P U B L I C A T I O N T R A N S M I T T A L

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DATER Oct. 7/02

V2500-D5 PROPULSION SYSTEMS SERVICE BULLETIN

This document transmits Revision 2 to Service Bulletin EV2500-72-0393

Document History

Service Bulletin Revision Status		Supplement Revision Status
Initial Issue	Jan.10/01	
Revision 1	May 25/01	

Bulletin Revision 2

Remove	Incorporate	Reason for change
Pages 1 to 20 of the Service Bulletin	Pages 1 to 21 of the Service Bulletin	To revise bolt torque figures Section 3.C. (3) and add associated illustration.

V2500-ENG-72-0393

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

LIST OF EFFECTIVE PAGES

The effective pages to this Service Bulletin following incorporation of Revision 2 are as follows:

Page		Revision Number	Revision Date
	Bulletin		
R	1	2	Oct.7/02
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ENGINE - HP COMPRESSOR VSV SYSTEM INSPECTION - NON-MODIFICATION SERVICE BULLETIN

1. Planning Information

A. Effectivity

(1) Boeing Longbeach Division MD 90

V2525-D5, V2528-D5 Engines prior to Serial No. V20286

(2) ATA Locator 72-00-00

B. Concurrent Requirements

None

C. Reason

The purpose of this Non-Modification Service Bulletin (NMSB) is to provide a one (1) time inspection check of the HP compressor stage 3 VSV system. The rig of the VSV system has a significant effect on the angle of the vanes and the performance of the HP compressor. Out of position stage 3 stator vanes, as a result of mis-rigging, can be a contributory factor to higher stage 4 blade root stresses, leading to blade root fracture. The bulletin also details any actions required to correct the rigging of the VSV system.

The NMSB includes the hysteresis check of the VSV system using the output from the VSV actuator, shown in 3.D. The previous mechanical check method can be used if the required electronic equipment is not available and is instructed in 3.G.

This Non-Modification Service Bulletin can be accomplished on-wing or in the overhaul shop prior to release of the engine.

D. Compliance

Category 4

Accomplish at the first visit of an engine to a maintenance base capable of compliance with the accomplishment instructions regardless of planned maintenance action. For engines in overhaul shops, this Non-Modification Service Bulletin should be accomplished after build and prior to despatch.

NOTE: The intent of this NMSB is to help minimise the occurrence of multiple-engine in-flight shutdown, powerloss or other anomaly due to maintenance error. Therefore, IAE recommends that operators avoid performing maintenance on multiple engines installed on the same aircraft at the same time, if at all possible. IAE however, recognises that some situations may be unavoidable. If it is not possible to avoid maintenance on more than one engine at the same time, IAE recommends that different maintenance teams service each engine. Maintenance guidelines should be revised, where possible, to promote this recommendation.

E. Approval

The compliance statement at 1.D. and the procedures in Section 3 of this Non-Modification Service Bulletin comply with the Federal Aviation Regulations and are FAA approved for the engine models listed.

F. Manpower

Estimated man-hours to embody this Service Bulletin in full:

In service

To gain access	1 hour 30 minutes
To embody Parts 3.C, D, E.	1 hour 30 minutes
If required, 3.G, H, I, J, K, L.	(2 hours 30 minutes)
To close up	1 hour
Total	4 hours (6 hours 30 minutes)

In Overhaul Shop

To embody	1 hour

G. References

(1) Internal reference OOVR852, OOVR852A

(2) Boeing MD 90 Aircraft Maintenance Manual (AMM), 72-00-00, Inspection/Check

(3) Service Bulletin V2500-ENG-72-0373 Ultrasonic inspection of HP compressor rotor 4 blades

2. Material Information

None.

3. Accomplishment Instructions

A. Tools and Equipment

The kit comprises:

NOTE: Equivalent standard of tooling may be used

(1) VSVA Test Set - IAE tool number IAE2R19548, must also include:

(a) Stage 3 Unison ring bracket - IAE tool number IAE1R19449

(b) VSV Crank shaft wrench adapter - IAE tool number IAE1R18674

(2) Stage 3 VSV Health Check Kit - IAE tool number IAE2R19549 (required to perform corrective action), includes:

(a) Unison ring build pins - IAE tool number IAE1R19547 (Equivalents IAE1R18247 and IAE1R18423)

(b) Crankshaft rig pin - IAE tool number IAE1R18254

(c) VSV actuator rig pin - IAE tool number IAE1R18891 (Equivalent IAE1R18282)

(d) Feeler gauges - various

B. Pre-Requisite Actions (for installed engines)

(1) Put a warning in the cockpit to tell persons not to start the engine

(2) Make sure that the engine has been shut down not less than 60 minutes before you do this procedure

(3) De-energise the FADEC

(4) Open the fan cowls (ref. AMM TASK 71-13-00)

(5) Deactivate the thrust reverser

WARNING: THE THRUST REVERSER HYDRAULIC CONTROL UNIT (HCU) MUST BE DEACTIVATED BEFORE WORKING ON OR AROUND THE THRUST REVERSER. FAILURE TO DEACTIVATE THE HCU CAN RESULT IN ADVERTENT THRUST REVERSER OPERATION AND INJURY TO PERSONNEL AND/OR DAMAGE TO EQUIPMENT

Deactivate the thrust reverser HCU (ref. AMM TASK 78-30-00)

(6) Open the thrust reverser halves (ref. AMM TASK 78-32-00)

(7) Remove the inner core cowls (ref. AMM TASK 71-12-11)

C. General condition of stage 3 VSV system (see Fig 1 and 2)

(1) Visually inspect the stage 3 VSV actuating levers and lever pin bushings (72-41-34, part number UP11069)

(a) If a cracked lever is found - Replace lever, see AMM 75-31-02

(b) If a bent lever is found - Replace lever within 50 cycles, see AMM 75-31-02

(c) If a broken lever is found - Reject engine

(d) If less than 22 bushings are found missing/incomplete - Replace bushings within 50 cycles, see 3.H.

(e) If more than 22 of the bushings are found missing/incomplete - Replace bushings within 50 cycles, see 3.H. - Accomplish Service Bulletin V2500-ENG-72-0373 within 50 cycles

(2) Make sure crankshaft assembly is securely attached to front casings - If attaching bolts are found to be loose (EIPC 72-41-34, Fig 1, items 604 and 762) - Re-torque bolts to between 180 and 220lbf.in (2.03 and 2.48 m.daN)

R (3) Make sure stage 3 connecting rods are securely attached to the crankshaft
R and unison rings - if attaching bolts are found to be loose re-torque the
R bolts iaw (a) or (b) below:

R (a) EIPC 72-41-34, Fig 1, bolt, item 234 torque between 170 and 210
R lbf.in. (1.92 and 2.37 m.daN)

R Ensure that castellated nut EIPC 72-41-34, Fig 1, item 230, is secured
R with split cotter pin EIPC 72-41-34, Fig 1, item 228.

