Department of Air

Technical Order

NENE INSTRUCTION NO.3 (Issue 2)
(Cancels and supersedes Issue 1)

Application: Nene (All types)

NOZZLE GUIDE VANES - LIMITS OF CRACKING AND DISTORTION

Introduction

1. Nozzle guide vane deterioration, which may occur in service, will be shown by:-

(a) cracking, tending ultimately to cause pieces of the vane to become detached due to intersection of the cracks; and

(b) bowing, causing local alteration in the turbine inlet area with consequent increase in jet pipe temperature, in addition to the undesirable distortion of the vanes with increased tendency to cracking.

2. This instruction lays down the standards of acceptance and rejection for nozzle guide vanes during engine life.

NOTE: The figures laid down are based on overseas experience and are to be carefully adhered to. They may, however, be subject to amendment as further operating experience is gained. Should any case occur which is obviously different from those quoted in this instruction, the individual problem is to be submitted to Department of Air for a decision.

3. Generally, only the trailing edges of the N.G.V. will be seen during service inspections. Only in cases where flame tubes are to be inspected or changed will the leading edges be visible through the discharge orifices.

4. It is pointed out that the associated deterioration of the leading edges has been taken into account in the compilation of this standard which refers only to the trailing edges.

5. Engines should only be rejected from service if any of the following conditions or combination of conditions are observed:-

(a) The bow on the trailing edge exceeds .250 inch or a number of vanes are bowed to a lesser degree, but are considered to be responsible for a J.P.T. outside the operational limitations.

(b) Thermal cracks in excess of .750 inch in length.

(c) Multiple tears, with associated deformation of trailing edge caused by mechanical damage, or a single tear in excess of .300 inch in length.

6. It should be noted that where mechanical damage to N.G.V.'s is apparent, the flame tubes should be inspected for break up and if confirmed, the offending tube or tubes must be changed. Where the flame tubes are intact and the cause of the damage is obscure, the engine should be submitted for complete overhaul.

Replacement of N.G.V.'s service

7. In cases where N.G.V. deterioration is the criterion for engine rejection, up to 9 vanes may be changed with no throat area checks. It is important, however, that the replacement vanes are fitted in the original position of the rejected vanes. Serviceable vanes which, for any reason, have been removed must be replaced in their original positions.

NOTE: The replacement of vanes must be entered in the Engine Log Book, as not more than a total of 9 vanes may be replaced, without throat area checks, during the overhaul life of the engine.

8. The recommended sequence of operations for replacing N.G.V.'s in the field is given below, and assumes that an engine build stand TH.122 and turbine transport stand SE.254 are available. For full details of the dismantling and reassembly procedure, reference should be made to the Nene Overhaul Manual Australian Air Publication 861.

(a) Remove Nos.1 and 9, 3 and 4 or 6 and 7 combustion chambers to gain access through one of the hand holes in the centre bearing housing through which the main shaft centre coupling may be disconnected.

Note: It may be found necessary for an operator to remove the two hand hold covers.

(b) Disconnect the centre coupling and remove the turbine assembly.

(c) With the engine still in the vertical position remove the N.G.V. outer ring complete with shroud ring.

(d) Remove the cooling air guide plate from the rear bearing housing.

(e) Slacken off the 18 nuts securing the N.G.V. inner ring just enough to allow the removal of the required N.G.V.'s.

(f) Fit new N.G.V.'s, but do not tighten the inner ring at this stage.

(g) Replace the N.G.V. outer ring complete with shroud ring, ensuring that the shroud ring locating dowel is at the top of the engine.

(h) Turn the engine to the horizontal position and very carefully remove the N.G.V. inner ring securing nuts one at a time in order to renew the tab washers. (This operation requires great care since there is nothing to prevent the bolts from slipping forward and falling inside the support ring when the nuts are removed).

(j) Tighten and lock the nuts securing the N.G.V. inner ring.

(k) Refit the cooling air guide plate to the rear bearing housing.

(l) Replace the turbine assembly and complete the reassembly of the engine.

