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V2500-D5 SERIES PROPULSION SYSTEM NON-MODIFICATION SERVICE BULLETIN

This document transmits Revision 1 to Service Bulletin EV2500-72-0501 and Revision 1 to the Supplement

Document History

Service Bulletin Revision Status		Supplement Revision Status	
Initial Issue	Jul.25/05	Initial Issue	Jul.25/05

Bulletin Revision 1

Remove	Incorporate	Reason for change
All pages of the Service Bulletin	Pages 1 to 15 of the Service Bulletin	To revise the Accomplishment Instruction.

Supplement Revision 1

Remove	Incorporate	Reason for change
All pages	Page 1	To revise the Accomplishment Instruction.

V2500-ENG-72-0501

CHECK THAT ALL PREVIOUS TRANSMITTALS HAVE BEEN INCORPORATED
If any have not been received please advise Customer Data Services, Rolls-Royce plc, Derby, England

LIST OF EFFECTIVE PAGES

The effective pages to this Service Bulletin following incorporation of Revision 1 to the Bulletin and Revision 1 to the Supplement are as follows:

	Page	Revision Number	Revision Date
	Bulletin		
R	1	1	Jul.14/06
R	2	1	Jul.14/06
R	3	1	Jul.14/06
R	4	1	Jul.14/06
R	5	1	Jul.14/06
R	6	1	Jul.14/06
R	7	1	Jul.14/06
R	8	1	Jul.14/06
R	9	1	Jul.14/06
R	10	1	Jul.14/06
R	11	1	Jul.14/06
R	12	1	Jul.14/06
R	13	1	Jul.14/06
R	14	1	Jul.14/06
R	15	1	Jul.14/06
	Supplement		
R	1	1	Jul.14/06

International Aero Engines

SERVICE BULLETIN

NON-MODIFICATION SERVICE BULLETIN - N2 VIBRATION MONITORING FOR THE HIGH PRESSURE TURBINE (HPT) STAGE 2 AIR SEAL

Printed in Great Britain

1. Planning Information

A. Effectivity Data (For Boeing MD-90)

Engine Models Applicable

V2525-D5, V2528-D5

Engine Serial No. - All engines

B. Concurrent Requirements

There are no concurrent requirements.

C. Reason

(1) Problem: There have been occurrences of cracks in the High Pressure Turbine (HPT) Stage 2 Air Seal. The crack can propagate and result in the fracture of a piece of the HPT Stage 2 Air Seal, which could result in significant damage to the HPT and LPT.

(2) Evidence: When a crack develops in the HPT Stage 2 Air Seal front fillet radius, an increasing trend in N2 vibration occurs. AOW 1069 provided a procedure to monitor steady state cruise N2 vibration for increasing trends.

R (3) Objective: This NMSB supersedes the interim fleet management actions provided in AOW 1069 and the original NMSB. This NMSB provides instructions to monitor N2 vibration which may be an indication of a cracked HPT Stage 2 Air Seal.

(4) Substantiation: The N2 vibration trend monitoring limits used to identify engines which may have a cracked HPT Stage 2 Air Seal are based on engineering analysis of data from operational engines including those which have been found with cracks in the HPT Stage 2 Air Seal.

(5) Effects of Bulletin on:

Removal/Installation: None.

Disassembly/Assembly: None.

Cleaning: None.

Inspection/Check: None.

Repair: None.

Testing: None.

(6) Supplemental Information

None.

D. Description

This Service Bulletin provides procedures for repetitive monitoring of steady state cruise N2 vibration to identify engines which are suspect of having a cracked HPT Stage 2 Air Seal.

E. Compliance

Category 3

R Monitoring of N2 vibration on all V2500-D5 engines should begin when the HPT Stage 2 Air Seal has accumulated 6000 cycles or more.

NOTE: After trend monitoring begins, N2 vibration data gathering and monitoring needs to continue. It is recommended that data be reviewed
R for N2 vibration trend at repetitive intervals not to exceed 150 cycles after monitoring begins.

