CHAPTER 1 - GENERAL INFORMATION AND TOOLS

Contents

Illustrations

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1. General information

A. The chapters in this section describe the removal, replacement and adjustment of these units of the engine which may be changed in service.

B. It may be necessary to remove an engine from the aircraft to permit the removal of certain units, in these instances, reference should be made to the engine removal procedure detailed in the relevant aircraft Air Publication.

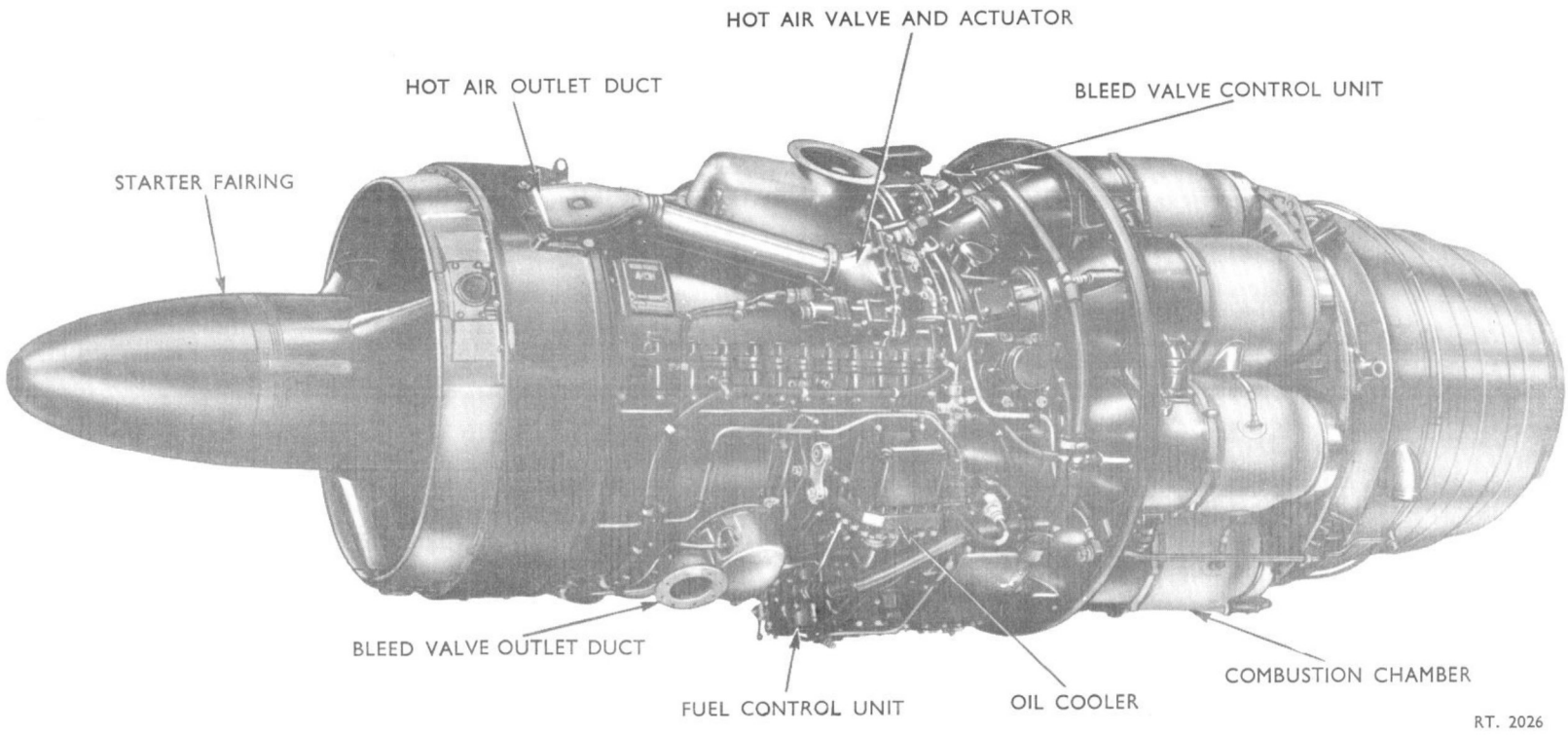
C. Joint washers, sealing rings and all locking devices (except spring washers and locking plates) which are disturbed during servicing operations, should be renewed.

2. Lubricants for assembling

A. It is essential that the correct lubricants are used during servicing and assembling.

(1) On control rod ball - joints, use low temperature grease XG-295 (Ref.No.34B/9423152 N.A.T.O. Code No.G-352).

(2) On screw threads use engine oil OX-38 (D.Eng.R.D.2487).



