HS 125 *

AIRCRAFT

MAINTENANCE MANUAL

Volume 3

ROLLS - ROYCE

VIPER 522 ENGINE

Publication reference MM 125 - 522

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Note
In the U.S.A. the H.S. 125 is known as the D.H. 125

Published August 1964

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BRITISH AEROSPACE: AIRCRAFT GROUP
HATFIELD - CHESTER DIVISION
Hatfield — Hertfordshire — England

TEMPORARY REVISION
LETTER OF TRANSMITTAL No. 19

This temporary revision complies with British Civil Airworthiness Requirements, Section A, Chapter A6-2

Signed ..... Date 12th February, 1981

CAA Approval No. DAI/1011/55

INSTRUCTIONS

(1) Insert or remove Temporary Revisions as detailed below.

(2) Check that the last Temporary Revision Letter of Transmittal incorporated is No.18. If it is not, inform the Superintendent, Technical Manuals Distribution Centre, Product Support Department, British Aerospace Public Limited Company, Aircraft Group, Hatfield-Chester Division, Hatfield, Hertfordshire, AL10 9TL, England.

T.R.No.	Position	Instructions
72-4	72-00-01 facing page 405	REMOVE
72-5	72-01-01 facing page 405	INSERT

Current T.R.'s (Manual to NORMAL Rev.41 standard)

NOTE : Remove T.R.'s from manual only when so instructed by a Letter of Transmittal issued with either a Temporary or NORMAL revision.

T.R.No	Position	Issued with Record Sheet No.
72-5	72-00-01 facing page 405	19 (522)

TEMPORARY REVISION No. 72-5

Insert in 72-00-01 facing page 405

REASON FOR ISSUE

To ensure the stay pin cap nuts are torque-tightened and lubricated correctly.

ACTION

Disregard the existing sub-paragraph (4) of paragraph 2.B. and read the following new sub-paragraph and NOTE :-

(4) Lubricate the stay pin capnut threads using graphite grease to Spec. DTD.806 or MIL-G-7187, then install and torque-tighten the capnuts to 5 lbf.ft. (60 lbf.in.).

NOTE : If Mod.CV.3974 is incorporated (identified by a reduced number of spanner slots in the capnut Part No.V.53148 i.e. five slots instead of ten) the capnuts should be torque-tightened to 45 lbf.ft. (540 lbf.in.).

* * *

HS.125 MAINTENANCE MANUAL (VOL.3)
RR VIPER 522

(Publication Ref.MM.125-522)

LETTER OF TRANSMITTAL
FOR
REVISION No. 43 (522)

Issued by
British Aerospace, Civil Aircraft Division,
Hatfield, Hertfordshire, AL10 9TL,
England.

This permanent revision complies with British Civil Airworthiness Requirements, Section A, Chapter A6-2.

Signed ..... Date 14th March, 1987
CAA Approval No. DAI/1011/55

INSTRUCTIONS FOR INCORPORATING THIS REVISION

(1) Check that Revision No. 43 has been incorporated.

(2) Insert the revision pages in numerical sequence, removing and destroying the existing pages replaced by revised pages.

(3) Record the incorporation of this revision on the RECORD OF REVISIONS (NORMAL) sheet at the front of Volume 3.

(4) Retain this Letter of Transmittal.

HIGHLIGHTS

CHAPTER 71 & 72 : Minor editorial changes.

* * *

MODIFICATION STATEMENT - (H.S.) - VIPER 522

Modifications which have an annotation in the 'Coverage' column have been investigated and any necessary data incorporated in the manual. Annotations may be one of the following :

* Full coverage
P Partial coverage
NE No effect on manual
C Cancelled

1. Modifications issued by Hawker Siddeley Aviation Ltd.

NOTE : H.S.A. Modifications are prefixed 25.

Mod No.	Coverage	Mod No.	Coverage	Mod.No.	Coverage
1026	NE	1407	C	1826	NE
1031	NE	1439	*	1860	*
1035	NE	1440	*	1902	NE
1048	NE	1444	NE	1911	*
1102	NE	1453	NE	1924	NE
1145	*	1512	*	1952	*
1167	NE	1587	*	1988	NE
1242	NE	1631	NE	2013	NE
1243	NE	1632	NE	2053	*
1280	NE	1652	C	2065	*
1301	*	1665	NE	2081	NE
1310	NE	1674	NE	2083	NE
1328	NE	1692	NE	2085	*
1335	*	1693	NE	5315	*
1338	NE	1721	*	5538	NE
1377	NE	1728	*	7127	*
1393	*	1744	*	7133	NE
		1748	NE	7196	NE
		1751	*	7233	NE
		1755	NE	7249	NE
		1760	*	7256	NE
		1802	NE	7274	*
		1817	NE		

MODIFICATION STATEMENT - (R.R.) - VIPER 522

Modification which have an annotation in the 'Coverage' column have been investigated and any necessary data incorporated in the manual. Annotations may be one of the following :

*	Full coverage
NE	No effect on manual
C	Cancelled
P	Partial coverage
NA	Not applicable

NOTE : Mods within the CV.3,000 range start on page 3.

Modifications issued by Rolls Royce Ltd.

Mod. No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage
CV.7127	*	CV.7162	N.A.	CV.7197	*
CV.7128	N.A.	CV.7163	N.E.	CV.7198	N.E.
CV.7129	N.A.	CV.7164	C	CV.7199	N.E.
CV.7130	N.A.	CV.7165	N.E.	CV.7200	N.E.
CV.7131	N.A.	CV.7166	C	CV.7201	N.A.
CV.7132	N.A.	CV.7167	N.A.	CV.7202	N.E.
CV.7133	N.A.	CV.7168		CV.7203	N.E.
CV.7134	N.A.	CV.7169	N.E.	CV.7204	N.E.
CV.7135	*	CV.7170		CV.7205	N.E.
CV.7136	N.A.	CV.7171	*	CV.7206	N.E.
CV.7137	N.A.	CV.7172	N.E.	CV.7207	*
CV.7138	N.A.	CV.7173	N.E.	CV.7208	N.E.
CV.7139	N.A.	CV.7174	N.E.	CV.7209	N.E.
CV.7140	N.E.	CV.7175	N.E.	CV.7210	*
CV.7141	N.A.	CV.7176	N.A.	CV.7211	N.E.
CV.7142	N.E.	CV.7177	N.A.	CV.7212	N.E.
CV.7143	N.E.	CV.7178	N.E.	CV.7213	N.E.
CV.7144	N.E.	CV.7179	*	CV.7214	N.A.
CV.7145	N.E.	CV.7180	N.E.	CV.7215	N.E.
CV.7146	N.E.	CV.7181	N.E.	CV.7216	N.E.
CV.7147	P	CV.7182	N.E.	CV.7217	N.A.
CV.7148	N.E.	CV.7183	N.E.	CV.7218	N.A.
CV.7149	N.E.	CV.7184	N.E.	CV.7219	N.E.
CV.7150	N.E.	CV.7185	*	CV.7220	N.E.
CV.7151	N.E.	CV.7186	N.E.	CV.7221	N.E.
CV.7152	N.A.	CV.7187	N.E.	CV.7222	N.E.
CV.7153	N.E.	CV.7188	N.E.	CV.7223	N.E.
CV.7154	N.E.	CV.7189	N.E.	CV.7224	N.E.
CV.7155	N.E.	CV.7190	N.E.	CV.7225	N.A.
CV.7156		CV.7191	N.A.	CV.7226	N.E.
CV.7157	N.A.	CV.7192	*	CV.7227	N.A.
CV.7158	N.E.	CV.7193	N.E.	CV.7228	N.E.
CV.7159	N.E.	CV.7194	N.E.	CV.7229	N.E.
CV.7160	*	CV.7195	N.E.	CV.7230	N.A.
CV.7161	N.E.	CV.7196	*	CV.7231	*

. . .Modification statement (R. R.) - Viper 522 continued

Mod. No.	Coverage	Mod.No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage
CV.7232	*	CV.7280	N.A.	CV.7328	N.E.	CV.7376	N.A.
CV.7233	*	CV.7281	N.E.	CV.7329	N.E.	CV.7377	N.E.
CV.7234	N.E.	CV.7282	N.E.	CV.7330	N.E.	CV.7378	N.A.
CV.7235	N.E.	CV.7283	N.E.	CV.7331	N.A.	CV.7379	N.E.
CV.7236	N.E.	CV.7284	*	CV.7332	N.A.	CV.7380	N.A.
CV.7237	N.E.	CV.7285	N.A.	CV.7333	N.A.	CV.7381	N.E.
CV.7238	N.E.	CV.7286	N.E.	CV.7334	N.E.	CV.7382	N.E.
CV.7239	N.A.	CV.7287	N.E.	CV.7335	N.A.	CV.7383	N.A.
CV.7240	N.E.	CV.7288	P	CV.7336	N.A.	CV.7384	*
CV.7241	N.E.	CV.7289	N.A.	CV.7337	N.A.	CV.7385	N.A.
CV.7242	N.E.	CV.7290	N.A.	CV.7338	N.A.	CV.7386	N.E.
CV.7243	N.E.	CV.7291	*	CV.7339	N.A.	CV.7387	N.E.
CV.7244	N.A.	CV.7292	N.A.	CV.7340	N.E.	CV.7388	N.A.
CV.7245	N.E.	CV.7293	N.A.	CV.7341	N.A.	CV.7389	N.A.
CV.7246	N.A.	CV.7294	N.A.	CV.7342	N.A.	CV.7390	N.A.
CV.7247	N.E.	CV.7295	N.E.	CV.7343	N.E.	CV.7391	*
CV.7248	N.E.	CV.7296	N.E.	CV.7344	N.E.	CV.7392	N.A.
CV.7249	N.E.	CV.7297	N.E.	CV.7345	N.A.	CV.7393	N.A.
CV.7250	N.E.	CV.7298	N.E.	CV.7346	N.E.	CV.7394	N.A.
CV.7251	N.E.	CV.7299	N.A.	CV.7347	N.E.	CV.7395	N.A.
CV.7252	N.A.	CV.7300	N.A.	CV.7348	*	CV.7396	N.E.
CV.7253GE	*	CV.7301	N.E.	CV.7349	N.A.	CV.7397	N.E.
CV.7254	N.E.	CV.7302	N.A.	CV.7350	N.E.	CV.7398	N.A.
CV.7255	N.E.	CV.7303	N.E.	CV.7351	N.E.	CV.7399	N.A.
CV.7256	N.E.	CV.7304	N.A.	CV.7352	N.E.	CV.7400	N.A.
CV.7257	N.E.	CV.7305	N.A.	CV.7353	N.E.	CV.7401	*
CV.7258	N.E.	CV.7306	N.A.	CV.7354	N.A.	CV.7402	*
CV.7259	N.A.	CV.7307	N.A.	CV.7355	N.E.	CV.7403	N.A.
CV.7260	N.A.	CV.7308	N.A.	CV.7356	N.E.	CV.7404	N.A.
CV.7261	N.A.	CV.7309	*	CV.7357	N.A.	CV.7405	N.E.
CV.7262	N.E.	CV.7310	N.A.	CV.7358	N.E.	CV.7406	*
CV.7263	N.A.	CV.7311	N.E.	CV.7359	N.A.	CV.7407	N.A.
CB.7264GE	*	CV.7312	N.E.	CV.7360	*	CV.7408	*
CV.7265	N.E.	CV.7313	N.A.	CV.7361	N.E.	CV.7409	N.E.
CV.7266	N.E.	CV.7314	N.A.	CV.7362	N.A.	CV.7410	*
CV.7267	N.E.	CV.7315	N.A.	CV.7363	N.A.	CV.7411	*
CV.7268	N.E.	CV.7316	N.A.	CV.7364	N.A.	CV.7412	N.A.
CV.7269	*	CV.7317	N.E.	CV.7365	N.E.	CV.7413	N.A.
CV.7270	N.E.	CV.7318	N.A.	CV.7366	N.A.	CV.7414	N.A.
CV.7271	N.E.	CV.7319	N.E.	CV.7367	N.A.	CV.7415	N.E.
CV.7272	*	CV.7320	*	CV.7368	N.A.	CV.7416	N.E.
CV.7273	N.E.	CV.7321	N.A.	CV.7369	N.A.	CV.7417	N.E.
CV.7274	N.E.	CV.7322	N.E.	CV.7370	N.A.	CV.7418	N.E.
CV.7275	N.A.	CV.7323	N.A.	CV.7371	N.E.	CV.7419	N.E.
CV.7276	N.E.	CV.7324	N.E.	CV.7372	N.A.	CV.7420	N.E.
CV.7277	N.E.	CV.7325	N.E.	CV.7373	N.A.	CV.7421	N.A.
CV.7278	N.A.	CV.7326	N.A.	CV.7374	N.A.	CV.7422	N.E.
CV.7279	N.E.	CV.7327	N.E.	CV.7375	N.A.	CV.7423	N.E.

... Modification statement (R.R.) - Viper 522 continued

Mod. No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage
CV.7424	N.A.	CV.7471	N.E.	CV.7518	N.A.	CV.7566	N.E.
CV.7425	N.E.	CV.7472	N.E.	CV.7519	N.A.	CV.7567	N.A.
CV.7426	N.A.	CV.7473	N.A.	CV.7520	N.E.	CV.7568	N.A.
CV.7427	N.E.	CV.7474	N.A.	CV.7521	N.A.	CV.7569	N.A.
CV.7428	N.A.	CV.7475	N.A.	CV.7522	N.A.	CV.7570	N.A.
CV.7429	N.A.	CV.7476	N.A.	CV.7523	N.A.	CV.7571	N.A.
CV.7430	N.E.	CV.7477	N.A.	CV.7524	N.E.	CV.7572	N.A.
CV.7431	N.E.	CV.7478	N.A.	CV.7525	N.E.	CV.7573	N.E.
CV.7432	N.E.	CV.7479	N.A.	CV.7526	N.E.	CV.7574	N.E.
CV.7433	N.E.	CV.7480	N.A.	CV.7527	N.A.	CV.7575	N.E.
CV.7434	N.A.	CV.7481	N.A.	CV.7528	N.A.	CV.7576	N.E.
CV.7435	N.E.	CV.7482	N.A.	CV.7529	N.A.	CV.7577	N.E.
CV.7436	N.E.	CV.7483	N.A.	CV.7530	N.A.	CV.7578	N.E.
CV.7437	N.E.	CV.7484	N.A.	CV.7531	N.E.	CV.7579	N.E.
CV.7438	N.E.	CV.7485	N.A.	CV.7532	N.A.	CV.7580	N.A.
CV.7439	N.E.	CV.7486	N.A.	CV.7533	N.A.	CV.7581	N.A.
CV.7440	N.E.	CV.7487	N.A.	CV.7534	N.E.	CV.7582	N.A.
CV.7441	N.A.	CV.7488	N.E.	CV.7535	N.A.	CV.7583	N.E.
CV.7442	N.E.	CV.7489	N.E.	CV.7536	N.A.	CV.7584	N.A.
CV.7443	N.A.	CV.7490	N.E.	CV.7537	N.A.	CV.7585	N.E.
CV.7444	P	CV.7491	N.A.	CV.7538	N.A.	CV.7586	
CV.7445	*	CV.7492	N.A.	CV.7539	N.A.	CV.7587	N.A.
CV.7446	N.E.	CV.7493	N.A.	CV.7540	N.A.	CV.7588	N.A.
CV.7447	N.E.	CV.7494	N.E.	CV.7541	N.A.	CV.7589	N.A.
CV.7448	N.E.	CV.7495	N.A.	CV.7542	N.E.	CV.7590	N.A.
CV.7449	N.E.	CV.7496	N.A.	CV.7543	C.	CV.7591JP	N.A.
CV.7450	N.A.	CV.7497	N.A.	CV.7544	N.E.	CV.7592	N.A.
CV.7451	N.A.	CV.7498	N.A.	CV.7545		CV.7593	N.E.
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CV.7453	N.E.	CV.7500	N.E.	CV.7547	N.E.	CV.7595	N.E.
CV.7454	*	CV.7501	N.A.	CV.7548	N.E.	CV.7596	
CV.7455	N.A.	CV.7502	N.A.	CV.7549	N.A.	CV.7597	
CV.7456	N.A.	CV.7503	N.A.	CV.7550	N.A.	CV.7598	N.E.
CV.7457	N.A.	CV.7504	N.A.	CV.7551	N.A.	CV.7599	N.A.
CV.7458	N.A.	CV.7505	N.A.	CV.7552	N.E.	CV.7600	N.A.
CV.7459	N.A.	CV.7506	N.A.	CV.7553	N.A.	CV.7601	N.A.
CV.7460	N.A.	CV.7507	N.A.	CV.7554JP	N.A.	All succeeding modifications fall within the CV.3000 range, beginning with CV.3313.	
CV.7461	N.A.	CV.7508JP	N.E.	CV.7555	N.A.		
CV.7462	N.A.	CV.7509	N.A.	CV.7556	N.E.		
CV.7463	N.A.	CV.7510	N.A.	CV.7557JP	N.A.		
CV.7464	N.A.	CV.7511	N.A.	CV.7558	N.A.	CV.3313	N.E.
CV.7465	N.A.	CV.7512	N.A.	CV.7559	N.A.	CV.3314	N.A.
CV.7466	N.A.	CV.7513JP	N.E.	CV.7560	N.A.	CV.3315	N.E.
CV.7467	N.E.	CV.7514JP	N.A.	CV.7561	N.A.	CV.3316	
CV.7468	N.E.	CV.7515	N.E.	CV.7562	N.A.	CV.3317	N.E.
CV.7469	N.A.	CV.7516	N.A.	CV.7563	N.E.	CV.3318	N.E.
CV.7470	N.E.	CV.7517	N.A.	CV.7564	N.E.	CV.3319	
				CV.7565	N.E.	CV.3320	N.E.

. . . Modification statement (R.R.) - Viper 522 continued

Mod. No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage	Mod. No.	Coverage
CV.3321	N.E.	CV.3368	*				
CV.3322	N.A.	CV.3369					
CV.3323	N.A.	CV.3370	N.A.				
CV.3324	N.A.	CV.3371	N.A.				
CV.3325	N.E.	CV.3372					
CV.3326	N.E.	CV.3373					
CV.3327		CV.3374	N.E.				
CV.3328		CV.3375					
CV.3329	N.E.	CV.3376	N.A.				
CV.3330		CV.3377	N.A.				
CV.3331		CV.3378					
CV.3332	N.A.	CV.3379					
CV.3333		CV.3380	N.A.				
CV.3334							
CV.3335							
CV.3336							
CV.3337	N.A.						
CV.3338	N.E.						
CV.3339							
CV.3340	N.E.						
CV.3341	N.E.						
CV.3342	N.E.						
CV.3343							
CV.3344							
CV.3345	N.A.						
CV.3346							
CV.3347	N.A.						
CV.3348							
CV.3349	N.E.						
CV.3350							
CV.3351							
CV.3352	N.E.						
CV.3353	N.A.						
CV.3354							
CV.3355	N.A.						
CV.3356	N.E.						
CV.3357							
CV.3358							
CV.3359	N.E.						
CV.3360							
CV.3361	N.E.						
CV.3362	N.E.						
CV.3363							
CV.3364							
CV.3365	N.E.						
CV.3366							
CV.3367	N.A.						

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* Indicates pages revised, added or deleted by the current revision.

LIST OF EFFECTIVE PAGES: CHAPTER 71 : POWER PLANT - GENERAL continued

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71-20	
1	Aug.21/64
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201	Sept.30/66 (Y)
202	Aug.16/65 (Y)
203	Nov.72
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1	May 67
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* Indicates pages revised, added or deleted by the current revision.

Chapter 71

POWER PLANT

TABLE OF CONTENTS

* No separate description
\+ No separate maintenance practices

* * *

POWER PLANT - GENERAL

1. General

The aircraft is propelled by two Rolls-Royce Viper engines installed in pods, mounted one at either side of the rear fuselage (Figs.1 and 2). A fillet, extending from each side of the fuselage, houses the support structure for mounting the engines. Mounts connect the inboard side of each engine to the respective fillet. Interchangeability of engines, between the left and right positions, is achieved by the ability to fit mounts on either side of the engine.

Part of the installation space is formed by the concave forward half of the fillet; side cowlings fitted in this area are secured directly to the fillet.

Firewalls divide each installation into zones which are ventilated by ram air and protected by self-resetting fire detectors. A 'two-shot' fire extinguishant system protects Zone 1 (Chapter 26). Pre Mod.252367: Fuel and oil drainage is dumped overboard either independently or via a self-emptying drains tank; Mod.252367 provides contained drains for ground emptying.

The nose cowl and parts of the engine and intake are anti-iced by hot air bled from the engine compressor (Chapter 75). Compressor bleeds are used also for the aircraft pressurization and air conditioning systems (Chapter 21) and rudder bias system (Chapter 27). Methanol injection is used to de-ice the low pressure filter of the engine fuel system (Chapter 28).

Throttle and high pressure fuel cock controls are cable operated from levers on the pilot's central control pedestal (Chapter 76). Each engine has a combined starter/generator and facilities are provided for starting, using either internal or external electrical power supplies (Chapter 80).

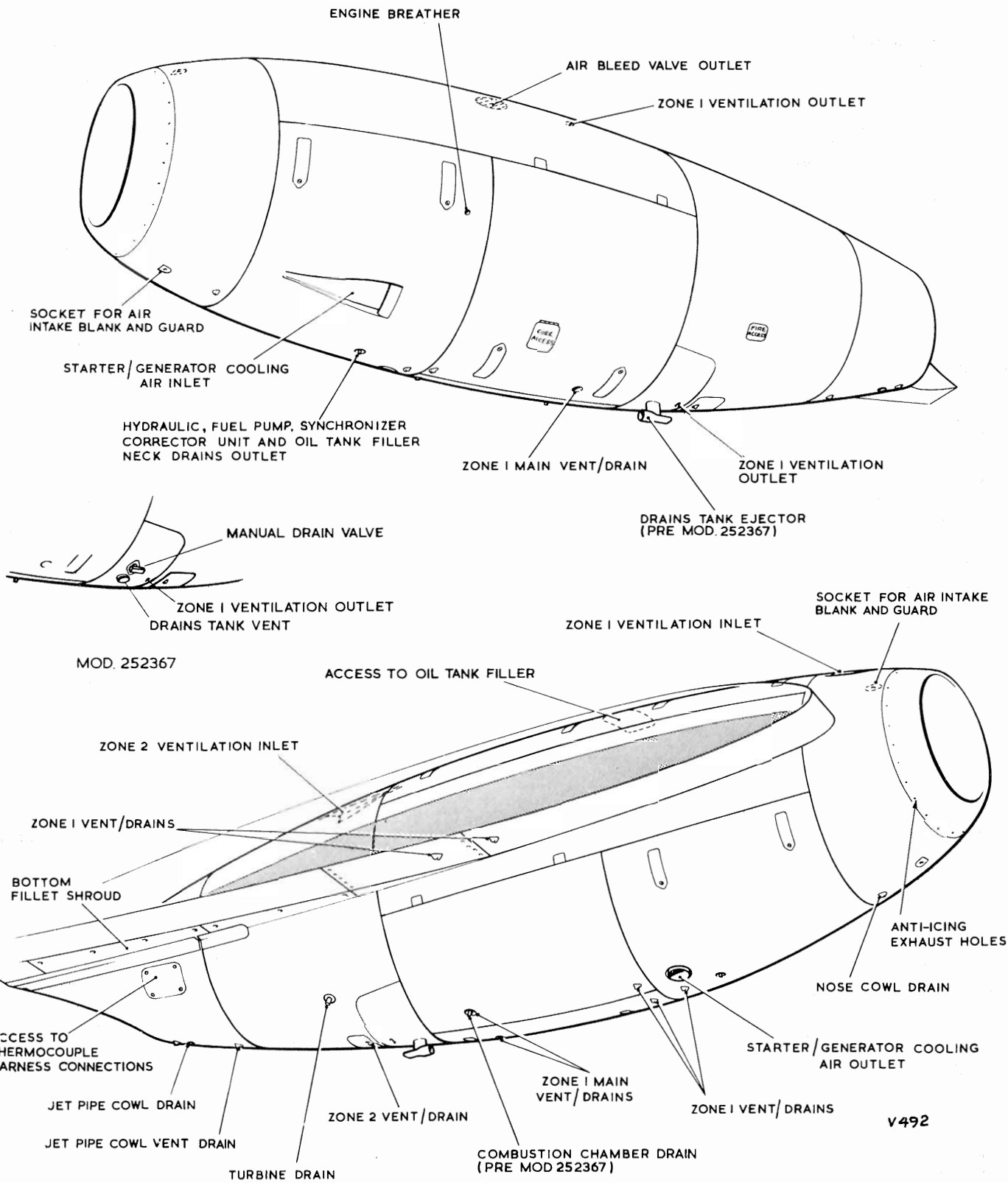
Engine/airframe accessory system disconnect points are grouped at convenient points to simplify the removal and installation of a power plant. When prepared, ready for installation, each power plant comprises a 'basic power plant' (consisting of the engine together with all items common to both installations) plus those additional parts peculiar to the specific installation. Power plants can be removed and installed in a substantially complete state with the nose cowl and rear cowl fitted.

The exhaust cone and propelling nozzle form an integral unit therefore the description and maintenance practices for the exhaust system appear in Chapter 72; there is no separate Chapter 78 for 'Exhaust'.

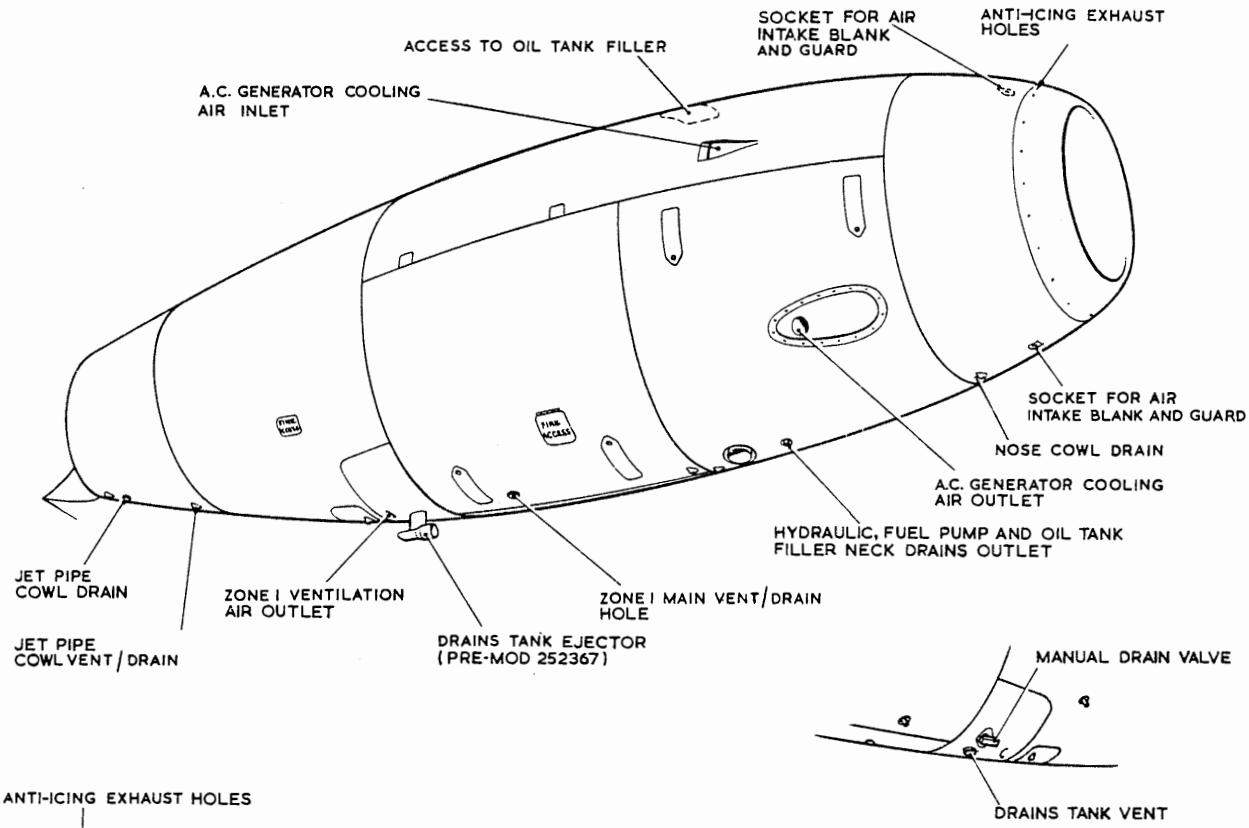
Details of Power Plant Build are given in this chapter.

2. Structure

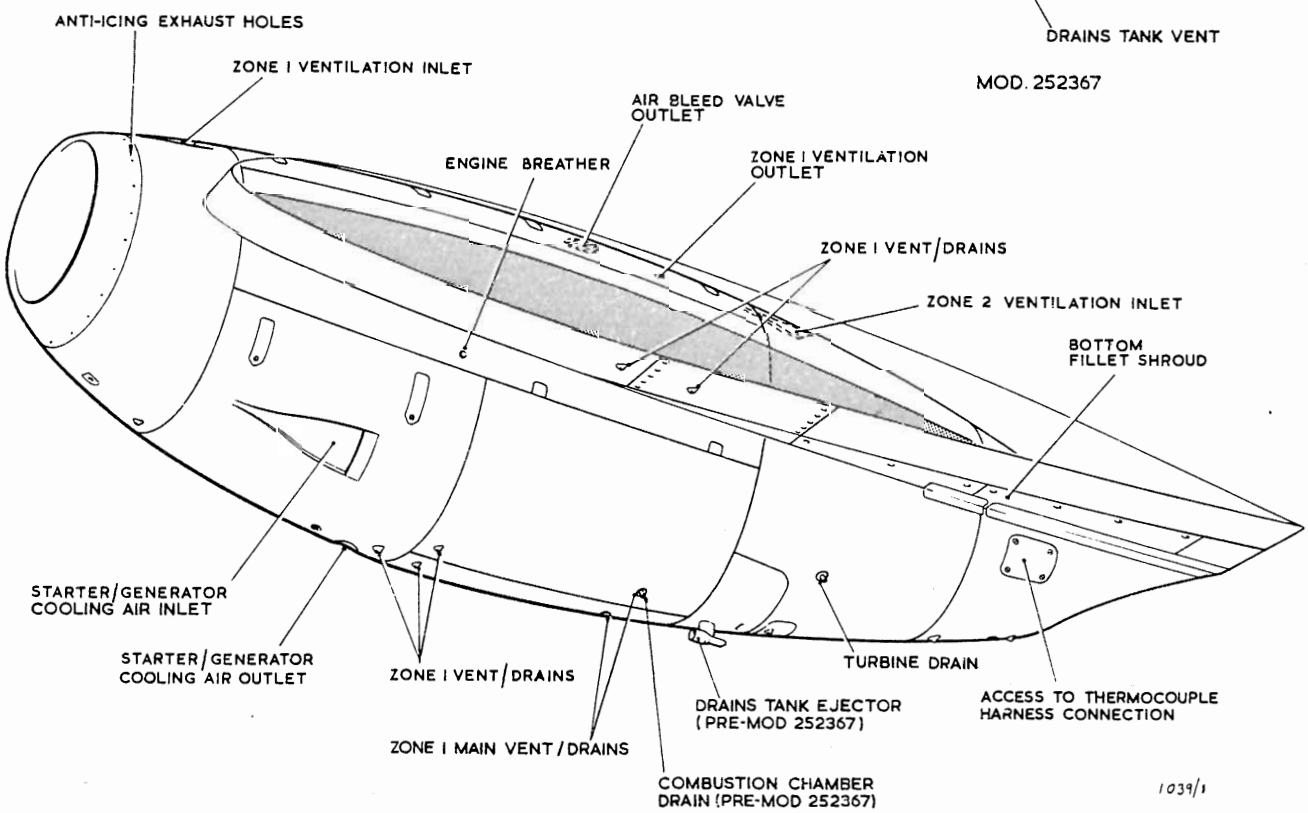
The support structure for the pods is integrated with the rear section of the fuselage, refer to Chapter 53.



Engine No.1 external details
Fig.1



MOD. 252367



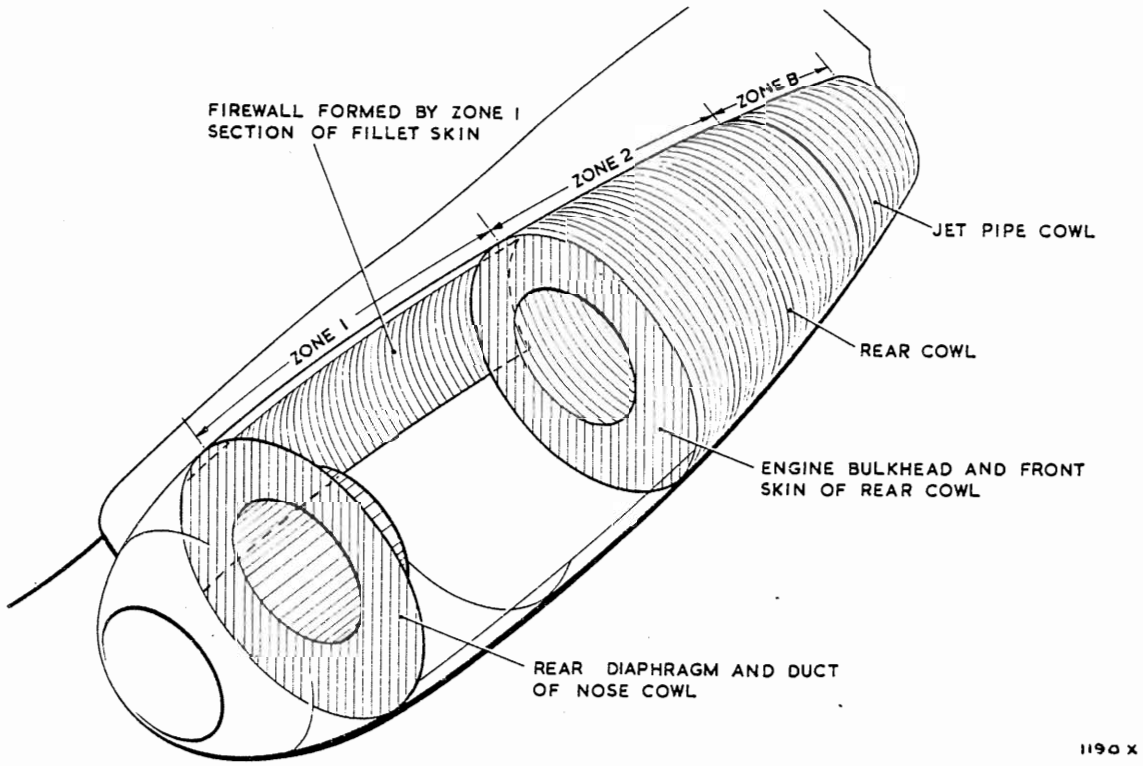
Engine No.2-external details
Fig.2

...Power plant - General continued

3. Firewalls

A. General

Each power plant is housed in a fireproof bay isolated from the remainder of the aircraft (Fig.3). To prevent the spread of a fire, the bay is divided into three zones. Zone 1, the front zone, houses all parts of the installation capable of sustaining a fire. Zone 2, the centre zone, encases the combustion system. Zone b, the rear zone, surrounds the exhaust system.



Firewalls
Fig.3

The forward section of the fillet is an integral part of Zone 1. The upper and lower skins of the fillet, except for the rear strake of each surface, are titanium.

B. Zone 1

Zone 1 is bounded at the front by a titanium firewall formed by the rear diaphragm of the nose cowl and the rear section of the intake duct. The rear firewall consists of the stainless steel diaphragm of the rear cowling, which also forms the Zone 1/Zone 2 inter-zonal boundary. The concave section of the fillet, fabricated from titanium, and the upper and lower skins of the fillet complete the fireproofing of Zone 1.

...Power plant - General continued

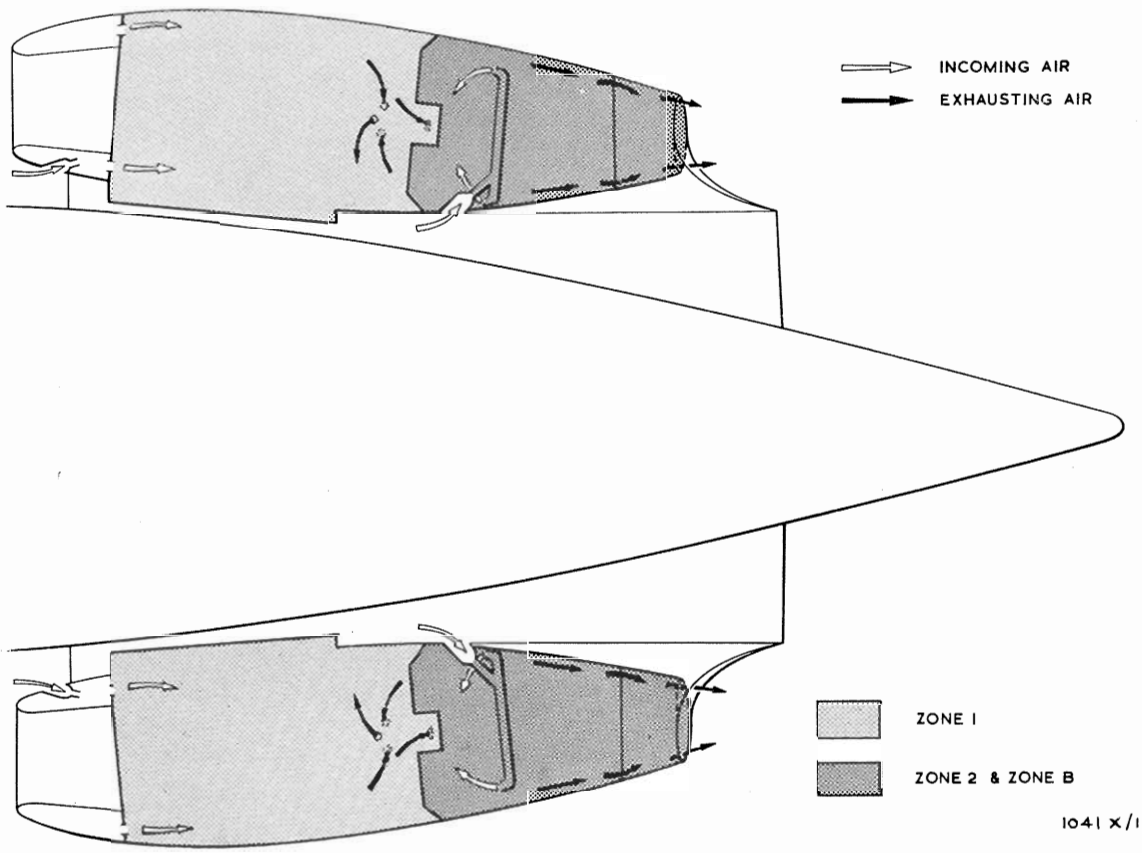
C. Zone 2 and Zone B

Zone 2 is fully enclosed by the rear cowling; apart from its front stainless steel diaphragm, this cowling is all titanium. Zone 2 terminates at a piston ring type seal at the rear of the rear cowling; aft of this is Zone B which is shrouded by the titanium jet pipe fairing.

4. Ventilation

A. General

During flight, ram air flows into each zone of the power plant bay (Fig.4) via non-icing flush intakes. The ventilation system is arranged so that the pressure in Zone 2 exceeds that in Zone 1, so reinforcing the confinement of a fire in Zone 1.



Ventilation
Fig.4.

B. Zone 1

Air enters an intake in the side of the nose cowl and flows into a plenum chamber, formed between the front and rear diaphragms of the nose cowl. Holes in the rear diaphragm (gauze covered to maintain the effectiveness of the firewall) permit the air to flow into Zone 1.

...Power plant - General continued

Air exhausts from Zone 1 via a gauze-covered hole in the top cowling and a series of shrouded ventilation/drain holes in each of the lower cowlings and the underside of the fillet. In addition, air flowing between the drains tank and rear cowling - exhausting via a slot at the rear underside of the tank - prevents the accumulation of fuel or oil on or around the drains tank.

C. Zone 2 and Zone B

An intake in the rear cowling admits air to a manifold secured to the inside of the cowling. Perforations in the manifold cause the air to diffuse throughout the zone.

Air exhausts from Zone 2 by leaking past and through holes in the rear seal. That air which escapes from the rear of Zone 2 flows into Zone B, and around the jet pipe, to atmosphere.

* * *

POWER PLANT - TROUBLE SHOOTING

General

These charts are based on the assumption that an engine fault does exist. Before resorting to the trouble shooting charts recheck such items as:-

(1) The correct drill has been completed so that the appropriate selections of levers and switches have been made and the relevant instruments and/or indicators are reading accurately or that errors are known.

(2) The relevant circuit breakers and/or fuses are satisfactory.

(3) The relevant busbars are powered and power supplies are satisfactory.

(4) Aircraft batteries, Nos. 1, 2 and 3, are connected and in a satisfactory state of charge.

(5) There is adequate fuel in the aircraft tanks.

(6) All appropriate blanks and covers have been removed.

(7) The engine intake and exhaust are unobstructed and there are no visible signs of damage to the engine.

(8) The engine rotates freely by hand and makes no abnormal noises.

(9) The aircraft is facing basically into wind, particularly in strong winds.

If a lubrication system fault is encountered refer to the trouble shooting charts in Chapter 72, LUBRICATION SYSTEM.

Refer to the relevant chapter table of contents for the precise ATA breakdown number whenever the trouble shooting charts cross refer to a specific subject.

