National Defence / Défense nationale

D-30-108-000/SF-001
1989-07-05

SPECIFICATION

FOR

REBUILDING THE VW 1.7 LITRE ENGINE ASSEMBLIES USED IN

TRUCKS, UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2805-21-896-1461

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the VW 1.7 litre engine complete with accessories, used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Cdn Series used by the Canadian Forces. This specification includes separate specifications for each of the accessories and all include rebuild procedures, standards, testing, special tools, painting, preservation, packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high quality standards for rebuilding the subject engine and accessories in order to provide an engine assembly with a long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Related documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal:

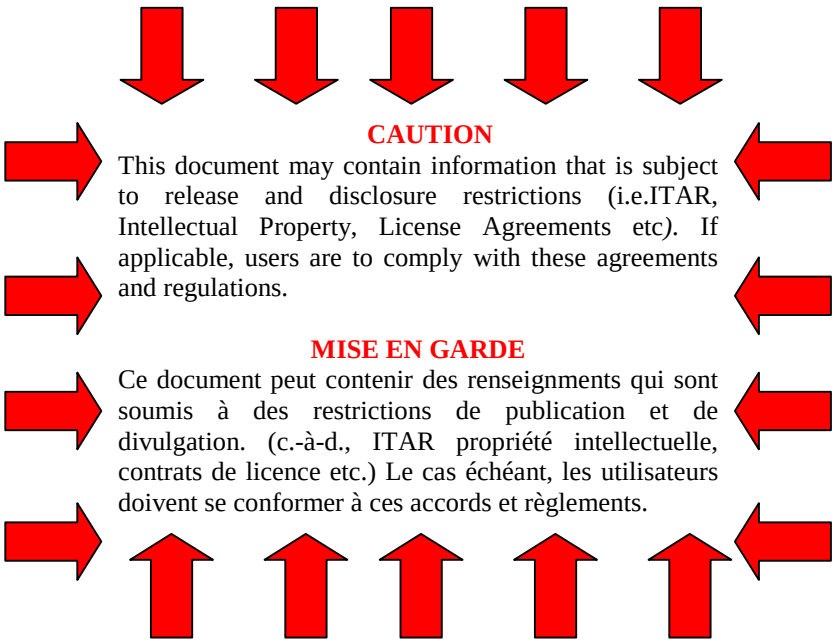
SPECIFICATIONS AND STANDARDS

AQAP-4	NATO Inspection System Requirements for Industry

OPI/BPR DSVEM 2

Issued on Authority of the Chief of the Defence Staff
Publiée avec l'autorisation du Chef de l'état-major de la Défense

Canada



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MIL-G-10924	Grease, Automotive and Artillery
MIL-L-2104	Lubricating Oil, Internal Combustion Engine, Tactical Service
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)
MIL-C-16173(1)	Gasoline, Automotive

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is as shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario K1A 0S9

1-GP-12	Standard Paint Colours
1-GP-76	Enamel, Heat Resistant, Interior and Exterior
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant
CAN2-3.890M	Coolant Concentrate, Automotive Engine
CAN2-3.8M	Dry Cleaning Solvent
1-GP-105	Paint, Primer, Quick Drying
31-GP-3	Compound, Corrosion Preventive, Solvent Cut- back, Cold Application (soft film)

3. REQUIREMENTS

3.1 General.- The contractor shall overhaul used engine assemblies and their related components supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.5. The contractor shall return each overhauled engine assembly to DND as a complete drop-in engine including all accessories and

components as specified herein. The engine shall be ready to run after depreservation and installation.

3.1.1 The engine assembly shall be completely stripped of all accessories and then completely disassembled. All components as listed in 3.5.2 shall be thoroughly cleaned and dried before being inspected for condition and wear. Dry cleaning solvent CAN2-3.8M or commercial equivalent may be used for cleaning.

3.1.2 The following accessories shall be completely disassembled, cleaned, inspected, and rebuilt as per the standards and procedures listed within their respective specifications. These specifications have been added as Annexes as follows:

(a) Annex A - Cylinder Head Rebuild Specifications.

(b) Annex B - Oil Pump Rebuild Specifications.

(c) Annex C - Coolant Pump Rebuild Specifications.

(d) Annex D - Distributor Rebuild Specifications.

(e) Annex E - Carburetor Rebuild Specifications.

(f) Annex F - Alternator Rebuild Specifications.

(g) Annex G - Flywheel Rebuild Specifications.

(h) Annex H - Clutch Assembly Rebuild Specifications.

3.1.3 Components listed in Table II Mandatory Parts Replacement shall be replaced with new Original Equipment Manufacturer (OEM) parts during rebuild.

3.1.4 Any components missing from the engine assembly at time of disassembly shall be replaced with serviceable or new OEM components at time of rebuild. Table III lists components that could be missing.

3.1.5 The contractor shall record all measurements required to determine component wear and condition. These measurements shall be recorded on data sheets designed and provided by the contractor and compared to the standards listed in 3.5.4. Components that do not meet minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices, If the serviceability of a component is in doubt, the component shall be replaced. Quality Assurance Authority shall be consulted in all such cases.

3.1.6 For procedures not detailed in this specification, the contractor shall complete the work in accordance with accepted good engineering practices. The standards of workmanship and material shall be acceptable to the Quality Assurance Authority (QAA).

3.1.7 The contractor shall ensure that all components are secured as per the Torque Standards listed in Table V.

3.1.8 The contractor shall use tools designed for the purpose of the operation to be performed. Tools other than the Special Tools listed in Table VI must be approved by QAA. General rebuild tools and machines, eg, ridge remover and surface grinder, shall be in good working order.

3.1.9 Upon completion of rebuild, the engine assembly shall consist of all the components listed in Table I. Figures 1 to 8 are provided for component identification and. location within the assembly.

3.1.10 Each overhauled engine shall be subjected to a break-in run and power check, on an engine dynamometer, as specified in 3.5.5.

3.1.11 When the overhaul and run-in has been given final acceptance by QAA, the engine assembly shall be painted, preserved and packaged in accordance with the procedures in 5.

3.1.12 General Engine Data.- The following information is provided to assist the contractor in rebuild and run-in of the engine assembly:

GENERAL ENGINE DATA

Manufacture	Volkswagen
Engine Code Letters	049 YX
Number of Cylinders	Four
Cylinder Layout	In-Line - No. 1 at camshaft drive end of engine and numbered consecutively to the rear
Cylinder Bore (Std)	79.5 mm
Piston Stroke	86.4 mm
Piston Displacement	1.7 litres or 1714 cu cm
Compression Ratio	8.2:1
Horsepower	55 kW at 5000 RPM

Torque	135 Nm at 2800 RPM
Valve Operation	Belt driven single overhead camshaft
Oil Type	SAE 15W40 (MIL-L-2104D)
Oil Capacity - without filter - with filter	4.0 litres 4.5 litres
Oil Pressure - minimum	2.0 bar at 2500 RPM with oil temperature approximately 80°C
Oil Filter - Make/Model	Fram PH-2870-A
Air Cleaner - Make/Model	FARR MC164213
Coolant Capacity	7.5 litres
Antifreeze - Type - Strength	Ethylene Glycol (CAN 2-3.890M) 60 per cent antifreeze/40 per cent water
Radiator Cap Opening Pressure	1.2 to 1.35 bar
Carburetor Type	Solex 1-B-l single barrel downdraft
Fuel Pump	24V electric
Fuel Requirement	Minimum 90 octane RON - regular leaded gasoline
Distributor Type	Bosch 24V transistorized
Starter - Make/Model	Bosch/0-001-316-00
Alternator - Make/Model - Output Voltage - Output Current	Leece Neville/7518 JA 28V 60/100 Amps
Spark Plug Type	Bosch WC7D

3.2 Engine Assembly Components.- The following Table lists all of the components of the VW 1.7 litre engine assembly, refer to Figures 1 to 8 for component identification and location within the assembly.

Table I Engine assembly

Figure	Item	NSN	MRN	Description	Qty
1	9	2510-12-175-4159	B 23 199 307	Support - Left Engine	1
1	10	5310-21-898-4417	N 012 040 1	Washer – Lock (10 X 18.1 X 1.8)	3
1	11	5305-12-126-8022	N 10 251 2	Scr - Hex Hd (M10 X 18)	3
1	14	2510-12-175-4158	183 199 308	Support – Right Engine	1
1	15		N 010 241 4	Scr - Hex Hd (M8 X 22)	4
1	16	5310-12-142-8159	N 012 229 3	Washer – Spring (A8 X 15 X .5)	4
2	1		B 183 100 103	Engine - Short	1
2	2		049 107 065 AE	Piston Assy (79.50)	4
2	2		049 107 071 AE	Piston Assy (79.75 OS)	4
2	2		049 107 081 AE	Piston Assy (80.00 OS)	4
2	2		049 107 091 AE	Piston Assy (80.50 OS)	4
2	3		056 107 441	Circlip (C22)	8
2	4		049 198 151 B	Set - Piston Rings (79.50)	4
2	4		049 198 153 B	Set - Piston Rings (79.75)	4
2	4		049 198 155 B	Set - Piston Rings (80.00)	4
2	4		049 198 157 B	Set - Piston Rings (80.50)	4
2	5		056 107 411	Pin - Piston	4
2	6		056 105 425 C	Bolt - Conrod	8
2	7		056 105 427	Nut - Hex	8
2	8		056 198 401	Set - Conrod	1
2	9		056 105 431	Bushing Conrod	1

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	10		056 198 501	Set - Conrod Brg Shell	1
2	10		056 198 503	Set - Conrod Brg Shell (0.25)	1
2	10		056 198 505	Set - Conrod Brg Shell (0.50)	1
2	10		056 198 507	Set - Conrod Brg Shell (0.75)	1
2	11		056 105 425 B	Conrod - Scr	2
2	12	2990-12-175-5016	056 103 541	Bushing - Dist and Oil Pump	1
2	13		B 183 198 011	Plate Assy – Blanking	1
2	14	5330-21-896-7460	056 127 311 A	Gasket	1
2	15	2805-21-896-1462	063 103 113	Plate - Blanking	1
2	16	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	5
2	17		N 014 707 2	Scr - Socket Hd (M8 X 15)	2
2	18	5340-21-897-8257	N 011 907 4	Cap (14)	2
2	19	5340-21-897-8283	059 103 113	Plug - Frost	3
2	20		B 183 198 007	Flange Assy -Rear	1
2	21		026 103 051 A	Seal - Shaft Ring	1
2	22	2805-12-175-1906	055 103 173 B	Flange - Rear Sealing	1
2	23	5330-12-174-1849	052 103 181	Gasket - Rear Flange	1
2	24	5305-12-172-7318	222 060 756	Scr - Hex Hd (M6 X 18)	8
2	25	5310-12-142-8171	224 860 025	Washer - Spring (B6 X 12 X 0.5)	8
2	26	5315-12-124-0032	N 043 207 2	Pin - Dowel (8H8 X 14)	4
2	27	5340-21-897-8282	056 103 117	Plug - (Optional)	1
2	27		N 016 201 1	Rivet – (4.8 X 14.5) (Optional)	1
2	28		049 105 021 AA	Crankshaft	1
2	29		049 198 451	Set Crankshaft Brg	1

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	30		N 010 465 3	Scr - Hex Hd (M10 X 65) (M14 X 1.5 X 40)	10
2	31	3020-12-175-5018	049 105 263 C	Wheel - Sprocket	1
2	32	5310-21-897-8241	068 105 193 A	Washer	1
2	33	5306-21-893-8665	N 100 132 01	Scr - Hex Hdl	
2	34	5315-12-195-4628	N 012 708 2	Key - Woodruff	1
				Pan Assy - Oil	1
2	36	5330-12-174-1354	049 103 609 A	Gasket - Pan	1
2	37	2805-12-175-1907	049 103 603 J	Pan	1
2	38	5340-21-897-8255	B 183 198 005	Plug - Assy	1
2	39	5330-12-156-4552	N 013 821 2	Seal (C26 X 32 X 2.5)	1
2	40	5365-12-175-8866	059 103 193	Plug	1
2	41	5305-21-893-8741	N 090 245 2	Scr - c/w Washer (M6 X 18)	19
2	42	5306-21-893-8778	N 040 347 2	Scr - Hex Hd (M6 X 90)	1
2	43	5330-12-156-4516	N 013 804 2	Seal (A6 X 10 X 1)	1
2	44	530.5-12-142-8501	222 081 355	Scr - Hex Hd (M8 X 75)	2
2	45	5310-21-896-2645	N 012 228 3	Washer - Spring (B8 X 15 X 0.8)	2
2	46	2805-12-175-1912	049 115 105 J	Pump - Oil	1
2	57	5305-12-156-4863	222 080 455	Scr - Hex Hd (M8 X 20)	1
2	58		B 183 198 009	Flange Assy -Front	1
2	59	5330-12-174-2427	056 103 161	Gasket – Front Flange	1
2	60	2805-12-175-1905	056 103 153	Flange – Front Sealing	1
2	61	5330-12-188-6480	068 103 085 A	Seal	1
2	62	5305-12-136-4443	N 010 137 1	Scr - Hex Hd (M12 X 1.5 X 35)	1
2	63	5310-12-175-6307	056 109 143	Washer	1
2	64	5305-12-141-9867	222 081 356	Scr - Hex Hd (M8 X 25)	2
2	65	3020-12-175-5023	049 109 111 B	Wheel - Sprocket	1
2	66	5330-12-188-6480	068 103 085 A	Seal	1
2	67		027 115 033	Flange - Guide Ring	1

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	68	5330-12-174-1848	056 115 037	Seal	1
2	69		049 115 017 B	Shaft -Intermediate	1
2	70	2990-21-896-1453	B 183 255 013	Heater Assy - Block	1
2	71	5340-21-897-8286	PC 2	Plug - Protector	1
2	72	6150-21-897-2647	555	Cord	1
2	73		108 B	Heater	1
2	74	5975-12-180-3172	431 971 848	Clip	1
2	77	5340-00-057-3037	MS 21333-111	Clamp	1
2	78		049 103 011 E	Cylinder Block Assy	1
2	79	2805-21-896-1452	049 115 631	Pipe – Guide Dipstick	1
2	80	2805-21-892-4543	049 198 001 E	Set - Engine Seal	1
2	81	3110-12-175-5017	056 105 313 C	Bearing - Pilot	1
3	4	5330-21-896-7426	B 183 198 015 A	Gasket – Cylinder Head Cover	1
3	5	5330-12-181-7436	049 103 383 D	Gasket – Cylinder Head	1
3	6	5310-12-175-6306	056 103 377	Washer	10
3	7	5305-12-175-2658	049 103 385 A	Scr - Cylinder Head	10
3	8	2805-12-175-1908	049 103 469 J	Cover - Valve	1
3	9	5330-12-173-5261	059 103 487	Gasket - Oil Filler Cap	1
3	10	2990-12-175-1909	056 103 591	Strip -Reinforcement	2
3	11	5310-12-156-4991	N 011 006 8	Nut - Hex (M6)	8
3	12	2805-12-175-3892	049 103 485 A	Cap - c/w Gasket-Oil Filler	1
3	13		B 183 198 012 E	Kit - Cyl Hd Gasket	1
3	14		B 183 198 012 C	Kit - Cyl Hd Gasket	1
3	15	5310-12-184-8509	N 011 524 7	Washer - Flat (6.4 X 12.5 X 1.6)	2
3	16	5340-12-180-3169	183 721 697	Holder – Accelerator Cable	1

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
3	17	2990-12-175-3352	B 049 905 477	Bracket - Ignition Cable Holder	2
3	18	2990-12-175-3891	049 905 471	Holder - Ignition Cable	2
4	9	6680-12-173-3878	049 115 611 A	Dipstick Assy - Oil	1
4	10	5330-12-188-5372	049 115 441	Gasket	1
4	11	2940-21-892-4546	049 115 417 D	Flange - Oil Filter	1
4	12	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	7
4	13	5305-21-893-8812	N 147 263	Scr - Socket Hd (M8 X 30)	3
4	14	4730-12-175-5024	059 115 721	Union	1
4	15	2940-12-172-8350	PH-2870A	Filter - Oil	1
4	16	3020-21-897-6988	8482006	Pulley	1
4	17	5305-21-893-8811	N 147 062	Scr - Socket Hd (M8 X 12)	4
4	18	5930-21-201-0858	049 919 521 A	Sending Unit - Oil Temp	1
4	19	5330-12-147-5526	059 121 119	Seal	1
4	20	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	4
4	21	5305-21-897-8248	N 102 441 1	Scr - Hex Hd (M8 X 30)	2
4	22	5306-21-893-8763	N 103 508	Scr - Hex Hd (M8 X 50)	2
5	3	2990-12-179-3680	055 109 127 A	Cover - c/w Packing Piece	1
5	4	5310-12-142-8171	N 012 226 5	Washer - Spring (B6 X 12 X 0.5)	3
5	5	5305-12-156-4860	N 102 121 4	Scr - Hex Hd (M6 X 12)	1
5	6	5340-12-179-5853	049 109 273	Plug	1
5	8	5307-12-175-6005	049 109 166	Stud - w/Hex Flats	1
5	9	5365-12-175-8249	049 109 271	Piece - Packing	1
5	10	3030-12-172-9974	056 109 119 A	Belt - Timing	1

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
5	11	5306-12-179-5059	N 900 534 01	Scr - Hammer (M6 X 35)	1
5	12	2990-12-179-3681	049 109 175	Cover - Timing Belt Lower	1
5	1.3	5310-12-142-8157	N 012 227 3	Washer - Spring (A6 X 11 X 0.5)	1
5	1.4	5305-12-142-5'943	N 147 053	Scr - Socket Hd (M6 X 25)	1
5	1.4	5305-12-142-0188	222 060 855	Scr - Hex Hd (M10 X 22)	1
5	15	5310-21-893-8682	N 011 133 2	Nut - Hex (M10)	1
5	16	5310-12-125-0069	N 012 231 1	Washer – Spring (A10 X 18 X .8)	1
5	17		026 109 243	Tensioner	1
5	18		B 183 198 029	Guard Assy - Timing Belt Upper	1
5	19	5310-12-175-6309	049 109 207	Nut - Collared w/Scr	1
5	20	5325-12-175-3893.	056 129 669 B	Grommet	1
5	21	5340-12-180-3594	049 109 291 A	Plug	1
5	22	2990-12-179-3679	055 109 107 B	Guard - Timing Belt Upper	1
5	23	9330-12-179-5385	049 109 188 B	Seal	1
6	1		N 020 353 5	Hose	4
6	2	4720-12-176-6064	N 020 139 1	Line - Vacuum (500 mm)	2
6	3	4730-21-896-9370	6822.316	Cap	1
6	4	4730-01-074-0060	1598738000	Tee	1
6	5		N 900 603 1	Clip - Cable (6.5 X 120)	1
6	6	2805-21-896-1466	B 183 198 085	Manifold Assy - Exhaust	1 1
6	7	5330-12-173-3045	056 129 589	Gasket – Exhaust Manifold	4
6	8	2805-12-175-3894	049 129 591 J	Manifold -Exhaust	1
6	9		N 044 514 1	Stud (M8 X 25)	6
6	10	5330-12-173-3046	B 183 253 137 A	Gasket – Front Exhaust	1
6	11	5310-12-175-6315	803 253 111	Nut - Hex	6

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
6	12	5310-12-145-5250	N 115 582	Washer - Flat (8.4 X 15 X 1.6)	14
6	13	5310-12-175-6310	059 129 601	Nut - Hex	9
6	14	5307-21-893-8677	N 044 511 1	Stud (M8 X 18)	1
6	15	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	2
6	16	5365-12-181-7815	055 129 723 A	Support – Intake Manifold	1
6	17	5305-12-164-6653	N 102 391 1	Scr - Hex Hd (M8 X 18)	1
6	18	5305-12-195-4626	N 147 513	Scr - Socket Hd (M8 X 50)	4
6	19	5305-21-893-8725	N 447 142	Scr - Socket Hd (M8 X 80)	2
6	20	2805-21-896-1467	B 183 198 087	Manifold Assy -	1
6	21	5330-12-179-4910	049 129 717 A	Gasket – Intake Manifold	1 1
6	22	2805-12-175-1915	049 129 711 L	Manifold - Intake	1
7	1	5305-21-896-9611	N 044 721 1	Scr - Socket Hd (M8 X 125)	1
7	2	5305-12-146-8456	N 010 241 15	Scr - Hex Hd (M8 X 22)	1
7	3	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	1
7	4	5365-12-175-8252	059 903 127 A	Bushing - Flanged	1
7	5	5325-12-176-5881	059 903 263 A	Bushing - Rubber	1
7	6	2920-21-896-1469	8482131	Arm Assy - Adj	1
7	7	5310-12-175-6314	059 903 265 A	Cup - Washer (R7)	1
7	8	5305-21-897-8248	N 010 244 11	Scr - Hex Hd (M8 X 30)	1
7	9	5305-21-897-8253	222 002 565	Scr - Hex Hd (M10 X 1.5 X 25)	1
7	10	5310-21-896-9750	224 701 170	Washer - Lock (10 MM)	1
7	11	5310-21-674-2825	W-179ZP Type 2	Washer - Flat	1
7	12	5310-21-896-9591	N 022 146 1	Nut - Lock (M8)	1
7	13	5305-12-158-7150	N 010 293 5	Scr - Hex Hd (M8 X 16)	2
7	14	5310-12-145-5250	N 011 558 2	Washer - Spring (8.4 X 15 X 1.6)	2
7	15	3030-21-899-4079	8136-2472 MA	"V" Belt	2

Table I Engine assembly (cont'd)

Figure	Item	NSN	MRN	Description	Qty
7	16	2990-12-175-5025	049 903 105 A	Plate Assy - Retaining	1
7	17	3120-21-897-5073	056 903 147 A	Bushing - Damper	1
7	18	2990-12-175-5026	049 903 103	Bracket Assy	1
7	19	3120-21-897-5073	056 903 147 A	Bushing - Damper	1
8	1	4730-21-896-4241	N 024 510 3	Clamp - Hose (LC16-25)	1
8	2	4720-12-172-8361	049 121 058 C	Hose - Coolant	1
8	3	4730-12-163-3344	N 024 511 3	Clamp - Hose (LC23-35)	4
8	4	4720-12-172-8363	049 121 069 C	Hose - Coolant	1
8	5	4720-12-172-8359	049 121 053	Hose - Water Pump	1
8	6	2920-12-176-1745	049 905 401	Cable - 24V Ign Cyl 1	1
8	7	2920-12-127-7497	049 905 403	Cable - 24V Ign Cyl 2	1
8	8	2920-12-176-1746	049 905 405	Cable - 24V Ign Cyl 3	1
8	9	2920-12-176-1747	049 905 407	Cable - 24V Ign Cyl 4	1
8	10	2920-12-175-5104	049 905 413 D	Cable - 24V Ignition Coil	1
8	11	5330-12-176-2557	049 905 997	Seal - Spark Plug	4
8	12	2920-21-892-4544	WC7D	Spark Plug – (Bosch)	4
8	13	2920-12-190-2405	035 905 251 A	Clamp	1
8	14	5305-12-156-4865	N 010 242 12	Scr - Hex Hd	1
8	14	5305-12-156-4865	N 010 242 12	Scr - Hex Hd	1

3.3 Mandatory Parts Replacement.- The following parts shall be replaced with OEM components during engine assembly rebuild, see Figures 1 to 8 for component identification:

Table II Mandatory Parts Replacement

Figure	Item	NSN	MRN	Description	Qty
1	10	5310-21-898-4417	N 012 040 1	Washer - Lock (10 X 18.1 X 1.8)	3
1	11	5305-12-126-8022	N 10 251 2	Scr - Hex Hd (M10 x 18)	3
1	15		N 010 241 4	Scr - Hex hd (M8 X 22)	4
1	16	5310-12-142-8159	N 012 229 3	Washer - Spring (A8 X 15 X .5)	4
2	4		049 198 151 B	Set - Piston Rings (79.50)	4
2	4		049 198 153 B	Set - Piston Rings (79.75)	4
2	4		049 198 155 B (80.00)	Set - Piston Rings	4
2	4		049 198 157 B (80.50)	Set - Piston Rings	4
2	9		056 105 431	Bushing - Conrod	4
2	10		056 198 501 Shell	Set - Conrod Brg	4
2	10		056 198 503 Shell (0.25)	Set - Conrod Brg	4
2	10		056 198 505 Shell (0.50)	Set - Conrod Brg	4
2	10		056 198 507 Shell (0.75)	Set - Conrod Brg	4
2	12	2990-12-175-5016	056 103 541	Bush - Dist and Oil Pump	1
2	14	5330-21-896-7460	059 127 311 A	Gasket	1
2	16	5310-21-896-2646	244 880 005 (B8 X 15 X 0.8)	Washer - Spring	5
2	17		N 014 708 2 (M8 X 15)	Scr - Socket Hd	2
2	18	5340-21-897-8257	N 011 907 4	Cap (14)	2
2	19	5340-21-897-8283	059 103 113	Plug - Frost	3
2	21		026 103 051 A	Seal - Shaft Ring	1
2	23	5330-12-174-1349	052 103 181	Gasket - Rear Fig	1
2	24	5305-12-172-7318	222 060 756	Scr - Hex Hd (M6 X 18)	8
2	25	5310-12-142-8171	224 860 025	Washer - Spring (B6 X 12 X 0.5)	8

Table II Mandatory parts replacement (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	29		049 198 451	Set - Crankshaft Brg (59 Out)	1
2	29				
2	29				
2	29				
2	32	5310-21-897-8241	068 105 193 A	Washer	1
2	33	5306-21-893-8665	N 100 132 01	Scr - Hex Hd (M14 X 1.5 X 40)	1
2	36	5330-12-174-1354	049 103 609 A	Gasket - Pan	1
2	38	5340-21-897-8255	B 183 198 005	Plug Assy	1
2	41	5305-21-893-8741	N 090 245 2	Scr c/w Washer (M6 X 18)	19
2	42	5306-21-893-8778	N 040 347 2	Scr - Hex Hd (M6 X 90)	1
2	43	5330-12-156-4516	N 013 804 2	Seal (A6 X 10 X 1)	1
2	44	5305-12-142-8501	222 081 355	Scr - Hex Hd (M8 X 90)	2
2	45	5310-21-896-2645	N 012 228 3	Washer - Spring (B8 X 15 X 0.8)	2
2	57	5305-12-156-4863	222 080 455	Scr - Hex Hd (M8 X 20)	1
2	59	5330-12-174-2427	056 103 161	Gasket - Front Flg	1
2	61	5330-12-188-6480	068 103 085 A	Seal	1
2	62	5305-12-136-4443	N 010 137 1	Scr - Hex Hd (M12 X 1.5 X 35)	1
2	64	5305-12-141-9867	222 081 356	Scr - Hex Hd M8 X 25)	2
2	66	5330-12-188-6480	068 103 085 A	Seal	1
2	68	5330-12-174-1848	056 115 037	Seal	1
2	71	5340-21-897-8286	PC 2	Plug - Protector	1
2	74	5975-12-180-3172	431 971 848	Clip	1
2	77	5340-00-057-3037	MS 21333-111	Clamp	1
2	81	3110-12-175-5017	056 105 313 C	Bearing - Pilot	1
3	1	4730-21-896-4241	N 024 510 3	Clamp - Hose (LC16-25)	3
3	2	4730-21-899-5617	B 183 199 449	Elbow - 90 Deg	1
3	3	4720-21-898-2986	B 183 121 033	Hose - Breather	1
3	4	5330-21-896-7426	056 198 025 A	Gasket – Cylinder Head Cover	1
3	5	5330-12-181-7436	049 103 383 D	Gasket – Cylinder Head	1

Table II Mandatory parts replacement (cont'd)

