

CIRCULATION / COPIES / 6	
E.F. MNGR ✓	FCT. ADM. SUPT.
DSGN. ENGR ✓	MC. SHOP. SUPT.
DEV. ENGR	PRODUCN. SUPT.
SERV. ENGR	ASSEMBLY. SUPT.
QUAL. ENGR	FOLNCRY. SUPT.
PROD. ENGR	METLICAL. SUPT.
MATL. ENGR	PROCESS SUPT.
CH. TL. DSGR	TOOL. PROD. SUPT.
CH. INSP. E.F.	TOOL. ROOM. SUPT.
A/F MANAGER	SUPT. INSPECTION

31st July 1961.

MISSION AUSTRALIENNE,
S. N. E. C. M. A.
70 Bd. Kellermann,
PARIS 13ème
F R A N C E.

Our Reference CB/WJM/SS P.22

COMMONWEALTH AIRCRAFT CORPORATION PTY. LTD.
BOX 779 H. P.O.
ELIZABETH ST.
MELBOURNE
A U S T R A L I A.

FR 2/26.

Mngr.....	Eng. Supt.....	
Sec.....	A/F. Mngr.....	
Asst. Sec.....	Ca. Eng. A/D.....	
Ch.....	Pers. Supt.....	
Acct. 1 4 AUG 1961		Supply Sales
Stores.....		
Ansd.....	Init.....	

ATTENTION - THE MANAGER

SUBJECT - ATAR 9 ENGINES

Dear Sir,

On Saturday 22nd July, Mr. Melbourne and I were able to visit VILLAROCHE, to inspect the condition of Atar 9 K N°04, after the completion of a 100 hour test. Messrs. Simpson, Woods and Hogarth also inspected the engine, as it was a unique opportunity to see the whole engine laid out.

The engine had been presented to the French Air Ministry and the Australian Air Attachés Office on Friday 21st, and the enclosed statement describing the test, was prepared for the presentation.

The engine, for this test was fitted with fixed stub inlet guide vanes, and with 4 bleed valves, equispaced round the engine, after the 4th stage. Stages 5 and 6 rotor blades were in Titanium, and an air starter was fitted. The turbine blades were precision forged in Udimet 700 and 500. This point led to a lot of confusion as, later, Gennevilliers told us that the precision forging of the turbine blades still had to be developed. We finally ascertained that these precision forged blades were made by Thompson Products and it is understood that Utica Forge have also or will also make some.

AK

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The jet pipe and afterburner arrangement was the 9 C type.

The engine stripped very well, the points requiring mention being as follows : -

- a) Compressor Rotor Seal rub. A rub had occurred on the labyrinth seal to the rotor, behind Stage 2. This was known at the beginning of the test and resulted in unbalance slightly an excess of that permitted (0.10 mm instead of 0.08 mm); but the test was completed on this condition.
- b) The combustion chamber showed some minor galling at the slip point half way along the outer wall. There was also some cracking in the legs of the swirlers (or flame holders) where these were welded to the body of the combustion chamber.
- c) There was some very light cracking in the L.P. NG Vs, in line with the A/B igniters (within acceptable limits, suitable for further use).
- d) The turbine blade shrouds interlock and are stellite on the rubbing face. Some small particles of the stellite had broken away on one blade.
- e) The turbine bearing was scored. The woven fibre glass insulation on the thermocouple wiring had broken away and got into the bearing. This was known early in the test, but the test was continued and the bearing survived the test satisfactorily.
- f) There was a crack in the skin of the afterburner pipe, and also one of the brackets between the pipes of the front set of spray rings in the afterburner was cracked. Also, the "anti - scream" liners had lifted a little in one area and have very minor burning. Finally, one of the nozzle petals (inner cast ones) had a crack which was put down to thermal shock, but which looked more like a casting defect to me - further, it occurred on only one petal, which seems to us to be more indicative of a casting defect.

In general, the engine is one converted from a 9D and many of the components had many hours of previous use. We were very impressed with the general excellent condition. The slight cracking in the LP N.G.Vs is hoped to be cured by better positioning of the afterburner igniters.