Location of engine units (left-hand side)
Fig.1

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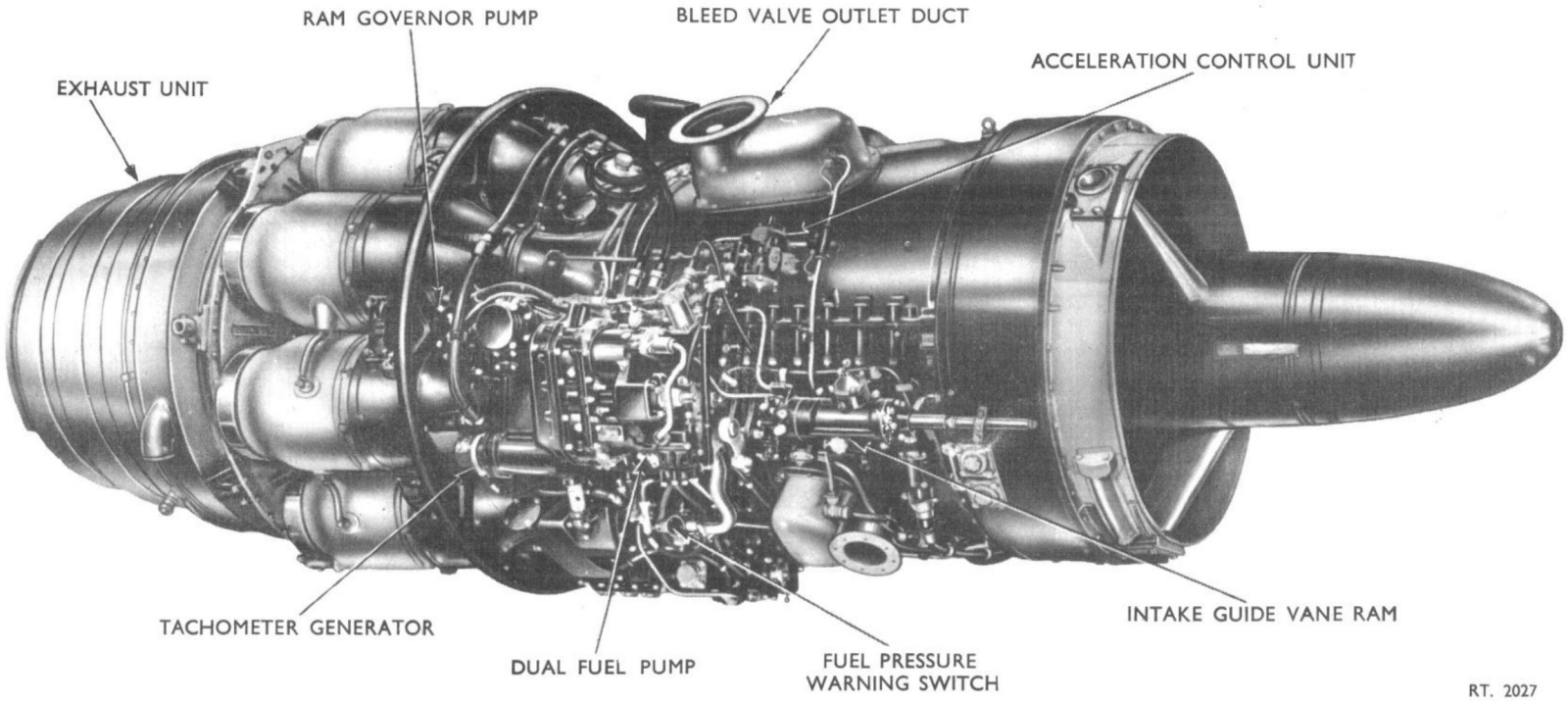

Location of engine units (right-hand side)
Fig.2

3. Identification, inspection, lubrication and fitting of rubber and synthetic rubber parts

A. Identification

(1) Rubber sealing ring identification is by the part number which is shown on the envelope in which sealing rings are individually packed. On the envelope (and on all associated packaging) is marked, as a minimum, the following information (examples given in brackets):

Description of part	(ring, sealing)
Quantity	(one, 1)
Rolls-Royce part number	(000,000)
Cure date	(2Q68)

(2) The sealing ring material is identified by self-colouring of the ring or by colour markings on the ring. A sealing ring which has become separated from its envelope can be identified as follows:

(a) Match the colour code marking on the sealing ring with the same marking in the identification of rubber sealing rings shown in the following table. Record the material code shown.

(b) Refer to the appropriate 'Schedule of Spare Parts' which relates the material code to the sealing ring part number, material description, dimensions and location.

B. Inspection

(1) Examine parts for signs of 'ageing' or degradation due to oxidation. This is shown by surface cracks and deterioration. To check, flex the part gently and discard if cracks are present before or after flexing.

(2) Do not automatically discard parts due to the presence of a white or coloured 'bloom' on their surface. Such blooms are often desirable anti-ageing layers and originate from the anti-oxidants used in high grade rubber.

(3) Examine, and discard if faulty, all parts for:

(a) Permanent distortion, flats and other obvious defects.

(b) Tackiness or surface hardening or softening.

(c) Blistering, peeling or cracks when rubber is extended or flexed.

(d) Chafing of outer covering and corrosion of, or damage to, end fittings of hose assemblies and cable harnesses.

(e) Corrosion of metal elements in bonded rubber to metal assemblies.

IDENTIFICATION OF RUBBER SEALING RINGS			
Identification colour code			
Base colour	Number and colour of spots or lines	Material	Code
black	1 yellow	F/E	or WAD
black	1 yellow, 1 white	PE/FK	or WAJ
black	1 yellow, 1 blue, 1 green	R/G	or WAG
black	2 yellow	E/ORK	
black	2 yellow, 1 blue	PE/EK	or WAM
black	2 yellow, 2 green	VE/S	or WAT
black	3 yellow	PE/OZR	or WAK
black	4 yellow	VE/KR	or WAS
black	part number in white ink	PE/DCR	or WAL
black	1 white, 1 blue	PE/ELR	
black	1 white, 2 blue	B/SK	or WAB
black	1 white, 2 green	E/PVC	or WAQ
black	1 white, 1 blue, 1 yellow	E/XCF	or WAP
black	1 blue, 1 green	E/ORP	
black	1 blue, 1 white, 1 green	PE/ERS	
black	1 blue, 1 green, 1 yellow	N/GP	or WAC
black	2 blue	E/ORS	
black	3 blue	N/Q	
black	1 green, 1 white	PE/FR	
black	1 green, 1 yellow	E/OR	
black	1 green, 2 yellow	E/ORK	or WAN
black	3 green	PE/RN	
black	4 green	VE/HT	or WAR
brick red	2 black graphite	SE/DT	
red	1 green	GF/ST	
red	None, self-coloured	E/ET	
orange	None, self-coloured	SE/MP	or WAH
green	None, self-coloured	SE/F	
blue	None, self-coloured	SE/G	
pale blue	None, self-coloured	SE/CH	or WAU
grey	None, self-coloured	SE/FM	
brown	None, self-coloured	SE/MH	
brownish red	None, self-coloured	SE/DTA	
light brown	None, self-coloured		WAF
brown	None, packaged		WAY
brown	None, packaged		WAZ

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(f) Obstruction of the bore (flexible hoses).