F. Approval Data

The part number changes and/or part modifications specified in the Accomplishment Instructions and Material Information sections of this Service Bulletin have been shown to comply with the applicable Federal Aviation Regulations and are FAA-APPROVED for the engine model(s) given.

The compliance statement and the procedures described in this Service Bulletin have been shown to comply with the applicable Federal Aviation Regulations and are FAA-APPROVED for the Engine Model listed.

G. Manpower

(1) In Service

Not applicable.

(2) At Overhaul

Not applicable.

H. Weight and Balance

(1) Weight Change

None.

(2) Moment Arm

No Effect.

(3) Datum

Engine Front Mount Centerline (Power Plant Station (PPS) 100).

I. Electrical Load Data

This Service Bulletin has no effect on the aircraft electrical load.

J. Software Accomplishment Summary

Not applicable.

K. References

1. IAE V2500 All Operators Wire 1069 (HPT2 Airseal Cracking).
2. V2500 Engine Manual (E-V2500-3IA), Chapter/Section 72-40-00.
3. Aircraft Maintenance Manual section 71-02-09 and 72-00-00.

R 4. Internal Reference No. - 05VC134 and 05VC134A.

5. ATA Locator - 72-40-00.

L. Other Publications Affected

None.

M. Interchangeability of Parts

Not applicable.

N. Information in the Appendix

Alternate Accomplishment Instructions (No)

Progression Charts (No)

Added Data (No)

Revision to Table of Limits (No)

Inspection Procedures (No)

2. Material Information

A. Industry Support Program

Not applicable.

B. Tooling - Price and Availability

Special tools are not required to accomplish this Service Bulletin.

C. Reidentified Parts

Not applicable.

D. Other Material Information Data

Not applicable.

3. Accomplishment Instructions

R Gather and monitor steady state cruise N2 vibration data for an increasing trend. R If automatic vibration data gathering is available follow the procedure given in R paragraph A. (N2 Vibration Monitoring When Automatic Data Gathering is Available) R below. If automatic vibration data gathering is not available refer to paragraph R C. (Manual N2 Vibration Monitoring - Outline) and to paragraph D. (Manual N2 Vibration Monitoring - Procedure for Data Collection and Review) for manual data gathering and monitoring.

Operators who are unable to comply with this NMSB should contact IAE technical support for assistance.

This requirement will remain in place, and operators should continue to monitor N2 vibration, until otherwise notified by IAE.

R A. N2 Vibration Monitoring When Automatic Data Gathering is Available:

R NOTE: Operators should ensure that the engine vibration monitoring system is R operating properly. Any problems with the vibration monitoring system R should be corrected as soon as possible but not to exceed 50 cycles from R when the problem is identified.

R (1) Gather steady state cruise N2 vibration data from each engine routinely. R It is recommended that data be gathered once per day or a minimum of once R every 8 flight cycles (see step B. below for procedures on how to gather R this data).

R (2) Monitor N2 vibration trend of each engine for every 100 to 150 cycles of R engine operation. If an increasing trend is identified prepare a plot of R N2 vibration. The plot should have N2 vibration amplitude on the Y-axis R versus data on the X-axis. The plot must meet the following requirements:

R (a) Y-axis range should be 0 to 2.0 Normalized Units (if vibration R amplitude is greater than 2.0 units, range can be 0 to 3.0 Normalized R Units).

R (b) X-axis should cover approximately 12 to 18 months (this range should R be used even if data is not available for the entire time period).

R (c) Individual vibration data points should be plotted and they should not R be connected with lines.

R (d) Do not use smoothed vibration data.

R (e) Do not use averaged vibration data.

R (3) The data must be plotted and reviewed for a vibration trend slope soon
R after it is obtained. No more than 175 cycles should accumulate on the
R engine from the beginning of the plot data and the time the plot is
R reviewed.