R CAUTION: ENSURE THAT COTTER PIN IS CORRECTLY FITTED. REFER TO FIGURE
R 11

R (b) EIPC 72-41-34, Fig 1, bolt, item 236 torque between 180 and 220
R lbf.in. (2.03 and 2.48 m.daN)

(4) Make sure connector assemblies are securely attached to unison ring at stage 3 - If attaching bolts are found to be loose (EIPC 72-41-34, Fig 3, items 202, 282 and 284) - Re-torque bolts to between 85 and 105lbf.in (0.96 and 1.18 m.daN)

D. Check stage 3 unison ring hysteresis

NOTE: If tool number IAE2R19548 is not available, the pad clearances can be measured using the procedure in 3.G.

NOTE: Avoid use of the test set IAE2R19548 in close proximity to high energy electrical fields such as those produced by radio transmitter equipment

NOTE: To check battery condition of test set IAE2R19548, press and hold the 'Battery Condition' button. If LOW or RECHARGE illuminates, re-charge the battery prior to use, or operate from a suitable mains supply

(1) Install clamping bracket (tool number IAE1R19449) to the aft side of the front casing flange at the stage 3 variable stator vanes (see Fig 3 and 4)

(a) Remove harness bracket attaching bolts

(b) Attach bolt (1) loosely to the casing at hole location A

(c) Loosen the dowel nut (4) on the bracket (3)

(d) Attach bracket (3) to the casing using bolt (2) at hole location B

(e) Locate bracket onto bolt (1)

(f) Move the VSV system towards the high speed position until the dowel locates into the hole on the stage 3 unison ring (see Fig 8)

NOTE: The lever arms should be approximately axial to the engine

(g) Hand tighten bolts (1) and (2)

(h) Tap the bracket (3) down with a soft faced hammer to make sure the bracket is tight against the unison ring

(i) Fully tighten the bolts (1) and (2) and the dowel nut (4)

(2) Disconnect the two LVDT electrical connectors from the rear end of the VSV actuator (see Fig 5)

(3) Connect the lead between the 'LVDT interface' on the LVDT measuring equipment (IAE2R19548) and the two connectors at rear of the VSV actuator

(4) Press the 'ON/OFF' button to turn the test set on

(5) Press the 'Select Channel' button until EXCITATION and LANE A LVDT is illuminated. Confirm that the readout shows 5.997 to 6.003 volts

(6) Press the 'Select Channel' button until only LANE A LVDT is illuminated. Check the reading shown. Make sure that the reading is in the range 0.500 to 2.000 volts. If not, repeat steps (6) and (7) for LANE B

NOTE: The test must be carried out using the same LANE

(7) Put a dial-indication torque wrench with wrench adapter (tool number IAE1R18674) onto the wrench flats of the crankshaft

NOTE: Make sure the adapter is fitted in-line with the wrench handle. If the adapter is not fitted in line with the handle, the appropriate conversion factor must be used

(a) Apply and hold 200lbin (2.251 m.daN) torque clockwise to the VSV crank until the LVDT reading becomes constant. Record the value

(b) Apply and hold 200lbin (2.251 m.daN) torque anti-clockwise to the VSV crank until the LVDT reading is constant. Record the value

(c) Calculate the difference between the two readings

(d) Repeat steps (a), (b) and (c)

(e) Calculate the average of the 2 results

(f) If the average is greater than 0.325 volts - Measure the pad clearances within 50 cycles, see 3.G.

(g) Remove clamping bracket and parts (tool number IAE1R19449)

(h) Re-attach the harness bracket

(i) Disconnect LVDT measuring equipment (tool number IAE2R19548)

(j) Reconnect the electrical connectors to the rear of the VSV actuator (ref AMM 70-23-15)

E. Check stage 3 VSV rigging (see Fig 5 and 6)

(1) Check actuator/crankshaft rigging

(a) Set the VSV system to the high speed condition

(b) Insert rig pin (part number IAE1R18891) into the actuator ram

(c) Attempt to insert rig pin (part number IAE1R18254) through the rig pin hole in the front bearing housing and the crankshaft

(d) If rigging is out by more than half but less than one hole - Re-rig the actuator within 50 cycles, see 3.L.

(e) If the pin cannot be inserted and the rigging is out by greater than one hole - Re-rig the actuator within 50 cycles, see 3.L. - Accomplish Service Bulletin V2500-ENG-72-0373 within 50 cycles

(2) Check stage 3 VSV rigging

(a) Set the VSV system to high speed condition

(b) Insert rig pin (part number IAE1R18254) through the rig pin hole in the front bearing housing and the crankshaft

(c) Insert the stage 3 rigging pin (part number IAE1R19547) at the rigging bracket

(d) If stage 3 rigging is greater than one quarter of a hole out, but less than half a hole out - Check alignment of connector assemblies within 50 cycles, see 3.I.- Check for bent stage 3 connecting rod - Replace if necessary within 50 cycles, see AMM 75-31-02 - Re-rig the stage 3 VSV within 50 cycles, see 3.K.

(e) If stage 3 rigging is greater than half a hole out - Check alignment of connector assemblies within 50 cycles, see 3.I. - Check for bent stage 3 connecting rod - Replace if necessary within 50 cycles, see AMM 75-31-02 - Re-rig the stage 3 VSV within 50 cycles, see 3.K. - Accomplish Service Bulletin V2500-ENG-72-0373 within 50 cycles

F. Close-up actions

(1) Remove all the build pins and feeler gauges

For installed engines only

(2) Re-install inner core cowls (ref. AMM TASK 71-12-11)

(3) Close the thrust reverser halves (ref. AMM TASK 78-32-00)

(4) Activate the thrust reverser HCU (ref. AMM TASK 78-30-00)

(5) Close the fan cowls (ref. AMM TASK 71-13-00)

(6) Remove the warning notices

(7) Perform Test 1 Dry Motor Leak or Test 3 Idle Leak Check (ref. AMM TASK 71-00-00)

(8) If the VSV system has been adjusted, perform Power Assurance Test 11 (ref. AMM TASK 71-00-00)

(9) If the VSV system has not been adjusted, perform Electronic Engine Control (EEC) system idle Test 6 (ref. AMM TASK 71-00-00)

(10) A record of accomplishment is required. Inform the IAE representative that this NMSB has been accomplished. Complete the form at the back of the bulletin and return it to IAE. (Refer to Recording Instructions 3.M.)