Figure	Item	NSN	MRN	Description	Qty
3	6	5310-12-175-6306	056 103 377	Washer	10
3	7	5305-12-175-2658	049 103 385 A	Scr - Cylinder Head	10
3	9	5330-12-173-5261	059 103 487	Gasket	1
3	11	5310-12-156-4991	N 011 006 8	Nut - Hex (M6)	8
3	15	5310-12-184-8509	N 011 524 7	Washer - Flat (6.4 X 12.5 X 1.6)	2
4	10	5330-12-188-5372	049 115 441	Gasket	1
4	12	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	7
4	13	5305-21-893-8812	N 147 263	Scr - Socket Hd (M8 X 30)	3
4	15	2940-12-172-8350	PH-2870A	Filter - Oil	2
4	17	5305-21-893-8811	N 147 062	Scr - Socket Hd (M8 X 12)	4
4	19	5330-12-147-5526	059 121 119	Seal	1
4	20	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	4
4	21	5305-21-897-8248	N 102 441 1	Scr - Hex Hd (M8 X 30)	2
4	22	5306-21-893-8763	N 103 508	Scr - Hex Hd	2
6	5		N 900 603 1	Clip - Cable (6.5 X 120)	1
6	7	5330-12-173-3045	056 129 589	Gasket – Exhaust Manifold	4
6	9		N 044 514 1	Stud (M8 X 25)	6
6	10	5330-12-173-3046	B 183 253 137 A	Gasket – Front Exhaust	1
6	11	5310-12-175-6315	803 253 111	Nut - Hex	6
6	12	5310-12-145-5250	N 115 582	Washer - Flat (8.4 X 15 X 1.6)	14
6	13	5310-12-175-6310	059 129 601	Nut - Hex	9
6	14	5307-21-893-8677	N 044 511 1	Stud (M8 X 18)	1
6	15	5310-21-896-2(546	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	2
6	17	5305-12-164-6653	N 102 391 1	Scr - Hex Hd (M8 X 18)	1
6	18	5305-12-195-4626	N 147 513	Scr - Socket Hd (M8 X 55)	4
6	19	5305-21-893-8725	N 447 142	Scr - Socket Hd (M8 X 80)	2

Table II Mandatory parts replacement (cont'd)

Figure		NSN		Description	Qty
6	21	5330-12-179-4910	049 129 717 A	Gasket – Intake Manifold	1
7	1	5305-21-896-9611	N 044 721 1	Scr - Socket Hd (M8 X 125)	1
7	2	5305-12-146-8456	N 010 241 15	Scr - Hex Hd	1
7	3	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	1
7	4	5365-12-175-8252	059 903 127 A	Bushing - Flanged	1
7	5	5325-12-176-5881	059 903 263 A	Bushing - Rubber	1
7	7	5310-12-175-6314	059 903 265 A	Cup - Washer (R7)	1
7	8	5305-21-897-8248	N 010 244 11	Scr - Hex Hd (M8 X 30)	1
7	9	5305-21-897-8253	222 002 565	Scr - Hex Hd (M10 X 1.5 X 25)	1
7	10	5310-21-896-S750	224 701 170	Washer - Lock (10 mm)	1
7	11	5310-21-674-2825	N-179ZP Type 2	Washer - Flat	1
7	12	5310-21-896-9591	N 022 146 1	Nut - Lock (M8)	1
7	13	5305-12-158-7150	N 010 293 5	Scr - Hex Hd (M8 X 16)	2
7	14	5310-12-145-5250	N 011 558 2	Washer - Spring (8.4 X 15 X 1.6)	2
7	15	3030-21-899-4079	B 136-2472 MA	"V" Belt	2
7	17	3120-21-897-5073	056 903 147 A	Bush - Damper	1
7	19	3120-21-897-5073	056 903 147 A	Bush - Damper	1
8	1	4730-21-896-4241	N 024 510 3	Clamp - Hose (LC16-25)	3
8	2	4720-12-172-8361	049 121 058 C	Hose - Coolant	1
8	3	4730-12-163-2344	N 024 511 3	Clamp - Hose	2
8	4	4720-12-172-8363	049 121 069 C	Hose - Coolant	1
8	5	4720-12-172-8359	049 121 053	Hose - Water Pump	1
8	11	5330-12-176-2.557	049 905 997	Seal - Spark Plug;	4
8	12	2920-21-892-4544	WC7D	Spark Plug – (Bosch)	4
8	14	5305-12-156-4865	N 010 242 12	Scr - Hex Hd (M8 X 25)	1

3.4 Possible Missing Components.- The following Table lists components that may be missing from the engine assembly at time of disassembly. Missing components other than Mandatory Parts Replacement shall be replaced with new or serviceable OEM components, refer to Figures 1 to 8 for component identification and location within the engine assembly.

Table III Possible missing components

Figure	Item	NSN	MRN	Description	Qty
2	71	5340-21-897-8286	PC 2	Plug - Protector	1
2	72	6150-21-897-2647	555	Cord	1
2	74	5975-12-180-3172	431 971 848	Clip	1
2	77	5340-00-057-3037	MS 21333-111	Clamp	1
3	18	2990-12-175-3891	049 905 471	Holder – Ignition Cable	2
4	9	6680-12-173-3878	049 115 611 A	Dipstick Assy	1
5	6	5340-12-179-5853	049 109 273	Plug	1
5	20	5325-12-175-3893	056 129 669 B	Grommet	1
5	21	5340-12-180-3594	049 109 291 A	Plug	1
5	23	9930-12-179-5385	049 109 188 B	Seal	1
6	1		N 020 353 5	Hose	4
6	2	4720-12-176-6064	N 020 139 1	Line - Vacuum (500 mm)	2
6	3	4730-21-896-9370	6822.316	Cap	1
6	4	4730-01-074-0060	1598738000	Tee	1
6	5		N 900 603 1	Clip - Cable (6.5 X 120)	1
6	9		N 044 514 1	Stud (M8 X 25)	6
6	10	5330-12-173-3046	B 183 253 137 A	Gasket – Front Exhaust	1
6	11	5310-12-175-6315	803 253 111	Nut - Hex	6
7	1	5305-21-396-9611	N 044 721 1	Scr - Socket Hd (M8 X 125)	1
7	9	5305-21-897-8253	222 002 565	Scr - Hex Hd (M10 X 1.5 X 25)	1
7	10	5310-21-896-9750	224 701 170	Washer - Lock (10 mm)	1
7	11	5310-21-674-2825	W-179ZP Type 2	Washer - Flat	1
7	12	5310-21-896-9591	N 022 146 1	Nut - Lock (M8)	1
7	13	5305-12-158-7150	N 010 293 5	Scr - Hex Hd (M8 X 16)	1
7	14	5310-12-145-5250	N 011 558 2	Washer - Lock	1
7	15	3030-21-899-4079	8136-2472 MA	"V" Belt	2
8	1	4730-21-896-4241	N 024 510 3	Clamp - Hose (LC16-25)	1
8	2	4720-12-172-8361	049 121 058 C	Hose - Coolant	1

3.5 Engine Rebuild Procedures.- The following provides the step by step procedures for rebuilding the VW 1.7 litre engine assembly:

3.5.1 Disassemble engine

3.5.1.1 Remove carburetor

(a) Remove the vacuum advance hose.

(b) Remove the four cap screws and flat washers at the base of the carburetor and remove the carburetor.

3.5.1.2 Remove intake manifold

(a) Remove the two coolant hoses from the manifold.

(b) Remove the cap screw, nut and flat washer from the intake to exhaust manifold bracket and remove the bracket.

(c) Remove the six socket head cap screws and flat washers from the manifold and remove the manifold and gasket.

3.5.1.3 Remove exhaust manifold

(a) Remove the eight nuts and flat washers from the manifold.

(b) Remove the manifold and. four gaskets.

3.5.1.4 Remove alternator

(a) Prior to removing the drive belts, loosen the coolant pump and crankshaft pulley cap screws.

(b) Remove the alternator adjusting bolt, flat and lock washer and remove the drive belts.

(c) Remove the oil level dipstick.

(d) Remove the bolt, spring washer, cup/washer and flanged bushing securing the adjusting arm to the head and remove the arm and rubber bushing.

(e) Remove the plug from the timing belt upper cover and using a 6 mm hex head socket, hold the mounting bolt and remove the nut.

(f) Support the alternator and withdraw the mounting bolt.

(g) Remove the alternator from the brackets.

3.5.1.5 Remove coolant pump

(a) Remove the coolant hose from the pump and the coolant connector.

(b) Remove the three socket head screws and remove the pulley.

(c) Remove the bolt, nut, and lock washer that secures the timing belt lower cover to the pump.

(d) Remove the four cap screws that secure the pump to the block and remove the pump and O Ring.

3.5.1.6 Remove distributor

(a) Disconnect the four high tension cables from the spark plugs.

(b) Remove the cap screw from the distributor locking collar.

(c) Remove the collar and distributor.

3.5.1.7 Remove oil filter and housing

(a) Remove the oil filter.

(b) Remove the oil temperature sending unit.

(c) Remove the three socket head screws and spring washers and remove the oil filter housing and gasket.

3.5.1.8 Remove engine mounting brackets and block heater

(a) Remove the three cap screws and lock washers from the left engine mounting bracket and remove the bracket.

(b) Remove the four cap screws and spring washers from the right engine mounting bracket and remove the bracket.

(c) Remove the cap screw and remove the block heater.

(d) Remove the cap screw and flat washer from the block heater cable clamp and remove the cable and clamp.

3.5.1.9 Remove crankshaft pulley

(a) Loosen the alternator adjusting arm screw and remove the two V belts.

(b) Remote the four socket head screws, flat washers and remove the pulley.

3.5.1.10 Remove timing belt and tensioner

(a) Remove the two nuts and flat washers that secure the timing belt upper cover to the valve cover front studs.

(b) Remove the collared nut from the front of the cover and remove the upper cover.

(c) Remove three socket head cap screws, three flat washers and remove the coolant pump pulley.

(d) Remove the socket head screw, cap screw, nut and spring washers securing the lower timing belt cover and remove the cover.

(e) Loosen the cap screws securing the camshaft, crankshaft, and intermediate shaft sprockets.

(f) Remove the nut and spring washer from the timing belt tensioner.

(g) Remove the timing belt and tensioner.

3.5.1.11 Remove intermediate shaft and sprocket

(a) Remove the cap screw and flat washer from the intermediate shaft sprocket and remove the sprocket and woodruff key.

(b) Remove the two cap screws and spring washers from the oil seal carrier and remove the carrier and O Ring.

(c) Pull the intermediate shaft from the block being careful not to hit the distributor drive gear or the fuel pump eccentric on the bearing recesses.

(d) Using a suitable puller, remove the two intermediate shaft bearings from the block.

3.5.1.12 Remove alternator

(a) Remove the alternator mounting screw and nut.

(b) Remove the screw, flat washers and lock washer from the alternator side of the adjusting arm.

(c) Remove the alternator.

3.5.1.13 Remove spark plugs

(a) Disconnect the four ignition cables from the spark plugs and pull the cables out of the ignition cable brackets.

(b) Remove the four spark plugs and four seals.

3.5.1.14 Remove the alternator adjusting arm

(a) Remove the screw» spring washer, washer cup, spacer sleeve and rubber bushing from the alternator adjusting arm.

(b) Remove the alternator adjusting arm.

3.5.1.15 Remove distributor

(a) Remove the screw, spring washer and clamp from the base of the distributor.

(b) Remove the distributor and gasket.

3.5.1.16 Remove oil filter flange

(a) Remove and discard the oil filter.

(b) Remove the four screws, spring washers and oil filter flange with gasket.

3.5.1.17 Remove coolant pump

(a) Remove coolant hoses from pump and engine head.

(b) Remove four cap screws and spring washers from the pump.

(c) Remove pump and O Ring seal from the block.

3.5.1.18 Remove timing belt rear plate

(a) Remove the cap screw and washer from the crankshaft sprocket and remove the sprocket.

(b) Remove the cap screw and the stud from the timing belt rear plate and alternator bracket.

(c) Remove the cap screw and spring washer that secures the rear plate to the head and remove the rear plate and the alternator front bracket.

3.5.1.19 Remove alternator rear bracket

(a) Remove the two cap screws and spring washers from the alternator rear bracket and remove the bracket.

3.5.1.20 Remove valve cover.

(a) Remove the nuts and flat washers securing the accelerator cable mounting bracket and two spark plug wire securing brackets from the left side of the valve cover and remove the brackets.

(b) Remove the remaining valve cover securing nuts and remove the two reinforcement bars.

(c) Remove the valve cover and gasket.

3.5.1.21 Remove cylinder head

(a) Starting at the front and rear of the cylinder head and working towards the centre, using cylinder head bolt bit (OTC 7016), loosen a little at a time, the cylinder head bolts in the sequence shown in Figure 9. Remove the bolts and flat washers.

(b) Remove the cylinder head and gasket. If the head is stuck on, insert a wooden hammer handle into an exhaust port and pry the head loose.

3.5.1.22 Remove oil pan and gasket

(a) Remove the drain plug from the oil pan and drain any oil into a suitable container.

(b) Remove the 20 cap screws and flat washers and remove the oil pan and gasket.

3.5.1.23 Remove oil pump

(a) Remove the two long cap screws and spring washers from the bottom of the oil pump housing.

(b) Lift the oil pump from the engine block.

3.5.1.24 Remove piston assemblies

(a) Mark the tops of unmarked pistons with the piston number and an arrow pointing towards the front of the engine so that the pistons will be reassembled properly.

(b) Remove the connecting rod nuts and connecting rod caps.

CAUTION

If the engine block has any top cylinder ridges, remove them with a ridge reamer before removing the pistons to prevent the rings from catching, see Figure 10.

(c) Using a wooden hammer handle, push the piston/connecting rod assembly away from the crankshaft and through the top of the cylinder.

(d) Immediately after each assembly is removed, mark the cylinder number on both the rod cup and the rod, on the intermediate shaft side. Remove the bearings from the rod and cap.

3.5.1.25 Remove connecting rods and rings from pistons

(a) Using a small punch, remove the circlips from both ends of each piston pin, see Figure 11.

(b) Using tool VW207C, press the pins out of the pistons and remove the connecting rods.

NOTE: If the piston pin is difficult to remove, heat the piston in oil to a temperature of 60°C.

(c) Using a ring remover/installer, remove the two compression and the oil ring from each piston.

3.5.1.26 Remove crankshaft

(a) Remove the six cap screws and spring washers and remove the crankshaft rear seal and carrier.

(b) Remove the three cap screws and spring washers and remove the crank-shaft front seal and carrier.

(c) Remove the seals from the seal carriers.

(d) Using extractor 10-202, remove the pilot bearing from the rear end of the crankshaft.

(e) Remove the bolts from the five main bearing caps and remove the caps and bearings.

NOTE: The main bearing caps are factory numbered to ensure correct installation.

(f) Remove the crankshaft.

(g) Remove the bearing shells from the main bearing saddles.

3.5.1.27 Remove the frost plugs

(a) Remove the caps from the front and rear end of the block.

(b) Remove the three frost plugs from the rear end of the block. 3.5.2 Cleaning and Inspection

3.5.2.1 Cleaning.- Following complete disassembly of the engine, the major accessories listed in 3.1.2 shall be rebuilt as per their respective specifications. The remaining components of the block shall be thoroughly cleaned and dried prior to inspection to determine wear and serviceability.

3.5.2.2 Inspection.- The following components shall be inspected and where necessary measured to determine wear and serviceability. The contractor shall record all measurements and compare them to the standards listed in 3.5.4:

(a) Cylinder block flatness check

i Ensure the block is clean.

ii Check the top of the block for flatness through the centre of bores with an accurate straight edge and feeler gauge, see Figure 12. The surface must not vary more than 0.10 mm longitudinally. If the flatness is not within the above limits, the cylinder block must be resurfaced.

NOTE: Previous rebuild data must be checked as the maximum amount of metal that can be removed from the block is 0.025 mm.

iii Check and clean all bolt hole threads and stud threads. Repair as necessary and lubricate.

(b) Cylinder Bore

i Using a cylinder bore gauge, determine the cylinder diameter and degree of wear. Record the readings, see Figure 13.

NOTE: When checking the cylinder bores, remove the cylinder block from the engine stand, take measurements at three points in each cylinder and at right angles to one another. The first measurement should be made 10 mm from the top. The second measurement should be in the middle of the cylinder, and the third 10 mm from the bottom. Take one set of measurements, first in one direction (eg, across the width of the engine) and then take a second set of measurements in another direction (eg, in line with the crankshaft).

ii Minor variations in cylinder diameter can be corrected by honing. If there is scoring, variations of 0.05 mm or more between the measurements in any one cylinder, or a cylinder is worn to more than 0.08 mm over the original or oversized bore, all the cylinders must be rebored and honed to accept the next larger-size piston.

iii Record the largest bore diameter measurement obtained for each cylinder.

iv Compare these measurements with the honing measurements, see Figure 14.

NOTE: Rebored cylinders must be honed to obtain a clearance of 0.03 mm between the piston and the cylinder wall.

v Compute the piston clearance between the original pistons and their respective cylinders. Subtract the diameter of the piston, see iii, from the maximum diameter of the cylinder. See (c) for piston measurement details.

vi If the piston clearance exceeds the wear limits, but the cylinders are not worn to a diameter that is 0.04 mm greater than their original or oversize honing measurements, correct the clearance by installing new pistons of the same diameter.

vii If piston clearance exceeds the wear limits because of cylinder wall wear, the cylinders must be bored and honed to the next oversize measurement and new pistons of the same oversize measurement installed.

viii If the cylinders have not been rebored, remove the cylinder wall glaze using a (220-grit) hone. Remove the glaze only so that

the rings will properly seat. Remove as little metal as possible, See Figure 15.

NOTE: New replacement engine blocks may have protrusions which will interfere with the proper positioning of the starter motor, see Figure 16. These protrusions must be ground off before assembling the engine components.

(c) Piston and Rings

i Check the pistons for wear. Measure the diameter of the piston at right angles to the piston pin at a point approximately 10mm from the lower edge of the piston skirt, see Figure 17. Compare the measurements obtained with the original piston diameter marked or. the piston crown. Comparison will give an indication of the extent to which the piston is worn. Maximum wear is 0.04 mm. However, it can only be determined whether the piston is suitable for reuse by also measuring the cylinder bore.

ii Using feeler gauges, check the side clearance of all the piston rings, see Figure 18. Piston ring side clearances should be 0,02 to 0.05mm with new parts. When installing new rings, ensure the side clearance is not less than specified. The maximum wear limit for old rings is 0.15mm.

iii Check the ring end gap in the cylinders by pushing each ring about 15 mm into the bottom of the cylinder. Measure the gap in the ring, see Figure 19. New ring gaps should be 0.30 to 0.45mm for the compression rings and 0.25 to 0.40mm for the oil scraper ring. If the gap is too narrow, enlarge it with a file or oil stone. Used rings must not have a ring gap larger than 1.00mm. When replacing rings, they must be of the same group size as the pistons and cylinders.

iv If reusing old pistons, clean the ring grooves with a ring groove cleaning tool.

(d) Piston Pin. - Check the piston pin fit in each connecting rod. If the clearance exceeds 0.04mm, replace the rod and pin or fit a new pin and rod bushing. Hone the bushing to obtain a clearance of 0.01 to 0.02mm. Check rod alignment after fitting new bushings.

(e) Crankshaft

i Using a micrometer, measure the crankshaft main bearing and connecting rod journals. Take measurements at each side of the journal to check for taper, see Figure 20.

ii Check eccentricity. Using a micrometer, take two measurements of the journals, one at 90 from the first, or place the crankshaft on "V" blocks and check run-out with a dial indicator, see Figure 21.

iii Record the measurements of each journal and compare to Figure 22.

NOTE: If the journals are rough, scored, tapered, or exceed 0.03mm out of round, the crankshaft must be replaced or reconditioned to the next repair stage.

(f) Intermediate shaft. - Inspect the intermediate shaft bearing surfaces for scoring and replace the shaft if necessary.

(g) Intake Manifold

i Using a straight edge, check the mating surfaces of the manifold for distortion. If necessary, surface grind until flat.

ii Clean around the ports and ensure the mating surfaces are smooth.

(h) Exhaust Manifold

i Inspect the manifold for cracks.

ii Using a straight edge, check the mounting surface for distortion. If necessary, surface grind until flat.

iii Check exhaust pipe mounting studs and replace as necessary.

(j) Engine mounts.- Inspect the mounts for cracks and damage. Replace if necessary.

(k) Oil seal flanges.- Ensure the mounting surface of the intermediate shaft oil seal flange, the crankshaft front and rear seal flanges and the blanking plate are free of nicks and are smooth.

(m) Timing sprockets.- Inspect the timing sprockets for damaged teeth. Repair or replace as necessary.

(n) Oil pan.- Ensure the sealing surface of the oil pan is free of nicks and is smooth. Inspect the plug threads for damage and repair as necessary.

(p) Oil filter flange.- Ensure the oil filter flange mounting surface is smooth. Inspect the threads of the union and replace if necessary.

(q) Timing belt tensioner.- Inspect the tensioner to ensure it turns freely without binding or grittiness and there is no excessive looseness.

(r) Timing belt covers.- Inspect the covers and rear plate for damage and dents. Repair as necessary.

(s) Valve cover.- Inspect the valve cover for dents and repair as necessary.

(t) Block heater.- Place the block heater in a container of water and check its operation. Inspect the cord for fraying and replace parts as necessary.

(u) Spark plug cables.- Inspect the cables for broken Bakelite, springs, frayed casing and cross threaded caps. Check the continuity in the cables. Replace cables as necessary.

3.5.3 Reassemble engine

3.5.3.1 Install crankshaft (See Figure 23)

NOTE: Ensure the crankshaft (4), bearing shells (3), bearing caps (1) and saddles are clean and the anti-rotation tabs engage in the notches in the saddles. The centre bearing is a flanged thrust bearing (2). Ensure that the shells with oil holes are placed in the saddles of the engine block.

(a) Using original-size new bearing or undersize bearings, depending on the condition of the crankshaft, install the upper bearing shells (with oil holes and lubrication grooves) in the saddles of the engine block.

(b) Place the crankshaft in the block.

(c) Place the lower bearing shells in the bearing caps.

(d) Place a small piece of 0.025 - 0.076mm plastigage on each main journal.

NOTE: If checking new bearings installed in a high mileage engine, use plastigage which measures clearances from 0.050 to 0.150mm.

(e) Install the bearing caps over the journals. Ensure the No. 1 cap is at the front and all the numbers are facing away from the intermediate shaft.

(f) Install the bearing cap bolts and torque to 35 Nm (25 ft lb).

NOTE: Do not turn the crankshaft.

(g) Remove the bolts and bearing caps.

(h) Using the plastigage package, measure the bearing clearance as indicated by the squash of the plastigage, See Figure 24. The clearance should be 0.03 to 0.08mm for new bearings. If the clearance exceeds 0.17 mm, replace or recondition the crankshaft.

CAUTION

To prevent damage to the journal, do not scrape off the plastigage.

(j) Using a cleaning solvent, remove the flattened plastigage from the journals and bearing,

(k) Remove the crankshaft and coat the upper bearing with assembly lubricant.

(m) Reinstall the crankshaft and coat the journals with assembly lubricant.

(n) Coat the bearing caps with lubricant and install them over the journals noting their correct location.

(p) Install the bolts and torque to 65 Nm (47 ft lb).

(q) Tap the crankshaft all the way to the rear of the block.

(r) Insert feeler gauges between the crank throw for No. 3 cylinder and the centre main bearing, see Figure 25. With new parts, axial play should be 0.07 to 0.17mm. Axial play is excessive if clearance is 0.37mm or greater. Excessive clearance can usually be corrected by replacing the centre main bearing.

(s) Place a new pilot bearing on bearing installer VW 207C so the writing will be visible when installed and drive the bearing into the rear of the crankshaft. The bearing should have a clearance of 1.5 mm from the end of the crankshaft.

(t) Install a new cap and frost plugs in the front and rear of the block.

(u) Install new seals in the crankshaft seal carriers so that the seal lips will face in when installed. Lightly oil the lips of the seals.

(v) Install new gasket to the rear carrier and secure to the block with the six cap screws and spring washers. Torque to 10 Nm (7 ft lb).

(w) Install a new gasket to the front carrier and secure it to the block with the three cap screws and spring washers. Torque to 10 Nm (7 ft lb). Do not install cap screws in the top and left centre holes as they are for the timing cover capscrews, see Figure 26.

3.5.3.2 Install pistons and connecting rods

NOTE: If the pistons or connecting rods are replaced, all four must be of the same weight class. Connecting rod weight classes are designated by a number on the rod cap. Pistons and connecting rods come in sets of four. Unmarked pistons must be within 10 grams of the weight of the other pistons.

(a) Install one circlip in one end of the piston pin bore.

(b) Heat the piston in an oil bath to 60°C.

(c) Insert the connecting rod into the piston so that when the arrow on the piston crown is facing the front end of the engine, the marks on the connecting rod will be towards the intermediate shaft side of the engine.

(d) Working quickly, so that the piston does not cool, hand press the piston pin into the piston and through the connecting rod bushing. Seat the pin against the circlip that is already installed and then install the second circlip. Ensure the circlips are fully engaged in their grooves.

(e) Using the ring remover/installer, carefully install the rings in the ring grooves. Install the oil scraper ring first.

NOTE: The top compression ring has a chamfer to the inside top. The second compression ring has a groove to the outside bottom. Both rings must be installed with the word "TOP" towards the piston crown. Install the oil scraper ring and its spring with the lettering towards the piston crown.

(f) Turn the crankshaft so that No. 1 connecting rod journal is at BDC.

(g) Thoroughly lubricate the cylinder walls and piston rings.

(h) Stagger the ring gaps so that the oil scraper ring gap is not over the end of the connecting rod pin and the other two gaps offset 120 to each side of the scraper ring gap, see Figure 27.

(j) Install the ring compressor over the piston and tighten to fully compress the rings.

(k) Install the connecting rod upper bearing ensuring that the anti-rotation tab engages in the rod.

(m) Install the piston/connecting rod assembly in the cylinder, with the arrow on the piston crown facing toward the front of the engine block until the ring compressor contacts the block.

(n) Using a wooden hammer handle, press the piston into the cylinder until the connecting rod bearing is seated squarely on the crankshaft journal. Ensure that the crankshaft journal is not nicked by the connecting rod studs.

(p) Install the bearing shell into No. 1 cap.

NOTE: If checking new bearings installed in a high mileage engine, use plastigage which measures clearances from 0.050 to 0.150 mm.

CAUTION

Do not lay the plastigage over the oil hole in the journal.

(q) Place a piece of 0.025-0.076mm plastigage on the bearing journal.

(r) Install the connecting rod cap and torque the nuts to 35 Nm (25 ft lb). Do not turn the crankshaft. Ensure the forged marks or numbers are towards the intermediate shaft.

(s) Remove the cap and measure the bearing clearance with the plastigage package, see Figure 28. with new parts, bearing clearance should be 0.028 to 0.088 mm. If clearance is at the wear limit, 0.12 mm or greater, remove the crankshaft and repair it to the next repair stage, see Figure 22.

(t) If clearance is within specifications, clean the plastigage from the journal with solvent, and lubricate the bearings and journal.

(u) Reinstall the cap and torque the nuts to 45 Nm (33 ft lb).

(v) Install No. 4 piston/connecting rod assembly and perform steps (p) to (u) inclusive.

(w) Hand turn the crankshaft 180° and install Nos. 2 and 3 piston/connecting rod assemblies. Perform steps (p) to (u) inclusive for each rod assembly.

(x) Using feeler gauges, check the axial play of each rod by pushing the rod as far as possible to one side and inserting the feeler gauges between the opposite side and the journal, see Figure 29. Maximum clearance is 0.37 mm. If clearance is in excess, replace the connecting rod or crankshaft.

3.5.3.3 Install oil pump

(a) Install the pump with two cap screws and flat washers and torque to 20 Nm (15 ft lb) .

3.5.3.4 Install oil pan

(a) Install a new gasket on the engine block.

(b) Install the oil pan.

(c) Install the 20 cap screws and flat washers. The longest cap screw is installed in the left rear corner and requires a copper washer.