R NOTE: This means that if you gather data every 100 cycles, you must
R review the plot within 75 cycles of the last data point. If you
R gather data every 150 cycles, you must review the plot within 25
R cycles of the last data point.

R (4) If there is an increase in vibration of 0.1 units or more, then the slope
R must be calculated. Since there is scatter in the data, this increase is
R based on the 'average vibration level' which is the mid-point of the
R vibration scatter. If the increase is less than 0.1 units engine vibration
R monitoring should continue per the above steps. The units of the slope are
R Normalized Units/Engine Cycles (abbreviated NU/cycle). Calculate slope as
R follows:

R (a) Determine 'average vibration level' at the first point of the line.

R (b) Determine 'average vibration level' at the end of the line.

R (c) Using engine or Aircraft records, determine engine cycles
R corresponding to the first and last points of the line. Calculate
R slope:

R Slope = Change in 'average vibration level' / Change in engine cycles.

R NOTE: Figure 1 shows a typical vibration plot, the 'average vibration
R level' and how to calculate the slope.

R (5) Take action as follows:

R (a) Slope less than .0007 NU/Cycle: The HPT Stage 2 Air Seal is not
R suspect of being cracked - the engine can remain in service and
R vibration monitoring should continue.

R (b) Slope is .0007 NU/Cycle or greater and less than .002 NU/Cycle: The
R HPT Stage 2 Air Seal is suspect of being cracked and the engine needs
R to be removed within 250 total cycles from when the slope began to
R increase.

R WARNING: FAILURE TO REMOVE THE SEAL WITHIN 10 CYCLES IF THE SLOPE IS
R GREATER THAN .002 NU/CYCLE COULD RESULT IN SEAL FRACTURE DURING
R ENGINE OPERATION.

R (c) Slope .002 NU/Cycle or greater: The HPT Stage 2 Air Seal is suspect of being cracked and the engine needs to be removed within 10 cycles of when the slope was calculated (Figure 2 shows the plot of an engine which needs to be removed within 10 cycles).

R NOTE: Step changes in vibration are not an indication that the HPT Stage 2 Air Seal has developed a crack but if observed the engine should continue to be monitored. Figure 3 shows a sample of what is considered a step change in vibration.

B. Information regarding data collection and monitoring systems:

NOTE: V2500-D5 operators who do not have the necessary equipment installed on their aircraft to automatically record data will need to utilize the MANUAL N2 VIBRATION MONITORING PROCEDURE. This procedure is defined in the following paragraph C. (Manual N2 Vibration Monitoring - Outline) and paragraph D. (Manual N2 Vibration Monitoring - Procedure for Data Collection and Review) This procedure may be utilized until automatic N2 vibration data collection is available in your fleet.

(1) Data recording

The majority of aircraft fitted with V2500 engines are equipped with onboard data recording capability. These systems provide the steady state cruise data that is required to monitor the engines. It is desirable to continue to use this automatic data recording system. In the event this capability is not available it is equally acceptable to use data recorded by other means. Operators must ensure that AVMH indicated vibration levels are included in the set of parameters that are recorded.

NOTE: The output of this data is already in Normalized Units, no conversion is required.

(2) Data quality

The automatic data recording systems on aircraft fitted with V2500 engines record low-rotor and high-rotor vibration levels to the nearest one-tenth (0.1) units. V2500 operators who record steady state cruise data by other means should assure that AVMH values are recorded to the nearest one tenth (0.1) units and they should utilize this data for steady state cruise N2 vibration trend monitoring.

(3) Data analysis

All operators are to establish a process for monitoring AVMH levels focused on identifying an increasing AVMH trend described in Figure 1.
R Only observed N2 vibration values should be used for plotting purposes.

R It is anticipated that most operators will use one of the engine health monitoring programs and/or services provided by either Pratt and Whitney or Rolls-Royce. It is equally acceptable for the operator to use software developed by themselves, others, or the monitoring services of another company to perform this task.