3.G. 3.H. 3.I. 3.J. 3.K. 3.L.
Actioned to be performed only as indicated in 3.C. 3.D. 3.E.

G. Measure the pad clearances (procedure can be an alternative to 3.D.)

(1) Set the VSV system to the high speed condition. Do not install the crankshaft rig pin.

(2) Insert four build pins (part number IAE1R19547) into the unison ring. Start with the build pin diametrically opposite the crankshaft and work clockwise. Minor adjustments to the system position may be required. The build pins may need tapping with a soft-faced hammer to make sure they are located correctly. If the final pin cannot be installed because of a fuel supply line (IPC ref. 73-11-49, Fig 19 item 100), obscuring the hole, remove the fuel tube in accordance with AMM 73-11-47

(3) Measure and record the gap between the casing and the 4 centralising pads (72-41-34, Fig 3 item 680) and 4 compensating pads (72-41-34, Fig 3 item 730)

(a) Leave feeler gauges in place at each individual pad location until all 8 pad locations are measured

(b) Feeler gauges must be inserted circumferentially (see Fig 9)

(i) For pad No 1, insert the feeler gauge from the bottom of the pad, through the levers

(ii) For pad No 2, insert the feeler gauge from the top of the pad, through the levers

(iii) For pad No 3, insert the feeler gauge from the bottom of the pad , through the levers

(iv) For pad No 4, insert the feeler gauge from the top of the pad, through the levers

(v) For pad No 5, insert the feeler gauge from the top of the pad, from forward of the unison ring

(vi) For pad No 6, insert the feeler gauge from the top of the pad, through the levers

(vii) For pad No 7, insert the feeler gauge from the top of the pad, through the levers

(viii) For pad No 8, insert the feeler gauge from the bottom of the pad, through the levers

(4) If the total pad clearance exceeds 2,00mm (0.079in.) but is less than 2,40mm (0.094in.) - Re-shim the centralising/compensating pads within 50 cycles, see 3.J.

(5) If the total pad clearance exceeds 2,40mm (0.094in.) - Re-shim the centralising pads, see 3.J. - Accomplish Service Bulletin V2500-ENG-72-0373 within 50 cycles.

(6) Remove all feeler gauges and rig pins

(7) If the fuel supply line (IPC ref. 73-11-49 Fig 19 item 100) has been removed, re-install the fuel tube in accordance with AMM 73-11-47

H. Replace lever bushings

(1) Remove the lever, (AMM 75-32-02-020-801)

(2) Remove the damaged bush

(3) Clean the hole. Remove burrs and any lubricant

(4) Push the new bush into the hole until the safety feature is engaged

(5) Re-install the lever, (AMM 75-32-42-420-801)

(6) With a non-aerosol hand pump, spray the pin end of the lever arm with Triflow lubricant (CoMat 10-108)

(7) Apply Triflow lubricant on the whole of the VSV system mechanism (ref. AMM TASK 75-32-42)

I. Check and correct connector (bridge piece) assembly installation

(1) Attempt to insert a 0.001 - 0.002in. (0,03 - 0,05mm) feeler gauge at points between the connector assembly and the unison ring. Slide it along towards the dowel. if the dowel can be contacted, the connector assembly may be mis-aligned.

(2) Check the heads of the dowels to check for correct seating. Compare the heads with other dowel heads of the same stage.

(3) If evidence of mis-alignment is found:

(a) Remove the unison ring connector

(i) Remove the four bolts

(ii) Remove the four dowels

(iii) Remove the connector

(iv) Do not remove the adjusting spacers

(b) Re-install the unison ring connector

(i) Put the connector in to position on the unison ring

NOTE: Make sure correct location of the connector with the unison ring

(ii) Install the four dowels

(iii) Install the four bolts

(iv) Torque the bolts to between 85 and 105lbf.in (0.96 and 1.18 m.daN)

J. Re-shim stage 3 VSV centralising/compensating pad clearances

(1) Check alignment of connector assemblies (bridge piece), see 3.I.

If mis-alignment of a connector assembly was found and corrected, re-check the pad clearances, see 3.G.

(2) Make sure that no pad has a zero clearance

(a) For pads with a zero clearance, add or remove shims as necessary to give a clearance

NOTE: It may be necessary to remove the stage 3 connecting rod and/or move the unison ring to gain access to pad bolts

(b) Once all pads have a clearance, re-check the pad clearances, see 3.G.

(3) Disconnect the connecting rod to the stage 3 unison ring. Remove the 4 build pins (part number IAE1R19547)

(4) Select the pads to be re-shimmed. For the re-shimming procedure, all pads should be set to between 0.004 and 0.005in. (0,10 and 0,13mm)

(5) Remove the shims from one of the centralising pads to be re-shimmed (72-41-34, Fig 3 item 680)

NOTE: It may be necessary to remove the stage 3 connecting rod and/or move the position of the unison ring to provide access to the pad bolts

(6) Measure the removed shims

(7) Calculate the reduction or increase in shim size to give the desired clearance:

For the centralising pads (72-41-34, Fig 3 item 680) the gap should be set to between 0.004 and 0.005in. (0,10 and 0,13mm). For an increase in clearance, the total value of the shims must be increased. For a reduction in the clearance, the total value of the shims must be decreased

(8) Re-install the required value of shims

NOTE: A maximum of two shims can be installed

(9) Re-install the bolts and washers

(10) Torque the bolts to between 36 and 45lbf.in (0.40 and 0.50 m.daN)

(11) Repeat steps (7) to (13) for the remaining centralising pads to be re-shimmed

(12) Remove the shims from one of the compensating pads to be re-shimmed (72-41-34, Fig 3 item 730)

NOTE: It may be necessary to remove the stage 3 conecting rod and/or move the position of the unison ring to provide access to the pad bolts

(13) Measure the removed shims

(14) Calculate the reduction or increase in shim size to give the desired clearance

For the compensating pads (72-41-34, Fig 3 item 730) the gap should be set to between 0.004 and 0.005in. (0,10 and 0,13mm). For an increase in clearance, the total value of the shims must be decreased. For a reduction in the clearance, the total value of the shims must be increased

(15) Re-install the required value of shims

NOTE: A maximum of two shims can be installed

(16) Re-install the bolts and washers

(17) Torque the bolts to between 36 and 45lbf.in (0,40 and 0.50 m.daN)

