VSP-48A
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VENDOR SERVICE PUBLICATION

(VSP-48A Supersedes and Voids VSP-48 dated April 15, 1985)

TO: All Affected Owners/Operators, Piper Cheyenne Sales Centers, Cheyenne Service Distributors, Factory Direct Dealers and Cheyenne Field Service Facilities.

SUBJECT: United Technologies - Pratt & Whitney Canada Service Information Letter No. 1035-13011

MODELS AFFECTED:	SERIAL NUMBERS AFFECTED:
PA-31T Cheyenne/Cheyenne II	31T-7400002 through 31T-8120104
PA-31T1 Cheyenne I/Cheyenne IA	31T-7804001 through 31T-8304003, 31T-1104004 through 31T-1104017
PA-31T2 Cheyenne IIXL	31T-8166001 through 31T-8166076, 31T-1166001 through 31T-1166008
PA-31T3 T-1040	31T-8275001 through 31T-8475001 and 31T-5575001
PA-42 Cheyenne III	42-7800001, 42-7800002, 42-7801003, 42-7801004, 42-8001001 through 42-8001106
PA-42-720R Cheyenne	42-5501024, 42-5501028, 42-5501032, 42-5501034 through 42-5501038
PA-42-720 Cheyenne IIIA	42-8301001, 42-8301002, 42-5501003 through 42-5501023, 42-5501025 through 42-5501027, 42-5501029, through 42-5501031, 42-5501033, 42-5501039 and up

PURPOSE: To distribute the attached United Technologies - Pratt & Whitney Canada Service Information Letter No. 1035-13011 to All Affected Owners/Operators, Piper Cheyenne Sales Centers, Cheyenne Service Distributors, Factory Direct Dealers and Cheyenne Field Service Facilities.

The attached United Technologies - Pratt & Whitney Canada publication affects Pratt & Whitney Canada equipment installed in the above listed Piper Airplanes. Refer to the publication for specific details.

UNITED TECHNOLOGIES
PRATT & WHITNEY CANADA

SIL NO. 1035
3017
4010
5028
7022
11008
12020
13011

SERVICE INFORMATION LETTER

Subject: **SULPHIDATION ATTACK**

Applicability: **ALL PT6 AND JT15D ENGINES**

This Information Letter replaces S.I.L. 1023, 3010, 4004, 5019, 12010, and 13004

GENERAL

Sulphidation is a common name for a type of hot corrosion which can affect turbine area components of gas turbine engines. It starts with the condensation of an alkali metal salt on the surface of the part. A cycle of chemical reactions follows which initially attack the oxide protective coating and progress to deplete the chromium element from substrate material. With chromium depletion, oxidation of the base material accelerates and blister scale begins to form.

This Service Information Letter is valid for one year from date of issue.

Issued: 29 October 1987

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FACTORS

Sulphates will form at operating temperature if sodium and sulphur are both present. Most aviation turbine fuels contain sulphur in sufficient amounts for sulphidation to occur if a source of sodium is present. The most common source of sodium is from seawater, but it can also be found in industrial atmospheric pollutants and in volcanic discharges. In addition to the presence of sulphates in the engine gas-path, the temperature of the component must be in the range where sulphate condensation can occur. An example of such a zone is the lower section of the 1st stage turbine blade.

ATTACK PROGRESSION

Sulphidation attack can generally be divided into four progressive stages from initial onset to failure. Examples of each stage on typical PT6 CT blades are given in Figures 1 through 4.

STAGE 1 MILD SULPHIDATION

Slight roughening of the surface caused by some growth and localized breakdown of the oxide scale layer is evident. Depletion of chromium in the substrate layer has not started. Mechanical integrity is not affected.

STAGE 2 OXIDE FAILURE

Roughness of surface is more marked as oxide layer breakdown continues. Depletion of chromium from underlying alloy has commenced. Mechanical integrity still not affected.