SNECMA admit that they have a vibration trouble in the afterburner pipe, but consider that the correction of this trouble will be fairly simple - probably by the means mentioned in my report enclosed with P.11.

On Thursday 27th July, Mr. Melbourne and I, together with Messrs. Fleming and Darling, were able to inspect a 9 C which had completed a Production Definition Test of 100 hrs; at Saclay - the Ministry Test Centre.

Once again, many of the parts of this engine had many hours of testing in 9 B configuration prior to this specific test. These are shown on the enclosure, which also gives brief details of the test itself.

This engine also stripped very well indeed. The points to be mentioned are : -

- a) There was some cracking, in two areas of the LP. NGVs, in the wake area of the igniters. Whilst more extensive than in the 9 K, the parts were considered serviceable for further running, and it is understood that the French Air Ministry are satisfied with them, on a full life basis.
- b) Two ignitor plugs had to be replaced, due to breaking away of the electrodes.
- c) The air collector ring casting, bolted to the front of the centre (compressor outlet) casing showed a lot of galling at the interface. This was a result of the holding bolts slacking off, due to bedding of the threads. SNECMA have a simple mod to cure this, in hand.
- d) There was some play developed on a split line compressor blade, one each in both St.3 and St.5. This did not look to be much of a problem.
- e) There were signs of local temperature variations, or hot spots, both in the combustion chamber, and in the N.G.V.s. However, in the combustion chamber, there were no cracks or buckles. This engine had a "Fluginox" combustion chamber.

f) The afterburner was generally very good. There were very minor cracks from the bolt holes, to the edge of the flange on the front flange of the afterburner, and the antiscream liner had lifted a little at the rear.

We were also very impressed with the condition of this engine. We had spoken to Mr. Darling, who saw the 9 C first and the 9 K after. He felt that the 9 K was probably superior, on the score of more even combustion, somewhat cleaner condition and less cracking in the LP. N.G.Vs.

We saw the two engines in the opposite order and our opinion is, that there is little to choose, in general condition. It must be added that the 9 K had done more high power, A/B running. My own feeling is, that such problems as do exist on the 9 C, appear either of less importance or more amenable to solution, than on the 9 K.

It must be realised that there are very definite limitations to our knowledge on the problem, due partly to the language problem and the lack of statistical data, particularly on the 9 K. Our impressions are very largely based on our own visual inspection of the parts, supported by verbal advice from the people showing us the engines.

The 9 K is as being reassembled for flight test, on Wednesday last the 26th, when we visited VILLAROCHE with Mr. Fleming.

Yours faithfully,


C. BELLWARD.

I. - HISTORIQUE DES DIFFERENTS ESSAIS REALISES ET TEMPS DE FONCTIONNEMENT

		<u>Fonctionnement officiel</u>
Essais de réception	- 18h23 dont 2h26 avec PC :	:
Préliminaires essai définition)	:	:
09B)	- 29h35 dont 3h15 avec PC :	:
Essai définition 09B	- 114h56 dont 14h51 avec PC :	100h25 dont 12h25 avec PC
Essais divers	- 6h45 :	:
Préliminaires essai définition)	:	:
09C)	- 19h24 dont 2h37 avec PC :	:
Essai définition 09C	- 123h27 dont 16h34 avec PC :	100h15 dont 12h15 avec PC
:		:
Fonctionnement global	- 312h30 dont 39h43 avec PC :	200h40 dont 24h40 avec PC:
:		:

II. - DETAIL DES TEMPS DE FONCTIONNEMENT AUX REGIMES DE DECOLLAGE POUR L'ESSAI DE DEFINITION 09C.

<u>Moteur sec</u>		<u>Avec PC</u>	
Règlage normal	Règlage chaud	Règlage normal	Règlage chaud
12 h 47	4 h 09	11 h 46	4 h 15
Cumul des temps de fonctionnement aux régimes de décollage			32 h 57