(18) Repeat steps (16) to (20) for the remaining compensating pads to be re-shimmed

(19) Re-check the system hysteresis:

(a) Re-connect the stage 3 connecting rod

(b) Perform 3.D. above

(20) If the fuel supply line (IPC ref. 73-11-49, Fig 19 item 100) has been removed, re-install the fuel tube in accordance with AMM 73-11-47

K. Re-rig stage 3 VSV system

(1) Insert four build rigging pins (part number IAE1R19547) into the unison ring. Start with the build rigging pin diametrically oposite the crankshaft and work clockwise. Minor adjustments to the system position may be required. The build rigging pins may need tapping with a soft faced hammer to make sure of correct location (see Fig 8). If the final pin cannot be installed because of a fuel supply line (IPC ref.73-11-49, Fig 19 item 100) obscuring the hole, remove the fuel tube in accordance with AMM 73-11-47

(2) Check if the rigging pin (part number IAE1R18254) can be inserted into the crankshaft

(3) If the rigging pin cannot be inserted, adjust the length of the stage 3 connecting rod until it can be installed in the crankshaft

(a) Remove the wire that safeties the locknuts of the connecting rod

(b) Loosen the locknuts of the connecting rod

NOTE: One of locknuts has a left hand thread

(c) Turn the centre part of the connecting rod to adjust the length of the connecting rod

(d) Torque the two locknuts to between 180 and 220lbf.in (2,03 and 2,48 m.daN)

(e) Make sure that the connecting rod ends are aligned to less than 5 degrees

(f) Make sure that the connecting rod ends are in safety

(g) Safety the locknuts to the connecting rod ends with corrosion resistant steel lockwire

NOTE: One of the locknuts has a left hand thread

(4) Remove the build and rigging pins

(5) If the fuel supply line (IPC ref. 73-11-49, Fig 19 item 100) has been removed, re-install the fuel tube in accordance with AMM 73-11-47

L. Re-rig VSV actuator connecting rod

(1) Insert the rigging pin (part number IAE1R18891) at the actuator end

(2) Check if the rigging pin (part number IAE1R18254) can be inserted into the crankshaft

(3) If the rigging pin cannot be inserted, adjust the length of the actuator connecting rod until it can be installed in the crankshaft

(a) Remove the wire that safeties the locknuts of the connecting rod

(b) loosen the locknuts of the connecting rod

NOTE: One of the locknuts has a left hand thread

(c) Turn the centre part of the connecting rod to adjust the length of the connecting rod

(d) Torque the two locknuts to between 180 and 220lbf.in (2,03 and 2,48 m.daN)

(e) Make sure that the connecting rod ends are aligned to less than 5 degrees

(f) Make sure the connecting rod ends are in safety

(g) Safety the locknuts to the connecting rod ends with corrosion resistant steel lockwire

NOTE: One of the locknuts has a left hand thread

(4) Remove the build and rigging pins

M. Recording Instructions

A record of accomplishment is required. Inform the IAE representative that this NMSB has been accomplished. Complete the form at the back of the bulletin and return it to IAE