References : Files Department of Air 150/4/7890 and 69/35/6, R.R. Turbine Servicing Notes, Section 16, No.3.

Attachments : Figures 1, 2, 3 and 4.

Date of Issue : 23rd February, 1955.

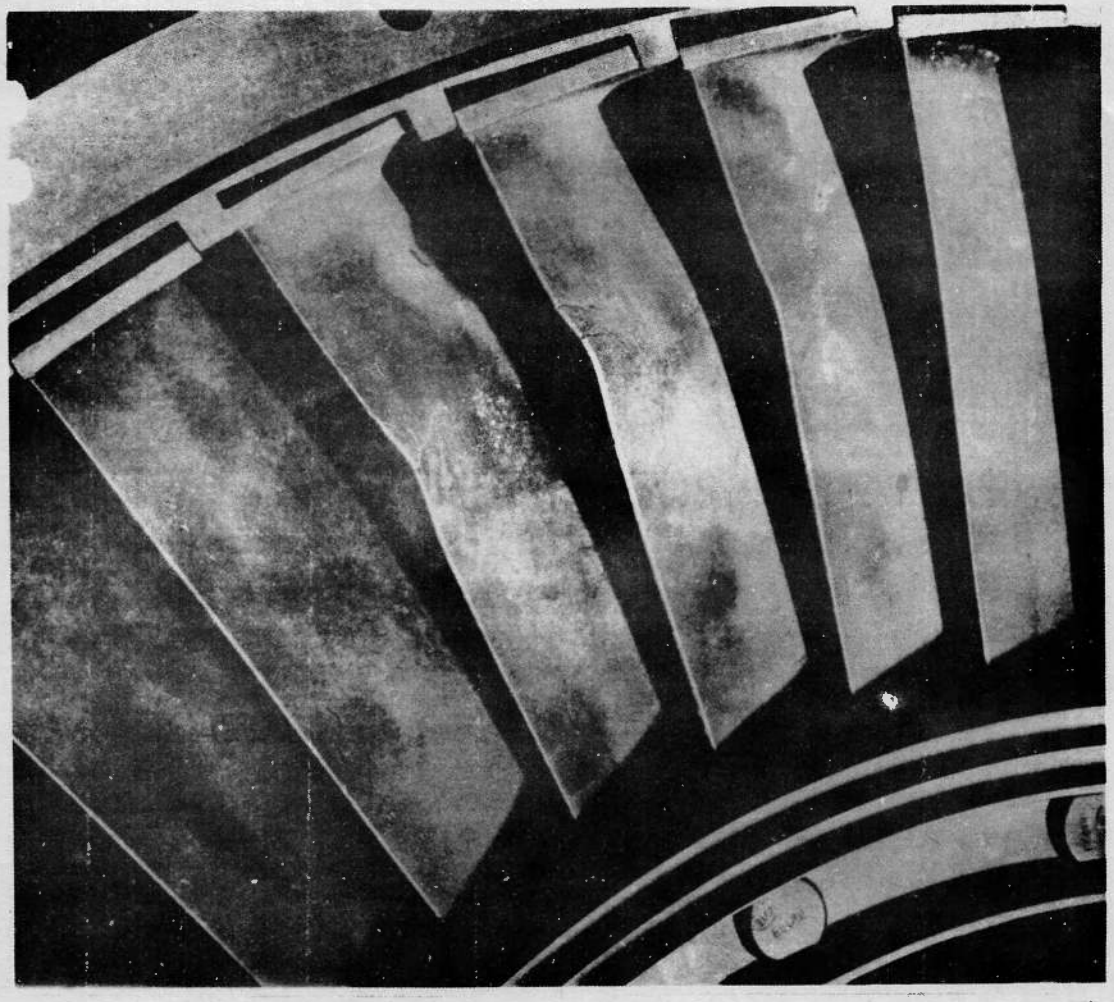


Fig. 1

View of N. G. V. trailing edges showing bowing and cracking at the limiting condition of the visual standard. When vanes are seen in this condition a further examination is necessary as detailed in the standard.

