International Aero Engines
NON-MODIFICATION
SERVICE BULLETIN

Date: Apr.19/2007

ENGINE – HP COMPRESSOR, STAGE 3 ROTOR – REPEAT INSPECTION OF CLAPPERS – NON-MODIFICATION SERVICE BULLETIN

V2500-D5 SERIES PROPULSION SYSTEMS NON-MODIFICATION SERVICE BULLETIN

This document transmits Initial issue of Non-Modification Service Bulletin V2500-ENG-72-0545

Document History

Service Bulletin Revision Status

Initial Issue	Apr.19/2007

Bulletin Initial Issue

Remove	Incorporate	Reason for change
	Pages 1 to 24 of the Non-Modification Service Bulletin	Initial issue

V2500-ENG-72-0545

List of Effective Pages

The effective pages to this Non-Modification Service Bulletin are as follows:

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Bulletin		
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ENGINE – HP COMPRESSOR, STAGE 3 ROTOR – REPEAT INSPECTION OF CLAPPERS NON-MODIFICATION SERVICE BULLETIN

1. Planning Information

A. Effectivity

MD-90 In-service engines

Pre SB72-0487 Standard V2500-D5 engines operated by Saudi Arabian Airlines (SVA)

B. Reason

A number of stage 3 blade fractures have occurred within the SVA D5 fleet and in other A5 / D5 operators' fleets. The majority of blade fractures in the non-SVA fleet have been connected with Foreign Object Damage (FOD) or birdstrike events. During the investigations of SVA event engines, it has been noted that these engines have all also had a degree of stage 3 blade clapper wear supported by erosion on the clappers due to the operational environment. It is thought that a FOD event can be made worse by worn clappers exhibiting certain types of wear patterns. These may shingle the clappers and cause the blade airfoil to vibrate in 1st Flap with possible blade fracture.
There is a possible connection between the stage 3 blade fractures and FOD or birdstrike events and some wear patterns at the clappers, which can be made worse by erosion due to the SVA operational environment.

C. Description

This Non-Modification Service Bulletin (NMSB) 72-0545 requires an inspection of the HPC stage 3 blade clappers for signs of irregular wear or mis-alignment and gives data to identify wear and to reduce stage 3 blade fractures.
The NMSB has been written to monitor wear on SVA HPC stage 3 blade clappers that have accumulated more than 3000 cycles in SVA operation only since new or since clapper repair.

D. Compliance

Category Code 3

For all engines in 1.A. Effectivity with HPC stage 3 blades that have accumulated more than 3000 cycles in SVA operation only since new or since clapper repair, inspect the clappers in accordance with 3. Accomplishment Instructions at the next 'A' check and repeat every 500 cycles unless specified by this Non-Modification Service Bulletin.

E. Approval

The compliance statement in section 1.D and the procedures in section 3 of this NMSB complies with the Federal Aviation Regulations and is FAA-Approved for the engine models listed.

F. Manpower

Estimated man-hours to embody the inspection task of this NMSB:

In Service	Est. Manhours
To gain access	1 hour
To embody	2 hours
To close up	0.5 hour
Total	3.5 hours

G. Material Price and Availablility

None

F. Tooling Price and Availability

None

H. References

(1) Boeing AMM Task 72-00-02-290-801 – Borescope of HP Compressor

(2) IAE Engineering Change Number – 07VR773

(3) ATA Locator – 72-00-00

2. Material Information

None.

3. Accomplishment Instructions

A. Do an inspection the HPC stage 3 blades for signs of damage (for example: nicks, tears, cracks, dents or any tip damage or discoloration). Follow the procedure in the applicable AMM at the next 'A' check and repeat every 500 cycles unless stated in the applicable task.

CAUTION: IN ORDER TO REDUCE THE POTENTIAL FOR MULTIPLE ENGINE IN-FLIGHT SHUT DOWN, POWER LOSS, OR OTHER ANOMALIES DUE TO MAINTENANCE ERROR, IAE RECOMMENDS THAT OPERATORS AVOID PERFORMING MAINTENANCE ON MULTIPLE ENGINES INSTALLED ON THE SAME AIRCRAFT AT THE SAME TIME. IF IT IS NOT POSSIBLE TO AVOID MAINTENANCE ON MORE THAN ONE ENGINE AT THE SAME TIME, IAE RECOMMENDS THAT ADDITIONAL CONTROLS BE APPLIED IN ORDER TO ENSURE THAT MAINTENANCE TASKS HAVE BEEN COMPLETED AS DEFINED. MAINTENANCE GUIDELINES SHOULD BE REVISED WHERE POSSIBLE, TO PROMOTE THIS RECOMMENDATION.