(4) Manual N2 Vibration Monitoring Procedure

V2500 D5 operators may utilize the Multifunctional Computerized Display Unit (MCDU) to access and record N2 vibration during flight if automatic recording is not available. This procedure is available in the AMM section 71-02-09. Although this procedure is utilized for ground vibration surveys, Boeing has confirmed that it is acceptable to use this function during flight. Boeing recommends that the operator alleviate the burden from the flight crew by utilizing dedicated personnel, specially trained for this specific task, to perform the manual data collection.

C. Manual N2 Vibration Monitoring - Outline:

NOTE: This procedure should only be used if an automatic vibration data system is not available.

(1) Obtain a baseline (starting point) for each engine.

(2) Begin monitoring for an increasing trend that has a slope of 0.0007 NU per cycle (example 0.3 NU over a 425 cycle period).

R (3) Collect N2 vibration data approximately once every 25 cycles and compare to your baseline for each data collection.

(4) If the average vibration increases by 0.1 NU or greater from baseline vibration (and other conditions as detailed in the following paragraph D. are met), reduce N2 vibration data collection interval to approximately 5 cycles.

(5) If an increasing trend that meets requirements in paragraph D. (Manual N2 Vibration Monitoring - Procedure for Data Collection and Review) is identified, remove the engine.

D. Manual N2 Vibration Monitoring - Procedure for Data Collection and Review:

NOTE: This procedure is not required unless the engine has accumulated 6000
R cycles or more.

NOTE: This procedure should only be used if an automatic vibration data system is not available.

(1) Obtain your Beginning Baseline Vibration:

Record the N2 vibration data:

(a) 25-30 data points should be collected within 30 flight cycles.

(b) Not more than 10 data points should be collected during a given flight (three data points are preferred).

(c) Use the guidelines in paragraph E. (Manual N2 Vibration Monitoring - Operating Condition for Data Collection).

(d) Calculate the numerical average of the data points.

(e) Multiply the average by a factor of 2 to convert IPS to Normalized Units (NU).

(f) This is your Beginning Baseline Vibration in NU's.

R (2) Manually record N2 vibration data at repetitive intervals not to exceed 25 cycles and monitor for an average increase of 0.1 NU or greater:

(a) Use the guidelines in paragraph E. (Manual N2 Vibration Monitoring - Operating Condition for Data Collection).

(b) Calculate the average from each flight where data was collected.

(c) Convert IPS to NU's by multiplying the average IPS by a factor of 2.

(d) Compare this data to your baseline vibration obtained in the previous
R step D.(1).

IMPORTANT: Make sure you convert the data from IPS to Normalized Units by multiplying the data by a factor of 2.

(i) If the N2 vibration increase is less than 0.1 NU continue to monitor for an increasing trend.

(ii) If the N2 vibration increases by 0.1 NU or more, do the following step (e).

(e) Verify that the elevated value is accurate:

(i) Collect another 25-30 data points within 30 flight cycles.

(ii) Not more than 10 data points should be collected during a given flight (three data points are preferred).

(iii) Use the guidelines in paragraph E. (Manual N2 Vibration Monitoring - Operating Condition for Data Collection).

(iv) Calculate the numerical average of the data points.

(v) Multiply the average by a factor of 2 to convert IPS to Normalized Units (NU).

(vi) This is your Verified Vibration Level in NU's.

(f) Compare your Verified Vibration Level to your Beginning Baseline Vibration. Does it confirm that N2 vibration increased by 0.1 NU or greater?

If the increasing trend is confirmed, do the following:

R (i) Reduce recording interval from 25 cycles to approximately every 5 cycles.

(ii) Continue to monitor for a vibration trend slope of 0.0007 NU per cycle or greater (example: 0.3 NU over 425 cycles).

(iii) Data should be reviewed for an increasing trend each time information is collected.