CHART NO.0

ENGINE ROTATION STIFF OR SHORT RUNDOWN TIME

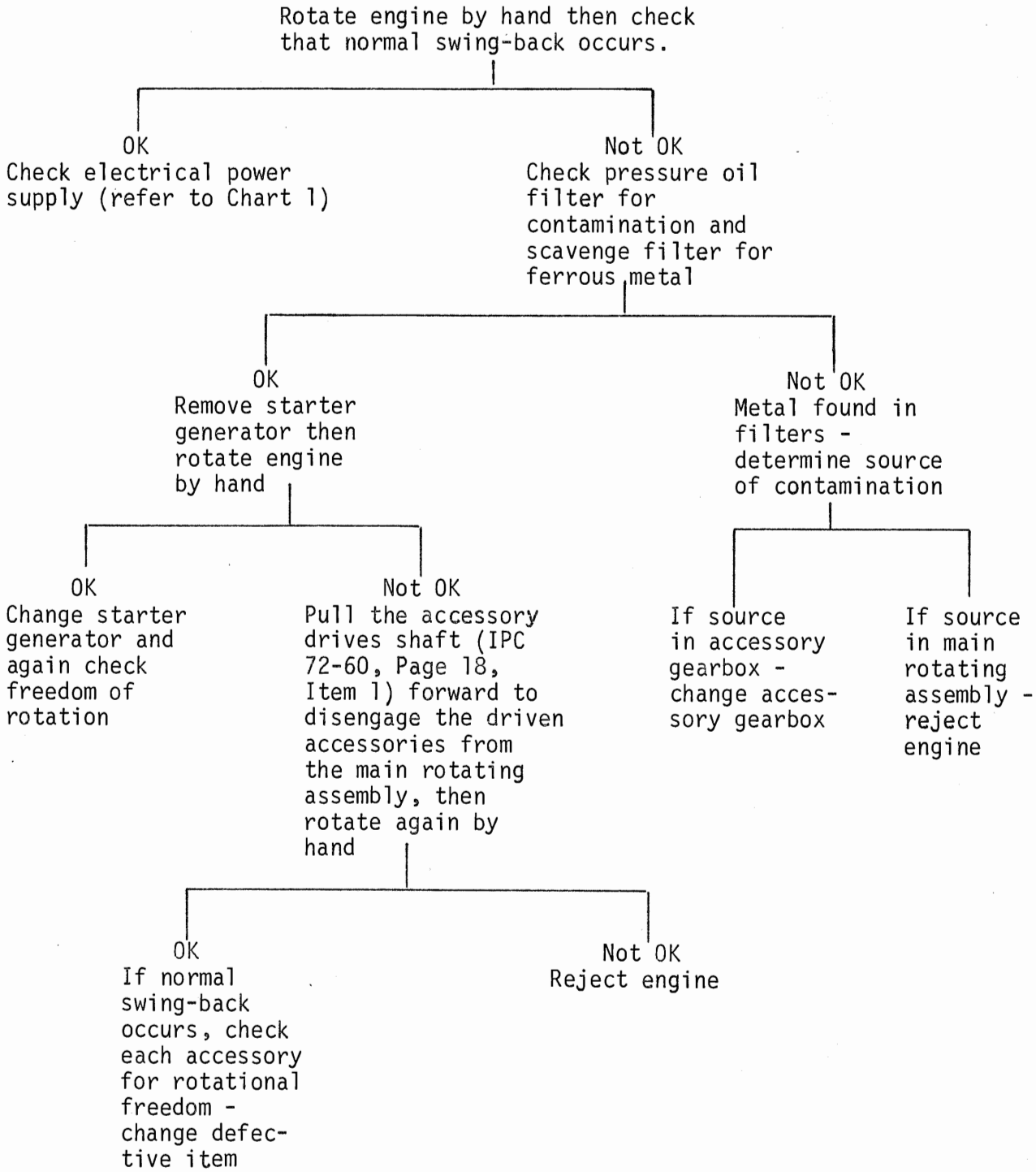


CHART NO.1

ENGINE DOES NOT ROTATE DURING STARTING CYCLE

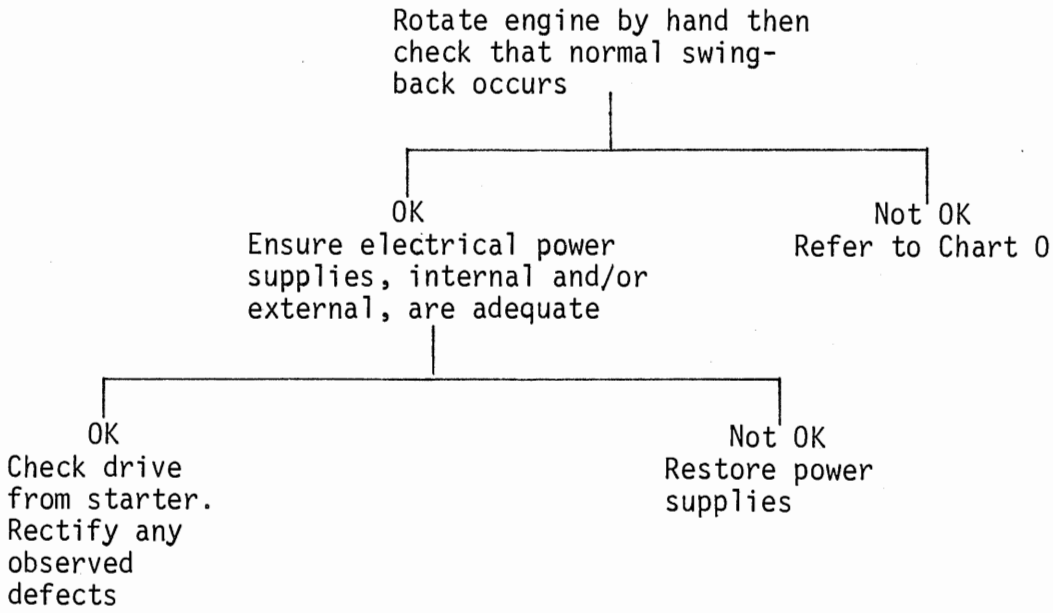


CHART NO. 2

ENGINE ROTATES BUT FAILS TO LIGHT DURING STARTING CYCLE

(Exhaust cone and nozzle dry)

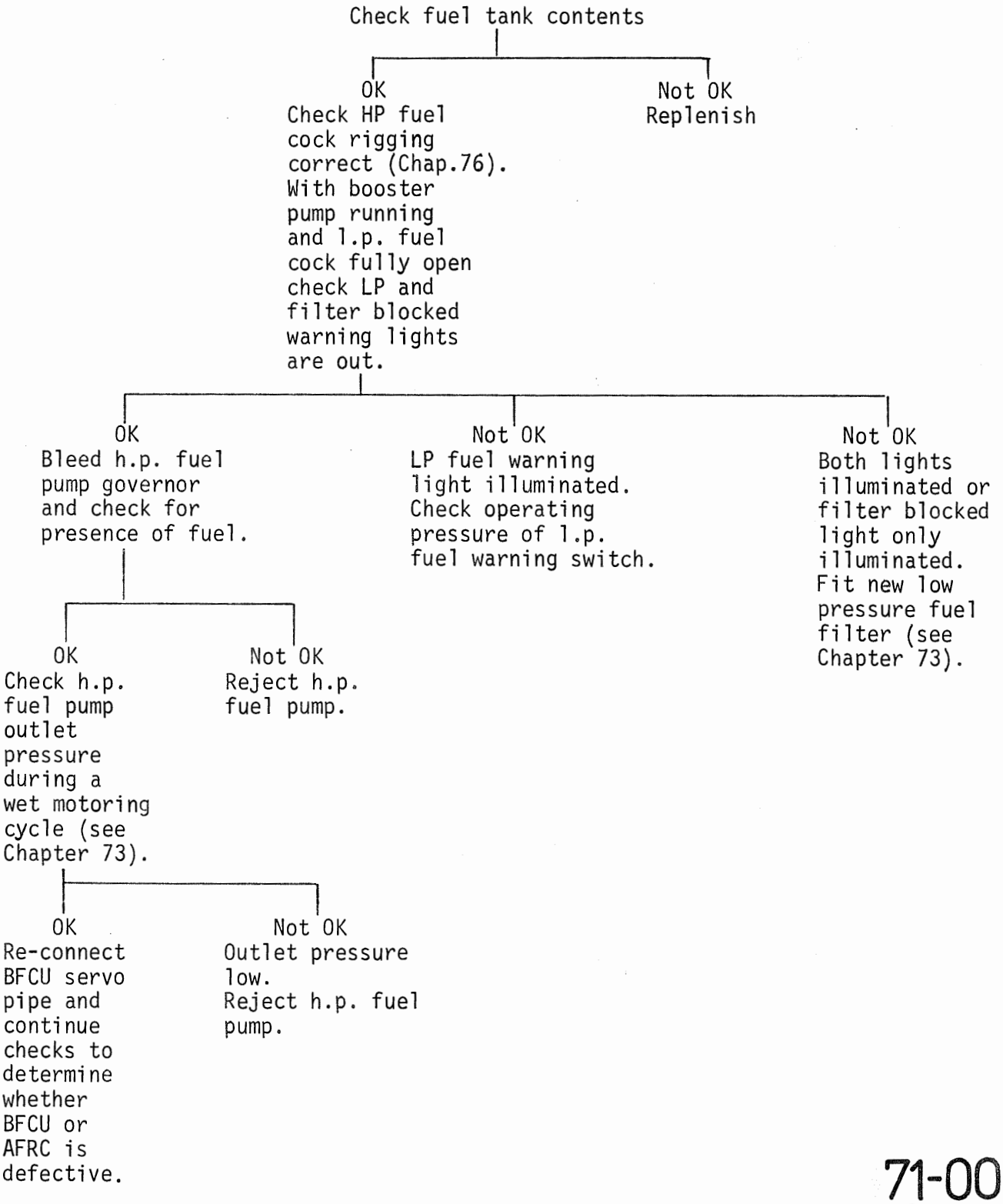


CHART NO. 3

ENGINE ROTATES BUT FAILS TO LIGHT DURING STARTING CYCLE

(Exhaust cone and nozzle wet)

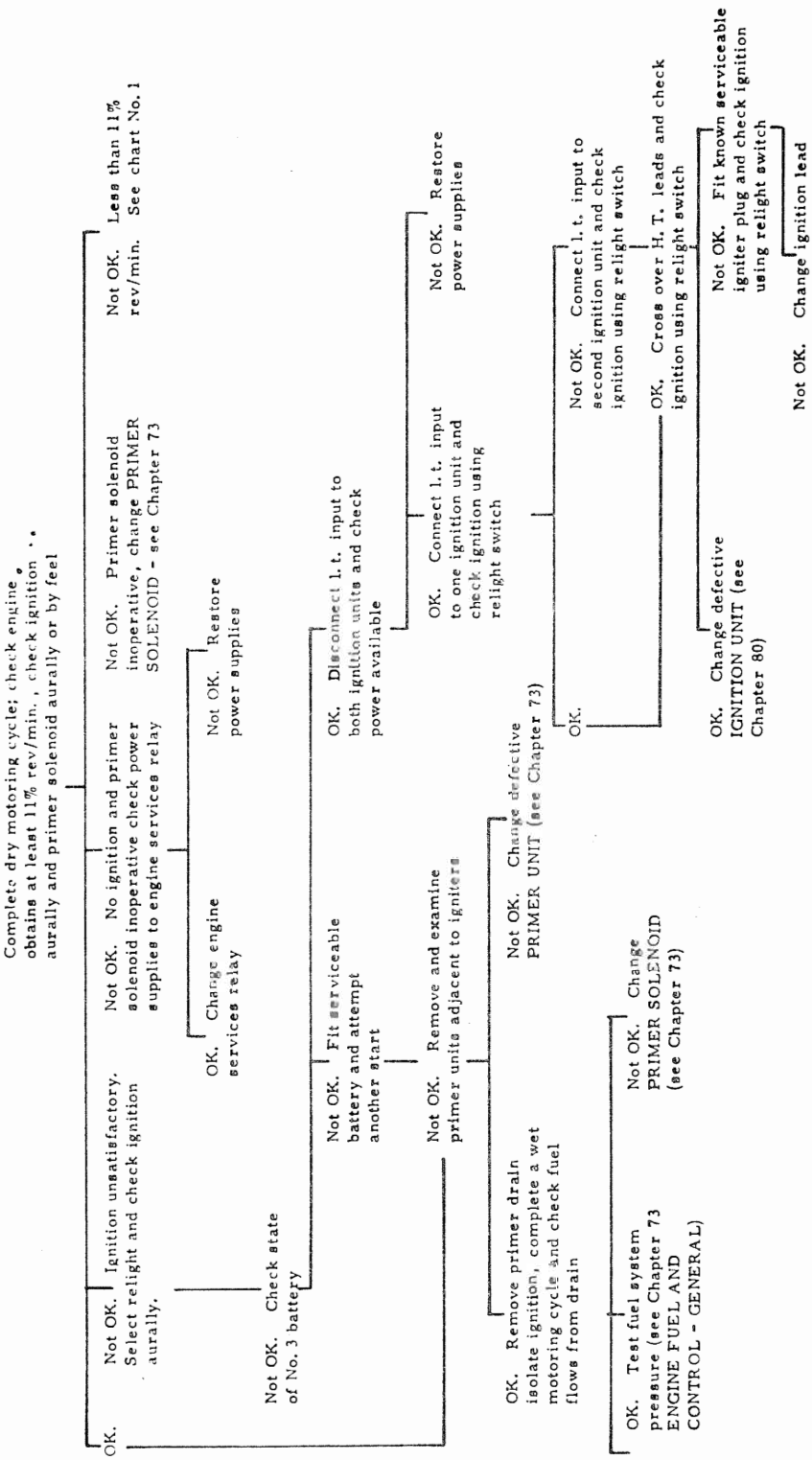


CHART No. 4

ENGINE LIGHTS BUT J.P.T. IS HIGH DURING START

See chart 1

OK. Check air intake and compressor air bleed valve outlet are unobstructed

Attach streamers to outlet of compressor air bleed, isolate ignition, complete a wet motoring cycle and check that streamers indicate compressor air bleed valve is open, time switch trips at 25 seconds (Pre Mod. 251728 only) and engine drains function normally.

Not OK. Drains inoperative, clear drains system of obstruction

Not OK. Time switch trips prematurely, Change time switch

OK. Check pressure increasing valve and primer solenoid close effectively on shut down

Not OK. Compressor air bleed valve operation unsatisfactory. Check P1/P2 balance pipe for blockage (Chapter 75)

OK. Service air bleed CONTROL VALVE (Chapter 75.)

Not OK. Change balance pipe.

Not, OK. Remove COMPRESSOR AIR BLEED VALVE and check smooth operation of piston. (Chapter 75)

O.K. Change PRESSURE RATIO SWITCH (see Chapter 75)

Not OK. Change COMPRESSOR AIR BLEED VALVE (Chapter 75).

OK. Change BAROMETRIC FLOW CONTROL UNIT (Chapter 73)

Not OK. Change PRIMER SOLENOID or PRESSURE INCREASING VALVE (Chapter 73)

CHART No. 5

ENGINE LIGHTS UP BUT FAILS TO REACH IDLING SPEED

J.P.T. low Fuel l.p. warning light out. Test fuel system pressure (Chapter 73 ENGINE FUEL AND CONTROL - GENERAL)

J.P.T. high See chart 4

CHART No. 6

ENGINE SLOW TO ACCELERATE

(All conditions)

Functionally test that anti-icing system and cabin pressurization valve are set as required.

OK. Test operation of compressor air bleed valve. (Chapter 71 Ground Running Tests).

OK. Adjust acceleration rate. (Chapter 71 Ground Running Adjustments)

Not OK. Check P2 air pipe to a.f.r.c. and filter, in line, for damage and for security of connections.

OK. Change the AIR/FUEL RATIO CONTROL (Chapter 73)

Not OK. Compressor air bleed valve operation unsatisfactory. Check P1/P2 balance pipe for blockage (Chapter 75).

OK. Service air bleed CONTROL VALVE (Chapter 75)

Not OK. Change balance pipe

Not OK. Remove COMPRESSOR AIR BLEED VALVE and check smooth operation of piston (Chapter 75)

OK. Change PRESSURE-RATIO SWITCH (Chapter 75)

Not OK. Change COMPRESSOR AIR BLEED VALVE (Chapter 75)

CHART NO.7

ENGINE STALLS OR FLAMES-OUT DURING ACCELERATION

Examine the engine air intake for damage or obstruction, inlet guide vanes and compressor stator blades for damage or mal-alignment.

Not OK
Reject engine if damaged beyond acceptance limits.

OK
Test operation of the compressor air bleed valve. (Chapter 71, Ground Running Tests).

Not OK
Compressor air bleed valve operation unsatisfactory. Check P1/P2 balance pipe for blockage (Chapter 75).

Not OK
(Valve closes prematurely). Check valve and pressure ratio switch connections for leakage.

OK
Service air bleed CONTROL VALVE (Chapter 75).

NOT OK
Change balance pipe.

Not OK
Remove COMPRESSOR AIR BLEED VALVE and check smooth operation of piston (Chapter 75).

OK
Change PRESSURE RATIO SWITCH (Chapter 75).

Not OK
Change COMPRESSOR AIR BLEED VALVE (Chapter 75).

If no apparent leakage, adjust (Mod.CV7161)- see Chapter 71 Ground running adjustments, or change PRESSURE RATIO SWITCH (Chapter 75) and recheck valve operation.

OK
Check acceleration rate, if outside limit adjust the a.f.c.r. (Chapter 71, Ground running adjustments) if insufficient adjustment available or stall still occurs, change AIR/FUEL RATIO CONTROL, (Chapter 73).

Not OK
Reject engine for investigation.

CHART NO. 8

ENGINE FAILS TO ATTAIN MAX SPEED ON GROUND

NOTE : Below approx. 4°C (522) or 5°C (520 & 521) ambient it will not be possible to reach max speed unless the b.f.c.u. capsule chamber is pressurized to 5 lb/sq.in. (See POWER PLANT - ADJUSTMENT/TEST), 'Ground running adjustments'.

With engine running at max attainable speed check LP and filter blocked lights remain out, t.t.c. is off, and the relationship between indication of engine speed, j.p.t., power loss and fuel flow is appropriate.

Not OK. LP and/or filter blocked lights on See chart 2.

Not OK. Engine speed indication suspect. Check speed indicating system. (Chapter 77).

OK. Check engine for damage and check throttle and h.p. cock rigging. (Chapter 76 POWER CONTROL).

OK. With engine running bleed engine fuel system and, at 70% rev/min. bleed rate reset valve. Recheck for max speed.

Not OK. But above 70% rev/min attainable, adjust maximum governed speed (see Chapter 71, Ground running adjustments).

Not OK. Test fuel system pressure (Chapter 73 ENGINE FUEL AND CONTROL - GENERAL).

Not OK. Less than 70% rev/min attainable, change AIR/FUEL RATIO CONTROL. (Chapter 73).

CHART NO. 9

ABNORMALLY HIGH JET PIPE TEMPERATURE UNDER STEADY RUNNING CONDITIONS

Ensure air intake and exhaust cone assemblies are free from obstruction and damage and thermocouple probe holes not blocked. Check rotating assembly by hand for normal swing-back.

- OK: Functionally check all compressor air bleeds and the primer solenoid are closed.
  - OK: Ensure prescribed nozzle diameter and trimmer state are correct.
    - OK: Check calibration of j.p.t. circuits, including harness resistance.
      - OK: Ground run engine and confirm compressor air bleed valve closes at correct r.p.m.
        - OK: Ground run engine and, using suitable accurate equipment such as Rolls-Royce E.S.1201 or E.S.1295 Test Set, obtain OAT/RPM/JPT data. Refer to nearest Rolls-Royce Limited representative to check whether engine is within acceptable limits.
        - Not OK: Refer to Chart 4
      - Not OK: Rectify as necessary
    - Not OK: Re-trim as stated in Engine Log Book. If exhaust cone has been changed re-trim as detailed in Chapter 72 - ENGINE, GENERAL - Trim exhaust nozzle.
  - Not OK: Change primer solenoid.
- Not OK: If damage acceptable - replace damaged part. If damage unacceptable - reject engine.

CHART No. 10

ENGINE FLAMES OUT UNDER STEADY RUNNING CONDITIONS

Check engine free to rotate by hand and undamaged.

OK. Check for indication of low fuel pressure and for filter blocked.

Not OK. Engine damaged Reject engine

Not OK. Not free to rotate See chart 1.

OK. Bleed engine fuel system (Chapter 73 ENGINE FUEL AND CONTROL - GENERAL) and attempt another start.

Not OK. Test fuel system pressure (Chapter 73 ENGINE FUEL AND CONTROL - GENERAL).

Not OK. Both lights on or filter blocked light only on. Fit new LOW PRESSURE FILTER. (Chapter 73)

CHART No. 11

ENGINE FLAMES - OUT ON DECELERATION

Check engine free to rotate by hand and undamaged

Not OK. Not free to rotate see chart 1.

Not OK. Damaged reject engine.

OK. Test operation of compressor air bleed valve (See chapter 71, Ground Running Tests).

OK. Test fuel system pressure (Chapter 73 ENGINE FUEL AND CONTROL - GENERAL)

Not OK. Compressor air bleed valve operation unsatisfactory. Check P1/P2 balance pipe for blockage (Chapter 75).

OK. Service air bleed CONTROL VALVE (Chapter 75).

Not OK. Change balance pipe.

Not OK. Remove COMPRESSOR AIR BLEED VALVE and check smooth operation of piston (Chapter 75).

OK. Change PRESSURE RATIO SWITCH (Chapter 75).

Not OK. Change COMPRESSOR AIR BLEED VALVE (Chapter 75).

CHART NO.12

SYNCHRONIZER FAILS TO CONTROL SLAVE ENGINE SATISFACTORILY

Check power supplies to synchronizer system and operation of aircraft relay.

- Not OK. Restore power supplies or change relay, as appropriate.
- OK. Check voltage output of each TACHOMETER/SYNCHRONIZER AC GENERATOR (CHAPTER 77).
  - OK. Change SYNCHRONIZER CORRECTOR UNIT (see Chapter 73).
  - Not OK. Change defective TACHOMETER/SYNCHRONIZER AC GENERATOR (see Chapter 77).

CHART NO.13

TOP TEMPERATURE CONTROL FAILS TO CONTROL ENGINE

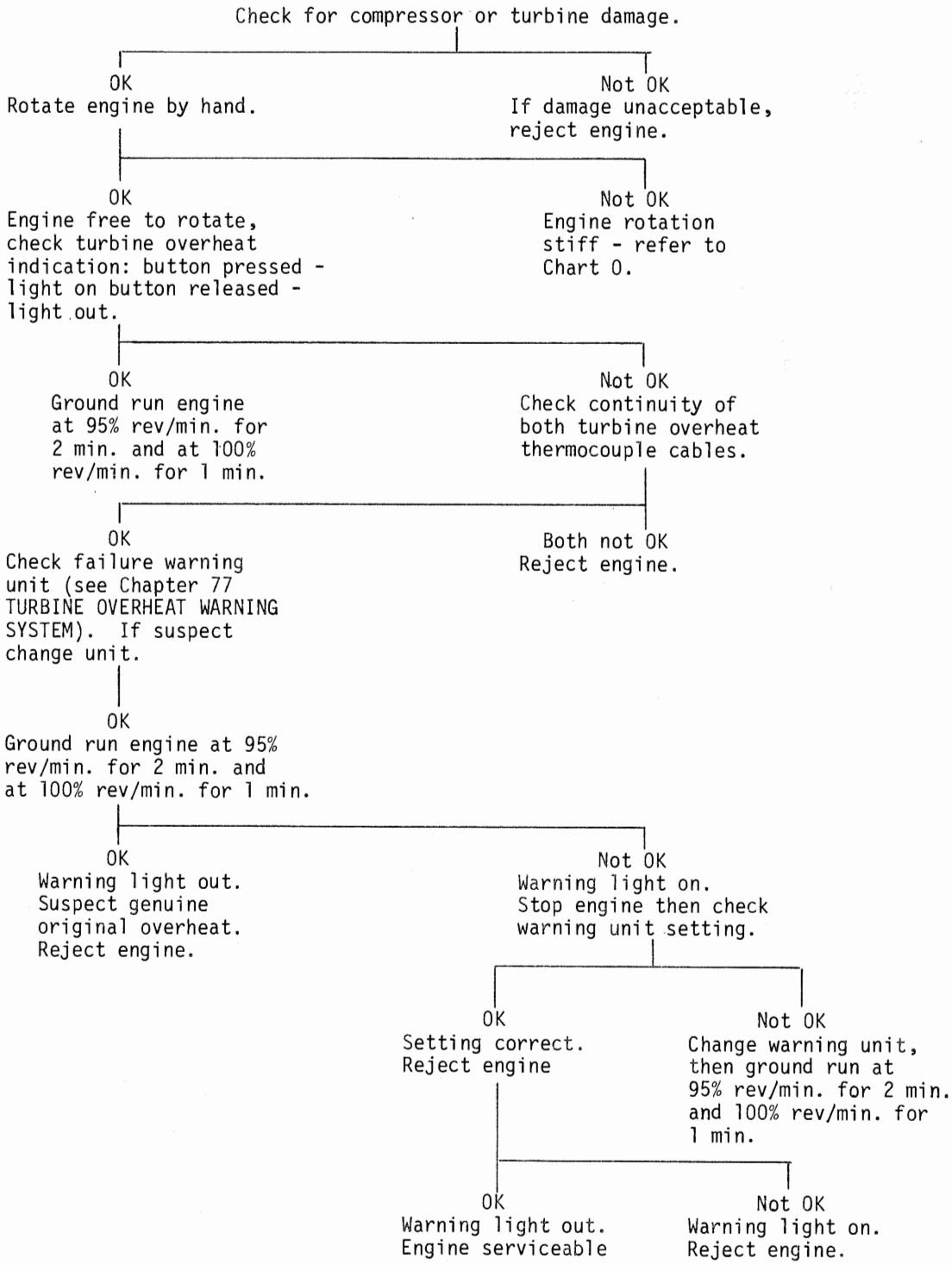
(Engine satisfactory with cockpit switch placed OFF).

Check a.c. and d.c. power supplies available at amplifier.

- OK. Calibrate system - engine static (see Chapter 73) TOP TEMPERATURE CONTROL SYSTEM).
  - Interchange amplifiers from left-hand to right-hand or vice-versa.
    - Not OK. Change electro-pressure control valve.
- Not OK. Restore power.

CHART NO.14

TURBINE OVERHEAT WARNING IN FLIGHT OR DURING GROUND RUN



POWER PLANT - SERVICING

1. Unit Servicing

A. Prepare power plant for service after prolonged standby

NOTE: This procedure is applicable to engines installed in aircraft, which have remained static for more than 28 days.

(1) Gain access to zone 1 of the power plant.

(2) Remove air intake and exhaust covers, and any temporary blanks (e.g. masking tape) from power plant installation.

(3) Check the installation for fuel and oil leaks, corrosion and damage; rectify as necessary.

(4) Replenish engine oil system as necessary (See Chapter 12 ENGINE OIL).

(5) Prime engine oil system (see Chapter 72 LUBRICATION SYSTEM).

(6) Complete Test B of POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS (See chapter 71).

* * *

1. Remove power plant

CAUTION : MAINTAIN AN INVENTORY OF ALL TOOLS, STORES AND EQUIPMENT USED BY PERSONS ACTIVELY EMPLOYED ON, OR IN THE VICINITY OF, TURBO-JET ENGINES. THE INGESTION OF SMALL OBJECTS SUCH AS SPLIT PINS MAY SERIOUSLY DAMAGE AN ENGINE. WHENEVER A PIPE OR OTHER COMPONENT IS REMOVED, IMMEDIATELY FIT A BLANK TO THE APERTURE.

A. Prepare to remove power plant

Special tools and equipment

Power plant sling .. 25Y27A

(1) Arrange for attendance of mobile hoisting gear or ensure aircraft is positioned beneath an overhead hoisting gantry.

NOTE : Hoisting gear must have a 'Safe Working Load' capacity of not less than 1200 lb.

(2) Prepare and position an empty stand to receive the removed power plant or engine.

NOTE : There are three types of stand : transit, parking and servicing. The latter will carry a complete power plant.

(3) Position and prepare aircraft.

(a) Apply brakes and chock wheels fore and aft.

NOTE : If aircraft is on jacks, use wing steadies.

(b) Ensure air intake blanks, bleed valve and exhaust covers are fitted both before and after removal of cowlings.

(c) Check that the appropriate LP and HP fuel cocks are off.

(4) Isolate electrical power supplies to the high energy ignition units (see Chapter 24, GENERAL).

(5) Disconnect l.t. input to high energy ignition units of power plant to be removed.

WARNING : THE ELECTRICAL DISCHARGE FROM HIGH ENERGY EQUIPMENT IS POTENTIALLY LETHAL. DO NOT HANDLE HT LEADS OR IGNITER PLUGS FOR AT LEAST ONE MINUTE AFTER DISCONNECTION OF LT INPUT.

(6) Uncowl the power plant.

(a) Open both hinged cowls.

...Remove power plant continued

(b) Disconnect cooling air inlet at starter/generator.

(c) Remove bottom front cowl.

(d) Left engine only - Disconnect breather hose from bottom front cowl.

(e) Remove inboard hinged cowl.

(f) Right engine only - Disconnect a.c. generator cooling air inlet and, Mod 25/1911 only, drain from flush air inlet from top cowl.

(g) Remove top cowl and outboard hinged cowl together.

(h) Remove the top and bottom fillet shroud panels.

CAUTION : 1. DO NOT ATTEMPT TO REMOVE THE JET PIPE COWL UNTIL THE THERMOCOUPLE LEADS HAVE BEEN DISCONNECTED.

2. HYDRAULIC PUMP QUILL SHAFT IS TO BE REMOVED AND ATTACHED EXTERNALLY TO ENGINE IN A SUITABLE CONTAINER. PUMP APERTURE SHOULD THEN BE COVERED WITH AN APPROVED BLANK.

(7) Position a drip tray beneath the engine.

(8) Inhibit the engine fuel system (Chapter 20, STORES DATA - SPECIAL, R.R. BRISTOL).

NOTE : If desired, or if the engine is damaged and cannot be rotated, this operation may be completed after removal.

(9) Isolate all electrical power supplies to the power plant(s) (Chapter 24, GENERAL).

B. Disconnect electrical connections

CAUTION : PRE-MOD 25/1952 AFTER DISCONNECTING CABLES ENSURE THAT THEY ARE EASILY IDENTIFIABLE; IF NECESSARY, TO AVOID ERRORS WHEN RECONNECTING, FIT IDENTIFICATION TAGS.

(1) Disconnect cables from starter/generator and secure them clear of engine.

NOTE : If power plant is to be stripped in situ, disconnect the starter/generator thermal switch cables from the engine terminal block and then remove thermal switch. Mod. 251800 only - it is unnecessary to disconnect cables from terminal block.

...Remove power plant continued

(2) Right engine only - Disconnect cables from windshield supply a.c. generator.

(3) Left engine only - If replacement power plant is devoid of corrector unit disconnect harness socket from synchronizer corrector unit.

NOTE : Release cables from clips on nose cowl.

(4) Disconnect both 1.t. harness plugs at top of engine and free cable from clips secure to engine.

(5) Mod. 252367 only - Disconnect the electrical connector from the primer shut-off valve actuator on the 1.p. filter housing.

(6) Disconnect the four Firewire cables at plugs.

NOTE : One on top of engine, one beneath rear of engine, two left and right on lower front face of rear cowl.

(7) Disconnect h.t. leads from both igniter plugs.

(a) Right engine only - Disconnect clamp at air tapping elbow.

(8) Disconnect clamp block beneath engine, securing ignition and Firwire cables.

(9) Disconnect turbine overheat system cables from terminal block beneath engine centre section, refit washers and nuts.

(10) Move electrical wiring clear of engine.

(11) Disconnect thermocouple harness from both terminal blocks on fillet.

CAUTION : DO NOT DISCONNECT TAKE-OFF LEADS FROM TERMINATION FITTING ON HARNESS.

(12) Slacken bolts on clamp, securing harness leads to jet pipe fairing; withdraw leads leaving them attached to the engine.

NOTE : Gain access to interior of jet pipe fairing via panel.

(13) If stripping in situ - disconnect electrical harness from differential pressure switch and disconnect extension lead from harness; transfer lead to replacement power plant.

C.Disconnect mechanical connections

(1) Disconnect fire extinguishant hose from spray ring around nose cowl.

(2) Disconnect cabin air pipe and fit blanks.

(a) Left engine only - Remove two bolts at upper end, push lower end of pipe into sliding joint, twist locking plate and withdraw pipe from the aircraft. Discard seals.

(b) Right engine only - Remove quick-release pin and push pipe down out of engagement with engine. Discard seal.

(3) Right engine only - Slacken clamps and disconnect hose from air intake casing breather pipe.

(4) Disconnect fuel feed hose (and differential pressure switch hoses, if stripping in situ) from l.p. filter.

CAUTION : HOLD FILTER ADAPTER WITH SPANNER WHEN SLACKENING HOSE NUTS.

(5) Disconnect throttle and h.p. fuel cock controls at lower ends of vertical rods.

(a) Right engine only - Discard tabwashers.

(b) Left engine only - Discard split pins.

(6) Remove hydraulic pump.

(a) Disconnect gland drain pipe.

(b) Right engine only - Disconnect windshields supply a.c. generator cooling air pipe at generator.

(c) Remove securing washers and nuts and withdraw hydraulic pump.

(d) Support pump clear of installation.

CAUTION : 1. DO NOT KINK HOSES OR ALLOW THEM TO CARRY WEIGHT OF PUMP.

2. HYDRAULIC PUMP QUILL SHAFT IS TO BE REMOVED AND ATTACHED EXTERNALLY TO ENGINE IN A SUITABLE CONTAINER. PUMP APERTURE SHOULD THEN BE BLANKED WITH APPROVED BLANK.

(7) Disconnect power loss indicator hose at adaptor on rear cowl.

(8) Remove jet pipe fairing, avoid fouling thermocouple flexible take-off leads.

(9) Applicable only if power plant is to be removed as a complete unit - Ignore the remaining operations of this para. and proceed with para.D. - 'Connect slinging gear and lower power plant.

(10) Disconnect power loss indicator hose at adapter on engine exhaust.

(11) Left engine only - Disconnect horizontal cross-over control rods from bell crank and engine levers; discard split pins and tab washers.

...Remove power plant continued

(12) Left engine only - Disconnect control rod bell crank block from compressor casing; discard tab washers.

(13) Remove starter/generator and air outlet casing.

(a) Remove cooling air inlet duct.

(b) Slacken clamp ring.

(c) Withdraw starter/generator.

(d) Remove nuts and washers and withdraw casing with exhaust duct intact.

(14) Right engine only - Remove a.c. generator.

(a) Slacken clamp ring and withdraw generator quill shaft.

(b) Discard O-ring seal.

(15) Disconnect drain pipes.

(a) Centre-section drain at drain valve and, Mod. 252367 only, at drains tank. Right engine only disconnect clips securing other items to pipe.

(b) Primer drain at drains tank and engine banjo, and Mod.252367 only, the drains tank and shut-off valve connection of the L.P. fuel filter.

(c) Mod. 252367 - Primer drain at inlet and outlet of primer drain valve.

(d) Drain from b.f.c.u. at b.f.c.u. and drains tank.

(e) Drain pipe at oil tank filler neck, and fuel pump.

(f) Engine breather at engine banjo.

(g) Left engine only - Synchronizer corrector unit drain pipe.

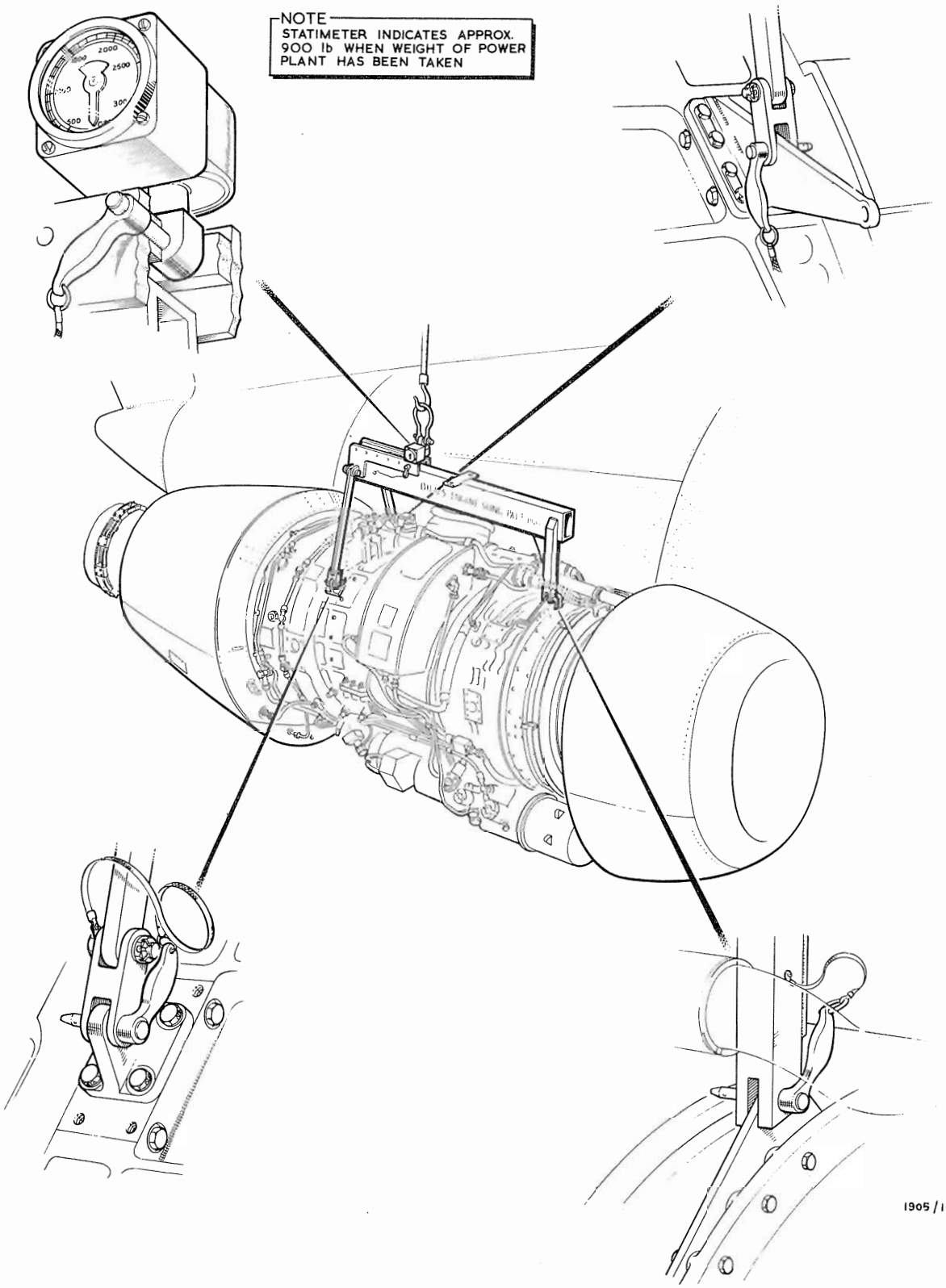
(h) Exhaust cone drain, via access panel in rear cowl.

(16) Slacken retaining nuts and slide guard off compressor air bleed valve.

(17) Remove hot air tapping elbow from engine. Discard seal and fit blank.

NOTE : Clean jointing compound (See Chapter 71 - SERVICING MATERIALS) from engine and elbow mounting faces and retain elbow for the replacement power plant.

...Remove power plant continued



Power plant slinging
Fig.401

...Remove power plant continued

(18) Disconnect fire extinguishant pipe from left side of engine.

(19) Remove nose cowl:-

(a) Disconnect bonding wire and clamp linking anti-icing duct to nose cowl.

(b) Release fire extinguishant pipe support bracket and harness at top of engine.

(c) Release cowl and ease forward to disengage anti-icing duct. Discard seal.

(20) Remove nose cowl anti-icing duct from engine and discard seal.

(21) Disconnect fuel differential pressure switch hoses from 1.p. fuel filter.

CAUTION : HOLD FILTER ADAPTERS WITH SPANNER WHEN SLACKENING HOSES.

(22) Mod. 252367 only - Remove primer shut-off valve (see Chapter 71) - PRIMER DRAIN).

(23) Remove rear cowl:-

(a) Remove access plate, bolted in front of drains tank complete with fuel differential pressure switch and hoses.

(b) Ensure that the thermocouple harness flexible take-off leads are firmly taped to the engine.

(c) Release cowl and move it rearward from the exhaust assembly.

(d) Remove rear piston ring type seal.

(e) Remove the cowl from the engine: avoid fouling the firewire and flexible take-off leads.

(24) Remove closure plate from outboard front mounting face and fit slave front mounting bracket. Tighten mounting bolts to 150-170 1bf.in.

NOTE : Place bolts, spring washers, distance pieces and closure plate in a clean bag and secure to engine.

(25) Remove closure plate from outboard trunnion mounting; refit washers and bolts, further tighten to 150 to 170 1bf. in.

NOTE : Use new tabwashers if engine is serviceable and is being refitted to the opposite handed position. Transfer closure plate to replacement engine or opposite side of a rehanded engine as appropriate.

...Remove power plant continued

D.Connect slinging gear and lower power plant

(1) Position hoisting gear (Fig.401).

(2) Attach power plant sling to hook of hoisting gear.

CAUTION : CHECK THAT THE STATIMETER OPERATES CORRECTLY.

(3) Connect sling to front and rear slinging points of engine (Fig.401).

(4) Position prepared empty power plant stand adjacent to installation postion.

(5) Take weight of power plant until Statimeter registers approx. 900lb.

CAUTION : CHECK THAT MOUNTS FROM THE ONLY CONNECTION BETWEEN POWER PLANT AND AIRFRAME.

(6) Disconnect front mount.

(7) Disconnect both main engine mounting links at engine: pivot links clear of engine.

(8) Ease the power plant away from the fillet to disengage the main mount trunnion.

(9) Lower the power plant and secure it in the prepared stand.

NOTE : This required two men, excluding the hoist operator.

(10) Disconnect sling from engine.

(11) Move power plant clear of aircraft.

CAUTION : ENSURE ELECTRICAL WIRING IS NOT DAMAGED.

(12) Right engine only - Remove air conditioning duct from connection at fillet; discard seal.

(13) If power plant was removed as a complete unit - Strip power plant (see relevant operations of para.C. or refer to 'strip power plant' in POWER PLANT BUILD LIST).

(14) If replacement power plant is not available immediately, blank all apertures left open on aircraft as the result of removing the power plant.

(15) Obtain inspection clearance for all parts which have been removed from the unserviceable power plant and are to be fitted to the replacement power plant.

End of 'Remove power plant'
Pages 409 to 420 intentionally omitted.

...Power plant - Removal/Installation continued

2. Install power plant

Materials required :-

For lubricants, jointing compounds, etc. see Chapter 71, SERVICING MATERIALS.

A. Prepare to install power plant

NOTE : All torque loading figures quoted are the actual loadings required; if an extension spanner is used between the torque spanner and the item being tightened, calculate the correct torque spanner dial reading required (see Chapter 20, TORQUE LOADING).

(1) Remove any dirt or foreign matter which may have accumulated on the cowlings or fillet.

(2) Check that the power plant is complete or that the components, quoted in the 'Power plant build list' are available ready for assembly.

NOTE : If a power plant servicing stand is available, assemble the power plant before installation. If a transit or parking stand only is available, complete the build of the power plant after installation of the engine change unit. Items which are to be transferred from one power plant to another must receive inspection clearance.

(3) Check that clearance between rear loops of thermocouple harness conduit and exhaust cone outer skin is 0.20 ± 0.050 in.

(4) Verify that any pre-installational checks, specified in the Maintenance Schedule, have been completed satisfactorily.

(5) Move power plant and stand adjacent to installation position.

(6) If building power plant in situ, remove all traces of old lubricant from starter/generator drive shaft, using white spirit. If replacement engine is not new also clean old lubricant from gear box starter/generator extension drive shaft. Dry with compressed air.

(7) Right engine only - Fit air conditioning duct to aircraft duct in fillet.

(8) Fit cooling air inlet duct to starter/generator; do not tighten clamp.

(9) Lubricate shouldered bolt and nut of front mounting, engine mounting link bolts and spherical bearing and socket of main engine mounting.

(10) Check that the aircraft installation is ready to receive the power plant.

B. Connect slinging gear, raise and secure power plant

(1) Position hoisting gear (Fig. 401).

(2) Attach power plant sling to hook of hoisting gear.

CAUTION : CHECK THAT STATIMETER OPERATES CORRECTLY.

(3) Connect sling to front and rear slinging points.

(4) Take weight of power plant until Statimeter registers approx. 900 lb.

CAUTION : DO NOT ATTEMPT TO LIFT POWER PLANT AND STAND.

...Install power plant continued

(5) Applicable only when using power plant servicing stand - Release power plant from stand.

(a) Disconnect front mount.
(b) Disconnect both main engine mounting links; pivot links clear.
(c) Ease power plant away from stand, to disengage main mount trunnion, and move stand clear of power plant.

(6) Applicable only when using transit or parking stand - Release power plant from stand.

(a) Disconnect stand from trunnion mount spigots and front mount.

(b) Raise power plant until mounts are clear of stand.

(c) Pre-mod CV.7096 - Remove slave front mounting bracket from engine and fit closure plate to outboard front mounting position; apply approved jointing compound to closure plate and to mounting face, and fit closure plate, using front mounting bolts, spring washers and distance pieces. Tighten bolts to 150 to 170 lbf.in.

(d) Pre-mod CV.7096 - Fit slave front mounting bracket to transit stand.

(e) Fit closure plate (transferred from removed power plant) to outboard trunnion mounting- apply approved jointing compound to closure plate and to mounting face and fit closure plate, using trunnion mounting bolts and two new double tabwashers. Tighten bolts to 150 to 170 lbf. in. and engage tabwashers.

(f) Check inboard trunnion mounting bolts are correctly fitted and locked with tabwashers.

(7) Raise power plant and secure in mounts.

NOTE : This requires two men, excluding the hoist operator.

(a) Engage spigot on main engine mounting trunnion; ensure top mounting link does not foul engine.
(b) Fit bolt to connect top and bottom mounting links to engine.
(c) Fit bolt to connect front mount to engine.

(8) Fit nuts to bolts of main engine mounting link and front mount bolt. Tighten each nut and lock with a split pin.

(9) Disconnect slinging gear.

This space intertionally left blank.

...Install power plant continued.

C.Connect mechanical connection

NOTE : If the power plant was installed as a complete unit ignore operations (1) to (12); they will have been completed prior to installation.

(1) Left engine only - Fit control rod bell crank block and horizontal cross-over control rods.

(a) Fit bell crank block and secure with tab washers and bolts.

(b) Fit throttle rod (painted green) and h.p. fuel cock rod (painted black) to bell crank and engine levers using a bolt and tab washer for each connection to the engine and a bolt, washer, nut and split pin at bell crank levers.

(2) Fit starter/generator and air outlet casing.

NOTE : Check dowel holes in engine mounting face and air outlet casing are clean.

(a) Lubricate stud threads.

(b) Fit casing, complete with air duct, with exhaust duct facing downward and locating dowels engaged.

(c) Fit special spring washers and nuts (flat faces of nuts towards casing) torque load nuts to 140-160lb.in.

(d) Pre Mod. 257127 - Pack starter/generator extension drive shaft grease sleeve with lubricant.

(e) Mod. 257127 only - Lubricate and fit new O-ring seal to the starter/generator grease retainer; pack retainer with lubricant.

(f) Lubricate threads, contact faces of attachment clamp, and starter/generator splines.

(g) Fit starter/generator and air inlet with duct aligned; torque load clamp nut to 120lb.in.

NOTE : 1. Ensure that the engine accessory gearbox starter/generator aperture is wiped clean to remove any residual oil or contaminate before the starter/generator is fitted.

2. When finally torque tightened to correct loading, the gap between the clamp ends must be 0.052 to 0.285 in.

(3) Right engine only - Fit windshield supply a.c. generator.

(a) Lubricate and fit a new O-ring seal.

(b) Lubricate new quill shaft, fit quill shaft and align generator with air inlet duct facing inboard and locating dowel engaged.

...Install power plant continued

(c) Lubricate threads and contact faces of clamp.

(d) Secure with clamp ring and torque load clamp nut to 55 to 60lb.in.

NOTE : Fit air inlet duct and connect hose to generator after installation of top cowl.

(4) Fit rear cowl.

(a) Tape the thermocouple harness flexible take-off leads firmly to the engine.

(b) Fit rear cowl over the exhaust assembly, avoid fouling the firewire and flexible take-off leads, up to the exhaust assembly.

(c) Fit the rear piston ring type seal.

(d) Complete positioning of exhaust assembly and secure, using plain washers and bolts.

(e) Remove the tape holding the flexible take-off leads to the engine.

(f) Secure access panel, complete with differential pressure switch and hoses, in front of drains tank using plain washers and bolts.

(5) Connect power loss indicator hose to adaptor on engine exhaust. Tighten and wire-lock.

(6) Fit compressor air bleed valve guard using stiffnuts and profile washers.

NOTE : Ensure seal is attached to top of guard.

(7) Fit air tapping elbow to engine.
(a) Lubricate threads.

(b) Apply approved jointing compound to matting faces of the elbow and centre section casing.

(c) Using new gasket fit and secure elbow with spring washers and nuts.

NOTE : One stud carries a wire-locking tab and another, on the left engine, a clip for the igniter cable.

(d) Torque load nuts to 70 to 80lbf.in.

(8) Fit nose cowl.

(a) Lubricate and fit new seals to front and rear joint of engine anti-icing duct. Position duct in engine.

(b) Offer up nose cowl, engage anti-icing duct, and assembly nose cowl to engine with stiffnuts and bolts.

NOTE : Do not tighten bolts until completion of (c) and (d).

(c) Fit fire extinguishant pipe, mounting clip, bracket on nose cowl attachment bolts at left side of engine.

...Install power plant continued

(d) Attach harness and clip to nose cowl attachment bolt at top of engine.

(e) Connect bonding wire and clamp linking nose cowl to anti-icing duct.

(9) Connect fire extinguishant spray pipe to left side of engine. Tighten pipe nut and wire-lock.

(10) Mod.252367 only - Fit primer shut-off valve (see Chapter 71, PRIMER DRAIN).

(11) Connect, tighten and wire-lock drain pipes.

(a) Centre-section drain to drain valve and mod.252367 only, to forward face of drains tank. On right engine only, connect and tighten clip linking Firewire connector to drain pipe.

(b) Primer drain - to drains tank and engine banjo; wire-lock both ends.

(c) Mod.252367 only - primer drain at drains tank and shut-off valve connection at L.P. fuel filter.

(d) Drain from b.f.c.u. - to b.f.c.u. and drains tank; wire-lock both ends.

(e) Drain pipe to oil tank filler neck and fuel pump drive gland; wire-lock each end. (Connect to hydraulic pump when fitting pump).

(f) Left engine only - Synchronizer corrector unit drain.

(g) Engine breather - To engine, do not wire-lock until pipe is aligned with cowling.

(h) Pre mod.252085 only - Fuel l.p. warning switch. Do not wire-lock yet.

(j) Exhaust cone drain. Wire-lock.

(12) Connect flexible fire hose to spray ring around nose cowl; wire-lock.

(13) Connect cabin air pipe (see Chapter 21- PIPES AND DUCTING - Fig.201).

(a) Left engine only - Lubricate and fit new O-ring seals, to each end of pipe. Insert lower (waisted) end of pipe into aircraft duct and engage locking plate, push upper end in engine air tapping elbow. Fit bolts and stiffnuts to top end. Tighten top bolts.

(b) Right engine only - Lift pipe into engagement with engine hot air tapping elbow and engage quick-release pin.

(14) Right engine only - Connect and tighten engine breather to hose, and hose to fillet. Wire-lock engine adapter.

(15) Fit hydraulic pump.

...Install power plant continued

(a) Lubricate threads and fit new gasket.

(b) Lubricate quill shaft with grease and fit quill shaft and pump.

(c) Secure pump with spring washers and nuts.

(d) Torque load nuts to 70 to 80 lb.in.

(e) Connect and tighten drain pipe; wire-lock.

(16) Right engine only - Fit a.c. generator air inlet duct to a.c. generator.

(17) Connect and tighten fuel feed hose and differential pressure switch hoses to l.p. filter; wire-lock.

(18) Mod.252367 only - Assemble 'P' clip to drain pipe at outlet end of the primer shut-off valve.

NOTE: Bolt the clip 'back to back' with the clip on the differential switch hose ensuring hose is clear of pipe assembly.

(19) Connect throttle and h.p. fuel cock controls at lower ends of inboard vertical rods. Right engine - use bolts and new tab washers. Left engine - use bolts (fitted with heads between levers) washer, nut and split pin.

(20) Check rigging and functioning of controls (see Chapter 76, POWER CONTROL).

(21) Connect and tighten power loss indicator hose to adapter on rear cowl; wire-lock.

(22) Fit jet pipe fairing; exercising care not to foul the taped back flexible take-off leads. Remove the tape from the flexible take-off leads and check clearance between thermocouple harness conduit and fairing frame is not less than 0.25 in.

NOTE: Dress fairing if necessary to obtain this clearance.

D. Connect electrical connections

(1) Connect and secure cables to starter/generator and fit rubber sheath over terminal block.

Right engine only - secure cable support clamp to base of fuel filter.

Left engine only - ensure cable terminal lugs will not foul the cowling.

(2) If the power plant is being built up in the aircraft - Lubricate the tip of the starter/generator thermal switch, fit switch and then - pre mod. 251800 only - connect cable to engine terminal block.

...Install power plant continued

(3) Left engine only - connect harness socket to synchronizer corrector unit, if replacement corrector unit has been fitted.

(4) Right engine only - connect and secure cables to a.c. generator and secure cables to clips on nose cowl.

(5) Connect and secure both l.t. harness plugs at top of engine. Ensure cables are supported in clips clear of engine.

(6) Connect and tighten Firewire cable plugs.

(a) One at top of engine.

(b) One beneath rear of compressor.

(c) Two, left and right on lower front face of rear cowl.

(7) Mod.252367 only - Connect electrical connector to primer shut-off valve actuator on l.p. fuel filter housing.

(8) Connect and secure h.t. leads to both igniter plugs.

Left engine only - Ensure cable is supported in clamp at hot air tapping elbow.

WARNING: THE ELECTRICAL DISCHARGE FROM HIGH ENERGY EQUIPMENT IS POTENTIONALLY LETHAL. ENSURE LT INPUT IS DISCONNECTED BEFORE HANDLING HT LEADS.

(9) Connect and secure clamp block, beneath engine, securing ignition and Firewire cables.

(10) Connect and secure turbine overheat system cables to terminal block beneath engine centre section.

(11) If building power plant in situ, connect extension lead to harness and connect electrical harness to fuel differential pressure switch.

(12) Feed thermocouple harness leads through clamp on jet pipe fairing and secure leads to terminal blocks on fillet; stack leads correctly (see Chapter 77, THERMOCOUPLES AND CABLES).

NOTE: Pre mod.CV 7127 - Connect harness take-off leads to links on thermocouple harness, wire-lock.

(13) Tighten clamp on jet pipe fairing to secure harness leads.

(14) Check all wiring is adequately secured, use local band clips as necessary.