STAGE 3 SEVERE SULPHIDATION

Oxidation of the base material has penetrated to significant depth, with obvious build-up of scale. Integrity seriously affected. Progression to stage 4 will accelerate with or without the continued presence of sodium.

STAGE 4 CATASTROPHIC ATTACK

Deep penetration of attack with large "blister" of scale. Failure likely due to loss of structural material.

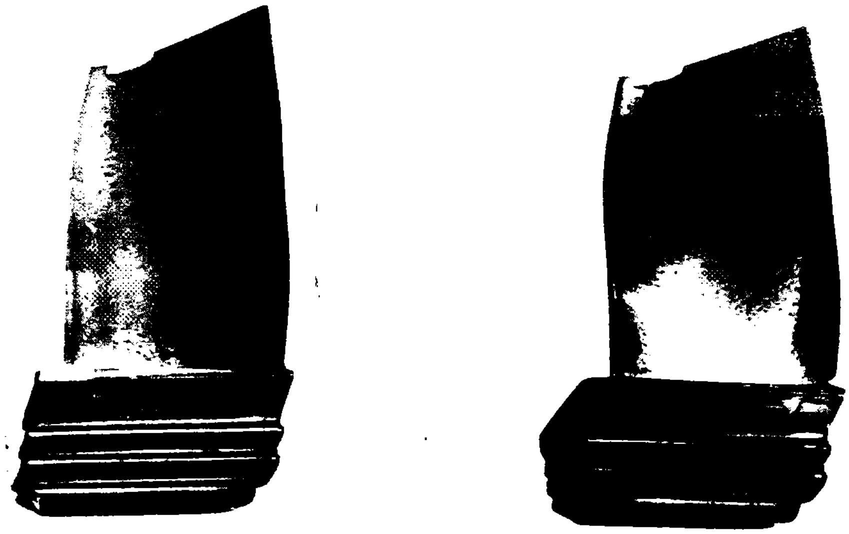

Figure 1, Typical Stage 1 Sulphidation

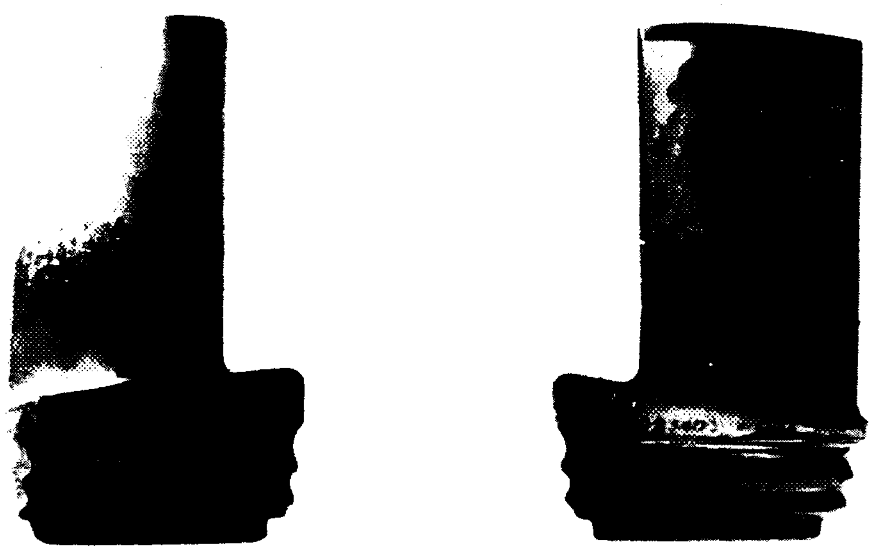

Figure 2, Typical Stage 2 Sulphidation

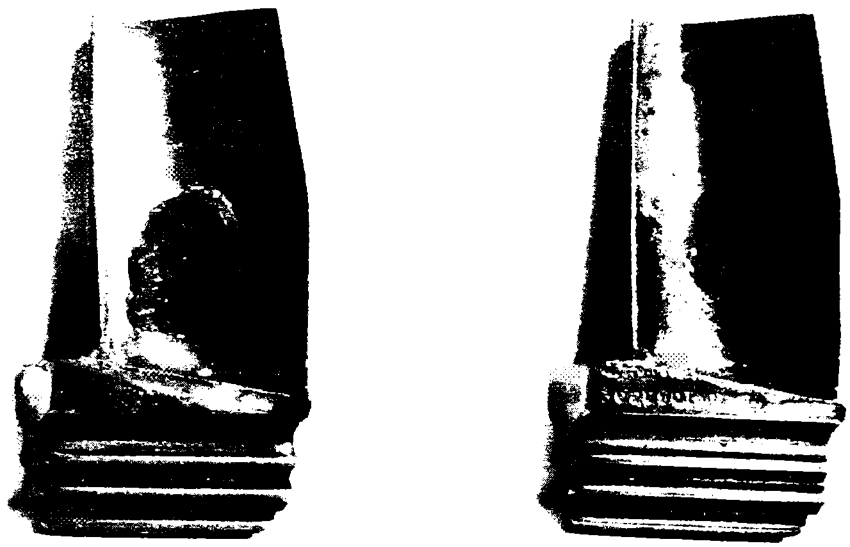

Figure 3, Typical Stage 3 Sulphidation

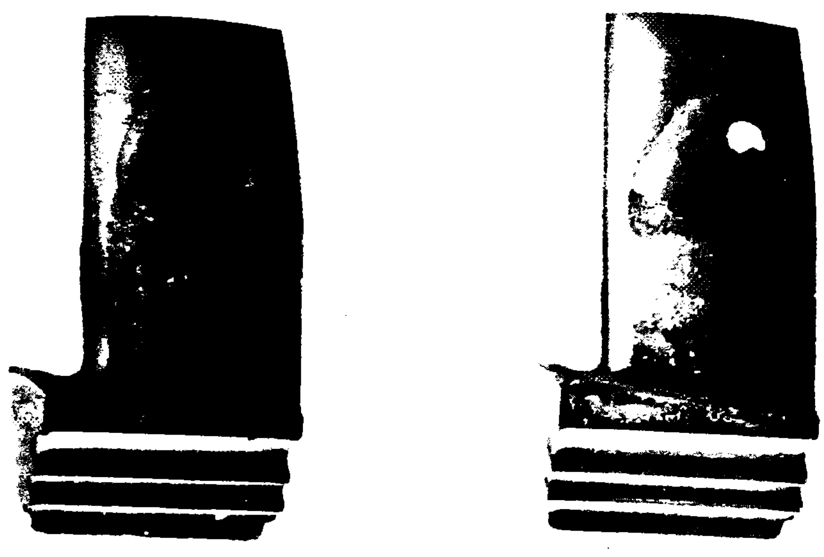

Figure 4, Typical Stage 4 Sulphidation

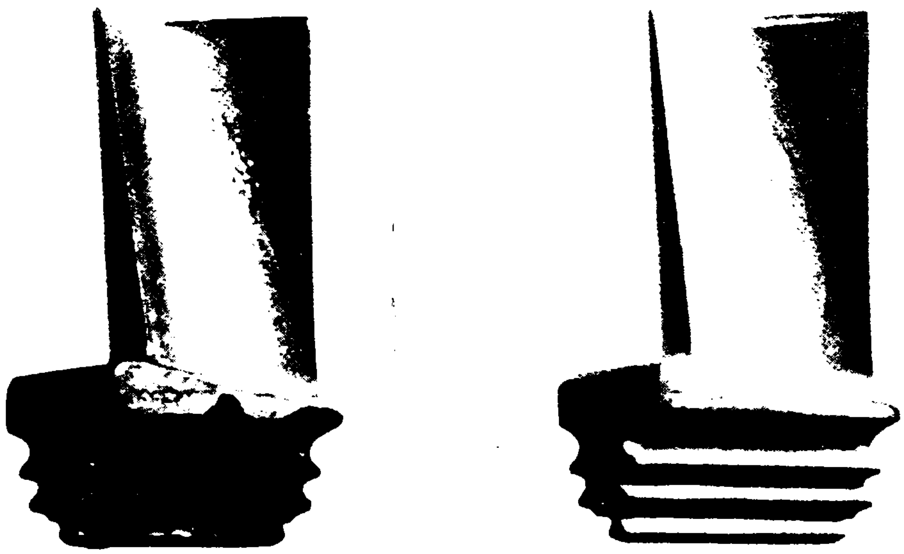

Figure 5, Typical Stage 2 Sulphidation After Coating Strip

P&WC EXPERIENCE

Sulphidation attack in the PT6 range of engines most often affects the CT blades. However, sulphidation of shroud segments and other non-rotating components is not uncommon. All stages of attack may be encountered, although stages 3 and 4 will normally be limited to those engines which are directly exposed to salt water. Hot corrosion of JT15D engines has been rare and to date HT blades only have been affected.

It should be noted at this point that the aluminide coating applied to the CT blades incorporates elements of the base alloy in varying amounts throughout, due to the diffusion process. Therefore any degradation of the coating will involve loss of the base alloy to some extent and with the inevitable unevenness of the attack, if stripping and recoating is entertained, it should be understood that a majority of components may be rejected on post stripping inspection. Figure 5 shows typical stage 2 sulphidation after coating strip.