(1) If the vibration trend slope as previously described is confirmed, do the following:

A Notify IAE of this condition through your local IAE representative. Please provide the following information:

1 All vibration data collected

2 Engine serial number

3 Seal total hours

4 Seal part number

5 Seal total cycles

6 Seal serial number

B Remove the engine within 50 cycles.

(2) If the vibration trend slope as previously described is not confirmed after 200 cycles, use the Verified Vibration Level calculated above as your new baseline and return to a 50 cycle interval

A If increase in vibration is not confirmed, return to the 50 cycle interval using your Beginning Baseline Vibration and continue to monitor.

E. Manual N2 Vibration Monitoring - Operating Condition for Data Collection:

(1) Engine Operating Conditions:

(a) One (1) minute of stabilized cruise is recommended before recording vibration data.

(b) N2 range for data collection is 82% to 89%.

(2) Aircraft Operating Conditions:

(a) Data should be recorded at stable cruise.

(b) Aircraft should be at same altitude and Mach number for 1 minute.

(c) Turbulence should be at 'most light' conditions.

(d) Throttles should not be moved during data collection.

(e) Engine to engine EPR and N2 do not need to be aligned or 'matched'.

(3) Recording Guidelines:

(a) Not more than 10 data points should be collected during a given flight (three data points are preferred).

(b) The data can be hand-recorded or printed from the MCDU. If it is recorded by hand the N2 speeds displayed on the MCDU (in RPM) should also be recorded for future reference.

(c) The MCDU data refreshes approximately once every 3 seconds. Pause at least 5 seconds between each recording to make sure the screen is updated with new information.

(d) The data for each engine should be collected at steady state conditions. As long as the conditions described above remain the same, data may continue to be collected.

(e) As long as this data is collected during the steady-state cruise conditions listed in the previous paragraph E.(2), it may be taken anytime at the pilots' discretion.

(f) Both engines may be done at the same time, or done separately.

(g) The following information should be recorded by the flight crew:

Flight #
Aircraft ID
Engine position
Date

N2 Vibration reading(s), and corresponding N2 in RPM, or equivalent percent
UTC Time / GMT

F. General Information Regarding Manual N2 Vibration Trending Using The MCDU

It is desirable to collect a minimum of three to a maximum of ten recordings per flight for each engine when vibration data is being recorded. However it is understood that in many cases, short flight duration may only allow one recording to be taken.

The N2 vibration data is updated once every 3 seconds on the MCDU after the 'START' key, Line Select Key (LSK) 5L is pushed. Pause at least 5 second between each recording.

G. All data collected for each engine should be stored in a database (such as Excel). This information may be required if historical vibration data is needed.

(1) Flight #.

(2) Aircraft ID.

(3) Engine position.

(4) Engine Serial number.

(5) Engine Total Time and Total Cycles.

(6) Engine Total Time and Total Cycles.