(4) Pressure test flexible hoses as instructed in the relevant sections of this manual. If it is essential to fit a flexible hose when no facilities for pressure testing exist, then the hose must be removed for testing at the first available opportunity. On completion of pressure testing, drain the hose, blow through with clean air and seal the ends with blanks.

(5) Test electrical cables and harnesses for resistance, leakage and conductivity, as well as for chafing of the loom and satisfactory condition of the end fittings, as instructed in the relevant sections of this manual.

C. Lubrication

(1) Avoid indiscriminate use of lubricants when fitting rubber sealing rings; use only the recommended lubricant and apply sparingly immediately before fitting the rings to a unit or engine. Failure to observe the foregoing instructions can result in premature swelling of the rubber sealing rings during assembling.

CAUTION: DO NOT USE A LUBRICANT ON RUBBER SEALING RINGS OTHER THAN THAT RECOMMENDED FOR THE PARTICULAR APPLICATION.

(2) The choice of lubricant is controlled by the environment of the rubber sealing rings, i.e. air, fuel or oil system, rather than by the type of material from which they are manufactured. Unless otherwise instructed, the lubricants to be used during the fitting of rubber sealing rings are as follows:-

(a) Air system - Silicone rubber lubricant, 33H/9424829

(b) Fuel system - Liquid paraffin, 63G/274

(c) Oil system - clean engine oil, 34B/9100591

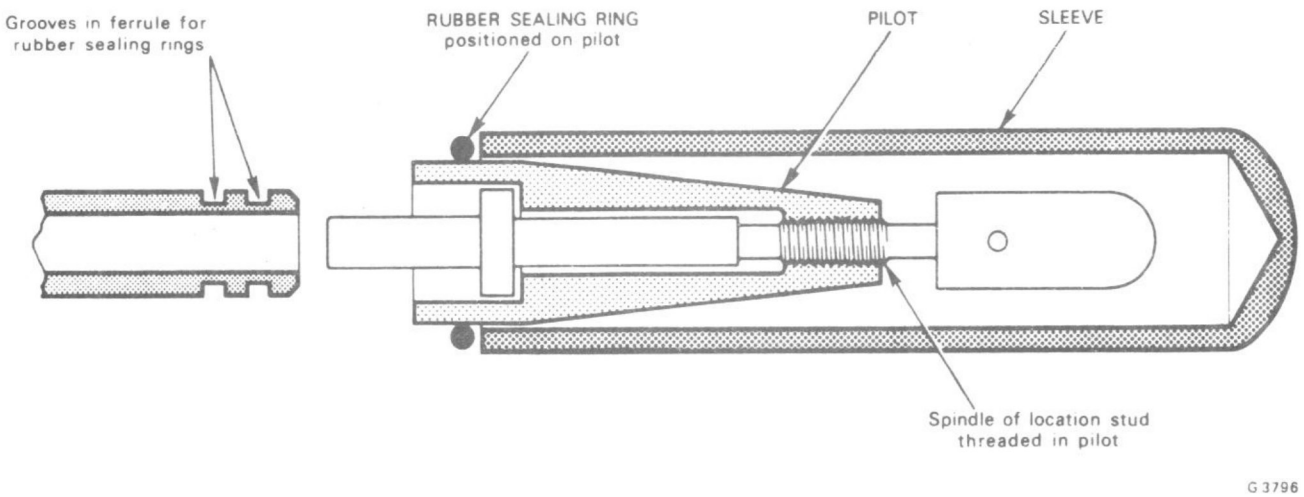
D. Fitting

(1) Use new rubber sealing rings when assembling units or engines.

(2) Cancelled

(3) Ensure that grooves and mating faces, to which the rubber sealing rings are to be fitted, are clean and smooth then lightly smear the grooves and mating faces with the recommended lubricant. Apply the lubricant, sparingly, to the total surface area of the rubber sealing rings before fitting.

(4) Take care to avoid stretching or twisting the rubber sealing rings whilst fitting; ensure that when fitted the rings are not twisted and that they are correctly seated in their grooves.



Typical pilot and sleeve assembling tool
Fig.2A

(5) Do not fit rubber sealing rings to any section of the engine whilst it is still hot, otherwise the sealing rings may stretch and be more liable to damage.

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(6) Prevent rubber sealing ring breakages when fitting these items in such locations as fuel pipe double grooved ferrules by using a suitable pilot and sleeve assembling tool (Fig.2.A).

(7) Before fitting ferrules and tubes into their mating sockets check that the exposed surfaces of the rubber sealing rings are thinly coated with the recommended lubricant. Use a straight pushing movement to fit the ferrules and tubes into their sockets; this action will prevent twisting of the rubber sealing rings.

4. Jointing compound application

A. Jointing compound SQ32L (Ref.No.34B/1983516) must be applied as follows:

(1) Degrease the mating faces with a clean cloth soaked in trichloroethylene.

(2) Apply the compound to both mating faces, using a stiff bristled brush.

(3) Allow at least 10 minutes to elapse before assembling; torque tighten the securing nuts or bolts, wait at least 5 minutes and re-tighten.

5. Torque tightening technique

A. General

(1) A predetermined torque load is applied to nuts, bolts and setscrews to prevent overstressing and to provide optimum security. During assembling of the parts and assembling of the complete engine, nuts, bolts and setscrews must be tightened to either a special load for a particular application or to a standard load for the size of screw thread used. The parts to be torque tightened to special loads are listed at the end of this section. Tables of standard torque loads are included in this section. Parts for which no special load is specified should be tightened to the standard loads listed in the tables.