MINIMIZING ATTACK IN ENGINES

A proven method of minimizing sulphidation is deluge motoring washes using plain water (with an anti-freeze agent if required). During stages 1 and 2 the sulphate is on the surface, and is dissolved and carried away by the water. Specific procedures are covered in detail in the relevant maintenance manual for the engine model concerned.

Water used for washing must be free from contamination, and in most cases the local drinking water is acceptable. Otherwise demineralized water should be used. It must be pointed out that a running wash is useless in minimizing sulphidation, as liquid water does not reach the turbine area.

Wash frequency very much depends on the degree of contamination. For slight contamination weekly is probably the minimum acceptable. For maritime areas daily or even before each flight may be necessary, although to avoid thermal shock, the engine must be quite cool before introducing the water.

Recommended wash frequency based on the operators estimate of the severity of his corrosion environment should be as follows:

Severe	-	daily (for constant flying in severe corrosion environment)
Moderate	-	weekly
Mild	-	monthly or 50 hours

These recommendations are based on operators' experience in areas known to cause corrosion problems. They do not take into account any future changes in levels of atmospheric contamination or alternatives to sodium as a catalyst in the process (such as lead in some fuels).

An alternative method of establishing wash frequency has been to monitor blade condition using a borescope inspection program; see CT Blade Inspection below. The wash schedule should be adjusted according to the inspection results.