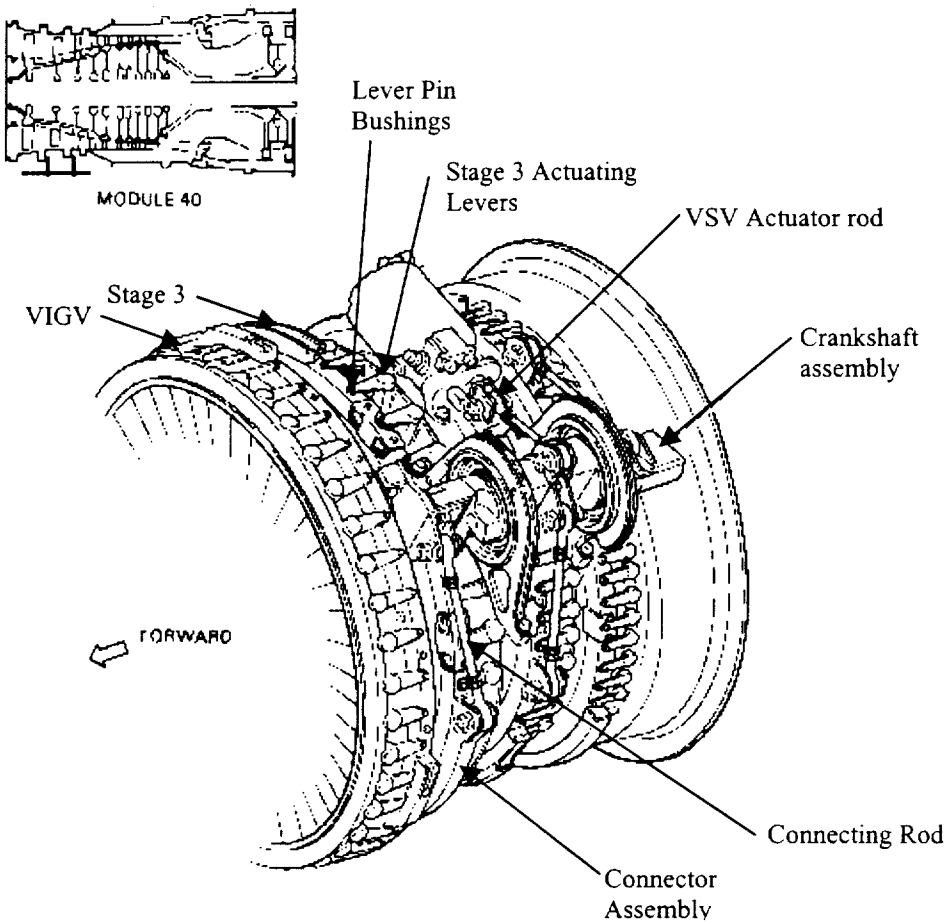


Figure 1 – VSV System

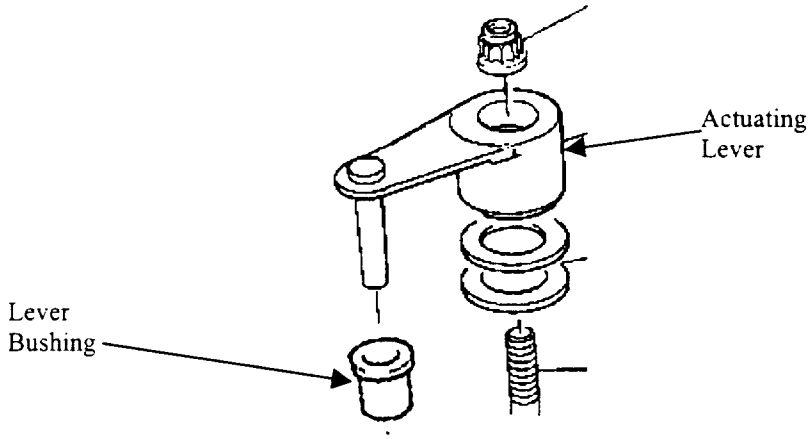
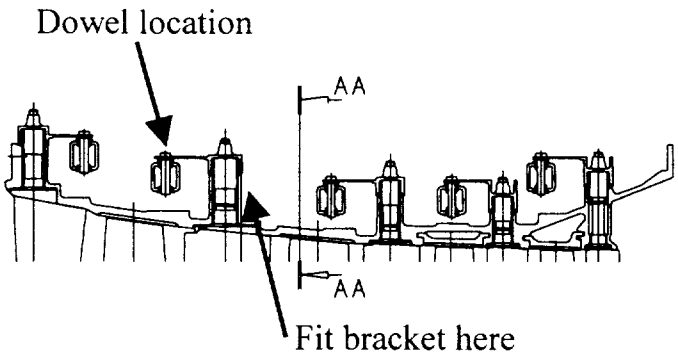
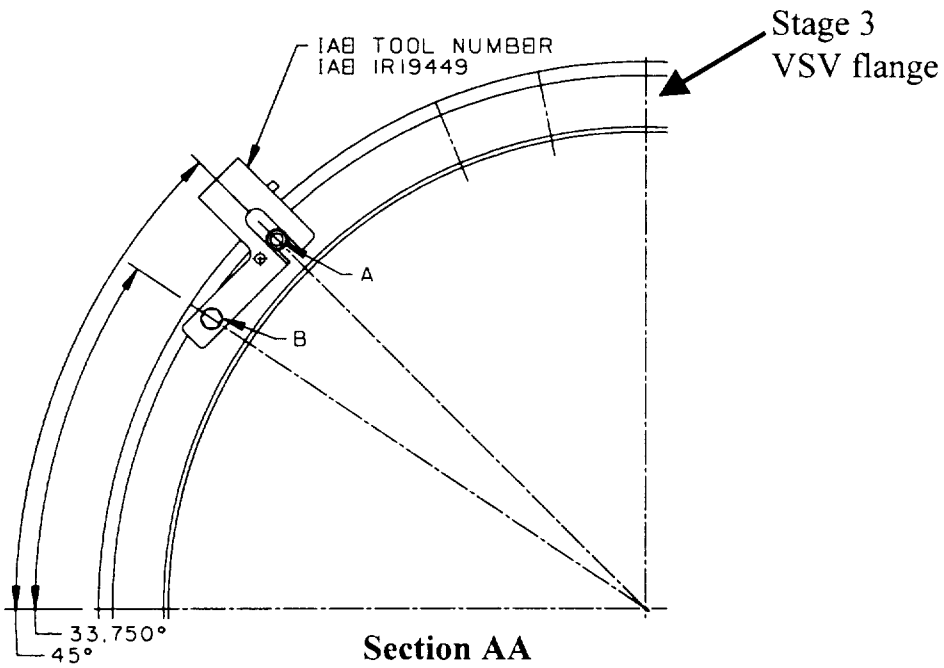


Figure 2 – Actuating Lever and bushing





Section AA
Looking forward showing tooling position on the front casing/stage 3 unison ring