(2) Use clean engine oil for lubricating screw threads and abutment faces unless otherwise instructed.

(3) Whenever it becomes necessary to retighten nuts, remove the nuts then clean and lubricate the threads before refitting the nuts and retightening to the specified torque load.

CAUTION: FAILURE TO CARRY OUT THE ABOVE INSTRUCTIONS COULD RESULT EITHER IN AN INADEQUATE CLAMPING LOAD OR, IF THE CORRECT TORQUE LOAD IS EXCEEDED IN AN ATTEMPT TO INCREASE THE CLAMPING LOAD, IN DAMAGE TO THE THREADS WHICH MAY NOT BE OBVIOUS AT THE TIME BUT WHICH MAY CAUSE FAILURE OF THE JOINT DURING SERVICE.

(4) Preliminary smoothing of threads and mating faces.

NOTE: This need only be carried out where torque loads in excess of 250 lbf ft are to be applied.

(a) Lubricate the threads and mating faces of the nut and washer with clean engine oil, unless otherwise instructed.

(b) Tighten the nut until approximately half the recommended torque load value is obtained.

(c) Slacken the nut then retighten until the full torque load value is reached.

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(5) Where locking plates, tabwashers or split pins (cotter pins) are used as locking devices observe the following:

(a) If a single torque load value is specified, then it is permissible, and in many instances, necessary, to exceed the prescribed torque load value by continuing to tighten the nut until the next locking position is reached.

CAUTION: DO NOT SLACKEN THE NUT TO OBTAIN THE LOCKING POSITION.

(b) If a minimum and a maximum torque load value is quoted, the final torque load value applied must be within the prescribed range.

CAUTION: FAILURE TO COMPLY WITH THESE INSTRUCTIONS MAY RESULT IN FAILURE OF THE UNIT OR ENGINE.

(6) When using jointing compound on a joint face which is to be torque loaded, recheck the torque load and retighten the nuts, bolts or setscrews, if necessary, after a delay of at least 10 minutes.

(7) Shrouded tabwashers are prone to 'dishing' during manufacture and, with a single torque tightening application, the washers do not always flatten satisfactorily. Therefore, where shrouded tabwashers are used, effect a double tightening procedure, as follows:

(a) Lubricate the screw threads and mating faces with clean engine oil unless otherwise instructed.

(b) Tighten the nut to the full torque load.

(c) Slacken the nut then retighten until the full torque load value is obtained.

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B. Hand torque wrenches

(1) Flexible beam type

(a) To obtain a correct reading, the handle should be gripped lightly with one hand. As the pull must be applied at right angles (90 degrees) to the centre line of the wrench, the handle should float on the pivot-point thus concentrating the force or load at the correct point, refer to fig.1 The position of the hand should not be altered so as to change the concentration of the force from the pivot-point to any other position on the handle. The following tables list flexible beam type torque wrenches and their torque load ranges:

FLEXIBLE BEAM TORQUE WRENCHES

Table 1 - lbf in range

Load range lbf in	Rolls-Royce tool number	Size of drive
0-50	1703079	7/32 in hexagon
40-200	1703080	9/32 in hexagon
150-600	1703081	3/8 in square

Table 2 - lbf ft range

Load range lbf ft	Rolls-Royce tool number	Size of drive
40-150	3403424	1/2 in square
100-300	3403426	3/4 in square

(b) To ensure the greatest possible accuracy in reading the scale values, choose a torque wrench which, when in use, will register within the higher range of the scale. The first quarter of the scale must not be used for mandatory loads. This is because the accuracy with which small loads can be read at the beginning of the scale is not considered adequate, and, wherever possible, a wrench should be selected where full benefit would be obtained from the scale provided. Some flexible beam torque wrenches may have the 'unacceptable' part of the scale blank.

(2) Inspection of wrenches in service

(a) Check, under conditions of no load, that the torque indicating pointer intersects the zero mark on the scale; if not, then adjust as instructed in the torque wrench manufacturer's instruction book.

C. Adapters

(1) Adapters for torque wrenches are available as follows:

Table 3

ADAPTERS FOR TORQUE WRENCHES			
Rolls-Royce tool No.	Adapter size		Application
	input	output	
KU12951A	7/32 in hexagon	9/32 in square	To enable socket spanners (input size 9/32 in sq) to be used with wrench 1703079 (driving tang size 7/32 in hex)
KU12952A	7/32 in hexagon	3/8 in square	To enable extension spanners (input size 3/8 in sq) to be used with wrench 1703079 (driving tang size 7/32 in hex)
AK137	9/32 in square	3/8 in square	To enable socket spanners (input size 3/8 in sq) and/or extension spanners (input size 3/8 in sq) to be used with wrench 1703080 (driving tang size 9/32 in sq)

D. Extension

(1) Use of an extension spanner has the effect of increasing the leverage of the torque wrench, therefore if the scale reading is not corrected to suit the length of extension used, then the nut or bolt would be overtightened with possible serious results.

(2) To obtain true readings when using an extension spanner:

(a) Grip the wrench handle as previously described and keep the extension spanner in line with the wrench (fig.1).