B. Do an inspection of the HPC stage 3 blade clappers and compare with the pictures in each of the coloured sections

(1) Description of clapper alignment and clapper wear

NOTE: The pictures shown in the accomplishment instructions are general and may not be typical of all examples of clapper wear. They should be used for general reference only.

(a) **Radial Alignment** – the faces of the two contacting clappers are covering each other completely. This is given as a percentage with 100% alignment. Refer to figure 2.

(i) **Aligned** – clappers which are at least 50% aligned of the contact surface.

(ii) **Mis -aligned** – clappers less than 50% aligned of the contact surface.

NOTE: There are differences in the clapper face areas between blade vendors. As a result, the clapper face of one blade may 'go across' the face of the mating blade on both the top and bottom. If this occurs, use the smaller of the two faces for determining the percentage alignment.

NOTE: 50% alignment usually is related to 0.040 in. (1 mm) of exposed clapper face in the radial direction.

(b) **Shingling** – clappers that are no longer abutting each other but are riding over each other. This happens after total misalignment of the clappers.

(c) **Vertical Wear** – wear/erosion of the mating clapper faces usually due to loss of hard-face coating on one or both faces. The clapper faces are not slanted. Refer to figure 1.

(i) **Regular Wear** – wear into the clapper faces which is flat or even, but is not slanted.

(ii) **Irregular Wear** – uneven wear into clapper faces when seen from the radial or axial direction.

(iii) **Stepped Wear** – wear into clapper faces which causes a step shape. The step can be in the radial direction, or along the face of the clapper (in the direction of the airflow). The wear between the two clapper faces is vertical (radial) – not slanted.

(d) **Slanted Wear –** wear between the clapper faces which is at an angle (usually 45 degrees). This type of wear shows a condition for the clappers to slide on top/under each other and become shingled. Refer to figure 1.

NOTE: Because of the different types of clapper wear conditions, it is not possible to give an accurate measure of permitted clapper wear. The wear condition of each pair of clappers must be inspected independently according to the inspection check. Any further, subsequent procedures must be agreed between the operator and IAE Technical Services.

(2) Shingled Clappers: reject the engine immediately if any shingled clappers are found. Refer to the red section

(3) Cracks or loss of material in non-contact areas: reject the engine immediately. Refer to the red section

(4) Peeling of material that indicates clapper override (e.g. Peeling of material on the clapper horizontal surface), or uniform heavy peeling along the full width of the clapper contact face indicating significant loss of hard coating: reject the engine within 10 cycles. Refer to the red section

NOTE: The conditions that follow can apply when the clappers look to be less than 50% aligned. There can be gaps between the clapper faces and this can be acceptable. However, gaps can visually make the misalignment look worse. Be very careful when inspecting wear and misalignment where there is a gap between clapper faces. If unsure, review from other angles to better assess alignment. The minimum recommendation for reviewing clappers is to inspect from two different angles (to assess both the vertical and horizontal faces of the clappers).

(5) Mis-aligned: Reject the engine immediately. Refer to the red section

(6) Aligned with no wear: Accept. Refer to the green section

(7) Aligned with mild vertical regular, irregular or stepped wear: Accept. Refer to the green section

(8) Aligned with advanced vertical regular, irregular or stepped wear: Accept and do an inspection again within 100 cycles. IAE experience suggests that once clapper wear is in the amber region, the engine will typically require removal within 500 cycles. Refer to the Amber section

(9) Aligned with slanted wear: Reject the engine within 10 cycles. Refer to the red section

C. Record Inspection

IAE recommends that operators digitally record evidence of inspections, either as videos or as photographs. Digital recording allows the previous condition to be reviewed when performing a repeat inspection which will enable a better understanding of how the clappers are wearing.

To assist operator feedback, Fig. 3 and Fig. 4 include a form and a sketch to record the results of the inspection. This form should be returned to the local IAE representative when the inspection in accordance with this NMSB 72-0545 is completed.