(d) Torque all cap screws to 10 Nm (7 ft lb).

3.5.3.5 Install cylinder head

(a) Ensure the sealing surface, pistons and cylinders are clean.

(b) Install a new cylinder head gasket on the engine block with the word "OBEN" (TOP) facing up.

(c) Ensure the sealing surface of the cylinder head is clean and place the head on the engine block.

(d) Apply an anti-seize compound to the 10 cylinder head bolts and washers to prevent seizure to the aluminium head and install the bolts and flat washers.

(e) Using Head Bolt Bit (OTC 7016), tighten the cylinder head bolts following the sequence shown in Figure 30 and torque the bolts to 30 Nm (22 ft lb).

(f) Torque the cylinder head bolts to 58 Nm (43 ft lb) following the sequence described in Figure 30.

(g) Torque the cylinder head bolts to 75 Nm (55 ft lb) following the sequence described in Figure 30.

(h) After torquing all cylinder head bolts, turn each bolt a further quarter turn following the sequence described in Figure 30. After completing step (h), it will not be necessary to torque the bolts a second time after the engine is hot or broken in.

3.5.3.6 Install oil filter housing

(a) Install the oil filter housing and a new gasket with three socket head cap screws and spring washers. Torque the screws to 20 Nm (15 ft lb).

(b) Coat the gasket of a new oil filter with clean oil and install the filter by hand. Tighten until the gasket contacts the housing and then turn an additional half turn.

(c) Install the oil temperature sending unit and torque to 10 Nm (7 ft lb).

3.5.3.7 Install alternator rear bracket

(a) Install the alternator rear bracket on the engine block with two cap screws and spring washers and torque to 20 Nm (15 ft lb) .

3.5.3.8 Install timing belt rear plate

(a) Install the alternator front bracket and rear plate on the engine block and install the cap screw and spring washer. Torque the cap screw to 20 Nm (15 ft lb).

(b) Install the stud that secures the top of the bracket and rear plate to the engine block and torque to 20 Nm (15 ft lb).

(c) Install the cap screw and spring washer that secures the timing belt rear plate to the cylinder head and torque the cap screw to 10 Nm (7 ft lb).

3.5.3.9 Install intermediate shaft

(a) Install new bearings ensuring that the oil hole in the bearing aligns with the oil hole in the block. Use a bearing installer that accurately fits the inside of the bearing.

(b) Coat the bearings and gear with engine oil and install the shaft, ensuring the fuel pump eccentric or distributor drive gear do not hit the bushings.

(c) With the lip facing in, install a new seal in the seal carrier, lightly coat the seal lip with oil, install an O Ring and secure the carrier to the block. Install the two cap screws and spring washers and torque to 25 Nm (18 ft lb). Check axial clearance. The maximum clearance is 0.25 mm. If axial clearance exceeds 0.25 mm, install a new seal flange and recheck.

(d) Install the woodruff key and intermediate shaft sprocket.

(e) Install the cap screw and flat washer and torque to 80 Nm (59 ft lb).

3.5.3.10 Install crankshaft sprocket

(a) Install the crankshaft sprocket.

(b) Install the bolt and flat washer and torque to 80 Nm (59 ft lb).

3.5.3.11 Install timing belt

(a) Install the timing belt tensioner on the stud and loosely install the flat washer and locking nut.

(b) Turn the camshaft sprocket until the timing mark on the sprocket is even with the tip at :he top of the timing belt rear plate, see Figure 31. Both camshaft lobes of the No. 1 cylinder must face up at similar angles.

(c) Install the crankshaft pulley with the four socket head screws and spring washers. Ensure the indentation in the pulley aligns with the protrusion in the sprocket.

(d) Turn the intermediate sprocket until the punch mark on the sprocket is in line with the "V mark on the crankshaft pulley, see Figure 32.

(e) Place the timing belt on the crankshaft, intermediate and camshaft sprockets. Ensure the sprockets do not turn while the belt is installed. Ensure the teeth of the belt are correctly engaged in the sprockets, and all the slack of the timing belt is on the side nearest the timing belt tensioner.

(f) Adjust the timing belt tensioner by turning clockwise until the timing belt has the correct tension and then torque the locking nut to 45 Nm (33 ft lb).

NOTE: The timing belt has the correct tension when it can be turned through 90° only, using the thumb and forefinger at a midpoint between the camshaft and intermediate sprockets, or belt deflection is 15 mm.

(g) Rotate the crankshaft through two complete revolutions. Ensure the timing marks are correctly aligned and recheck timing belt tension.

(h) Remove the crankshaft pulley.

(j) Install the lower timing belt cover and torque the cap screws to 10 Nm (7 ft lb).

3.5.3.12 Install distributor and spark plugs

NOTE: Ensure the timing marks are still aligned and the cam lobes of No. one cylinder are facing up.

(a) Turn the rotor and shaft until the rotor electrode faces toward the TCI electrical connector socket.

(b) Turn the oil pump drive lug so that it will align with the slot in the distributor shaft when the distributor is installed, see Figure 33.

NOTE: Ensure there is a rubber seal and fibre washer on the base of the distributor.

(c) With the TCI electrical connector facing the rear, insert the distributor shaft into the engine block and then turn the distributor rotor shaft until the gears mesh, the oil pump lug enters the slot in the distributor shaft and the distributor sits flush on the block.

(d) Install the distributor locking collar and cap screw and torque the cap screw to 15 Nm (11 ft lb).

(e) Install the distributor cap.

(f) Ensure there is a copper gasket and O Ring on each spark plug and install them in the head. Torque to 30 Nm (22 ft lb).

CAUTION

Do not over-tighten the cables.

(g) Install the coil wire and the spark plug high tension cables to the distributor and the spark plugs in a clockwise firing order 1, 3, 4,

2. The distributor No., 1 spark plug terminal is nearest the rear of the engine over the TCI connector.

(h) Tighten the cables using a 19 mm wrench or crows foot.

(j) Install the gasket and blanking plate over the fuel pump hole and secure with two spring washers and socket head screws. Torque to 20 Nm (15 ft lb).

3.5.3.13 Install coolant pump

(a) Install a new O Ring seal in the pump and position it on the engine block. Install the four cap screws and spring washers. The two long cap screws go in the bottom mounting holes. Torque the four cap screws to 20 Nm (15 ft lb).

(b) Install the bolt, nut and spring washer that secure the lower timing belt cover to the coolant pump and torque to 10 Nm (7 ft lb) .

(c) If required, install the coolant pump pulley with three cap screws w/washers.

(d) Install the coolant hose to the pump and the coolant connector on the head.

3.5.3.14 Install the alternator.

(a) Install a new rubber bushing in the alternator adjusting arm and install the arm to the head with the cap screw, spring washer, cup washer and flanged bushing.

(b) Install the alternator in the mounting bracket and insert the mounting bolt through the brackets and alternator from front to rear.

(c) Install the nut on the mounting bolt.

(d) Position the alternator adjusting arm to the alternator and loosely install the cap screw, lock washer and flat washer.

3.5.3.15 Install the valve cover

(a) Ensure the top gasket surface of the cylinder head is clean.

(b) Place a new rubber half seal on the front camshaft bearing cap,

(c) Install a new rubber plug at the rear of the cylinder head.

(d) Install a new cover gasket in the valve cover.

(e) Install the cover on the head and install reinforcement bars on both sides, ensuring the flat side of the bar faces toward the valve cover and the pointed end points toward the rear of the engine, see Figure 34.

(f) Install the timing belt upper cover.

(g) Place the two spark plug wire retaining brackets on the centre left valve cover securing studs.

(h) Place the accelerator cable mounting bracket on the second stud from the front on the left side.

(j) Install a flat washer on both front valve cover securing studs,

(k) Install the eight nuts and torque to 10 Nm (7 ft lb).

(m) Install the plug nut in the timing belt upper cover.

(n) Install a new gasket in the oil filler cap and install it on the valve cover.

3.5.3.16 Install drive belts

(a) Install the crankshaft pulley. Ensure the indentation on the pulley engages in the protrusion on the crankshaft sprocket and install the four socket head screws and spring washers. Do not tighten the screws at this time.

(b) Install the drive belts and adjust belt deflection to 15 mm.

(c) Torque the crankshaft, pulley screws to 20 Nm (15 ft lb) .

(d) Torque the coolant pump pulley cap screws to 20 Nm (15 ft lb).

(e) Torque the alternator mounting screw to 20 Nm (15 ft lb). Torque the alternator adjusting arm cap screw to 20 Nm (15 ft lb).

3.5.3.17 Install engine mounting brackets

(a) Install the right engine mounting bracket with four cap screws and spring washers and torque to 25 Nm (18 ft lb).

(b) Install the left engine mounting bracket with three cap screws and lock washers and torque to 55 Nm (41 ft lb).

(c) Install the oil dipstick.

3.5.3.18 Install exhaust manifold

(a) Install the manifold and new exhaust gaskets. Ensure the gaskets are correctly positioned with the inner edge towards the block.

(b) Install eight nuts and flat washers and torque to 25 Nm (18 ft lb).

(c) Install a new exhaust manifold to exhaust pipe gasket and loosely install six nuts on the studs.

3.5.3.19 Install intake manifold

(a) Install a new gasket on. the intake manifold ports and install the manifold.

(b) Install the socket head cap screws and flat washers and torque to 25 Nm (18 ft lb) .

NOTE: The two longer cap screws go in the second hole from either end.

(c) Install the exhaust to intake manifold bracket on the exhaust manifold stud and install a nut and spring washer.

(d) Install the cap screw and spring washer through the bracket and into the intake manifold and. torque to 20 Nm (15 ft lb) .

(e) Torque the nut on the exhaust manifold bracket to 25 Nm (18 ft lb).

(f) Install the coolant hoses. The lower hose goes to the rear of the cylinder head on the heater connector.

3.5.3.20 Install the carburetor

(a) Ensure the carburetor and intake manifold mounting surfaces are clean.

(b) Install the carburetor on the intake manifold, ensure the side of the carburetor with the air/fuel cutoff valve is nearest the valve cover.

(c) Install the four cap screws, ensuring the ground wire is attached to the cap screw under the: air/fuel cutoff valve.

(d) Tighten the four cap screws.

(e) Install the vacuum advance hose to the carburetor and the front of the vacuum advance unit on the distributor and the vacuum retard hose from the manifold to the rear of the vacuum advance unit.

3.5.3.21 Install the block heater

(a) Install the block heater into the right front frost plug opening and secure it with a socket head screw and flat washer. Torque to 190 Ncm (17 in lb).

(b) Attach the electrical cord to the block heater and secure the cable bracket to the block with a cap screw and spring washer.

3.5.4 Engine rebuild standards.- The following standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of a component. If the sesrviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Engine rebuild standards

Description	Standard
1. Cylinder Block:	
a. Maximum Warpage (total length).	0.10 mm
b. Maximum Permissable Grind (from Original Surface).	0.025 mm
c. Cylinder Bore - Original dia:	79.53 mm
(1) Maximum variations between cylinders.	0,05 mm
(2) Maximum wear before reboring/honing to next size.	0.08 mm
(3) 1st reboring/honing dia.	79.78 mm
(4) 2nd reboring/honing dia.	80.03 mm
(5) 3rd reboring/honing dia.	80.53 mm
(6) Deglazing Cylinder Walls.	Use a. (220-grit) hone.

Engine rebuild standards (cont'd)

Description	Standard
2. Pistons:	
a. Sizes:	
(1) Original dia.	79.50 mm
(2) 1st Oversize.	79.75 mm
(3) 2nd Oversize .	80.00 mm
(4) 3rd Oversize.	80.50 mm
b. Difference between piston and cylinder bore diameter.	0.03 mm
c. Maximum Wear (measured at right angles to piston pin and approx 10 mm from lower edge of. skirt) .	0.04 mm
d. Piston Rings :	
(1) Groove Clearance:	
(a) New parts.	0.02 to 0.05 mm
(b) Max wear.	0.15 mm
(2) Gap - (measured approx 15 mm from bottom of cylinder) :	
(a) New rings - compression.	0.30 to 0.45 mm
(b) New rings - oil scraper.	0.25 to 0.40 mm
(c) Used rings - compression and oil.	1.00 mm - maximum

Engine rebuild standards (cont'd)

Description	Standard
e. Piston Pin:	
(1) Max clearance - pin to bushing.	0.04 mm
(2) Honing clearance - pin to bushing.	0.01 to 0.02 mm
3. Crankshaft Main Journals:	
a. Run-out.	0.03 mm
b. Taper.	0.03 mm
c. Original diameter.	54.00 mm 0.022 mm 0.042 mm
d. 1st Grind undersize.	53.75 mm 0.022 mm 0.042 mm
e. 2nd Grind undersize.	53.50 mm 0.022 mm 0.042 mm
4. Main Bearings:	
a. Clearance:	
(1) New bearings - (using 0.025-0.076 mm plastigage) Torqued to 35 Nm (25 ft lb).	0.03 to 0.08 mm
(2) Used bearings - (using 0.050-0.150 mm plastigage) Torqued to 35 Nm (25 ft lb).	Max 0.17 mm

Engine rebuild standards (cont'd)

Description	Standard
5. Crankshaft End Play (measured at centre main bearing) :	
a. New parts.	0.07 to 0.17 mm
b. Used parts.	0.37 maximum
6. Crankshaft Pilot Bearing:	
a. Diameter new. Max Wear. Clearance from outer end of bearing to end of crankshaft.	1.5 mm
7. Connecting Rod Journals:	
a. Out of round - max.	0.03 mm
b. Taper - max.	0.03 mm
c. Original diameter.	46.00 mm 0.022 mm 0.042 mm
d. 1st Grind underside.	47.75 mm 0.022 mm 0.042 mm
e. 2nd Grind undersize.	45.50 mm 0.022 mm 0.042 mm
f. 3rd Grind undersize.	45.25 mm 0.022 mm 0.42 mm
g. Axial play - max.	0.37 mm
h. Bearing clearance (new bearings using 0.025-0.076 mm plastigage torqued to 35 Nm (25 ft lb).	0.028-0.088 mm

Engine rebuild standards (cont'd)

Description	Standard	
8. Intermediate shaft:		
a. Bearing wear.	Copper shows through silvery bearing surface	
b. Axial Clearance (end play).	0.25 mm - maximum	
9. Valve Clearance (coolant temperature above 35oC and cylinder head warm).		
a. Valve:	SPECIFIED FIGURE	SETTING FIGURE
(1) Intake.	0.2 to 0.3mm	0.25mm
(2) Exhaust.	0.4 to 0.5mm	0.45mm
10. Spark Plug High Tension Cables.	Continuity	
11. Spark Plugs. - gap.	0.7-0.8 mm (.028"- .032")	
12. Engine Mounts.	Not damaged	
13. Oil Seal Flanges.	Not damaged	
14. Timing Sprockets.	Not damaged	
15. Timing Belt Tensioner.	Rotates freely without binding or excessive looseness	
16. Timing Belt Covers.	Not damaged	
17. Valve Cover.	Not damaged	
18. Oil Filler Cap.	Not damaged	
19. Drive Belts - deflection.	10 to 15mm when tested by pressing in centre with thumb	

Engine rebuild standards (cont'd)

Description	Standard
20. Timing Belt - tension.	It should be possible to twist the belt 90° in centre with thumb and forefinger

3.5.5 Engine Dynamometer Break-in Run and Power Check.- Each rebuild engine shall be subjected to a break-in run and power check, on an engine dynamometer, as specified herein.

NOTE: In order to provide a starter installation and power connection to the dynamometer, the contractor will be provided with the following components GSM.

Table IV Government supplied material

NSN	MRN	Description	Qty
2520-21-896-8902	B 183 398 101	Transmission Assy	1
2920-21-896-1319	B 183 911 023	Starter Assy - 24 Volt	1
2805-12-172-8349	056 105 269 N	Flywheel Assy	1
5305-12-179-5384	N 900 720 02	Scr c/w Washer (M10 X 1 X 20)	6
2520-21-894-1606	B 049 1 3 549	Plate - Interim Eng/Gear Box	1
5330-12-175-8254	049 103 583	Gasket - Interim Plate	1
	A 302 101 501	Disc Clutch	1
2520-12-192-3596	A 102 101 203	Pressure Plate - Clutch	1
5305-12-169-6486	N 014 739 1	Scr - Socket Hd (M8 X 16)	1
2520-12-166-2743	113 141 165 B	Bearing - Release	1
5360-12-175-6327	113 141 178 C	Spring - Release Bearing (Right)	1
5360-12-175-6328	113 141 177 C	Spring - Release Bearing (Left)	1
5310-12-156-4982	N 011 030 1	Nut - Hex (M12)	1
5310-12-184-5360	N 011 531 7	Washer - Flat (13 X 24 X 2.5)	5
5306-21-897-8247	N 010 464 1	Scr - Hex Hd (M12 X 80)	1
5306-21-893-8770	N 010 493 2	Scr - Hex Hd (M12 X 68)	4
5306-21-897-824.6	N 010 350 6	Scr - Hex Hd (M8 X 50)	3
5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	6
5305-12-142-8496	N 010 361 4	Scr - Hex Hd (M8 X 65)	3
5310-12-144-6214	N 011 008 13	Nut - Hex (M8)	3
5310-12-175-6312	B 049 911 493	Washer	1
5305-12-142-5841	N 014 721 2	Scr - Socket Hd (M10 X 25)	1

3.5.5.1 Prepare engine for dynamometer check.- Perform the following steps to install the components listed in the previous paragraph to the engine assembly.

(a) Install the intermediate plate

i Remove the engine assembly from the stand.

ii Coat the engine side of the intermediate plate with sealing compound and install the plate.

(b) Install the flywheel

NOTE: Clean the flywheel of paint if necessary.

i Apply Loctite 270 or 271 to each cap screw. Install the flywheel and secure with the capscrews. Install holding tool 10-201 and torque the capscrews to 75 Nm (55 ft lb), See Figure 35.

(c) Install the clutch disc and pressure plate

NOTE: Remove paint from disc and plate if necessary.

i Insert pilot 10-213A into the clutch disc and then into the flywheel pilot bearing.

NOTE: Cloth disc protrusions face towards the pressure plate.

ii Install the clutch pressure plate against the flywheel ensuring the indexing pins of the flywheel fit into the indexing holes of the pressure plate, see Figure 36.

iii Install the six socket head screws and torque to 25 Nm (18 ft lb) in a diagonal sequence.

iv Remove the pilot shaft and flywheel holding tool.

(d) Install the clutch release bearing

i Install the clutch bearing release springs on their respective sides of the bearing.

ii Place the bearing over the transaxle input shaft and sleeve. iii Hook the springs to the release shaft arms

(e) Attach the transaxle to the engine

i Place the gasket cm the clutch housing.

ii Push the transaxle towards the engine, ensuring the input shaft goes through the pressure plate, clutch disc and into the crankshaft pilot bearing.

iii Install the three cap screws and lock washers at the top of the housing but do not. tighten.

iv Install the bolt, washer and nut on the right side of the housing.

v Install the two cap screws and lock washers to the bottom of the housing and torque to 25 Nm (18 ft lb).

vi Torque the other four to 55 Nm (41 ft lb).

(f) Install the starter

i Place the starter into the clutch housing ensuring the teeth of the starter pinion engage the teeth of the flywheel ring gear and the shaft enters the starter bushing.

ii Install the three bolts, through the clutch housing and the starter. Install the flat washers and nuts and torque to 25 Nm (18 ft lb).

iii Install the socket head screw through the front bracket and into the block. Torque to 45 Nm (33 ft lb).

3.5.5.2 Before the engine start-up, the engine shall be prelubricated by forcing SAE 15W40 lubricating oil (MIL-L-2104) into the engine's oiling system and up to the full mark on the dipstick. New oil shall be used for each engine.

3.5.5.3 A remote engine oil cooler shall be used during dynamometer testing.

3.5.5.4 The air induction system for the fuel combustion air shall be so designed that recirculation into the engine of exhaust gases will be prevented.

3.5.5.5 The air induction system for the combustion air shall have an air flow restriction not greater than that of the ILTIS truck.

3.5.5.6 The exhaust system shall be so arranged that back pressures will not exceed normal vehicular conditions. If exhaust systems are constructed to accommodate two or more engines, each engine shall be disconnected from the system immediately after shut down.

3.5.5.7 The contractor shall supply a Cooling System for the dynamometer test. The cooling system capacity shall be adequate to prevent engine overheating with the engine cooling system thermostat in the fully open position.

3.5.5.8 The dynamometer break-in run and power check schedule is as follows :

PERIOD	MINUTES	ENGINE RPM	LOAD ENGINE TO TORQUE NM	OR	LB FT	EQUIVALENT BHP
1	10	1300	84		62	15
2	20	1600	90		66	20
3	20	2400	99		73	33
4	20	2800	101		74	40
5	10	3600	96		71	49
6	10	3800	95		70	51
7	10	2600	100		74	37
8	10	1300	84		62	15

TOTAL TIME: 1 HOUR AND 50 MINUTES.

3.5.5.9 Data shall be compiled on test log sheet during test run format, see Figure 37.

3.5.5.10 Maximum oil consumption during complete test is 0.56 litres (1 pint).

3.5.5.11 Carburetor idle mixture and speed shall be adjusted after completion of test run.

3.5.5.12 Malfunctions noted during run shall be corrected. In the event of major malfunctions, a penalty run shall be performed after correction.

3.5.5.13 Penalty run

(a) Minor defects.- Engine shall be run to assure serviceability of replacement components and satisfactory operation.

(b) Major defects.- Engine shall be completely retested prior to release.

3.5.5.14 Tests and adjustments.- The following tests and adjustments will be performed before the dynamometer break-in check and during, if required:

(a) Valve tappet clearance adjustment

i Warm the engine to a coolant temperature above 35ºC and remove the valve cover.

ii Turn the crankshaft so that the two camshaft lobes for one of the cylinders are facing up at similar angles.

iii Using a feeler gauge measure the clearance between each camshaft lobe and corresponding shim for the intake and exhaust valves of the cylinder.

NOTE: When hot, the clearance between the intake valves and camshaft lobes should be 0.20 mm to 0.30 mm. When hot, the clearance between the exhaust valves and camshaft lobes should be 0.40 mm to 0.50 mm.

iv If the clearance is not within the specified clearance range, remove the shim and install a new shim that is the correct thickness. Proceed as follows:

a. Turn the buckets so that both slots in the bucket face toward the sides of the cylinder head.

b. Using compressing tool Hazet 2574, press both buckets down, away from the camshaft lobes, see Figure 38.

c. Using shim pliers tool 10-208, remove the shim from the buckets. If shim pliers are not available, use low air pressure to remove the shim.

NOTE: Do not discard the shim unless it is damaged. If the numbering, which indicates the thickness of the shim, is worn off, measure the thickness, scribe the thickness on the shim and place the shim in a shim set Matra 10-212.

d. Select a shim from the shim set Matra 10-212 and place the shim in the bucket ensuring the numbering on the shim faces down. Try to choose a shim which will provide a clearance that is in the middle of the clearance range. For example, if installing a new shim for an intake valve in a hot engine, choose a shim that will provide a valve clearance of 0.25 mm.

v Measure the clearance between each of the remaining camshaft lobes and corresponding shims following steps ii and iii for each of the three remaining cylinders and replace the shims as required following step iv.

vi Install the valve cover.

(b) Adjust ignition timing

i Warm the engine to normal operating temperature.

ii Turn "OFF" the accessory switch and attach a tachometer and timing light. Clamp the induction pickup of the timing light over special cable Z401138WE, which is connected between the distributor and spark plug lead for the No. 1 cylinder.

iii Remove the timing plug from the flywheel housing.

NOTE: Do not disconnect the distributor vacuum lines when timing the engine or incorrect timing will result.

iv Start the engine and set the RPM between 900 and 1000 RPM.

v Point the timing light at the timing mark on the flywheel. The TDC timing mark must align with the pointer.

vi Loosen the distributor clamp screw and rotate the distributor as necessary to align the TDC mark with the pointer.

vii Tighten the clamp screw, recheck engine RPM and check the timing again. Torque the clamp screw to 15 Nm (11 ft lb).

(c) Vacuum advance/retard test

i Complete ignition timing.

ii Set the engine at approximately 1500 RPM.

iii Disconnect the vacuum advance hose from the front of the unit. The engine RPM should decrease.

iv Install the vacuum advance hose on the unit.

v Set the engine at idle speed.

vi Disconnect the vacuum retard hose from the rear of the unit. Engine RPM should increase.

vii Install the vacuum retard hose on the unit.

NOTE: If the engine RPM fails to change as described above, check the rubber cap on the vacuum retard line "T" fitting before replacing the unit.

viii Install the timing plug.

ix Disconnect all test equipment.

(d) Cold idling speed adjustment

i Ensure the engine temperature is a minimum of 60ºC (140°F).

ii Connect a tachometer to the engine.

iii Start the engine and adjust the idle speed between 900 and 1000 RPM.

iv Stop the engine and disconnect the carburetor air intake hose from the carburetor.

v Pull the choke cable fully out and check the choke valve operating lever. The lever should be against the stop. Adjust the cable, if necessary.

vi Ensure the mark on the disc points to the centre of the adjusting screw, see Figure 39. If necessary, loosen the clamping screw and rotate the disc until the mark on the disc points to the centre of the adjusting screw and tighten the clamping screw.

vii Without pressing the accelerator pedal, start the engine. With the choke fully open, the engine speed should be 3000 to 3600 RPM.

viii If necessary, adjust engine speed to 3300 RPM. Turn the adjusting screw on the choke clockwise to increase RPM or counter-clockwise to decrease engine RPM.

ix Connect the carburetor air intake hose to the carburetor and disconnect the tachometer from the engine.

(e) Carburetor pulldown unit inspection

i Disconnect the carburetor air intake hose from the carburetor.

ii Start and run the engine at idling speed.

iii Pull the choke choke fully out and close the choke valve by hand. If the choke valve can be easily closed to a gap of about 4 mm before resistance is felt, the pulldown unit is operating correctly. If the choke valve can be completely closed without resistance, the pulldown diaphragm is split or there is a leak In the vacuum system.

iv Connect the carburetor air intake hose to the carburetor.

(f) Choke valve gap adjustment

i Pull the choke cable fully out.

ii Loosen the choke cover screws and rotate the cover counter-clockwise until the choke valve is closed and tighten the cover screws.

iii Using a screwdriver, push the pulldown operating rod in the direction of the pulldown unit until the rod contacts the stop and, using a feeler gauge, measure the choke valve gap on the enrichment tube side of the valve, see Figure 40. The valve gap should be 3.85 to 4.15 mm.

iv If necessary, adjust the choke valve gap. Turn the adjusting screw on the pulldown unit clockwise to decrease the gap and counter-clockwise to increase the gap, see Figure 41.

v Realign the mark on. the choke cover with the mark on the choke body, see Figure 42 and tighten the cover screws.

(g) Air/fuel cutoff valve inspection

i Disconnect the electrical wire from the air/fuel cutoff valve terminal.

ii Turn the accessory switch "ON".

iii Touch the wire to the air/fuel cutoff valve terminal several times. A clicking sound should be heard if the valve is operating correctly.

iv Turn the accessory switch "OFF".

v Connect the wire to the cutoff valve terminal.

(h) Carbon monoxide (CO) content adjustment

i Ensure the exhaust system does not leak.

ii Ensure the engine is at normal operating temperature.

iii Ensure all electrical accessories are turned off.

iv Disconnect the crankcase breather hose from the valve cover and plug the hose.

v Ensure the choke is fully open.

vi Ensure the idle speed is set between 900 and 1000 RPM.

vii Ensure the ignition timing is properly set.

viii Ensure the cooling fans are not operating.

ix Connect the exhaust analyzer following the manufacturer's instructions.

x Start the engine and allow it to run for five minutes.

xi Note the meter reading of the carbon monoxide content and adjust the carburetor CO needle valve until a reading of 0.5 to 1.5% volume of carbon monoxide is obtained.

xii Install the plug over the CO screw.

xiii Turn off the engine, unplug the crankcase breather hose and connect the hose to the valve cover.

xiv Note the CO output. An increase in CO content after connecting the crankcase breather hose is caused by fuel enrichment from the crankcase as the result of oil dilution. If necessary, change the oil to reduce the CO content and recheck.

xv Disconnect the exhaust analyzer.