(b) Correct the wrench scale reading in accordance with the following formula:

$$\text{Indicated scale reading} = \frac{\text{required torque x length of wrench lever (A)}}{\text{length of wrench lever (A) + length of extension spanner (B)}}$$

Example

An 0.250 in diameter nut is to be tightened by a 10 in torque wrench using a 3 in extension spanner. The actual torque load required is 75 lbf in at the nut. Then, using the formula.

$$\text{Indicated scale reading} = \frac{75 \times 10}{10 + 3} = \frac{750}{13} = 58 \text{ lbf in}$$

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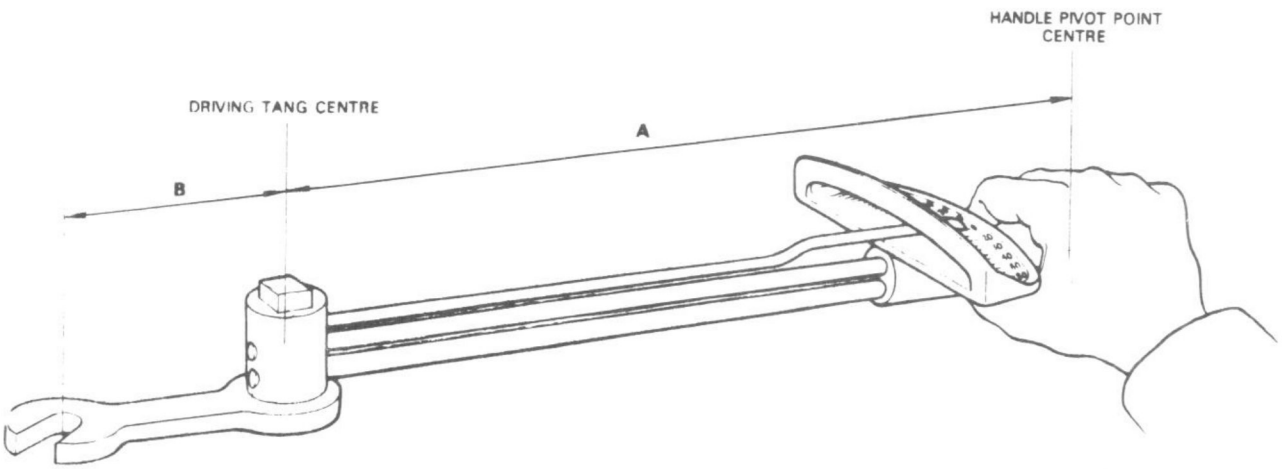

Correct method of using extension spanner with torque wrench
Fig.3.

E. Reduction gearbox

(1) Reduction gearboxes may be fitted to torque wrenches when the torque load required is greater than the normal maximum of the wrench, and the torque wrench reading corrected to compensate for the reduction gear ratio.

PS14/6
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F. Power wrenches

(1) Power wrenching must only be used for preliminary tightening of nuts and bolts. The power wrench must be set to give 50 per cent of the final torque load and the final torque applied by use of the approved hand torque wrench.

G. Fitting studs

(1) Apply the standard torque loads listed in table 4 unless special torque loads are specified.

H. Fitting serrated head sealing plugs

(1) Apply the torque loads listed in table 5 to serrated head sealing plugs fitted into either aluminium or magnesium unless special values are specified elsewhere.

(2) Do not overtighten sealing plugs beyond the recommended torque load value to cure a leak. If necessary, fit a new sealing plug and/or recondition the plug seating.

J. Fitting non self-locking nuts to studs or bolts; also fitting bolts, used as setscrews, in non self-locking thread holes

(1) Apply the standard torque loads listed in table 6 unless special torque loads are specified.

K. Fitting self-locking nuts to studs and bolts; also fitting bolts, used as setscrews, in self-locking wire thread inserts or in self-locking thread captive nuts

(1) Apply the standard torque loads listed in table 8 unless special torque loads are specified.

(2) Self-locking nuts and inserts have a limited life which depends, mainly, on their ability to retain their in-built (self-locking) torque. For values of acceptable range of in-built torque, refer to table 7.

(3) In-built torque of self-locking nut or insert.

(a) In-built torque is the torque required to start the nut or setscrew turning when:

(i) The nut is engaged on the stud or bolt (or the setscrew is engaged in the insert or captive nut) with the full chamfer of the stud or bolt (or setscrew) extending beyond the locking device of the nut, insert or captive nut.

(ii) There is no axial load on the nut or bolt.

(b) Do not alter the in-built torque of a nut or insert by 'crimping' the locking device or by 'easing' it by use of a thread tap.

L. Tube connections (union nuts, tube and hose connections)

(1) Apply the torque load values listed in tables 9, 10 and 11 to all standard connections unless otherwise instructed.

CAUTION: PREVENT DAMAGE TO TUBES AND UNIONS BY USING A SUITABLE SPANNER TO PREVENT ROTATION OF THE UNION WHEN ASSEMBLING OR DISASSEMBLING A TUBE CONNECTION.

(2) Bed-in nut and nipple connections as follows:

(a) Assemble nut and nipple to the union and tighten to the recommended torque load value.

(b) Loosen the connection by slackening the nut by half a turn.

(c) Tighten and loosen twice more.

(d) Finally tighten to recommended torque load value.

(3) Rectify a leaking connection by disassembling the nut and nipple connection, examining parts for cause of failure to seal, and, if necessary, fitting new parts. Reassemble as detailed in L. (2) (a) to (d).

CAUTION: DO NOT EXCEED THE SPECIFIED TORQUE LOAD VALUE WHEN TRYING TO ACHIEVE A SATISFACTORY SEAL.