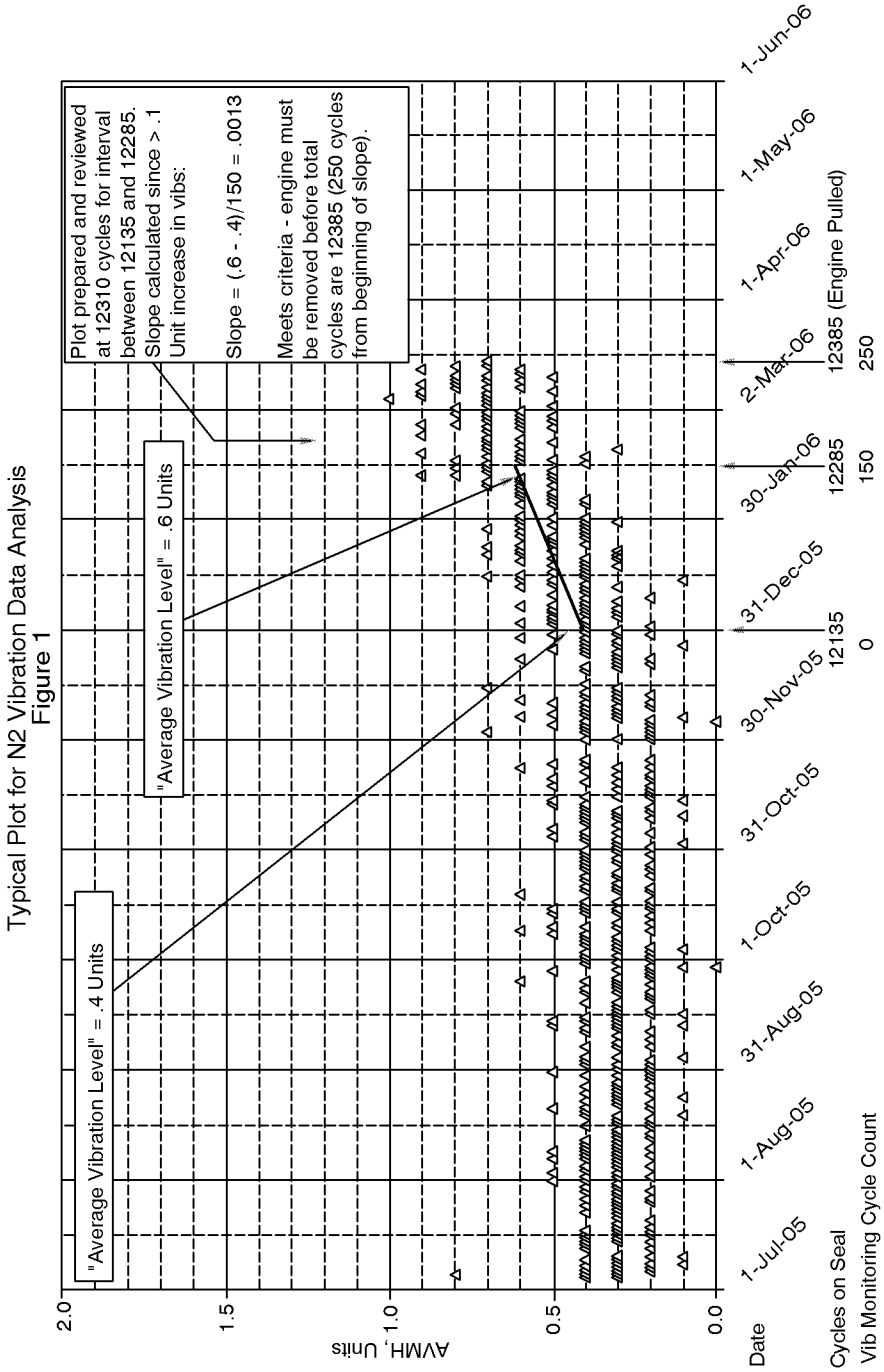
(7) N2 Vibration readings and corresponding N2 in RPM or equivalent percent.

(8) Average value calculated for each set of data.

(9) UTC time when data was collected.

H. The vibration values displayed on the MCDU vibration page are in Inches Per Second (IPS). They must be converted to Normalized Units (NU) 0.5 IPS = 1.0 NU. To accomplish this, you multiply the value displayed on the MCDU by a factor of 2.