(j) Cylinder compression test

xvi Start and warm up the engine to about 40°C (104°F).

xvii Remove the spark plugs.

xviii Disconnect the coil HT cable from the distributor cap and connect the cable to a good ground.

xix Install the compression gauge in a spark plug opening.

v Hold the throttle valve fully open and crank the engine until the needle of the compression gauge stops rising and record the reading.

vi Repeat steps iv and v for the remaining three cylinders. The cylinder compression for a new engine should be 900 to 1200 kPa (130 to 174 psi). The minimum allowable cylinder compression is 700 kPa (101 psi). The maximum allowable difference between cylinders is 300 kPa (43 psi).

vii Connect the coil high tension cable to the distributor cap.

Viii Install the spark plugs.

3.5.5.15 Basic tune-up standards

Valve Timing (at 1 mm valve lift)

- Inlet opens	10° before TDC
- Inlet closes	40° after BDC
- Exhaust opens	50° before BDC
- Exhaust closes#	at TDC

Valve Clearance (coolant temperature above 35°C and cylinder head warm.)

- Intake	0.25 mm
- Exhaust	0.45 mm

Compression Pressure	New Engine	Min Allowable	Max Difference
(throttle valve open, engine oil temperature above 30°C)	900-1200kPa	700kPa	300 kPa
Firing Order	1-3-4-2 clockwise		
Stator to Trigger Wheel Gap	0.25 mm		
Rotor Resistance	approximately 5 k ohm		
Pick-up Coil Resistance	.990 to 1.210 k ohm		
Governed RPM	6160-6540 RPM		
Spark Plug Gap	0.7-0.8 mm		
Centrifugal Advance	Crankshaft degrees and RPM		
- Starts	1000-1600 RPM		
	12-17° at 3000 RPM		

- Ends	23-27° at 4200 RPM
Vacuum Advance	Crankshaft degrees
- Begins	26 -340 mbar (195-250 mm Hg)
- Ends	450 mbar (340 mm Hg) 11-15°
Vacuum Retard	Crankshaft degrees
- Begins	140-280 mbar (105-210 mm Hg)
- Ends	320-420 mbar (240-315 mm Hg) 8-10°
Ignition Timing (minimum Oil temperature 30°C - 900-1000 RPM vacuum hoses on)	TDC "0" mark on flywheel in-line with pointer,
Choke Valve Gap (measured on enrichment tube side)	3.85 to 4.15 mm
Cold Idling Speed (adjusted at choke, minimum oil temperature 60°C)	3000-3600 RPM (3300 RPM preferred)
Idling Speed (minimum oil temperature 60°C, no current draw, choke fully open, crankcase breather hose off and plugged)	900-1000 RPM
CO Content (minimum oil temperature 60°C, no current draw, choke fully open, crankcase breather hose off and plugged, idling and timing adjusted)	0.5-1.5% by Volume
V-Belt Tension (checked by pressing with thumb mid-way between alternator and crankcase shaft pulleys)	10-15 mm
Timing Belt Tension	It should be just possible to twist belt 90° in centre with thumb and forefinger

3.5.6 Torque standards.- The following torque standards shall be used when rebuilding the VW 1.7 litre engine assembly, see Figures 1 to 8 for component identification.

Table V Torque standards

Figure	Item	Description	NM	FT LB
1	11	Left Engine Mount Bracket Cap Screws	55	41
1	15	Right Engine Mount Bracket Cap Screws	25	18
2	7	Connecting Rod Nuts	45	3
2	11	Connecting Rod Cap Screws	45	3
2	17	Fuel Pump Blanking Plate Socket Head Screws	20	15
2	24	Crankshaft Seal Carrier Cap Screws (Front and Rear)	10	7
2	30	Crankshaft Bearing Cap Screws	65	47
2	33	Crankshaft Sprocket Cap Screw	80	59
2	40	Oil Pan Drain Plug	30	22
2	41	Oil Pan Cap Screws (Short)	10	7
2	42	Oil Pan Cap Screws (Long)	10	7
2	44	Oil Pump to Block Cap Screws	20	15
2	57	Crankshaft Front Seal Carrier Cap Screws	10	7
2	62	Intermediate Shaft Sprocket Cap Screw	80	59
2	64	Intermediate Shaft Seal Carrier Cap Screw	25	18
2	75	Block Heater Cap Screw	20	15
3	7	Cylinder Head Cap Screws		

0	0	0	0	0
9	3	1	5	7
8	6	2	4	10
0	0	0	0	0

First	30	22
Second	58	43
Third	75	55
Final	1/4	Turn

Table V Torque standards (cont'd)

Figure	Item	Description	NM	FT LB
3	11	Valve Cover Nuts	10	7
4	13	Oil Filter Flange Socket Head Screws	20	15
4	17	Crankshaft Pulley Socket Head Screws	20	15
4		Coolant Pump Cap Screws	20	15
5	5	Timing Belt Rear Plate to Cylinder Head Cap Screw	10	7
5	8	Timing Belt Rear Plate Stud	20	15
5	1	Timing Belt Lower Cover Hammer Screw Nut	10	7
5	14	Timing Belt. Lower Cover Cap Screws	10	7
5	15	Timing Belt. Tensioner Locking Nut	45	33
5	19	Timing Belt. Upper Cover Collared Nut	10	7
6	13	Exhaust Manifold Nuts	25	18
6	13	Exhaust Manifold Bracket Nut	25	18
6	17	Intake Manifold Bracket Cap Screw	20	15
6	18	Intake Manifold Socket Head Screws (Short)	25	18
6	19	Intake Manifold Socket Head Screws (Long)	25	18
7	2	Alternator Front Bracket Cap Screw	20	15
7	8	Alternator Adjusting Arm to Head Cap Screw	30	22
7	9	Alternator Adjusting Cap Screw	20	15
7	12	Alternator Mounting Bolt Nut	20	15

Table V Torque standards (cont'd)

Figure	Item	Description	NM	FT LB
7	13	Alternator Rear Bracket Cap Screws	20	15
8	12	Spark Plugs	30	22
8	14	Distributor Clamp Cap Screw	15	11

3.5.7 Special tools.- The following special tools shall be used when rebuilding the VW 1.7 litre engine. Figure 43 illustrates these tools.

Table VI Special tools

Item	Description	Use	MRN
1	Bolt-Metric Hd Bit (12 mm)	Removing/Installing Head Bolts	OTC 7016
2	Drift-Piston Pin Pilot	Removing /Installing Piston Pins and Installing Pilot Bearing	VW 207C or 10-213
3	Extractor	Removing Crankshaft Pilot Bearing	10-202
4	Pliers	Removing Valve Shims	10-208
5	Tool - Compressing	Compressing Valve Tappets	2574
6	Arrangement - Suspension	Engine Lifting Sling	2024A
7	Holder - Counter	Prevent Flywheel from Turning	B 183 012 361
8	Adapter – Timing Light	Performing Ignition Timing	Z401138WE
9	Kit - Tachometer	Performing Ignition Timing	4071

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PAINTING, PRESERVATION, PACKAGING AND MARKING

5.1 Painting.- When the overhaul is complete, the engine block, the camshaft drive belt guard assembly, the cylinder head cover left mount and the exhaust manifold shall be painted with heat resisting enamel 1-GP-76 gloss black 412-101 to CGSB colour code manual 1-GP-12. The exhaust manifold shall not be painted until engine running has been completed.

5.2 Preservation.- Preservation as specified hereunder shall not be carried out until the complete engine overhaul and the engine dynamometer break-in runs have been completed.

(a) Drain cooling system, flush and refill with unused 60 per cent CAN2-3.890M ethylene glycol base antifreeze containing rust inhibitor and 40 per cent clean water.

(b) Drain crankcase and refill with unused SAE 15W40 lubricating oil (MIL-L-2104D). Run engine on clean gasoline 1000-1200 RPM under no load for 15 minutes.

(c) Combustion chambers shall be preserved by two stages of fogging. The engine shall be cooled to the temperature of the surrounding air not over 37°C (100°F) before doing any preservation by fogging.

(d) The amount of unused SAE 15W40 lubricating oil to be used for each stage of fogging shall be 2 fluid oz in each cylinder.

(e) For first stage fogging, run engine at a fast idle and power atomize spray 8 fluid oz of the SAE 15W40 lubricating oil through the carburetor into the combustion chambers. Stop engine immediately after all the oil has been introduced.

(f) For second stage fogging, after engine has cooled, remove spark plugs.

(g) Into each cylinder atomize spray a further 2 fluid oz of the SAE 15W40 lubricating oil in each cylinder with piston at bottom dead centre and both valves closed.

(h) When all cylinders have been fogged, reinstall spark plugs and wiring.

(j) Drain crankcase and cooling system. Replace the oil filter elements with a new element. All openings shall be inspected to ensure that they are plugged or closed off as specified.

(k) Clean all exposed machined surfaces and coat with Compound, Corrosion Preventive, Solvent Cutback, Cold Application (soft film) 31-GP-3.

(m) All fuel shall be removed from the carburetor.

(n) A new exhaust manifold to pipe gasket shall be installed and loosely held in place with six manifold stud nuts.

(p) The exhaust opening and carburetor intake opening shall then be sealed with Barrier Material (MIL-B-131) and Tape, Adhesive, Pressure Sensitive (43-GP-3M).

(q) The coolant openings shall be sealed with plastic caps.

(r) All electrical connections, sending units, distributor TCI connector and the two vent nipples On the distributor shall be sealed with Tape, Adhesive, Pressure Sensitive (43-GP-3M).

(s) Tension on the "V" belts shall be released and the Preservation Tag CF2248 marked as follows:

"TENSION RELEASED ON "V" BELTS, ADJUST BEFORE USING."

(t) Any further preservation requirements will be specified in the contract.

5.3 Packaging.- A legible stamped or engraved metal plate shall be attached to the engine in an approved location showing the following information.

(a) Name of firm or workshop that rebuilt the engine.

(b) Day, month and year of. engine rebuild.

(c) Firm or workshop order number.

(d) Cylinder bore.

(e) Size of crankshaft main bearing journals.

(f) Size of crankshaft connecting rod journals.

(g) Amount removed from top of block.

5.3.1 The engine shall be properly supplied with:

(a) CF942, NSN 8135-21-872-2435, Identity and Condition Tag.

(b) CF2248, NSN 7530-21-870-3866, Lubrication Record for Shipment and Preservation Tag.

(c) The NSN for the engine assembly 2805-21-896-1461.

5.3.2 A depreservation guide shall be attached to the engine. The guide shall be in the form of a checklist and will list all of the steps required to depreserve the engine assembly.

5.3.3 Prior to placing the engine assembly in the container, the container shall be inspected and the following steps performed.

(a) If needed, the sides, top and platform shall be painted in accordance with 1-GP-12 Standards for Paint Colours, one coat of primer 1-GP-12 and one coat of enamel paint olive drab 503-321.

(b) Mandatory parts replacement.- The following Table lists hardware and components of the container that shall be replaced with new OEM components; see Figure 44 for identification.

Table VII Container mandatory parts replacement

Item	NSN	MRN	Description	Qty
3	5330-21-896-7216	RG-240	Seal (.5 X .5 X 99" Long)	1
10	5310-12-146-8397	N 111 852	Nut - Hex Elastic (M10)	2
13	5310-12-146-8397	M 111 852	Nut - Hex Elastic (M10)	1
14	6685-00-618-1822	2155	Indicator - Moisture	1
15	4820-00-242-4064	645E-6	Valve - Filler	1
16	4820-01-099-4231	C-13-B	Valve - Relief	1
20	5310-00-088-1251	MS 51922-1	Nut - Self Locking (1/4-20)	1
23	5310-00-057-7080	MS 51922-29	Nut - Self Locking (7/16-20)	12
27	5310-21-898-4885	228 521 045	Nut - Elastic (M12)	1
32	6850-21-883-0610	VC6 - 2	Capsule - Zerust VCI	1
32		MIL-D-3464	Dessicants - Activated Bagged	1
33		34 X 8 X 3 X 26 GA	Seal - Wire	2

(c) Container Components.- The following lists all of the components of the shipping and storage container. All components less Mandatory Parts Replacement shall be inspected and replaced with new OEM components as required, see Figure 44 for component identification.

Container components

ITEM	NSN	MRN	DESCRIPTION	QTY
1	8145-21-897-9076	8477857	Container Assy - Engine	1
2	8145-21-897-9077	8477849-1	Cover Assy	1
3	5330-21-896-7216	RG-240	Seal (.5 X .5 X 99" Long)	1
4	5305-00-709-8523	MS 90726-87	Scr - Hex Hd (7/16 X 20 X 1-1/4)	12
5	5310-00-809-4061	MS 27183-15	Washer - Flat (7/16)	24
6		B 183 099 001	Bolt - Hex Hd (M10 X 110)	2
7	5310-12-145-2243	N 154 024	Washer - Flat (10.5 X 25 X 4)	2
8	5310-12-175-6305	B 183 199 447	Washer	4
9	5340-12-173-7964	A 183 199 381	Mount - Rubber	4
10	5310-12-146-8397	N 111 852	Nut - Hex Elastic (M10)	2
11	8145-21-897-9078	8477848-1	Base Assy	1
12	5310-12-145-4776	N 011 672 3	Washer Flat (10.5 X 30 X 2.5)	1
13	5310-12-146-8397	N 111 852	Nut - Hex Elastic (M10)	1
14	6685-00-618-1822	2155	Indicator - Moisture	1
15	4820-00-242-4064	645E-6	Valve - Filler	1
16	4820-01-099-4231	C-13-B	Valve - Relief	1
17	8145-21-899-9701	8384318-1	Cover - Instrument	1

Container components (cont'd)

Item	NSN	MRN	Description	Qty
18	5310-00-809-4058	MS 27183-10	Washer - Flat (9/32)	2
19		WN-6	Nut - Wing (1/2 X 20 UNC)	1
20	5310-00-088-1251	MS 51922-1	Nut - Self Locking (1/4-20)	1
21	5320-21-842-7104	SD54BS	Rivet - Pop (5/32 X .379)	4
22	9905-21-897-6996	8477856-1	Plate - Identification	1
23	5310-00-057-7080	MS 51922-29	Nut - Self Locking (7/16-20)	12
24	5340-21-897-8287	3477854-1	Cushion - Rubber	2
25	3120-21-897-8930	8477855-1	Bushing	1
26	5340-21-897-8285	8477837-1	Support - Angle	1
27	5310-21-898-4885	228 521 045	Nut - Elastic (M12)	1
28	5310-12-184-5360	N 115 317	Washer - Flat (13 X 24 X 2.5)	1
29		222 025 565	Bolt - Hex Hd (M12 X 1.75 X 55)	1
30		1294	Washer - Flat	1
31		222 005 565	Bolt - Hex Hd (M10 X 1.5 X 55)	1
32		MIL-D-3464	Dessicants - Activated Bagged	1
32	6850-21-883-0610	VC6 - 2	Capsule - Zerust VCI	1
33		34 X 8 X 3 X 26 GA	Seal - Wire	2

5.3.4 The engine assembly shall be placed and secured on the holding brackets on the base of the shipping and storage container.

5.3.5 The following Table lists components that shall remain in their original packaging or rebuilt packaging and be secured around the engine assembly (see Figure 45) in the base of the container with a checklist, see Figure 46 for component identification.

Table VIII Engine replacement accessories

Item	NSN	MRN	Description	Qty
1	2940-12-172-8350	PH-2870A	Oil Filter	1
2	2805-12-172-8349	056 105 269 N	Flywheel Assy	1
3	5305-12-179-5384	N 900 720 02	Scr c/w Washer (M10 X 1 X 20)	6
4	2520-21-894-1606	049 103 549	Plate - Interm Eng/Gear Box	1
5	5330-12-175-8254	049 103 583	Gasket - Interm Plate	1
5A	2520-12-192-3595	A 302 101 501	Disc Clutch	1
6	2520-12-192-3596	A 102 101 203	Pressure Plate - Clutch	1
7	5305-12-169-6486	N 014 739 1	Scr - Socket Hd (M8 X 16)	6
8	2520-12-166-2743	113 141 165 B	Bearing - Release	1
9	5360-12-175-6327	113 141 178 C	Spring - Release Bearing (Right)	1
10	5360-12-175-6328	113 141 177 C	Spring - Release Bearing (Left)	1
11	5365-12-175-8256	113 141 176	Collar - Locking	1
12	5305-21-896-9743	N 090 194 1	Scr - w/Washer (M7 X 16)	3
13	5310-12-156-4982	N 011 030 1	Nut - Hex (M12)	1
14	5310-12-184-5360	N 115 531 7	Washer - Flat (13 X 24 X 2.5)	5
15	5306-21-897-8247	N 010 464 1	Scr - Hex Hd (M12 X 80)	1

Table VIII Engine replacement accessories (cont'd)

Item	NSN	MRN	Description	Qty
16	5306-21-893-8770	M 010 493 2	Scr - Hex Hd (M12 X 68)	4
17	5306-21-897-8246	N 010 350 6	Scr - Hex Hd (M8 X 50)	3
18	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	3
19	5305-12-142-8496	N 010 361 4	Scr - Hex Hd (M8 X 65)	3
20	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	3
21	5310-12-144-6214	N 011 008 13	Nut - Hex (M8)	3
22	5310-12-175-6312	B 049 911 493	Washer	1
23	5305-12-142-5841	N 014 721 2	Scr - Socket Hd (M10 X 25)	1

5.3.6 Sufficient new dessicant bags or ZERUST VC capsules shall be placed in the container base to prevent condensation.

5.3.7 The hardware holding the two halves of the container together shall be torqued to the value stipulated by the container manufacturer.

5.3.8 The container shall be pressurized with dry air in a manner and to the pressure stipulated by the container manufacturer.

5.4 Marking.- The shipping and storage container shall have the following stencilled on each end.

(a) The NSN - 2805-21-896-1461.

(b) The description - Engine Assembly - 1.7 litre.

(c) The MRN - 183 198 001.

(d) Quantity - 1 each.

(e) Weight.

(f) Date of engine rebuild.

5.4.1 The following shall be stencilled on both sides.

"REUSABLE CONTAINER DO NOT DESTROY CF PROPERTY".

6. NOTES

6.1 Ordering data.- Procurement documents should specify the title, number, and date of this specification.

6.2 Design authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality assurance authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through the Quality Assurance Authority.