Another approach is to use alloys which are more resistant to sulphidation. Such alloys are available - Inco 792 is an example for CT blades - but have several drawbacks. One is that they have less resistance to oxidation and therefore may deteriorate faster in a non-sulphidation environment, another is that these alloys are rather more difficult to form and therefore component costs are higher. In conjunction with our turbine component suppliers we are continuing research in this area, and we will offer any cost effective improvements as they become available.

BLADE INSPECTION

Two points are important to consider when evaluating sulphidated blades. Firstly to recognize the stage of attack, and secondly to estimate future progression rate to onset of stage 3. At stage 3 mechanical integrity should be considered as jeopardized and the blades removed from service. When estimating progression, beyond stage 1 or 2 damage changes in exposure to contamination and improvements in wash programs should be taken into account.

If it is decided to continue sulphidated PT6 CT blades in service a borescope inspection program should be instituted to monitor progression. This program should continue until such time as a reliable progression rate for the particular circumstances can be established and a blade life limit can be determined. The recommended periodicity for this inspection is 200 hours. Blade lives established this way should be reviewed periodically to account for possible changes in the factors affecting sulphidation.

Yours truly,

PRATT & WHITNEY CANADA INC.

G. Hogg
Director - Technical Support
Turboshaft & Turbofan Engines

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