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Bracket installation
Fig 3

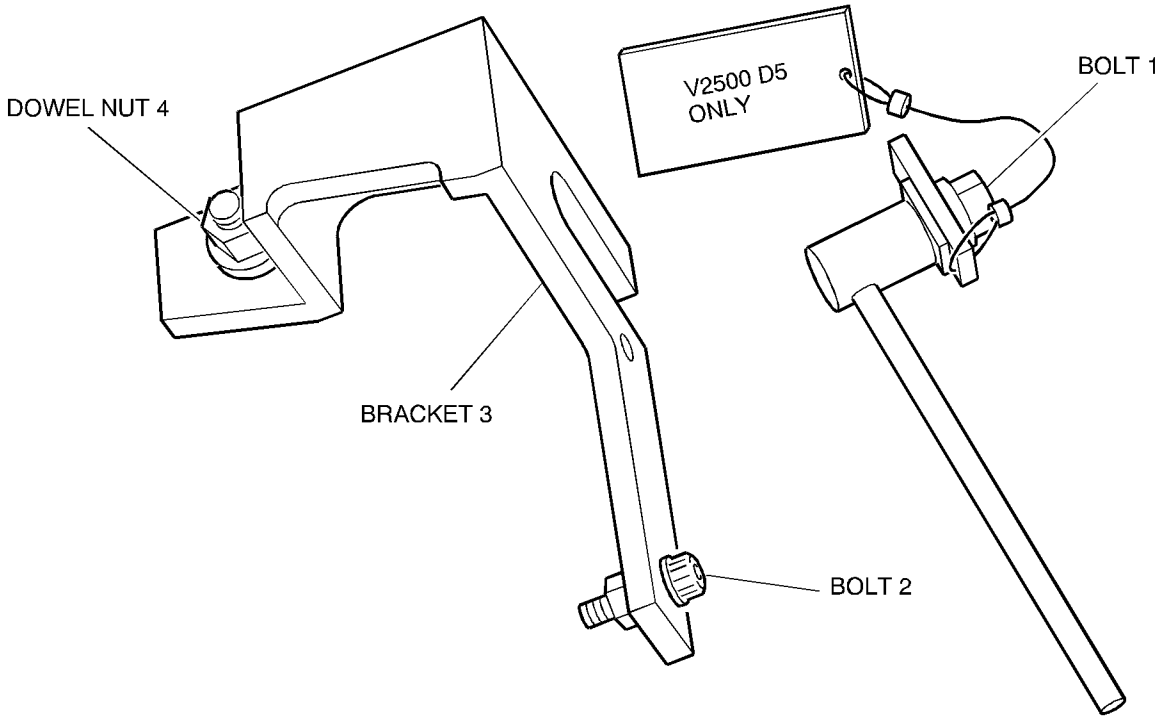

FIGURE 4 – BRACKET ASSEMBLY

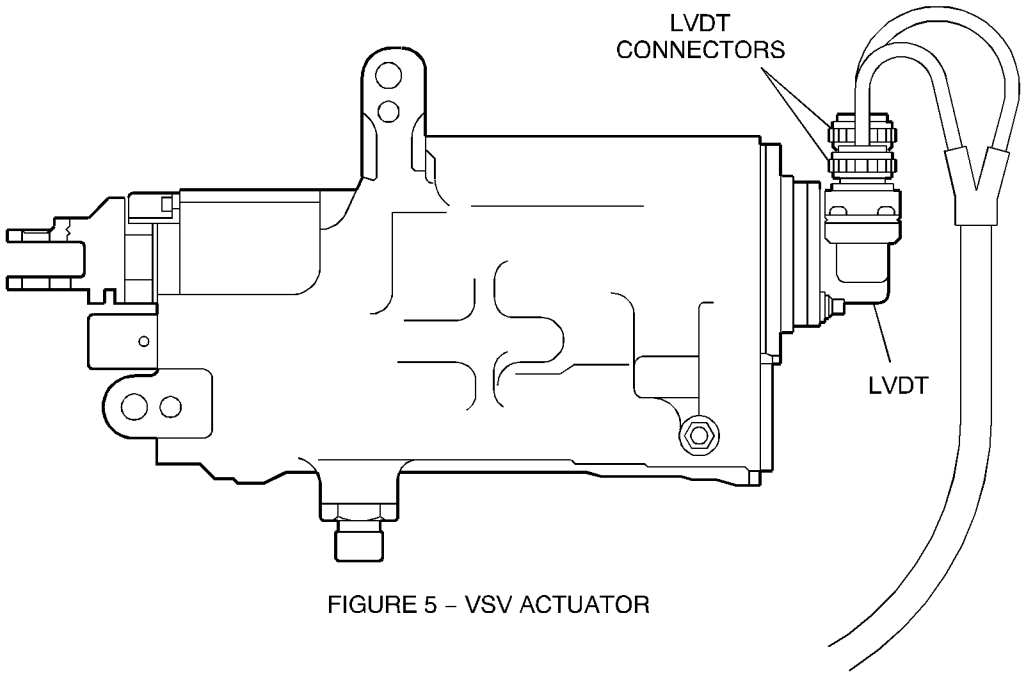

FIGURE 5 – VSV ACTUATOR

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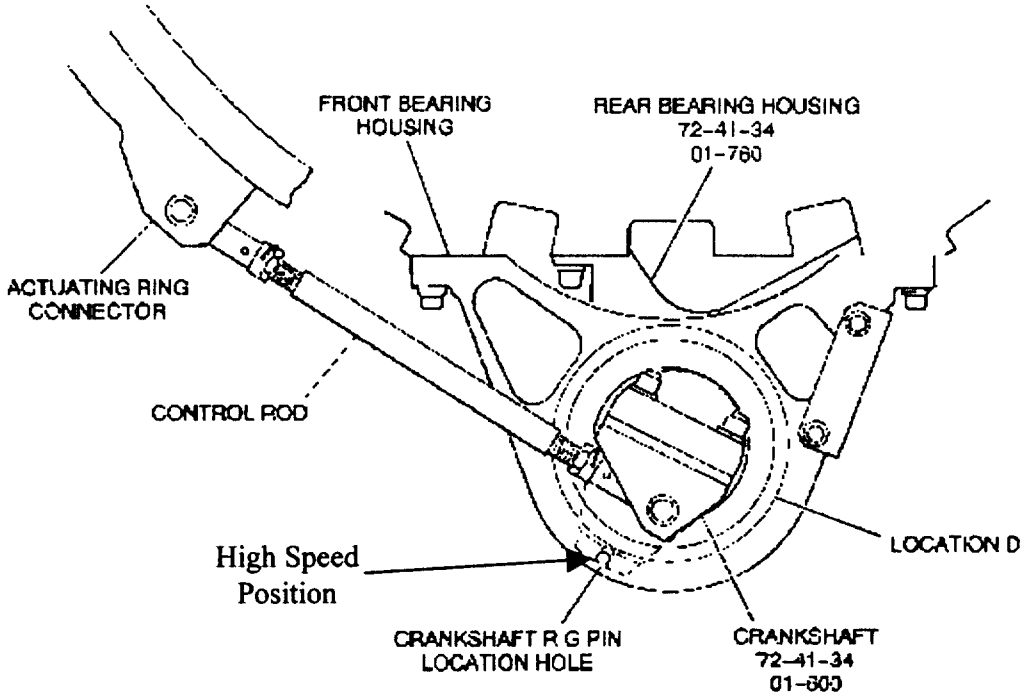