R



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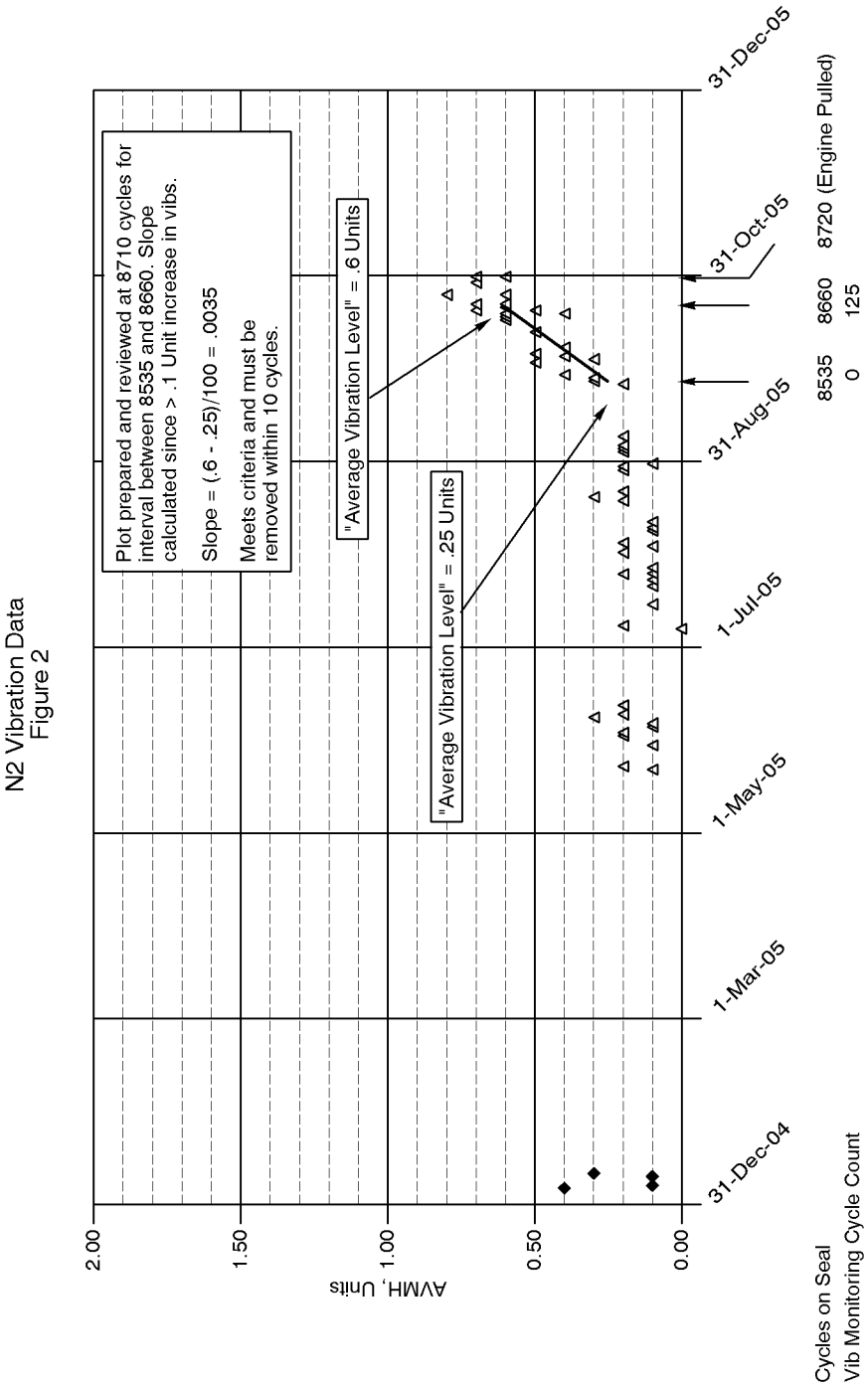
R R Typical Plot for N2 Vibration Data Analysis
Figure 1



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R N2 Vibration Data
R Figure 2