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M. Torque load tables

Table 4

STANDARD TORQUE LOADS FOR DRIVING STUDS						
Nominal thread size (small end if stepped)	Minimum			Maximum		
	lbf in	kgf cm	N m	lbf in	kgf cm	N m
2 BA	21.0	24.2	2.37	42.0	48.4	4.74
10 UN	23.0	26.5	2.60	46.0	53.0	5.20
0.250 in	45.0	51.9	5.08	90.0	104.0	10.2
0.3125 in	104.0	120.0	11.7	207.0	238.0	23.4
0.375 in	178.0	205.0	20.1	356.0	410.0	40.2
0.4375 in	285.0	328.0	32.2	569.0	655.0	64.3

Table 5

STANDARD TORQUE LOADS FOR FITTING SERRATED HEAD SEALING PLUGS (UNIFIED OR WHITWORTH THREADS)			
Nominal diameter	Torque load		
	lbf in	kgf cm	N m
0.250 in	20.0	23.04	2.26
0.3125 in	30.0	34.56	3.39
0.375 in	45.0	51.85	5.08
0.4375 in	65.0	74.88	7.34
0.500 in	90.0	103.69	10.2
0.5625 in	90.0	103.69	10.2
0.625 in	140.0	161.30	15.8
0.6875 in	180.0	207.38	20.3
0.750 in	180.0	207.38	20.3

Table 6

STANDARD TORQUE LOADS
FOR NON SELF-LOCKING NUTS AND FOR SETSCREWS IN NON SELF-LOCKING THREAD HOLES

Thread size	Column A (See NOTE: 1 below)			Column B (See NOTE: 2 below)		
	lbf in	kgf cm	N m	lbf in	kgf cm	N m
6 UN	8.0	9.22	0.90	10.0	11.52	1.13
8 UN	10.0	11.52	1.13	15.0	17.28	1.69
10 UN	25.0	28.80	2.82	35.0	40.32	3.95
2 BA	25.0	28.80	2.82	35.0	40.32	3.95
1 BA	35.0	40.32	3.95	50.0	57.61	5.65
0.250 in	75.0	86.41	8.47	100.0	115.21	11.3
0.3125 in	135.0	155.53	15.25	170.0	195.86	19.2
0.375 in	235.0	270.75	26.55	300.0	345.64	33.9
0.4375 in	360.0	414.76	40.68	450.0	518.46	50.8
0.500 in	575.0	662.47	64.97			
	lbf ft	kgf m	N m	lbf ft	kgf m	N m
0.500 in				63.0	8.71	85.4
0.5625 in	62.0	8.57	84.1	79.0	10.92	107.0
0.625 in	90.0	12.44	122.0	113.0	15.62	153.0

NOTE: 1. For combinations of cadmium plated nuts with cadmium plated bolts, cadmium plated nuts with unplated bolts and unplated nuts with cadmium plated bolts, use column A of the above table.

2. For combinations of silver plated nuts with unplated bolts, unplated nuts with silver plated bolts and unplated nuts with unplated bolts, use column B of the above table.

PS14/6
Mvn

Table 7

IN-BUILT (OR RUN-DOWN) TORQUE
RANGE OF ACCEPTABLE LIMITS FOR SELF-LOCKING NUTS, SELF-LOCKING WIRE THREAD INSERTS AND CAPTIVE NUTS

Thread size	Minimum			Maximum		
	lbf in	kgf cm	N m	lbf cm	kgf cm	N m
4 UN	0.5	0.57	0.056	3.00	3.46	0.338
6 UN	1.0	1.15	0.113	6.0	6.91	0.676
8 UN	1.5	1.72	0.169	9.0	10.37	1.017
10 UN	2.0	2.30	0.225	18.0	20.74	2.03
0.250 in	3.5	4.00	0.394	30.0	34.56	3.39
0.3125 in	6.5	7.48	0.733	60.0	69.12	6.78
0.375 in	9.5	10.94	1.07	80.0	92.17	9.04
0.4375 in	14.0	16.13	1.58	100.0	115.21	11.3
0.500 in	18.0	20.74	2.03	150.0	172.82	17.0
0.5625 in	24.0	27.65	2.71	200.0	230.43	22.6
0.625 in	32.0	36.86	3.62	300.0	345.64	33.9
0.750 in	50.0	57.61	5.65	400.0	460.85	45.2
0.875 in	70.0	80.65	7.91	600.0	691.27	67.8
				lbf ft	kgf m	N m
1.000 in	92.0	105.4	10.4	66.6	9.20	90.3
1.125 in	117.0	134.79	13.2	75.0	10.37	102.0
1.250 in	143.0	164.76	16.2	83.3	11.52	113.0

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Table 8

STANDARD TORQUE LOADS
FOR SELF-LOCKING NUTS, ALSO FOR SETSCREWS IN SELF-LOCKING WIRE THREAD INSERTS AND CAPTIVE NUTS

Thread size	Column A (See NOTE: 1 below)			Column B (See NOTE: 2 below)		
	lbf in	kgf cm	N m	lbf in	kgf cm	N m
6 UN	10.0	11.52	1.13	12.0	13.82	1.36
8 UN	15.0	17.28	1.69	20.0	23.04	2.26
10 UN	30.0	34.56	3.39	40.0	46.09	4.52
0.250 in	90.0	103.69	10.17	100.0	115.21	11.3
0.3125 in	170.0	195.86	19.2	210.0	241.95	23.7
0.375 in	310.0	357.16	35.0	370.0	426.27	41.8
0.4375 in	410.0	472.37	46.3	490.0	564.54	55.4
	lbf ft	kgf m	N m	lbf ft	kgf m	N m
0.500 in	53.33	7.373	72.3	65.83	9.100	89.3
0.5625 in	69.16	9.560	93.8	84.16	11.628	114.0
0.625 in	100.00	13.826	136.0	120.83	16.705	164.0

NOTE: 1. For combinations of cadmium plated nuts or inserts with cadmium plated bolts, cadmium plated nuts or inserts with unplated bolts, and unplated nuts or inserts with cadmium plated bolts, use column A of the above table.

2. For combinations of silver plated nuts or inserts with unplated bolts, unplated nuts or inserts with unplated bolts and unplated nuts or inserts with silver plated bolts, use column B of the above table.