(15) Check Firewire system element is correctly supported and insulated from metallic parts of engine.

...Install power plant continued

E. Prepare for flight clearance

(1) Prime engine oil system (Chapter 72, LUBRICATION SYSTEM).

(2) Replenish engine oil system (Chapter 12, SERVICING ENGINE OIL).

(3) Restore d.c. power supplies to the power plant(s) (Chapter 24, GENERAL).

(4) Bleed engine fuel system (Chapter 73, ENGINE FUEL AND CONTROL - GENERAL).

(5) Check that power plant installation is clean and free from tools, servicing materials, etc.

(6) Place drip trays beneath rear of jet pipe and engine drain pipes.

(7) Complete two motoring cycles, one wet (with l.p. and h.p. fuel cocks open) and one dry (Chapter 71, POWER PLANT - Adjustment/Test, Ground running general, para.3).

NOTE: During first motoring cycle check functioning of primer solenoid by feel, check for evidence of fuel and oil leaks and check functioning of drains system.

Mod.252367 only - Check correct functioning of primer shut-off valve by the "see-feel" device on top of the actuator.

After dry motoring cycle ensure that the jet pipe fairing, the cowlings around the drains and the ground beneath the installation are free from fuel.

(8) Connect and secure l.t. input to high energy ignition units.

(9) Complete high power performance tests of power plant installation (Chapter 71, POWER PLANT - Test 1B of Adjustment/Test - Ground running tests).

(10) Calibrate exhaust gas temperature indicating system - Engine running, see Chapter 77, EXHAUST GAS TEMPERATURE INDICATION.

(11) With engine static, service the lubrication system pressure and scavenge filters (Chapter 72, LUBRICATION SYSTEM).

(12) Replenish engine oil system.

(13) Fit all cowlings and access panels.

(a) Connect cooling air inlet duct to starter/generator after fitment of bottom front cowl, lubricate and use new seal.

(b) Left engine only - Connect and tighten breather hose to bottom front cowl.

...Install power plant continued

(c) Right engine only - After fitment of top cowl connect and tighten cooling air inlet to a.c. generator and, Mod.25/1911 only, drain to flush air inlet.

(14) Check alignment of drain pipes and wire-lock adapters.

(a) Pre mod.252085 only. Wire-lock fuel l.p. warning switch drain pipe.

(b) Left engine only - Wire-lock engine breather pipe.

(15) Finally cowl up power plant.

* * *

Pages 430 to 500 intentionally omitted.

1. Ground running - General procedures

A. Preliminary actions prior to ground running

(1) Position aircraft (headed into wind whenever possible and standing on concrete free from cracks, joints, debris and dust) so that all building etc. which will be in line with the jet efflux are clear of the danger zones (Fig.501).

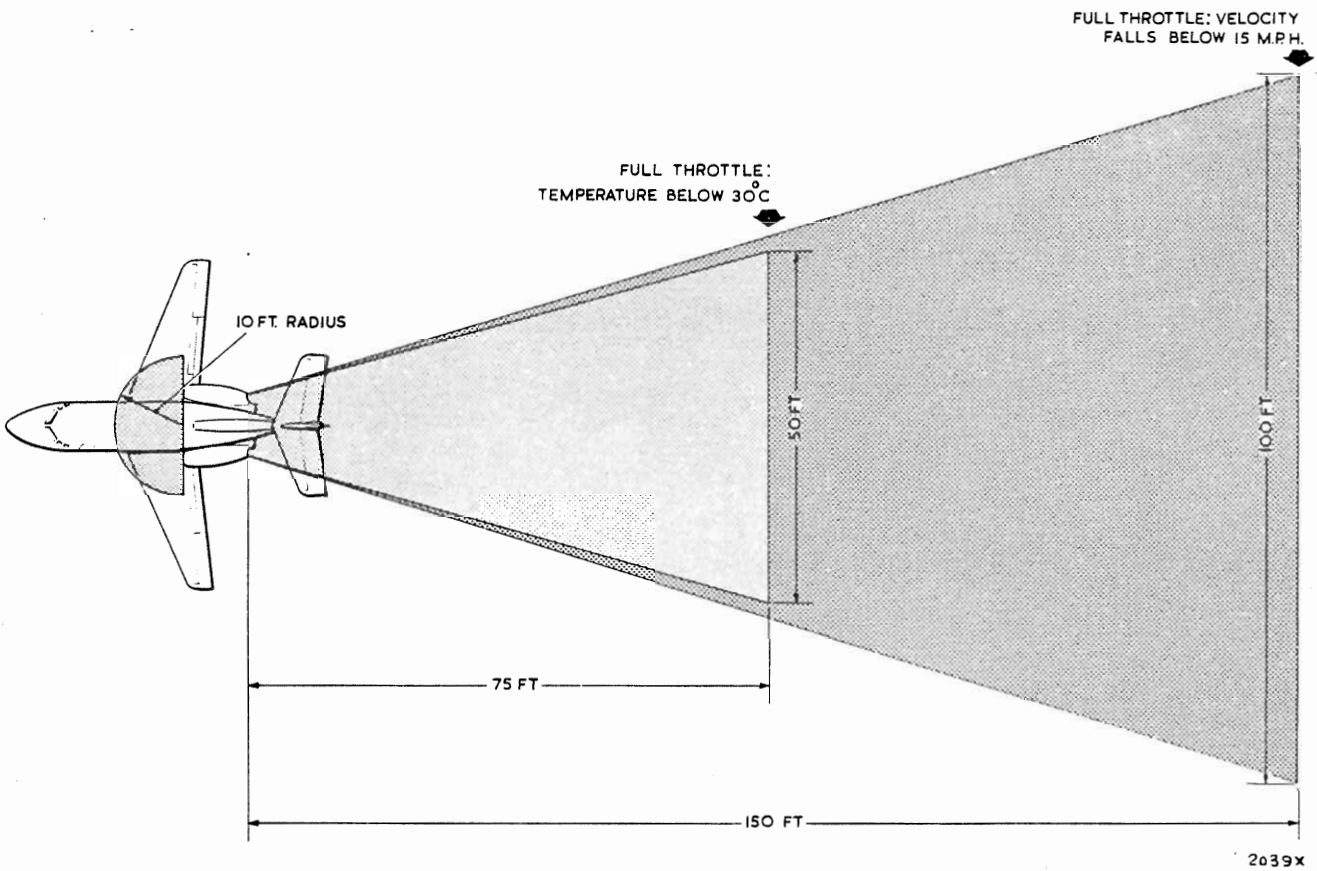
(2) Centralize nose gear and chock the wheels, if the aircraft is to stand unattached chock the wheels fore and aft and lash the chocks together.

(3) Check that landing gear lock pins and steering disconnect pin are fitted

(4) Ensure that the aircraft has serviceable internal batteries fitted and connected.

(5) Position serviceable fire fighting equipment adjacent to the aircraft.

(6) Position a suitable external electrical power supply adjacent to the aircraft, if available.



Danger areas
Fig.501

...Power plant Adjustment/Test ground running - General continued

(7) Clear the danger areas (Fig.501) of all equipment etc.

(8) Remove all covers and blanks from engine intakes, exhausts, compressor air bleed valve(s), and pitot heads.

(9) Check engine intakes and exhausts are free from foreign matter.

B. Fire fighting equipment

This equipment must be of the mobile type and comprise not less than two separate cylinders, coupled to a remote discharge nozzle. Each cylinder must contain not less than 10 lb of CO_2 and be capable of being discharged individually.

C. External electrical power for engine starting

A 24-volt battery trolley is unlikely to be capable of meeting the engine starting demand. An unregulated 28-volt transformer/rectifier starting set, provided it does not suffer a high voltage drop, may be satisfactory. A 28-volt generator starting set, having voltage regulation, is the ideal piece of ground equipment; with this set a voltage range of between 26 to 30 volts is acceptable.

D. Safety precautions during engine running

(1) Hats or loose clothing must not be worn by persons working on, or in the vicinity of, running engine(s).

(2) Ear protectors should be worn by persons working on, or in the vicinity of, running engines.

(3) Keep all persons clear of the danger areas.

(4) When running engines during ground pressurization tests, all persons involved must be aware of the effect of an emergency depressurization.

E. Engine handling

(1) Item deleted.

(2) Ventilation of rear equipment bay
If the a.p.u. is running keep the rear equipment bay door closed, otherwise it may remain open during main engine running.

(3) Intercommunication system.
During ground running, when adjusting or testing the installation, use the intercommunication system to maintain close liaison between the ground and the flight compartment.

...Power plant - Adjustment/Test ground running - General continued

(4) Icing conditions
At ambient temperatures of 4°C and below, combined with relative humidity above 60%, select engine anti-icing on for ground running. If engine checks are necessary, with air bleeds off, it is permissible to run under icing conditions for one minute with anti-icing switched off. This must be followed by not less than one minute at 95% rev/min with anti-icing switched on. The use of anti-icing will cause a rise in oil temperature.

(5) Fuel filter icing
In the event of icing being indicated during ground running, manually select filter de-ice and attempt to clear warning. If warning persists, stop engine.

(6) Hot starts
Starting with the aircraft tail into wind will tend to increase the starting j.p.t. During starts, if the j.p.t. rises too quickly, exceeds, or tends to exceed 750°C (to avoid exceeding the max. j.p.t. limitation) close the HP fuel cock immediately and investigate cause.

(7) Abortive starts
If the engine does not light up within 15 seconds of pressing the starter switch close the HP fuel cock, Mod.251728 aircraft, switch engine selector switch off, allow the engine to stop, check the cause for failure to start. After an abortive start, before attempting another start, allow excess fuel to drain from engine for time specified in Ground Running Limitations (para.2). After an abortive start, move aircraft clear of any fuel on the ground, or clear fuel from ground before attempting another start.

(8) Cooling starter/generator
In the event of three motoring cycles being carried out in quick succession, allow the starter/generator to cool for time specified in Ground Running Limitations (para.2).

(9) Throttling
Except during slam checks, operate the throttles slowly and deliberately; frequent and rapid throttling produces thermal stresses which may impair the life and reliability of the engine. Keep ground running to a minimum.

(10) Excessive j.p.t. during ground running
Avoid exceeding the max. j.p.t. limitation, whenever possible, by closing the throttle and/or HP fuel cock. Report and record, in the engine log book, all instances in which the j.p.t. exceeds the limits specified in Ground Running Limitations (para.2).

(11) Turbine overheat warning system
If an overheat warning occurs during engine running, close the HP fuel cock immediately and investigate cause (see Chapter 71, TROUBLE SHOOTING).

(12) Compressor surge or stall
In the event of a sudden increase in j.p.t. or a rumbling or banging, close the throttle and/or HP fuel cock immediately and investigate the cause.

...Power plant - Adjustment/Test ground running - General continued

(13) Engine fuel pumps
Avoid engine operation on suction feed, see Ground Running Limitations (para.2).

(14) Run down time
Establish on initial run and record. Run down times may vary between engines. Investigate any run down time of less than 45 seconds.

(15) Prolonged idling
During prolonged ground running at idling speed, there is a tendency for the progressive rise in starter/generator temperature to cause the bus bar voltage to drop below the required minimum. To combat this, when prolonged running (nominally at idling speed) is required, run the engine at 45 $^{+1}_{-0}$% rev/min - not at the normal idling speed. This is particularly important when testing electrical power supplies and/or services.

(16) Starting order
When starting both engines the normal starting order is engine No.2, engine No.1.

(17) Mod.251742 - Gust locks
If both engines are to be run it is necessary to unlock the aileron and elevator gust locks (see Chapter 27, GUST LOCKS) to obtain simultaneous full throttle on both engines.

(18) Operating limitations
Do not contravene operating limitations, given in this paragraph and in para.2.

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...Power plant - Adjustment/Test ground running - General continued

2. Ground running limitations - Rolls Royce Bristol Viper 522

A. General

NOTE : 100% rev/min. equals 13760.

Condition	Rev/Min %	Max. j.p.t. °C	Time
Drainage period after abortive start			1 minute
During starts		740-800	5 seconds
Idling speed	$40 \pm \frac{1}{0}$ (at 1013 mb.)	645	Unlimited
Max. governed speed	100 + 0 - 0.5	740	5 minutes
Overspeed range	100 to 103		20 seconds

NOTE : For max. installed j.p.t. (aircraft static) see Fig.502.

B. Lubrication

Temperature

Minimum for starting	-40°C
Minimum for opening up	-26°C
Maximum for running	
Anti-icing off	125°C
Anti-icing on	135°C

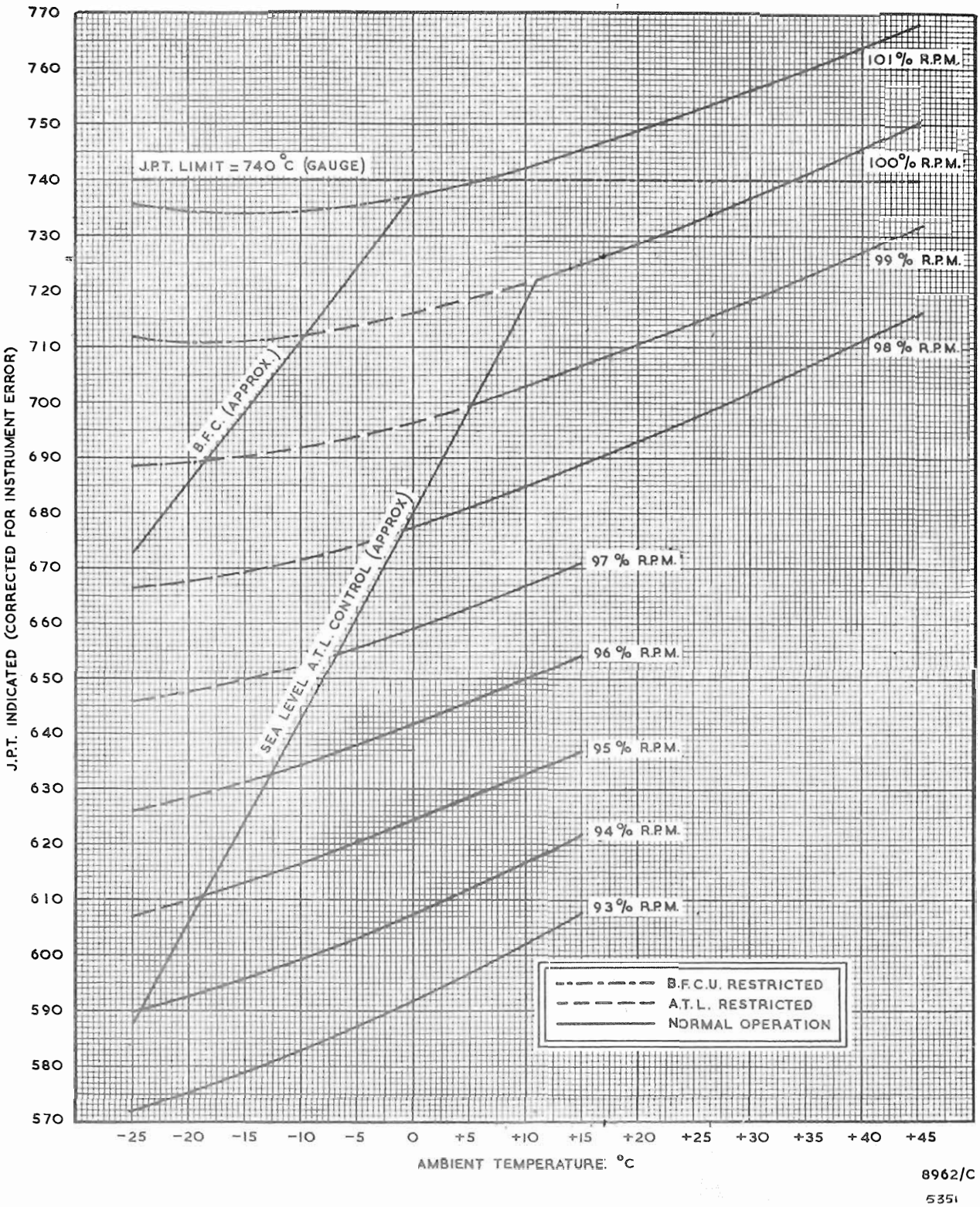
Pressure

	Mod CV 7291	Pre-mod CV 7291
Max. & min. at 95% rev/min. (Oil temp below 80°C	-	27-38 lb/sq.in.
Max. & min at 95% rev/min. (Oil temp above 80°C	21-38 lb/sq in.	-
Max. at idling speed - 3 minutes after starting	15-38 lb/sq in.	-
Min. at idling speed	25 lb/sq in.	25 lb/sq.in.
Min. to complete flight - at max. oil temp.	No limit	No limit
	5 lb/sq.in.	5 lb/sq.in.

Consumption and approved oils ... ... See Chapter 12, SERVICING, ENGINE OIL

Low pressure warning switch setting ... ... 6 ± 0.5 lb/sq.in.

Continued...



NOTE
MAX. J.P.T. FOR ACCEPTANCE OF NEWLY INSTALLED ENGINE IS 725°C. SEE 'TOP TEMPERATURE CONTROL SYSTEM, CALIBRATE SYSTEM — ENGINE RUNNING' FOR J.P.T./MILLIVOLT EQUIVALENTS AND PROCEDURE FOR CHECKING J.P.T.

...Power plant - Adjustment/Test ground running - General continued

C. Fuel system

Maximum fuel temp at engine inlet	50°C - Kerosene & Widecut 30°C - Avgas
Approved fuels	See Chapter 12, SERVICING, FUEL
Low pressure warning switch setting	3 ± 0.5 lb/sq.in.
Differential pressure switch setting ...	2.4 ± 0.4 lb/sq.in.

Engine operation on suction feed is limited to a total time of 5 minutes when using Avtur or Avtag, or 3 minutes when using Avgas. The duration of any single period must not exceed 1 minute.

D. Starter/generator

After 3 quick consecutive attempts to start, allow starter/generator to cool for 15 minutes.

Maximum load for each d.c. generator, on the ground, is 100 amps continuous or 150 amps for 40 minutes at 45% rev/min.

E. Top temperature control datum settings

Take off datum	735°C
Climb datum	675°C

F. Miscellaneous

Turbine overheat warning setting	300°C

Pages 508 to 510 intentionally omitted

...Power plant - Adjustment/Test ground running continued

3. Starting, stopping and motoring

A. Pre-starting preliminary internal check list

(1)	Preliminary actions prior to ground running	....	Completed
(2)	LANDING GEAR selector lever	....	DOWN, indicated down
(3)	Hand brake lever	....	PARK, brakes supply 1750 lb/sq. in. min.
(4)	BATTERY switch	....	On, cancel CAGS.
(5)	Flight compartment lighting	....	As required

NOTE : If lighting is required use STORM lights; switch off red and unnecessary white lights. Ensure emergency lighting is off.

(6)	Radio and accessory electrical systems	....	All off
(7)	FIRE bottle selector switches	....	Guards down
(8)	EXT FIRED indicators	....	Clear
(9)	ELECTRICAL POWER		
	(a) AC INV 1 and 2 switches	....	Off, 3 fail lights on
	(b) VOLTS, No. 2 battery	....	24 volts nominal
	(c) Battery selector lever	....	EMERGENCY
	(d) VOLTS, No. 1 battery	....	24 volts nominal
	(e) Battery selector lever	....	NORMAL
	(f) FAIL GEN 1 and 2 warning lights	....	On
(10)	Connect d.c. ground supply	....	See Chapter 24

NOTE: If d.c. ground power is not available ignore this operation but limit use of the aircraft batteries to the absolute minimum.

...Power plant - Adjustment/Test ground running continued

(11)	Fuel contents	....	Check adequate
(12)	AIR BRAKE selector lever	....	SHUT
(13)	Flaps selector lever	....	UP
(14)	Engine instruments	....	Satisfactory
(15)	Emergency hydraulic system indicator	....	IN
(16)	Hand electric torch	....	Stowed

NOTE : The items in operations (16) and (17) are stowed behind the Captain's seat.

(17)	Fire extinguisher	....	Stowed
(18)	Intercom headsets	....	Stowed
(19)	DUMP VALVE selector	....	Wire-locked closed
(20)	Emergency exit (passenger compartment)	....	Closed and locked
(21)	Flight compartment windows and entrance door	....	As required

CAUTION : DO NOT LEAVE THE AIRCRAFT DOOR OPEN IN INCLEMENT WEATHER.

(22)	BATTERY switch.	....	Off

End of pre-starting preliminary internal check list.

...Power plant Adjustment/Test ground running - continued

B. Pre-starting external check list

NOTE : An electric hand torch will be required when completing checks in the rear equipment bay.

Mod 252367 only - A container of capacity approx. 1 Imp.gal. (1.2 US, 4.5 litres) is required to empty drains tank.

(1) Pre-starting preliminary internal check list	..	Completed
(2) Fuselage nose - left side		
(a) Static vent plate	..	Plugs removed, vents unobstructed.
(b) Pitot head	..	Cover removed, undamaged.
(c) Ventilation intakes (on top of nose)	..	Unobstructed
(d) Nose cone	..	Closed, fasteners locked.
(3) Nose gear bay		
(a) Gear lock pin	..	Fitted
(b) Cooling and ventilating exhaust duct	..	Unobstructed
(c) Hydraulic leaks	..	Check none
(4) Fuselage nose right side		
(a) Nose cone fasteners	..	Locked
(b) Ground power (when available)	..	Power connected, socket undamaged.
(c) Pitot head	..	Cover removed, undamaged.
(d) Dump valve outlet	..	Unobstructed
(e) Static vent plate	..	Plugs removed, vents unobstructed.
(f) Emergency exit	..	Locked
(5) Right wing		
(a) Wing/fuselage fillet panel	..	Secure

...Pre-starting external check list - continued

NOTE : While in front of aircraft check engine and heat exchanger intakes from here - See operations (6) (a) and (7) (a).

(b) Top skin access panels	..	Secure
(c) Tank filler cap	..	Secure
(d) Bottom skin access panels - including centre section	..	Secure
(e) Fuel leaks	..	Check none
(f) Surge tank vent intake	..	Unobstructed
(g) Right main gear	..	Lock pin fitted, no leaks, chock in position.
(h) Stall warning vent	..	Plugs removed, vent clean.
(j) Intercom jack socket	..	Satisfactory

(6) Right engine

(a) Air intake	..	Cover removed, free from foreign bodies.
(b) Exhaust	..	Cover removed, free from foreign bodies.
(c) Compressor air bleed valve outlet	..	Cover removed
(d) Fire access panels	..	Secure
(e) Atmospheric vents and exhausts	..	Unobstructed and undamaged.
(f) Engine oil system dipstick level	..	6 pints minimum
(g) Engine drains tank, Mod 252367	..	Operate valve to empty tank.
(h) Servicing access panels	..	Secure
(j) Fuel and oil leaks	..	Check none
(k) Cowlings	..	Closed and locked or open and secured as required.
(l) Fillet access panels	..	Secure

...Pre-starting external check list - continued

(7) Rear fuselage		
(a) Heat-exchanger exhaust	..	Unobstructed
(b) Fuel filter de-icing fluid tank contents	..	Adequate, tank cap and panel secure
(c) Mod 251605: APU inlet and exhaust doors	..	Open or closed as appropriate.
(d) Tail cone fairing	..	Fasteners locked
(e) Panels, fairings and aerials	..	Secure and undamaged.
(f) Heat-exchanger air intake	..	Undamaged and unobstructed.
(g) Fire bottle pressure relief discharge indicators	..	Discs intact
(8) Rear equipment bay		
(a) Hydraulic accumulator, emergency	..	Check pressure 1750 lb/sq.in. min.
(b) Hydraulic reservoir	..	Check contents appropriate to pressure cap secure.
(c) Fire extinguisher bottles	..	Charged, pins flush with bottle head.
(d) All loose extraneous equipment	..	Removed
(e) Bay door	..	Open
(9) Left engine	..	Check as per operation (6).
(10) Left wing	..	Check as per operation (5).

End of pre-starting external check list
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...Power plant Adjustment/Test ground running - continued

C. Engine starting check list - External or internal power

NOTE : Do not attempt an internal start unless external ground power is positively not available. Before attempting an internal start ensure that the condition of the batteries is such as will permit a start to be made.

(1)	Pre-starting external check list	....	Completed
(2)	Fuses and circuit breakers	....	As required
(3)	Battery selector lever	....	NORMAL
(4)	BATTERY switch	....	ON (cancel CAGS flashers if starting on internal batteries)
(5)	GROUND/FLIGHT switch	....	As required
(6)	I/C switch (Inter-communication)	....	ON
(7)	TEST		
	(a) FIRE WARNING 1 and 2	....	Check bell and lights
(8)	ICE PROTECTION		
	(a) ICE DET, HEADS, WING, TAIL & ICE IND.	....	All systems off, engine valves indicated closed.

NOTE : On internal power, anti-icing valve indicators are inoperative.

(9)	PRESSN & AIR COND		
	(a) BLEED AIR VALVE switches 1 and 2	....	CLOSE, indicators SHUT
	(b) Mod 251600 a/c only CKPT TEMP switch	....	Decrease for 13 seconds
	(c) Mod 251605 a/c only APU OPEN/CLOSE switch	....	CLOSE
(10)	Engine		
	(a) Oil temperature	....	Check within limits
	(b) Oil L.P. warning light (s)	....	ON
	(c) TOP TEMPERATURE control	....	Off

...Engine starting check list - External or internal power continued

(11) External start only - Test turbine overheat warning system

(a) AC INVerter 1	....	ON, failure warning lamp out.
(b) TURBine overheat warning light (s)	....	PRESS TO TEST
(12) Throttle(s)	....	Check for full travel, set closed
(13) Fuel control levers - centre pedestal		
(a) Fuel CROSSFEED and TRANSFER selector	....	CLOSED
(b) Fuel TRANSFER valve indicator	....	CLOSED
(c) LP FUEL COCK(S)	....	ON
(d) HP FUEL COCK(S)	....	ON
(e) LONG RANGE TANK COCK (Mod 255640)	....	Off
(14) Check clear with ground for ignition test	....	Clear
(15) Function RELIGHT switch(es) te test ignition	....	Aurally checked

NOTE : External crew member to check each engine to be run.

(16) FUEL - overhead panel

(a) FILTER DE-ICE switch(es)	....	Off
(b) FILTER blocked warning light(s)	....	PRESS TO TEST
(c) FUEL LP light(s)	....	ON
(d) PUMP switch, engine to be started	....	ON, check LP. warning light out
(e) SYNCH	....	Off
(17) Check clear with ground for starting	....	Clear
(18) Internal start only - Battery selector	....	INT. START, AVAILABLE warning light on
(19) ENG. selector switch	....	1 or 2 as appropriate

NOTE : If starting both engines, start No.2 first.

(20) START SELECTED red lamp	....	ON
(21) START selector switch	....	Press to START for 2 seconds

... Engine starting check list - External or internal power continued

(22) START OPERATING amber light .... On

NOTE : Observe rising oil pressure, rev/min and JPT.

CAUTION : IF THERE IS NO LIGHT UP, WITHIN 15 SECONDS OF INITIATING START, OR EXCESSIVE JPT, CLOSE HP FUEL COCK, SWITCH ENGINE SELECT SWITCH OFF AND INVESTIGATE. AFTER AN ABORTIVE START ALLOW ENGINE TO DRAIN FOR 1 MIN. IF ON INTERNAL START, ENSURE BATTERIES ARE OK BEFORE ATTEMPTING ANOTHER START.

(23) With engine idling, check :-

(a) START OPERATING amber lamp	....	Out
(b) Internal start only - Battery volts	....	Not more than 25 volts
(c) ENG. selector switch	....	Off
(d) START SELECTED red lamp	....	Out
(e) Oil pressure	....	No min. limit, 25 lb/sq. in. max. (3 minutes after starting), l. p. warning light out above 6 lb/sq. in.
(f) JPT	....	645°C max.
(g) Engine speed	....	40^{+1}_{-0} % at 1013 mb., Fig. 562
(h) Fuel flow	....	Stable
(i) FAIL GEN warning lamp	....	Out, generator charging
(j) HYDraulic pressure	....	Rising to 3000 lb/sq. in. approx. Check flow indicated.
(k) Hydraulic system	....	Functionally check
(24) To start second engine	....	Repeat operations (16) (d), (17) and (19) to (23) inclusive
(25) Internal start only - Battery selector	....	NORMAL, warning light out.

...Engine starting check list - External or internal power continued

(26) External start only - Disconnect ground power

(a) GROUND/FLIGHT switch .... FLIGHT

(b) Ground power socket .... Disconnected

CAUTION : SOCKET MUST NOT BE LIVE DURING DISCONNECTION.

(27) Battery-not-charging amber lamp .... Out

(28) (a) Pre mod. 25/1335 BUS TIE warning lamp .... Out

(b) Mod 25/1335 BUS TIE switch .... CLOSE: BUS TIE light out,

(29) INVERTER switches .... On, as required failure warning lamps out

(30) After internal start only

(a) TURBine overheat warning light(s) .... PRESS TO TEST

(31) Applicable only if right engine is running

(a) A C GEN. switch .... Hold ON until GEN INOP lamp goes out, trip if not required

(32) CAGS flashers .... Out, with all systems operative

NOTE : The CAGS will flash to indicate a failure if both or one engine is static, if the d.c. and/or a.c. generators are not functioning, if the inverters are not switched on or if a defect exists in any of the engine or aircraft systems being monitored (Chapter 33).

End of engine starting check list

...Power plant Adjustment/Test ground running continued

D. Engine stopping check list

NOTE : If both engines are running, stop the first engine to be started, functionally test the hydraulic pump of the engine running and note the cut-in to cut-out time.

(1) Flaps	...	UP
(2) AIR BRAKE	...	IN
(3) Throttle(s)	...	60% rev/min.approx. Allow j.p.t. to stabilize.
(4) Radio and accessory electrical systems		All off
(5) ICE PROTECTION (roof panel)	...	All systems off, engine valves indicated closed.
(6) PRESSN & AIR COND. (roof panel)	...	All systems off
(7) HP FUEL COCK(S)	...	OFF
(8) Throttles	...	Closed
(9) Check run down time(s)	...	Compare with established figure.
(10) Generator FAIL warnings	...	On (as engines run down below 40% rev/min.)

NOTE : (i) If the generator FAIL warnings are not displayed the engine starter/generator may be energized, therefore, select the battery selector switch to EMERG and, on aircraft with Mod.251335 embodied, ensure the BUS TIE is open.
(ii) On aircraft with an APU fitted and running, shut it down.
(iii) Subsequent to satisfactory shutdown of engines, accomplish existing operations (11) to (16) inclusive.
(iv) Before accomplishing operations (17 to 20) inclusive and before further application of electrical power to the aircraft, the cause of the malfunction must be found and rectified.

(11) PUMP switch(es), engine(s) stationary		Off
(12) TOP TEMPERATURE control	...	Off
(13) LP FUEL COCK(S), engine(s) stationary		Off

NOTE : Aircraft with an a.p.u. - Do not close No.1 engine l.p. cock if a.p.u. is running.

...Power plant Adjustment/Test ground running continued

(14)	BATTERY switch	...	Off
	NOTE : Do not complete operation (14) until both engines have been stopped.		
(15)	GROUND/FLIGHT switch	...	GROUND
(16)	Fuses and circuit breakers	...	As required.
(17)	Engine and aircraft covers	...	Fit as necessary.
(18)	Landing gear wheels	...	Chocked.
(19)	Handbrake lever	...	Off
(20)	Flight compartment windows and all access doors	...	As required

NOTE : Remove steering disconnect pin prior to towing aircraft.

End of stopping check list

...Power plant Adjustment/Test ground running continued

E. Engine motoring check list

NOTE : 'Wet' or 'dry' motoring cycles are called for in various engine and power plant maintenance practices. Before motoring, de-energize the ignition system. During 'wet' cycles, both the l.p. and h.p. fuel cocks are opened; for 'dry' cycles only, the l.p. fuel cock is opened. After a 'wet' cycle, before attempting to start an engine, either complete a 'dry' cycle or, preferably, allow the engine to drain for 1 minute.

(1) Landing gear lock pins .... Fitted

(2) Engine and airframe covers .... Removed as necessary

(3) Engine air intakes and exhausts .... Clear of foreign bodies

(4) Power plant atmospheric vents and exhaust .... Unobstructed

(5) Engine oil system dipstick level .... 6 pints minimum

(6) Cowlings .... Closed and locked or open and secured as required.

(7) Fuses and circuit breakers

(a) High energy ignition .... Remove fuses (Chapter 24)

NOTE : Alternatively remove the l.t. input to each high energy unit.

(b) All other fuses and circuit breakers .... As required

(8) Radio and accessory electrical systems .... All off

(9) Connect d.c. ground supplies .... See Chapter 24

NOTE : Do not motor on internal batteries during routine maintenance.

(10) Battery selector .... NORMAL

(11) ELECTRICAL POWER (roof panel)

(a) AC INV 1 and 2 .... Off

(b) BATTERY switch .... Off

(c) GROUND/FLIGHT switch .... GROUND

(d) VOLTS, ground power .... 28 volts nominal

(12) Throttle(s) .... Closed

(13) Fuel CROSSFEED AND TRANSFER selector .... Closed.

...Engine motoring check list continued

(14)	LP FUEL COCK	....	ON
(15)	FUEL PUMP switch, engine to be motored	....	ON, check l.p. warning light out
(16)	Check clear with ground for motoring	....	Clear
(17)	ENG selector switch	....	1 or 2 as appropriate
(18)	START SELECTED red lamp	....	On
(19)	START selector switch	....	Press to START for 2 seconds
(20)	START OPERATING amber lamp	....	On

NOTE : Observe rising oil pressure as engine rotates.

(21)	'Wet' cycle only - HP FUEL COCK	....	Move to ON 20 seconds after initiating start
(22)	Mod.251728 aircraft only - ENG selector switch	....	OFF to terminate cycle.
(23)	With cycle completed and engine stationary :-		
	(a) 'Wet' cycle only - HP FUEL COCK	....	SHUT
	(b) LP FUEL COCK	....	OFF

NOTE : Aircraft with an a.p.u. - Do not close No.1 engine l.p. cock if a.p.u. is running.

	(c) Fuel PUMP switch	....	OFF
	(d) START OPERATING amber lamp	....	Out
	(e) ENG selector switch	....	Off
	(f) START SELECTED red lamp	....	Out
(24)	Fuses and circuit breakers	....	High energy ignition fuses fitted

NOTE : If, instead of removing fuses, the l.t. input to each high energy unit was disconnected - reconnect it.

(25)	DC ground power supplies	....	Disconnect
(26)	Engine and aircraft covers	....	As required

End of motoring check list

Pages 525 to 540 intentionally omitted

POWER PLANT - ADJUSTMENT/TEST

4. Ground running tests

NOTE : Maintain records of test running. After changing or servicing specific units selected portions of the Low and High Power Tests may be used (as detailed in the respective maintenance practices) to test the relevant parts of the installation.

A. Low power test

ITEM	CONDITION	NOTES
(1) Fuel Type		Kerosene or wide cut
(2) Fuel temperature		
(3) OAT		
(4) Ambient pressure	Before start	Millibars
(5) Aircraft battery No.2		24 volts min.
(6) DC ground supply		26 volts min. for external start
(7) Oil temperature		-40° C min.
(8) Time	On selecting start	
(9) Time to light up		Record abortive starts
(10) JPT	During start	740-800° max. for not more than 5 secs.
(11) Starting cycle		Record time from selecting start to idling
(12) Oil pressure	Idling	No min. limit, 25 lb/sq. in. max. (3 minutes after starting), l. p. warning light out above 6 lb/sq. in.
(13) Engine speed	Idling	40^{+1}_{-0} % at 1013 mb., Fig. 562
(14) JPT	Idling	645°C max.
(15) Fuel pressure	Idling	Warning light out
(16) Fuel flow	Idling	Check for stable reading

...Ground running tests continued

	ITEM	CONDITION	NOTES
(17)	Fuel, oil and gas leaks	Idling	Run for 2 minutes and check for leaks, see Chapter 71, DRAINS
(18)	DC power generation	Idling	See Chapter 24
	(a) Failure warning		Light out
	(b) Voltage		$28 \pm \frac{0}{0.5}$ volts
	(c) Ammeter		Showing charge
	(d) Load sharing	Both engines running	Within 60 amps
(19)	AC power generation (Windscreen heating)	Idling	See Chapter 24
	(a) Power failure indication		Warning light out
(20)	Hydraulic system	Idling	See Chapter 29
	(a) Flow indication		NORMAL
	(b) Cut-out pressure		$3000 \pm \frac{50}{0}$ lb/sq.in.
	(c) Cut-in pressure		$2500 \pm \frac{20}{0}$ lb/sq.in.
	(d) System functioning		Check operation.

NOTE : If High power test is to follow check there are no fuel and oil leaks and ignore remainder of this test.

(21)	Select 60% rev/min		
(22)	Time	On closing h.p. fuel cock	
(23)	Run down time from 60% rev/min		Compare with established figures
(24)	Fuel drains	During run down	Check satisfactory
(25)	Fuel and oil leaks	Engine static	Check none exist
(26)	Total running time for this test		Record

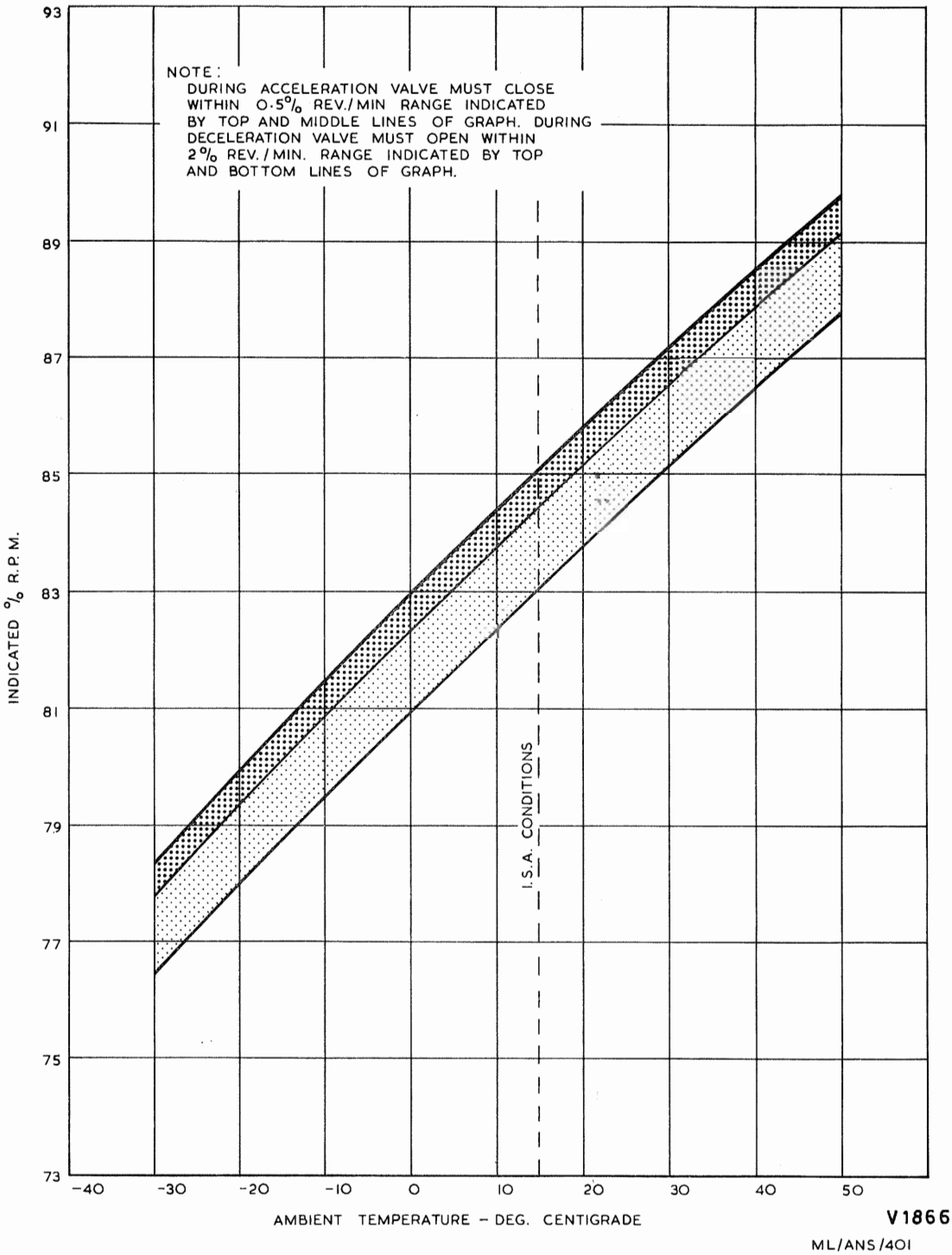
...Ground running tests continued

ITEM	CONDITION	NOTES
B. High power test		
(1) Complete items (1) to (20) inclusive of low power check		
(2) Parking brake supply		Check adequate
(3) Compressor air bleed valve	Slow acceleration and deceleration	See Test C. Use intercom.
(4) Warm up period	90% rev/min	1 min duration
(5) Fuel flow	95% rev/min	Pressure warning light out.
(6) Oil pressure	95% rev/min	Pre-mod CV7291 27-38 lb/sq.in. Mod CV7291 21-38 lb/sq.in. at 80°C or below and 15-38 lb/sq.in. above 80°C.
(7) JPT acceptance limit (newly installed zero hour engines)	100 $^{+0}_{-0.5}$% rev/min	725°C max at 15°C ambient. See Fig.502.
(8) Governed speed	Full throttle	100 $^{+0}_{-0.5}$% Dependent upon ambient conditions and fuel s.g., 100% rev/min may not be attainable.
(9) JPT	Full throttle	740°C max. See Fig.502.
(10) TURBine overheat light	Full throttle	OUT
(11) Oil temperature	Full throttle	(125°C max.(anti-icing OFF) (135°C max.(anti-icing ON)
(12) Max speed governor test		See Test D
(13) Throttle alignment	Both engines -75% rev/min	No stagger
(14) Air bleeds	75 to 80% rev/min	
(a) Air conditioning and pressurization system	No other bleeds	See Chapter 21. Air bleed valve indicators open, duct temp. rises, engine speed decreases and j.p.t. rises. Close air bleed valve.

WARNING : DO NOT DEPRESSURIZE RAPIDLY UNLESS ABSOLUTELY ESSENTIAL.

...Ground running tests continued

ITEM	CONDITION	NOTES
(b) Engine anti-icing	No other bleeds	See Test E. Valve indicator open. Engine speed decreases and j.p.t. rises. Switch off anti-icing.
(15) Warm up period	90% rev/min	1 min duration
(16) Acceleration		See Test F
NOTE : All air bleeds off after this test.		
(17) Primer solenoid		See Test G
(18) Relight	Idling	See Test H
(19) Synchronization	Both engines running	See Test K
(20) Power loss indicators	Both engines at 100% rev/min or max attainable	Check pointers are aligned; adjust as necessary.
(21) Top temperature control		See Test L
(22) Automatic thrust limiter		See Test M
(23) Select 60% rev/min		
(24) Time	On closing h.p. valve	
(25) Run down time from 60% rev/min		Compare with established figures
(26) Fuel drains	During run down	Check satisfactory
(27) Fuel and oil leaks	Engine static	Check none.
(28) Total running time for this test		Record



Compressor air bleed valve operating limits
Fig.541

...Ground running tests continued

C. Test operation of compressor air bleed valve

(1) Select all bleeds OFF.

(2) Open the throttle slowly and note the rev/min at which the rev/min indicator needle shows a sudden increase of approximately 2% rev/min. (Indicating the closing of the compressor air bleed valve).

(3) Slowly decelerate and note the rev/min at which the rev/min indicator needle suddenly decreases by approximately 2% rev/min. This indicates the valve opening.

(4) Determine the ambient temperature, then refer to Fig.541 to ascertain that the valve operates within acceptable limits.

NOTE : Adjust the pressure ratio switch if the compressor air bleed valve operates outside the limits; see GROUND RUNNING - ADJUSTMENTS.

...Ground running tests continued

D. Test functioning of maximum speed governor

NOTE : In high ambient temperatures it may be necessary to remove jet pipe nozzle trimmers to avoid exceeding the maximum permissible j.p.t.

(1) Switch off top temperature control system.

(2) At ambient temperatures of 11 deg.C (ISA - 4 deg.C) and below - Disconnect P2 pipe from a.t.1. and blank unit and pipe end.

(3) With engine running, fully open throttle and check that j.p.t., engine speed and oil pressure are within limits - See operating limitations.

NOTE : At ambient temperatures below 5 deg.C (ISA minus 10 deg.C) it may not be possible to obtain 100% rev/min. due to the flow limiting characteristics of the b.f.c.u. Under these conditions it will not be possible to check over-swing and 'dead throttle' movement effectively. However, equipment is available for pressurizing the capsule chamber of the b.f.c.u. so that max. governed rev/min. can be obtained. See para. B of GROUND RUNNING - ADJUSTMENTS.

(4) Close throttle to obtain approx. 60% rev/min.

(5) Slam throttle fully open and check over-swing does not exceed 103%.

NOTE : A maximum of five over-swing oscillations is permitted during an acceleration check.

(Fuel pump over-swing definition - an over-swing is a momentary occurence when the fuel pump governor maximum 100% rev/min. is exceeded during a slam acceleration, but swings back almost immediately. It is usual for a limited number of over-swing oscillations to occur until the engine rev/min stabilizers at 100%).

(6) Check for 'dead throttle' movement.

NOTE : At the full throttle end of throttle lever quadrant, at 15 deg.C ambient there should be approx. 10 deg. of lever movement to which there is no engine response. As the temperature decreases 'dead throttle' movement will decrease until the a.t.1. takes control. If 'dead throttle' movement is inadequate, change b.f.c.u.

(7) Close throttle.

(8) When the engine is static remove any test equipment, connect P2 pipe to a.t.1. install any jet pipe nozzle trimmers removed during this check.

...Ground running tests continued

E. Test engine anti-icing system

(1) Run the engine at 60% rev/min; note j.p.t.

(2) Move the ANTI-ICING switch to ON. Check that the indicator shows OPEN.

NOTE : The j.p.t. will increase and rev/min. decrease by approx. 20 deg.C and 2% respectively.

(3) Select switch to above 92% REV/MIN, check warning lamp ON and no change in j.p.t. or rev/min.

(4) Move the ANTI-ICING switch to OFF. Check that the indicator shows SHUT and that the j.p.t. decreases.

(5) Close throttle when rev/min. increases to 60%.

F. Test acceleration rate

(1) If necessary, disconnect P2 pressure pipe from automatic thrust limiter (a.t.1.). Blank the unit and pipe end.

NOTE : At ambient temperatures of 11 deg.C (ISA minus 4 deg.C) and below, isolate the a.t.1. to avoid interference with the fuel flow.

(2) Select anti-icing bleed ON, if required by the graph of setting limits (Fig.542).

(3) With engine running at 60% rev/min, slam the throttle lever fully open, taking 0.5 to 1.0 secs for the movement.

NOTE : The engine should accelerate from 60% to 98% rev/min within the time given on Fig.542.

(4) If necessary, adjust the air/fuel ratio control; see para.C. of GROUND RUNNING - ADJUSTMENTS.

(5) Close throttle to 40% rev/min.

(6) If required, select anti-icing bleed ON; see setting limits (Fig.542).

(7) Slam throttle lever fully open; record time taken to reach 98% rev/min.

(8) Check the max. rev/min., see Test D.

(9) Close throttle to 40% rev/min and check engine decelerates and runs steadily.

(10) If the a.t.1. was rendered inoperative, connect the P2 pressure pipe to the automatic thrust limiter.

G. Test primer solenoid

(1) Run engine at 60% rev/min.

(2) Select RELIGHT ON and check that rev/min. decrease, momentarily, by 5% to 8% and then gradually increase to 58% to 59%.

NOTE : The initial rev/min drop is due to fuel loss to the engine during charging of the primer manifold.