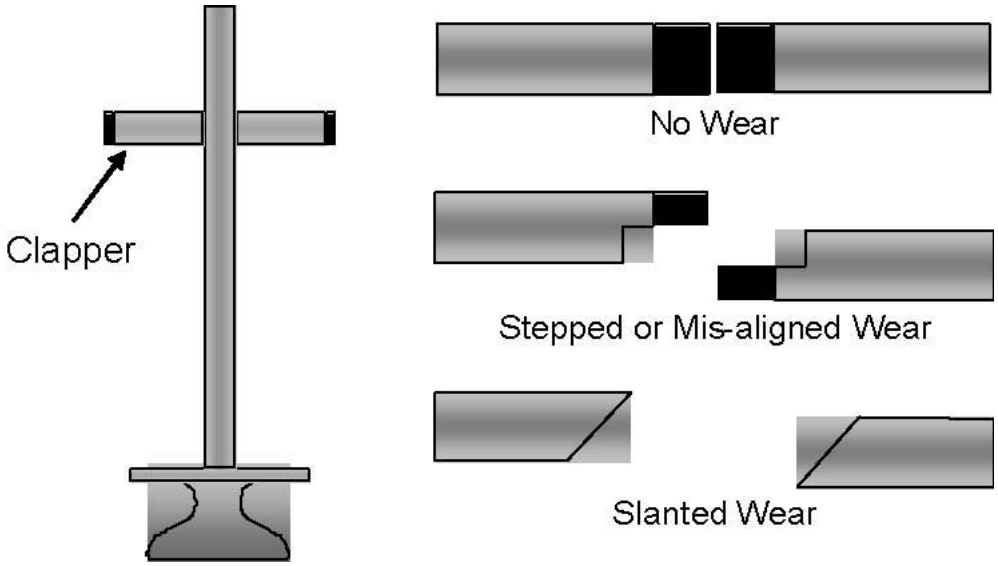

Fig 1: Axial views of clapper showing types of wear

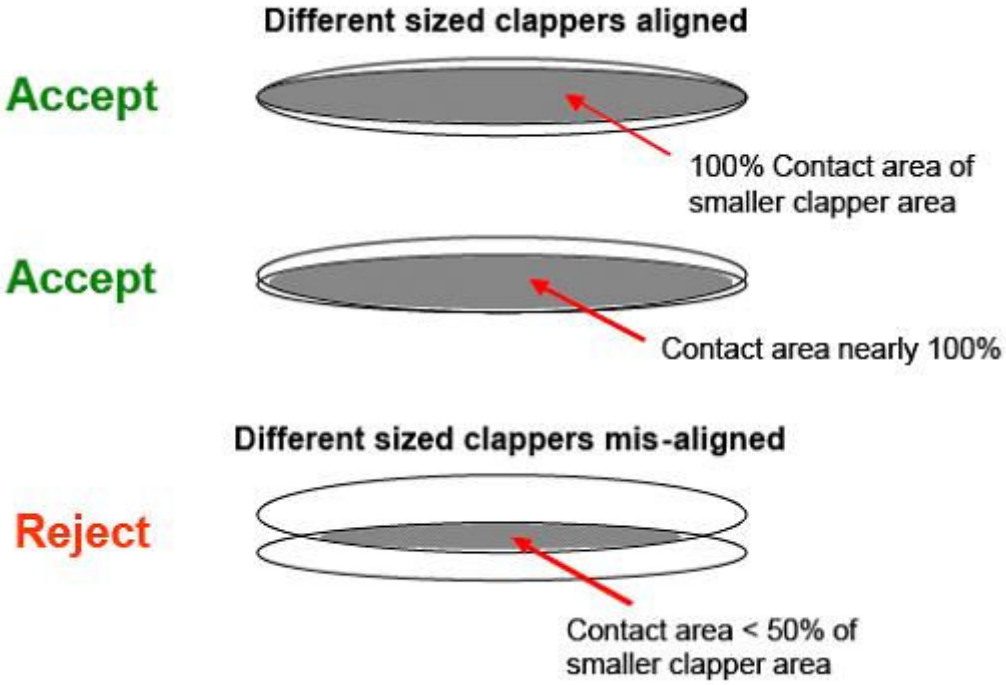

Fig 2: Clapper alignment criteria

Fig 3: Form for recording NMSB72-0545 inspection results

Operator:	Engine Serial No:	Date:
Engine Hours Since New:	Engine Cycles Since New:	Overall Classification: GREEN / AMBER / RED*
Engine Hours Since Last Shop Visit:	Engine Cycles Since Last Shop Visit:	

	Wear description tick list (more than one may apply)			
Clapper pairs (between blades)	Misaligned wear	Shingled	Vertical wear	Slanted wear
1-2				
2-3				
3-4				
4-5				
5-6				
6-7				
7-8				
8-9				
9-10				
10-11				
11-12				
12-13				
13-14				
14-15				
15-16				
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21-22				
22-23				
23-24				
24-25				
25-26				
26-27				
27-28				
28-29				
29-30				
30-31				
31-1				