III. - MATIERE ET TEMPS DE FONCTIONNEMENT DES PRINCIPALES PIECES DU MOTEUR.

<u>Carter admission</u> - Matière <u>Z</u> /RE 1	-	312 h 30 dont 39 h 43 avec PC
Aubes directrices d'entrée	-	142 h 51 " 19 h 11 " "
Porteur de réducteur	-	283 h 13 " 36 h 15 " "
<u>Rotor de compresseur</u>	-	283 h 13 " 36 h 15 " "

Roulement palier avant	-	142 h 51	dont 19 h 11 avec PC		
Roulement palier central	-	142 h 51	" 19 h 11	"	"
<u>Carter de compresseur</u>	-	302 h 22	" 37 h 44	"	"
<u>Carter central</u> - Matière ZT 1	-	312 h 30	" 39 h 43	"	"
Directrice de sortie compresseur)		312 h 30	" 39 h 43	"	"
<u>Matière</u> Z 10 CNT 18	)				
Collecteur d'air	-	312 h 30	" 39 h 43	"	"
Anneau labyrinthe	-	142 h 51	" 19 h 11	"	"
Anneau porte-brûleurs	-	312 h 30	" 39 h 43	"	"
Carter extérieur de chambre)					
<u>Matière</u> Fluginox 130	) -	342 h 22	" 42 h 28	"	"
Mélangeur extérieur)					
<u>Matière</u> Hastelloy X	) -	142 h 51	" 19 h 11	"	"
Mélangeur intérieur)					
<u>Matière</u> Hastelloy X	) -	142 h 51	" 19 h 11	"	"
Carter support pallier de)					
turbine. <u>Matière</u> Titane	) -	195 h 43	" 26 h 34	"	"
Brûleurs étoilés	-	312 h 30	" 39 h 43	"	"
Préchambres d'allumage)					
"Naseaux" <u>Matière</u>	) -	259 h 06	" 19 h 11	"	"
Hastelloy X	)				
<u>Stator de turbine</u>					
Distributeur des turbines)					
<u>Matière</u> HS 25	) -	142 h 51	" 19 h 11	"	"
Redresseur de turbine)					
<u>Matière</u> HS 31	) -	142 h 51	" 19 h 11	"	"
Anneau de turbine 1er étage	-	142 h 51	" 19 h 11	"	"
Anneau de turbine 2ème étage	-	312 h 30	" 39 h 43	"	"
<u>Rotor de turbine</u>					
Arbre disque	-	149 h 36	" 19 h 11	"	"
Roulement palier AR	-	142 h 51	" 19 h 11	"	"

Aubage 1er étage Matière NKCD 20 AT - 149 h 36 dont 19 h 11 avec P.C.
 Disque de turbine 2ème étage - 149 h 36 " 19 h 11 " "
 Aubage 2ème étage Matière NCK 20 AT - 149 h 36 " 19 h 11 " "

Pignonnerie de commande

Carter support des accessoires - 387 h 37
 Renvoi d'angle accessoires - 293 h
 Renvoi d'angle cellule - 312 h 30 " 39 h 45 " "

Accessoires

Démarrreur - 793 lancements
 Régulateur principal - 144 h 51
 Régulateur PC - 216 h 29
 Pompe à carburant - 174 h 06

IV. - MATIERE ET TEMPS DE FONCTIONNEMENT DES PRINCIPALES PIECES DU CANAL.

RACCORDEMENT A VIROLE INCORPORÉE.

Enveloppe extérieure. Matière N 155)
 pour la partie raccordement)
 et Z 10 CNW 17 pour la partie) 142 h 51 dont 19 h 11 avec PC
 virole.)
 Cône intérieur. Matière Z 10 CNW 17 - 142 h 51 " 19 h 11 " "
 Anneaux brûleurs. Matière HS 25 - 123 h 27 " 16 h 34 " "
 Rampes amont - 123 h 27 " 16 h 34 " "
 Chemise de raccordement. Matière)
 Titane) - 142 h 51 " 19 h 11 " "
 Collecteurs d'air. Matière Titane - 142 h 51 " 19 h 11 " "

Support de tuyère

Enveloppe extérieure. Matière N 155)
 pour le divergent et la partie) 142 h 51 " 19 h 11 " "
 cylindrique et HS 25 pour le)
 convergent.