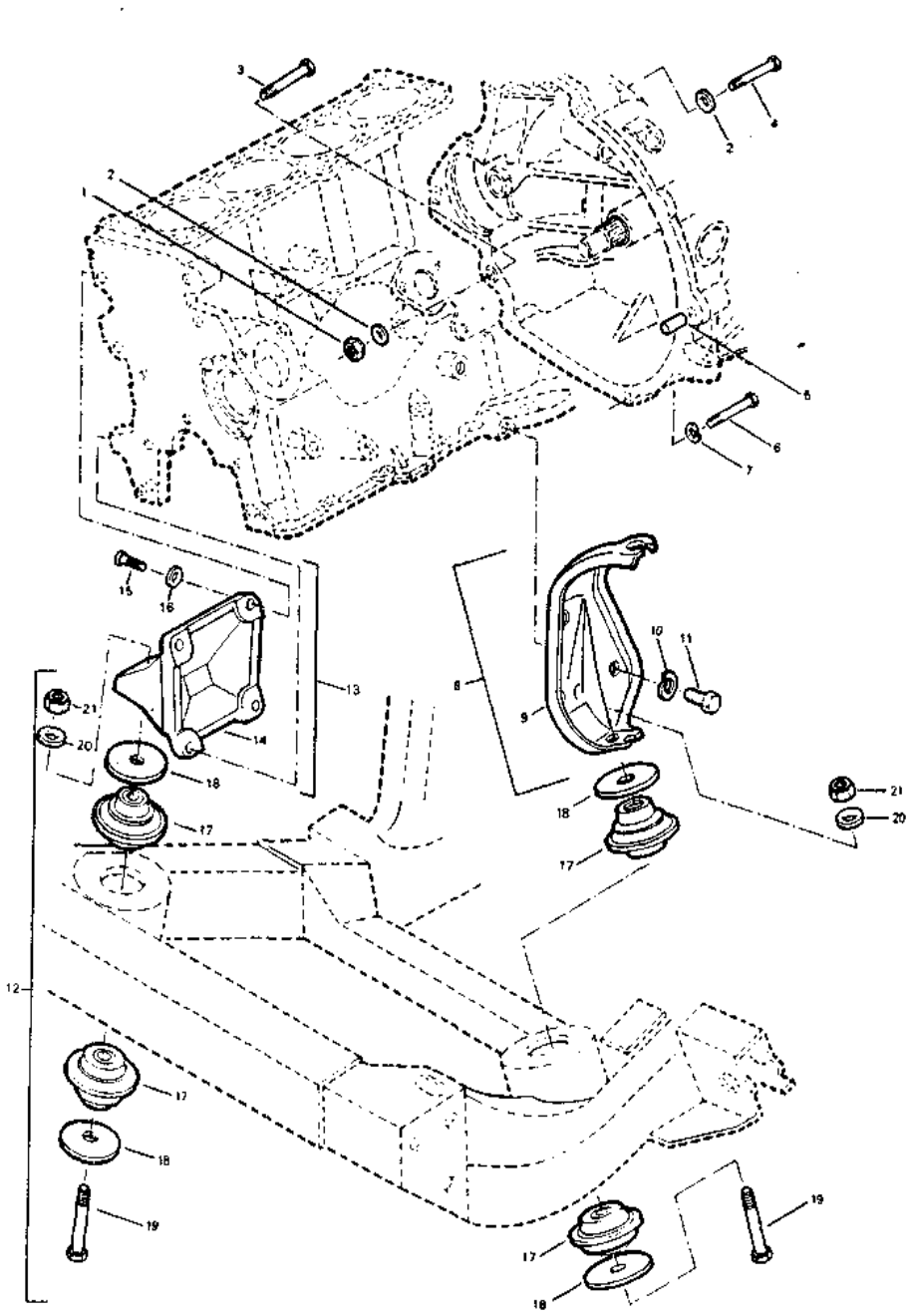


Figure 1 Engine mounts

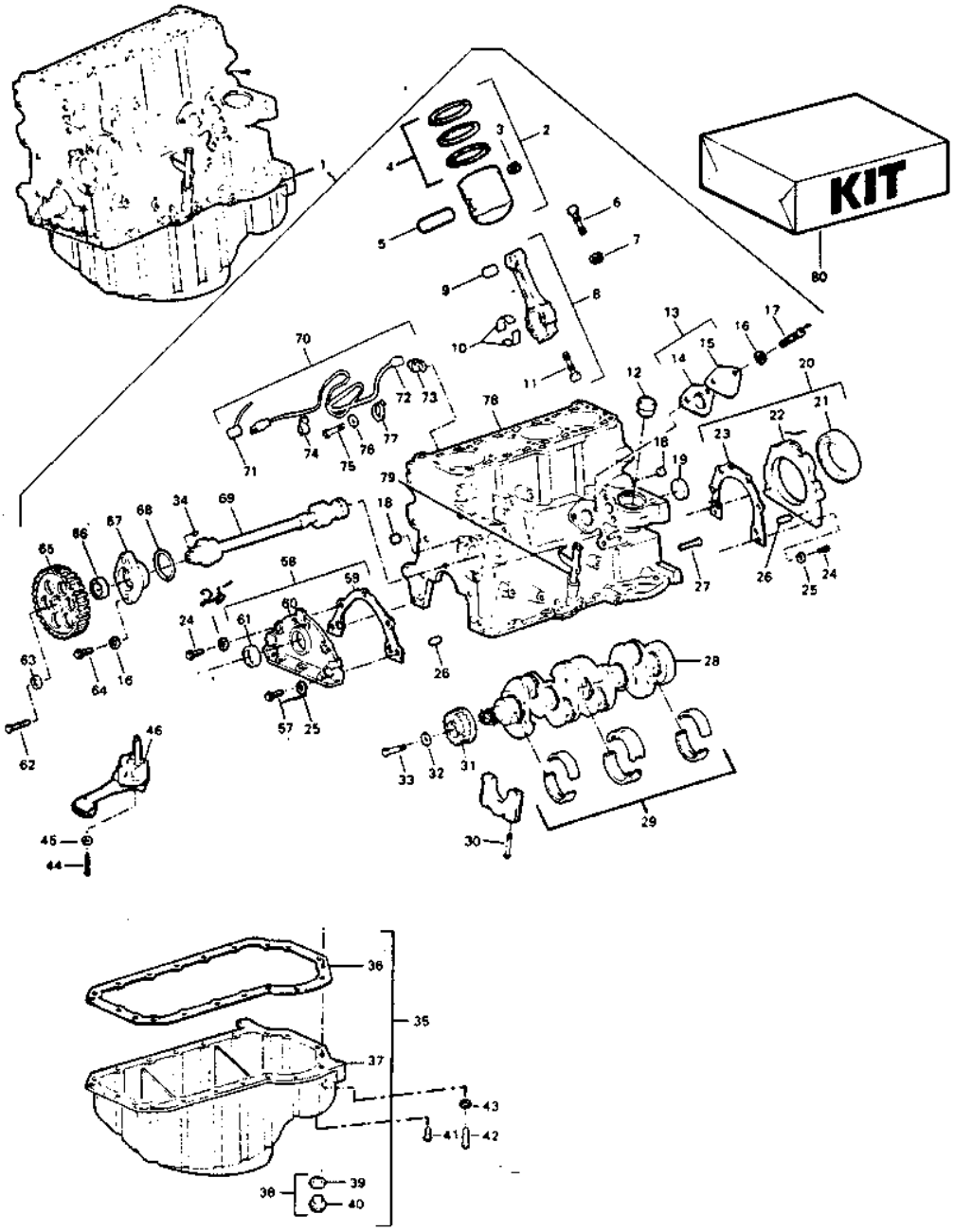


Figure 2 Cylinder block assembly

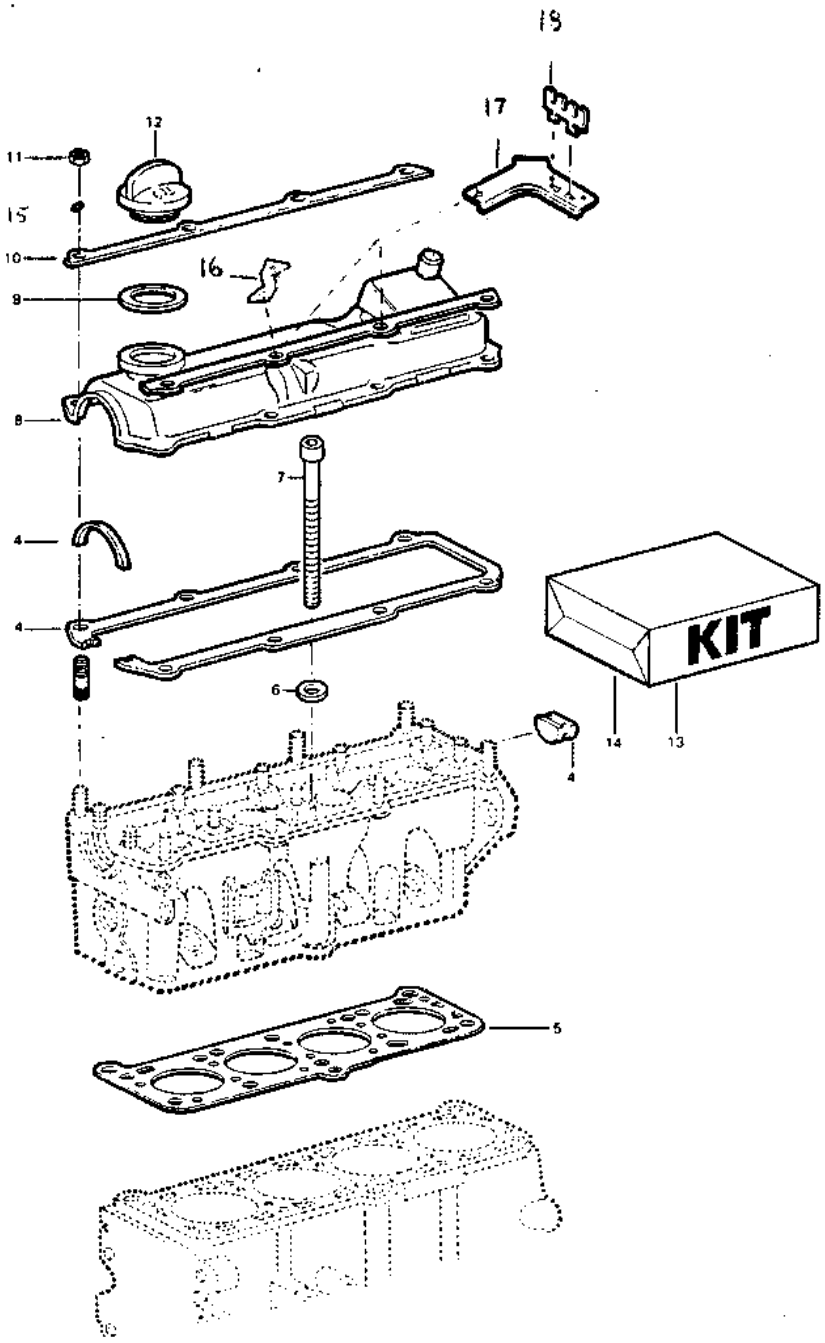


Figure 3 Oil filler cap and rocker cover

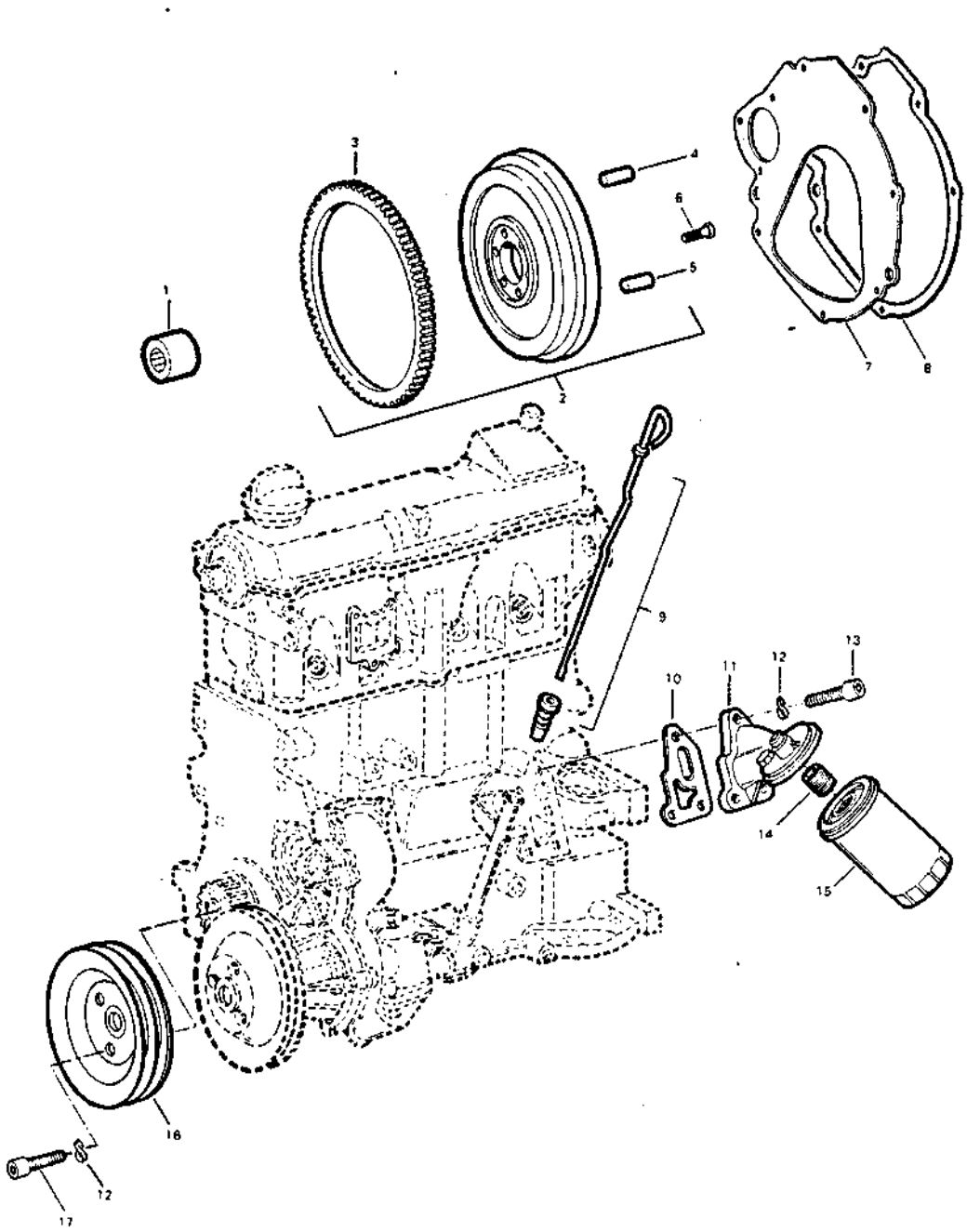


Figure 4 Flywheel and oil filter

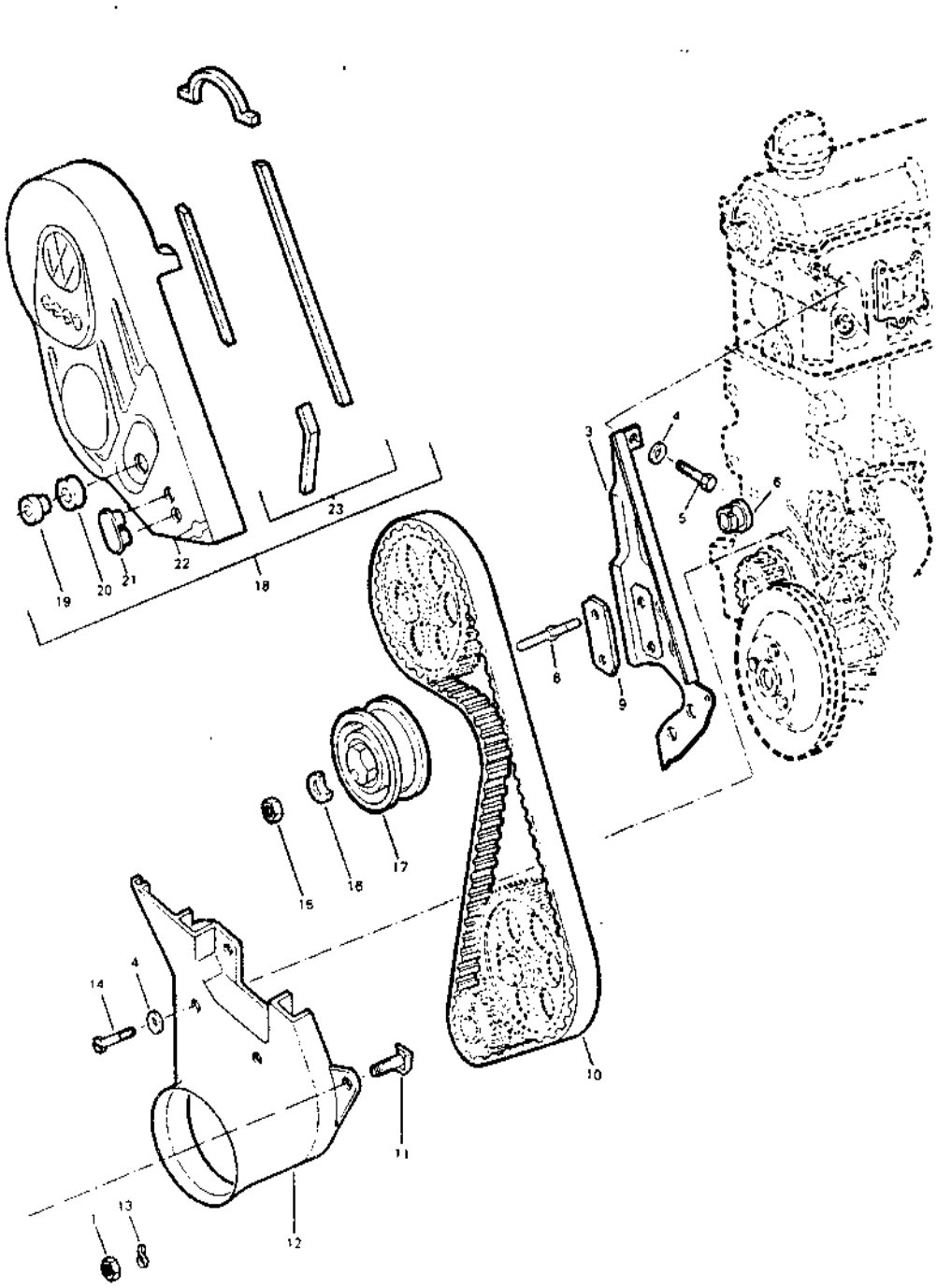


Figure 5 Front cover and timing belt

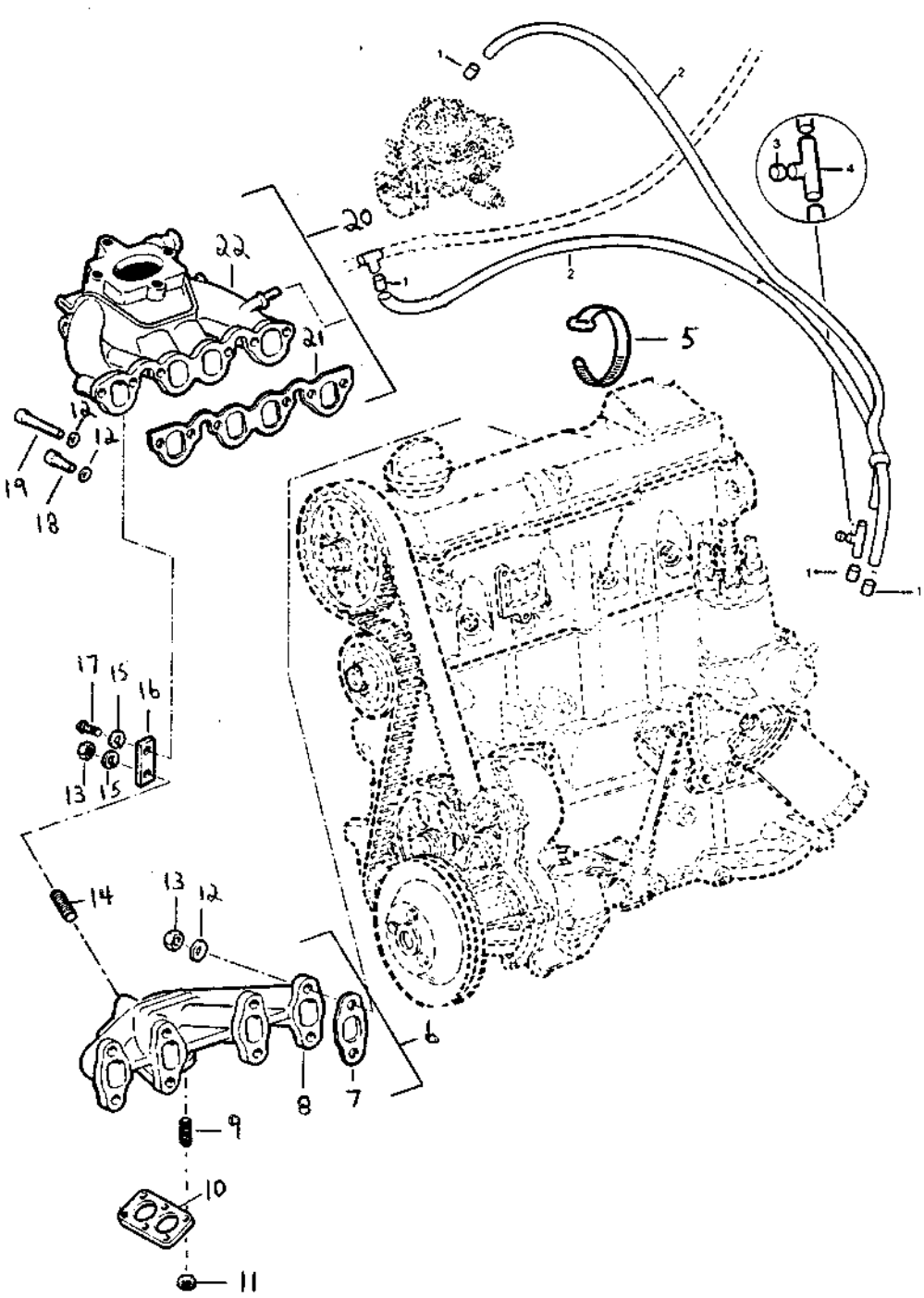


Figure 6 Intake and exhaust manifold

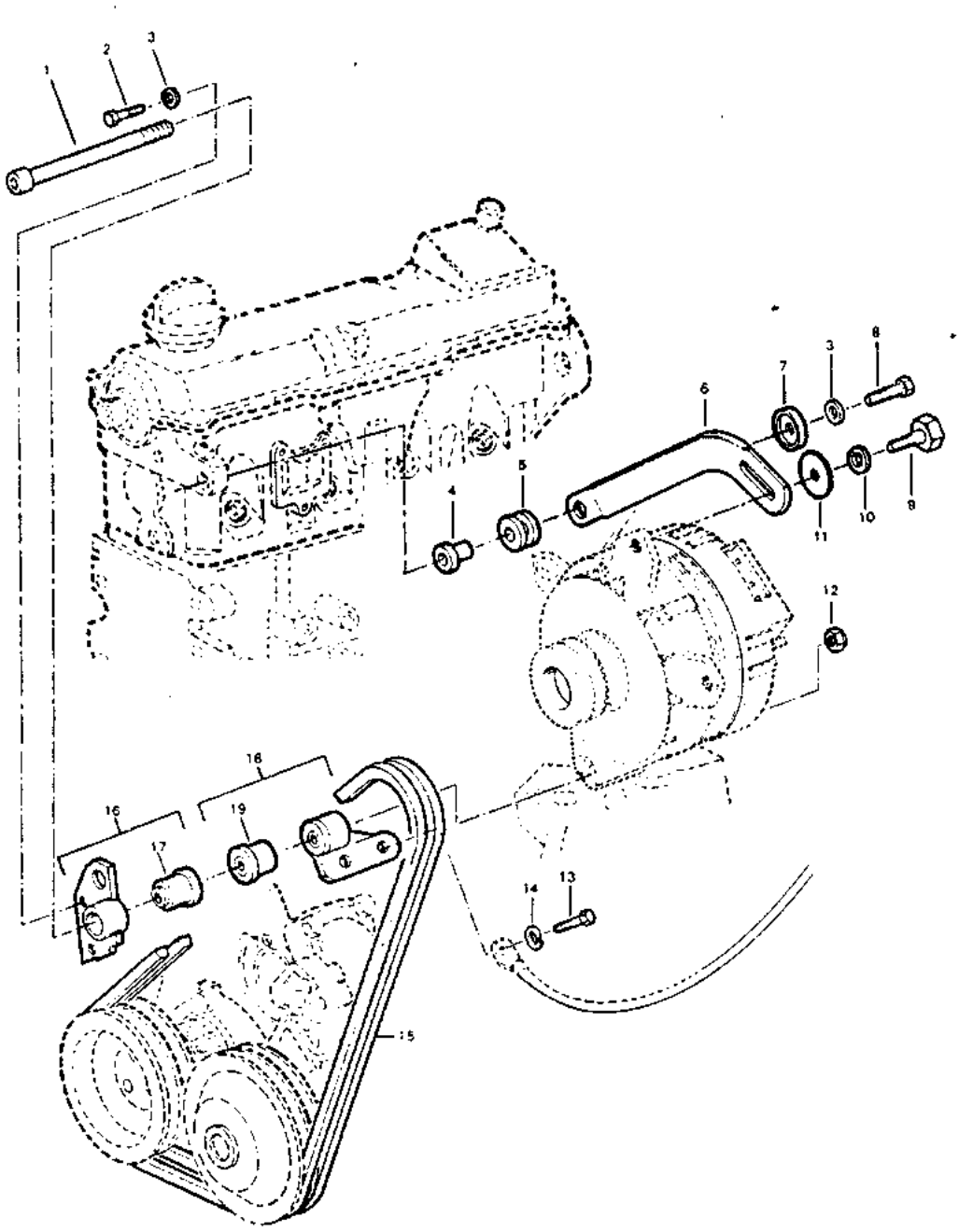


Figure 7 Belts and alternator adjusting arm

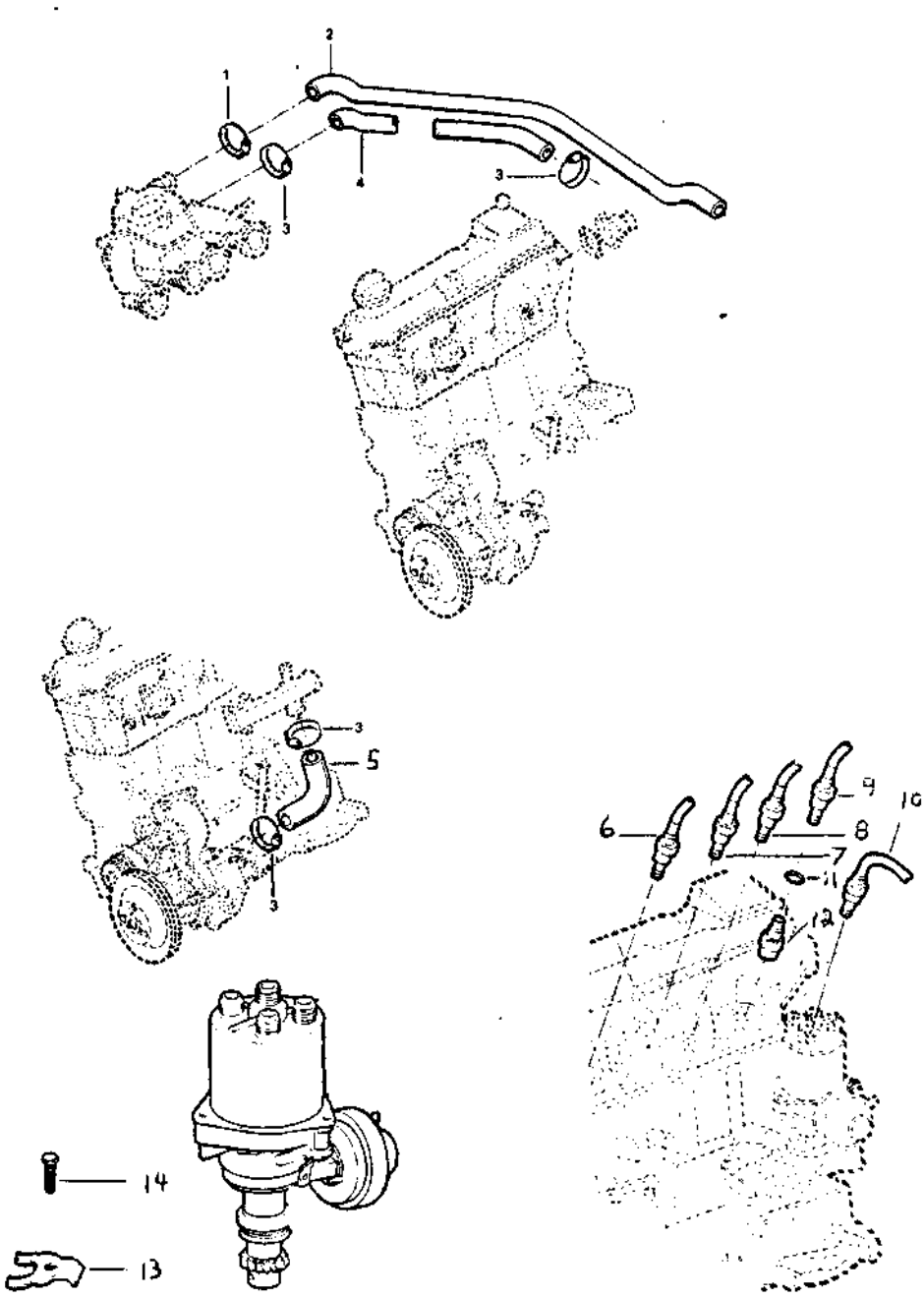


Figure 8 Coolant hoses and ignition components

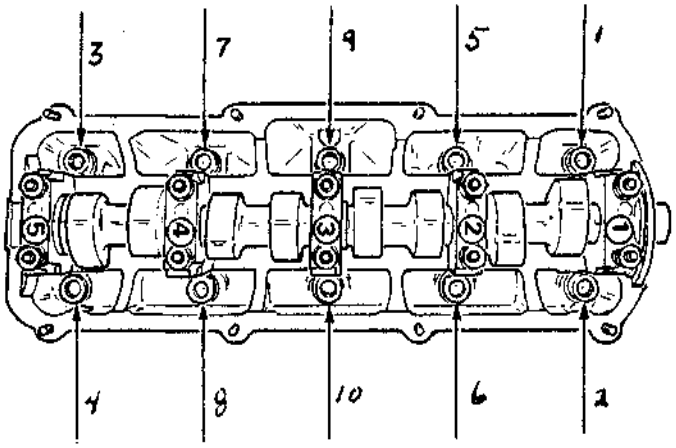


Figure 9 Cylinder head bolts

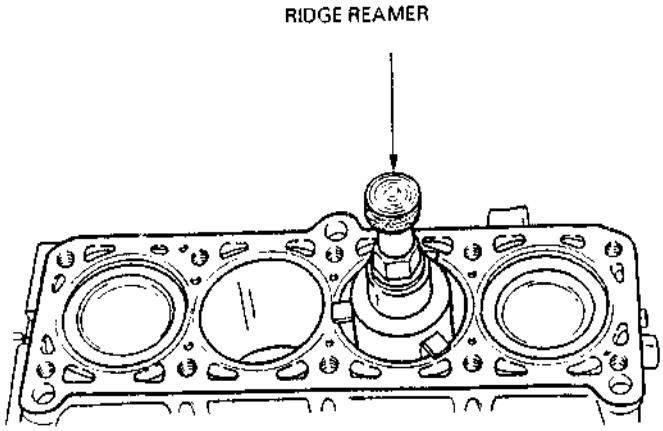


Figure 10 Removal of top cylinder ridges

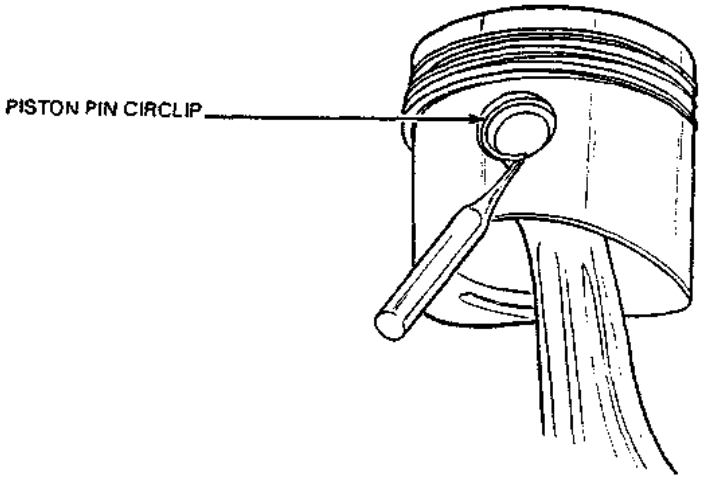


Figure 11 Removal of piston pin circlip

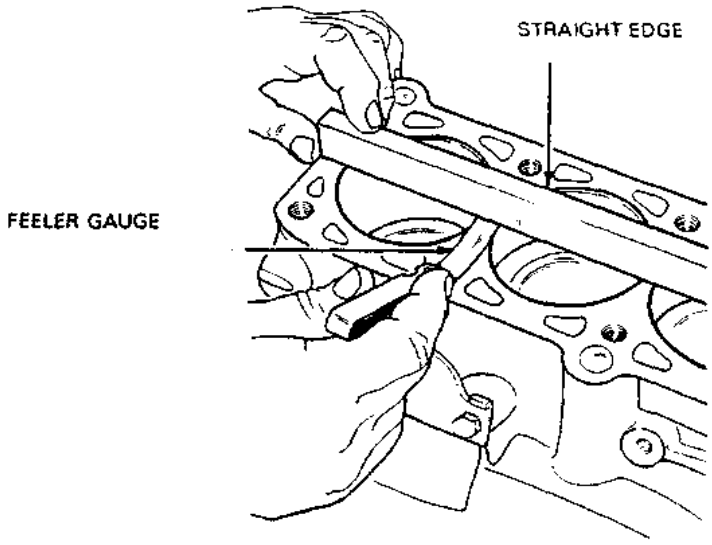


Figure 12 Checking cylinder block for flatness

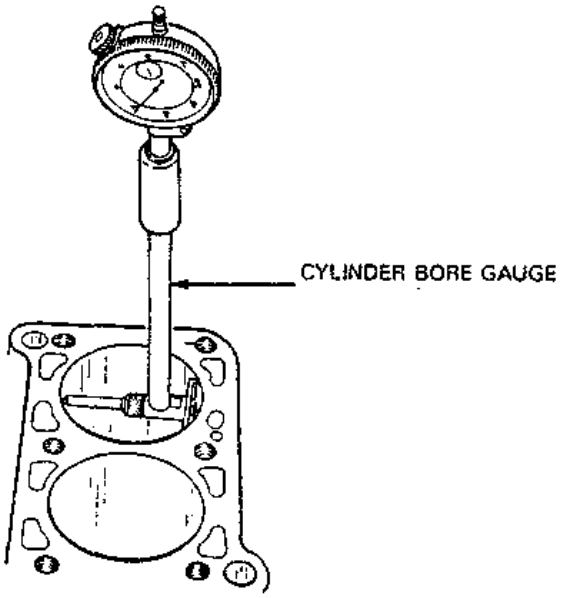


Figure 13 Checking cylinder diameter and degree of wear

Size	Piston marking	Cylinder bore honing dia
Original Dia	79.50 mm	79.53 mm
1st Oversize	79.75 mm	79.78 mm
2nd Oversize	80 mm	80.03 mm
3rd Oversize	80.50 mm	80.53 mm