PS14/6
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Table 9

STANDARD TORQUE LOADS
FOR DOUBLE-ENDED UNIONS (PARALLEL TYPE)
WHITWORTH (B.S.P.) THREAD

Outside diameter of pipe (inches)	Nominal thread diameter (inches)	Torque load		
		lbf in	kg cm	N m
1/8	0.383	150.0	172.82	17.0
3/16	0.4375	175.0	201.63	19.8
1/4	0.518	205.0	236.19	23.2
5/16	0.600	260.0	299.55	29.4
3/8	0.656	290.0	334.12	32.8
7/16	0.750	320.0	368.68	36.2
1/2	0.825	355.0	409.01	40.1
5/8	0.902	390.0	449.33	44.1
3/4	1.041	505.0	581.82	57.1
7/8	1.189	600.0	691.27	67.8
		lbf ft	kg m	N m
1.00	1.309	59.0	8.157	80.0
1 1/4	1.650	87.5	12.097	119.0
1 1/2	1.882	119.0	16.453	161.0
1 3/4	2.116	160.0	22.121	217.0
2.00	2.347	208.0	28.757	282.0

NOTE: When fitted into a casing or casting, the 'fast' (or casing) ends of parallel unions are subject to a torque load which, to aid security of location, is of a higher value than the torque load specified for the union nuts.

PS14/6
Mvn

Table 10

STANDARD TORQUE LOADS
FOR DOUBLE-ENDED UNIONS (STEPPED TYPE)
WHITWORTH (B.S.P.) THREAD

Outside diameter of pipe (inches)	Nominal thread diameter (inches)		Torque load		
	large end	small end	lbf in	kg cm	N m
1/8	0.518	0.383	170.0	195.86	19.2
3/16	0.518	0.4375	170.0	195.86	19.2
1/4	0.600	0.518	215.0	247.71	24.3
1/4	0.656	0.518	240.0	276.52	27.1
5/16	0.750	0.600	265.0	305.31	29.9
3/8	0.750	0.656	265.0	305.31	29.9
3/8	0.825	0.656	295.0	339.88	33.3
7/16	0.825	0.750	295.0	339.88	33.3
1/2	0.902	0.825	325.0	374.44	36.7

NOTE: When fitted into a casing or casting, the 'fast' (or casing) ends of stepped unions are subject to a torque load which, to aid security of location, is of a higher value than the torque load specified for the union nuts.

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Table 11

STANDARD TORQUE LOADS
FOR UNION NUTS (THRUST WIRE TYPE)
WHITWORTH (B.S.P.) THREAD

Outside diameter of pipe (inches)	Nominal thread diameter (inches)	Torque load		
		lbf in	kg cm	N m
1/8	0.383	125.0	144.01	14.1
3/16	0.4375	145.0	167.06	16.4
1/4	0.518	170.0	195.86	19.2
5/16	0.600	215.0	257.71	24.3
3/8	0.656	240.0	276.52	27.1
7/16	0.750	265.0	305.31	29.9
1/2	0.825	295.0	339.88	33.3
5/8	0.902	325.0	374.44	36.7
3/4	1.041	420.0	483.89	47.5
7/8	1.189	500.0	576.06	56.5
1.00	1.309	590.0	679.75	66.7
		lbf ft	kg m	N m
1 1/4	1.650	73.0	10.093	99.0
1 1/2	1.882	99.0	13.687	134.0
1 3/4	2.116	133.0	18.389	180.0
2.00	2.347	173.0	23.919	235.0

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6. Special torque loads

A. Using engine oil as lubricant.

(1) Nut, high pressure oil filter cover - 90 lbf in.

(2) Bolt, return oil filter cover - 90 lbf in.

(3) Nuts, main fuel manifold to burners - 200 lbf in.

(4) Nuts, pilot fuel manifold to burners - 80 lbf in.

(5) Nuts, burner main fuel connection - 300 lbf in.

(6) Setscrews, front bearing housing to compressor casing - 80 lbf in.

(7) Nuts, compressor casing halves - 220 lbf in.

(8) Setscrews, compressor casing to compressor outlet casing - 125 lbf in.

(9) Nuts, auxiliary gearbox housing bracket - 135 lbf in.

(10) Nuts, exhaust unit to nozzle box - 50 lbf in.

(11) Gland nuts, securing pipe between the upper outlet connection and the metering block - 150 lbf in.

(12) Gland nuts, securing pipe between the fuel cooled oil cooler and the metering block - 150 lbf in.

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(13) Screws, filter housing to pump - 75 lbf in.

(14) Nut, jet pipe top temperature control, actuator lever ball end to control rod - 30 lbf in.

(15) Screw, control rod end to relay lever Mod.5489 - 75 lbf in.

B. Using anti-seize compound ZX-28G (Ref.No.34B/9437518) as lubricant.

(1) High energy igniter plugs - 100 lbf in.

7. Locking devices

To accommodate locking devices, it is permissible to continue tightening to the next locking position. For all locking wire applications use 22 S.W.G. stainless steel wire.

8. Precautions

It is possible for deposits of cadmium to be transferred from a cadmium plated tool to the surface of an engine component; in the case of titanium components this could result in rapid failure of the component under certain running conditions. The failure is caused by the cadmium reacting at certain temperatures with the titanium resulting in embrittlement and cracking. In view of this, any tool or item or equipment which is liable to come into contact with titanium must not be cadmium plated.

If it is necessary to rotate, or 'motor' the engine disconnect the low tension (l.t.) electrical supply to the high-energy ignition units.

WARNING: THE ELECTRICAL ENERGY WHICH MAY BE STORED IN THE CONDENSERS OF THE HIGH ENERGY IGNITION UNITS IS POTENTIALLY LETHAL. BEFORE HANDLING THE UNIT, PLUG OR H.T. CABLE, DISCONNECT THE L.T. SUPPLY AND WAIT FOR AT LEAST ONE MINUTE TO PERMIT THE STORED ENERGY TO DISSIPATE.

Before commencing work on or near an engine, ensure that the starting switch is OFF and that the high pressure and low pressure fuel cocks are CLOSED.