Figure 6 – Crankshaft Assembly

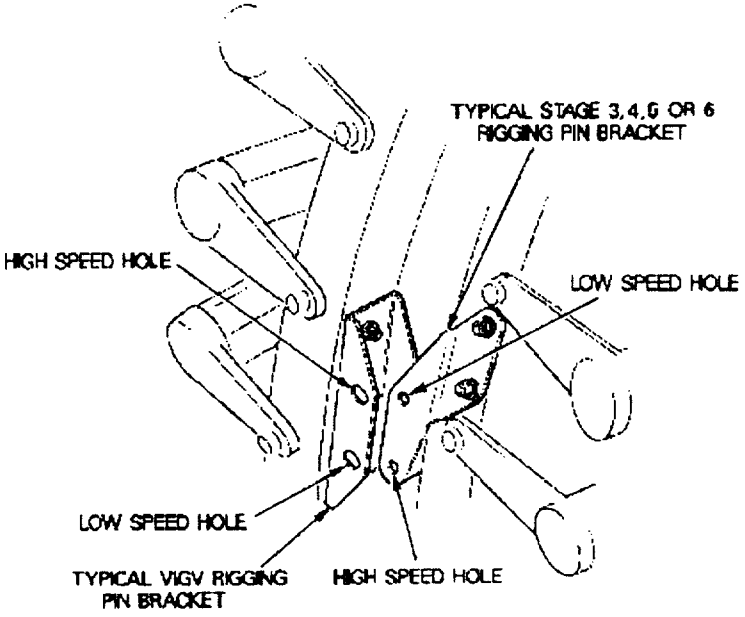

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Figure 7 – Rigging Bracket

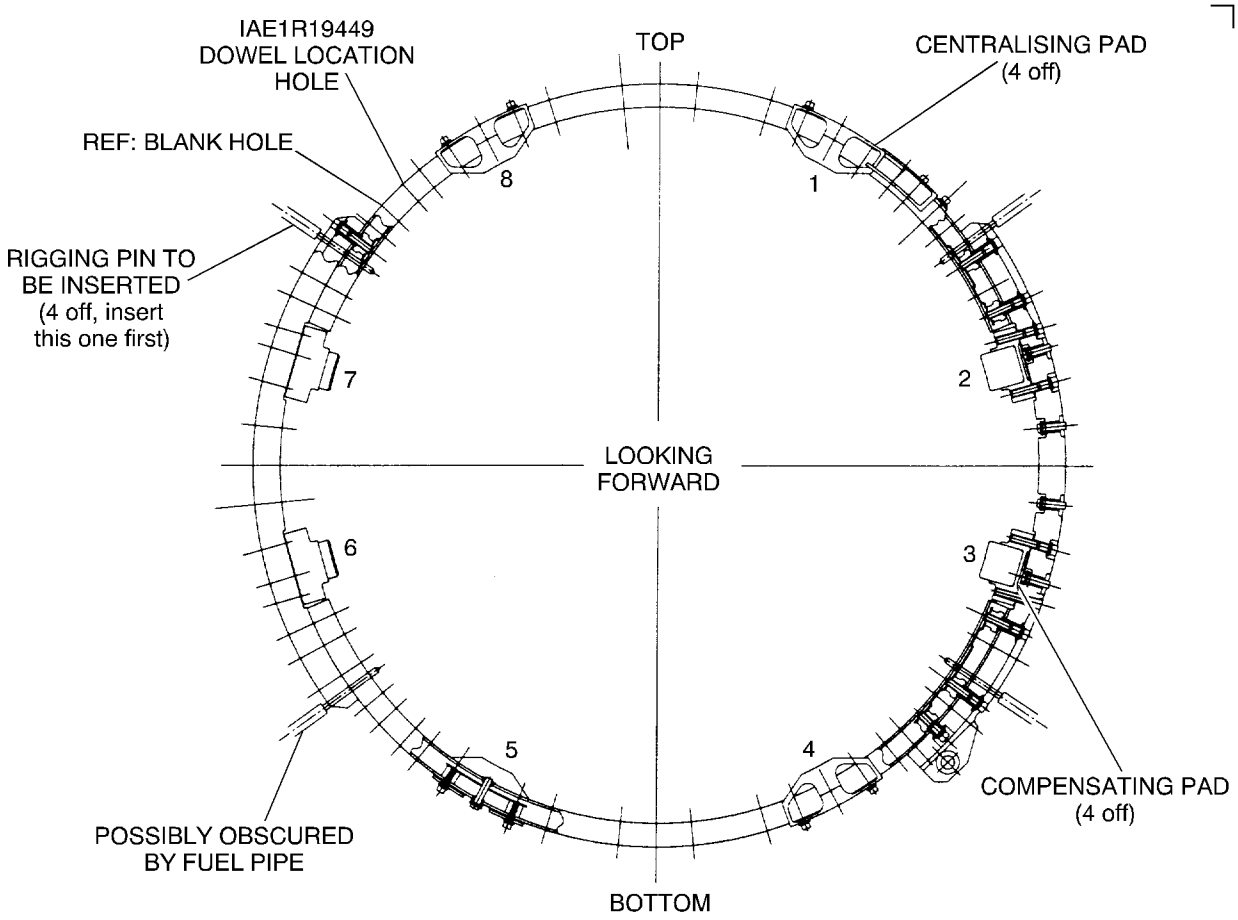

FIGURE 8 – STAGE 3 UNISON RING

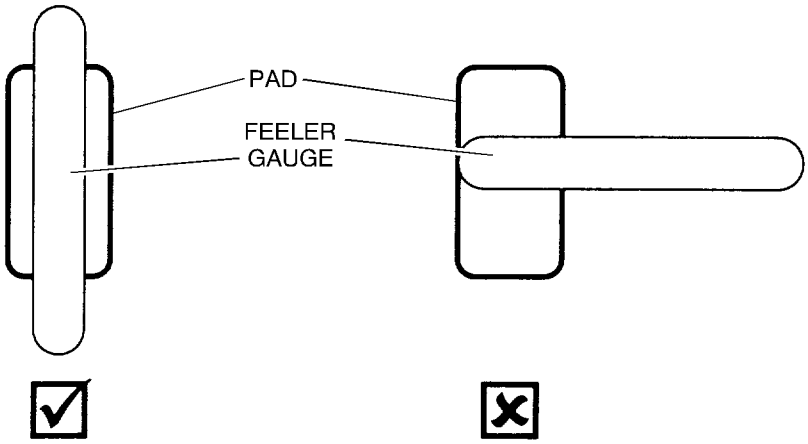

FIGURE 9 – FEELER GAUGE POSITION

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NMSB 72-0379 Record Form

Engine Number: _____ Hours: _____ Cycles: _____

Part A – General Condition Check

Lever condition:	Total Cracked	Total Bent	Total Broken

Lever Pin Bushings:	Total Damaged	Total Missing

Crankshaft securely attached:	Yes	No
Connecting rod secure:	Yes	No
Connector assembly secure:	Yes	No
Tri-flow VSV syst em:	Yes	No

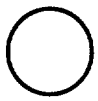
Part B – Stage 3 unison ring hysteresis

LVDT reading (clockwise):		
LVDT reading (anti-clockwise):		
Difference in reading:		
Average:		

Part C – Stage 3 VSV Rigging

Actuator Crank shaft rigging:

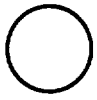
Amount of mis-rig:		of a hole
Re-Rigged:	Yes	No



(Indicate mis-rig on the hole)