Figure 14 Cylinder bore honing measurements

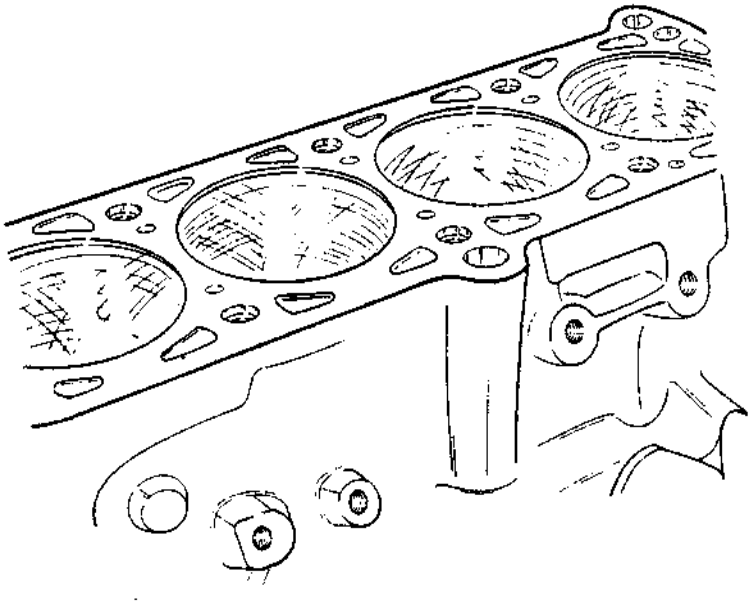


Figure 15 Cylinder wall glaze removed

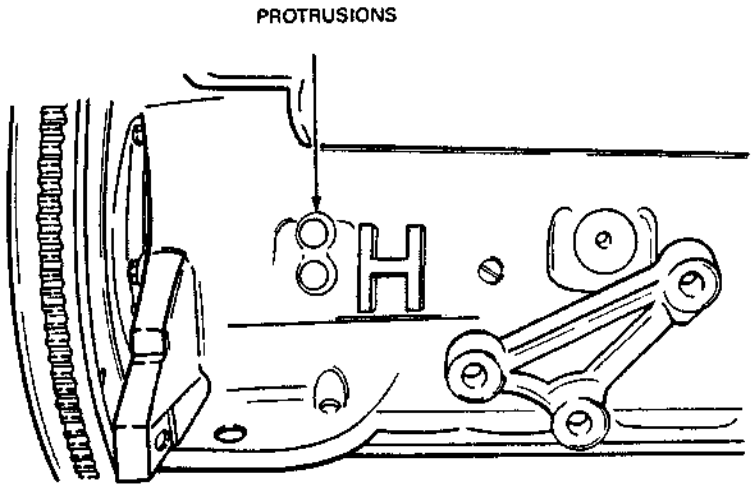


Figure 16 Protrusions on engine block

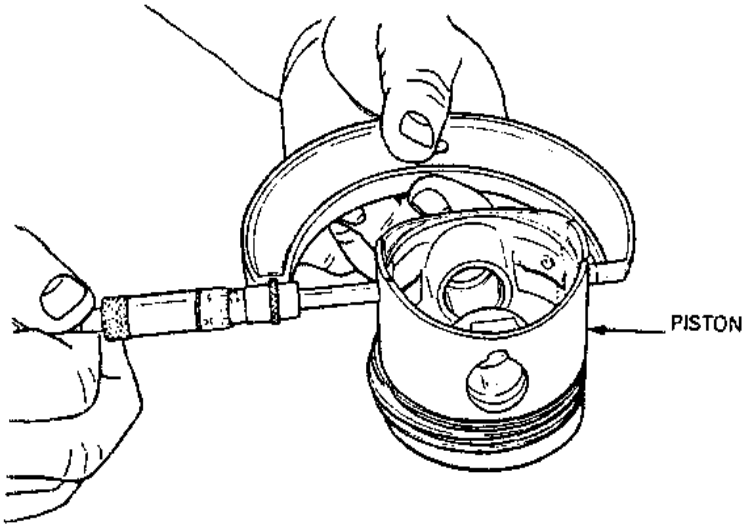


Figure 17 Measurement of piston diameter

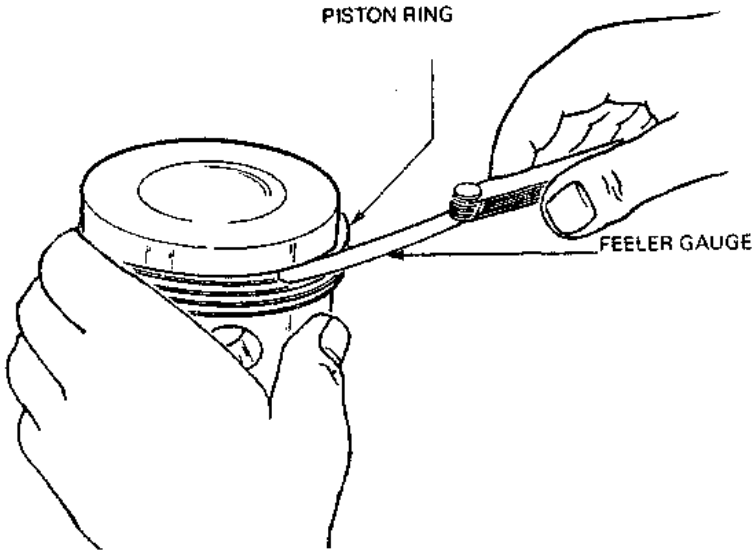


Figure 18 Checking piston ring side clearance

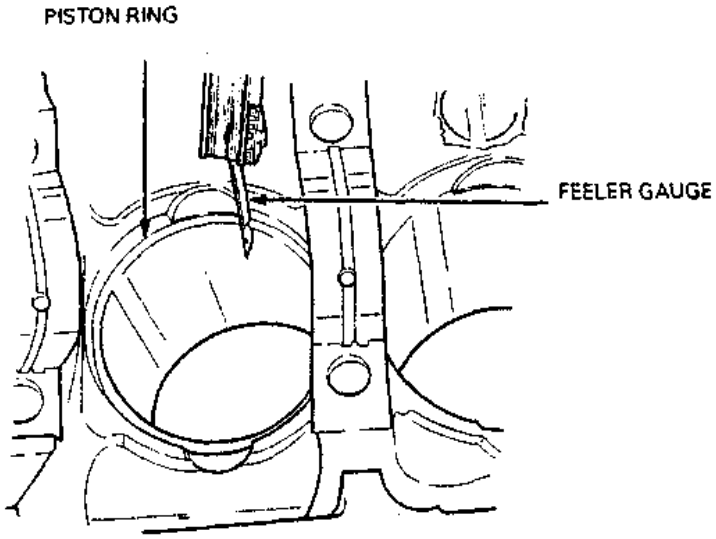


Figure 19 Measurement of ring end gap

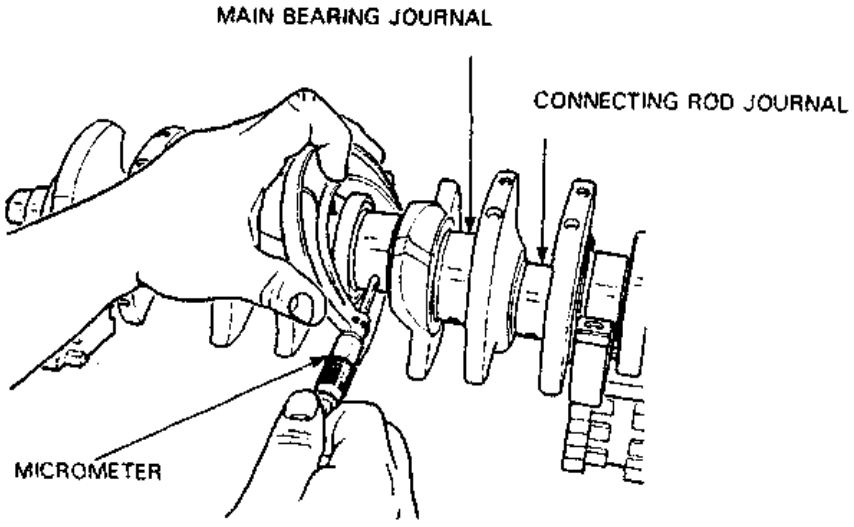


Figure 20 Checking connecting rod journals for taper

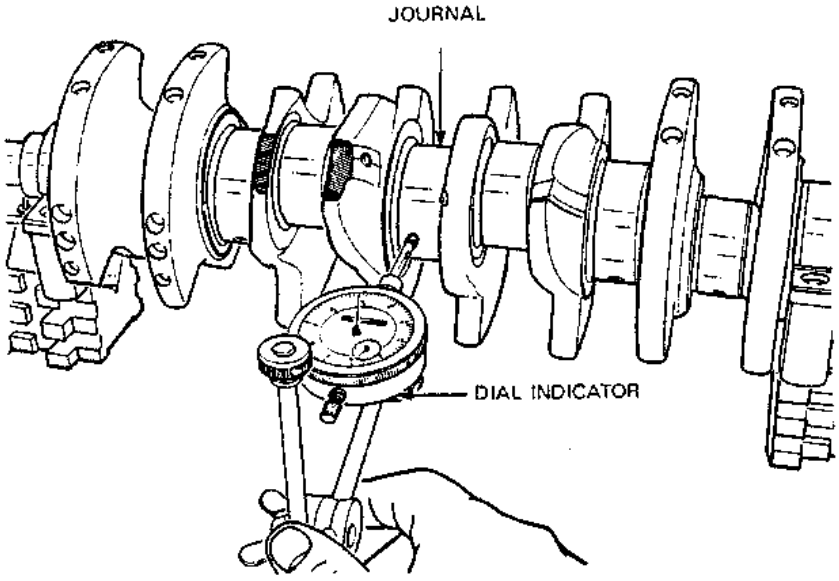


Figure 21 Checking journals for run-out

Repair stage	Crankshaft main journal diameter	Crankshaft connecting rod journal DIAMETER
Original Diameter	54.00 mm - 0.022 mm - 0.042 mm 53.75 mm	46.00 mm - 0.022 mm - 0.042 mm 45.75 mm
Repair Stage 1	- 0.022 mm - 0.042 mm 53.50 mm	- 0.022 mm - 0.042 mm 45.50 mm
Repair Stage 2	- 0.022 mm - 0.042 mm	- 0.022 mm - 0.042 mm

Figure 22 Crankshaft repair stage chart

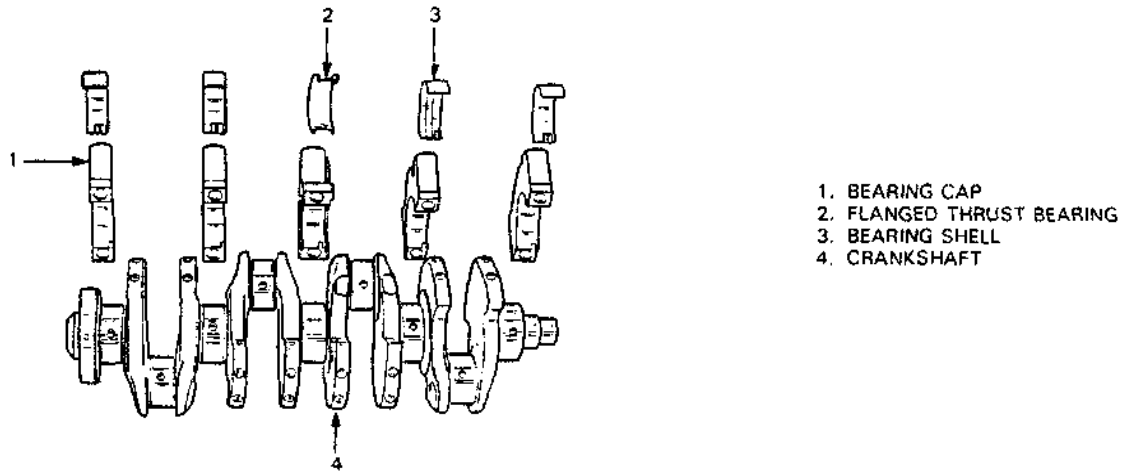


Figure 23 Crankshaft assembly

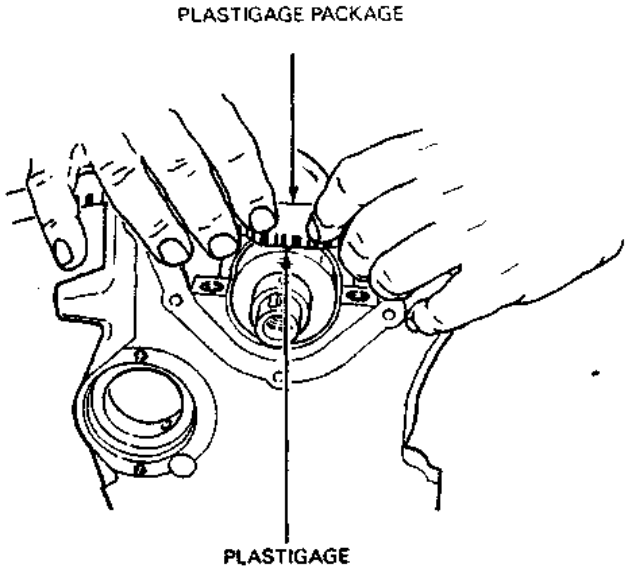


Figure 24 Measurement of crankshaft bearing clearance

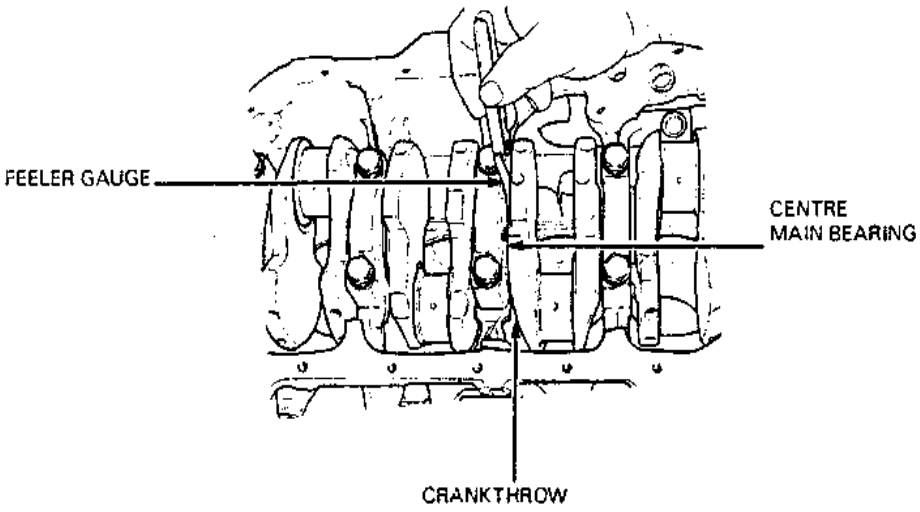


Figure 25 Measurement of axial play

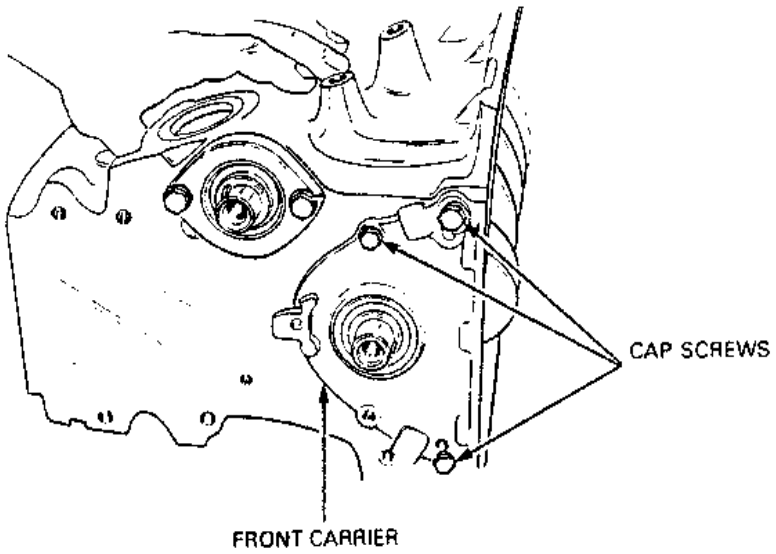


Figure 26 Front crankshaft seal carrier

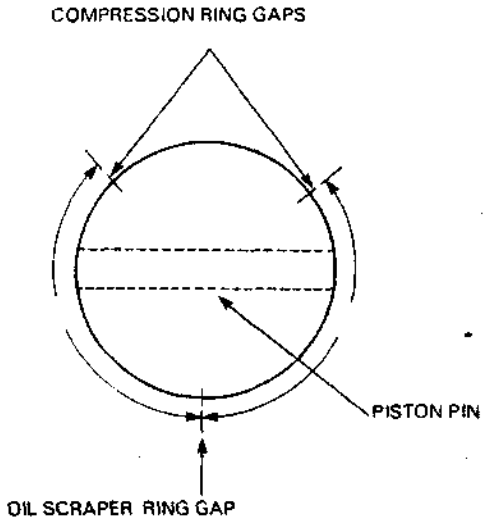


Figure 27 Position of ring gaps

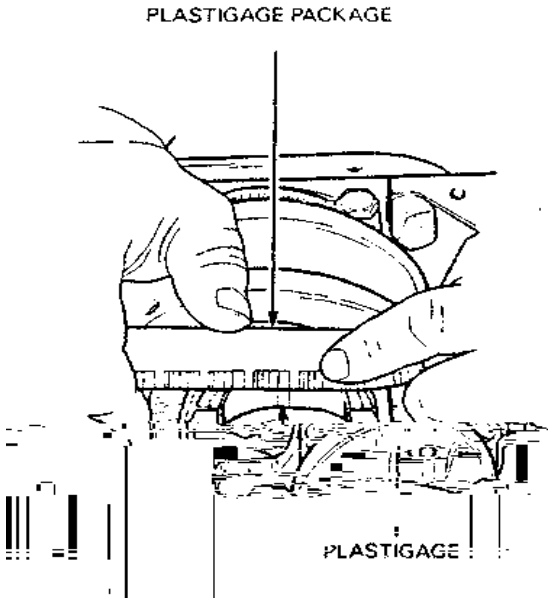


Figure 28 Checking clearance between crankshaft and connecting rod bearing

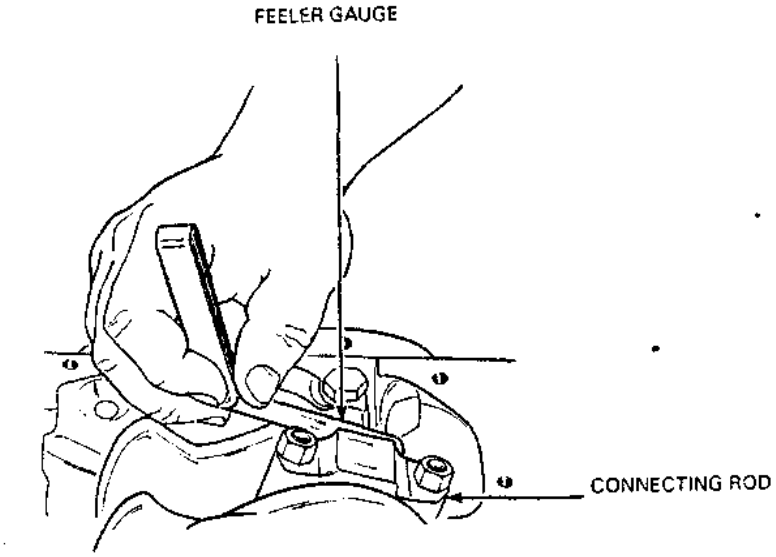


Figure 29 Measurement of connecting rod axial play

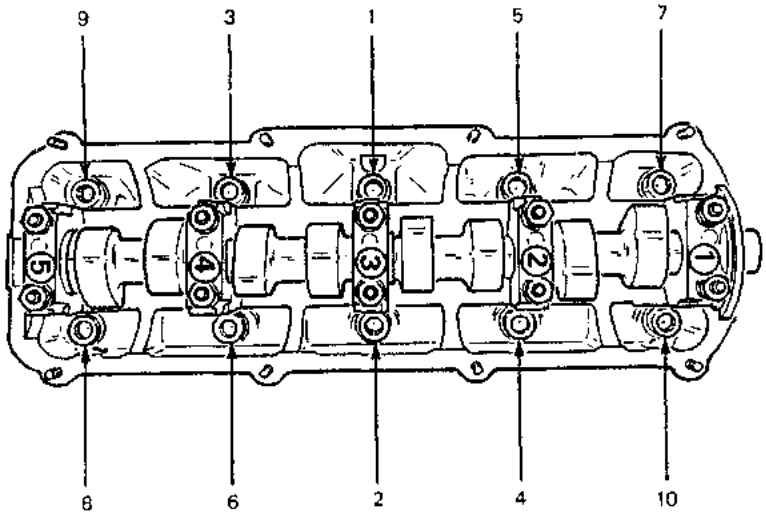


Figure 30 Cylinder head bolts

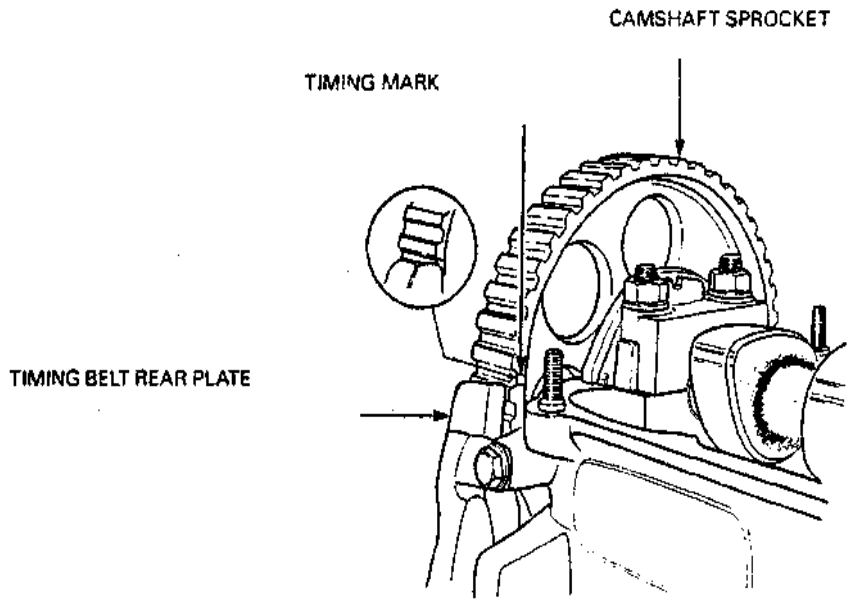


Figure 31 Camshaft sprocket timing mark

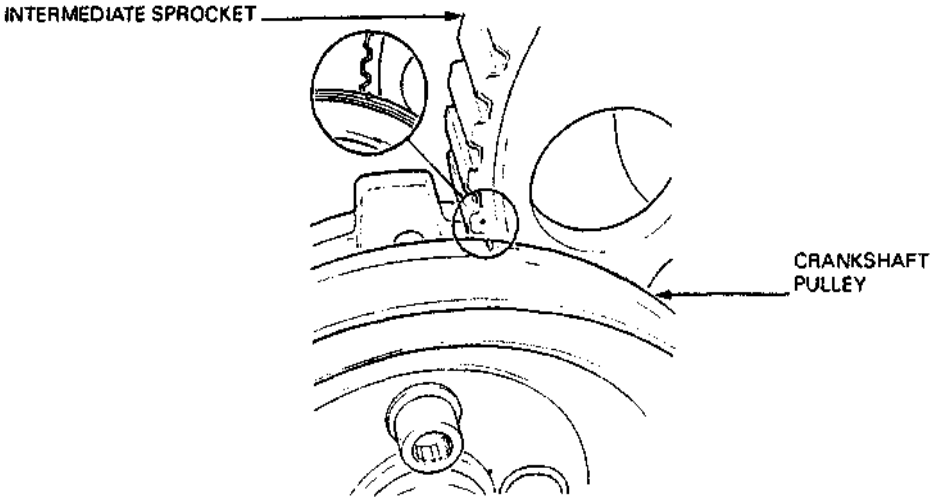


Figure 32 Alignment of intermediate sprocket and crankshaft pulley

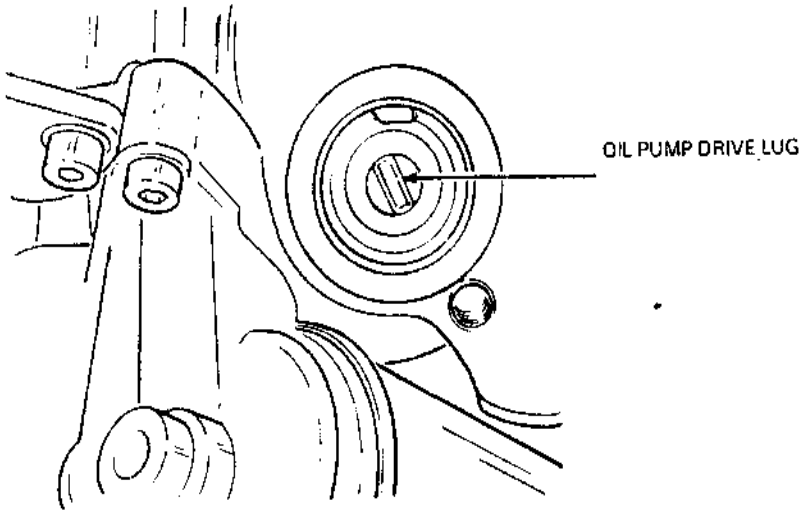


Figure 33 Oil pump shaft

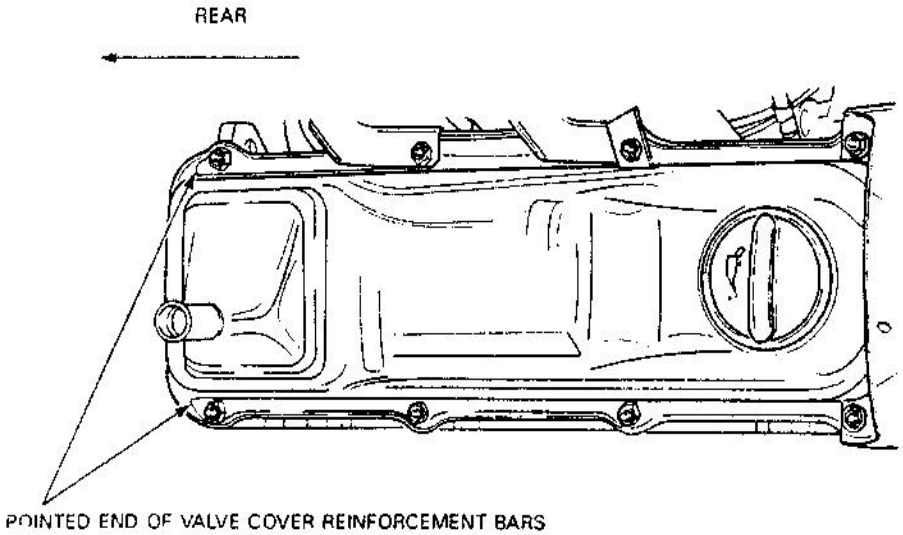


Figure 34 Valve cover reinforcement bars

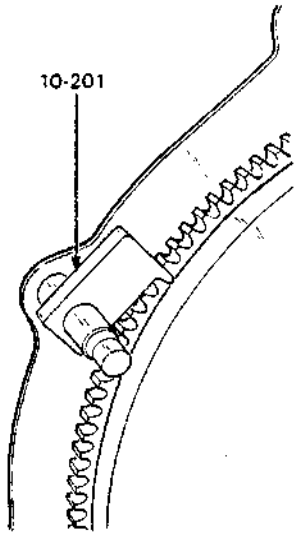


Figure 35 Tool 10-201 Installed on flywheel

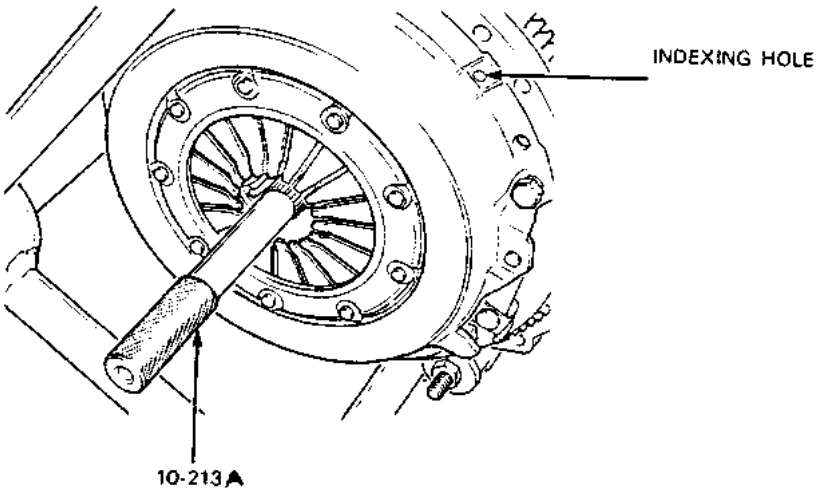


Figure 36 Installation of clutch assembly

OVERHAULED BY		DATE		NAME		MODEL	REBUILD NO.	
CVL BORE SIZE		CRANKSHAFT SIZE, MAINS		CRANKSHAFT SIZE CON ROD		DYNO TESTED BY BED TESTED BY		
						AT END OF PERIOD		
PERIOD	TIME IN MINS	ENGINE RPM	DYNO RPM	DYNO LOAD	BHP	OIL PRESS	OIL TEMP	WATER TEMP
	TOTAL					FINAL INSPECTED BY		
REMARKS						PRESERVED BY		
						BOXED BY		
						SPECIFICATION GHP FOR "FLASH" _____ CONTACT NO. _____		