NOTE The turbine assembly has been removed for ease of photography.

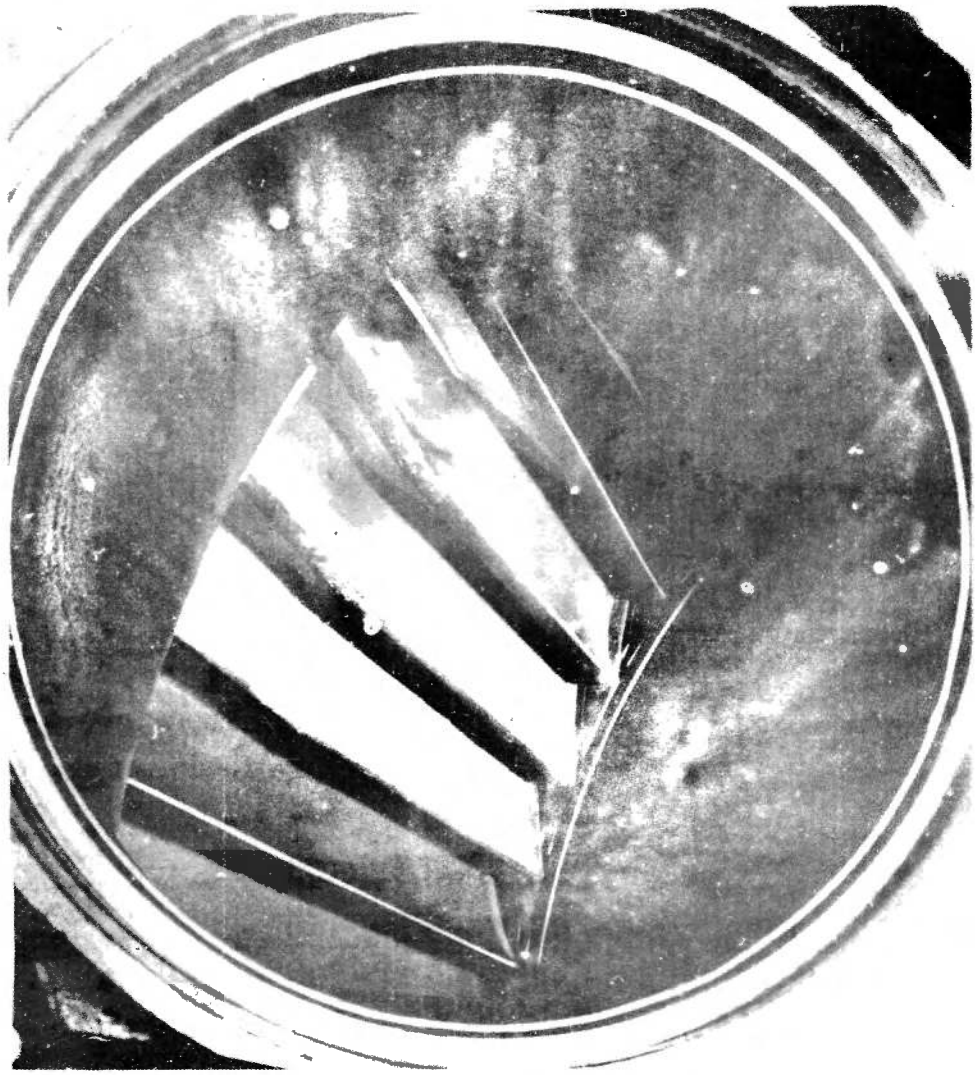


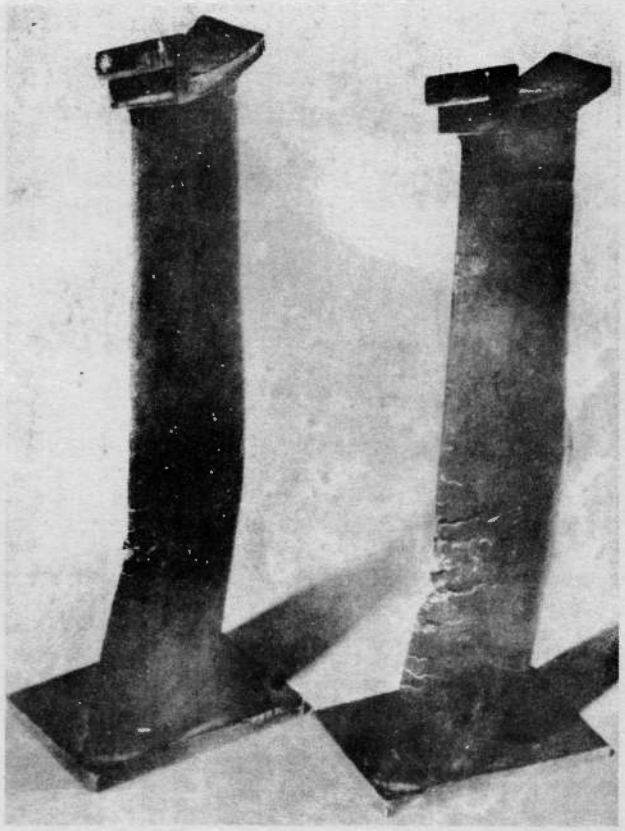
Fig. 2

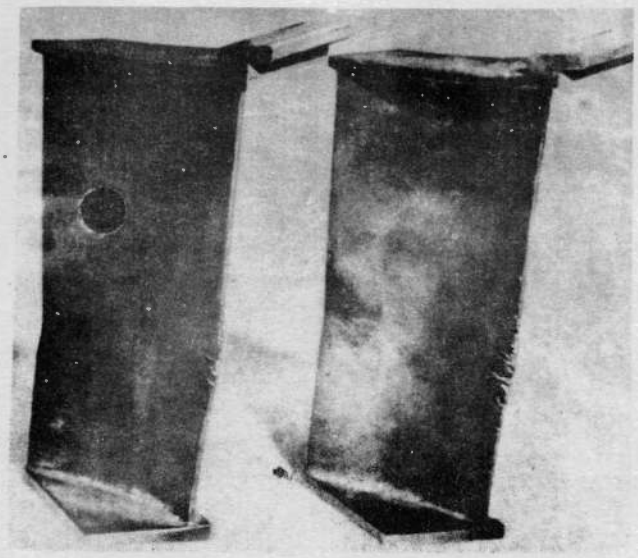
View of N. G. V's with No. 3 (~~Port Torch Igniter~~) combustion chamber removed. Showing N. G. V's approaching the limit of acceptance for both bowing and cracking.

Fig. 3

Views of the convex and concave surfaces of 2 N. G. V's, showing cracking and bowing of the leading edge at the limit of acceptance.

