up of material on what appears to be an abrasive-blasted or sprayed undersurface

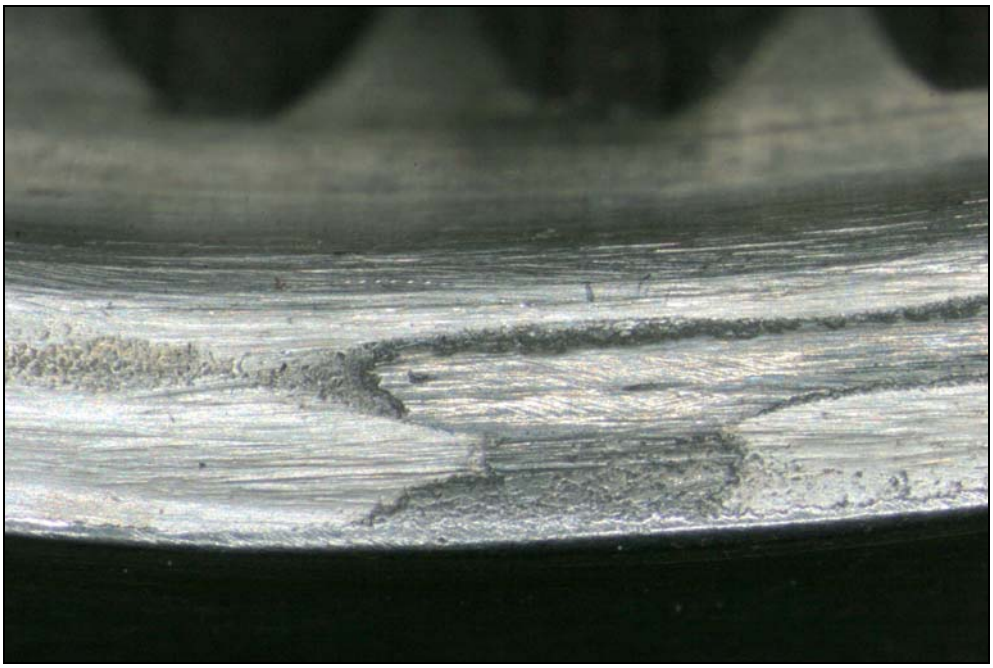
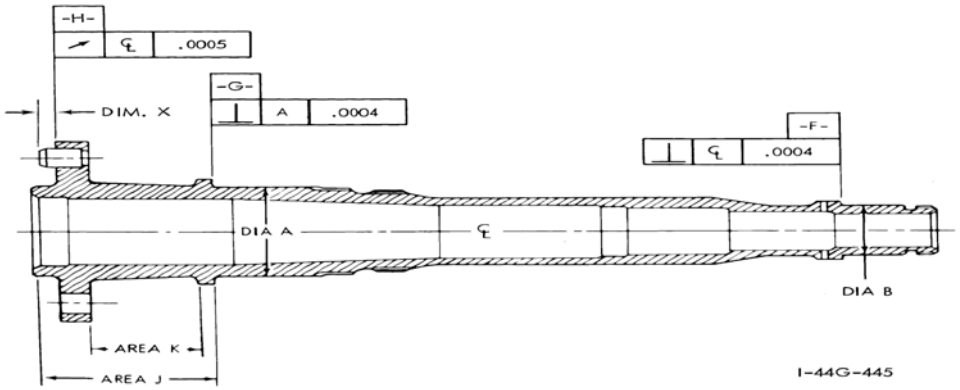


Figure 4: Forward end of the journal showing a prominent transition between the machined journal surface and the rougher, lightly abraded end face

Component repair

The engine manufacturer's inspection/repair manual for the part number 3102572-1/-2 propeller shaft assembly[1], established a number of approved repair procedures for the restoration of wear and damage sustained during operational service. Those procedures included the application of a plasma spray process for the restoration of diameter 'A' (see figure 5). Included in the spraying procedure was the requirement for hand-finishing to deburr and remove excess plasma spray deposits.

Figure 5: Critical diameters and locations – p/n 3102572 propeller shaft[1]



1 Allied-Signal Aerospace Company (Honeywell) Inspection/Repair Manual, Garrett TPE331, Propeller Shaft Assembly Part No. 3102572-1/-2, REPAIR 72-IR-15, 3102572-Page-403, Jan 15/90

ANALYSIS

On the basis of the visual studies conducted, the appearance of the propeller shaft forward bearing/seal seat region was entirely consistent with the application of a thermally sprayed coating to the journal surface as part of a repair/reclamation process. The dressing to the inboard end was likely carried out to remove gross oversprayed material from the spline transition. While irregular, the dressed surfaces presented no features that were considered to be potentially injurious to the physical integrity, or service performance of the propeller shaft.

A review of the engine manufacturer's inspection/repair manual for the propeller shaft, confirmed the approval of a plasma/metal spray process for the repair of surface damage to the two primary shaft journal surfaces. Prescriptions for the repair process included the requirement to hand-finish and deburr the repaired areas.