D-30-108-000/SF-001

Figure 37 - Engine test log/run-in data

(SAMPLE - REPRODUCE LOCALLY)

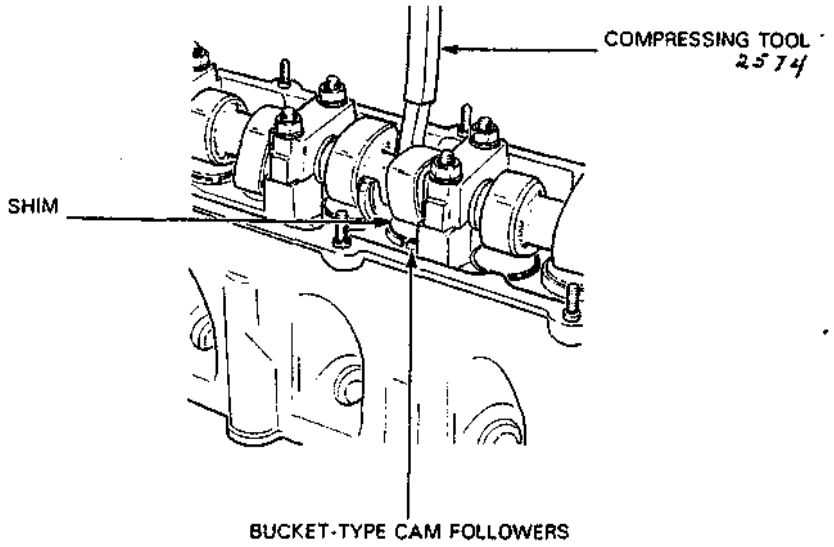


Figure 38 Pressing bucket-type cam followers

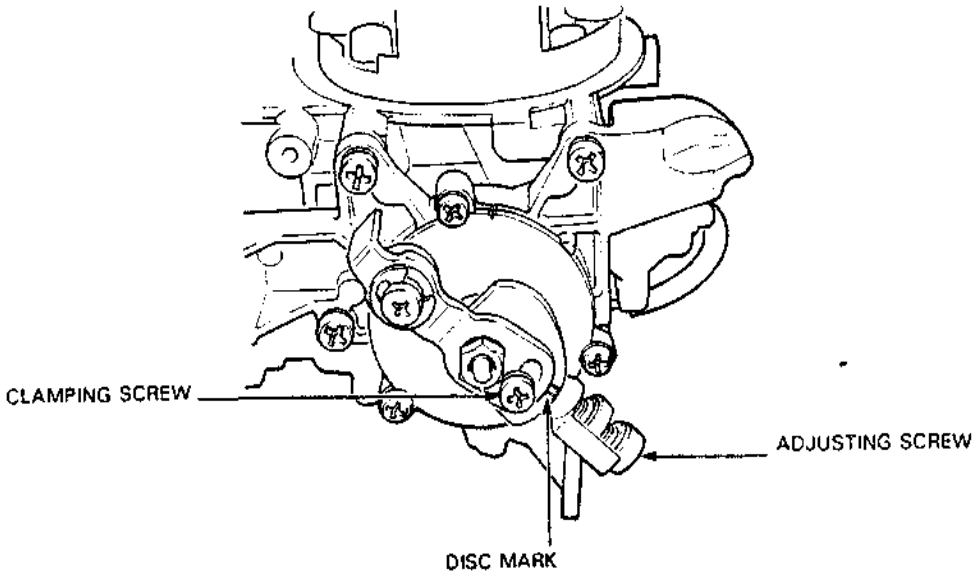


Figure 39 Cold idling speed check

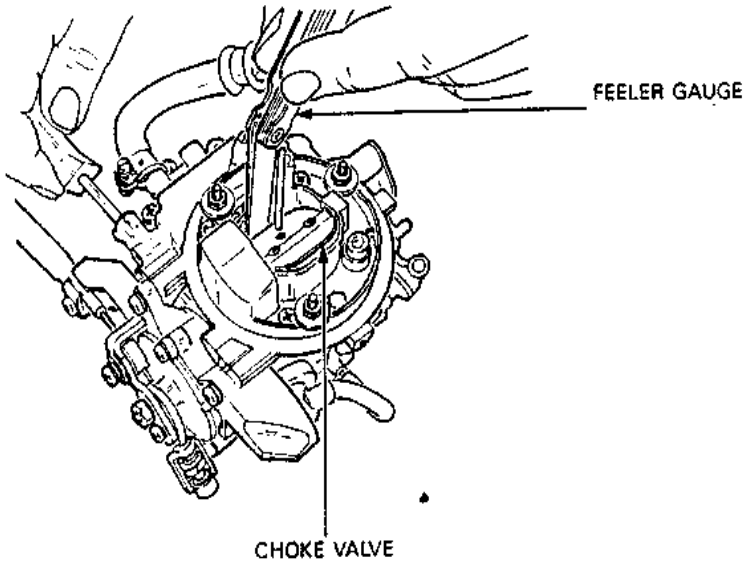


Figure 40 Measurement of choke valve gap

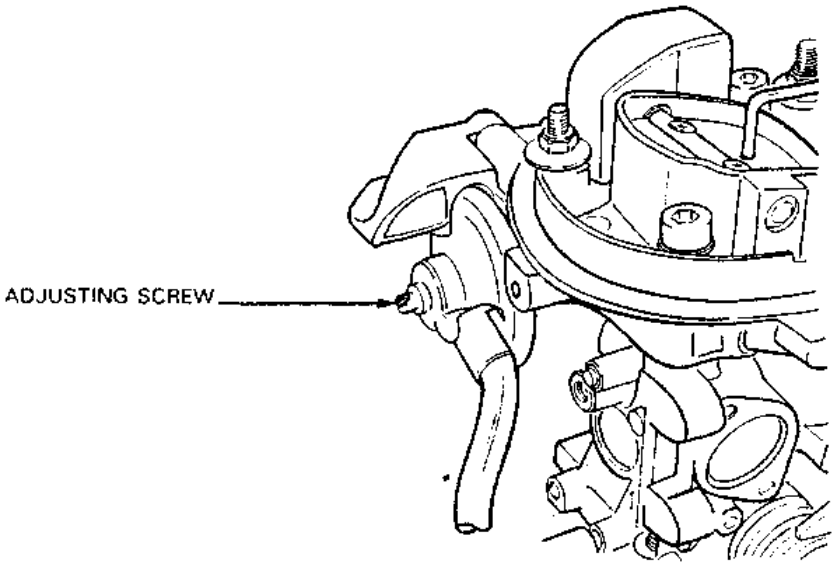


Figure 41 Adjusting screw on pulldown unit

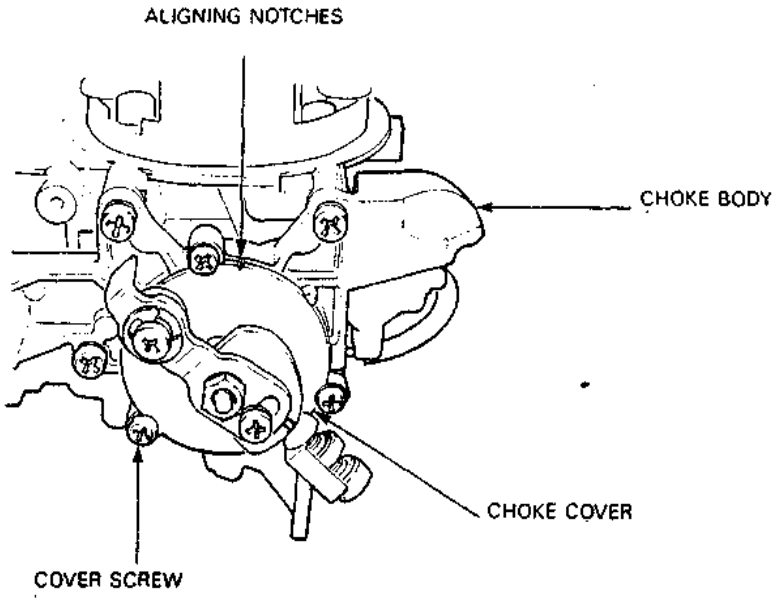


Figure 42 Choke cover and choke body alignment

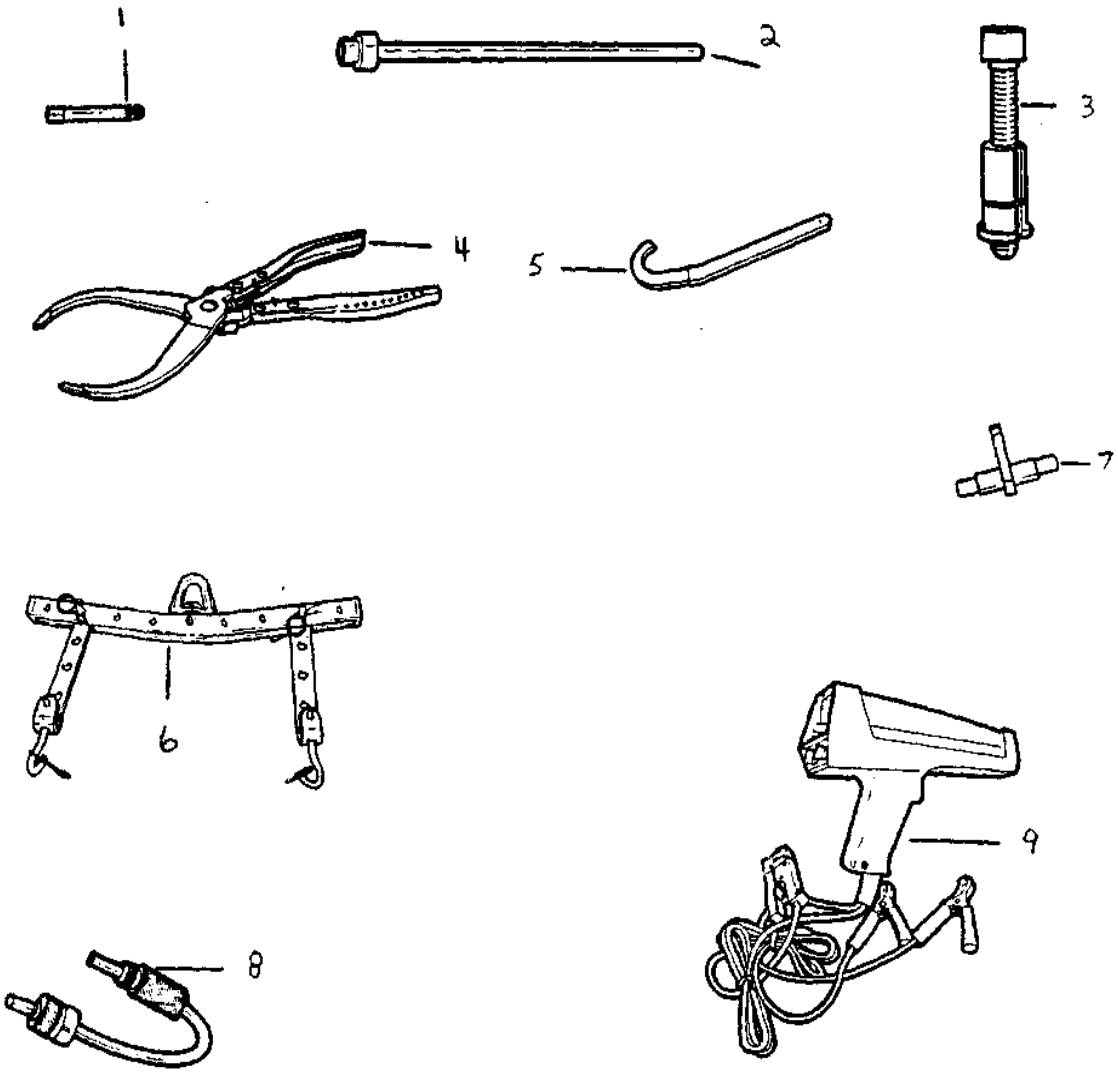


Figure 43 Special tools

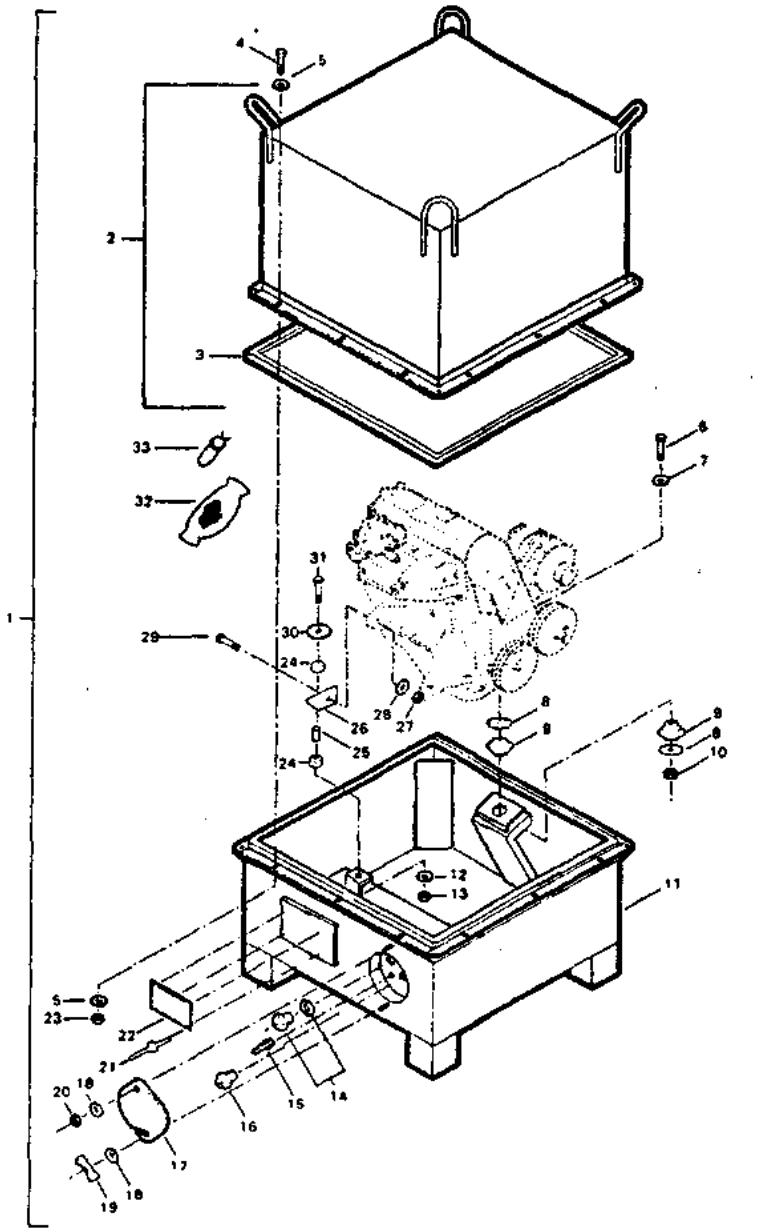


Figure 44 Engine container

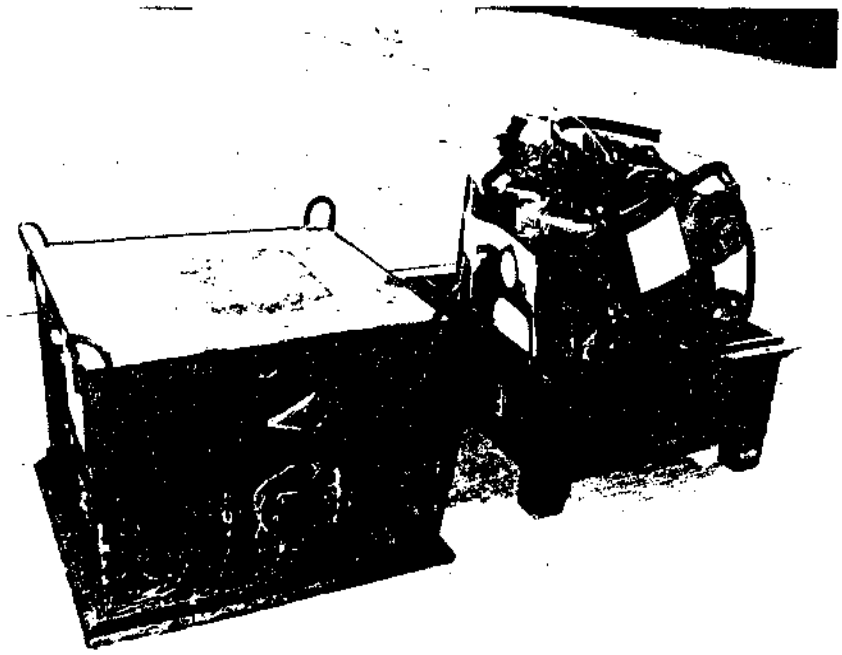


Figure 45 Placing of engine components for shipment/storage

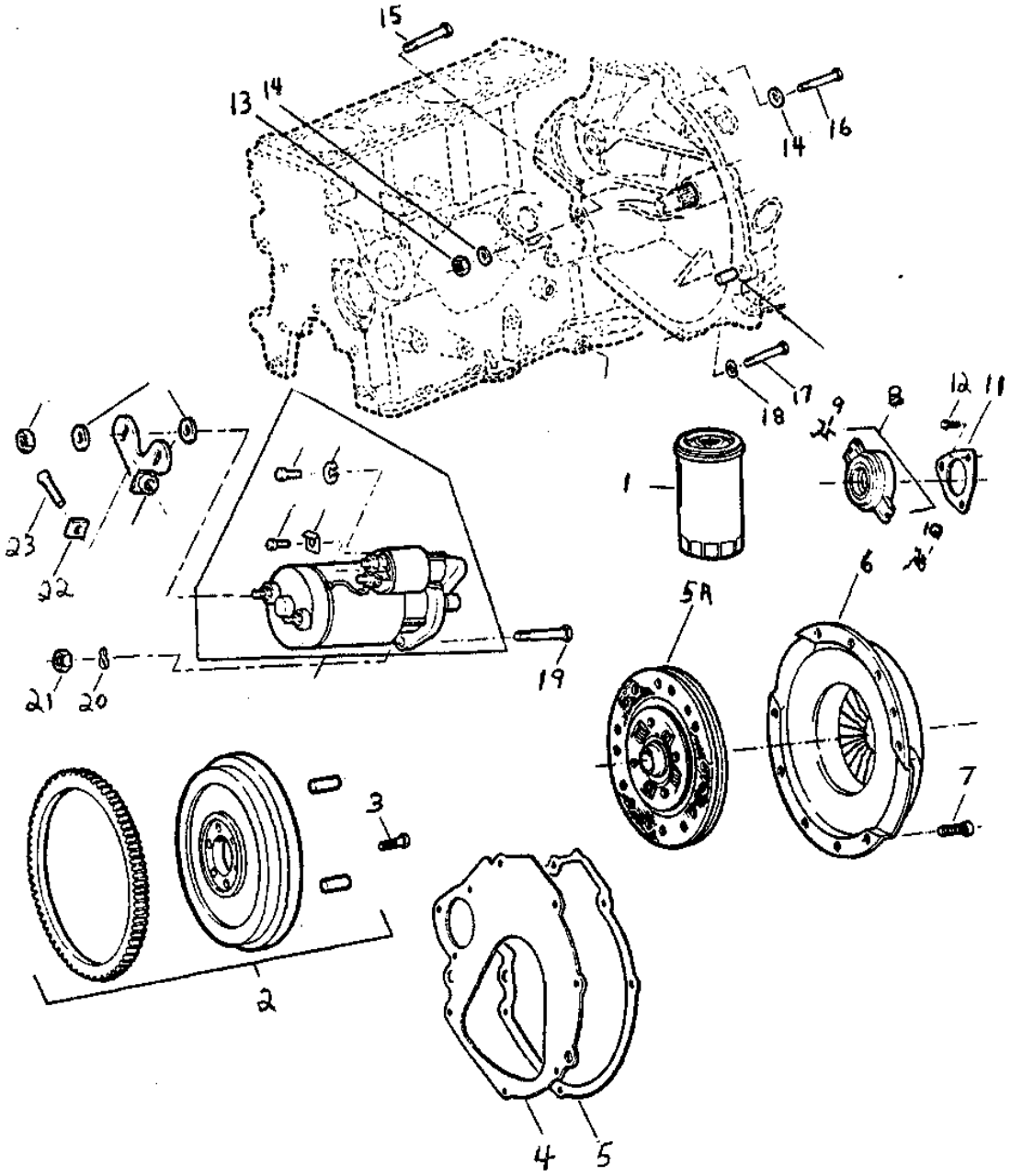


Figure 46 Engine components (shipment/storage)

Annex A

SPECIFICATION

FOR

REBUILDING THE VW 1.7 LITRE ENGINE CYLINDER HEAD USED IN

TRUCKS, UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2805-12-190-9208

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the cylinder head of the VW 1.7 litre engine used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, adjustments, packaging, and quality assurance provisions.

1.2 Purpose. - The purpose of this specification is to establish high-quality standards for rebuilding the cylinder heads to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

SPECIFICATIONS AND STANDARDS

AQAP-4	NATO Inspection System Requirements for Industry
MIL-L-210	Lubricating Oil, Internal Combustion Engine, Tactical Service
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components

MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)
D-84-010-001/SF-001	Enamel, Alkyd, Lustreless, Infrared Reflective, Camouflage

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada, Ottawa, Ontario, K1A 0S9

l-GP-12	Standard Paint Colours
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant
CAN2-3.8M	Dry Cleaning Solvent
1-GP-84	Paint, Primer

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each cylinder head supplied by DND in accordance with the requirements of this specification using procedures and standards specified in 3.5 and 3.6. The contractor shall return each rebuilt cylinder head to DND as a complete drop in cylinder head packaged in a reusable storage and shipping container as specified herein.

3.1.1 The cylinder head shall be completely disassembled and all components shall be thoroughly cleaned with dry cleaning solvent CAN 2-3.8M or commercial equivalent and dried before being inspected for condition and wear.

3.1.2 Components listed in Table II - Mandatory Parts Replacement shall be replaced with new OEM parts during rebuild.

3.1.3 The contractor shall record all measurements required to determine component wear and condition. These measurements shall be recorded on

data sheets designed and provided by the contractor and compared to the standards listed in 3.6. Components that do not meet the minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices. If the serviceability of a component is in doubt, the component shall be replaced. The Quality Assurance Authority shall be consulted in all such cases.

3.1.4 Any components missing from the cylinder head at time of disassembly will be replaced with serviceable OEM components at time of rebuild. A list of possible missing components can be found at Table III.

3.1.5 The contractor shall use tools designed for the purpose of the operation to be performed. A list of special tools can be found at Table V.

3.1.6 The contractor shall ensure that all components are secured as per Torque Standards listed in Table IV.

3.1.7 Upon completion of rebuild, the cylinder head shall consist of all the components listed in Table I. Figure 1 is provided for component identification and location within the cylinder head.

3.2 Cylinder head components.- The following Table lists all of the components comprising the VW 1.7 litre engine cylinder head; refer to Figure 1 for component identification and location within the cylinder head.

Table I Cylinder Head Components

Item	NSN	MRN	Description	Qty
1	5315-12-195-4628	N 012 708 2	Key - Woodruff	1
2	3020-12-175-5023	049 109 111 B	Wheel - Sprocket	1
3	5310-12-175-6307	056 109 143	Washer	1
4	5305-12-136-4443	N 010 137 1	Scr - Hex Hd (M12 X 1.5 X 35)	1

Table I Cylinder head components (cont'd)

Item	NSN	MRN	Description	Qty
5	5305-12-156-4862	222 062 055	Scr - Hex Hd (M6 X 20)	5
6	5310-12-142-8171	224 860 025	Washer - Spring (B6 X 12 X 0.5)	5
7	2540-21-896-9402	B 183 198 083	Flange Assy - Heater	1
8	5330-12-173-3042	056 121 149	Gasket - Flange	1
9	5307-12-187-9736	056 103 400	Stud (M6 X 15)	8
10	5330-12-188-6480	068 103 085 A	Seal	1
11	5307-21-893-8683	056 103 379	Plug - Oil Passage	1
12	2930-21-896-1458	B 183 198 081	Connector Assy	1
13	5330-12-173-3041	056 121 139 B	Gasket - Connector	1
14	2805-12-190-9208	049 103 063 AF	Head Assy - Cylinder	1
15	5340-21-897-8258	N 100 914 2	Cap (24)	1
16	5340-21-897-8284	059 103 381 A	Plug - Scr	1
17		049 103 353 AC	Head - Cylinder	1
18		N 044 411 1	Stud (M8 X 30)	8
19	5307-12-199-2277	056 103 397	Stud (M8 X 56)	1
20	2805-21-896-1451	056 103 419 A	Guide - Inlet Valve	4
20	2805-21-896-1468	049 103 419	Guide - Exhaust Valve	4
21	5310-12-145-5250	N 011 558 6	Washer - Flat (8.4 X 15 X 1.6)	10
22	5310-21-898-4371	N 902 442 01	Nut - Hex (M8)	10

Table I Cylinder head components (cont'd)

Item	NSN	MRN	Description	Qty
23	2805-21-892-4541	041 109 101 E	Camshaft	1
24	2805-12-173-5235	056 109 555	Shim (3.00)	1
24	2805-12-173-5236	056 109 556	Shim (3.05)	1
24	2805-12-173-5237	056 109 557	Shim (3.10)	1
24	2805-12-173-5238	056 109 558	Shim (3.15)	1
24	2805-12-173-5239	056 109 559	Shim (3.20)	1
24	2805-12-173-5240	056 109 560	Shim (3.25)	1
24	2805-12-173-5 41	056 109 561	Shim (3.30)	1
24	2805-12-173-5 42	056 109 562	Shim (3.35)	1
24	2805-12-173-5 43	056 109 563	Shim (3.40)	1
24	2805-12-173-5 44	056 109 564	Shim (3.45)	1
24	2805-12-173-5 45	056 109 565	Shim (3.50)	1
24	2805-12-173-5 60	056 109 566	Shim (3.55)	1
24	2805-12-173-5 46	056 109 567	Shim (3.60)	1
24	2805-12-173-5 47	056 109 568	Shim (3.65)	1
24	2805-12-173-5 48	056 109 569	Shim (3.70)	1
24	2805-12-173-5 49	056 109 570	Shim (3.75)	1
24	2805-12-173-5 50	056 109 571	Shim (3.80)	1
24	2805-12-173-5 51	056 109 572	Shim (3.85)	1
24	2805-12-173-5 52	056 109 573	Shim (3.90)	1
24	2805-12-173-5 53	056 109 574	Shim (3.95)	1

Table I Cylinder head components (cont'd)

Item	NSN	MRN	Description	Qty
24	2805-12-173-5 54	056 109 575	Shim (4.00)	1
24	2805-12-173-5 55	056 109 576	Shim (4.05)	1
24	2805-12-173-5 56	056 109 577	Shim (4.10)	1
24	2805-12-173-5 57	056 109 578	Shim (4.15)	1
24	2805-12-173-5 58	056 109 579	Shim (4.20)	1
24	2805-12-173-5259	056 109 580	Shim (4.25)	1
25	2805-21-892-4545	056 109 311 A	Tappet	8
27	5340-21-897-8319	056 109 629 A	Seat - Spring	1
28	5330-21-893-1656	026 109 675	Seal - Valve Stem Kit	1
29	5360-21-897-8879	056 109 623 A	Spring - Outer Valve	1
30	5360-21-897-8889	056 109 633 A	Spring - Inner Valve	1
31	2805-21-896-1464	B 183 198 025 A	Kit Valve Assy-Intake	4
31	2805-21-896-1465	B 183 198 027 A	Valve Assy - Exhaust	4
32	5340-12-199-3576	049 109 641	Seat - Spring	1
33	2805-12-147-6610	113 109 651 A	Collet - Valve	2
34	5930-12-175-1929	049 919 521 B	Sending Unit – Coolant Temp Light	1
35	5330-12-156-4518	N 013 806 2	Gasket - Copper (A10 X 14 X 1)	1
36	5930-21-201-0789	VDO 0323008 MF	Sending Unit – Coolant Temp Gauge	1

Table I Cylinder head components (cont'd)

Item	NSN	MRN	Description	Qty
37	5930-21-201-0781	VDO 0360531 MF	Sending Unit - Oil Pressure	1
38	5307-12-175-6004	056 103 399	Stud	1

3.3 Mandatory parts replacement.- The following Table lists parts that shall be replaced with new OEM components during cylinder head rebuild, see Figure 1 for component identification and location within the cylinder head.