N. B. It is normal for cracking to progress further on the convex surface than on the concave as shown in photographs.





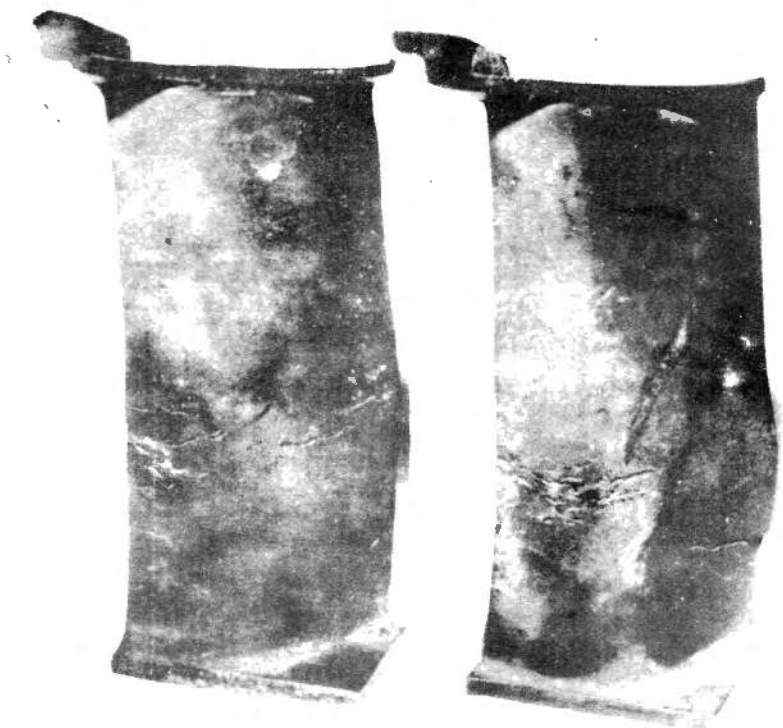


Fig. 4

View of two typical unacceptable Vanes showing cracking progressing across each vane.

Restricted

AIR FORCE HEAD-QUARTERS — NENE INSTRUCTION NO. 3

TECHNICAL ORDER — APPLICATION: Nene (All types)

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LIMITS

3. Guide vanes are to be rejected for further service if -

(a) leading edge cracks exceed 1.1 inches in length on either side of the vane (see Fig. 2);

(b) trailing edge cracks exceed 0.75 inches in length (see Fig. 4);

(c) the sum of the lengths of the longest leading and trailing edge cracks exceed 1.1 inches;

(d) the bow of the trailing edge is greater than 0.250 inches (see Fig. 6);

(e) the bow is within above limits, but after eliminating other causes, excessive jet pipe temperatures are being experienced.

References: File R.A.A.F. 150/4/7890.
Rolls-Royce Serving Note Section 3, Part 5, No.11.

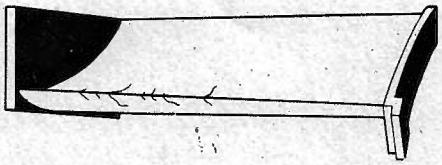
Drawings: Drawing No. B.11072, Sheets 1 and 2 attached.

Date of Issue: 23rd December, 1949.

DO NOT SCALE

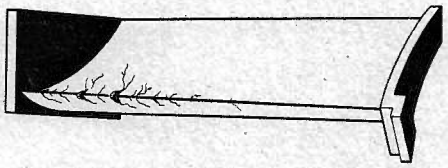
ISSUE NO.	DATE	ALTERATION	D & L	INITIALS	APPD
1					

FIG 1



ACCEPT

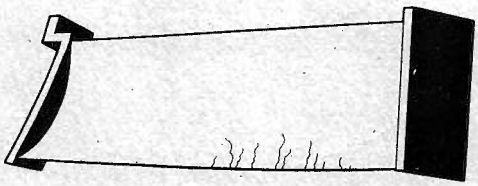
FIG 2



REJECT

LEADING EDGE

FIG 3



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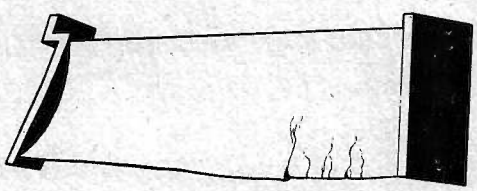

REJECT

TRAILING EDGE

NOZZLE GUIDE VANE CRACKING

REFERENCE	ISSUED BY	TITLE
	DIRECTORATE OF TECHNICAL SERVICES R.A.A.F	NOZZLE GUIDE VANE, LIMITS OF CRACKING & DISTRIBUTION

LIMITS UNLESS STATED		MATERIAL		COMPONENT OF	
DECIMALS	± .010"	SPEC.		MACHINE	
FRACTIONS	± 1/32"	TREATMENT		ENGINE	NENE 2- VH- AUS.
ANGLES	± 1°	FINISH		TECH. ORDER	NENE INST N°3
SURFACE FINISH AUSTRALIAN STANDARD ENG. DRWG. PRACTICE A.S.C.2		SCALE		DRAWING NO.	B.11072 SHT 1
		DRAWN	APPROVED		DRWG. A SIZE
		TRACED	CHECKED