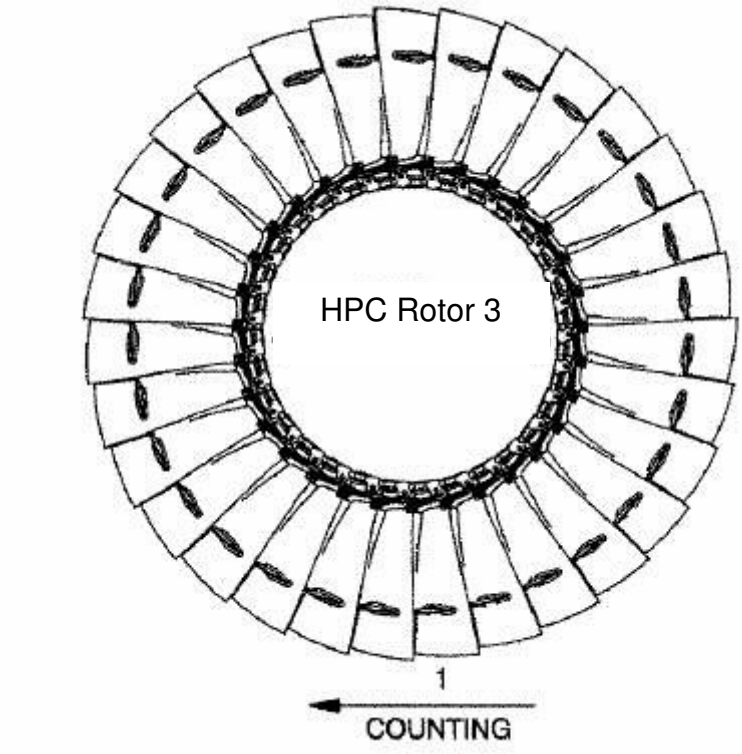
*Delete as applicable

NOTE: Where there is no significant wear, enter NONE in the wear description column
NOTE: Blade numbers are relative to each other only. There are no absolute blade positions.

Fig 4: Sketch for recording NMSB72-0545 inspection results

Operator:	Engine Serial No:	Date:
Engine Hours Since New:	Engine Cycles Since New:	Overall Classification: GREEN / AMBER / RED*
Engine Hours Since Last Shop Visit:	Engine Cycles Since Last Shop Visit:	

*Delete as applicable



NOTE: Count the blades as the rotor is rotated in the anti-clockwise direction (viewed from the front). The first blade to be inspected should be designated number 1.