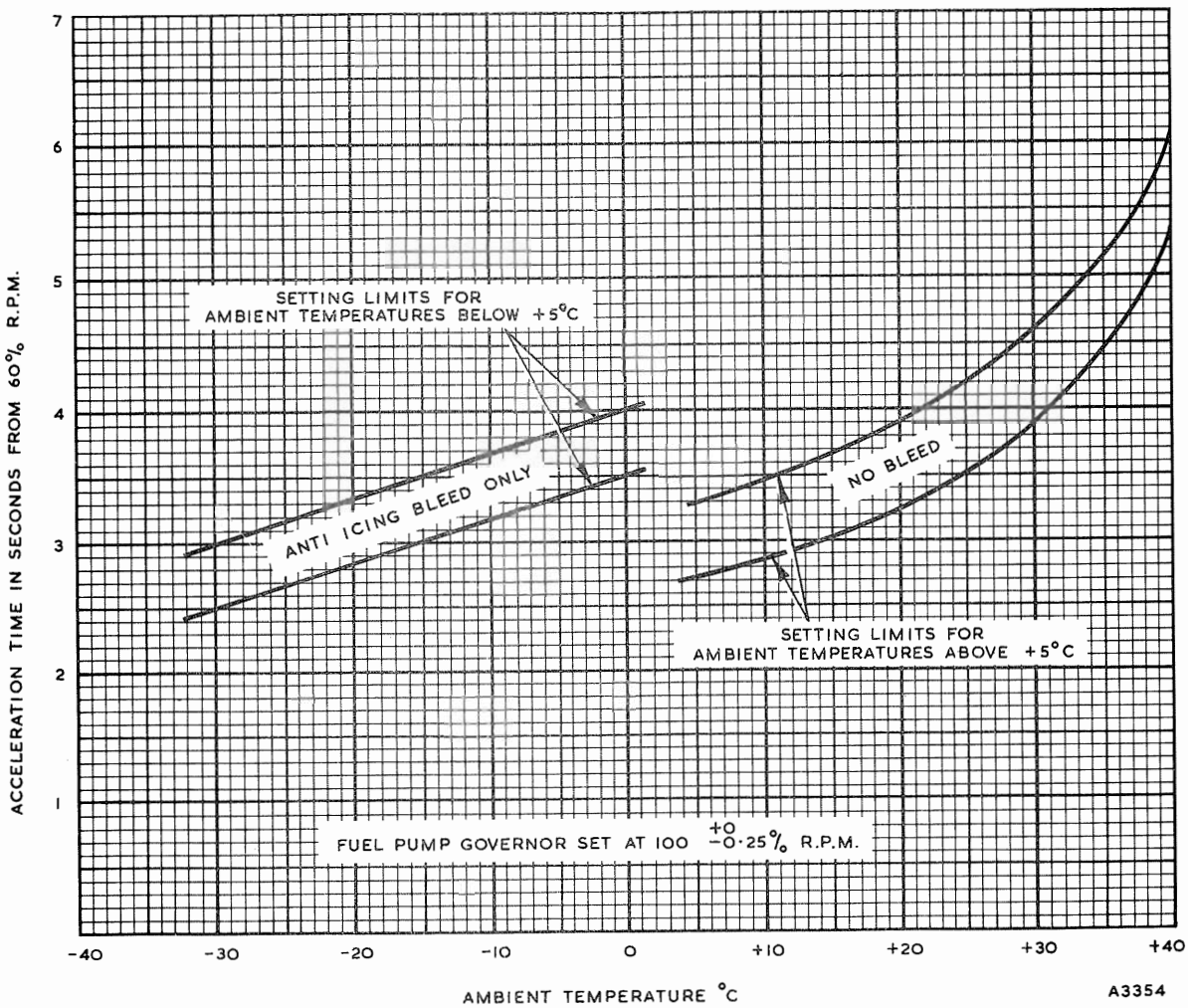
(3) Select RELIGHT off and fully open throttle for 15 secs.

(4) Close throttle to 40% rev/min.

NOTE : If the test is to repeated, wait 2 min., before repeating operation (2).

(5) Check primer manifold and solenoid, feed pipes for leaks.

NOTE : If leaks are found, check tightness of unions and pivot bolts; change seals as necessary.



Air/fuel ratio control setting limits
Fig.542

...Ground running tests continued

H. Test engine relight system

(1) Run the engine at idling rev/min for at least one minute

(2) Move the HP FUEL COCK lever to the OFF position.

(3) When the rev/min has fallen to 30% move the HP FUEL COCK lever to ON and select relight switch to RELIGHT. The engine should relight and the rev/min increase to 40% without stalling.

NOTE : If the engine fails to relight, complete the engine stopping procedure and check the igniter system.

(4) Select RELIGHT switch OFF.

J. Test oil pressure and temperature

(1) Complete items (1) to (20) inclusive of Test A.

(2) Open up slowly to full throttle and check the pressure and temperature are satisfactory throughout the range.

(3) Close throttle.

K. Test engine speed synchronizer

(1) Run both engines at idling speed, with synchronizer switch OFF.

(2) Move left THROTTLE to obtain 89% rev/min.

(3) Move right THROTTLE to obtain 91% rev/min.

(4) Select synchronizer switch ON.

(5) When left-hand engine rev/min. have increased to 90% retract right THROTTLE to obtain 90% rev/min.

(6) Move right THROTTLE to obtain 90.5% rev/min. and note that left-hand engine rev/min. increases to the same figure.

(7) Switch the synchronizer OFF and move both throttle levers to CLOSED.

L. Test top temperature control system

NOTE : It may be necessary to select anti-icing bleed and/or cabin air bleed ON to obtain max. j.p.t. Instances may also occur where it will be necessary to isolate the automatic thrust limiter (a.t.l.) and/or open the compressor air bleed valve.

(1) If necessary, disconnect the P2 static air pressure pipe from the a.t.l.

(2) Start the engine.

...Ground running tests continued

(3) With the t.t.c. switched to TAKE-OFF move the throttle lever to OPEN and allow the j.p.t. to stabilize at ~~735~~ 740 °C.

NOTE : If 735°C cannot be obtained, move the throttle to 40% rev/min select anti-icing and air conditioning on and return the throttle lever to OPEN.

(4) Retract throttle to give 690°C j.p.t. and allow temperature to stabilize.

(5) Switch the t.t.c. to CLIMB and anti-icing and air conditioning OFF. A drop in j.p.t. and rev/min should occur as the t.t.c. assumes control at ~~675~~ 680 °C.

(6) Switch the t.t.c. OFF and note that the j.p.t. and rev/min increases.

(7) Move the throttle lever to 60% rev/min.

ADJ: DEC. ← NOM → INC.
H-I-J-K-L-M-N
EACH CLICK 3½°

M. Test automatic thrust limiting system

NOTE : Complete this test only if o.a.t. is below 11°C (ISA SL minus 4°C).

(1) Record the ambient temperature and atmospheric pressure and refer to the relative climate graph (see chapter 73 AUTOMATIC THRUST LIMITER, Fig.202, to find the relative climate.

(2) Refer to the a.t.l. rev/min setting curve (see chapter 73 AUTOMATIC THRUST LIMITER, Fig.203, and ascertain the rev/min at which the a.t.l. should control for the pre-determined relative climate.

(3) Select all air bleeds OFF and start the engine.

(4) Move the throttle lever to OPEN.

(5) Observe the maximum speed of the engine when stabilized.

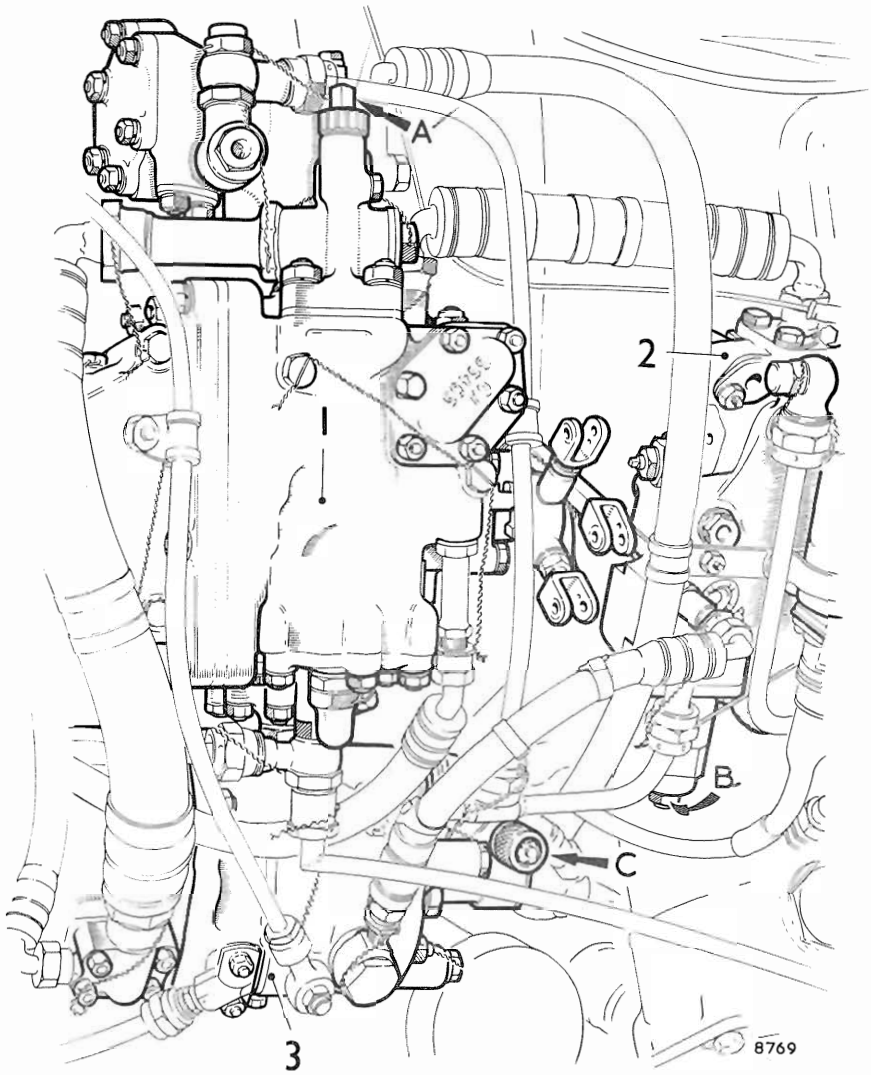
NOTE : The engine speed should correspond to the rev/min figure obtained from the a.t.l. rev/min setting curve. If the figures do not correspond, reset the a.t.l. (see chapter 73, AUTOMATIC THRUST LIMITER).

End of tests

Pages 552 to 560 intentionally omitted

POWER PLANT – ADJUSTMENT/TEST

5. Ground running adjustments



A. IDLING SPEED ADJUSTER
B. ACCELERATION RATE ADJUSTER
C. FUEL PUMP GOVERNOR ADJUSTER

1. BAROMETRIC FLOW CONTROL UNIT
2. AIR/FUEL RATIO CONTROL UNIT
3. FUEL PUMP

4572

Engine adjustment points
Fig. 561

...Ground running - Adjustments continued

A. Adjust idling speed

Special tools and equipment

Idling speed adjuster tool ... ... PE.4797.

(1) Start engine and run at 90% rev/min. for 1 minute.

(2) With engine idling, generator on line and one invertor on, gain access to idling speed adjuster (Fig.561).

(3) Rotate idling speed adjuster, anti-clockwise to increase speed, or clockwise to decrease speed, as necessary (Fig.562).

NOTE : One ~~turn~~ CLICK alters speed by approximately 1% rev/min.

(4) Accelerate to 60% rev/min.

(5) Close throttle to idling and verify adjustment.

B. Adjust maximum governed speed

Special tools and equipment

Pressurizing equipment	... ...	PE.14889.
Gauge	... ...	PE.13868
Oil priming syringe	... ...	PE.4483.

NOTE : If governed speed is low, ensure that throttle rigging is correct before adjusting governor. At ambient temperatures below 5°C. it may not be possible to obtain 100.0% rev/min. due to fuel flow limitation by the b.f.c.u., this may be overcome by using the pressurizing equipment. At ambient temperatures of 11°C. (ISA minus 4°C) and below, the automatic thrust limiter (a.t.l.) must be made inoperative to avoid interference with the fuel flow when carrying out adjustments and checks on fuel system components.

(1) Applicable only if ambient temperature is below 5°C. Connect b.f.c.u. pressurizing equipment.

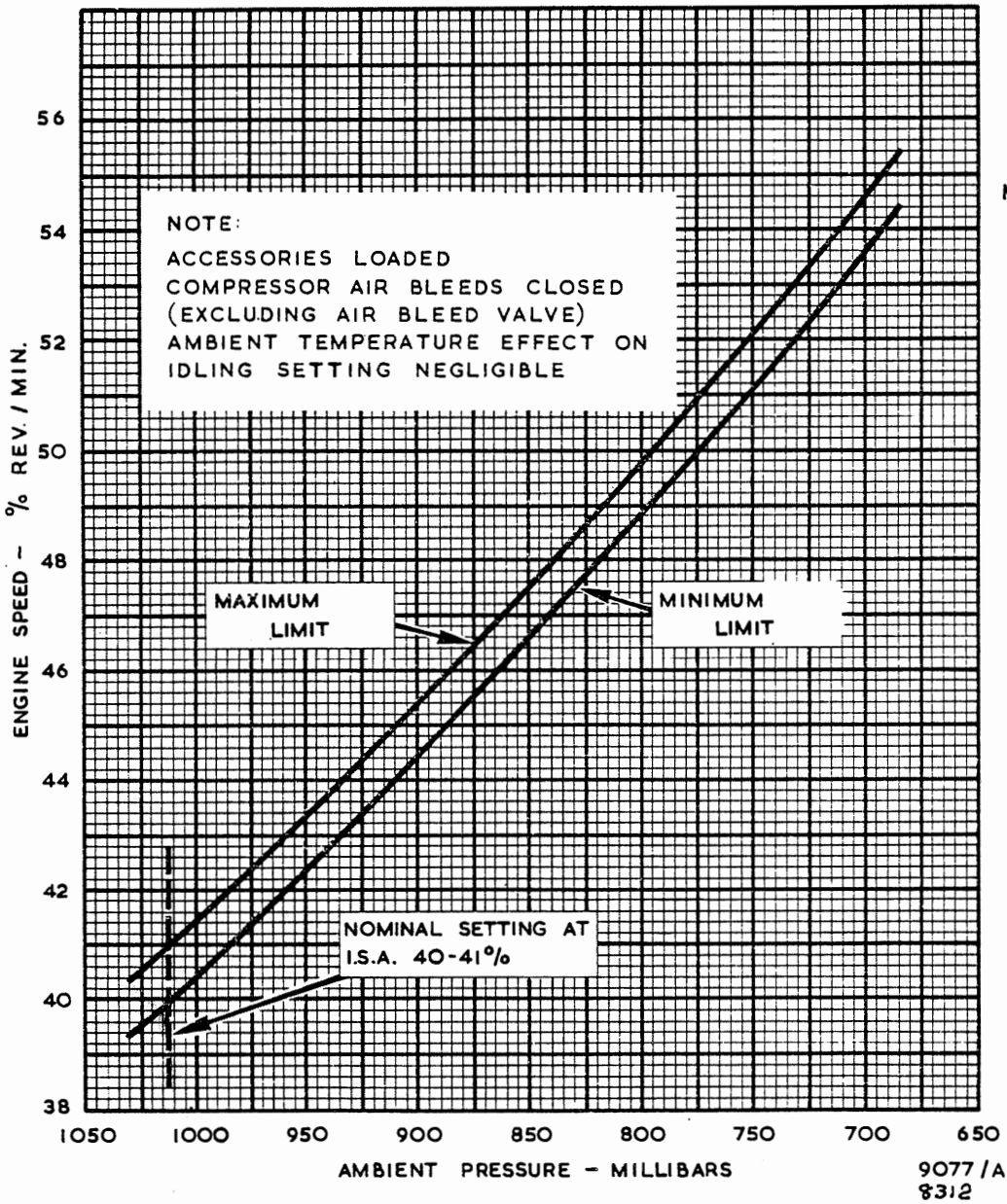
(a) Gain access to the b.f.c.u. Remove the bottom front cowl, if installed.

(b) Disconnect the aircraft drain pipe from the connection at the base of the b.f.c.u. capsule chamber, unscrew and remove the banjo pivot bolt from the connection and in its place install the inlet connection of the pressurizing equipment. This will blank the P1 air supply to the capsule.

(c) Connect the delivery pipe of the non-return valve and pressure gauge portion of the equipment to the inlet connection, then couple the oil priming syringe.

NOTE : Make sure that there is no oil in the syringe and that it is clean.

(d) Close the relief valve.



CONVERSION TABLE.
MILLIBARS / INCHES HG.

677	20
694	20.5
711	21
728	21.5
745	22
762	22.5
779	23
796	23.5
813	24
830	24.5
847	25
864	25.5
880	26
897	26.5
914	27
931	27.5
948	28
965	28.5
982	29
997	29.5
1016	30
1033	30.5
1050	31

Idling speed/ambient pressure setting data
Fig.562

...Ground running - Adjustments continued

(e) Check that the pressure remains constant, indicating that the non-return valve is seating efficiently.

NOTE : Maintain observation of the gauge throughout the ensuing engine run to ensure that the capsule remains pressurized.

(2) Gain access to acceleration rate adjuster (Fig.561).

(3) Rotate acceleration rate adjuster clockwise three or four turns.

NOTE : Operations (3) and (4) ensure that these units have no influence on the engine during adjustment of governed speed.

(4) Disconnect P2 pipe from the automatic thrust limiter (a.t.l.).

(5) Ensure that the top temperature control system is selected to OFF.

CAUTION : OBSERVE TEMPERATURE AND TIME LIMITS WHEN RUNNING ENGINE.

(6) Start the engine.

(7) Operate the oil priming syringe to pressurize the capsule to a pressure between 5 and 7 p.s.i., as registered by the equipment gauge.

(8) Slowly open throttle to fully open position and note maximum obtainable rev/min., then return throttle to idling speed.

CAUTION : ENGINE SPEED MUST NOT EXCEED 103%.

(9) If necessary adjust the governor to obtain a maximum of 100.5% rev/min by depressing and rotating the fuel pump governor adjuster (Fig.561) anti-clockwise to increase, or clockwise to decrease governed speed.

NOTE : One turn of adjuster will alter rev/min by 0.25%.

(10) Re-adjust governor to 100 $^{+0}_{-0.25}$% rev/min and then slowly decelerate to idling speed.

(11) Slowly accelerate to governed speed to verify adjustment; slowly decelerate to idling speed.

CAUTION : THE ACCELERATION CONTROL IS OUT OF SETTING.

(12) Restore acceleration rate adjuster to its original setting.

(13) Recheck that the acceleration rate and governed speed are satisfactory.

(14) Stop the engine.

(15) Connect P2 pipe to a.t.l.

...Ground running - Adjustments continued

(16) Applicable only if ambient temperature is below 5°C.

(a) Open relief valve then disconnect and remove the pressurizing equipment.

(b) Install the capsule chamber banjo pivot bolt, connect the drain pipe and install the bottom front cowl.

C. Adjust acceleration rate

(1) With engine idling, gain access to the acceleration rate adjuster (Fig.561).

(2) Using adjuster tool, T2 BJ 3231SN, depress and rotate adjuster clockwise to increase acceleration rate (decrease acceleration time) or anti-clockwise to decrease the acceleration rate (increase acceleration time).

NOTE : An adjustment of one serration will affect time by approximately 0.5 second.

(3) Release adjuster and ensure its locking plate engages the internal serrations of the adjuster housing.

(4) Run engine at full throttle and check that max governed speed is controlled by the pump governor.

(5) Close throttle.

D. Adjust pressure ratio switch

(1) Gain access to the pressure ratio switch adjuster.

(2) Remove the lockwire and using adjuster tool, PE 17433, release the locknut. Ensure adjuster is not rotated when slackening locknut.

(3) Reset the metering orifice adjuster. Turn the adjuster clockwise to decrease the speed at which the air bleed valve operates and vice versa.

NOTE : One flat of the adjuster alters the bleed valve setting by approx:-

Pre-mod CV 7454	.. ..	2% rev/min.
Mod CV 7454	.. ..	1% rev/min. {L 24 R 24

(4) Tighten the locknut.

(5) Start the engine and complete Tests C & F Ground running tests, Chapter 71.

(6) Wire-lock the locknut.

E. Adjust automatic thrust limiter

NOTE : See Chapter 73, AUTOMATIC THRUST LIMITER.

End of adjustments

Pages 566 to 580 intentionally omitted

GROUND RUNNING - FIRE FIGHTING

1. Fire drills-unpressurized aircraft

A. Primary actions

NOTE : This drill is applicable to warnings of engine fire or rear equipment bay overheat.

(1) HP FUEL COCK(s). ... OFF

NOTE : On completion of operation (1), if warning does not persist, ignore remainder of drill.

(2) LP FUEL COCK(s). ... OFF

(3) X FEED/TRANSFER selector ... Closed

(4) BATTERY switch ... Off

(5) Advise external crew members ... External crew actions

(a) Disconnect external electrical power
(b) Investigate suspected external fires, attract help and complete 'Secondary Actions', as necessary.
(c) Advise internal crew members as necessary.

(6) One internal crew member ... Investigate suspected internal fires and combat, using aircraft portable extinguisher, as necessary.

WARNING : BROMOCHLORODIFLUORMETHANE IS OF LOW TOXICITY BUT IT HAS AN OBNOXIOUS ODOUR AND, IN CONTACT WITH FIRE, BECOMES SLIGHTLY MORE TOXIC; AVOID INHALING IT.

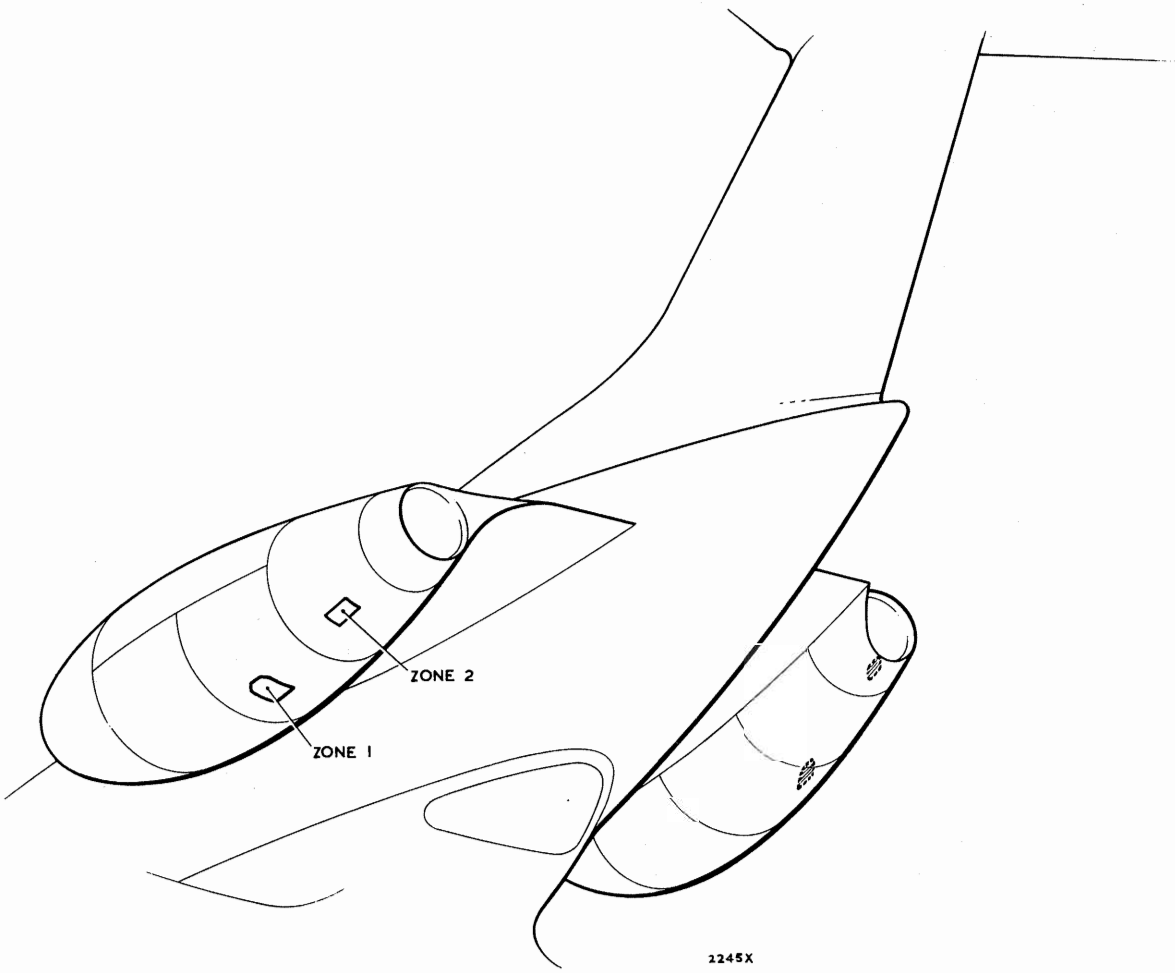
B. Secondary actions

(1) Fight fires using ground CO_2 extinguishers or, in the event of a major emergency only, foam type extinguishant.

WARNING : AVOID DIRECT CONTACT BETWEEN THE PERSON AND METALLIC PARTS OF A DISCHARGING CO_2 EXTINGUISHER. DO NOT INHALE CO_2 OR THE CO RESULTING FROM THE DECOMPOSITION OF CO_2 IN CONTACT WITH HEAT.

CAUTION : DO NOT APPLY FOAM EXTINGUISHANT TO ENGINE AIR INTAKE OR EXHAUST UNIT UNLESS ABSOLUTELY NECESSARY. IF FOAM TYPE EXTINGUISHANT HAS CONTAMINATED POWER PLANT REFER TO 701 PAGE BLOCK OF CHAPTER 72.

...Ground running-Fire fighting continued



Fire access points
Fig. 581

2. Fire drills-pressurized aircraft

A. Primary actions

NOTE : This drill is applicable to warnings of engine fire or rear equipment bay overheat.

(1) BLEED AIR VALVE(s) .... OFF

(2) PRESSN O/RIDE lever .... Close

WARNING : DO NOT ATTEMPT TO DEPRESSURIZE RAPIDLY.

...Ground running - Fire fighting continued

(3) HP FUEL COCK(s) .... OFF

NOTE : On completion of operation (3) if warning does not persist, ignore remainder of drill except for operation (10).

(4) LP FUEL COCK(s). .... OFF

(5) X FEED/TRANSFER selector .... Closed

(6) Advise external crew members.... External crew actions
(a) Disconnect external electrical power.
(b) Investigate suspected external fires, attract help and complete 'Secondary Actions', as necessary.
(c) Advise internal crew members, as necessary.

(7) BATTERY switch .... OFF

(8) All internal crew members .... Fit smoke masks.

(9) One internal crew member .... Investigate suspected internal fires and combat, using aircraft portable extinguisher, as necessary

WARNING : BROMOCHLORODIFLUORMETHANE IS OF LOW TOXICITY BUT IT HAS AN OBNOXIOUS ODOUR AND IN CONTACT WITH FIRE BECOMES SLIGHTLY MORE TOXIC; AVOID INHALING IT.

(10) DUMP VALVE selector .... Slowly to OPEN

B. Secondary actions

(1) Fight fires using ground CO_2 extinguishers or, in the event of a major emergency only, foam type extinguishant.

WARNING : AVOID DIRECT CONTACT BETWEEN THE PERSON AND METALLIC PARTS OF A DISCHARGING CO_2 EXTINGUISHER. DO NOT INHALE CO_2 OR THE CO RESULTING FROM THE DECOMPOSITION OF CO_2 IN CONTACT WITH HEAT.

CAUTION : DO NOT APPLY FOAM EXTINGUISHANT TO ENGINE AIR INTAKE OR EXHAUST UNIT UNLESS ABSOLUTELY NECESSARY. IF FOAM TYPE EXTINGUISHANT HAS CONTAMINATED POWER PLANT REFER TO 701 PAGE BLOCK OF CHAPTER 72.

* * *

POWER PLANT - INSPECTION/CHECK

1. Shock loading tests

A. General

A shock loaded engine is defined as an engine involved in a heavy landing which results in structural damage to the aircraft, foreign object ingestion leading to compressor blade damage beyond blending limits, or mechanical failure leading to engine seizure or rapid run-down. The procedure for dealing with a shock loaded engine is dependent on the nature of the occurence, and qualified in para.B. and C. All scrapped parts must accompany an engine rejected for complete overhaul.

B. Engine seizure

(1) Mechanical failure.

(a) An engine which runs down from ground idling rev/min. in less than two seconds, following mechanical failure which would not normally cause engine rejection, must be returned to the nearest overhaul base, suitably labelled, for shock loading tests and complete overhaul.

(2) Foreign object ingestion

(a) If foreign object ingestion is suspected but unconfirmed, the compressor top half casing must be removed and the rotor and stator blades examined for damage; refer to Chapter 72, COMPRESSOR.

(b) An engine which has been stopped by foreign object ingestion must be returned, suitably labelled, to the nearest overhaul base for shock loading tests and complete overhaul.

C. Heavy landing

(1) If, following a heavy landing, no structural damage to the aircraft is apparent, no procedures other than normal pre-flight checks are necessary.

(2) Where the aircraft has made a heavy landing which results in structural damage to the aircraft, the engine must be returned to the nearest overhaul base for shock loading tests and complete overhaul.

* * *

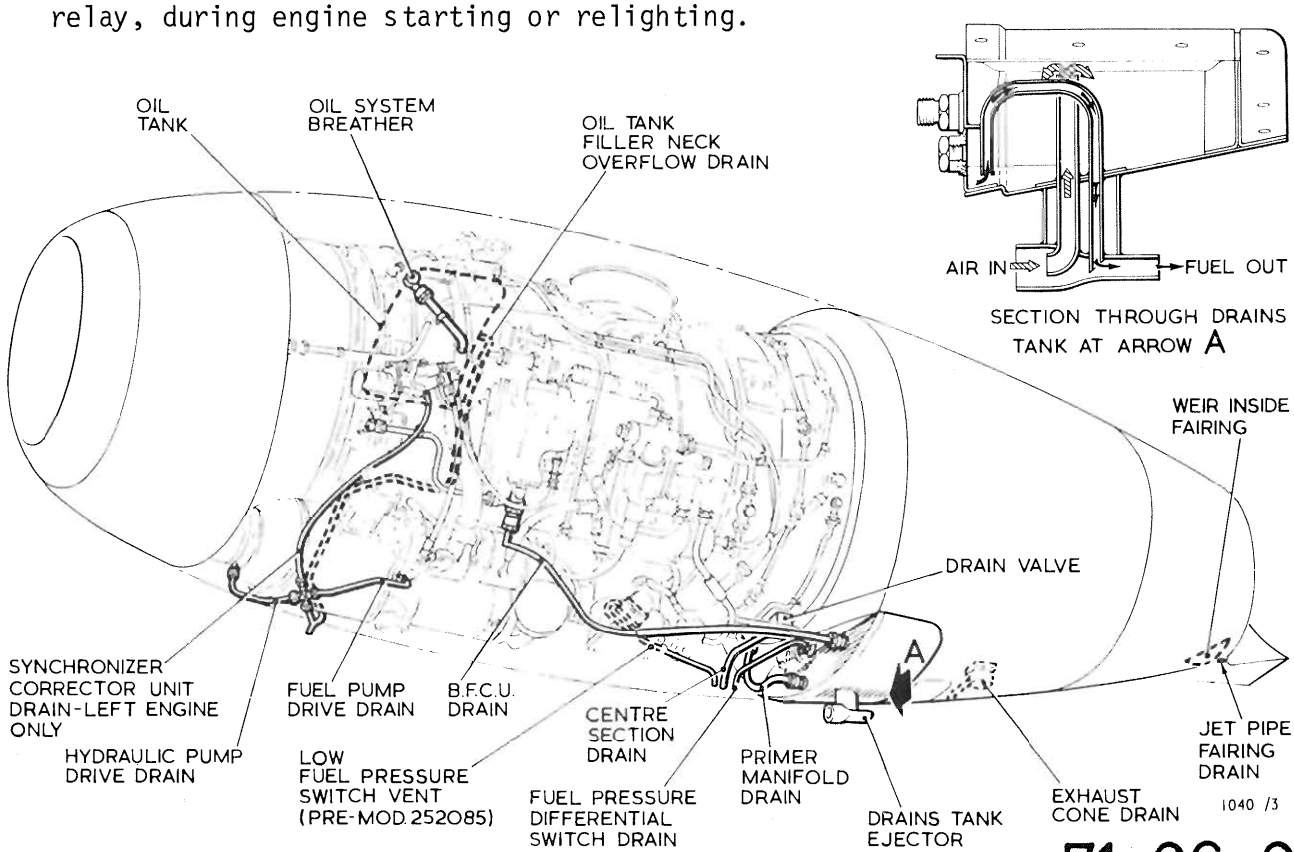
DRAINS SYSTEM

General

Each zone of the power plant installation is purged of inflammable vapours by the ventilation system, but to prevent the accumulation of liquids capable of creating a fire hazard, within the cowlings, a drains disposal system is incorporated.

Pre mod.252367 - Fig.1: a self-emptying drains tank collects drainage from the primer drain and b.f.c.u. and discharges it overboard. Simple drain pipes, venting directly to atmosphere, are provided for the fuel and hydraulic pump drive housings, the synchronizer corrector unit (left engine only), the combustion chamber, turbine case, oil tank filler, engine breather, fuel pressure differential switch, and, Mod.251911 aircraft, the a.c. generator flush cooling air intake (right engine only). Spring-loaded plate valves, which blank the drain lines when the engine is running, are fitted; one to the combustion chamber (centre section drain) and another to the turbine case (exhaust cone drain). Pre mod.252085, an overboard drain is fitted to the low fuel pressure switch.

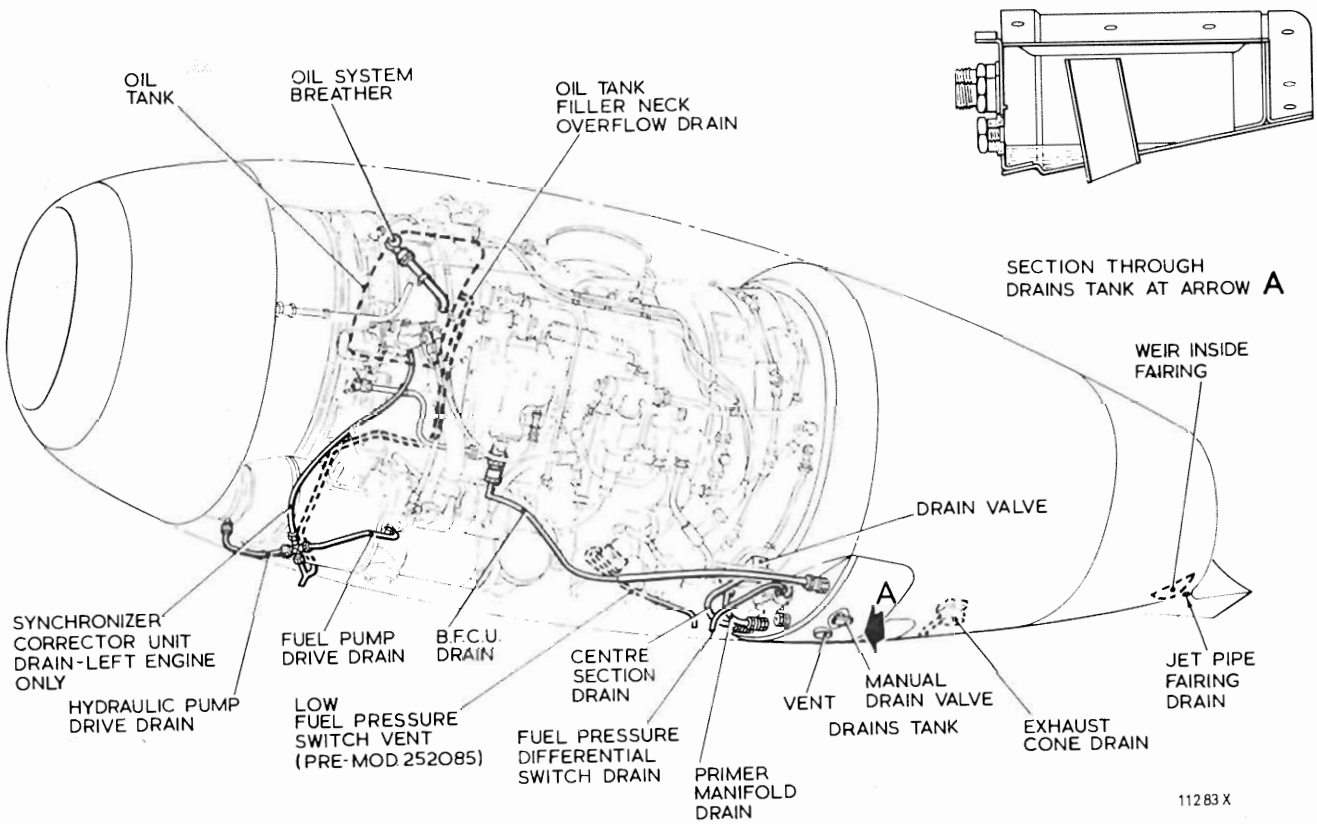
Mod.252367 - Fig.2:introduces a manually-operated drains tank drains valve for ground use, and a simple tank vent. The combustion chamber drain from the engine centre section is fed directly into the drains tank while the primer drain is routed through an electrically-actuated shut-off drain valve mounted on the L.P. fuel filter; the valve is energized closed by the engine services relay, during engine starting or relighting.



Engine drains system - Pre mod.252367
Fig.1

...Drains system continued

Combined ventilation/drain holes and a series of small (shrouded) holes, all in the lower cowlings, form emergency drains to dispose of major leakage such as could result from a fractured pipe. In the event of a 'wet start', fuel draining from the rear of the jet pipe is dumped via a hole in the underside of the jet pipe fairing. A weir prevents fuel running down inside the cowlings.



Engine drains system - Mod.252367
Fig.2

* * *

DRAINS SYSTEM - MAINTENANCE PRACTICES

1. Inspection/Check

A. Check leakage rates

(1) Run engine at idling speed (see Chapter 71, GENERAL).

(2) Check forward drain; leakage must not exceed:-

(a) Hydraulic fluid or engine oil - 2 cc/hr.

(b) Fuel - 5 cc/hour from fuel pump drive drain only; no leakage acceptable from synchronizer corrector unit - left engine only.

NOTE: To check synchronizer corrector unit disconnect drain pipe at unit.

(3) Check BFCU to drains tank drain.

(a) Disconnect BFCU drain from drains tank; leakage must not exceed 2 cc/min.

NOTE: With engine static, leakage must not exceed 5 cc/min.

(4) Check l.p. fuel filter differential pressure switch drain; no leakage is acceptable.

(5) Check fuel l.p. switch drain; no leakage is acceptable.

(6) Check exhaust cone and centre section drains; no leakage is acceptable except temporarily during starting and shut-down.

NOTE: Mod.252367 only - to check the centre section drain for leakage it must be disconnected from the drains tank.

(7) Check primer drain - Pre mod.252367 - immediately after starting temporary leakage acceptable, otherwise no leakage acceptable.

(8) Check primer drain (Mod.252367) - immediately after starting with motorized shut-off drain valve closed; no leakage acceptable.

* * *

COMBUSTION CHAMBER/CENTRE SECTION DRAIN - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove combustion chamber/centre section drain valve

Special tools and equipment

Spanner for drain valve retaining bolts ...	PE.8653
Torque wrench	PE.25492 or T2EM1987BR

(1) Isolate electrical power supplies to engine. (See Chapter 24, GENERAL).

(2) Gain access to, and place a tray beneath the engine.

(3) Disconnect relevant Firewire element connections.

NOTE: See Chapter 26, FIREWIRE SENSING ELEMENTS for details of fittings, seals, blanks, etc.

(a) Disconnect the aircraft Firewire lead from the termination fitting on the bracket unit secured to the base of the centre section drain valve.

(b) Disconnect the Firewire element from the termination fitting on the bracket unit.

(c) Remove the support clip securing the Firewire element to the bracket unit. Carefully move the element to avoid its possible damage.

(d) Secure the Firewire support clip temporarily to the bracket unit.

(4) Release the aircraft leads and the engine rear main bearing thermocouple leads from the terminal blocks on the bracket unit.

(5) Disconnect the drain pipe from the centre section drain valve, and, Mod.252367 only, the drains tank.

(6) Support the drain valve and the bracket unit then remove the four retaining bolts.

(7) Lift the drain valve and bracket unit away from the engine, do not lose the distance pieces interposed between the valve body and bracket unit.

(8) Install a blank on the centre section casing. Discard the sealing washer.

(9) If necessary, service the drain valve as described in paragraph 2.

B. Install combustion chamber/centre section drain valve

(1) Place a new sealing washer on the drain valve body.

(2) Fit spring washers on the retaining bolts.

...Combustion chamber/Centre section drain - Maintenance practices continued

(3) Offer the valve into position, with the outlet union facing the right-hand side of the casing.

(4) Position the bracket unit (with the stencilled letters 'L' and 'K' toward the front of the centre section casing) on the drain valve. Interpose four distance pieces between the valve and bracket unit.

(5) Secure the assembly with the bolts and spring washers. Torque load the bolts to 80 to 90 lbf.in.

(6) Connect the centre section drain pipe to the drain valve outlet union - and, Mod.252367 -the drains tank.

(7) Tighten the drain pipe union nut then wire-lock it to the primer ring drain pipe union nut.

(8) Connect the aircraft leads and the engine rear main bearing leads to the terminal blocks on the bracket unit.

(9) Connect relevant Firewire element connections.

NOTE: See Chapter 26, FIREWIRE SENSING ELEMENTS for all details of fittings, seals, torque loading, etc.

(a) Remove the Firewire support clip from the bracket unit.

(b) Make sure that the rubber grommet is correctly positioned on the Firewire element then secure the element to the bracket unit with its support clip.

(c) Remove the blanks from the termination fitting, and the Firewire element end-fitting.

(d) Fit a new sealing washer to the Firewire end-fitting. Draw back the end-fitting gland nut and check that the assembly is correct - see Chapter 26.

(e) Insert the Firewire element end-fitting into the termination fitting, engage the locating lugs and slots then screw up the gland nuts.

(f) Torque load the gland nut - (see Chapter 26.)

(g) Connect the aircraft Firewire leads to the termination fitting then wire-lock the Firewire element and aircraft leads to the termination fitting.

(h) Functionally test the engine fire detection and warning system. (See Chapter 26, FIRE DETECTION AND WARNING.)

(10) Start the engine (see Chapter 71, GENERAL) and check that the centre section drain valve closes then stop the engine and check that the drain valve opens.

...Combustion chamber/Centre section drain - Maintenance practices continued

2. Servicing

Special tools and equipment:

Spanner for valve retaining nut PE.8709

A. Service drain valve

(1) Disassemble the drain valve.

(a) Unscrew the drain valve retaining nut with the tool kit spanner.

(b) Withdraw the valve, spring and valve guide insert from the valve body.

(2) Inspect the drain valve.

(a) Wash all components in clean kerosine; dry them in an air blast.

(b) Examine the valve, valve guide insert and retaining nut for condition. Check the seating of the valve and valve guide insert for pitting and corrosion. Slight pitting can be removed by light lapping.

(c) Wash away all traces of abrasive.

(d) Check with marking compound that 100% seating is obtained.

(3) Assemble the drain valve.

(a) Install the valve guide insert in the valve body.

(b) Install the spring and valve into the valve guide insert. Secure the components in the valve body with the retaining nut, using the tool kit spanner.

* * *

TURBINE/EXHAUST CONE DRAIN - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment

Spanner for drain valve retaining bolts	PE.8653
Tension wrench	PE.25491 or T2EM1986BR

A. Remove turbine/exhaust cone drain valve

(1) Gain access to, and place a tray beneath, the engine.

(2) Disconnect the drain valve pipe from the drain valve.

(3) Support the drain valve and remove the four retaining bolts.

(4) Lift the drain valve away from the exhaust cone. Discard the seal washer.

(5) If necessary, service the drain valve as detailed in paragraph 2.

B. Install turbine/exhaust cone drain valve

(1) Place a new seal washer on the drain valve body.

(2) Install spring washers on the retaining bolts and a wire-locking tab on one of the bolts.

(3) Offer the drain valve into position and secure with the retaining bolts. Position the retaining bolt and wire-locking tab in a forward position adjacent to the valve outlet union.

NOTE: On left-hand engines, the valve outlet union faces to the right (viewed from the rear) and vice-versa.

(4) Torque load the retaining bolts to 60 to 70 lbf.in.

(5) Connect and wire-lock the drain valve pipe to the drain valve union.

(6) Start the engine - (see Chapter 71, GENERAL) and check that the drain valve closes. Check that the drain valve opens when the engine is stopped.

2. Servicing

Special tools and equipment

Spanner for valve retaining nut	PE.8709

A. Service drain valve

(1) Disassemble the drain valve.

...Turbine/exhaust cone drain - Maintenance practices continued

(a) Unscrew and remove the drain valve retaining nut, using the tool kit spanner.

(b) Withdraw the valve, spring and valve guide insert from the drain valve body.

(2) Inspect the drain valve.

(a) Wash all components in clean kerosine; dry them in an air blast.

(b) Examine the valve, valve guide insert and retaining nut for condition. Check the seating of the valve and valve guide insert for pitting and corrosion. If slight defects are present, remove by light lapping.

(c) Wash away all traces of abrasive.

(d) Check with marking compound that 100% seating is obtained.

(3) Assemble drain valve.

(a) Install the valve guide insert in the valve body.

(b) Install the spring and valve in the valve guide insert. Secure the components in the valve body with the retaining nut, using the tool kit spanner.

* * *

PRIMER DRAIN - TROUBLE SHOOTING

Fault	Probable cause	Remedy
Excessive internal leakage	Defective valve seal(s)	Replace seal(s)
Valve has slow transit or will not operate when selected.	(1) Valve bearing stiff or jammed.	Remove valve from system and investigate.
	(2) Actuator faulty.	Replace actuator.

* * *

PRIMER DRAIN - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove primer drain shut-off valve

(1) Isolate electrical power supplies to the engine (see Chapter 24, GENERAL).

(2) Gain access to, and place a drip tray beneath the engine.

(3) Disconnect the electrical connector from the shut-off drain valve motor.

(4) Disconnect the primer drain pipe between the shut-off valve and drains tank.

(5) Disconnect the primer drain pipe between the shut-off valve and the primer manifold spill coupling.

(6) Remove the four nuts, washers and bolts, securing the valve to the engine low pressure filter; remove the shut-off valve.

B. Install primer drain shut-off valve

(1) Assemble the drain valve to its base plate on the engine low pressure filter with the four existing nuts, bolts and washers.

NOTE: The valve is mounted with the electrical connection facing inboard.

(2) Connect the primer drain pipes from the valve to the drain tank, and, manifold spill coupling.

(3) Tighten the pipe union nuts and wire-lock.

(4) Connect and tighten the electrical connection to the shut-off valve motor.

(5) Check the valve operation as follows:

(a) Check that with the engine services electrical supply isolated, the primer drain valve is 'open'.

NOTE: The setting of the valve is indicated by a "see-feel" device, mounted on the actuator gearbox, when looking forward onto the valve.

(b) Disconnect the electrical input to the H.E. Ignition unit (rear equipment bay).

(c) Select RELIGHT-ON (pilot's roof panel CG). Check that the primer shut-off valve closes.

(d) Ensure that the engine services electrical power is isolated and connect the input supply to the H.E. Ignition unit.

(6) Replace the engine cowlings as necessary and remove the drip tray.

* * *

POWER PLANT BUILD LIST

1. General

If a power plant servicing stand is available (capable of holding a complete power plant) build the power plant as detailed in para.2A.

If only a transit or parking stand is available (capable of holding an engine change unit (e.c.u.) alone) install the e.c.u. in the aircraft and complete the build of the power plant as detailed in POWER PLANT - REMOVAL/INSTALLATION (Chapter 71).

If a replacement power plant is required, and only an e.c.u. of the opposite 'handing' is available, change the 'handing' of the e.c.u. as detailed in ENGINE GENERAL - SERVICING (Chapter 72).

If a replacement power plant is required, and only a power plant of the opposite handing is available, strip the replacement power plant to the e.c.u. stage (as detailed in para.2B). Change the 'handing' of the e.c.u. and, either install the e.c.u. in the aircraft and then build up the power plant or build up the power plant in a servicing stand prior to installation.

Items, which are to be transferred from one power plant to another, must receive inspection clearance in accordance with the routine maintenance inspections.

2. Power plant build and strip

NOTE: These procedures assume that during build, the e.c.u. is 'handed' correctly and that, during build or strip, a servicing stand is being used.

Materials required:

For lubricants, jointing compounds, etc. see Chapter 71, SERVICING MATERIALS.

A. Build power plant

(1) Left engine only - Fit control rod bell crank block and horizontal cross-over control rods.

(a) Fit bell crank block and secure with tab washers and bolts.