R

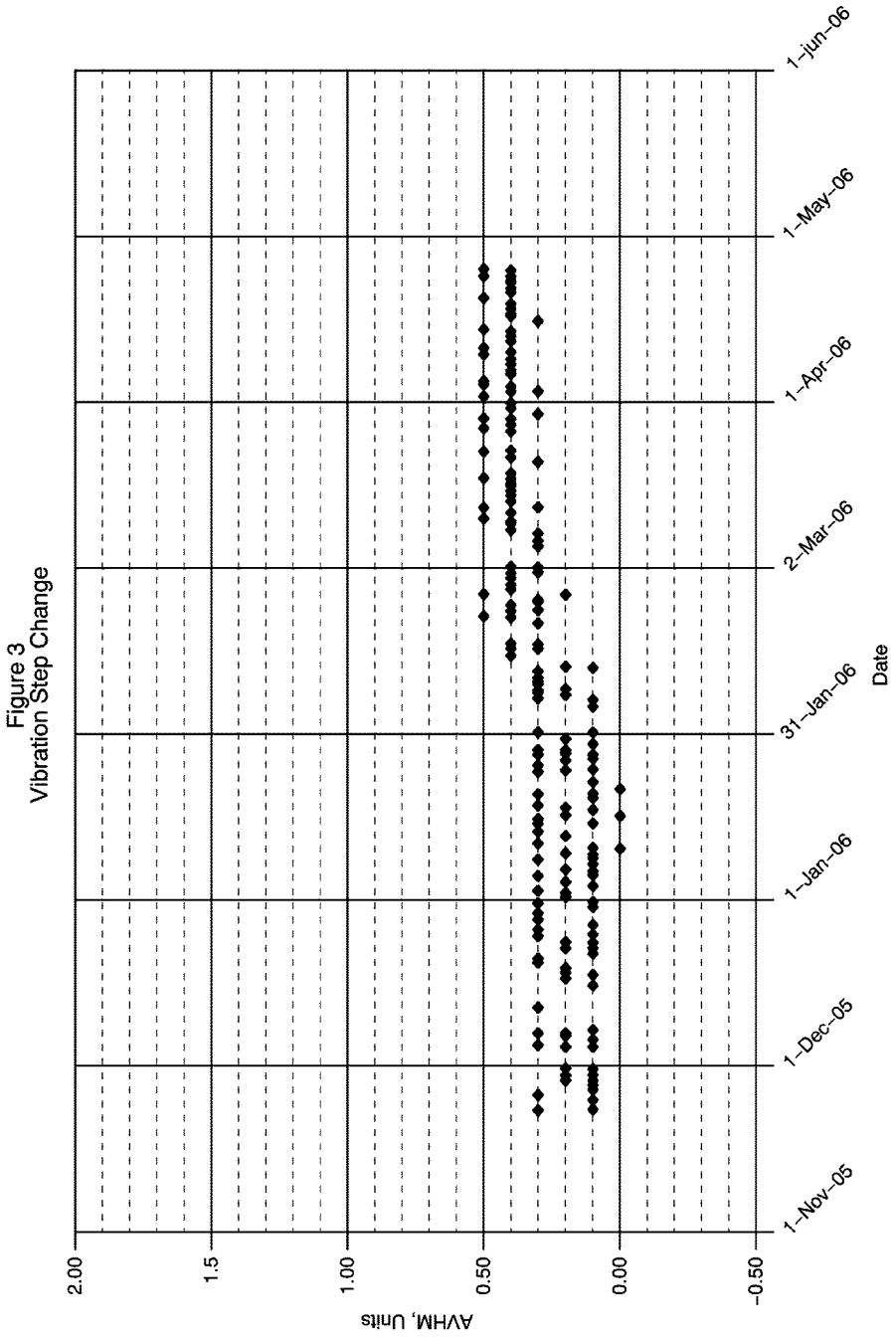

Figure 3
Vibration Step Change

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R Vibration Step Change
R Figure 3

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SERVICE BULLETIN

NON-MODIFICATION SERVICE BULLETIN - N2 VIBRATION MONITORING FOR THE HIGH PRESSURE TURBINE (HPT) STAGE 2 AIR SEAL

Supplement

Printed in Great Britain

V2500-D5

1. Modification Kit

There is no kit provided to do this Service Bulletin.

2. Material Cost

Not applicable

3. New Production Parts

Not applicable