The air intake and the final nozzle must be protected by the covers provided and all apertures which are uncovered as work progresses must be immediately and adequately blanked. Transportation blanks removed from a replacement unit should be fitted to the unserviceable unit as soon as convenient after it is removed.

WARNING: THE SYNTHETIC OIL USED IN THE LUBRICATION SYSTEM CONTAINS ADDITIVES WHICH, IF ALLOWED TO CONTACT THE SKIN FOR PROLONGED PERIODS, CAN BE TOXIC THROUGH SKIN ABSORPTION. THE OIL MUST NOT BE MIXED WITH ANY OTHER OIL. IT IS INJURIOUS TO PAINTWORK AND CERTAIN TYPES OF RUBBER AND MUST NOT BE ALLOWED TO CONTAMINATE ANY COMPONENT NOT NORMALLY IN CONTACT WITH IT. SPILLED OIL MUST BE WIPED UP IMMEDIATELY. MJG Gwn

Only the oil specified in Leading Particulars may be used for internal lubrication of the engine and for assembling the parts which are lubricated by the oil.

Before a replacement unit is fitted, it must be drained and flushed out to ensure that inhibiting oil does not mix with the fluid in the system.

To avoid damage to rubber seals and pipe union threads, all pipes should, where possible, be disconnected at their seal housing flanges. During reassembling, special care is required to ensure that each rubber sealing ring is correctly located in its groove and does not become trapped between the joint faces.

Ensure that all bonding leads are refitted correctly; leads which are too slack or too tight are liable to failure.

A note should be made of all tools and loose items used in the vicinity of the engine and a check made on completion of work. Ensure that all tools and loose items are removed before attempting to start the engine.

8A. Identification of 12-point self-locking nuts for low and high temperature applications

A. These two types of self-locking nuts are geometrically similar, but with the following distinguishing features.

(1) Nuts that must be used in the hotter engine zones, in working temperatures of 230°C (446°F) to 650°C (1,202°F) are non-magnetic, silver plated and partically knurled on the flange; see Fig.4.

(2) Nuts that are restricted to use in the colder engine zones, in working temperatures not exceeding 230°C (446°F) are magnetic, cadmium plated and coated with molybdenum disulphide (black. They feature a plain flange. See Fig.4.

(3) Positive identification of used nuts into these two broad groups, can only be done by individually checking each nut with a magnet.

(4) Ensure that only the correct nut (as defined in the schedule of spare parts) if fitted. It must not be assumed that all low temperature zones of the engine feature cadmium plated nuts, as quite often high temperature type nuts are by design to be found in these areas.

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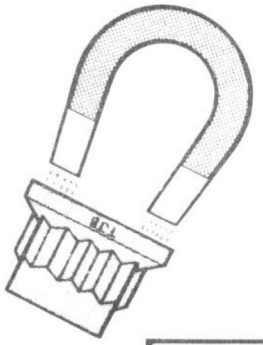
IDENTIFICATION OF SELF-LOCKING NUTS

FITTING OF LOW TEMPERATURE NUTS IN HIGH TEMPERATURE AREAS WILL CAUSE ENGINE FAILURE

LOW TEMPERATURE NUTS UP TO 230°C



MATERIAL:- MEDIUM CARBON Ni-Cr-Mo STEEL

FINISH :- CADMIUM PLATE + BLACK COATING OF MOLYBDENUM DISULPHIDE

IDENTIFICATION:-NUT FLANGE HAS NO KNURLING

THESE NUTS ARE **MAGNETIC**

HIGH TEMPERATURE NUTS UP TO 650°C

MATERIAL:- 15% Cr - 25% Ni HEAT & CORROSION - RESISTANT STEEL.

FINISH:- SILVER PLATE

IDENTIFICATION:- NUT FLANGE IS **KNURLED**

THESE NUTS ARE NOT MAGNETIC

THESE NUTS BECOME BLACK AFTER USE

LOW TEMPERATURE NUTS ARE BLACK & HIGH TEMPERATURE NUTS ARE BRIGHT WHEN NEW BUT-

DO NOT IDENTIFY BY COLOUR AFTER USE

NUT TYPE	THREAD SIZE	ALTERNATIVE RR NUMBERS		NUT TYPE	THREAD SIZE	ALTERNATIVE RR NUMBERS		SBAC N°
THESE NUTS HAVE MANUFACTURER'S CODE ONLY ON THE FLANGE				THESE NUTS HAVE PART N° AND/OR MANUFACTURER'S CODE ON THE FLANGE	No 8-36	1205943	U125943	AS20623
	No 10-32	1205924	U125924		No 10-32	1205944	U125944	AS20624
	.250-28	1205925	U125925		.250-28	1205945	U125945	AS20625
	.3125-24	1205926	U125926		.3125-24	1205946	U125946	AS20626
	.375-24	1205927	U125927		.375-24	1205947	U125947	AS20627
	.4375-20	1205928	U125928		.4375-20	1205948	U125948	AS20628
REGULAR NUT	.500-20	1205929	U125929	REGULAR NUT	.500-20	1205949	U125949	AS20629
THESE NUTS HAVE PART N° & MANUFACTURER'S CODE ON THE FLANGE				THESE NUTS HAVE PART N° AND/OR MANUFACTURER'S CODE ON THE FLANGE	No 8-36	1209171	U129171	AS27821
	No 10-32	1209162	U129162		No 10-32	1209172	U129172	AS27822
	.250-28	1209163	U129163		.250-28	1209173	U129173	AS27823
	.3125-24	1209164	U129164		.3125-24	1209174	U129174	AS27824
	.375-24	1209165	U129165		.375-24	1209175	U129175	AS27825
DEEP COUNTERBORED NUT				DEEP COUNTERBORED NUT				

TML 5405

Identification of 12-point self-locking nuts
Fig.4