RED SECTION

REJECT THE FOLLOWING

Aligned Severe Irregular Wear, Cracking and Material Missing

Mis-Aligned

Severe Stepped Wear

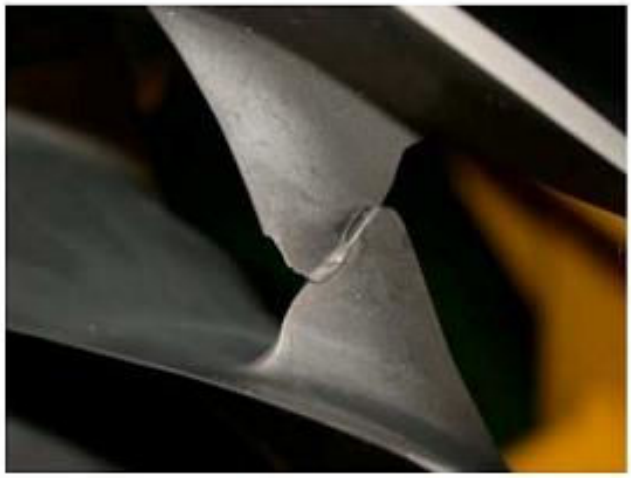
Material Peeling

Bent or Totally Mis-Aligned Clappers

Clapper Shingling

Slanted Wear

RED SECTION



Severe Irregular Wear Material Missing and Cracking

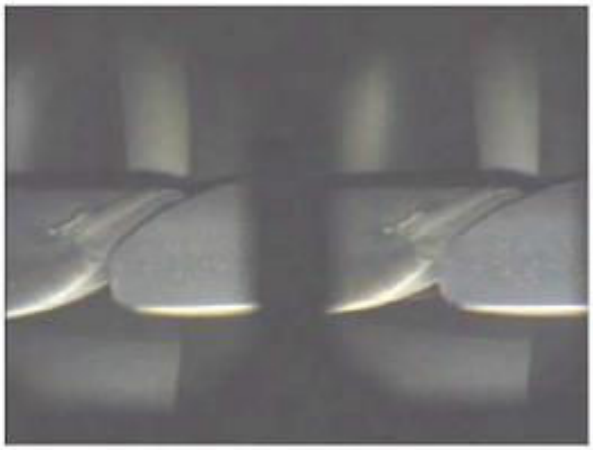
Material Peeling

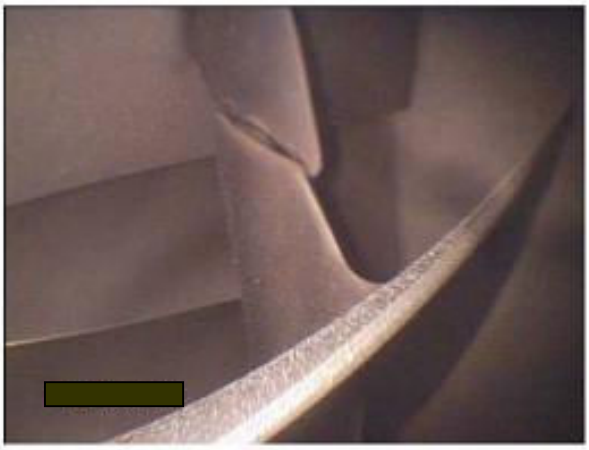
Material Peeling

RED SECTION

Mis-Aligned Stepped Wear

Irregular Wear Leading to Slanted Wear



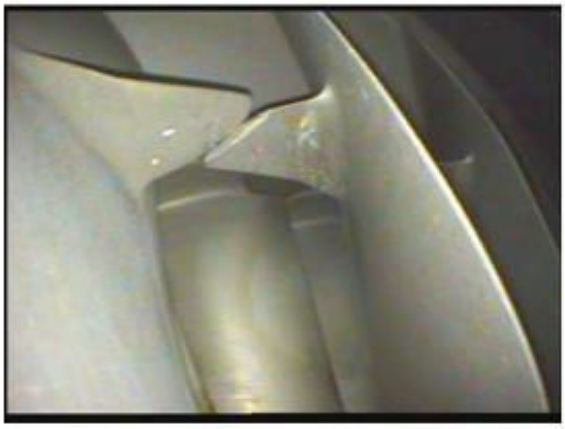


HAS THE APPEARANCE OF SLANTED WEAR REVIEW FROM OTHER ANGLES

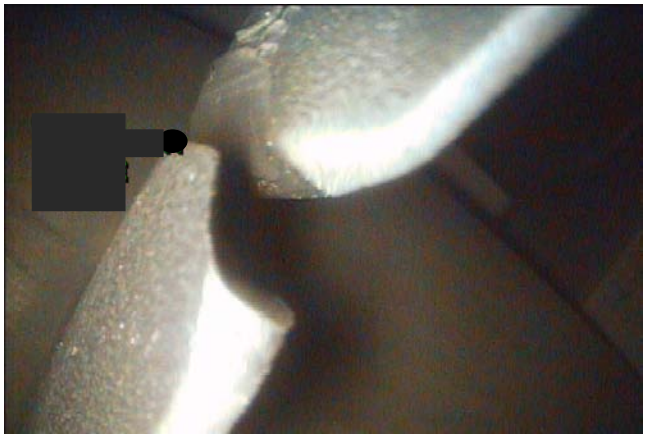
RED SECTION

Shingled

RED SECTION



Shingled as a Result of Bird Strike



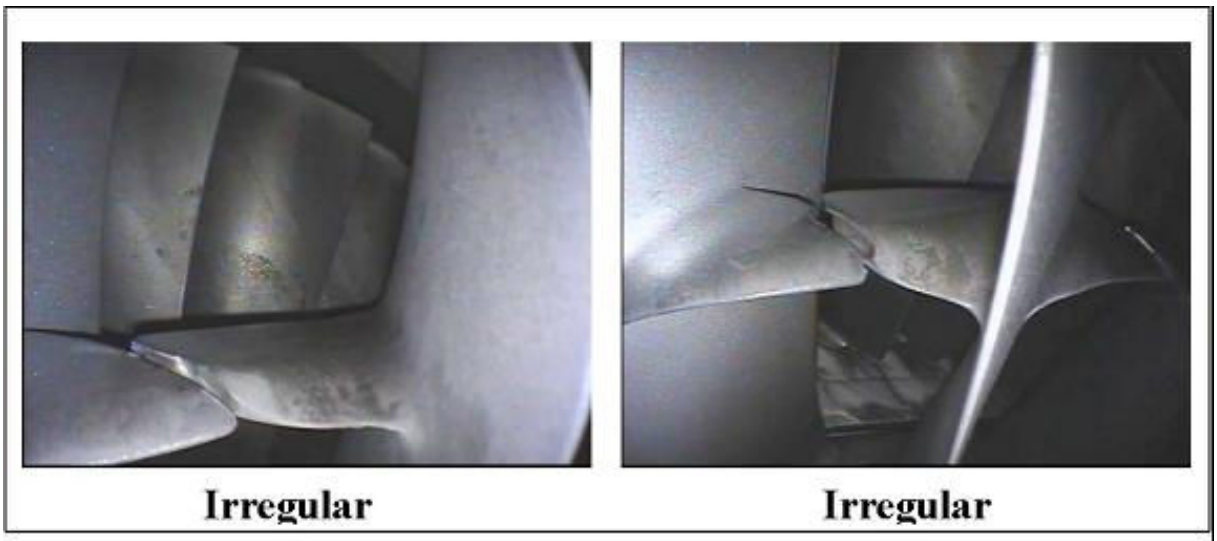
Peeling Material along large section of clapper horizontal surface – evidence of clapper override