Chemises de protection thermique

Chemise divergente. Matière)
 Hastelloy X) - 142 h 51 " 19 h 11 " "

Chemises cylindriques et convergente	)	
<u>Matière HS 25</u>	)	- 142 h 51 dont 19 h 11 avec PC
Chemises de refroidissement	)	
<u>Matière Inox</u>	)	- 142 h 51 " 19 h 11 " "
<u>Tuyère 18 volets</u>		- 142 h 51 " 19 h 11 " "

Villaroche , le 21 Juillet 1961

REACTEUR ATAR. 9K N° 04

Fonctionnement global: 105h. 12, dont 25h 38 avec P.C. - Allumages PC = 486.

Fonctionnement officiel: " vol type" = 100 h. dont 25h 10 avec P.C. - Allumages PC = 480.

8 h. - ^{GROUND IDLING} ralenti sol - 2900 t/mn.
8 h. - ^{FLIGHT IDLING} ralenti vol - 6000 t/mn.
32h. - ^{PART LOAD} charges partielles, ^{cycling through all conditions between} balayages de tous les régimes compris entre 7900 et 4000 t/mn de 100 en 100 t/mn en 4 périodes de 0h 12 (soit 40 fois 0h 48).

{ 16h. - Maxi continu à 8150 t/mn
{ 8 h. - Décollage sec T.O. Dry.
{ 18h24 - P.C. maxi
{ 5 h36 - à 90 % de la P.C. maxi
{ 4 h. - ^{OVERSPEED} Survitesse à 8900 t/mn, dont 1h 10 de ralenti PC.

TOTAL T.O.
Cumul aux régimes de décollage : 36 h. dont 9h. en réglage chaud.

CARBURANT : JP.4

LUBRIFIANT : ESSO IV. 15

Moyenne des performances réalisées
durant l'essai.

		N	C _m	P	C _s	T ₄
		t/ma	kg/h	kgp	kg/ke.h	°C
	Décollage sec.....	8415	4780	4715	1,013	745
<u>Règlage normal:</u>	Décollage sec } survitesse.....	8920	4735	4455	1,063	725
	P.C. mari.....	8415	4770	6725	2,088	745
	Décollage sec.....	8420	4975	4860	1,023	775
<u>Règlage chaud:</u>	Décollage sec } survitesse.....	8920	4925	4670	1,054	750
	P.C. mari.....	8425	4965	6925	2,105	770
<u>A 90% de F_{mari}</u>	{ Règlage "normal"	8405	4770	6065	1,66	745
	{ Règlage "chaud".....	8425	4955	6215	1,67	771

COPY

S.N.E.C.M.A.-VILLAROCHE

DIRECTION TECHNIQUE

Département des Essais

Villaroche , le 21 Juillet 1961

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Fonctionnement global: 105h. 12, dont 25h 38 avec P.C.-
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en 4 periodes de 0h 12 (soit 40 fois 0h 48).

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(18h24- P.C. maxi

(5h36-à 90 % de la P.C. maxi

(4h. - Survitesse à 8900 t/mn, dont 1h 10 de ralenti PC.

Cumul aux régimes de décollage : 36 h. dont 9h. en réglage
chaud.

CARBURANT : JP.4

LUBRIFIANT: ESSO TJ. 15

.../...

Moyenne des performances réalisées.
durant l'essai.

		N	C _m	F	C _s	T ₄
		t/mn	kg/h	kgp	kg/kg.h.	°C
<u>Reglage normal:</u>	Décollage sec...	8415	4780	4715	1,013	745
	Décollage sec) survitesse. }...	8920	4735	4455	1,063	725
	P.C. maxi.....	8415	4770	6725	2,088	745
<u>Reglage chaud:</u>	Decollage sec...	8420	4975	4860	1,023	775
	Décollage sec) survitesse. }...	8920	4925	4670	1,054	750
	P.C. Maxi.....	8425	4965	6925	2,105	770
<u>A 90% de F maxi</u>	(Reglage "normal"	8405	4770	6065	1,66	745
	(Reglage "chaud"	8425	4955	6215	1,67	771