(b) Fit throttle rod (painted green) and h.p. fuel cock rod (painted black) to bell crank and engine levers using a bolt, and tab washer for each connection to the engine and a bolt, washer, nut and split pin at bell crank levers.

(2) Fit starter/generator and air outlet casing.

NOTE: Check dowel holes in engine mounting face and air outlet casing are clean.

(a) Using white spirit clean starter/generator drive shaft and also remove traces of old lubricant from starter/generator extension drive grease sleeve; dry using compressed air.

(b) Lubricate stud threads.

(c) Fit casing, complete with air duct, with exhaust duct facing downward and locating dowels engaged.

(d) Fit spring washers and nuts; torque load nuts to 140 to 160 lb.in.

...Power plant build list continued

(e) Pre mod.257127 - Pack starter/generator extension drive shaft sleeve with lubricant.

(f) Mod.257127 starter/generators only - lubricate and fit new O-ring seal to grease retainer.

(g) Lubricate threads and contact faces of attachment clamp and starter/generator splines.

(h) Fit starter/generator with air inlet, with duct aligned; torque load clamp nut to 120 lb.in.

NOTE: When finally torque tightened to the correct loading, the gap between the clamp ends must be 0.052 to 0.285 in.

(j) Lubricate tip of thermal switch and fit switch.

(k) Pre mod.251800 only - Connect thermal switch cables to terminal block on engine.

(3) Right engine only - Fit windshield supply a.c. generator.

(a) Lubricate and fit a new O-ring seal.

(b) Lubricate new quill shaft, fit quill shaft and align generator with air inlet duct facing inboard and locating dowel engaged.

(c) Lubricate threads and faces of attachment clamp.

(d) Secure with clamp ring and torque load clamp nut to 55 to 60 lb.in.

NOTE: Fit air inlet duct and connect hose to generator after installation of top cowl.

(4) Fit rear cowl.

(a) Fit rear cowl over exhaust unit, avoid fouling Firewire, and engage rear piston ring type seal over collar on exhaust unit.

(b) Fit plain washers and bolts to affix cowl.

(c) Fit plain washers and bolts to affix access panel (complete with fuel differential pressure switch) in front of drains tank.

(d) Tighten all attachment bolts.

(5) Connect and tighten fuel differential pressure switch hoses to l.p. filter; wire-lock.

(6) Connect extension to harness and harness to fuel differential pressure switch.

...Power plant build list continued

(7) Connect power loss indicator hose to adapter on engine exhaust. Tighten and wire-lock.

(8) Fit jet pipe fairing, and thread thermocouple harness leads through clamp.

(9) Fit compressor air bleed valve guard using stiffnuts and profile washers.

NOTE: Ensure seal is attached to top of guard.

(10) Fit air tapping elbow to engine.

(a) Lubricate threads.

(b) Apply approved jointing compound to the mating faces of the elbow and centre section.

(c) Using new gasket fit and secure elbow with spring washers and nuts.

NOTE: One stud carries a wire-locking tab and another, on the left engine, a clip for the igniter cable.

(d) Torque load nuts to 70 to 80 lb.in.

(11) Fit nose cowl.

(a) Lubricate and fit new seals, to front and rear joints of engine anti-icing duct. Position duct in engine.

(b) Offer up nose cowl, engage anti-icing duct, and assemble nose cowl to engine with stiffnuts and bolts.

NOTE: Do not tighten bolts until completion of (c) and (d).

(c) Fit fire extinguishant pipe, mounting clip, bracket on nose cowl attachment bolt at left side of the engine.

(d) Attach harness and clip to nose cowl attachment bolt at top of engine.

(e) Connect bonding wire and clamp linking nose cowl to anti-icing duct.

(12) Connect fire extinguishant spray pipe to left side of engine. Tighten pipe nut and wire-lock.

(13) Mod.252367 only - Fit primer shut-off valve (see Chapter 71, PRIMER DRAIN).

(14) Connect, tighten and wire-lock drain pipes.

(a) Centre-section drain to drain valve and, Mod.252367 only, to drains tank. Right engine only, connect and tighten clip linking Firewire connector to drain pipe.

...Power plant build list continued

(b) Primer drain - to drains tank and engine banjo; wire-lock both ends.

(c) Mod.252367 only - To inlet and outlet of primer shut-off valve.

(d) Drain from b.f.c.u. - to b.f.c.u. and drain tank; wire-lock both ends.

(e) Drain pipe to oil tank filler neck and fuel pump drive gland; wire-lock each end. Connect to hydraulic pump when fitting pump.

(f) Left engine only - Synchronizer corrector unit drain.

(g) Engine breather - To engine, do not wire-lock until pipe is aligned with cowling.

(h) Pre mod.252085 only - Fuel l.p. warning switch. Do not wire-lock yet.

(j) Exhaust cone drain. Wire-lock.

(15) Connect flexible fire hose to spray ring around nose cowl; wire-lock.

(16) Fit closure plate to outboard front mounting face position.

(a) Apply approved jointing compound to the closure plate and mounting face.

(b) Secure closure plate to engine mounting face; using front mounting bolts, spring washers and distance pieces; tighten bolts to 150-170 lb.in.

(17) Fit closure plate to outboard trunnion mount.

(a) Apply approved jointing compound to closing plate and mounting face.

(b) Secure closure plate using trunnion mounting bolts and two new double tab washers. Tighten bolts to 150-170 lb.in. and engage tab washers.

B. Strip power plant

(1) Disconnect power loss indicator hose at adapter on engine exhaust.

(2) Left engine only - Disconnect horizontal cross-over control rods from bell crank and engine levers; discard split pins and tab washers.

(3) Left engine only - Disconnect control rod bell crank block from compressor casing; discard tab washers.

(4) Remove starter/generator and air outlet casing.

(a) Pre mod.251800 only. Disconnect thermal switch cables from engine terminal block.

...Power plant build list continued

(b) Remove thermal switch.

(c) Remove cooling air inlet duct.

(d) Slacken clamp ring.

(e) Withdraw starter/generator.

(f) Remove nuts and washers and withdraw casing with exhaust duct intact.

(g) Mod.257127 only - Remove all traces of old lubricant from drive shaft grease retainer.

(5) Right engine only - Remove a.c. generator.

(a) Slacken clamp ring and withdraw generator and quill shaft.

(b) Discard O-ring seal.

(6) Disconnect drain pipes.

(a) Centre-section drain at drain valve. Right engine only disconnect clips securing other items to pipe.

(b) Primer drain at drains tank and engine banjo.

(c) Drain from b.f.c.u. at b.f.c.u. and drains tank.

(d) Drain pipe at oil tank filler neck, and fuel pump.

(e) Engine breather at engine banjo.

(f) Pre mod.252085 only - Fuel l.p. warning switch.

(g) Left engine only - Synchronizer corrector unit drain pipe.

(h) Exhaust cone drain, via access panel in rear cowl.

(7) Slacken retaining nuts and slide guard off compressor air bleed valve.

(8) Remove hot air tapping elbow from engine. Discard seal and fit blank.

NOTE: This elbow must be transferred to the replacement power plant.

(9) Disconnect fire extinguishant pipe from left side of engine.

(10) Remove nose cowl.

(a) Disconnect bonding wire and clamp linking anti-icing duct to nose cowl.

...Power plant build list continued

(b) Release fire extinguishant pipe support bracket and harness at top of engine.

(c) Release cowl and ease forward to disengage anti-icing duct. Discard seal.

(11) Remove nose cowl anti-icing duct from engine and discard seal.

(12) Disconnect harness from fuel differential pressure switch and disconnect extension lead from harness.

(13) Disconnect fuel differential pressure switch hoses from l.p. filter.

CAUTION: HOLD FILTER ADAPTERS WITH SPANNER WHEN SLACKENING HOSE NUTS.

(14) Mod.252367 only - Remove primer shut-off valve (see Chapter 71, PRIMER DRAIN).

(15) Remove rear cowl.

(a) Remove access plate, bolted in front of drains tank, complete with fuel differential pressure switch.

(b) Release cowl and move it rearward off engine; avoid fouling Firewire and rear, piston ring type, seal.

(16) Remove closure plate from outboard front mounting face position and fit slave front mounting bracket. Tighten bolts to 150-170 lb.in.

NOTE: Place bolts, spring washers, distance pieces and closure plate in a clean bag and secure to engine.

(17) Remove closure plate from outboard trunnion mounting position and transfer to replacement engine.

* * *

POWER PLANT - SERVICING MATERIALS

1. General servicing materials - specifications

Code No.	BRITISH SPECS.			AMERICAN SPECS.		
	Product	No.	Vendor	Product	No.	Vendor
1	Engine oil	See chapter 12	-	Engine oil	See chapter 12	-
2	AeroShell grease 8	DTD 806 A	Shell Mex & B.P. Ltd.	AeroShell grease 8	MIL-G-7187	Shell Oil Co.
2	Aircraft starter grease	DTD 806 A	Regent Oil Co.Ltd.	Aircraft starter grease	MIL-G-7187	Texaco Inc.
3	Molypaul 100	DTD 5617	K.S.Paul Products,London N.18	Grease HI-LO MS No.1	-	All-Lube California, USA
3	Silkolene 751	DTD 5617	Dalton & Co.Ltd.,Belper,Derby	Eclipse No.31	-	-
4	Silkolene 762	DTD 900/4344	Dalton & Co.Ltd.,Belper,Derby	-	-	-
5	P.T.F.E. spray	-	Camlam Ltd., Cambridge	-	-	-
6	Duralac 3389	DTD 900/4360	Llewellyn Ryland Ltd., Birmingham 12	-	-	-
6	Titanine J.C.5A	DTD 900/4488	Titanine Ltd., Colindale, London, N.W.9.	-	-	-
7	Plastic Hermetite 1310	DTD 900/4134	Kenilworth Mfg. Co. Ltd., W.Drayton, Middlesex.	-	-	-
7	Hylomar PL32	DTD 900/4586A	Marston Lubricants Ltd., Liverpool.	Hylomar PL32	-	Kingsley & Keith Ltd., Montreal, Canada.
8	Colloidal graphite	DTD 900/4639	Achesons Colloids Ltd.	-	-	-
9	Bostik 1787	-	B.B. Chemical Co.Ltd., Leicester	Bostik 1787	-	B.B. Chemical Company, Massachusetts, USA
9	Evostik 5007/3	-	Evode Ltd., Stafford	-	-	-
10	Loctite Grade B	DTD 900/4588	-	-	-	-
11	Liquid paraffin B.P.	Tech.white oil	-	-	-	-

NOTE : See para.2 for code usage data

Page 2 intentionally left blank

...Power plant - Servicing materials continued

2. Usage code data

GENERAL	CODE	POWER PLANT (including accessories)	CODE	ENGINE	CODE	FUEL AND CONTROL	CODE	IGNITION	CODE
All 'O' ring seals and threads except when otherwise specified	1	MOUNTS Bearings of front and main	8	ACCESSORY DRIVES Starter/gen extension drive - male splines	1	CONTROLLING Synchronizer corrector unit mounting faces	6		
Standard jointing compound	7	Link bolts	8	Starter/gen extension drive - female splines	3	B.F.C.U.,A.F.R.C., E.P.C. and A.T.L. rubber mounting bushes	9		
'V' clamp contact faces	3	Mounting and lifting bracket joint faces	6	Starter/gen extension drive grease sleeve	3	'O'-rings in fuel systems	11		
Specified threads	10	DRAINS Exhaust drain valve securing bolts	2						
		ACCESSORIES Starter generator Drive splines	3						
		Mod 257127. Drive spline grease retainer and 'O' ring seal	3						
		Starter clamp	3						
		Cooling air inlet duct seal and attachment bolts	3						
		Tip of thermal switch	3						
		AC Generator Quill shaft splines	3						
		Hydraulic pump Quill shaft splines	3						

NOTE : See para.1 for materials relevant to code

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...Power plant - Servicing materials, continued

AIR	CODE	ENGINE CONTROLS	CODE	INDICATING	CODE	EXHAUST	CODE	OIL	CODE
GENERAL 'O' ring seals in anti-icing and air cond. supply ducts.	5			TEMPERATURE Thermocouple harness attachment bolts	2	Exhaust cone Securing bolts, except lower 6	2	INDICATING Oil pressure Transmitter mounting faces	6
ANTI-ICING Centre section and air intake anti-icing elbow joint faces	6			ANALYZERS Power loss pitot securing bolts	2	Securing bolts, lower 6 Nozzle trimmer bolts Cone and turbine stator joint faces	4 2 4		

NOTE : See para.1 for materials relevant to code.

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...Power plant servicing materials - continued

3. Miscellaneous materials continued

	BRITISH			AMERICAN		
Application	Product	Specification	Supplier	Product	Specification	Supplier
Cleaner and degreasing agent	Croda Gel	-	Croda Ltd., Snaith, Goole, Yorks, England.	-	-	-
	Red Band Fluid (Kearsleys)	-	International Pinchin Johnson Ltd., Birmingham 16, England.	-	-	-
	White spirit Solvent naphtha	BS 245 BS 479		Stoddarts solvent or Mineral spirit	-	-
	Trichloroethane (Genklene)	TS367D Type 1 or 2	I.C.I. Ltd., (Chemical Division), Slough, Bucks, England.	-	-	-
Solvent for Duralac 3389 and Titanine JC5A	Synstrip	-	Synthite Ltd., Ryders Green, West Bromwich, Staffs. England.	-	-	-
Solvent for Hermetite 1310	Methylated spirit	BS 3591	-	-	-	-
Solvent for PL32	Trichloroethane	TS367D Type 1 or 2	-	-	-	-
Reprotecting magnesium and aluminium alloys	Epihard varnish 700-452-004	DTD900/4492		Ault & Wiborg. (Industrial Finishes Ltd.,) Wharfedale Road, Birmingham, England.		
	Epihard catalyst 656-452-004					
	Thinners 375/224					
Reprotecting anodized surfaces	Alocrom 1200	DTD900/4413	I.C.I. Ltd., (Chemical Division), Slough, Bucks, England			
	Nitric acid	-	-	-	-	-

...Power plant servicing materials - continued

	BRITISH			AMERICAN		
Application	Product	Specification	Supplier	Product	Specification	Supplier
Restoring enamel finish	Cold-curing grey enamel No.578/0588 Catalyst No.416/0129 Thinners No.485/80 or	DTD5555A	International Pinchin Johnson Ltd. (J.Hall product) Rotton Park Street, Ladywood, Birmingham 16, England	-	-	-
Restoring clear varnish finish	Clear varnish CO.5187	AFS.307	International Pinchin Johnson Ltd.			
Compressor Anti-Corrosion De-watering fluid)	Rocket WD40 Inhibiting oil	DEF.STAN.68/10				
Crack detection on non-ferrous and non-magnetic ferrous materials	Ardrox 996 dye penetrant, Ardrox 9D2 developer	- -	Ardrox Ltd., Commerce Road, Brentford, Middlesex.England.			
Power loss system leak test	Lensodel A or Nonidet P40	-	-	-	-	-
Restoring primer enamel	Grey enamel finish base No.SL5459 Catalyst No.CSH5538 Thinners No.TSL5373	DTD5555A	International Pinchin Johnson Ltd.			
	Primer base No.578/517 Catalyst No.416/32 Thinners 485/80 or	-	International Pinchin Johnson Ltd.,			
	Primer base No.SL6362A Catalyst No.CSH6331 Thinners No.TSL5373	-	International Pinchin Johnson Ltd.,			

SERVICING MATERIALS - MAINTENANCE PRACTICES

1. Cleaning and painting

NOTE : These procedures detail the approved method of touching-up local damage to the protective external finishes on the engine. Where the anodised surface under the finish of aluminium alloy components is also damaged, this must be treated prior to restoring the finish.

A. Cleaning

(1) Loosen damaged enamel or corrosion products by scraping or by brushing with a stiff non-metallic brush (e.g. nylon).

(2) Carefully blend the edges of damaged areas with fine grade emery cloth.

(3) Remove loose particles with a suction hose or a clean, fluff-free cloth.

(4) Clean the affected area with a cloth soaked in trichloroethane.

B. Restore local areas of anodised surface (aluminium alloy components)

WARNING : ALOCROM 1200 IS POISONOUS. OBSERVE ALL THE PRECAUTIONS APPROPRIATE TO THE USE OF CHEMICALS DURING THE PREPARATION AND USE OF THE SOLUTION.

(1) Prepare the solution.

(a) Pour one gallon of water into an acid-proof container.
(b) Add five ounces of alocrom 1200 powder and half a fluid ounce of concentrated nitric acid to the water.
(c) Stir the solution thoroughly until the powder is dissolved. A small residue will remain and may be ignored.

(2) Degrease the affected area with a cloth soaked in trichloroethane.

(3) Apply the solution to the area affected with cotton wool swab on the end of a stick.

(4) Allow the solution to remain until a light brown or golden irridescent film is produced on the area. This should occur within two to seven minutes, depending on the temperature and the alloy being treated.

(5) Wash the surface thoroughly in clean cold water.

WARNING : WASH THE COTTON WOOL SWABS THOROUGHLY BEFORE DISCARDING THEM. IF THEY ARE ALLOWED TO DRY WITHOUT WASHING, THEY CONSTITUTE A FIRE HAZARD.

(6) Dry the component with clean, moisture-free compressed air.

C. Touch-up protective enamel (primer exposed)

(1) Clean the affected area as in sub-paragraph A.

...Servicing materials - Maintenance practices continued

(2) Prepare the cold curing enamel; J. Hall product :

(a) Mix together the following enamel and catalyst (curing agent) in equal volumes to the amount required.

Epoxy	...	...	No.578/0588
Catalyst	...	...	No.416/0129

(b) Stir the mixture thoroughly. If necessary, add thinners (No.485/80) to obtain a consistency suitable for brushing or spraying. Allow to stand for 30 minutes before using.

NOTE : This enamel will remain usable up to 48 hours at normal room temperature.

(3) Prepare the cold curing enamel, Pinchin Johnson product :

(a) Mix together the following enamel and catalyst in equal volumes to the amount required.

Epoxy finish base	No.SL.5459
Epoxy finish catalyst	No.CSH.5538

(b) Stir the mixture thoroughly. If necessary, add thinners (TSL.5373) to obtain a consistency suitable for brushing or spraying. Allow to stand for 30 minutes before using.

NOTE : This enamel will remain usable up to 8 hours at normal room temperature.

(4) Apply the enamel to the affected area and allow to dry for 5 to 6 hours.

D. Touch-up protective primer (bare metal exposed).

(1) Clean the affected area as in sub-paragraph A.

(2) Prepare the primer, J. Hall product :

(a) Mix together the following primer and catalyst in equal volumes to the amount required.

Primer base	...	...	No.578/517
Catalyst	...	...	No.416/32

(b) Stir the mixture thoroughly. If necessary, add thinners (No.485/80) to obtain a consistency suitable for brushing or spraying. Allow to stand for 30 minutes before using.

NOTE : This primer will remain usable up to 48 hours at normal room temperature.

...Servicing materials - Maintenance practices continued

(3) Prepare the primer, (Pinchin Johnson product) :

(a) Mix together the following primer and catalyst in equal volumes to the amount required.

Primer base	...	...	No.SL.6362A
Catalyst	...	...	No.CSH.6331

(b) Stir the mixture thoroughly. If necessary, add thinners (No. TSL.5373) to obtain a consistency suitable for brushing or spraying. Allow to stand for 30 minutes before using.

NOTE : This primer will remain usable up to 8 hours at normal room temperature.

(4) Apply the primer to the affected area and allow to dry for a minimum of 4 hours before applying the finish enamel as detailed in sub-paragraph C.

E. Local restoration of protective clear varnish

NOTE : Whenever the clear varnish finish is damaged or external accessories and engine components are disturbed or changed in the area forward of the combustion chamber, the following procedures should be adopted.

(1) Remove any loose or flaking varnish and clean the affected area using trichloroethane.

(2) When an accessory or component has been changed or refitted, apply a coating of Kearsley's lacquer to the attachment joint area and surfaces of any new parts using a brush.

CAUTION : DO NOT CONTAMINATE RUBBER COMPONENTS. TAKE ADEQUATE FIRE PRECAUTIONS, SINCE THE VARNISH EMITS A HIGHLY INFLAMMABLE VAPOUR.

(3) Allow to air dry for the period stated on the container before applying a second coat.

F. Reprotect magnesium of aluminium alloys (treated surface damaged and bare metal exposed).

(1) Prepare the epihard clear varnish.

(a) Mix the varnish and catalyst (see list of materials) in the following proportions by volume.

3 parts varnish base
1 part catalyst

...Servicing materials - Maintenance practices continued

(b) Stir the mixture thoroughly. If necessary, add thinners to obtain a consistency suitable for brushing or spraying.

NOTE : The varnish will remain usable up to 8 hours at normal room temperature.

(2) Apply the varnish to the affected area and allow to dry for 5 to 6 hours.

2. Jointing compounds

A. Apply jointing compounds

(1) Clean both the joint faces with trichloroethane.

(2) Apply a thin, even coating of compound. Leave the inner edges of the faces clean.

(3) Allow the compound to become 'tacky' before mating the components. Make the joint within 15 minutes of applying the compound.

CAUTION : ENSURE THAT COMPOUND DOES NOT ENTER OIL HOLES OR PASSAGES.

B. Remove jointing compounds

Remove the compounds from the joint faces with the recommended solvents in preference to scraping.

* * *

TORQUE LOADING - MAINTENANCE PRACTICES

1. General

Mandatory torque loadings are quoted, where applicable, in the relevant Maintenance Practices in the chapters of this manual. For all other torque loadings refer to para.2 of this section.

All torque loading figures quoted are the actual loadings required; if an extension spanner is used between the torque spanner and the item being tightened, calculate the correct torque spanner dial reading required (see Chapter 20, TORQUE LOADING).

2. Non-mandatory torque loadings

All nuts and/or bolts, which are not subject to a mandatory torque loading, should be tightened to the following torque loadings :-

Thread size		Torque loading (lb.in.)
2 BA	-	35
$\frac{1}{4}$ in.	-	90
5/16 in.	-	180
3/8 in.	-	315
7/16 in.	-	500
$\frac{1}{2}$ in.	-	700
5/8 in.	-	1300

3. Torque loading 'V' clamps

Before fitting a clamp, ensure that the contact faces of the clamp, and the component parts to which it is to be fitted, are free from damage. Lubricate the contact faces and bolt threads as specified in Chapter 71, SERVICING MATERIALS.

When torque loading, tighten the clamp nut(s) or bolt(s) to the specified loading, slacken half a turn and then torque to the specified loading. Repeat this sequence until the bolt(s) cease to advance. This ensures that the clamp beds down correctly and maintains the correct torque loading in service.

* * *

PIPES - GENERAL - MAINTENANCE PRACTICES

1. General

Exercise care when installing pipes.

Before installing a pipe, install the relevant clips and fittings in approximately their correct positions. Refer to the Illustrated Parts Catalogue for component part numbers if necessary.

Pipes requiring a special technique for removal and installation are detailed in their relevant Chapter.

2. Flexible Pipes

A. Install flexible pipes

(1) Lubricate the pipe union connection threads with clean engine oil.

(2) Connect the pipe between its union connections and tighten the nuts as far as possible by hand.

(3) Position and secure the pipe support clips to their relevant positions.

(4) Ensure the pipe is not twisted, kinked or distorted.

(5) Hold each union connection with a spanner, in turn, and tighten the union nuts. Do not over-tighten the pipe nuts.

(6) Wire-lock the nuts.

3. Rigid Pipes

A. Install rigid pipes

(1) Lubricate the pipe union connection threads with clean engine oil.

(2) Lubricate and install new O-seals on the pipe ends, where necessary, then offer the pipe into position and check that it aligns freely between its union connections.

(3) Tighten the union nuts as far as possible by hand.

(4) Check that the pipe support clips align with their anchorage points without imposing side stresses on the pipe.

(5) Hold each union connection with a spanner, in turn, and tighten the union nuts. Take care not to over-tighten the pipe union nuts.

(6) Wire-lock the nuts.

(7) Position and secure the pipe support clips to their relevant positions.

* * *

...Servicing materials - Maintenance practices continued

2. Jointing compounds

A. Apply jointing compounds

(1) Clean both the joint faces with trichloroethane.

(2) Apply a thin, even coating of compound. Leave the inner edges of the faces clean.

(3) Allow the compound to become 'tacky' before mating the components. Make the joint within 15 minutes of applying the compound.

CAUTION : ENSURE THAT COMPOUND DOES NOT ENTER OIL HOLES OR PASSAGES.

B. Remove jointing compounds

Remove the compounds from the joint faces with the recommended solvents in preference to scraping.

3. Serviceability test for self locking nuts

(1) Self locking nuts may be used repeatedly providing the nut or, in the case of captive nuts, the bolt cannot be screwed on or in completely by hand.

* * *

TORQUE LOADING - MAINTENANCE PRACTICES

1. General

Mandatory torque loadings are quoted, where applicable, in the relevant Maintenance Practices in the chapters of this manual. For all other torque loadings refer to para.2 of this section.

All torque loading figures quoted are the actual loadings required; if an extension spanner is used between the torque spanner and the item being tightened, calculate the correct torque spanner dial reading required (see Chapter 20, TORQUE LOADING).

2. Thread lubricants

A. General use

Thread lubrication is specified in Chapter 71-09-21 General Servicing Materials - Specifications, or as specified in the relevant procedure.

B. Misuse of molybdenum disulphide lubricants

Molybdenum disulphide lubricants break down above 300 deg.C. (572 deg.F) releasing sulphur which can induce stress corrosion and premature failure of engine parts so lubricated.

Most of the bolt materials used in the higher temperature zones of the engine are sensitive to sulphur attack; therefore it is essential that the supply and use of lubricants containing molybdenum disulphide is strictly limited to those parts for which they are specified in the manual.

3. Non-mandatory torque loadings

All nuts and/or bolts, which are not subject to a mandatory torque loading, should be tightened to the following torque loadings :-

Thread size		Torque loading (lbf.in.)
2 BA	-	35
¼ in.	-	90
5/16 in.	-	180
3/8 in.	-	315
7/16 in.	-	500
½ in.	-	700
5/8 in.	-	1300

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...Torque loading - Maintenance practices continued

4. Torque loading 'V' clamps

Before fitting a clamp, ensure that the contact faces of the clamp, and the component parts to which it is to be fitted, are free from damage. Lubricate the contact faces and bolt threads as specified in Chapter 71, SERVICING MATERIALS.

When torque loading, tighten the clamp nut(s) or bolt(s) to the specified loading, slacken half a turn and then torque to the specified loading. Repeat this sequence until the bolt(s) cease to advance. This ensures that the clamp beds down correctly and maintains the correct torque loading in service.

* * *

SELF-LOCKING NUTS - MAINTENANCE PRACTICES

1. Re-use of self-locking nuts

A. General

The following procedures concern the fitting of self-locking nuts of the deformed thread type (including captive self-locking nuts) and apply to internal and external use; an internal nut being defined as a nut within any engine casing. To avoid the possibility of self-locking nuts becoming loose or detached (which could result in costly damage to the engine and hazarding of the aircraft) it is necessary to ensure that the efficiency of the locking feature, as measured by the 'Locking Torque' (run-down torque) is satisfactory at the time of fitting.

The measured run-down torque check, using a direct reading torque wrench, must be complied with for all nuts of self-locking, deformed thread, type used internally, and for nuts, with a thread diameter more than 5/16 inch, used externally. Nuts of this type, up to, and including 5/16 inch thread diameter, used externally may be checked by the manual method described in sub-para.C where it is impossible to use the torque method.

B. Check the measured run-down torque, with a direct reading torque wrench

(1) Ensure that the threads of the bolt or stud are clean and undamaged and lubricated with clean engine oil (or as detailed in the relevant instructions).

(2) Screw the self-locking nut on the bolt or stud until the bolt or stud end is flush with, or slightly protruding from, the nut end face.

(3) Refer to Table 201 and, using a direct reading torque wrench, check the load required to turn the nut or bolt. During this operation, ensure that the thrust face of the nut does not contact the component face.

(4) Reject the nut if it has a locking torque below the value for size given in Table 201, then select a new nut and repeat the measured run-down torque check until satisfactory.

NOTE : Scrap any nut which has obviously lost its locking qualities. Do not attempt to restore, or improve, the locking torque of any nut.

Table 201 on following page

Table 201 Minimum run-down locking torque for self-locking nuts

Thread Size		Minimum Torque lbf.in.	Minimum Torque N.m.
No. 4	UNF	0.5	0,06
No. 6	UNF	1.0	0,12
No. 8	UNF	1.5	0,17
No.10	UNF	2.0	0,23
1/4	UNF	3.5	0,4
5/16	UNF	6.5	0,73
3/8	UNF	9.5	1,1
7/16	UNF	14.0	1,6
1/2	UNF	18.0	2
9/16	UNF	24.0	2,7
5/8	UNF	32.0	3,7

C. Check the run-down torque manually

NOTE : This procedure is an alternative to that given in sub-para.B. but applies only to nut sizes up to, and including 5/16 inch thread diameter in external areas where it is impossible to use the torque method.

(1) Attempt to screw the self-locking nut on the bolt or stud beyond the locking section using maximum finger pressure.

(2) If the nut can be screwed beyond the locking section reject it. Select a new nut and repeat the check until satisfactory.

D. Checks on final assembly

During final assembly (after torque-tightening), check to ensure that a minimum of one full thread (in addition to the chamfered portion of the bolt or stud end) is protruding beyond the outer face of the nut.

CAUTION : INSUFFICIENT BOLT OR STUD THREAD PROTRUSION IS UNACCEPTABLE.

* * *

COWLINGS

1. General

The power plant is enclosed by seven cowlings, two of which (the nose cowl and rear cowl) are bolted directly to the engine to form a foundation for the fitment of the remainder. A guard duct is bolted to the compressor air bleed valve, Fig.1 overleaf).

Zone 1 is accessible via four quickly detachable cowlings: the top cowl, the bottom forward cowl and the two hinged side cowls. The side cowls have quick-release hinge pins, but the remaining Zone 1 cowls are attached via toggle fasteners also used to lock adjacent cowls. On the right engine only, the top cowling has a flush intake for the a.c. generator cooling air.

Zone 2 and the exhaust zone are enclosed by the rear cowl and jet pipe fairing respectively; the latter is bolted to the rear cowl and both are connected to the fillet (via the upper and lower fillet shrouds) by quick-action rotary fasteners.

The cowlings, of conventional construction, are fabricated from Alclad, except where they constitute firewalls (see 'Firewalls). Cowlings are handed and therefore not interchangeable between the two power plants. Support struts are fitted to the hinged cowls to permit them to be secured in the open position during servicing. Fire access/blow-out panels and small panels, giving access to 'first line' servicing points, are provided where necessary. A drains tank is bolted to, and completes the contour of, the lower forward part of the rear cowl (see 'Drains').

Thiokol sealant is used for all edge seals between over-lapping cowlings.

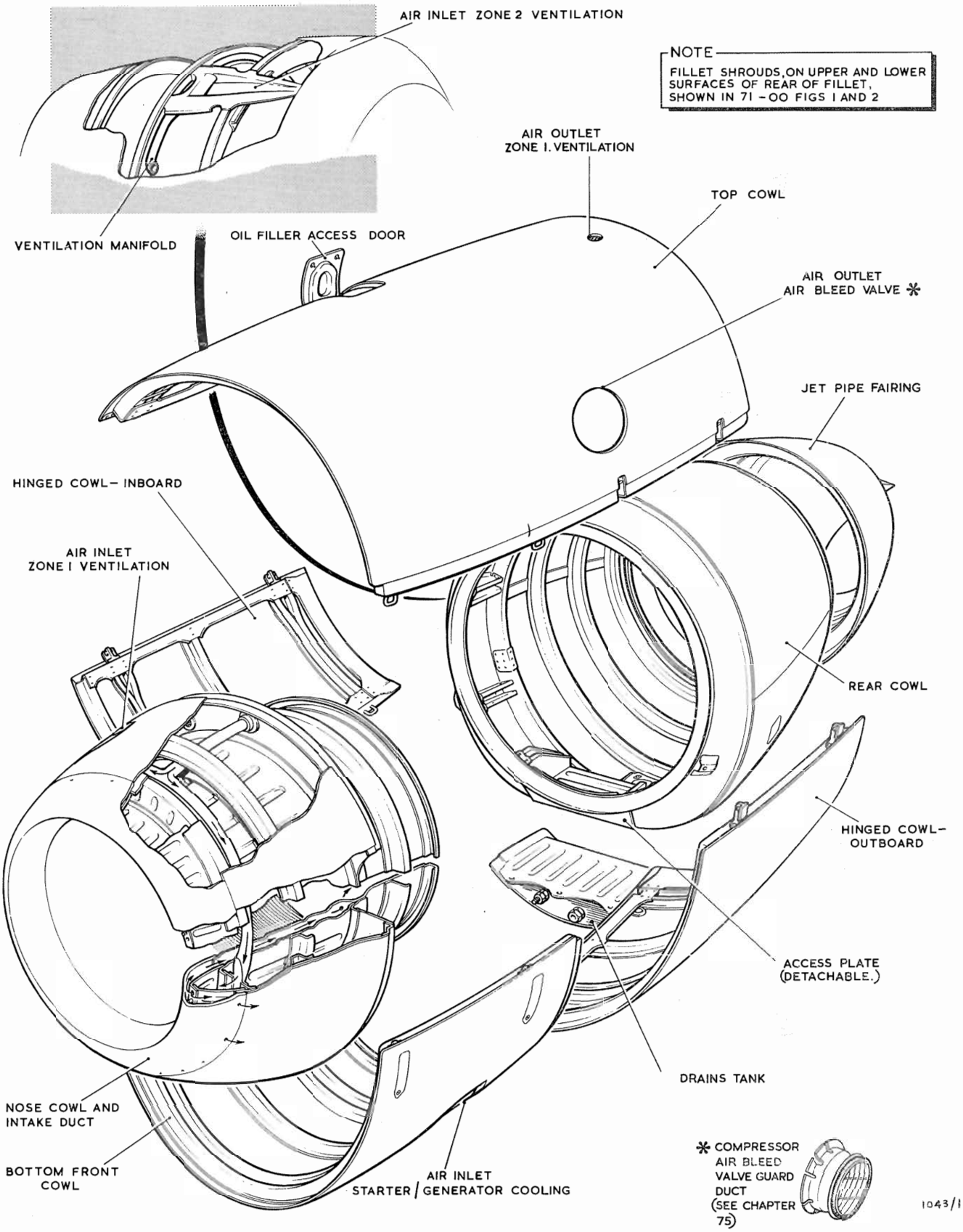
2. Nose cowl and intake duct

The nose cowl and intake duct comprises three (permanently joined) portions: the intake lip, the plenum chamber and the duct. A sealed diaphragm separates the intake lip from the plenum chamber and another diaphragm forms the rear member of the plenum chamber. The rear diaphragm has a number of gauze-covered holes which link the plenum chamber with Zone 1. A flush intake, in the side of the nose cowl, connects directly to the plenum chamber (see 'Ventilation').

The intake lip and the section of duct between the diaphragms are double skinned and anti-iced by hot air. An anti-icing air distribution duct and manifold are housed within the plenum chamber. A series of small holes on the outside of the intake lip, and others at the rear inner periphery of the double-skinned portion of the duct form exhausts for nose cowl anti-icing air (see Chapter 75 for 'Engine and intake anti-icing').

Attachment points for debris guards and intake blanks are provided on the nose cowl.

Fig.1 overleaf


AIR INLET ZONE 2 VENTILATION
NOTE
FILLET SHROUDS, ON UPPER AND LOWER SURFACES OF REAR OF FILLET, SHOWN IN 71-00 FIGS 1 AND 2
AIR OUTLET ZONE 1. VENTILATION
TOP COWL
VENTILATION MANIFOLD
OIL FILLER ACCESS DOOR
AIR OUTLET AIR BLEED VALVE *
JET PIPE FAIRING
HINGED COWL- INBOARD
AIR INLET ZONE 1 VENTILATION
REAR COWL
HINGED COWL- OUTBOARD
ACCESS PLATE (DETACHABLE.)
DRAINS TANK
NOSE COWL AND INTAKE DUCT
BOTTOM FRONT COWL
AIR INLET STARTER / GENERATOR COOLING
* COMPRESSOR AIR BLEED VALVE GUARD DUCT (SEE CHAPTER 75)
1043/1

MOUNTS

1. General

Each power plant is secured to the airframe by two mounting assemblies (Fig.1) connected to attachments on the side of the engine. Thrust is applied to the airframe via the main rear mount only; the front mount merely supports and aligns the front of the engine. Spherical bearings are incorporated in both mounts, to facilitate the alignment of a power plant.

2. Main mount

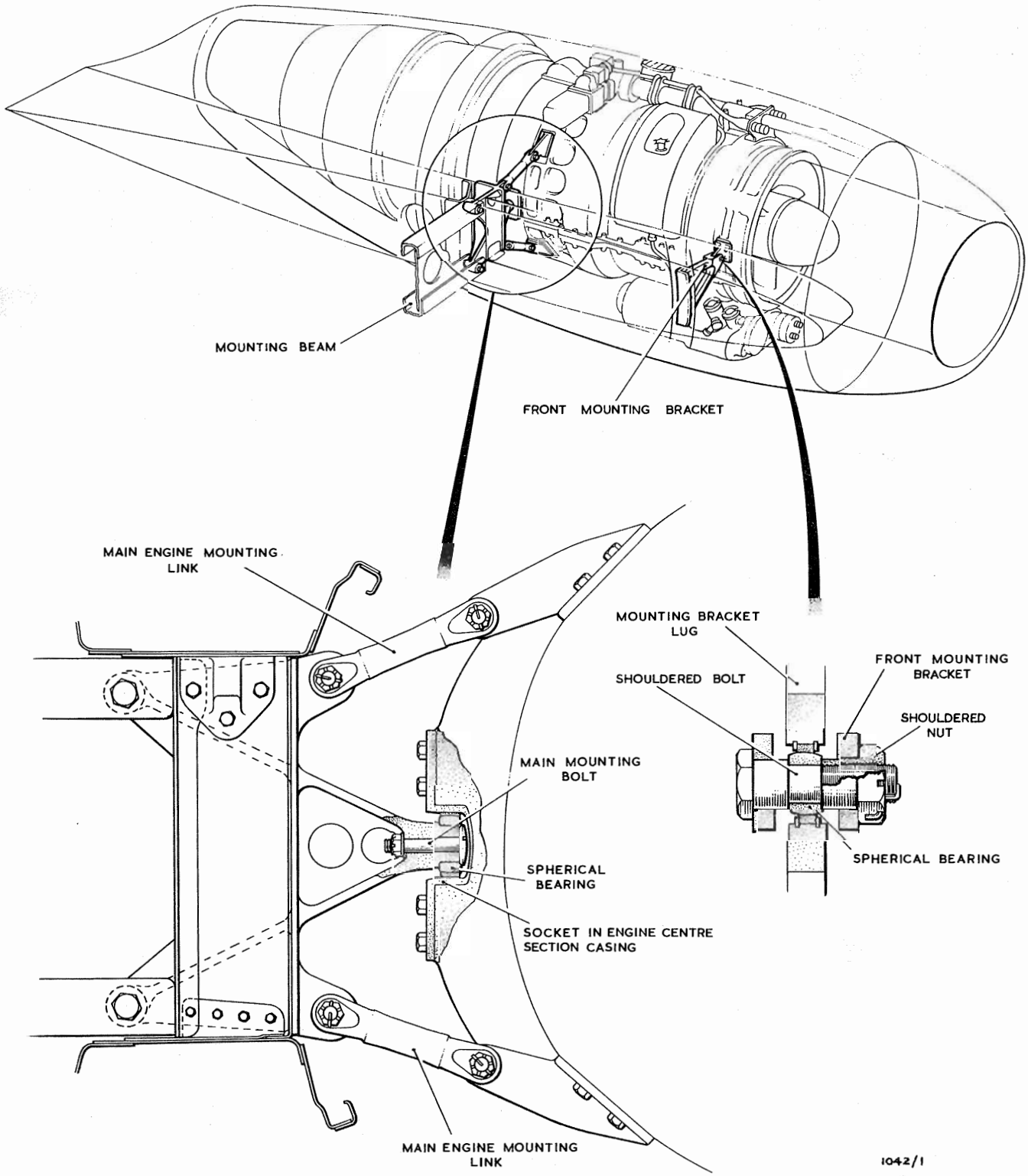
Each main mount comprises three basic portions: a central trunnion, two fixed-length attachment links and an engine-mounted socket. The trunnion is forged integral with a base plate which is bolted to the airframe; the outer end of the trunnion carries a spherical bearing, the outer race of which mates with the socket in the side of the engine centre section. The attachment links are bolted (one above and one below the trunnion) to lugs on the compressor casing and trunnion base plate, to retain the trunnion bearing in engagement with the casing socket.

Thrust loads are transmitted from the engine via the trunnion spherical bearing; loads in the vertical plane are carried by the trunnion in conjunction with the attachment links.

3. Front mount

The front mount consists of a forged mounting bracket bolted, via spherical bushes, to lugs on the airframe structure and compressor.

Fig. 1 overleaf


MOUNTING BEAM
FRONT MOUNTING BRACKET
MAIN ENGINE MOUNTING LINK
MOUNTING BRACKET LUG
FRONT MOUNTING BRACKET
SHOULDERED BOLT
SHOULDERED NUT
MAIN MOUNTING BOLT
SPHERICAL BEARING
SPHERICAL BEARING
SOCKET IN ENGINE CENTRE SECTION CASING
MAIN ENGINE MOUNTING LINK
1042/1

...Mounts - Maintenance practices continued

2. Inspection/check

A. Check wear on mounts

NOTE : Excessive vibration has been attributed to wear between the main engine mounting links and attachment bolts, and also between the front mounting bracket and the attachment bolts and shouldered nuts (Fig. 1). The max. acceptable worn clearance between any of these bolts or shouldered nuts and the bore of the link or mounting bracket is 0.0025 in. If an excessive clearance exists, a new bolt and shouldered nut (diameter new 0.4992 - 0.4997 in.) may cure vibration. If the bore of the link or bracket (diameter new 0.500 - 0.501 in.) is excessive, either fit a new link or bracket (and bolt) or refer to Structural Repair Manual. When assembling the mounts use the grease specified in SERVICING MATERIALS (Chapter 71).

* * *

MOUNTS - MAINTENANCE PRACTICES

1. Unit servicing

A. Reposition mounting and slinging brackets

Special tools and equipment

Torque wrench PE.25492

NOTE : This procedure details the method of repositioning the mounts and slinging brackets, as part of the procedure for changing a left-hand engine change unit (e.c.u.) to a right-hand e.c.u. and vice versa. It is assumed the e.c.u. is mounted in a transit stand.

(1) Connect hoist and slinging equipment to the e.c.u.

(2) Take weight of e.c.u., release it from stand and hoist it clear.

(3) Remove lower mounting bracket (1 left or 2 right see Fig.201); ensure liner at each mounting face remains in position.

NOTE : After removing each mounting bracket and retaining plate clean the old jointing compound from the appropriate faces; apply approved jointing compound to these faces before fitting the items in their new positions. See POWER PLANT - SERVICING MATERIALS.

(4) Remove retaining plate (4 see Fig.201) from compressor.

(5) Fit retaining plate, with new tab washer and original bolts to new position (4 see Fig.201) on compressor casing.

(6) Torque tighten retaining plate bolts to 70-80 lb in. and lock with tab washer.

(7) Lower e.c.u. into stand and secure.

(8) Remove lifting bracket (3 left and right see Fig.201).

(9) Fit mounting bracket, removed in operation (3), to new position (1 right or 2 left see Fig.201) using new tab washer and original bolts.

(10) Remove upper mounting bracket (2 left or 1 right see Fig.201).

(11) Fit lifting bracket (3 left and right see Fig.201), removed in operation (8), to new position using new tab washers and original bolts.

(12) Torque tighten retaining bolts fitted in operation (9) and (11) to 70-80 lb in. and lock with tab washers.

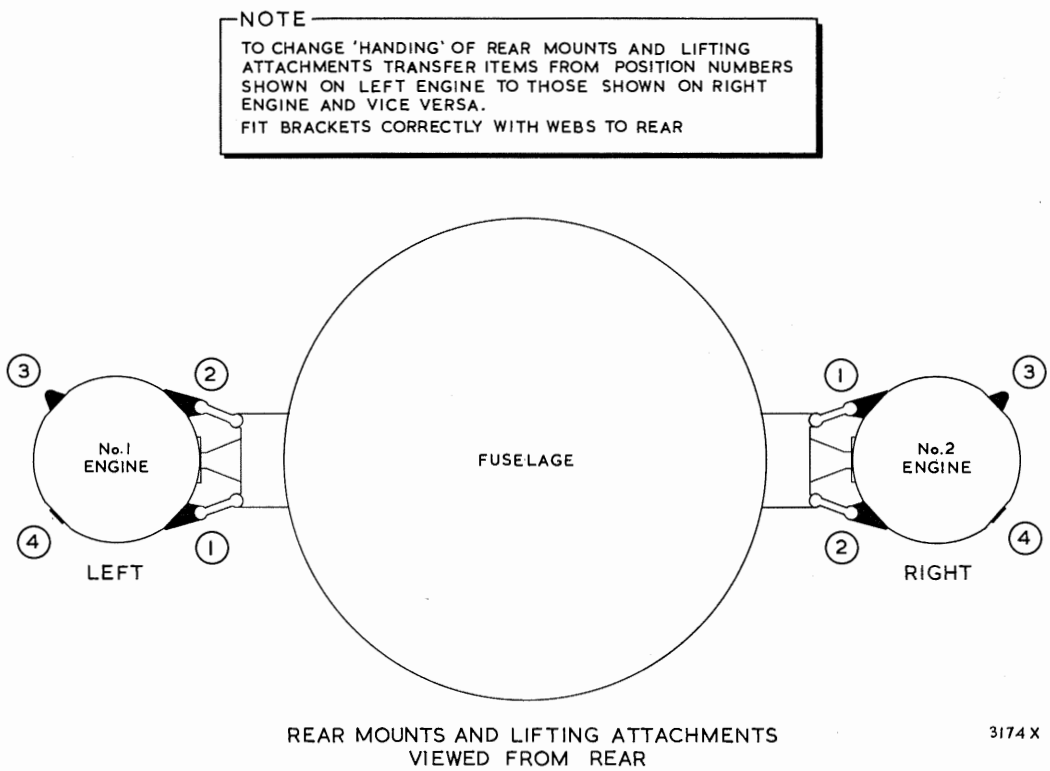
(13) Connect hoist and slinging equipment to e.c.u.

(14) Take weight of e.c.u., release it from stand and hoist it clear.

(15) Fit mounting bracket removed in operation (10) to the remaining mounting face using new tab washers and original bolts.

...Mounts - Maintenance practices continued

(16) Torque tighten retaining bolts to 70-80 lb in. and lock with tab washers.



Relative position of rear mounting and lifting brackets
Fig. 201

(17) Remove front mounting slave bracket (painted red).

(18) Remove front mounting bracket and transfer it, complete with new tab washers and original bolts, to position vacated by slave bracket.

NOTE : Retaining rings must be to rear.

(19) Torque tighten retaining bolts to 150-170 lb in. and lock with tab washers.

(20) Fit front mounting slave bracket and torque tighten to 150-170 lb in.

(21) Transfer front mountings on stand.

(22) Lower engine into stand and secure.