RED SECTION

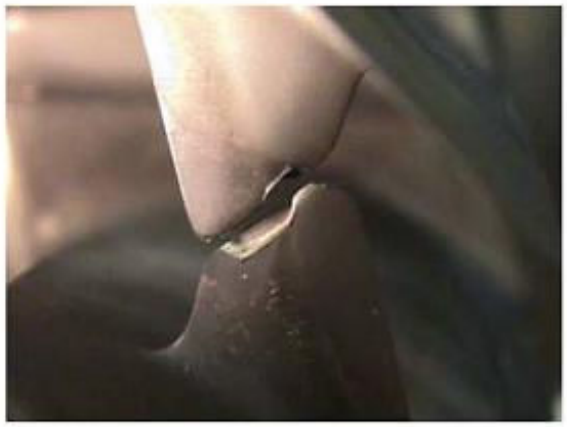
Clappers Totally Mis-Aligned and Blade Bent
Result of Bird Strike

AMBER SECTION
ACCEPT, RE-INSPECT WITHIN 100 CYCLES

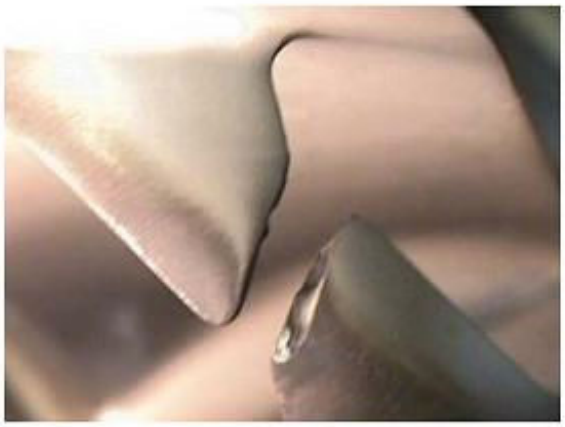
Advanced Aligned Irregular and Stepped Wear, Advanced Mis-Aligned Irregular and Stepped Wear, Mis-Aligned Clappers With More Than 50% Clapper Face Contact.