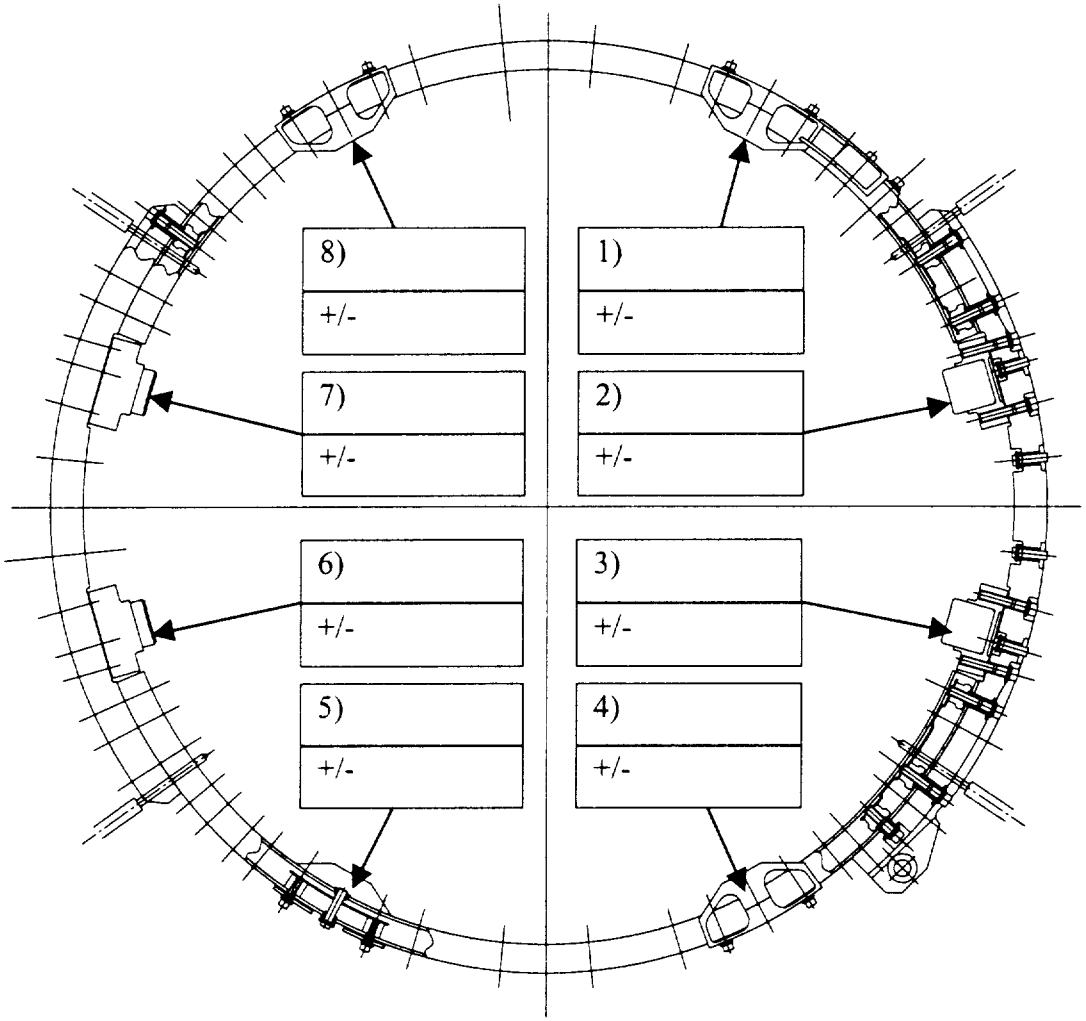
Stage 3 VSV Rigging:

Amount of mis-rig:		of a hole
Re-Rigged:	Yes	No



(Indicate mis-rig on the hole)

Return completed form to Mark Norridge, IAE Technical Services
Fax number: 44-1332-244067



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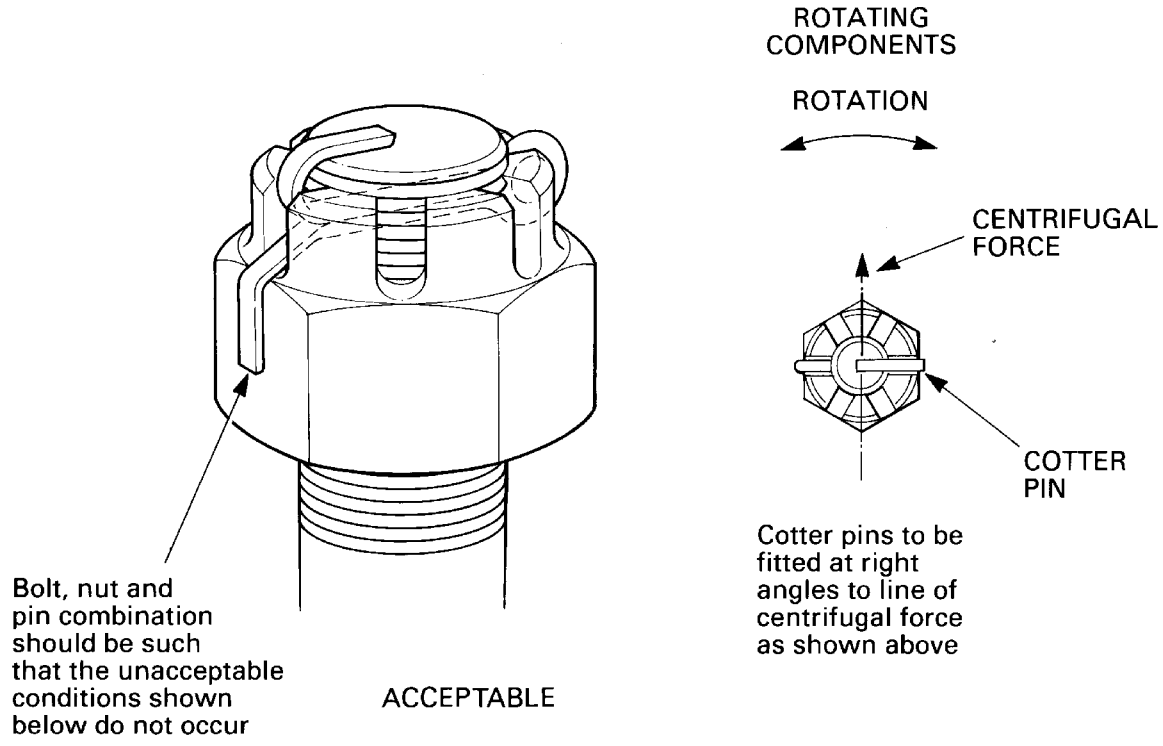
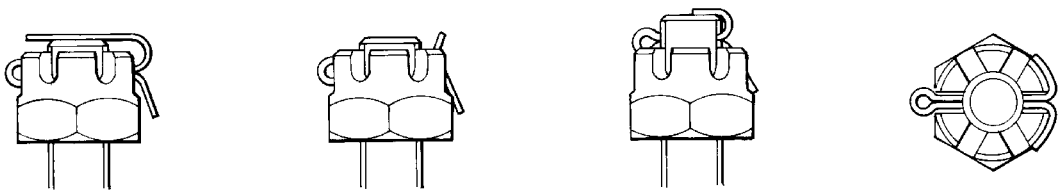
3.G.3.J. - Stage 3 pad clearances (if required)
(Indicate change in size of shim installed, as required, in box provided)
Fig 10





UNACCEPTABLE CONDITIONS

94731

R Installation of split cotter pin
R Fig 11