* * *

...Mounts - Maintenance practices continued

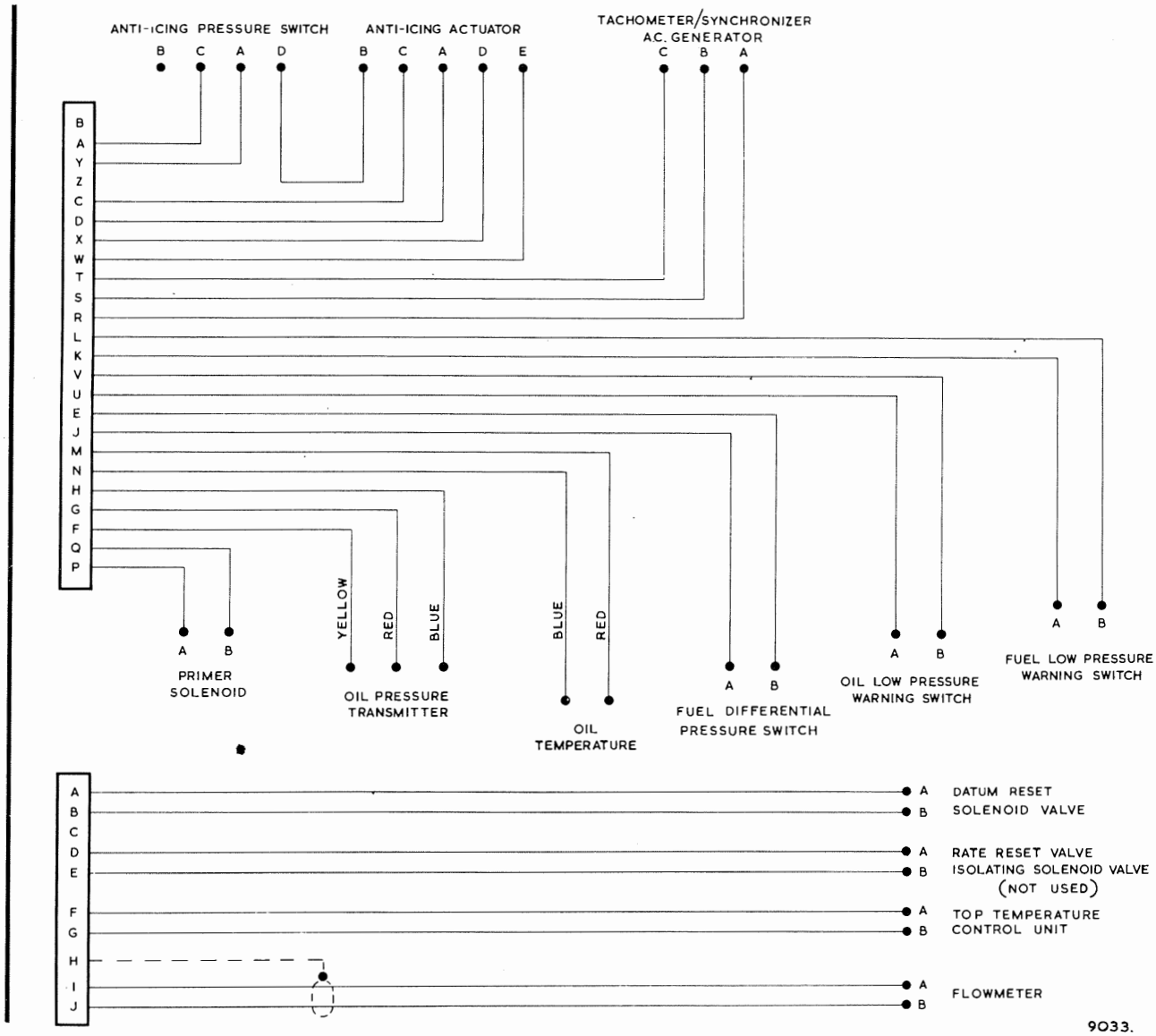
2. Inspection/check

A. Check wear on mounts

NOTE : Excessive vibration has been attributed to wear between the main engine mounting links and attachment bolts, and also between the front mounting bracket and the attachment bolts and shouldered nuts (Fig. 1). The max. acceptable worn clearance between any of these bolts or shouldered nuts and the bore at the link or mounting bracket is 0.0025 in. If an excessive clearance exists, a new bolt and shouldered nut (diameter new 0.4992 - 0.4997 in.) may cure vibration. If the bore of the link or bracket (diameter new 0.500 - 0.501 in.) is excessive, either fit a new link or bracket (and bolt) or refer to Structural Repair Manual. When assembling the mounts use the grease specified in POWER PLANT - SERVICING MATERIALS.

* * *

LIGHT DUTY ELECTRICAL HARNESS



3721/2

ELECTRICAL HARNESS - MAINTENANCE PRACTICES

1. Adjustment/Test

Equipment required

500 Volt Megger (insulation test)
Buzzer or lamp Equipment (continuity test).

A. Test insulation resistance of harness

(1) Using a 500 V. Megger, check the insulation resistance between each socket insert, and all the remaining inserts in the socket.

(2) Repeat this check between each insert and the socket shell. In each case the reading must not be less than 40 Megohms.

B. Test continuity of harness

(1) Using a buzzer or lamp equipment, check that there is continuity throughout the wiring system (refer to the wiring diagram).

NOTE : During this test a maximum potential of 4.5 Volts d.c. should be used, passing no more than 0.5 amp. current.

* * *

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Chapter 72

ENGINE

TABLE OF CONTENTS

* No separate description
\+ No separate maintenance practices

...Contents continued

LIFE LIMITATION - ENGINE PARTS

Engine parts that are subject to a life limitation are listed in the 'Hawker Siddeley and Proprietary Ultimate Lives' section of the HS 125 Maintenance Schedule.

The list of parts also appears, together with details of the method of recording, in Chapter 5-10 of the Rolls Royce Viper Overhaul Manual.

LIFE CONTROL - ENGINE PARTS

A record of flight cycles is required for all engine parts that are subject to a life limitation.

A flight cycle unit is defined as, and equal to, one 'Flight'.

One start/take-off/stop, equals one 'Flight'.
Three 'touch and go' operations are equal to two 'Flights'.

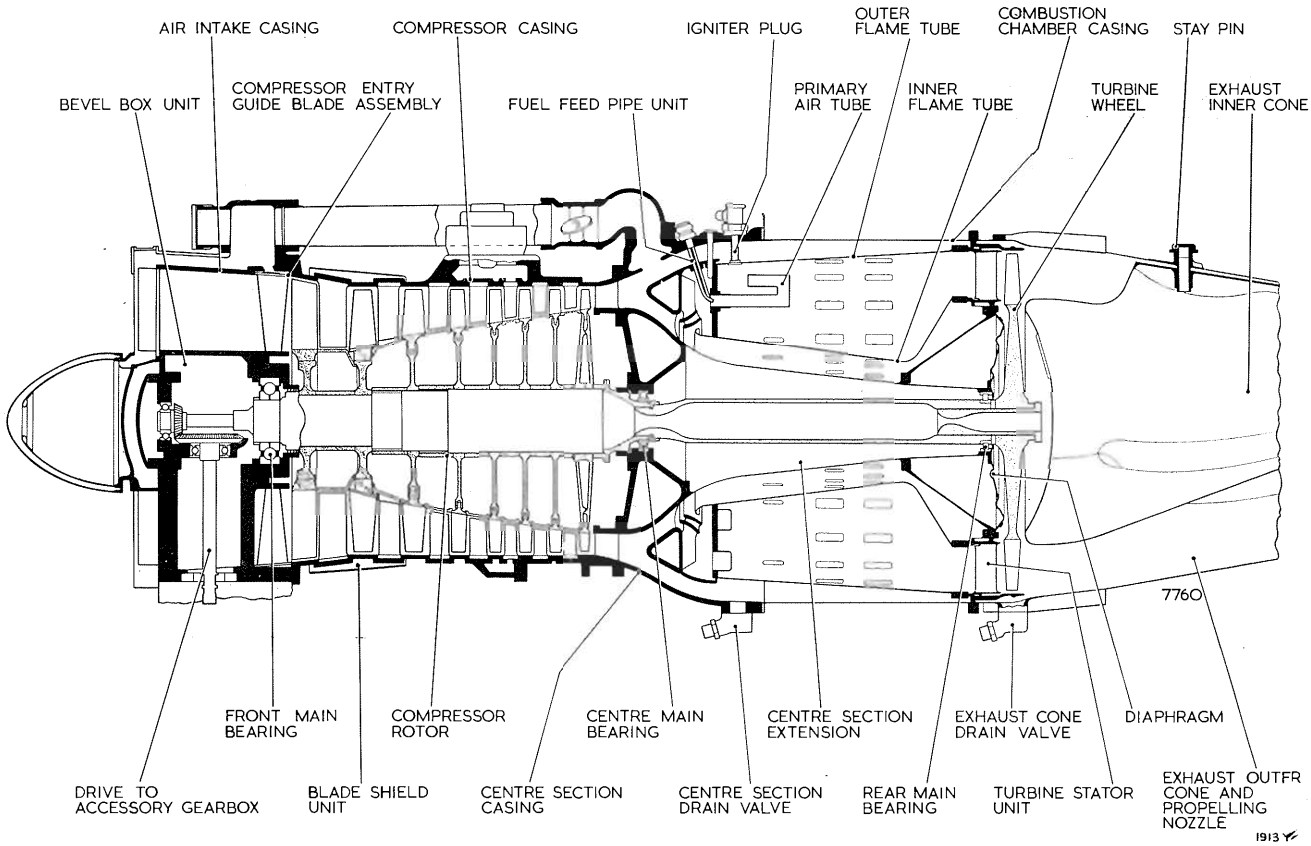
* * *

1. Description and operation

A. General

The Viper (Figs. 1,2 and 3) is a straight-flow turbo-jet with an eight-stage axial compressor, coupled direct to a single-stage impulse/reaction turbine, and an annular combustion chamber. The rotating assembly is mounted in three main bearings; a ball bearing at the front and a roller bearing at the centre and rear.

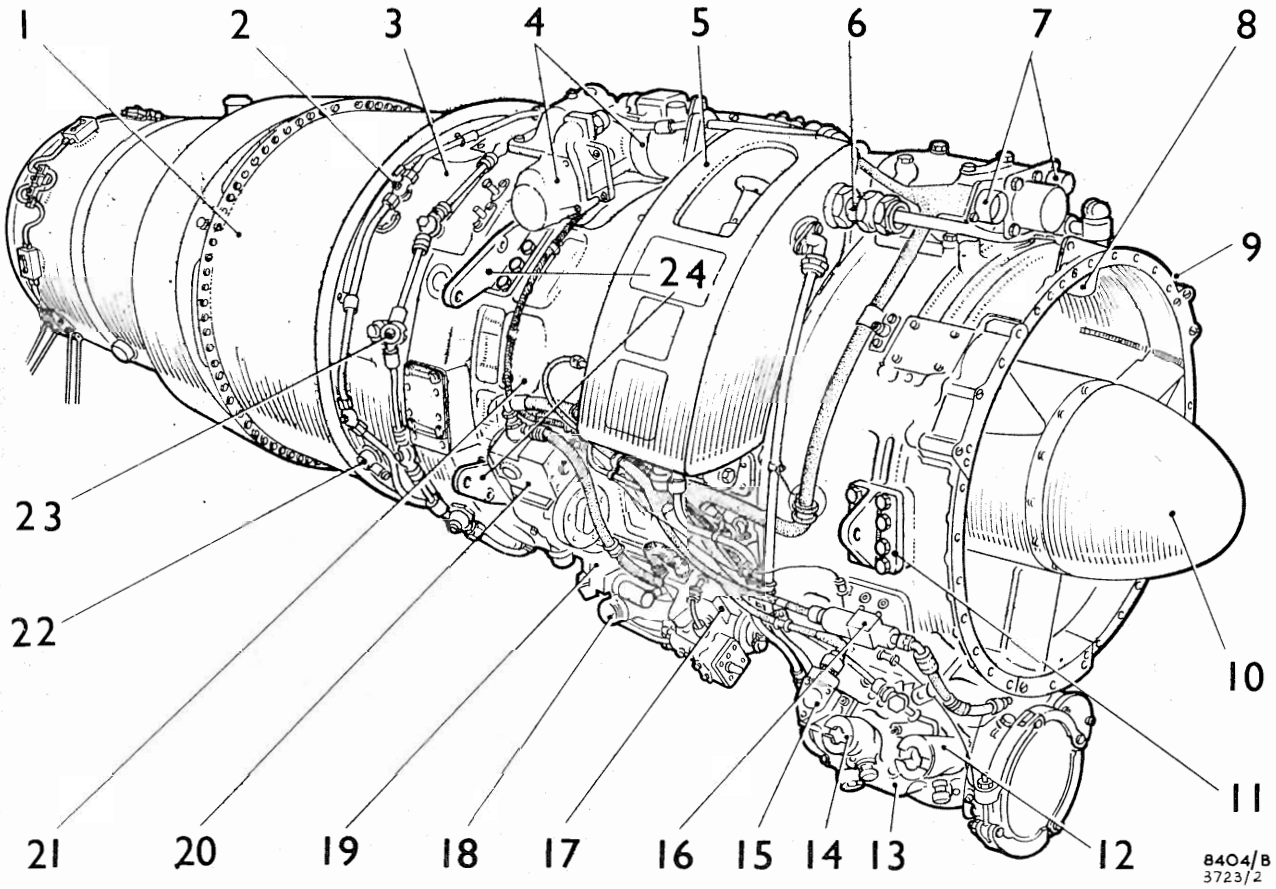
Air flowing into the air intake is directed by entry guide vanes into the compressor where, progressively through each stage, the pressure is increased. When the airflow reaches the centre section, a two stage airflow straightening blade assembly guides the air into the combustion chamber, where fuel is injected.



Sectioned view of engine
Fig. 1

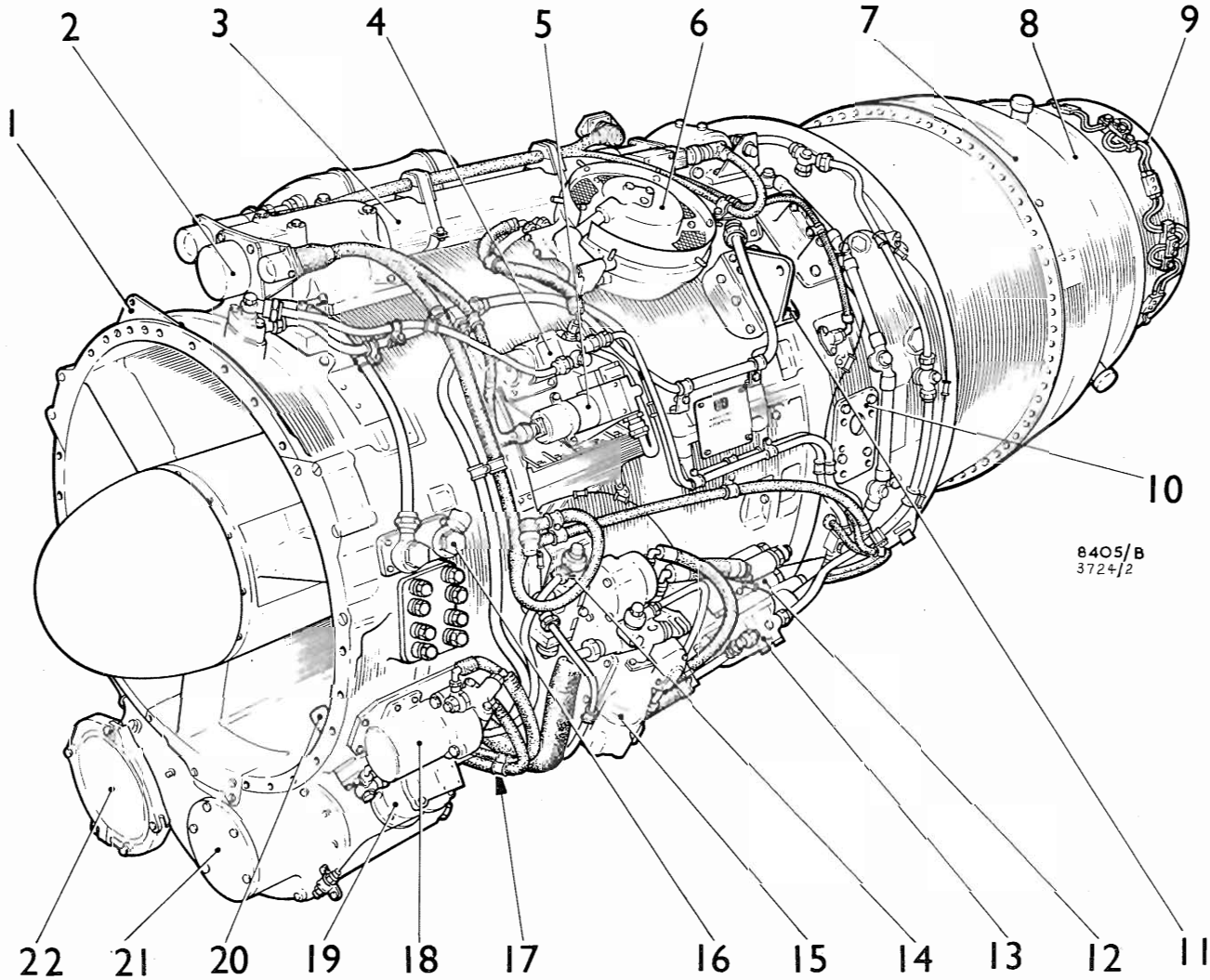
Initially the mixture is ignited by two igniter plugs and the ensuing continuous combustion raises the temperature and velocity of the gas. Immediately downstream of the combustion zone, air is introduced to reduce the gas temperature to a value acceptable to the turbine blades. The turbine wheel is air cooled.

From the combustion chamber the gas flow is expanded through the turbine, with a resultant drop in pressure and temperature. The energy absorbed by the turbine



1. COMBUSTION CHAMBER OUTER CASING.
2. PRIMER UNITS.
3. CENTRE SECTION CASING.
4. ANTI-ICING BUTTERFLY VALVE AND ACTUATOR ASSEMBLY
5. OIL TANK.
6. OIL TANK PRESSURE RELIEF VALVE.
7. ELECTRICAL SERVICES CONNECTIONS.
8. PITOT HEAD SERVING PRESSURE RATIO SWITCH.
9. AIR INTAKE CASING.
10. NOSE BULLET.
11. ENGINE FRONT MOUNTING BRACKET.
12. SCAVENGE OIL FILTER.
13. ACCESSORY GEARBOX.
14. MICROPUMPS FILTER.
15. OIL LOW PRESSURE WARNING SWITCH.
16. OIL PRESSURE TRANSMITTER.
17. AUTOMATIC THRUST LIMITER.
18. FUEL INLET TO LOW PRESSURE FUEL FILTER.
19. FUEL LOW PRESSURE WARNING SWITCH.
20. TOP TEMPERATURE CONTROL UNIT.
21. COMPRESSOR CASING.
22. IGNITOR PLUG.
23. FUEL FEED PIPE UNITS.
24. ENGINE REAR MOUNTING BRACKETS.

¾ Right hand view of engine
Fig. 2



1. ENGINE FRONT LIFTING BRACKET
2. ANTI-ICING AIR SUPPLY ADAPTER (TO POD NOSE COWL).
3. ANTI-ICING AIR DUCT.
4. PRESSURE RATIO SWITCH (COMPRESSOR AIR BLEED CONTROL SYSTEM).
5. SOLENOID VALVE (DATUM RESETTING OF COMPRESSOR AIR BLEED VALVE).
6. COMPRESSOR AIR BLEED VALVE.
7. TURBINE SHIELD.
8. EXHAUST CONE AND PROPELLING NOZZLE ASSEMBLY.
9. THERMOCOUPLE HARNESS.
10. ENGINE MOUNTING TRUNNION HOUSING.
11. ENGINE REAR LIFTING BRACKET.
12. AIR/FUEL RATIO CONTROL.
13. PRIMER SOLENOID VALVE.
14. RATE RESET VALVE.
15. BAROMETRIC FLOW CONTROL UNIT.
16. BREATHER CONNECTION.
17. FUEL PUMP.
18. SYNCHRONIZER CORRECTOR UNIT (LEFT-HAND ENGINE ONLY).
19. TACHOMETER/SYNCHRONIZER A.C. GENERATOR.
20. PITOT HEAD SERVING BAROMETRIC FLOW CONTROL UNIT.
21. HYDRAULIC PUMP LOCATION.
22. A.C. GENERATOR LOCATION.

¾ Left hand view of engine
Fig.3

...Engine - General continued

wheel is utilized to drive the compressor and the accessories. On leaving the turbine, the gas flows through the exhaust cone and is finally discharged to atmosphere, at high velocity, via the propelling nozzle.

For descriptive purposes, the engine is divided into six main sections : Air inlet, Compressor, Combustion, Turbine, Exhaust cone and propelling nozzle and the Accessory drives and gearbox.

B. Air inlet section

The light alloy air intake casing is bolted to the front end of the compressor casing and serves the following purposes :-

Directs the air into the compressor.

Houses the front bearing of the rotating assembly.

Houses a bevel box unit centrally in the casing which transmits the drive from the rotating assembly to an accessory gearbox at the base of the casing.

Embodies the engine breather system.

Accommodates the compressor entry guide blade assembly at its rear.

Provides location for two pitot heads, one providing sensing air (P1) for the pressure ratio switch of the compressor air bleed valve control system, the other providing sensing air to the barometric flow control unit (b.f.c.u.) and the automatic thrust limiter (a.t.l.) of the fuel system.

C. Compressor section

The compressor comprises two major components, the rotor and the casing.

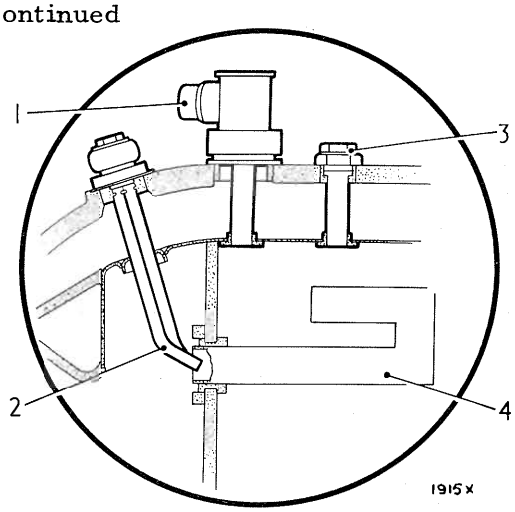
The rotor is mounted in two main bearings and has eight stages, the initial stage being referred to as the 'zero' stage. The zero and first stage rotor blades are steel and their blade roots are of fir-tree form. The remaining six stages are all light alloy, except for the last which is steel, and all are riveted to their respective discs. The bore of the rotating assembly forms part of the compressor bearing seal pressurizing and turbine cooling bleed air systems (Chapter 75). Internal serrations at the front of the rotor receive a quill shaft to engage and drive the bevel box unit in the air intake casing. Serrations at the rear of the rotor are engaged by the turbine mainshaft serrations, thus transmitting the drive.

The compressor casing consists of two half-sections, bolted together at their axial joint flanges. The stator blades are retained in carrier ring halves which locate in the casing grooves. Two separate blade shield units encircle the casing at the location of the first two stages. An annular chamber in the casing is linked to the compressor fourth stage by a series of radial ports, the outlet from the chamber being controlled by an air bleed valve (Chapter 75).

D. Combustion section

There are four major components in this section : the centre section casing, combustion chamber casing and concentrically-mounted inner and outer flame tubes (Fig. 1).

...Engine - General continued



1. Igniter plug
2. Fuel feed pipe unit
3. Primer unit
4. Primary air tube

Scrap section detail of centre section/combustion chamber
Fig. 4

The centre section is bolted to the rear of the compressor casing, has a rearward extension and serves the following purposes :-

Directs the air from the compressor into the combustion chamber, through a two stage airflow straightening blade assembly. This blade assembly is bolted to the front face of the centre section, and forms the final stage of stator blades.

Houses the centre and rear main bearings of the rotating assembly. The rear bearing is housed in the rearward extension.

Provides locations for the primer units of the starting fuel system, the fuel feed pipe units (burners) of the main system and the igniter plugs, together with the engine mounting trunnion housings (Chapter 71).

Incorporates an integral annular chamber which is in direct communication with the compressor delivery air and provides connections to the engine anti-icing and compressor air bleed control systems (Chapter 75), engine fuel system units, (Chapter 73) and the Aircraft services.

A spring-loaded poppet-type drain valve is secured to the base of the casing and carries an overboard drain pipe.

Secured to the rear of the centre section, the combustion chamber casing encloses the inner and outer flame tubes and provides the mounting for the turbine stator unit and the exhaust cone at its rear. At their front ends, the flame tubes are secured to an air tube support plate which incorporates primary and secondary air tubes, the plate being retained within the centre section. Deeply-grooved flanges at the rear end of the flame tubes engage support rings in the turbine assembly, thus permitting axial expansion of the tubes.

...Engine - General continued

E. Turbine section

Bolted between the combustion chamber outer casing and the exhaust cone, the turbine stator unit has a rearward extension that provides the turbine wheel shroud. The stator inner ring is bolted to a conical support secured to a flange on the centre section extension. The forward end of the turbine chamber is closed by a diaphragm attached to the rear of the centre section and the stator inner ring.

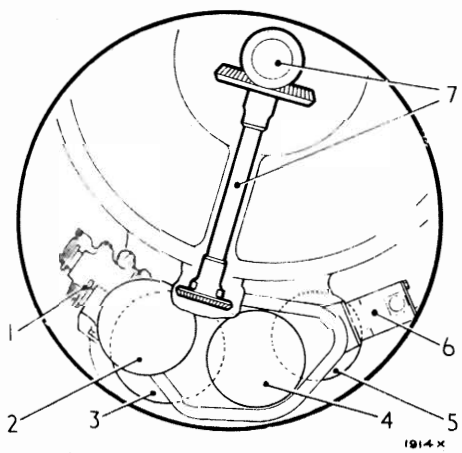
A hollow clamp bolt secures the turbine wheel to the radial serrations at the rear end of the mainshaft, the shaft being mounted in the rear main bearing and extending forward to engage the compressor rotor. The turbine wheel unit incorporates a damper wire, divided into five segments, which passes through each turbine blade at 80% blade height.

F. Exhaust cone and propelling nozzle

Bolted to the rear of the turbine stator ring, the exhaust cone and its integral propelling nozzle has an inner cone secured to it by three radial staypins that locate in housings in the outer cone and in the vanes of the inner cone. The pins are retained by capnuts. A spring-loaded drain valve is housed at the lower forward end; in addition, the outer casing is encircled at this location by a turbine shield. Provision is made in the exhaust cone for the installation of exhaust temperature thermocouples and a power loss pitot (Chapter 77). The complete assembly is made interchangeable for left or right-hand installation; any such change requires the drain valve to be moved to its alternative position.

G. Accessory drives and gearbox

The drives for all engine accessories are housed in the accessory gearbox mounted on the bottom of the intake casing. The drive is transmitted from the bevel box unit in the air intake casing to the gearbox through a radial drive shaft. The gearbox provides mountings and/or drives for the following accessories as shown on Fig.5 (looking from the front).



1. Oil pump.
2. AC generator.
   (front face R.H. engine only).
3. Starter/generator
   (rear face).
4. Hydraulic pump
   (front face).
5. Fuel pump (rear face).
6. Tachometer/synchronizer generator.
7. Drive to accessory gearbox.

Detail of drive to accessories
Fig.5

...Engine - General continued

The gearbox incorporates oil drain, level and filler plugs and a connection for the pipe to the oil pressure transmitter.

2. Data

Type of engine	Viper Mk. 522
Engine mounting system	See Chapter 71
Dimensions	
Length, air intake front flange to final nozzle centre line	85.050 in. nominal
Maximum width (at engine horizontal centre line)	28.200 in.
Maximum height (at engine vertical centre line	32.850 in.
Centre of gravity	
Left-hand engine	2.600 in. forward of trunnion housing.
Right-hand engine	2.300 in. forward of trunnion housing.
Weight	
Left-hand engine E.C.U.	816 lb.
Right-hand engine E.C.U.	806 lb.

NOTE : These weights are quoted as a guide only to ensure the use of safe lifting tackle and will not be subject to regular amendment action.

Exhaust system	
Nozzle	13.64 to 13.70 in. dia.

* * *

ENGINE GENERAL - SERVICING

1. Unit servicing

NOTE: Reference to the left or right hand side of an engine is as viewed from the rear.

Special tools and equipment

Torque wrench .. .. .. PE.25492 or T2EM1987BR

NOTE: These procedures detail the method of changing a left-hand e.c.u. to a right-hand and vice versa. It is assumed that the e.c.u. is mounted in a transit stand.

A. Change 'left-hand' e.c.u. to 'right-hand'

(1) Remove and reposition exhaust cone, and its drain valve, and exhaust nozzle trimmers (see 401 page block).

(2) Reposition the power loss pitot (see para. 1C).

(3) Mod.CV7135 - Reposition exhaust cone static pressure pipe; see para.1D.

(4) Mod.CV7284 engines - Reposition thermocouple harness (see Chapter 77, ENGINE INDICATING).

(5) Reposition the engine mounting brackets and the rear lifting bracket (see Chapter 71, MOUNTS).

(6) Remove the synchronizer corrector unit, transpose the fuel inlet union body and reposition e.c.u. and engine name plates. (See Chapter 73, ENGINE FUEL AND CONTROL).

(7) Release the serrated ring nut on both igniter plugs and position the plugs with their connections facing as follows:-

Right-hand plug - vertically downward from the engine horizontal line.

Left-hand plug - 5^{o} forward and down from the engine horizontal line.

Torque-tighten the serrated ring nuts to 240 to 260 lb.in. (see Chapter 80).

B. Change 'right-hand' e.c.u. to 'left-hand'

(1) Remove and reposition exhaust cone and drain valve and exhaust nozzle trimmers (see 401 page block).

(2) Reposition the power loss pitot (see para. 1C).

...Engine general - Servicing continued

(3) Mod.CV7135 - Reposition exhaust cone static pressure pipe; see para.1D.

(4) Mod.CV7284 engines - Reposition thermocouple harness (see ENGINE INDICATING - MAINTENANCE PRACTICES Chapter 77).

(5) Reposition the engine mounting brackets and the rear lifting bracket. (see Chapter 71, MOUNTS).

(6) Install the synchronizer corrector unit, transpose the fuel inlet union body and reposition e.c.u. and engine name plates (see Chapter 73, ENGINE FUEL AND CONTROL).

(7) Release the serrated ring nut on both igniter plugs and position the plugs with their connections facing as follows:-

Right-hand plug - 45^{o} forward and down from the engine horizontal line.

Left-hand plug - 60^{o} forward and down from the engine horizontal line.

Torque tighten the serrated ring nuts to 240 to 260 lb.in.

C. Reposition the power loss pitot connection

(1) Remove the power loss pitot and its elbow from the exhaust cone; discard seal.

(2) Remove the blanking plate from the alternative pitot mounting position; discard seal.

(3) Lubricate the pitot and blanking plate retaining bolt threads (see Chapter 71 SERVICING MATERIALS).

(4) Fit the power loss pitot, a new seal and the elbow, to the exhaust cone and secure with the bolts.

(5) Fit the blanking plate and a new seal, to the alternative pitot position on the exhaust cone, and secure with the bolts.

(6) Torque tighten both sets of retaining bolts to 60-70 lb.in.

(7) Wire-lock bolt heads together.

D. Reposition exhaust cone static pressure pipes (Mod.CV7135)

NOTE: This procedure is necessary when the 'handing' of the exhaust cone has been changed.

(1) Slacken the union nut at each pipe connection (Fig.301).

...Engine general - Servicing continued

(2) Remove the banjo pivot bolts from the pipe units.

(3) Remove the bolts and tabwashers securing the pipe clips to the exhaust cone.

(4) Separate and remove the sections of the pipe assembly.

(5) Remove the banjos.

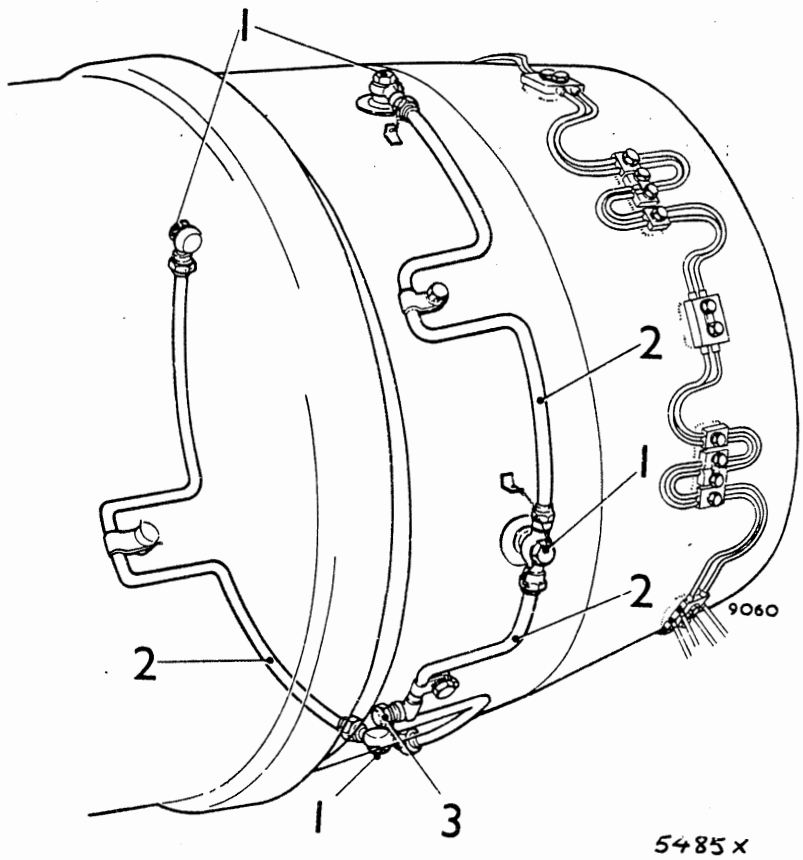
(6) Commence installing the pipes at the twelve o'clock position on left-hand engines and at the three o'clock position on right-hand engines.

(7) Install the banjo pivot bolts together with their banjos and new sealing washers. Do not tighten the pivot bolts at this stage.

(8) Connect the pipes to their respective banjos.

NOTE: On a left-hand engine the take-off banjo is at the four o'clock position and at eight o'clock for the right-hand engine.

(9) Tighten the pivot bolts, wire-lock all connections and secure all support clips.



1. BANJO PIVOT BOLTS
2. STATIC PRESSURE PIPE UNIT
3. TAKE-OFF UNION

Static pressure pipe details
Fig.301

* * *

ENGINE GENERAL - REMOVAL/INSTALLATION

1. Removal/Installation exhaust cone

Special tools and equipment

Torque wrench	PE.25492 or T2 EM1987BR
Socket (special)	T2 BJ1326SN
Socket	PE.8653
Extension	T2 EC3022SN

A. Remove exhaust cone

(1) Release and remove the drain valve setbolts then lift the valve away from the exhaust cone. Discard the seal washer.

(2) Remove the stiffnuts and bolts securing the turbine shield support brackets to the engine. Withdraw the shield rearward.

(3) Support the exhaust cone and remove the securing stiffnuts and bolts. Lift away the cone and transfer it to a bench. Take care not to damage the mounting face.

CAUTION : DO NOT REMOVE THE STIFFNUTS FROM THE FOUR COUNTERSUNK SCREW LOCATIONS; THESE RETAIN THE TURBINE OUTER CASING.

(4) If the 'handing' of exhaust cone is being changed:-
(a) Remove blank from alternative drain valve position; discard seal.
(b) Fit blank to alternative position: fit a new seal.
(c) Torque tighten set bolts to 60-70 lb. in.
(d) Wire lock set bolts to each other.

(5) Protect the turbine wheel with a suitable cover.

(6) Clean jointing compound from the exhaust cone and turbine outer casing joint faces with warm water. Dry with compressed air.

B. Install exhaust cone

(1) Apply a thin coating of grease (see Chapter 71, SERVICING MATERIALS) to the exhaust cone and turbine shield retaining bolt threads.

(2) Apply a thin film of jointing compound (see Chapter 71, SERVICING MATERIALS) to the exhaust cone and turbine stator casing joint faces.

NOTE : Compound must not obstruct air holes between turbine stator casing flange and ring.

(3) Fit the exhaust cone to the engine (drain valve location at the bottom) and secure with four bolts and stiffnuts.

(4) Offer the turbine shield into position, locating it by the drain valve aperture.

(5) Mark on the exhaust cone the positions of the turbine shield support brackets retaining bolt locations; use tailors chalk.

(6) Remove the turbine shield.

...Engine general - Removal/Installation continued

(7) Coat the shanks of six of the exhaust cone attachment bolts with jointing compound (see Chapter 71, SERVICING MATERIALS).

(8) Fit the remaining exhaust cone securing bolts and stiffnuts except at the marked locations and torque tighten at 80 to 90 lbf/in.

NOTE : The coated bolts are to be fitted in the six lower positions.

(9) Position the turbine shield and install the bracket securing bolts and stiffnuts.

(10) Torque tighten all the stiffnuts to 80 to 90 lb. in.

(11) Mod. CV7197 engines only, check that a clearance of at least 0.180 in. exists between the rear end of the turbine shield and the exhaust cone.

(12) Fit a new seal washer and the drain valve on the exhaust cone, arranging the valve with its outlet union facing away from the direction of the exhaust nozzle offset.

(13) Lubricate the setbolt threads with graphite grease (see Chapter 71, SERVICING MATERIALS).

(14) Fit the bolts; fit the bolt equipped with a wire-locking tab to the front position adjacent to the outlet union.

(15) Torque-tighten the drain valve setbolts to 60 to 70 lb. in.

(16) Wire-lock the setbolts to each other.

(17) Check that the following exhaust attached components are correctly handed (see 301 page block).

(a) Mod.CV7284 - Thermo-couple harness (see Chapter 77, ENGINE INDICATING).
(b) Power loss pitot.
(c) Mod.CV7135 - Exhaust cone static pressure pipe.

(18) Reposition exhaust cone nozzle trimmers and/or trim exhaust nozzle as necessary (see paras.1C and 1D).

(19) Ground run the engine to check performance at 100% rev/min. (see Fig.502, Chapter 71-00).

C. Reposition exhaust cone nozzle trimmers

(1) Release the tabwashers and remove the trimmers and, if fitted, blanking bolts.

(2) Lubricate (see Chapter 71 SERVICING MATERIALS) the trimmer bolt and blanking bolt threads; install new tabwashers on the bolt.

(3) Install the trimmers (Fig.401).

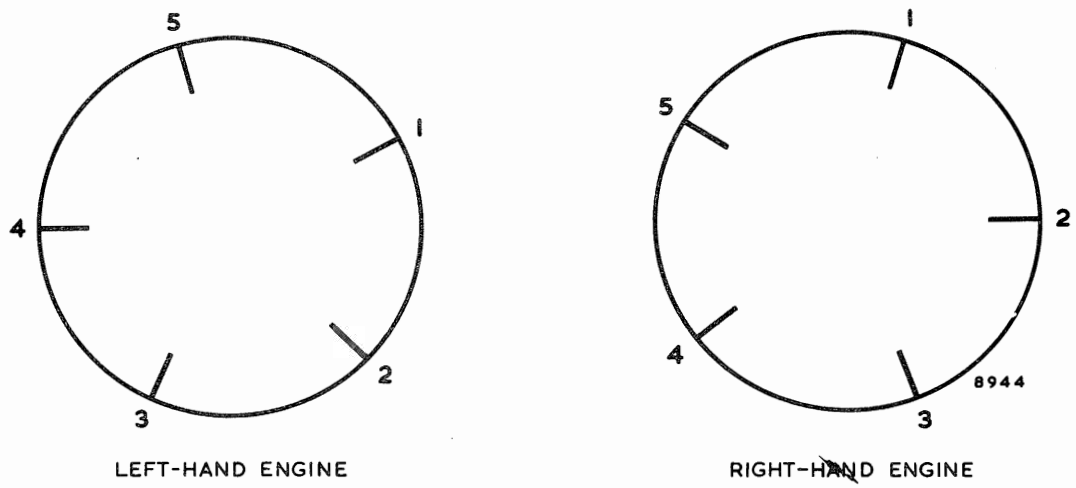
CAUTION: ENSURE THAT THE TRIMMERS AND TRIMMER GUIDES ARE NOT DISTORTED.

(4) Install the blanking bolts in unused trimmer locations.

...Engine general - Removal/Installation continued

(5) Torque-tighten the trimmer and blanking bolts to 80 to 90 lb.in.

(6) Ground run the engine to check performance at 100% rev/min (see Fig.502, Chapter 71-00).



Position of exhaust cone nozzle trimmers
Fig.401

D. Trim exhaust nozzle

NOTE: When an exhaust cone is changed it is necessary to ensure that the new exhaust cone is trimmed to the same effective nozzle diameter as the removed exhaust cone. If a change of engine hand is being carried out, only repositioning of the trimmers is necessary (see para.1C).

(1) Measure the nozzle diameter of the removed exhaust cone at five equally spaced positions and calculate the mean nozzle diameter by averaging the five dimensions.

(2) Ascertain the size and number of trimmers fitted and reduce the recorded nozzle mean diameter by the amount of trim:-

V.25299 - Large trimmer = 0.078 in.
V.25296 - Medium trimmer = 0.047 in.
V.25315 - Small trimmer = 0.031 in.

EXAMPLE: Trimmers fitted are:-

...Engine general - Removal/Installation continued

1 x V.25299	=	0.078 in.
1 x V.25296	=	0.047 in.
1 x V.25315	=	0.031 in.
Total	=	0.156 in.

The nozzle mean diameter is reduced by 0.156 in.

(3) Measure the nozzle diameter of the new exhaust cone at five equally spaced positions and calculate the mean nozzle diameter by averaging the five dimensions.

(4) Install trimmers in the nozzle of the new exhaust cone as required to obtain a nozzle mean diameter equivalent to the removed exhaust cone with trimmers fitted.

EXAMPLE:

Removed cone mean diameter	=	13.660 in.
Trimmer fitted - 1 x V.25299	=	0.078 in.
Diameter required on new exhaust cone	=	13.582 in.

New cone mean diameter	=	13.691 in.
Diameter required	=	13.582 in.
Trimmers required	=	0.109 in.

i.e. 1 x V.25299 - 0.078 in.
1 x V.25315 - 0.031 in.

= 0.109 in.

NOTE: Trimmers should be installed as detailed in Fig.401 of this Chapter. Ensure that the trimmer guides are not distorted or standing proud, dress as necessary to correct the contour.

(5) Where it is not possible to obtain an identical nozzle mean diameter on the new exhaust cone, the nozzle should be trimmed to a smaller rather than a larger mean diameter.

NOTE: This may increase j.p.t. slightly, but will ensure that engine thrust is maintained.

(6) Ground run the engine as detailed in Chapter 71-00 ADJUSTMENT/TEST, Ground Running Tests, para.4B. Record ambient temperature, engine r.p.m. and j.p.t. and forward the information to the Service Department of Rolls-Royce Limited.

...Engine general - Removal/Installation continued

2. Removal/Installation exhaust inner cone unit

Special tools and equipment

Extractor	PE 16099
Spanner	PE 8662
Lubricant	Felpro C5A or Floiac G.576

A. Remove exhaust inner cone unit

(1) Remove exhaust cone (para.1.A.).

(2) Release the locking wire and remove the three stay pin retaining capnuts.

(3) Remove the three stay pins using extractor.

(4) Withdraw the inner cone unit from the outer casing.

(5) Clean the inner cone stay pin bores and surrounding areas.

(6) Examine the stay pins and stay pin bores for damage and/or corrosion then check to ensure the stay pins slide freely in the bores.

(7) Ensure the stay pins retaining capnuts are a good fit on their respective bosses.

B. Install exhaust inner cone unit

(1) Position the inner cone unit within the outer casing.

(2) Lubricate the stay pins and locate them through the outer casing steady bearings to engage the inner cone bosses.

(3) Ensure that each pin is free in its location with the remaining two pins in position.

(4) Lubricate the stay pin capnut threads then install and tighten the capnuts.

(5) Wire-lock the capnuts to the lugs on the steady bearing bosses.

* * *

ENGINE - ADJUSTMENT/TEST

1. Test engine RPM and JPT

Special tools and equipment :

Test set (complete with r.p.m. and j.p.t. cables)	..	ES.1201
Test set (r.p.m. and j.p.t. monitor kit) ..	..	ES.1292 or ES.1295

The monitor kits are comprised of the following items :-

JPT signal cable	..	ES.1252 and ES.1253
RPM signal cable	..	ES.1256 or ES.1257

A. General

This equipment is approved for carrying out the ground run performance check for engine life extension as detailed in Service Bulletin 72-1. It can also be used for checking the correct operation of the 'Top Temperature Control System' and will provide a means of checking the r.p.m. and j.p.t. instruments.

Test set ES.1201 may also be used to indicate engine exhaust (P4) pressure by means of the power loss indicating system.

NOTE : The test set should be placed inside the aircraft in a safe place to avoid damage. This is normally in the front luggage compartment.

B. Connecting the test set signal cables

(1) Connect the long j.p.t. signal cable ES.1252 to the t.t.c. amplifier test socket in the rear equipment bay.

NOTE : Route the cable to the entrance door ensuring that the cable is not in a position to be ingested by the engine.

(2) Connect the free end of the cable to the test set.

NOTE : If the t.t.c. amplifier test socket is not available, join the plugs of the two cables ES.1252 and ES.1253 and attach the leads of cable ES.1253 to the t.t.c. amplifier or spare terminal block in the aircraft fillet.

CAUTION : ENSURE THAT THE ORDER OF STACKING THE LEADS AT THE TERMINAL BLOCK IS MAINTAINED AND THAT ONLY THE CORRECT SPACER WASHERS ARE USED.

(3) Remove the aircraft r.p.m. gauge and disconnect the input cable. Connect the appropriate end of the r.p.m. signal cable ES.1256 or ES.1257 to the aircraft r.p.m. gauge input cable connector. Connect the two remaining ends of the cable, one end to the aircraft r.p.m. gauge the other end to the test set.

...Engine - Adjustment/Test continued

(4) If test set ES.1201 is being used, P4 pressure should be recorded. To achieve this remove the blank from the power loss indication system pipe, which is situated in the nosewheel bay.

CAUTION : THE P4 READINGS WILL BE AFFECTED BY ANY MOISTURE IN THE POWER LOSS SYSTEM. THE ENGINE SHOULD THEREFORE BE RUN AT HIGH POWER FOR SEVERAL MINUTES TO DRY OUT THE SYSTEM BEFORE CONNECTING TO THE TEST SET.

(5) Connect the test set ES.1201 neoprene tubing to the power loss pipe connection and the test set.

(6) If test set ES.1201 is being used, it will be necessary to connect the set to the aircraft 28V. electrical supply. To achieve this, remove one of the storm light bulbs and connect the test set supply cable.

CAUTION : WHEN USING THE AIRCRAFT ELECTRICAL SUPPLY, THE TEST SET SWITCH SHOULD BE SELECTED OFF DURING ENGINE START, AS DAMAGE TO THE TEST SET COULD OCCUR DUE TO FLUCTUATING VOLTAGE.

(7) If test set ES.1292 or ES.1295 is being used, no aircraft electrical supply is required as they are battery powered.

NOTE : Ensure that the test set to be used is serviceable, refer to the appropriate instruction manual which should accompany the set.

(8) Test run the engine as required :

NOTE : It is essential that 115V. inverter supplies are available at the t.t.c. amplifiers, by switching on the aircraft inverter during the engine ground run. Failure to do this will result in erroneous j.p.t. indications.

(9) When the tests are completed, disconnect the j.p.t. and r.p.m. signal cables, and if applicable the P4 neoprene tubing. Then restore and secure all electrical connections and pipe connections.

* * *

ENGINE GENERAL - INSPECTION/CHECK

1. Inspection/Check

A. Acceptance Standard for damaged rigid pipes associated with the engine

(1) Reject any pipe having an abrasion resulting in sharp edges, or where loss of material has occurred.

(2) Reject any pipes having dents exceeding 0.0250 in. in depth on straight sections or exceeding 0.0150 in. in depth on bends.

(3) Reject any pipe if a dent is less than 0.250 in. from a weld.

B. Inspect exhaust cone for cracked vanes

Cracking is usually confined to the end (face) of the bullet vanes in the area adjacent to the pin stay bore. If a crack is found which is progressing radially inwards on the concave side of the bullet vane apply the following standard.

One crack per vane (on the concave side only) is permitted provided it does not exceed 0.375 inches in length.

Regular checks should be carried out where cracks are known to exist to ensure they do not progress beyond the limit.

* * *

ENGINE - CLEANING/PAINTING

1. Cleaning

A. Clean engine after contamination with foam extinguishant

NOTE : Foam extinguishant will corrode various parts of the engine. Minimise damage to the installation by promptly removing the foam before it has solidified. Foam that is not removed forms a cream coloured sludge or crust on hot surfaces.

CAUTION : IT IS VITAL THAT THE ENGINE IS CLEANED AS SOON AS POSSIBLE AFTER CONTAMINATION.

(1) Quickly scrape out any foam from the engine intake and exhaust system.

(2) Remove all traces of foam by washing the engine, externally and/or internally as necessary, with copious quantities of clean water.

(3) Spray a solution of equal parts of ammonia and water into air intake and over affected areas.

NOTE : To enhance penetration rotate the engine main shaft during this operation.

WARNING : OBSERVE PRECAUTIONS ASSOCIATED WITH ALKALI SOLUTIONS.

(4) Flush engine with clean (preferably distilled) water.

(5) Dry the engine thoroughly with warm air; motor engine if possible.