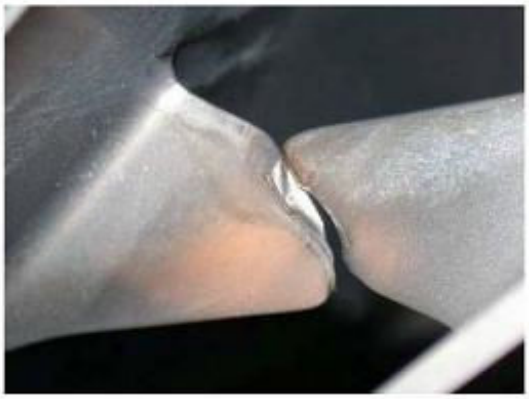
AMBER SECTION



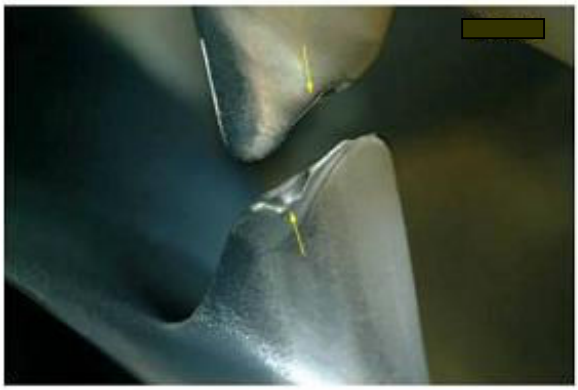
Irregular and Stepped



Irregular Hollowing



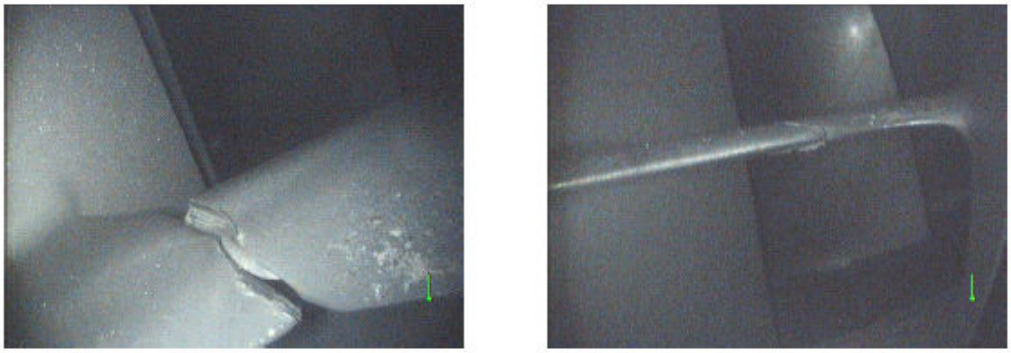
Irregular and Stepped



Irregular and Stepped

AMBER SECTION

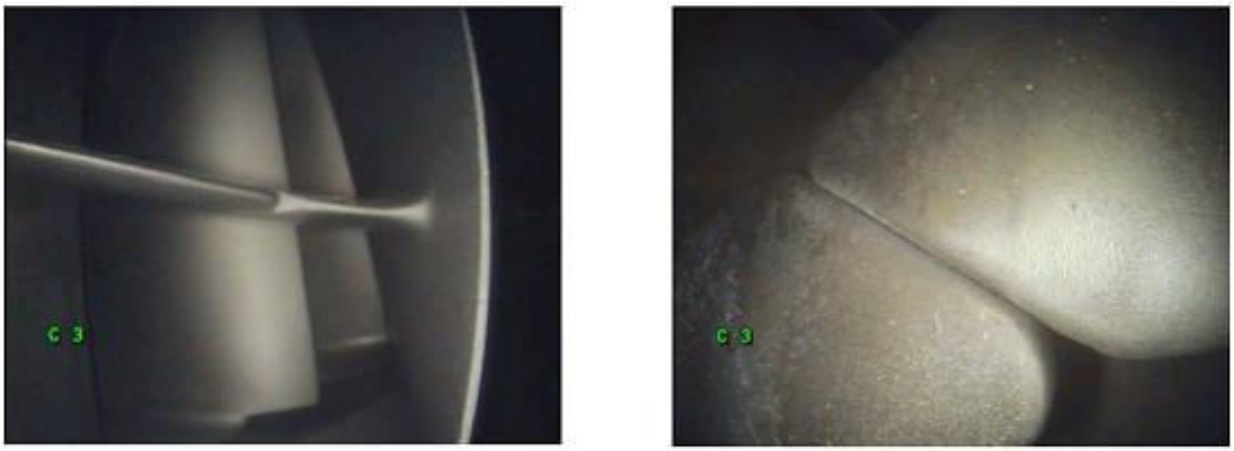
Aligned Stepped Wear



Advanced Aligned Irregular Wear to same pair of blades

GREEN SECTION
ACCEPT

CLAPPERS WITH GOOD ALIGNMENT NO OBVIOUS WEAR



CLAPPERS WITH GOOD ALIGNMENT NO OBVIOUS WEAR

GREEN SECTION

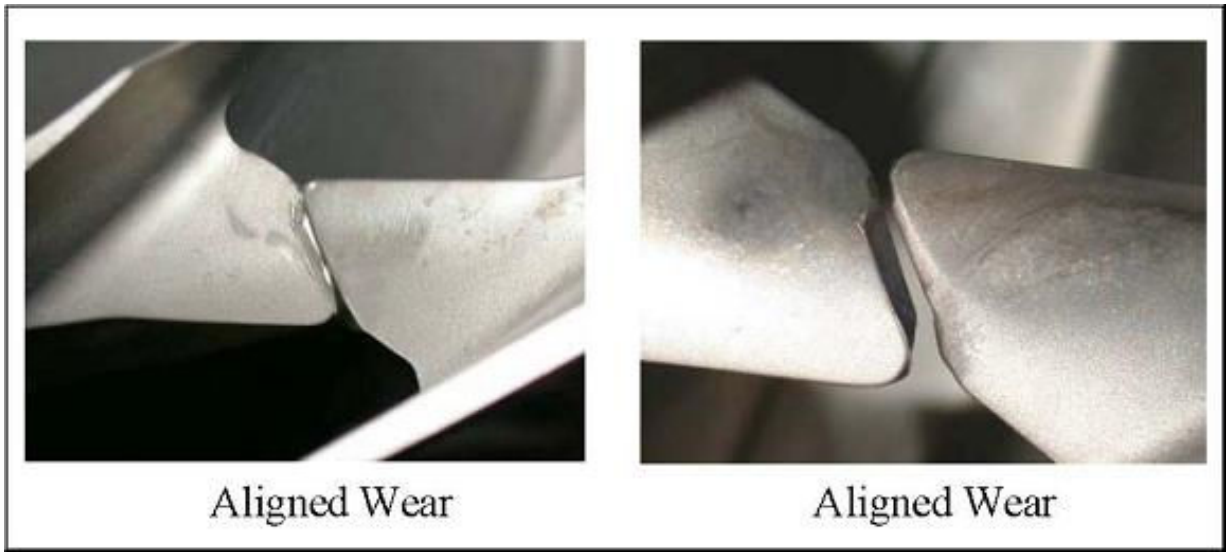
COULD BE HIDING
SOME WEAR REVIEW

GOOD ALIGNMENT NO
OBVIOUS WEAR

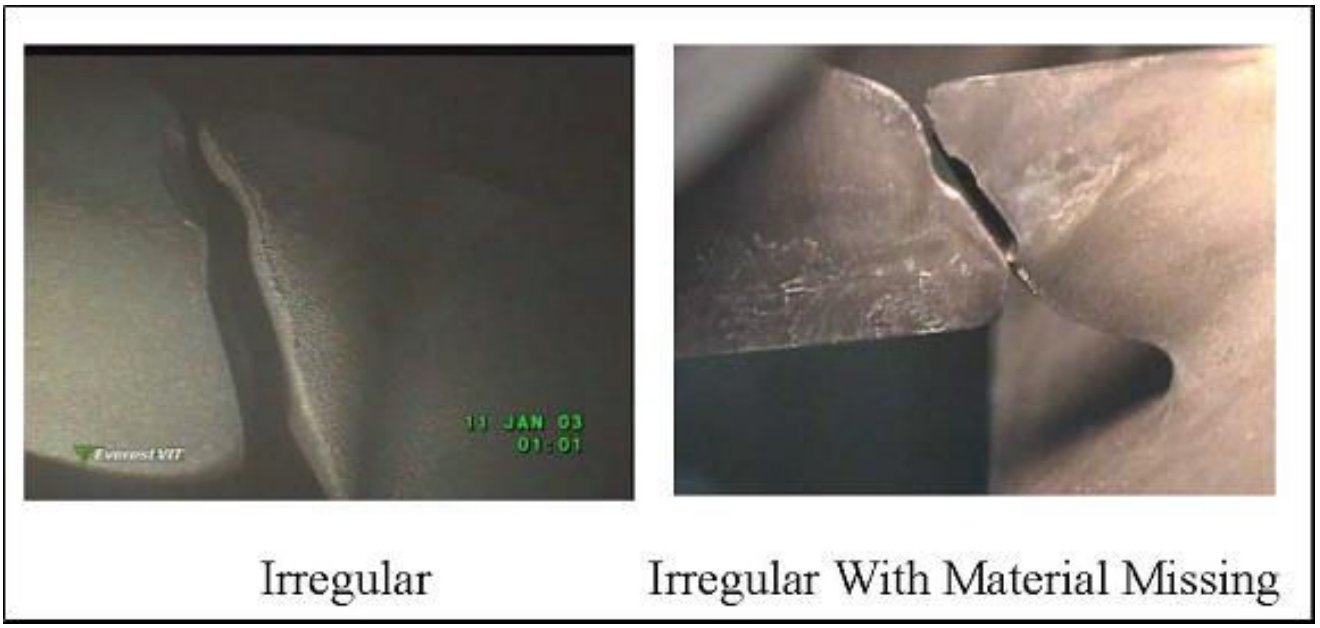
Normal

Normal

GREEN SECTION



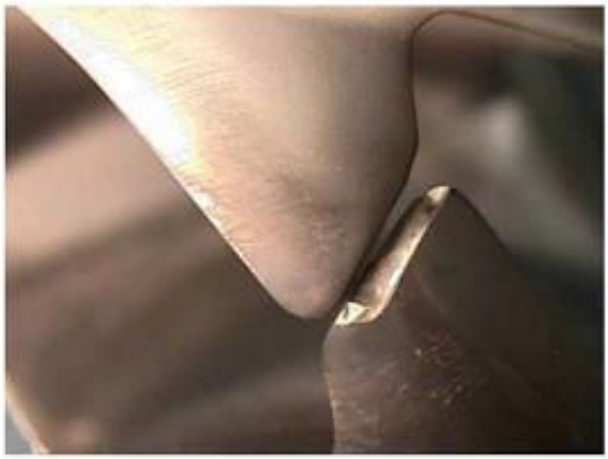
Wear evident on the clapper faces is vertical (no step evident)



GREEN SECTION

Aligned Stepped Wear

GREEN SECTION



Aligned Wear

Aligned, some irregular wear

Aligned Vertical wear

Aligned

GREEN SECTION

Aligned

50% Aligned

Aligned 100% face Wear

Aligned irregular Wear

GREEN SECTION

Aligned Irregular Wear

Aligned Hollowing of Face