(6) Examine the installation for defective protective surfaces and other damage; repair as necessary.

(7) Spray engine with a de-watering fluid, if available.

(8) Return engine for overhaul, immediately after it has been cleaned. Mark documents "Foam contaminated engine".

B. Clean engine after contamination with B.F.C. or methyl bromide on ground.

NOTE : No special cleansing is required after airborne use of extinguishers.

(1) Within an hour of operation of fire extinguishers, open all cowlings to ventilate bay.

(2) Wipe off extinguishant, where possible.

WARNING : DO NOT INHALE EXTINGUISHANT

(3) Dry engine with clean, dry compressed air.

* * *

LUBRICATION SYSTEM - DESCRIPTION AND OPERATION

1. General

The entire lubrication system forms an integral part of the engine; there are no oil coolers or oil cocks. Rigid steel external pipes are used throughout, except for a single flexible pipe to the oil pressure transmitter. The main oil pump unit embodies separate gear-type pressure and scavenge pumps and provides a mounting for two plunger-type micro pumps. The system comprises three principal circuits : the pressure circuit, the metered circuit and the scavenge circuit. The breather system is described in conjunction with the scavenge circuit.

2. The pressure circuit

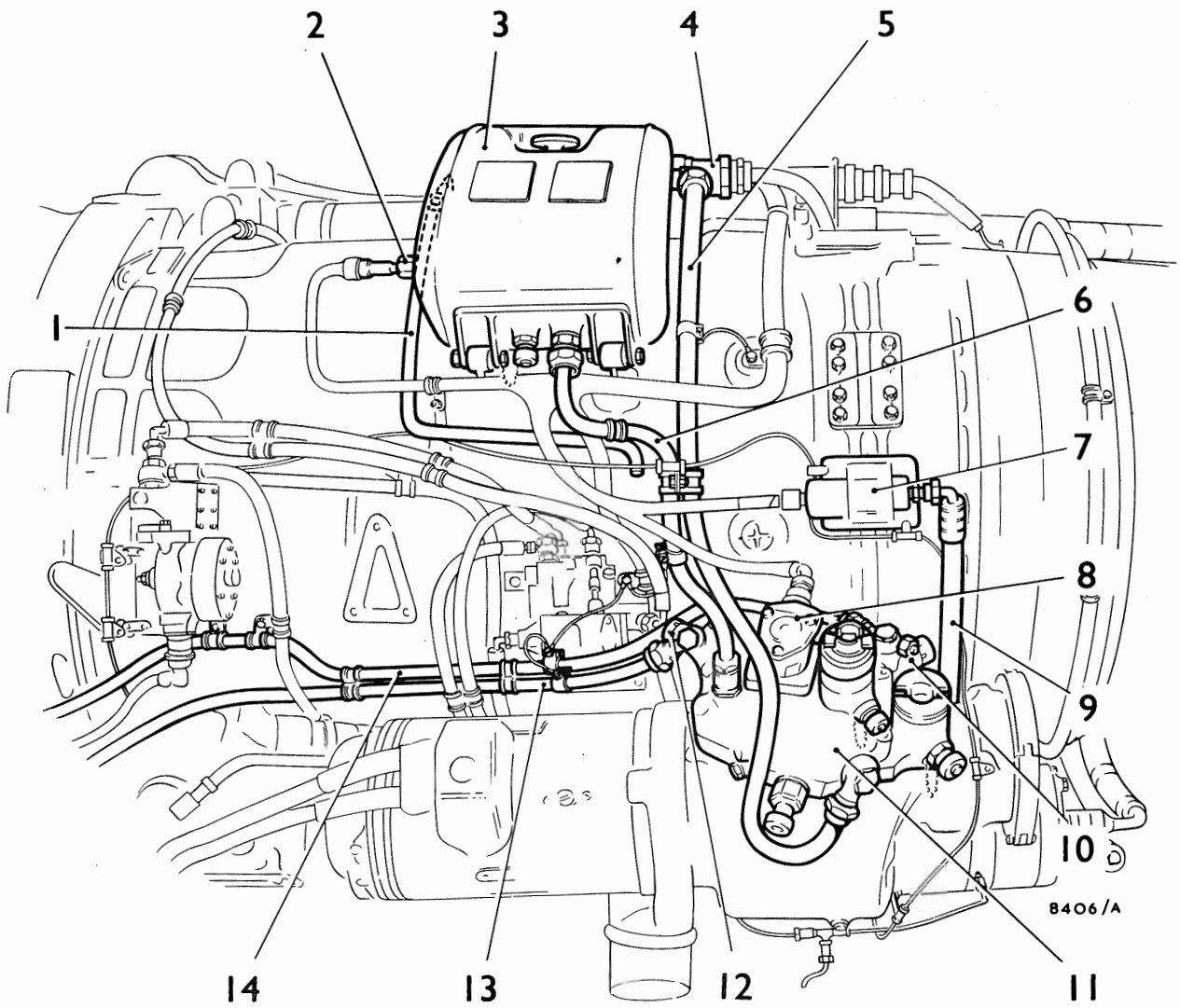
The pressure pump draws oil from the tank, through a fixed screen, and discharges it, via a static sealing valve, a gauze element pressure filter and past a relief valve to the air intake casing and also to the two micro pumps. When the engine is stationary the static sealing valve closes and prevents oil seeping back into the engine. Part of the excess oil flow, which the relief valve by-passes back to the accessory gearbox, is bled off to lubricate the pump-driven intermediate gear, and the driving and transfer pinions. The pressure flow to the air intake casing lubricates the front main bearing, the bevel box unit, the accessory gearbox and also supplies the oil pressure transmitter. Pressure oil is ducted from the outlet of the pressure filter, via the intermediate gear and pump cover, to the oil low pressure warning switch. Oil draining from the air intake casing is returned to the tank by the scavenge system.

3. The metered circuit

Part of the pressure oil flow is ducted through a felt element micro filter to the micro pumps; each pump delivers a metered flow of oil to its respective centre or rear main bearing. After passing through the bearings, metered oil is discharged to atmosphere via the exhaust gas stream. An intermediate gear, which transfers the drive from the scavenge pump to the pressure pump, has an integral cam which provides the drive for the micro pumps.

4. The scavenge circuit

Drain oil from the front main bearing and bevel box unit flows into the accessory gearbox and then is drawn through the gauze element scavenge filter to the scavenge pump, which returns it to the oil tank. The tank is vented to the air intake casing but, to ensure a positive feed to the pressure pump - regardless of altitude - a pressure limiting relief valve is interposed between the tank and the vent pipe. The air intake casing is vented to atmosphere by a breather pipe (see Drains System, Chapter 71). The oil tank filler neck has an overflow drain which, on replenishment, prevents oil accumulating within the cowlings. The filler cap incorporates a dip-stick, and an oil temperature bulb is fitted to the tank.



1. OIL TANK FILLER DRAIN PIPE
2. OIL TEMPERATE THERMOMETER BULB
3. OIL TANK
4. TANK RELIEF VALVE (PRESSURE MAINTAINING VALVE)
5. SCAVENGE OIL RETURN PIPE
6. OIL SUPPLY PIPE TO OIL PUMP
7. OIL PRESSURE TRANSMITTER
8. OIL LOW PRESSURE WARNING SWITCH
9. OIL PRESSURE TRANSMITTER SUPPLY PIPE
10. MICRO PUMP (SUPPLYING REAR MAIN BEARING)
11. OIL PUMP UNIT
12. MICRO PUMP (SUPPLYING CENTRE MAIN BEARING)
13. CENTRE MAIN BEARING OIL FEED PIPE
14. REAR MAIN BEARING OIL FEED

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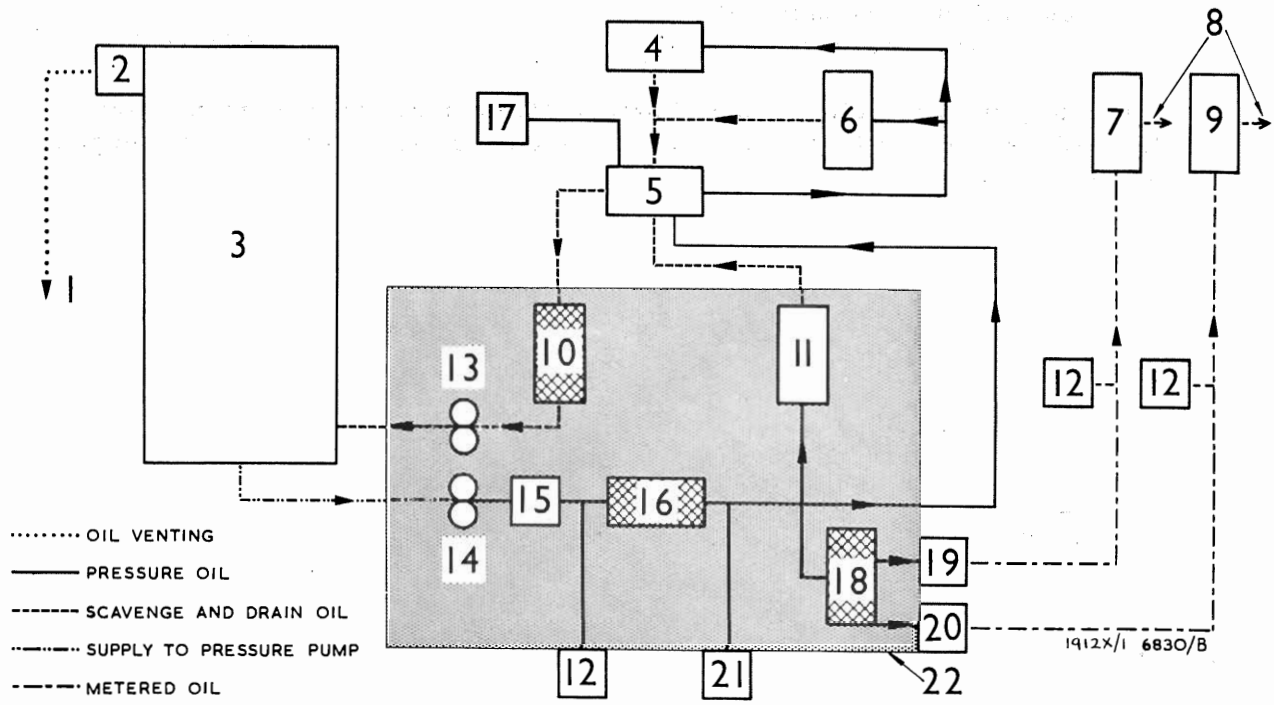
Lubrication system external components and pipelines
Fig. 1



1. Oil tank vent
2. Tank relief valve
3. Oil tank
4. Bevel box unit
5. Accessory drives gearbox
6. Front main bearing
7. Centre main bearing
8. Total loss to exhaust gas efflux
9. Rear main bearing
10. Scavenge oil filter
11. Relief valve
12. Priming connections
13. Scavenge pump
14. Pressure pump
15. Static sealing valve
16. Pressure oil filter
17. Pressure transmitter
18. Micro filter
19. Centre main bearing micro pump
20. Rear main bearing micro pump
21. Oil low-pressure warning switch
22. Oil pump unit.

Schematic diagram of lubrication system
Fig. 2

... Lubrication system - Description and operation continued

5. Data

Tank capacity (including air space)	....	15 pints (Imperial)
Air space	....	4 pints
Maximum consumable oil	....	7 pints (Imperial)
Tank relief valve blow-off and reseat pressure	....	3 lb/sq.in.

Refer to Operating Limitations (Chapter 71) for temperature and pressure limitations. Refer to (Chapter 12) for details of permissible oil consumption and approved oils

* * *

LUBRICATION SYSTEM - TROUBLE SHOOTING

INDICATOR REGISTERS NO OIL PRESSURE AND OIL LP WARNING LIGHT ON

Check oil tank contents adequate, oil system for leaks

- Not OK. Rectify any leaks, Replenish oil system (See SERVICING ENGINE OIL, Chapter 12) Prime oil system (See LUBRICATION SYSTEM, Chapter 72)
- OK. Service oil pressure and scavenge filters (See LUBRICATION SYSTEM, Chapter 72)

Not OK. No oil pressure. Disconnect flexible hose to oil pressure transmitter, complete dry motoring cycle and check for oil flow from hose.

- Not OK. Remove MAIN OIL PUMP (See Chapter 72) and check drive from accessory gearbox
- OK. Service pressure relief valve (See LUBRICATION SYSTEM, Chapter 72)

- Not OK. Change accessory gearbox (See ACCESSORY DRIVES, Chapter 72)
- OK. Change MAIN OIL PUMP assembly (See Chapter 72)

... Lubrication system - Trouble shooting continued

LOW OIL PRESSURE INDICATED

Check the oil tank contents and oil for aeration, flow to pump and general condition.

- OK. Check engine indicating and examine the pipe to the transmitter for security of connections
  - OK. Disconnect the pipe from the transmitter and fit a slave pressure gauge to the pipe
    - Not OK. Service pressure and scavenge filters. (See Chapter 72 LUBRICATION SYSTEM)
      - Service the pressure relief valve (See Chapter 72 LUBRICATION SYSTEM)
        - Relief valve satisfactory, remove MAIN OIL PUMP (See Chapter 72) and check the drive
          - Drive OK. Change the main oil pump.
            - Still not OK. Reject the engine for investigation.
          - Drive not OK. Change the ACCESSORY GEARBOX (See Chapter 72)
    - OK. Change defective oil TRANSMITTER and/or oil pressure INDICATOR (See Chapter 79) then re-check
- Not OK. Check the oil tank relief valve
  - Not OK. Change TANK RELIEF VALVE (See Chapter 72)
- Not OK. Check the system for leaks and rectify as necessary. Check the scavenge pump filter then top up the oil tank as necessary

... Lubrication system - Trouble shooting continued

HIGH OR FLUCTUATING OIL PRESSURE

Check oil condition, specification, level and oil tank relief valve

OK. Check engine oil pressure using slave gauge

Not OK. Rectify as necessary

Not OK. Service oil pressure and scavenge filters. (See Chapter 72 LUBRICATION SYSTEM)

OK. Rectify indicating system as necessary

Not OK. Service oil pressure relief valve assembly. (See Chapter 72 LUBRICATION SYSTEM)

Not OK. Change relief valve assembly

Not OK. Change the MAIN OIL PUMP assembly. (See Chapter 72)

NOTE : Fluctuations in oil pressure of up to 3 p.s.i. are acceptable.

OIL CONSUMPTION HIGH - EXCEEDING 1.25 IMP. PTS./HR

(1.5 US, 0.7 LITRES)

NOTE : When high oil consumption is suspected, maintain an accurate record of oil replenishments to ascertain consumption per flying hour.

Check oil system for leaks, compressor air bleed valve exit and compressor for signs of oil contamination and oil tank relief valve for excessive venting

OK. Service scavenge filter (See Chapter 72, LUBRICATION SYSTEM)

OK. Change MAIN OIL PUMP assembly (See Chapter 72)

Not OK. Oil consumption still high. Reject engine for further investigation

Not OK. Compressor air bleed valve exit and/or compressor contaminated by oil. Reject engine for further investigation.

Not OK. Excessive oil tank venting. Change TANK RELIEF VALVE (See Chapter 72)

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... Lubrication system - Trouble shooting continued

HIGH OIL TEMPERATURE

(Exceeding max. permissible)

NOTE : During ground running a rise of 20 to 30°C approx. can be expected when engine anti-icing is selected 'ON'.

Check oil level condition and specification

OK. Check that the vent holes from air intake to zone 1 are clear of obstruction, permitting air flow over oil tank

OK. Check engine oil temperature indicating system

Not OK. Clear obstruction from the vent holes

OK. Service the pressure and scavenge oil filters (See Chapter 72 LUBRICATION SYSTEM)

Not OK. Rectify as necessary

OK. Reject the engine for investigation

LOW OIL CONSUMPTION - LESS THAN 0.9 IMP. PTS./HR

(1.08 US, 0.5 LITRES)

NOTE : Low oil consumption is indicitive of an insufficient oil supply to the centre and/or rear main bearings.

Check run down time from 60% rev/min is at least 45 seconds

- Not OK. Reject engine for investigation
- OK. Check feed pipes (micro pumps to centre section casing) are clear
  - Not OK. Clear pipes of obstruction. Prime oil system (See Chapter 72 LUBRICATION SYSTEM) Check oil drainage from centre section and turbine drain valves
    NOTE : Allow 5 minutes for drainage to take place
    - Not OK. Reject engine for investigation
  - OK. Change MAIN OIL PUMP assembly, (See Chapter 72)

OIL SYSTEM CONTAMINATION BY A FLUID LISTED BELOW

A. FUEL - Aviation Kerosene or Diesel
B. HYDRAULIC FLUID - Mineral and Phosphate
C. NON-APPROVED SYNTHETIC AERO ENGINE OILS
D. MINERAL OILS.

ACTION : Inform Rolls-Royce and carry out the following procedure as required.

ENGINE NOT RUN

(a) Drain oil system including the accessory gearbox. Remove and inspect pressure and scavenge filters, clean and refit (Refer Chapter 72-00-11 and 72-00-51). DO NOT REMOVE MICRO PUMP FILTER.

(b) Refill with approved clean engine oil and prime bearings (Refer Chapter 12-79-0 and 72-00-11).

ENGINE RUN FOR SHORT PERIOD (UP TO 1 HOUR OR 1 FLIGHT)

(a) Drain oil system including the accessory gearbox. Remove and inspect pressure and scavenge filters and filter magnets (Refer Chapter 72-00-11 and 72-00-51). If satisfactory, clean and refit. DO NOT REMOVE MICRO PUMP FILTER.

(b) Refill with approved clean engine oil and prime the bearings (Refer Chapter 12-79-0 and 72-00-11).

(c) Ground run the engine for five minutes at 95% RPM. Check oil temperature/pressure are within limits (Refer Chapter 71-00). Check run-down time from 60% RPM is comparable with established figures.

(d) Repeat operations (a) and (b).

(e) Closely check oil consumption (Refer Chapter 12-79-0) is within limits over next five flights.

ENGINE OPERATED FOR EXTENDED OR UNKNOWN PERIOD ON CONTAMINATED OIL

REJECT ENGINE

NOTE : If the engine oil system has been contaminated by a fluid or substance not listed above, the operator should contact the local Rolls-Royce representative or Product Support Engineering, Coventry, for advice, giving as much detailed information as possible.

* * *

LUBRICATION SYSTEM - MAINTENANCE PRACTICES

1. Servicing

A. Drain oil tank

Special tools and equipment :-

Drain adapter and pipe for oil tank PE.22712

(1) Gain access to the engine.

(2) Place a drip tray beneath the engine.

(3) Fit drain tool and drain the oil tank.

(a) Arrange the pipe end of the oil tank drain tool to deliver into a container.

(b) Unscrew the blanking cap from the drain valve and connect the drain tool; this will open the valve.

(c) When draining is complete, remove the drain tool and install the blanking cap.

NOTE : When the oil system is replenished after draining the tank, complete Test J given in Chapter 71 POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS.

B. Drain the oil system

(1) Drain oil tank.

(2) Item deleted.

continued overleaf

...Lubrication system - Maintenance practices continued

(3) Drain pressure filter.

(a) Unscrew the pressure filter housing, remove the spring and withdraw the filter element. Discard the filter housing sealing washer.

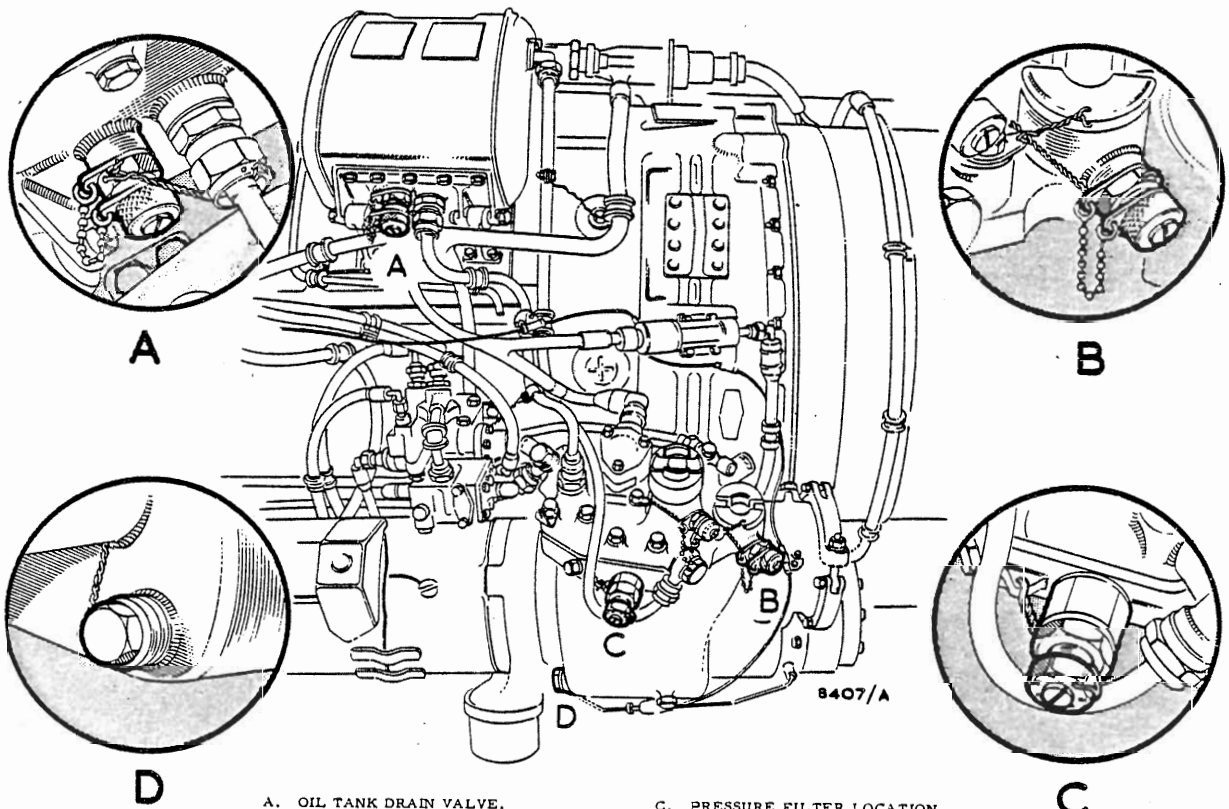
(b) Allow housing to drain.

(4) Install the pressure oil filter.

(a) Insert the filter element into the oil pump body; ensure that the inner end of the filter seats correctly in its recess.

(b) Install the filter spring.

(c) Install a new sealing washer on the filter housing and screw it in position. Tighten and wire-lock the filter housing.



Lubrication system drains locations
Fig. 201

...Lubrication system - Maintenance practices continued

(5) Drain accessory gearbox.

(a) Remove the drain plug from the rear face of the accessory gearbox, adjacent to the starter/generator. Discard the sealing washer.

(b) When the draining is complete, install a new sealing washer on the drain plug and install and wire-lock the drain plug. (Mod.CV7348 engines only - wire-lock drain plug to locking tab under fuel pump stiffnut).

CAUTION : IF THE OIL TANK OR OIL SYSTEM IS NOT TO BE REFILLED IMMEDIATELY AFTER DRAINING, ATTACH A WARNING NOTICE TO THE OIL TANK.

(6) Replenish the oil system (see SERVICING - ENGINE OIL, Chapter 12).

(7) Prime the oil system.

C. Prime the oil system

Special tools and equipment

Syringe	...	...	...	PE 4483
Priming pipe	...	...	...	PE 4484
Adapter	...	...	...	PE 4485

(1) Gain access to the engine.

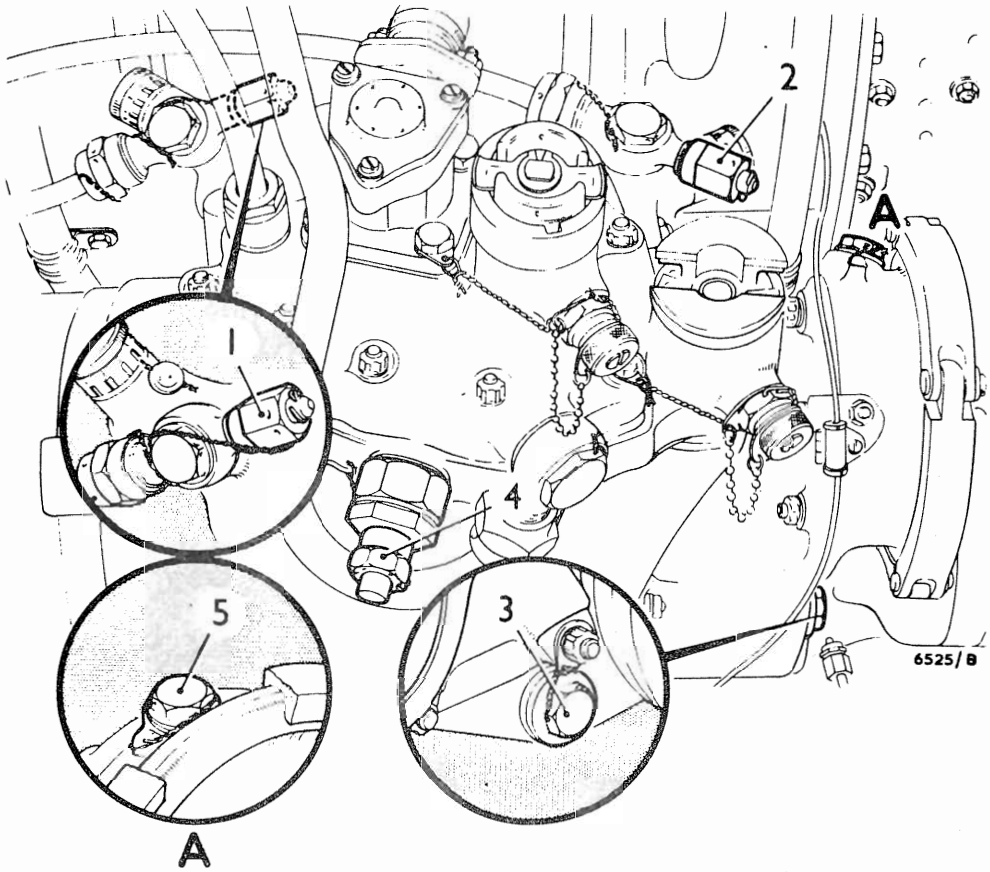
(2) Remove the union nuts from each of the micro pump banjo priming connections (Fig.202).

(3) Pump 1/8th of a print of approved engine oil into each priming connection with the tool kit syringe and priming pipe.

NOTES : 1. It is essential that the oil system is primed less than 24 hours prior to initial ground run after initial installation, or when the engine has not been run for a period of 14 days or more. This will alleviate the possibility of there being insufficient lubrication to the centre or rear bearings during the initial period of engine operation. Inadequate lubrication could result in bearing failure.

2. It is important to ensure that only clean approved oil is used for the engine lubrication system priming operation, the equipment is kept scrupulously clean, and the priming syringe is air purged before use, to ensure air is not induced into the system during priming.

...Lubrication system - Management practices continued



1. PRIMING CONNECTION - CENTRE MAIN BEARING
2. PRIMING CONNECTION - REAR MAIN BEARING
3. ACCESSORY GEARBOX LEVEL PLUG
4. PRESSURE OIL FILTER PRIMING CONNECTION
5. AC GENERATOR DRIVE ADAPTER FILLER PLUG.

Priming connections
Fig.202

(4) Install and wire-lock the micro pump banjo priming connection union nuts.

(5) Remove the level plug from the front face of the accessory gearbox cover and the filler plug from the a.c. generator drive adapter.

(6) Remove the union nut from the pressure oil filter.

(7) Pump approved oil into the priming point on the pressure oil filter with the tool kit syringe and priming pipe until oil flows from the level plug orifice in the front face of the accessory gearbox cover.

...Lubrication system - Maintenance practices continued

(8) Couple the tool kit adapter to the priming pipe. Rotate the engine by hand (in the correct direction of rotation) and inject approved oil into the filler orifice on the a.c. generator drive adapter until oil flows from the level plug orifice.

(9) Install new sealing washers on the filler and level plugs.

(10) Install, tighten and wire-lock the union nut, filler and level plugs.

(11) Complete Test J of POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS (Chapter 71).

D. Change oil

NOTE : This procedure is to be used when the oils are not intermixable.

(1) Drain the oil tank and system (see para. 1.B.).

(2) Top up the oil tank with 3 pints of the new oil.

(3) Prime the oil system (see para.1.C.).

(4) Carry out a dry motoring cycle - See Chapter 71 ENGINE MOTORING CHECK LIST in POWER PLANT - ADJUSTMENT/TEST.

(5) Drain the oil tank and system; discard the oil.

(6) Fill the oil tank with the new oil (see Chapter 12 SERVICING ENGINE OIL).

(7) Prime the oil system.

(8) Complete Test J of POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS (Chapter 71).

* * *

OIL TANK - MAINTENANCE PRACTICES

1. Removal/Installation

Special tools and equipment :-

Tension wrench	PE25492
Spanner for tank relief valve	PE1617
Spanner for tank connection	PE7390

A. Remove oil tank

(1) Isolate the electrical supply to the oil tank thermometer bulb.

(2) Gain access to the engine.

(3) Drain the oil tank. See Chapter 72 LUBRICATION SYSTEM.

(4) Disconnect the oil tank filler drain pipe, oil tank vent pipe, scavenge oil return pipe and oil outlet pipe to oil pump from the oil tank; discard O-seals and blank the pipes (Fig.201 overleaf).

NOTE : There is a nipple in the tank vent pipe connection.

(5) Release the bonding cable from the scavenge oil return pipe adapter on the oil tank.

(6) Disconnect and withdraw the thermometer bulb from the oil tank. Support the thermometer bulb in a safe position on the engine to prevent damage to the bulb.

(7) Remove the relief valve using the special spanners for connection and valve. Discard the Dowty sealing washer.

(8) Remove the stiffnuts and plain washers from the three oil tank mounting bolts. Support the tank, withdraw the mounting bolts and detach the tank from the engine.

B. Install oil tank

(1) Offer up the tank and engage the oil tank mounting brackets with the mounting brackets on the compressor blade shield (Fig.201).

(2) Insert the mounting bolts and secure them with the plain washers and stiffnuts. Torque-load the stiffnuts to 80 to 90 lb.in.

(3) Check that the clearance between the oil tank and compressor blade shield front unit is not less than 0.050 in.

NOTE : If the clearance is less than 0.050 in., remove the tank and then tap the bush in each bracket rearwards (use a recessed, soft metal drift the same diameter as the bonded bush outer shell) until the rear end, of the inner shell is 0.175 in. from the rear face of the mounting bracket boss.

...Oil tank - Maintenance practices continued

(4) Install a new Dowty sealing washer on the relief valve and install the valve, using the special spanners. Wire-lock the valve.

(5) Connect the bonding cable to the scavenge oil return pipe adapter on the oil tank.

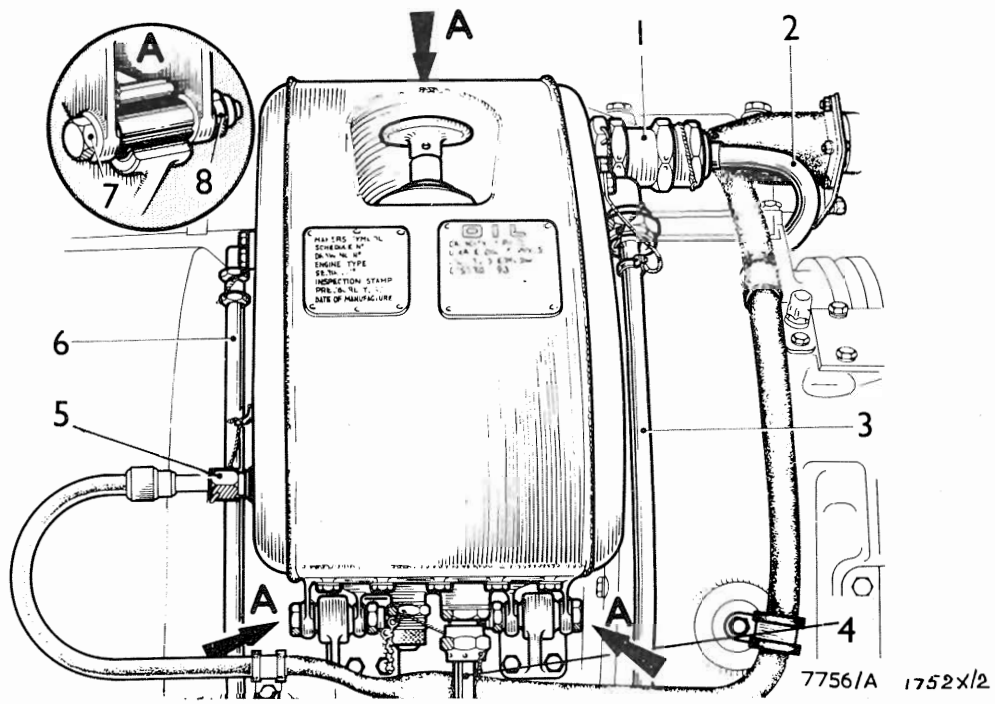
(6) Install the thermometer bulb; tighten and wire-lock the union nut.

(7) Remove the blanks from the pipes.

(8) Lubricate and install new O-seals on the pipe ends (see Chapter 71 POWER PLANT - SERVICING MATERIALS).

(9) Connect the oil outlet pipe to oil pump, scavenge oil return pipe, oil tank vent pipe and oil tank filler drain pipe connections in sequence.

CAUTION : INSTALL NIPPLE TO VENT PIPE CONNECTION.



1. RELIEF VALVE
2. OIL TANK VENT PIPE
3. SCAVENGE OIL RETURN PIPE
4. OUTLET PIPE TO OIL PUMP
5. THERMOMETER BULB
6. OIL TANK FILLER DRAIN PIPE
7. OIL TANK MOUNTING BOLT
8. SELF LOCKING NUT

A. OIL TANK MOUNTING BRACKET DETAIL

Oil tank details
Fig.201

...Oil tank - Maintenance practices continued

(10) Tighten and wire-lock all the pipe connections.

(11) Replenish oil system (Chapter 12).

(12) Restore the electrical supply to the thermometer bulb.

(13) Complete Test J given in Chapter 71 POWER PLANT - ADJUSTMENT/TEST-GROUND RUNNING TESTS.

* * *

TANK RELIEF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove tank relief valve

Special tools and equipment

Spanner for relief valve	PE1617
Spanner for tank connections	PE7390

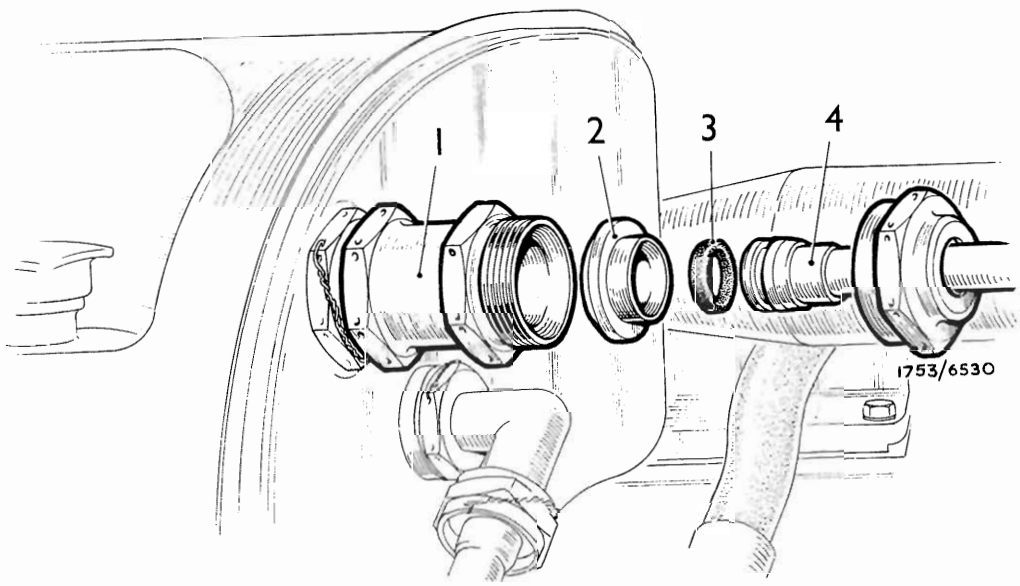
(1) Gain access to engine.

(2) Release the oil tank vent pipe support clip.

(3) Disconnect the oil tank vent pipe from the valve (Fig.201). Do not lose the nipple from the end of the pipe. Discard the O-seal.

(4) Remove the valve using the special spanner for the connection and valve. Discard the Dowty sealing washer.

(5) Blank the oil tank connection, vent pipe and valve.



1. Hymatic relief valve
2. Nipple
3. O-seal.
4. Vent pipe.

Hymatic tank relief valve connection details
Fig.201

B. Install tank relief valve

(1) Remove the blanks from the valve.

(2) Install the new Dowty sealing washer on the valve body (Fig.201).

(3) Screw the valve into its location in the oil tank and tighten with the special spanners. Wire-lock the valve.

... Tank relief valve - Maintenance practices continued

(4) Lubricate and install a new O-seal on the vent pipe end (Chapter 71 POWER PLANT - SERVICING MATERIALS).

(5) Position the nipple correctly on the pipe end; connect the pipe to the valve. Tighten and wire-lock the pipe union nut.

(6) Secure the vent pipe support clip.

* * *

OIL PUMP ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation

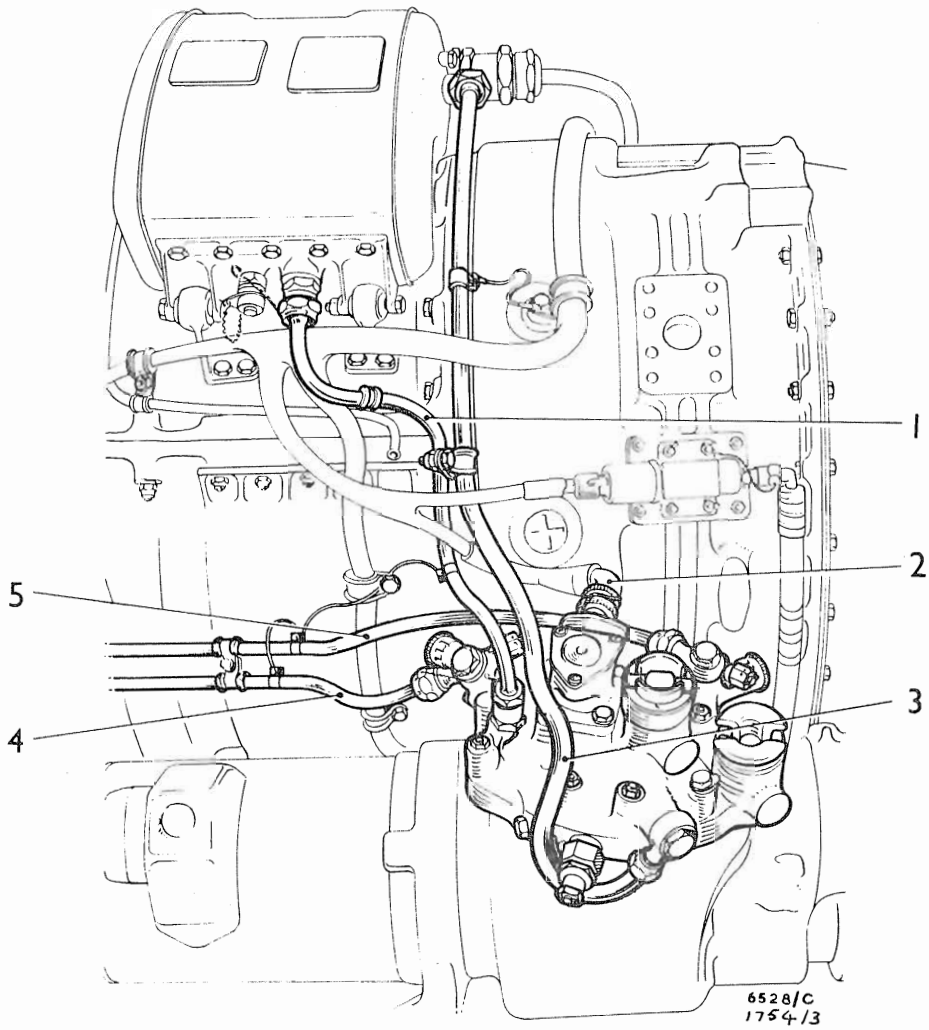
A. Remove oil pump

Equipment required :-

Spanner (Bearing feed pipe)	...	...	...	PE 1618
Torque wrench	...	...	...	T2 EM1987 BR

(1) Isolate the electrical supply to the oil low pressure warning switch.

(2) Gain access to the engine and place a tray beneath the engine.



1. OIL OUTLET PIPE TO OIL PUMP
2. OIL LOW PRESSURE WARNING SWITCH ELECTRICAL CONNECTION
3. SCAVENGE OIL RETURN PIPE
4. CENTRE MAIN BEARING OIL FEED PIPE
5. REAR MAIN BEARING OIL FEED PIPE

...Oil pump assembly - Maintenance continued

(3) Drain the oil tank and system (see Chapter 72, LUBRICATION SYSTEM).

(4) Release the bonding cable from the scavenge oil return pipe and the oil outlet pipe (oil tank to oil pump).

(5) Release both ends of the oil outlet pipe (oil tank to oil pump), and scavenge oil return pipe, and remove the pipe support clips. Remove and blank the pipes. Discard the O-seals.

(6) Remove the wire-locking from the accessory gearbox to the static sealing valve.

(7) To withdraw the pump :-

(a) Disconnect the centre and rear main bearing feed pipe unions.
(b) Remove the oil low pressure warning switch (see Chapter 79, OIL).
(c) Remove the oil pump retaining nuts and washers.
(d) Remove the bolts which secure the a.t.l. to the compressor blade shield (see Chapter 73, ENGINE FUEL AND CONTROL) to allow the bearing oil feed pipes to be withdrawn with the oil pump until they can be disengaged.

(8) Withdraw the oil pump and the aircraft oil drain pipe clip support bracket. Discard the joint washer and base flange O-seal.

B. Install oil pump

Equipment required :-

Torque wrench PE.25492

(1) Lubricate and install new O-seals on the ends of all disconnected pipes (see Chapter 71, SERVICING MATERIALS).

(2) Check the oil pump drive shaft for freedom of rotation.

(3) Install a new joint washer over the oil pump attachment studs.

(4) Position the oil pump over the attachment studs and engage bearing oil feed pipes. Make sure the splines on the oil pump drive shaft are engaged with the engine drive before easing the pump fully home.

(5) Secure the pump with washers and nuts. Interpose the two scavenge filter wire-locking tabs and the aircraft oil drain pipe clip support bracket. Torque-load the nuts to 70 to 80 lbf.in.

(6) Connect the rear main bearing oil feed pipe and centre main bearing oil feed pipe. Tighten and wire-lock the centre and rear main bearing oil feed pipe union nuts.

...Oil pump assembly - Maintenance practices continued

(7) Install the oil low pressure warning switch (see Chapter 79, OIL).

(8) Install the bolts which secure the a.t.l. to the compressor blade shield (see Chapter 73, ENGINE FUEL AND CONTROL).

(9) Connect the oil outlet pipe (oil tank to oil pump) and scavenge oil return pipe loosely to the oil tank and oil pump. Install and secure the pipe clips. Tighten and wire-lock the pipe union nuts.

(10) Wire-lock the static sealing valve to the accessory gearbox.

(11) Connect the bonding cable to the scavenge oil return pipe and the oil outlet pipe (oil tank to oil pump).

(12) Replenish oil system, see Chapter 12, SERVICING - OIL.

(13) Restore the electrical supply to the oil low pressure warning switch.

(14) Prime the oil system, see Chapter 72, LUBRICATION SYSTEM.

* * *

OIL FILTERS - MAINTENANCE PRACTICES

1. Servicing

NOTES : 1. During normal engine operation a small amount of fine metal particles (some of which may be magnetic) are generated by wear of the moving parts of the engine. In that part of the engine where oil is recirculated, it is usual for these metal particles to be deposited in the scavenge and pressure filters or on the bottom of the oil tank.

2. It is also normal for light deposits (including hair like slivers) of ferrous metal to form a dust or fur around the scavenge filter magnets, particularly when engine running hours are low. Such minor deposits of metal should be removed from the filters by washing in clean kerosene.

3. Minute particles of tin flashing in suspension in the oil is acceptable.

4. If it is considered that the amount of contamination is excessive, the filters should be cleaned, the engine ground run and the filters rechecked. If further contamination is detected, retain the metal deposits for analysis and request advice from Rolls-Royce.

5. If large flakes of metal are found, retain the metal deposits for analysis. Do not run the engine, but request advice from Rolls-Royce.

A. Service pressure filter

(1) Gain access to, and place oil tray beneath engine.

(2) Remove filter (Fig.201).

(a) Cut wire locking.

(b) Unscrew filter housing, remove spring and withdraw filter.

(c) Discard filter housing sealing washer.

(3) Check filter for contamination (refer to Notes).

(4) Wash all components in clean kerosene and dry with air blast.

(5) Check filter for damage and integrity of soldered joints.

(6) Install filter.

(a) Insert filter into oil pump body and engage in its recess.

NOTE : Check filter centre pin is below pump filter housing locating surface, to ensure inner end is seated correctly.

...Oil filters - Maintenance practices continued

(b) Fit new sealing washer to filter housing and install filter spring.

(c) Engage filter spring then screw housing into poisition, tighten, and wire-lock.

(7) Complete Test J of Chapter 71 POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS.

B. Service scavenge filter (Pre Mod.CV7445)

CAUTION : DO NOT DISTURB MICRO-FILTER (FIG.201) AS THIS ENTAILS REJECTION OF PUMP.

(1) Gain access to, and place oil tray beneath, engine.

(2) Remove filter (Fig.201).

(a) Cut wire locking from filter cover.

(b) Depress and turn filter cover until internal lugs on filter cover align with entry slots in pump body : withdraw filter.

(c) Discard filter seal ring.

(3) Check filter for contamination (refer to para.1 Notes 1-5).

(4) Wash filter in clean kerosene, and dry with air blast.

(5) Check filter for damage and integrity of soldered joints.

(6) Install filter.

(a) Lightly lubricate new seal ring with clean engine oil (see Chapter 12, SERVICING - OIL) and fit to filter.

(b) Align internal lugs on filter cover with entry slots in the pump body, and insert filter.

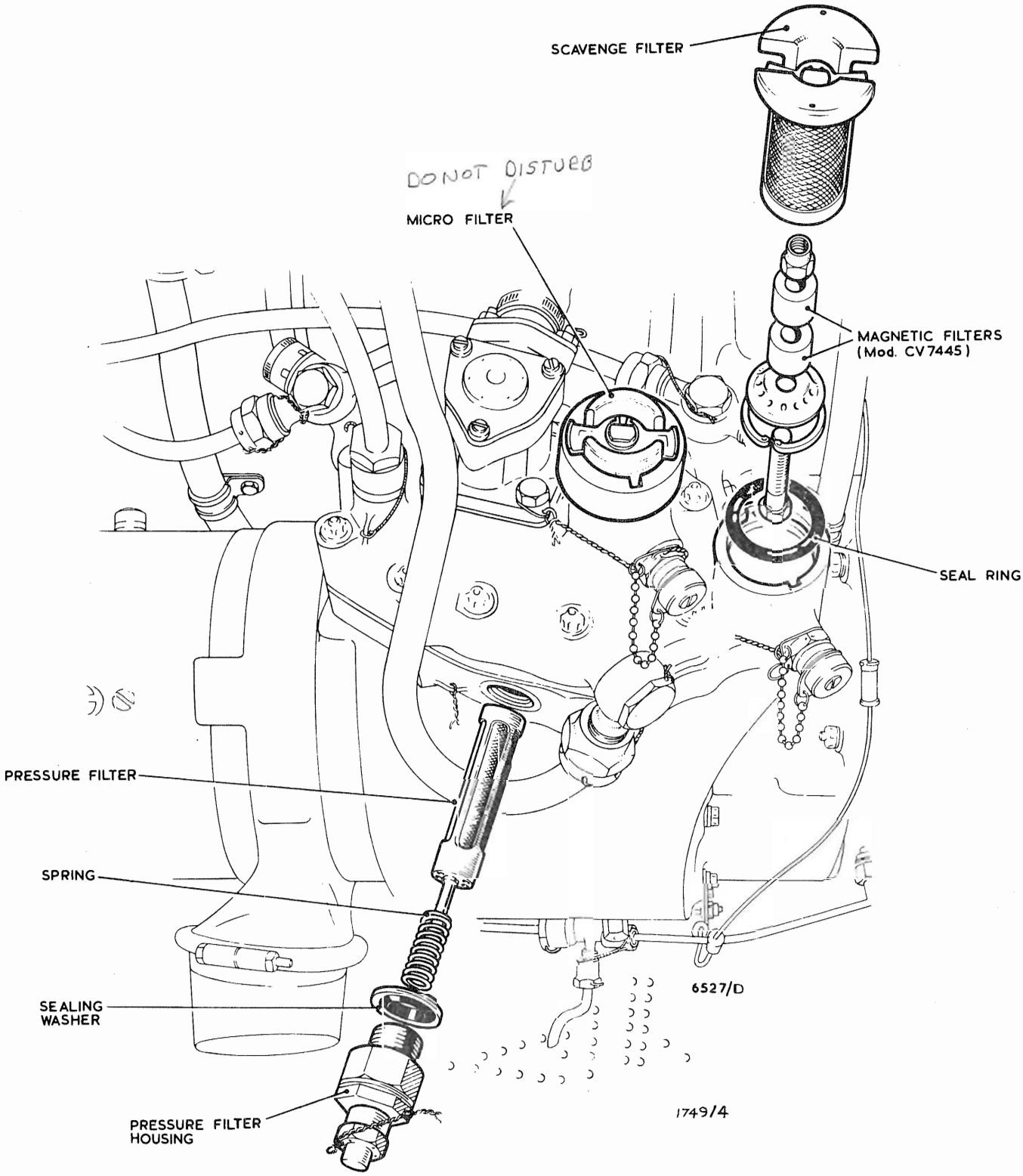
(c) Depress cover, turn as far as possible in either direction.

(d) Wire-lock the cover.

(7) Complete Test J of Chapter 71, POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS.

C. Service scavenge filter (Mod.CV7445)

CAUTION : DO NOT DISTURB MICRO-FILTER (FIG.201) AS THIS ENTAILS REJECTION OF PUMP.



Pressure and scavenge oil filter details
Fig.201

...Oil filters - Maintenance practices continued

(1) Gain access to, and place oil tray beneath engine.

(2) Remove filter (Fig.201).

(a) Cut locking wire from filter cover.

(b) Depress and turn filter cover until internal lugs on cover align with entry slots in oil pump body. Withdraw filter.

(c) Discard filter seal.

(3) Check the filter for contamination (refer to para.1 Notes 1-5).

(a) If the filter is clean and no particles of metal are attached to the magnets, proceed as in operations (6), (7), (10) and (11).

(b) If the filter and the magnets are contaminated proceed as in operation (4).

(c) If the filter is contaminated with a light deposit of ferrous metal and the magnets appear to be clean, proceed as in operation (4) and check their magnetic strength :

(i) Pick up one magnet with the other (end to end).

(ii) Suspend two half inch carbon steel balls (in chain fashion) from the magnets.

(iii) If the magnets will not hold the balls in suspension reject them.

(iv) Repeat the check with new magnets until a satisfactory test is obtained, then proceed as in operation (5).

(4) Release the circlip and withdraw the magnet assembly from the filter.

(5) Remove the self-locking nut from the bolt securing the magnets to the filter plate, wash the magnets in clean kerosene, then dry with an air blast.

(6) Wash the filter in clean kerosene and dry with air blast.

(7) Check filter for damage and integrity of soldered joints.

(8) Assemble serviceable magnets to the filter plate in correct sequence i.e. N-S, N-S) with bolt and self-locking nut.

(9) Insert the magnet assembly into the filter and locate with the circlip.

...Oil filters - Maintenance practices continued

(10) Install filter.

(a) Lightly lubricate new seal rings with clean engine oil (see Chapter 12, SERVICING - OIL) and fit to filter.

(b) Align interval lugs on filter cover with entry slots in the pump body and insert filter.

(c) Depress cover and turn as far as possible in either direction.

(d) Wire lock filter.

(11) Complete Test J of Chapter 71, POWER PLANT - ADJUSTMENT/TEST-GROUND RUNNING TESTS.

D. Check strength of magnets (Mod.CV7445 scavenge filters only)

(1) Pick up one magnet with the other (end to end) and suspend vertically.

(2) Suspend two half inch carbon steel balls, chain fashion, from the lower magnet.

NOTE : If balls do not remain suspended, reject magnets.

* * *

OIL PRESSURE RELIEF VALVE MAINTENANCE PRACTICES

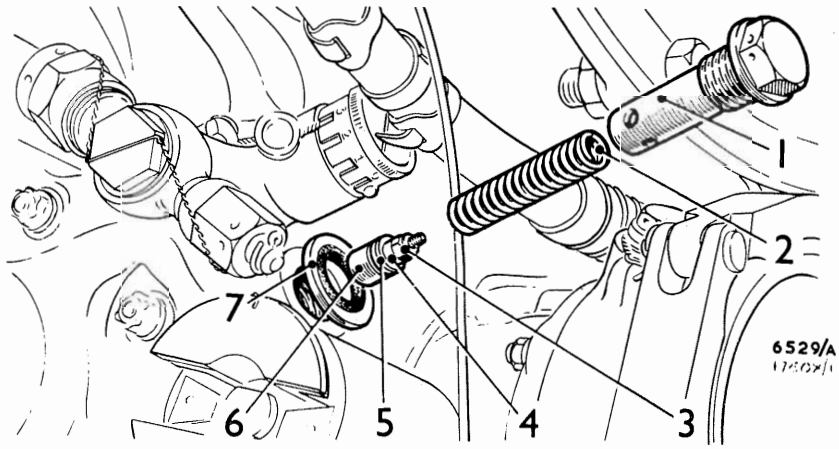
1. Servicing

A. Service oil pressure relief valve (Fig.201)

NOTE : The relief valve is not normally removed unless high, low or fluctuating oil pressure is reported.

(1) Gain access to the engine.

(2) Remove the relief valve unit from the oil pump.



1. RELIEF VALVE BODY
2. SPRING
3. STIFFNUT
4. DISTANCE PIECE
5. ADJUSTING SHIM(S)
6. PLUNGER
7. SEALING WASHER

Oil pressure relief valve details
Fig.201

(3) Remove the plunger unit and spring from the relief valve housing. Discard the sealing washer.

(4) Wash all components in clean kerosine; dry them in an air blast.

(5) Examine all the parts for damage. Ensure that adjusting shims and distance piece are retained securely on the plunger stem by the stiffnut.

NOTE : Dress light scoring of plunger by stoning. Renew a badly scored plunger; transfer shim(s), distance piece and stiffnut from unserviceable plunger.

(6) Insert the spring into the valve housing, followed by the plunger unit.

(7) Install a new sealing washer on the valve housing. Install the unit in the oil pump. Tighten and wire-lock the valve.

... Continued

... Oil pressure relief valve - Maintenance practices continued

(8) Complete Test J of POWER PLANT - ADJUSTMENT/TEST - GROUND RUNNING TESTS (Chapter 71).

NOTE : If new valve components have been installed and the oil pressure is outside the permissible limits, adjust the number of shims fitted to the plunger unit and re-test until the pressure is satisfactory. When tightening the stiffnut on the relief valve plunger, hold the plunger with a screwdriver and tighten the stiffnut just sufficiently to screw up to the distance piece. Take care not to damage the valve surface.

* * *

STATIC SEALING VALVE - MAINTENANCE PRACTICES

1. Servicing

A. Service static sealing valve

NOTE : Normally the static sealing valve will be removed only if an excessive quantity of oil transfers from the oil tank to the accessory gearbox after engine shut-down.

(1) Gain access to the engine.

(2) Drain the oil tank. See Chapter 72, LUBRICATION SYSTEM.

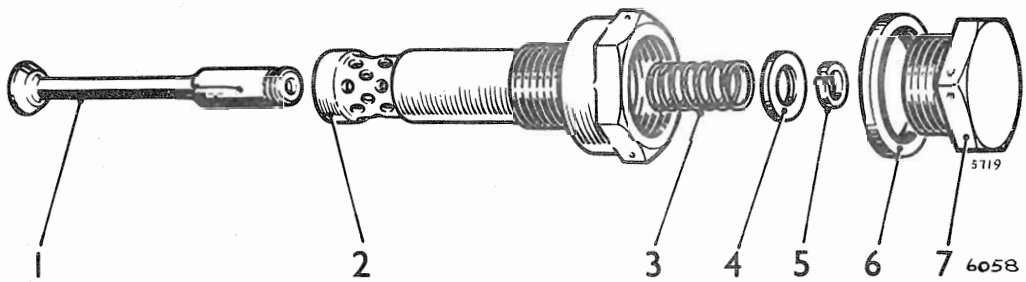
(3) Unscrew and withdraw the static sealing valve from the oil pump body. Discard the bonded seal.

(4) Unscrew the capnut from the valve housing and discard the bonded seal.

(5) Compress the valve spring then expand and detach the retaining circlip.

(6) Remove the retaining collar, lift out the valve spring and withdraw the valve from the housing.

(7) Wash all components in clean kerosine; dry them in an air blast.



1. Valve
2. Valve housing
3. Valve spring
4. Retaining collar
5. Retaining circlip
6. Bonded seal
7. Capnut

Static sealing valve unit
Fig.201

(8) Examine all the parts for damage. Check the conical faces of the valve and its seating in the valve housing for pitting. Slight pitting can be removed by lapping.

(9) Lubricate the valve, with clean engine oil, and install it in the valve housing.

... Static sealing valve - Maintenance practices continued

(10) Check that the valve slides freely into place, then push it fully home against its seating.

(11) Install the valve spring and retaining collar over the valve stem, compress these components and spring the retaining circlip into its groove.

(12) Check that the circlip has contracted fully into its groove then depress the valve by hand and check that it returns fully under the spring loading.

(13) Hold the valve housing lightly in a smooth jaw vice, fit a new bonded seal to the capnut then screw the capnut into the housing. Tighten the capnut.

(14) Remove the valve from the vice.

(15) Position a new bonded seal over the valve unit.

(16) Lubricate the threads with clean engine oil then screw the unit into its location in the oil pump body.

(17) Tighten the unit securely then wire-lock the capnut and the valve housing to the adjacent drilled lug on the pump body.

* * *

1. Restoration of damaged UNC stud and bolt holes in aluminium and magnesium alloy components

A. General

CAUTION : THIS MATERIAL CONTAINS THORIUM.

This repair permits the installation of wire thread inserts, to restore damaged or worn stud and bolt holes in aluminium alloy and magnesium alloy components. This procedure is not permissible on holes previously repaired.

NOTE : Wire thread inserts must not be used in a through hole unless it is possible to check visually after assembly that the insert has not rotated.

B. Prepare location (Fig.801)

(1) Degrease the component, (see Chapter 71, SERVICING MATERIALS).

(2) Mark the holes to be repaired.

(3) Drill the location :-

(a) Drill, tap and countersink the repair location to the dimensions shown on Fig.801 and Table 801.

(b) Clean the repair location, then remove any burrs.

(c) Inspect the component for cracks, using the dye penetrant method (see Chapter 72, COMMON PROCEDURES - IDENTIFICATION OF CRACKS).

(4) Protective treatments :-

(a) Using an artist's brush apply Alocrom 1200 solution to all salvaged holes in aluminium alloy components (see Chapter 71, SERVICING MATERIALS). Apply the solution sparingly.

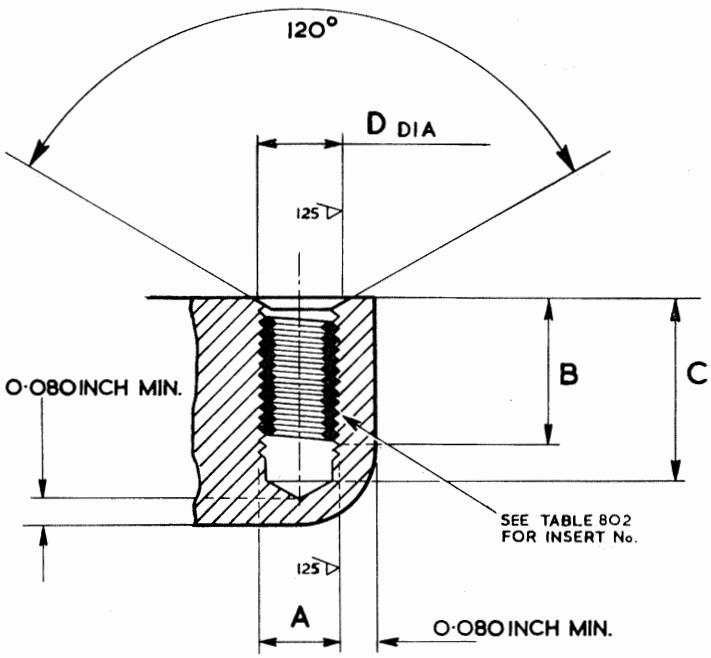
CAUTION : STRICT CARE MUST BE EXERCISED TO ENSURE THAT ONLY THE MINIMUM QUANTITY NECESSARY FOR COVERAGE IS USED, SINCE RESIDUAL SOLUTION MAY INITIATE CORROSION.

(b) Using a small brush apply Titanine grease LS.4668 to all salvaged holes in magnesium alloy components.

C. Install insert (Fig.801 and Tables 801 and 802)

(1) Install the correct size insert.

NOTE : When selecting an insert, ensure that the tapping and drilling depths are as quoted in Table 801. If this condition cannot be obtained, select the next shorter insert.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D DIA
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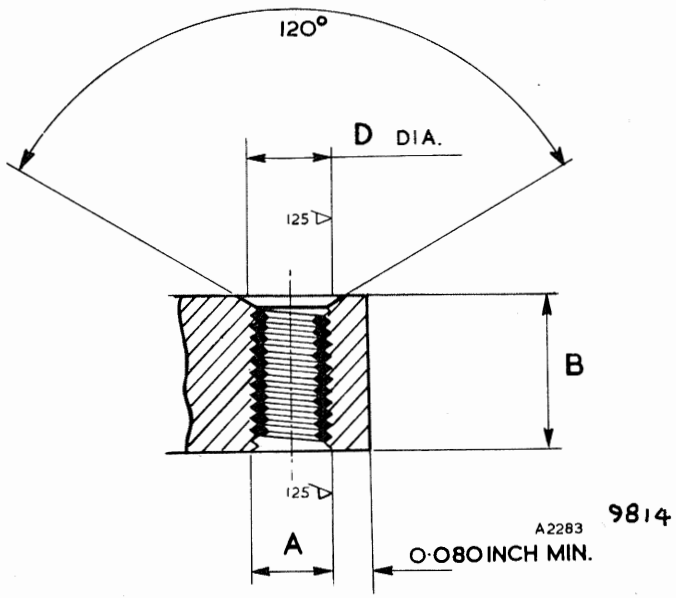
B
C
0·080 INCH MIN.
SEE TABLE 802
FOR INSERT No.
125
A
0·080 INCH MIN.


120°
D DIA.
125
B
125
A
0·080 INCH MIN.
A2283
9814

...Common procedures - Approved repairs continued

	'A' DIAMETER	'D' DIAMETER						
No.4 UNC	40 T.P.I. UNC FORM MAJ. DIA. 0.1445 inch (3,8703 mm.) Min.	0.1600 inch (4,0640 mm.)	'B' Depth	0.1250 inch (3,1750 mm.)	0.1850 inch (4,6990 mm.)	0.2350 inch (5,9690 mm.)	0.2950 inch (7,4930 mm.)	0.3450 inch (8,7630 mm.)
	EFF. DIA. 0.1257/0.1274 inch (3,1928/3,2360 mm.)		'C' Depth	0.1750 inch (4,4450 mm.)	0.2350 inch (5,969 mm.)	0.2850 inch (7,2390 mm.)	0.3450 inch (8,7630 mm.)	0.3950 inch (10,0330 mm.)
	MIN. DIA. 0.1174/0.1223 inch (2,9820/3,1064 mm.)		INSERT No.	AS.8456/71	AS.8456/72	AS.8456/73	AS.8456/74	AS.8456/75
1/4 UNC	20 T.P.I. UNC FORM MAJ. DIA. 0.3150 inch (8,0010 mm.) Min.	0.3300 inch (8,3820 mm.)	'B' Depth	0.2900 inch (7,3660 mm.)	0.4200 inch (10,6680 mm.)	0.5400 inch (13,7160 mm.)	0.6600 inch (16,7640 mm.)	0.7900 inch (20,0660 mm.)
	EFF. DIA. 0.2800/0.2826 inch (7,1120/7,1780 mm.)		'C' Depth	0.3400 inch (8,6360 mm.)	0.4700 inch (11,9380 mm.)	0.5900 inch (14,9860 mm.)	0.7100 inch (18,0340 mm.)	0.8400 inch (21,3360 mm.)
	MIN. DIA. 0.2608/0.2703 inch (6,6243/6,8656 mm.)		INSERT No.	AS.8456/3	AS.8456/15	AS.8456/27	AS.8456/39	AS.8456/51
5/16 UNC	18 T.P.I. UNC FORM MAJ. DIA. 0.3847 inch (9,7714 mm.) Min.	0.4000 inch (10,1600 mm.)	'B' Depth	0.3550 inch (9,0170 mm.)	0.5150 inch (13,0810 mm.)	0.6650 inch (16,8910 mm.)	0.8250 inch (20,9550 mm.)	0.9850 inch (25,0190 mm.)
	EFF. DIA. 0.3461/0.3490 inch (8,7909/8,8646 mm.)		'C' Depth	0.4050 inch (10,2870 mm.)	0.5650 inch (14,3510 mm.)	0.7150 inch (18,1610 mm.)	0.8750 inch (22,2250 mm.)	1.0350 inch 26,2890 mm.)
	MIN. DIA. 0.3245/0.3341 inch (8,2423/8,4861 mm.)		INSERT No.	AS.8456/4	AS.8456/16	AS.8456/28	AS.8456/40	AS.8456/52
3/8 UNC	16 T.P.I. UNC FORM MAJ. DIA. 0.4562 inch (11,5875 mm.) Min.	0.4700 inch (11,9380 mm.)	'B' Depth	0.4200 inch (10,6680 mm.)	0.6000 inch (15,2400 mm.)	0.7900 inch (20,0660 mm.)	0.9800 inch (24,8920 mm.)	1.1600 inch (29,4640 mm.)
	EFF. DIA. 0.4131/0.4164 inch (10,4927/10,5766 mm.)		'C' Depth	0.4700 inch (11,9380 mm.)	0.6500 inch (16,5100 mm.)	0.8400 inch (21,3360 mm.)	1.0300 inch (26,1620 mm.)	1.2100 inch (30,7340 mm.)
	MIN. DIA. 0.3885/0.3985 inch (9,8679/10,1219 mm.)		INSERT No.	AS.8456/5	AS.8456/17	AS.8456/29	AS.8456/41	AS.8456/53
7/16 UNC	14 T.P.I. UNC FORM MAJ. DIA. 0.5303 inch (13,4696 mm.) Min.	0.5500 inch (13,9700 mm.)	'B' Depth	0.4900 inch (12,4460 mm.)	0.7100 inch (18,0340 mm.)	0.9300 inch (23,6220 mm.)	1.1400 inch 28,9560 mm.)	1.3600 inch (34,5440 mm.)
	EFF. DIA. 0.4814/0.4850 inch (12,2276/12,3190 mm.)		'C' Depth	0.5400 inch (13,7160 mm.)	0.7600 inch (19,3040 mm.)	0.9800 inch (24,8920 mm.)	1.1900 inch (30,2260 mm.)	1.4100 inch (35,8140 mm.)
	MIN. DIA. 0.4530/0.4636 inch (11,5062/11,7754 mm.)		INSERT No.	AS.8456/6	AS.8456/18	AS.8456/30	AS.8456/42	AS.8456/54

A2282

NOTE: Effective diameters quoted in the above table for unified threads are 0.0025 inch (0,0635 mm.) below standard UNC sizes.

Drilling information and insert part numbers
Table 801

...Common procedures - Approved repairs continued

(2) Apply a coating of zinc chromate paste to the selected insert.

(3) Screw the selected insert into position using the appropriate size insert tool (refer to Table 802). Ensure that the insert is screwed one quarter turn below the bottom of the chamfer as shown on Fig.801.

(4) Using the correct break-off tool (refer to Table 802) remove and discard the tang.

SIZE UNC	INSERT TOOL	TANG BREAK-OFF TOOL	EXTRACTING TOOL
4-40	PE.19700	PE.19701	PE.19702
1/4-20	PE.19730	PE.19731	PE.19732
5/16-18	PE.19733	PE.19734	PE.19732
3/8-16	PE.19735	PE.19736	PE.19732
7/16-14	PE.19737	PE.19738	PE.19739

Table 802 Tools required

D. Complete repair

(1) Inspect the assembly for satisfactory completion.

(2) Mark SAL.V.37776 adjacent to the unit part number (see Chapter 72, COMMON PROCEDURES - MARKING COMPONENTS) and record this number in the engine log book.

2. Restoration of damaged UNF stud and bolt holes in aluminium and magnesium alloy components

CAUTION : THIS MATERIAL CONTAINS THORIUM.

A. General

This repair permits the installation of wire thread inserts to restore damaged or worn stud and bolt holes in aluminium alloy and magnesium alloy components. This procedure is not permissible on holes previously repaired.

NOTE : Wire thread inserts must not be used in a through hole unless it is possible to check visually after assembly that the insert has not rotated.

B. Prepare location (Fig.801)

(1) Degrease the component (see Chapter 71, SERVICING MATERIALS).

(2) Mark the holes to be repaired.

...Common procedures - Approved repairs continued

(3) Drill the location :-

(a) Drill, tap and countersink the repair location; refer to Fig.802 for dimensions.

(b) Clean the repair location, then remove any burrs.

(c) Inspect the component for cracks, using the dye penetrant method (see Chapter 72, COMMON PROCEDURES).

(4) Protective treatment.

(a) Using an artist's brush, apply Alocrom 1200 solution to all salvaged holes in aluminium alloy components (see Chapter 71, SERVICING MATERIALS). Apply the solution sparingly.

CAUTION : STRICT CARE MUST BE EXERCISED TO ENSURE THAT ONLY THE MINIMUM QUANTITY NECESSARY FOR COVERAGE IS USED, SINCE RESIDUAL SOLUTION MAY INITIATE CORROSION.

(b) Using a small brush, apply Titanine grease LS.4668 to all salvaged holes in magnesium alloy components.

C. Install insert (Fig.802)

(1) Install the correct size insert.

NOTE : When selecting an insert, ensure that the tapping and drilling depths are as quoted in Fig.802. If this condition cannot be obtained, select the next shorter insert.

(2) Apply a coating of zinc chromate paste to the selected insert.

(3) Screw the selected insert into position, using the appropriate size insert tool. Ensure that the insert is screwed one quarter turn below the bottom of the chamfer.

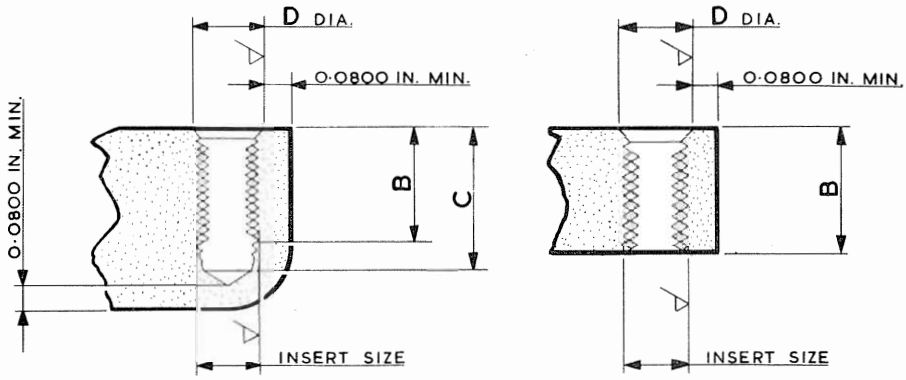
(4) Using the correct break-off tool, remove and discard the tang.

D. Complete repair

(1) Examine the assembly for satisfactory completion.

(2) Mark SAL.V.33485 adjacent to the unit part number (see Chapter 72, COMMON PROCEDURES - MARKING COMPONENTS) and record this number in the engine log book.

...Common procedures - Approved repairs continued



THREAD SIZE	INSERT AS PART Nº	TAPPING DRILL DIA.	DIMENSION B	DIMENSION C	DIMENSION D
2 BA 31·4 T.P.I.	4947/2 4947/14 4947/26 4947/38 4947/50	0·1935 IN.	0·2100 IN. 0·3000 IN. 0·3900 IN. 0·4800 IN. 0·5700 IN.	0·2600 IN. 0·3500 IN. 0·4400 IN. 0·5300 IN. 0·6200 IN.	0·2300 IN. X 45°
1/4 IN. U.N.F. 28 T.P.I.	8455/2 8455/17 8455/32 8455/47 8455/62	0·2570 IN.	0·2700 IN. 0·4000 IN. 0·5200 IN. 0·6400 IN. 0·7700 IN.	0·3200 IN. 0·4500 IN. 0·5700 IN. 0·6900 IN. 0·8200 IN.	0·3000 IN. X 45°
5/16 IN. U.N.F. 24 T.P.I.	8455/3 8455/18 8455/33 8455/48 8455/63	0·3230 IN.	0·3350 IN. 0·4950 IN. 0·6450 IN. 0·8050 IN. 0·9650 IN.	0·3850 IN. 0·5450 IN. 0·6950 IN. 0·8550 IN. 1·0150 IN.	0·3700 IN. X 45°
3/8 IN. U.N.F. 24 T.P.I.	8455/4 8455/19 8455/34 8455/49 8455/64	0·3860 IN.	0·4050 IN. 0·5850 IN. 0·7750 IN. 0·9650 IN. 1·1450 IN.	0·4550 IN. 0·6350 IN. 0·8250 IN. 1·0150 IN. 1·1950 IN.	0·4300 IN. X 45°

A.1288
9813

...Common procedures - Approved repairs continued

3. Restore damaged 1/4 UNF wire thread inserts in magnesium alloy components

A. General

CAUTION : THIS MATERIAL CONTAINS THORIUM.

This repair may be used to restore damaged 1/4 UNF wire thread inserts by fitting steel inserts at any of the following locations :-

Anti-icing air inlet and outlet elbow attachment faces.
Pitot attachment faces.
Compressor air bleed valve attachment face.
Fuel system control rod mounting face.

B. Prepare location

(1) Remove and discard the damaged insert; use a standard 1/4 UNF wire thread extractor.

(2) Drill insert location :-

(a) Drill, tap and countersink the repair location to the dimensions shown in detail A of Fig.803, using the following tools :-

Standard letter Q (0.3320 in.dia) drill
Standard 0.3750/0.3800 in.dia. counterbore.
Standard 3/8 - 24 UNF - 3B taps.

(b) Clean the location, then check for dimensions and finish.

(3) Locally treat the location (see Chapter 71, SERVICING MATERIALS).

C. Install insert

(1) Screw the insert V.20895.L4 into the location and file flush with the casing. If the original tapped hole breaks through the flange, file the insert to the boss profile.

(2) Peg insert :-

(a) Drill and ream the location to the dimensions shown in detail B of Fig.803 using the following tools :-

Standard No.43 (0.0890 in.dia.) drill
Standard 0.0912 in.dia. reamer

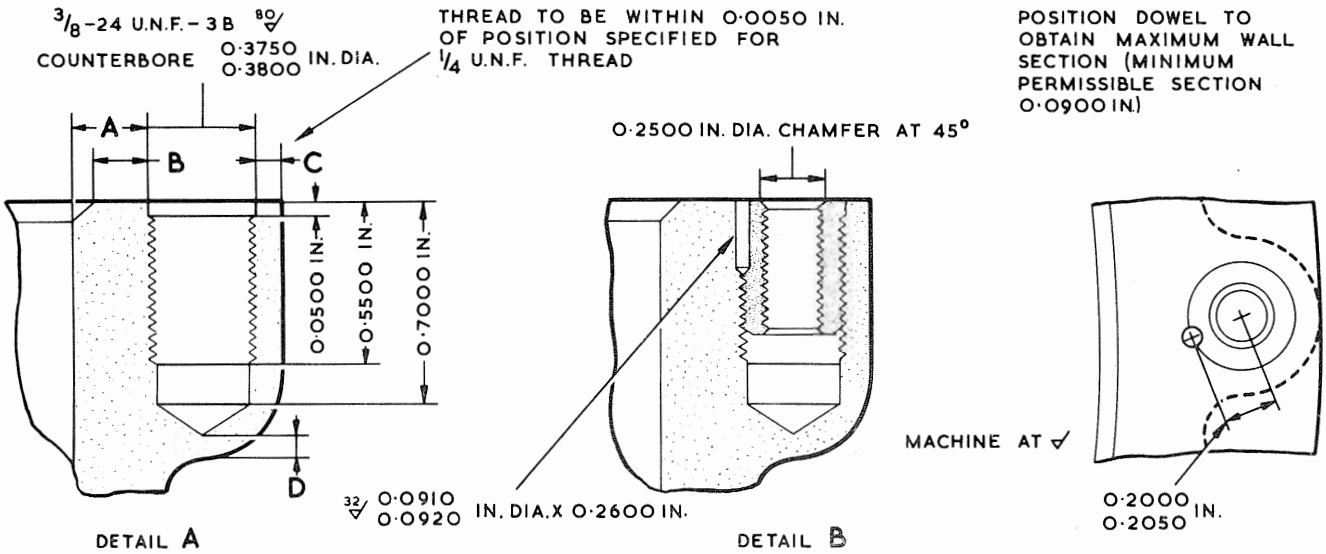
(b) Clean the location, then insert the dowel FB.93521.

...Common procedures - Approved repairs continued

(c) Drive the dowel below the surface of the casing and lightly peen the surrounding surface over the top of the dowel.

(3) Chamfer the insert to the dimensions shown in detail B of Fig.803.

(4) Locally treat the exposed surfaces of the casing (see Chapter 71, SERVICING MATERIALS).



MINIMUM PERMISSIBLE SECTION (INCHES)			
A	B	C	D
0·0950	0·0650	0·0950	0·1000

6451X

Section through typical insert location
Fig.803

D. Complete salvage

(1) Inspect the assembly for satisfactory completion.

(2) Mark SAL.V20892 adjacent to the unit part number (see Chapter 72, COMMON PROCEDURES - MARKING COMPONENTS) and record this number in the engine log book.

* * *

COMMON PROCEDURES - MARKING COMPONENTS

1. Marking identification symbols on engine components

A. General

Always mark salvage numbers and identification symbols on the component in the position indicated in the relevant repair procedure. Take great care in marking and never mark a running or mating face or one which is subject to lapping or bedding.

Avoid engraving or etching near the component edge or highly stressed locations, especially on hardened or stainless steel components.

The methods for marking various materials are given below. Use only those types of vibro-percussion engraving machine approved by Rolls-Royce (1971) Ltd., Bristol Engine Division; any other type of engraving machine may set up undue stress in the materials involved, with possible danger of subsequent failure.

WARNING : WHEN USING CHEMICALS, OBSERVE THE PRECAUTIONS REQUIRED BY THE FACTORY ACTS OF THE COUNTRY CONCERNED AND/OR THOSE STIPULATED BY THE MANUFACTURER.

B. Vibro-percussion engraving

This is suitable for general application; produce a marking as light as possible. Do not employ the method, however, on highly stressed components.

C. Acid etching

This method of marking is alternative to vibro-percussion engraving for the following materials :-

Case-hardened steel
Nitrided steels
Nimonic alloy steels
Corrosion-resisting steels

The composition of the etching solution is dependent upon the steel to be marked.

(1) For case-hardened steel make up a solution as follows :-

Selenious acid	.. ..	20 grammes
Copper sulphate (crystals)	..	10 grammes
Nitric acid (concentrated)	..	15 mls.
Water	.. ..	80 mls.

(2) For nitrided steels, Nimonic alloys and corrosion-resisting steels, use a solution comprising :-

...Common procedures - Marking components continued

Selenious acid	.. ..	20 grammes
Copper sulphate (crystals)	..	10 grammes
Nitric acid (concentrated)	..	25 mls.
Hydrochloric acid	.. ..	60 mls.
Water	.. ..	10 mls.

Apply the etchant with rubber stamps. Immediately after marking, wash and dry the component thoroughly to protect it against corrosion.

CAUTION : NEVER USE THE RUBBER STAMPS EMPLOYED WITH ETCHANTS FOR ANY OTHER MARKING PURPOSE.

D. Electro-mechanical marking

Do not use this method on stressed light alloy components or upon materials having a hardened surface or protective treatment.

2. Marking hot end components temporarily

A. Use Spectra Color or, if this is not available, tailor's chalk or french chalk (talc) for temporarily marking any component subjected to high temperatures.

CAUTION : DO NOT USE LEAD PENCILS, WAX CRAYONS, OR ANY MEDIUM WHICH LEAVES A CARBON DEPOSIT SINCE THESE WILL RESULT IN CARBURIZATION AND EMBRITTLEMENT OF THE AFFECTED AREA PROMOTING SUBSEQUENT FAILURE OF THE COMPONENT. COMMON OR BLACKBOARD CHALK WILL PRODUCE A DEEP ETCHING EFFECT WHEN SUBJECTED TO HEAT.

B. Where Spectra Color is used, remove it as soon as possible with Spectra remover. Do not subject a component to heat or finally assemble it to the engine without first removing this marking medium.

* * *

COMMON PROCEDURES - IDENTIFICATION OF CRACKS

1. Dye penetrant method

A. General

This process may be applied to all non-ferrous and non-magnetic ferrous materials. The penetrant and developer are proprietary brands which are supplied ready for use (see Chapter 71, SERVICING MATERIALS). Observe the manufacturer's instructions.

CAUTION : WEAR POLYTHENE GLOVES DURING DYE PENETRANT APPLICATION. ANY PENETRANT CONTACTING THE SKIN SHOULD BE WASHED OFF IMMEDIATELY TO PREVENT POSSIBLE SKIN IRRITATION.

NOTE : Penetrant checks must be implemented prior to vacu-blasting, machining or polishing, since these operations will peen over the edges of the defect.

B. Application

(1) Ensure that the suspect areas are free from paint, plating or scaling and are absolutely clean and dry.

(2) When the area is cool enough to handle comfortably, apply the penetrant by brushing, spraying or dipping. When checking in situ use the BCP.60 Jet Pak. Allow a minimum drying period of ten minutes. The maximum drying time is one hour, after which period the penetrant must be re-applied.

(3) Remove penetrant in localized areas by applying a clean cloth, slightly moistened with trichloroethane (Genklene). Dry off with clean compressed air.

(4) Apply the developer in accordance with manufacturer's instructions.

CAUTION : AVOID INHALING DEVELOPER POWDER AND APPLY IN A WELL VENTILATED AREA.

C. Defect identification

Identify the defect by examination in good light. Defect indications are as follows :-

(1) Solid red lines indicate cracks, forging folds or faulty adhesions of white metal or electro-deposited coatings.

...Common procedures - Identification of cracks continued

(2) A line of red dots indicates a hair-line crack or forging fold.

(3) Scattered or clustered red dots indicate micro shrinkage, porosity or corrosion.

D. Completion

Remove excess developer coating with hot water and a bristle brush or by pressure paraffin washing. Dry off with clean compressed air.

* * *

AIR INLET - MAINTENANCE PRACTICES

1. Inspection/Check

A. Air intake casing - Acceptance standard for damage to aerofoil extension units

(1) Dents and scores up to 10% of the aerofoil surface area are acceptable, provided they are not in close proximity to each other.

(2) The scores do not exceed 0.010 in. in depth.

(3) The dents do not exceed 0.020 in. in depth, and any scoring does not exceed 0.010 in. in depth.

(4) A score which has raised the aerofoil material proud of the surface should be removed by blending; it is not necessary to blend scores which are below the surface level.

* * *

AIR INLET - APPROVED REPAIRS - SALVAGE SCHEMES No. V.27277 TO V.27280

1. Restore oil pressure transmitter retaining stud locations

A. General

(1) Applicable to the following units :-

Viper 520	No. VU.20406	V.20951	V.25160	V.27367
Viper 521	-	V.20951	V.25160	V.27367
Viper 522	V.26943	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore the oil pressure transmitter retaining bolt location, by fitting oversize and/or stepped studs.

(3) One repair of either type is permitted at any of the locations.

B. Prepare location

(1) Drill, counterbore and tap the location to the dimensions shown on Fig.801.

(2) Clean the location, then check for dimensions and finish.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Screw the stud into the location; refer to Fig.801 for the correct size.

(2) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

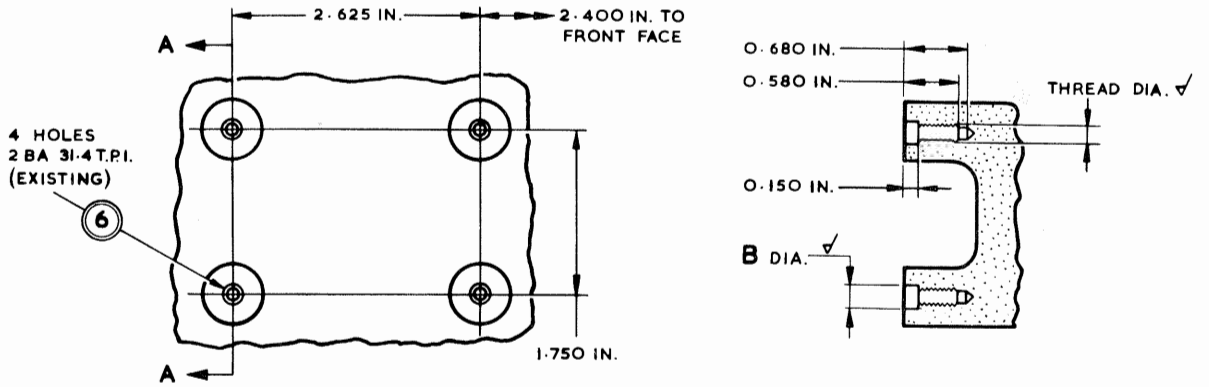
D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig.801) in the engine log book.

Fig.801 overleaf

THIS MATERIAL CONTAINS THORIUM



SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL SIZE	COUNTERBORE SIZE	TAP SIZE	NON STANDARD STUD REQUIRED
V 27277	STANDARD	0·1570 IN.	0·2031 IN.	2BA 31·4 T.P.I.	B155630 LO55
V 27278	0·0050 IN.	——	0·2031 IN.	0·192 IN. DIA. 31·4 T.P.I.	B155631 LO55
V 27279	0·0100 IN.	——	0·2187 IN.	0·197 IN. DIA. 31·4 T.P.I.	B155632 LO55
V 27280	STEPPED	0·2187 IN.	0·2656 IN.	1/4 IN. 28 UNF. 3B	V 27281

9146

Section through typical stud location
Fig. 801

* * *

AIR INLET - APPROVED REPAIRS - SALVAGE SCHEME No. V.28758

1. Restore damaged 5/16 in. UNF wire thread insert locations at the mounting bracket position

A. General

(1) Applicable to the following units :-

Viper 520	V.25160	V.27167	V.20406	V.24795	V.20951
Viper 521	-	V.27367	V.26760	V.24795	V.20951
Viper 522	V.26943	V.20879	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged 5/16 UNF wire thread insert locations at the engine mounting bracket attachment bolt position, by fitting steel inserts.

B. Prepare location

(1) Remove and discard the damaged wire thread insert, use a standard 5/16 in. UNF wire thread extractor.

(2) Drill, counterbore and tap the location to the dimensions shown on Fig. 801. Employ the following tools :-

Standard 0.3906 in. dia drill
Standard 0.4531 in. dia counterbore
Standard 7/16 in. - 20 UNF - 3B taps
Standard 0.3200 in. dia x 45 deg. chamfer tool.

(3) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install insert

(1) Screw the insert V.26090 into the location, file the insert flush with the casing.

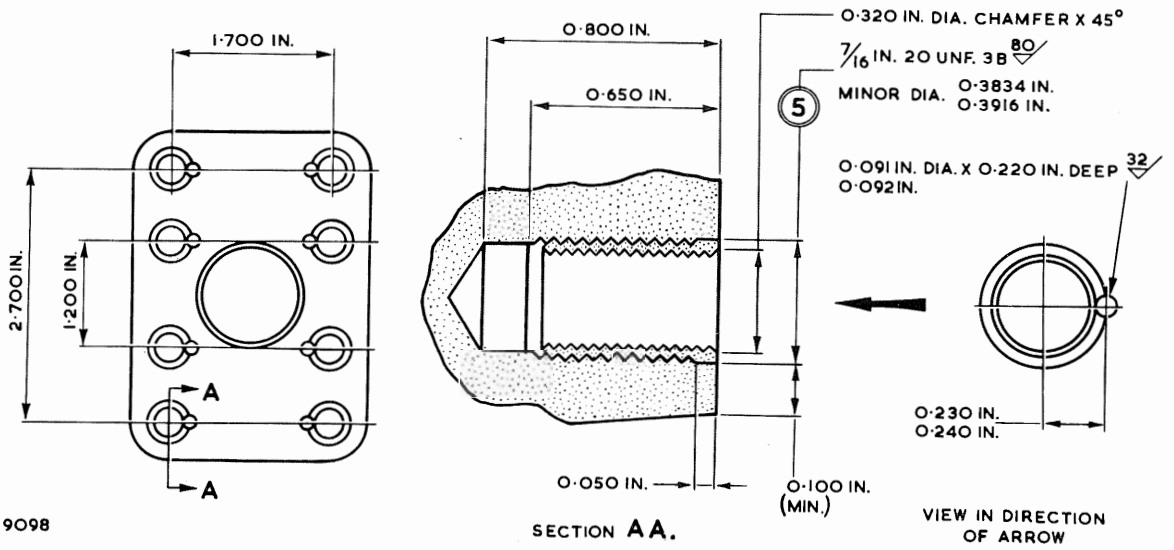
(2) Peg the insert.

(a) Mark off, drill and ream the dowel location to the dimensions shown on Fig. 801. Employ the following tools :-

Standard No. 43 (0.0890 in. dia) drill
Standard 0.0912 in. dia reamer.

(b) Clean the location and insert the dowel B.362690.

(c) Drive the dowel below the surface of the casing and lightly peen the surrounding metal over the top of the dowel. Finish flush.



Section through typical insert location
Fig. 801

(3) Chamfer the insert to the dimensions shown on Fig. 801.

(4) Locally treat the exposed surface of the casing - see SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the salvage number V. 28758 in the engine log book.

* * *

AIR INLET - APPROVED REPAIRS - SALVAGE SCHEMES No. V.27239 TO V.27241

1. Restore damaged standard 5/16 in. UNC stud locations

A. General

(1) Applicable to the following units :-

Viper 520	V.20406	V.20951	V.24795	V.25160	V.27367
Viper 521	-	V.20951	V.24795	V.25160	V.27367
Viper 522	V.26943	V.29019	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged standard 5/16 in.-18 UNC stud locations at the aerofoil extension attachment positions, by fitting oversize studs.

(3) Only one salvage of this type is permitted on any of the six locations.

B. Prepare location

(1) Drill the location.

(a) Drill, counterbore and tap the location to the dimensions shown on Fig.801.

(b) Clean the locations, check for finish and dimension.

(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud - see Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES, and Fig.801 for identification and dimensions.

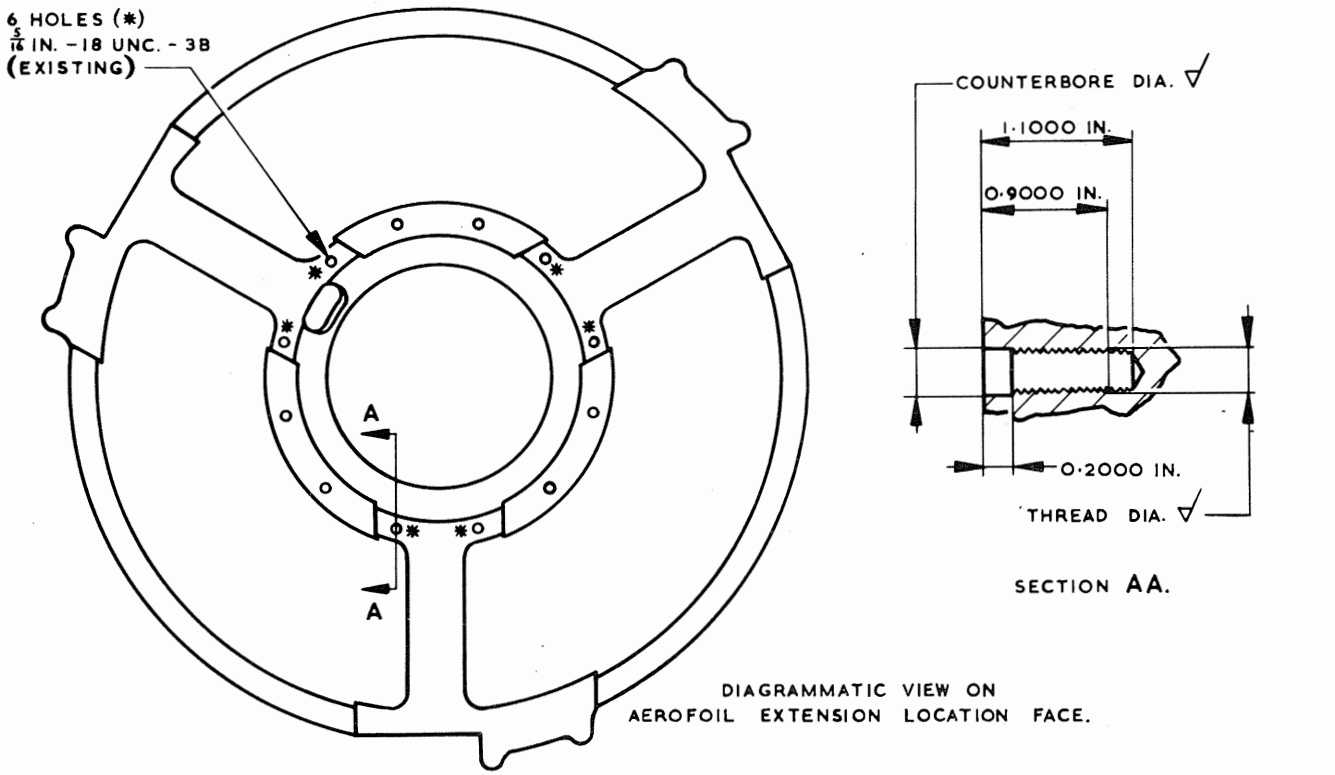
(2) Screw the stud into the location.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig.801) in the engine log book.



SALVAGE NUMBER	STUD FAST END OVERSIZE	DRILL DIA.	COUNTERBORE DIA.	3B TAP SIZE	NON-STANDARD STUD REQUIRED.
V. 27 239.	STANDARD	0·2570 IN.	0·3281 IN.	5/16 IN. -18 UNC.	B. 311515L235. B. 311515L245.
V. 27240.	0·005 IN.	-	0·3281 IN.	0·3175 IN. -18 UNC.	B. 311516L235. B. 311516L245.
V. 27241	0·010 IN.	-	0·3437 IN.	0·3225 IN. -18 UNC.	B. 311517L235. B. 311517L245.

9279.

6454

Section through typical stud location
Fig. 801

* * *

AIR INLET - APPROVED REPAIRS - SALVAGE SCHEMES No. V. 27242 TO V. 27244

1. Restore damaged standard 5/16 in. UNC stud location

A. General

(1) Applicable to the following units :-

Viper 520	V.20406	V.20951	V.24795	V.25160	V.27367
Viper 521	-	V.20951	V.24795	V.25160	V.27367
Viper 522	V.26943	V.29019	-	-	-

CAUTION : THIS MATERIAL CONTAINS THORIUM.

(2) This repair may be used to restore damaged standard 5/16 in. UNC stud locations at the nose bullet attachment position, by fitting oversize studs.

(3) Only one repair of this type is permitted to each location.

B. Prepare location

(1) Drill the location.

(a) Drill, counterbore and tap the location to the dimensions shown on Fig. 801.

(b) Clean the location, then check for dimensions and finish.

(2) Locally treat the location - see Chapter 71, SERVICING MATERIALS.

C. Install oversize stud

(1) Select the correct size stud - see Chapter 72, APPROVED REPAIRS - COMMON PROCEDURES and Fig. 801 for identification and dimensions.

(2) Screw the stud into the location.

(3) Locally treat the exposed surface of the casing - see Chapter 71, SERVICING MATERIALS.

D. Complete repair

(1) Finally inspect the assembly.

(2) Record the relevant salvage number (Fig. 801) in the engine log book.