Table II Mandatory parts replacement

Item	NSN	MRN	Description	Qty
4	5305-12-136-4443	N 010 137 1	Scr - Hex Hd (M12 X 1.5 X 35)	1
5	5305-12-156-4862	222 062 055	Scr - Hex Hd (M6 X 20)	5
6	5310-12-142-8171	224 860 025	Washer - Spring (B6 X 12 X 0.5)	5
8	5330-12-173-3042	056 121 149	Gasket - Flange	1
10	5330-12-188-6480	068 103 085 A	Seal	1
11	5307-21-893-8683	056 103 379	Plug - Oil Passage	1
13	5330-12-173-3041	056 121 139 B	Gasket - Connector	1
15	5340-21-897-8258	N 011 914 2	Cap (24)	1
16	5340-21-897-8284	059 103 381 A	Plug - Scr	1
21	5310-12-145-5250	N 011 558 6	Washer - Flat (8.4 X 15 X 1.6)	10
22	5310-21-898-4371	N 902 442 01	Nut - Hex (M8)	10
31	2805-21-896-1464	B 183 198 025 A	Kit - Intake Valve	4
31	2805-21-896-1465	B 183 198 027 A	Kit - Exhaust Valve	4
28	5330-21-893-1656	026 109 675	Seal - Valve Stem	1
35	5330-12-156-4518	N 013 806 2	Gasket - Copper (A10 X 14 X 1)	1

3.4 Possible missing components.- The following Table lists components that may be missing from the cylinder head at time of disassembly. Missing components other than Mandatory Parts Replacement, will be replaced with serviceable OEM components, see Figure 1 for component identification and location within the cylinder head.

Table III Possible missing components

Item	NSN	MRN	Description	Qty
1	5315-12-195-4628	N 012 708 2	Key - Woodruff	1
2	3020-12-175-5023	049 109 111	Wheel - Sprocket	1
3	5310-12-175-6307	056 109 143	Washer	1
4	5305-12-136-4443	N 010 137 1	Scr - Hex Hd (M12 X 1.5 X 35)	1
5	5305-12-156-4862	222 062 055	Scr - Hex Hd (M6 X 20)	5
6	6310-12-142-8171	224 860 025	Washer - Spring (B6 X 12 X 0.5)	5
7	2540-21-896-9402	B 183 198 083	Flange Assy - Heater	1
8	5330-12-173-3042	056 121 149	Gasket - Flange	1
12	2930-21-896-1458	B 183 198 081	Connector Assy	1
13	5330-12-173-3041	056 121 139 B	Gasket - Connector	1
34	5930-12-175-1929	049 919 521 B	Sending Unit -Coolant Temp Light	1
35	5330-12-156-4518	N 013 806 2	Gasket - Copper (A10 X 14 X 1)	1
36	5930-21-201-0789	VDO 0323008 MF	Sending Unit – Coolant Temp Gauge	1
37	5930-21-201-0781	VDO 0360531 MF	Sending Unit - Oil Pressure	1

3.5 Cylinder head rebuild procedures.- The following provides the step by step procedures for rebuilding the 1.7 litre engine cylinder head.

3.5.1 Disassemble the cylinder head

(a) Remove the spark plugs if necessary.

(b) Remove the three cap screws and spring washers from the coolant connector and remove the connector and gasket.

(c) Remove the coolant temperature sending units and copper gasket for the coolant temperature light and gauge from the heater connector at the rear of the head.

(d) Remove the two cap screws and spring washers and remove the heater connector and gasket.

(e) Remove the oil pressure sending unit and copper gasket from the rear of the head.

3.5.2 Remove the camshaft

(a) Remove the camshaft sprocket cap screw and flat washer.

(b) Remove the sprocket and woodruff key.

(c) Remove the nuts and flat washer from the camshaft bearing caps one, three and five, see Figure 2.

NOTE

If caps are not marked, mark them prior to removal or keep them in order for proper installation.

(d) To avoid camshaft distortion, loosen the four nuts on camshaft bearing caps two and four a little at a time until the tension is released. Remove the nuts, flat washers and bearing caps.

(e) Remove the camshaft from the cylinder head and remove the seal from the front end of the camshaft.

3.5.3 Inspect the camshaft bearing caps

(a) Clean and inspect the bearing caps for cracks or gouges.

(b) If either condition exists, the cylinder head assembly must be replaced.

3.5.4 Inspect the camshaft

(a) Thoroughly clean the camshaft and inspect the toes and flats of the camshaft lobes for wear and grooving. Wear and grooves are an indication of engine oil contamination.

(b) Inspect the camshaft bearing surfaces for grooves and replace the camshaft, if necessary.

(c) Place the camshaft bearing surfaces one and five on V-blocks or between centres and, using a dial indicator, measure the run-out of the camshaft, see Figure 3. Replace the camshaft, if the run-out is greater than 0.01 mm.

(d) To measure the camshaft axial clearance, proceed as follows:

i Remove the shims and bucket-type cam followers from the cylinder head and set aside, in order, so that each will be reinstalled in the same location.

CAUTION

The bearing caps are off centre. If a cap is installed incorrectly, the cap or cylinder head will crack.

ii Clean the camshaft bearing saddles and caps and install the camshaft and bearing caps one and five and install washers and nuts. Torque to 20 Nm (15 ft lb).

iii Tap either end of the camshaft so that all the clearance is at one end.

iv Place a dial indicator, set at zero, at the end of the camshaft with all the clearance and tap the opposite end of the camshaft, see Figure 4, to eliminate the clearance at the dial indicator end of the camshaft. If the axial clearance is greater than 0.15 mm, install a new camshaft and measure axial clearance. If the clearance is still unacceptable, replace the cylinder head.

(e) To measure the camshaft bearing clearance, proceed as follows:

i Install the camshaft and place a small piece of 0.001-0.003 inch plastigage on all five bearing surfaces.

ii Install the bearing caps, washers, and nuts in their correct positions and torque to 20 Nm (15 ft lb) . Do not turn the camshaft.

iii Remove the bearing caps.

iv Using the plastigage package, measure the plastigage squash, See Figure 5. The bearing clearance should be 0.02 mm to 0.05 mm. Replace the camshaft if the bearing clearance is greater than 0.05 mm. If the clearance is still unacceptable, replace the cylinder head.

v Remove plastigage from camshaft and bearing before final assembly.

3.5.5 Remove the valves

(a) Install valve spring compressor bar 2036 on the mounting studs of camshaft bearing caps one and five and install four nuts and flat washers, see Figure 6.

(b) Using valve spring compressor VW541/1, compress the valve springs of each valve assembly and remove both halves of each valve keeper from each valve stem and set aside, in order.

(c) Remove the valve spring retainer, the inner and outer springs.

(d) Using valve seal remover from Kit KD2899 remove the seal from each valve.

(e) Remove the spring seat from each valve and set in order.

CAUTION

Damage will occur to the valve guides during valve removal if burrs and roughness are not removed first.

(f) Feel all valve keeper grooves for roughness and, using either a small file, stone, or emery cloth, remove all burrs and roughness before removing the valve from the valve guide in the cylinder head.

(g) Remove the valves from the head and set aside in order.

3.5.6 Clean and inspect the cylinder head

(a) Using solvent and a plastic scraper, remove any pieces of gasket that are stuck to the cylinder head. Do not use a metal scraper or wire brush. Submerge the head into a cleaning solution and thoroughly clean ensuring all oil passages are clear.

(b) Thoroughly clean all bolt holes and using a tap or thread chaser, clean the threads.

(c) Inspect all studs for security and clean the threads. Replace damaged or loose studs as necessary.

(d) Inspect the valve seats for cracks or severe gas-cuts. If there are cracks or gas-cuts that cannot be removed by grinding, replace the head.

(e) Inspect the cam follower bores for gouges, roughness or damage. Replace the head if any of these conditions exist.

(f) Using a straight edge and feeler gauge, check the sealing surface of the cylinder head for distortion, see Figure 7. If the distortion is greater than 0.10 mm, the head must be resurfaced. After resurfacing, the thickness of the head must not be less than 132.55 mm, see Figure 8.

3.5.7 Clean, inspect and recondition valve components

(a) Remove carbon deposits from the valves and valve guides and insert the valves into the guides.

(b) Install dial indicator bracket VW387 and dial indicator V35/1 to the head.

(c) Move each valve stem back and forth in its guide and measure the rocking play, see Figure 9. The stem tip must be flush with the top of the guide. The maximum allowable rocking play of the intake valve stems is 1.00 mm. The maximum allowable rocking play of the exhaust valve stems is 1.30 mm. If the valve exceeds the allowable free play, install a new valve and measure the free play. Remove the dial gauge and bracket.

(d) If the new valve exceeds the allowable free play, replace the guide. Proceed as follows:

i From the combustion side of the cylinder head, press out the guide using tool 10-206, see Figure 10.

CAUTION

To prevent damage to the valve guide seating collars, do not use more than one ton of pressure after the seating collar contacts the cylinder head as the collar may break off.

ii Lubricate the new guide with oil and press into the cold cylinder head from the camshaft side ensuring the shoulder of the guide firmly contacts the top of the cylinder head.

iii Ream the valve guide with reamer 10-215 to obtain a uniform inside diameter of 8.013 to 8.035 mm, see Figure 11. Lubricate the reamer with cutting oil while reaming the guide.

iv Check the diameter of the guide bore with a go/no-go gauge that has a go diameter of 8.013 and a no-go diameter of 8.035 mm. The 8.013 mm end of the gauge should enter the guide easily, but it should be impossible to insert the 8.035 mm end into the valve guide.

(e) Grind the intake valves to a 45° angle. The intake valves must have a minimum margin of 0.50 mm, see Figure 12.

CAUTION

Do not grind exhaust valves. Exhaust valves can be lapped only.

(f) Grind the valve seats to 45°. Intake valve seats should have a maximum width of 2.00 mm and exhaust valve seats a maximum width of 2.40 mm, see Figure 12. Lessen with a 30° stone.

(g) Using a valve spring tester, test the tension of the springs, see Figure 13. When the outer springs are compressed to 22.30 mm (7/8 in.), the spring pressure should be 43.5 to 48.0 kg (96 to 106 lb). When the inner springs are compressed to 18.30 mm (23/32 in.), the spring pressure should be 21.0 to 23.0 kg (46 to 51 lb). Replace valve springs as required.

(h) Inspect the valve seats and valve seat retainers for wear and damage and replace as necessary.

(j) Inspect the cam followers for galling or signs of seizure.

(k) If aluminum from the head is found adhering to the cam followers, replace them.

(m) Inspect the valve adjusting shims for damage and measure their thickness at the centre and outer edge.

(n) If there is a variation in thickness or the surface is slightly scored, it can be lapped until it is smooth and to a uniform lower thickness in graduals of 0.05 mm, reinscribe the new thickness on the shim.

(p) Oil the keepers and then place both halves of each keeper in the corresponding keeper grooves on each valve. Rotate the valve while holding the keepers. The valve stem should rotate freely without excessive free play. If the keepers are loose, grind or file the keeper mating surfaces to make a tighter fit.

(q) Set aside all valve keepers in order.

(r) Lap each valve in its corresponding seat, see Figure 14.

(s) Clean all valves, stems and seats.

(t) Apply a little Prussian blue to each valve at four points where the valve will contact the seat. Insert the valve stems into their corresponding guides and turn each valve one quarter turn in both directions. Withdraw the valves from the cylinder head and examine the circle of bluing on each valve. If the valves are correctly lapped, there will be a complete circle of bluing on each valve. If a circle is incomplete, lap the valve until a complete circle can be formed. Clean the bluing from the valves and seats.

3.5.8 Install the valves

(a) Oil the valve stems and guides and insert the valve stems into their corresponding guides.

(b) Place a covering over the bottom of the cylinder head to prevent the valves from falling out and turn the head over.

(c) Install the spring seats over the corresponding valve stems.

(d) Place a plastic sleeve from the seal replacement kit on a valve stem to prevent damage when installing valve stem seals.

(e) Insert the spring end of a seal into valve seal installer from Kit KD2899, see Figure 15, and apply a coat of oil to the valve stem.

(f) Push the seal onto the valve stem and remove the plastic sleeve from the valve stem.

(g) Install seals on all valve stems following steps (d), (e) and (f) and install the inner and outer springs and retainers on the corresponding valve stems.

(h) Place valve spring compressor 2036 on the mounting studs of camshaft bearing caps one and five and install four nuts and flat washers.

(j) Using valve spring compressor VW541/1, compress each set of valve springs and place both halves of each valve keeper in the corresponding keeper groove on each valve stem.

(k) Remove valve spring compressor bar 2036.

(m) Tap the top of each valve assembly to ensure the keepers are securely in place.

3.5.9 Install the camshaft

(a) Oil the bucket-type cam followers, cylinder head bores, and shims and install on the corresponding valve assemblies.

NOTE

Ensure shims are installed with their etched dimensions facing down.

(b) Clean and lubricate the camshaft bearing cap surfaces of the cylinder head.

(c) Lubricate the lip of the new seal and install the seal on the front end of the camshaft with the lip facing toward the rear.

(d) Install the camshaft.

(e) Lubricate the camshaft and caps with oil and install bearing caps two and four over the corresponding camshaft bearing surfaces, see Figure 16. Ensure the bearing caps are correctly positioned.

(f) Install flat washers and nuts on bearing caps two and four and tighten each nut a little at a time. Torque to 20 Nm (15 ft lb).

(g) Lubricate with oil and install bearing caps one, three and five over the corresponding camshaft bearing surfaces, ensuring the bearing caps are correctly positioned.

(h) Install washers and nuts on bearing caps one, three and five and torque to 20 Nm (15 ft lb).

(j) Install the woodruff key, camshaft sprocket, flat washer and cap screw. Torque to 80 Nm (59 ft lb).

(k) Adjust the valve tappet clearance, by performing the following:

i Turn the camshaft so that the two camshaft lobes for one of the cylinders are facing up at similar angles.

ii Using feeler gauges measure the clearance between each camshaft lobe and corresponding shim for the intake and exhaust valves of the cylinder.

NOTE

Cold Valve Clearance is:

Intake Valve	Exhaust Valve
0.15 to 0.25 mm	0.35 to 0.45 mm

iii If the clearance is not within the specified clearance:

a. Turn the buckets so that both slots in the bucket face towards the sides of the cylinder head.

b. Using compressing tool Hazet 2574, press both buckets down, away from the camshaft lobes, see Figure 17.

c. Using shim pliers 10-208, remove the shim from the bucket.

d. Select a new shim that will give a clearance in the mid-range of the specified clearance.

e. Install the new shim in the bucket with the size of the shim facing down.

f. Remove the compressing tool and recheck the clearance.

g. Perform the valve adjustment on the remaining cylinders.

3.5.10 Install coolant connectors

(a) Install a new gasket and the coolant connector to the opening at the left side of the head and secure it with three cap screws and spring washers. Torque to 10 Nm (7 ft lb).

(b) Install a new gasket and the heater connector to the rear of the head and secure it with two cap screws and spring washers. Torque to 10 Nm (7 ft lb).

(c) Install the coolant temperature light sending unit and copper gasket in the top of the heater connector. Torque to 25 Nm (18 ft lbs).

(d) Install the coolant temperature gauge sending unit and copper gasket in the side of the heater connector. Torque to 25 Nm (14 ft lb).

(e) Install the oil pressure sending unit and copper gasket in the rear of the head and torque to 25 Nm (18 ft lb).

3.6 Standards.- The following lists the standards for the VW 1.7 litre engine cylinder head. These standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of the component. If the serviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Description	Standards
Cylinder Head - Distortion	0.10 mm maximum
- Thickness	132.55 mm minimum
Valve Guides - Inside dia	8.013 to 8.035 mm
Valve Stem to Guide Rocking Play - Inlet	1.00 mm maximum
- Exhaust	1.30 mm maximum

Valve Seats - Inlet:	
- Depth	9.00 mm
- Diameter	33.20 mm
- Seat Width	2.00 mm
- Seat Angle	45°
- Correction Chamfer Angle	30°
Valve Seats - Valve Exhaust:	
- Depth	9.60 mm
- Diameter	30.80 mm
- Seat Width	2.40 mm
- Seat Angle	45°
Correction chamfer angle	30°
Inlet Valve - Margin	0.50 mm minimum
- Face Width	3.50 mm maximum
- Face Angle	45°
Exhaust Valve - Face Angle	45°
- Margin	DO NOT MACHINE GRIND. HAND LAP ONLY.
Valve Spring Tension - Outer	43.5 to 48.0 kg (96 to 106 lb) when compressed to 22.3 mm (7/8 in.)
- Inner	21.0 to 23.0 kg (46 to 51 lb) when compressed to 18.3 mm (23/32 in.)
Valve Tappet Clearance - Cold	Inlet - 0.15 to 0.25 mm Exhaust - 0.35 to 0.45 mm
Camshaft - Bearing Clearance	0.02 to 0.05 mm
- Axial Clearance	0.15 mm maximum
- Run-Out	0.01 mm maximum

3.7 Torque standards.- The following Table lists torque standards that shall be used when rebuilding the VW 1.7 litre engine cylinder head, see Figure 1 for component identification.

Table IV Torque standards

Item	Description	Nm	FT LB
4	Camshaft Sprocket Capscrew	80	59
5	Heater and Coolant Connector Capscrews	10	7
22	Camshaft Bearing Cap Nuts	20	15
34	Coolant Temperature Light Sending Unit	6	4
36	Coolant Temperature Gauge Sending Unit	6	4
47	Oil Pressure Sending Unit	6	

3.8 Special Tools.- The following Table lists special tools that shall be used during the rebuild of the VW 1.7 litre engine cylinder head. Tools other than listed shall be approved by QA, see Figure 18 for tool identification.

Table V Special tools

Item	NSN	MRN	Description	Qty
1	5120-21-896-7686	2036	Device - Valve Mounting	1
2	5120-21-896-7704	VW 541/1	Lever	1
3	5120-21-896-7687	KD 2899	Tool - Valve Guide Seal	1
4		V/35.1	Gauge - Dial	1
5	5120-21-896-7697	VW 387	Bracket - Dial Gauge	1
6		10-215	Reamer	1

4 QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PAINTING, PRESERVATION, PACKAGING AND MARKING

5.1 Painting.- The cylinder head and components of the head shall not be painted.

5.2 Preservation.- After final rebuild acceptance by Quality Assurance Authority, the contractor shall attach a legible stamped or engraved metal plate to the head showing the following information:

(a) Name of firm or workshop that rebuilt the head.

(b) Day, month and year of cylinder head rebuild.

(c) Firm or workshop order number.

(d) Thickness of the head as determined in 3.5.6(f).

5.2.1 The cylinder head shall be properly supplied with:

(a) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(b) CF 2248 - NSN 7530-21-870-3866 - Lubrication Record for Shipment and Preservation Tag.

(c) The NSN for the head - 2805-12-190-9208.

5.2.2 The camshaft, sprocket and valve assemblies shall be lightly misted with oil and then the head wrapped in barrier material MIL-B-131 and sealed with tape pressure sensitive 43-GP-3M.

5.3 Packaging.- The wrapped cylinder head shall be placed in a wooden shipping and storage container containing 2 inches of styrofoam on all sides, top, and bottom. Sufficient new desiccant bags to prevent

condensation shall be placed in the container and then the container sealed.

5.3.1 Prior to packaging, the container shall be placed in Class "S" condition by replacing hardware for the lid, repairing any holes and applying one coat of primer to 1-GP-84 and one coat of enamel paint to D-84-010-001/SF-001, the colour shall conform to l-GP-12c olive drab no. 503-321.

5.4 Marking.- The shipping and storage container shall have the following stencilled on each ends

(a) The NSN - 2805-12-190-9208.

(b) The Description - CYLINDER HEAD - 1.7 LITRE.

(c) The MRN - 049 103 063 AF.

(d) Qty - 1 ea.

(e) Wt -

(f) Date of Rebuild.

5.4.1 The following shall be stencilled on both sides:

"REUSABLE CONTAINER-DO NOT DESTROY CF PROPERTY"

5.4.2 A CF 942A, NSN 7690-21-868-6739, Identity and Condition Label properly filled out will be stapled to the container.

5.4.3 Any further preservation, packaging or marking instructions will be stipulated in the contract.

6. **NOTES**

6.1 Ordering data.- Procurement documents should specify the title, number, and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be specified in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through Quality Assurance Authority.

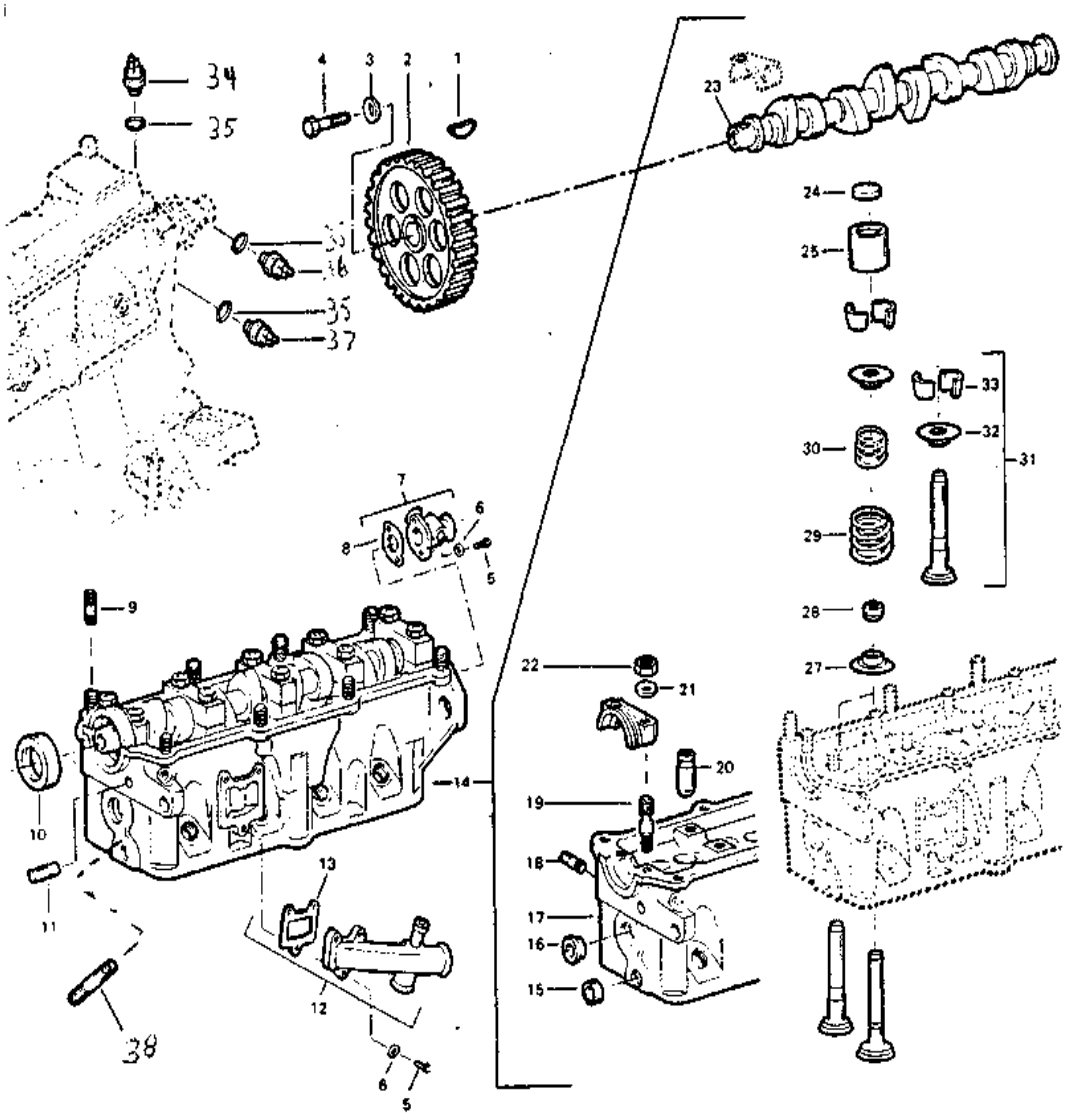


Figure 1 Cylinder head assembly

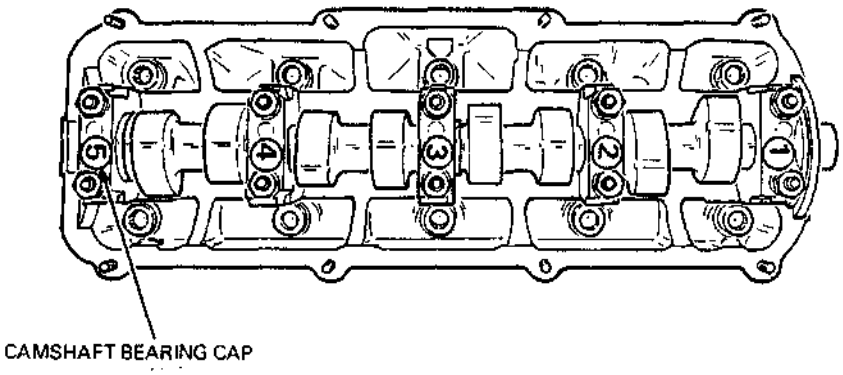


Figure 2 Camshaft bearing caps

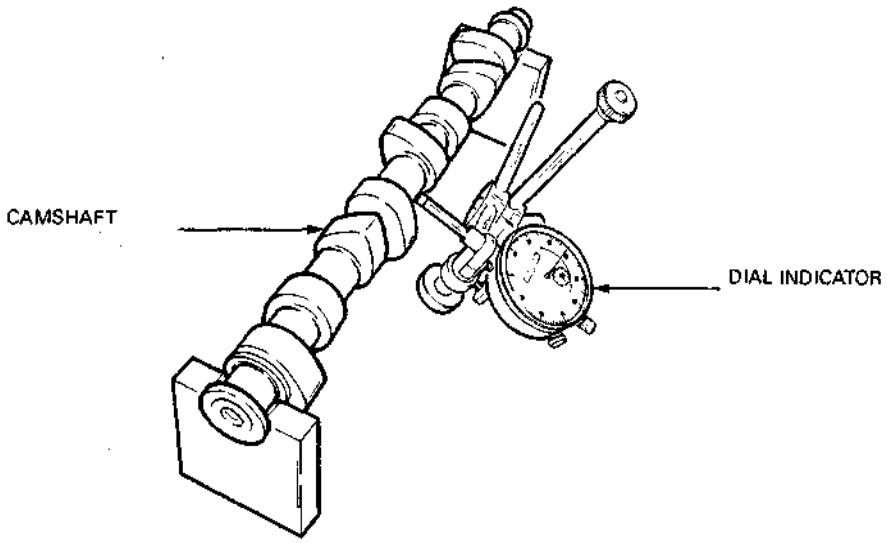


Figure 3 Measurement of camshaft run-out

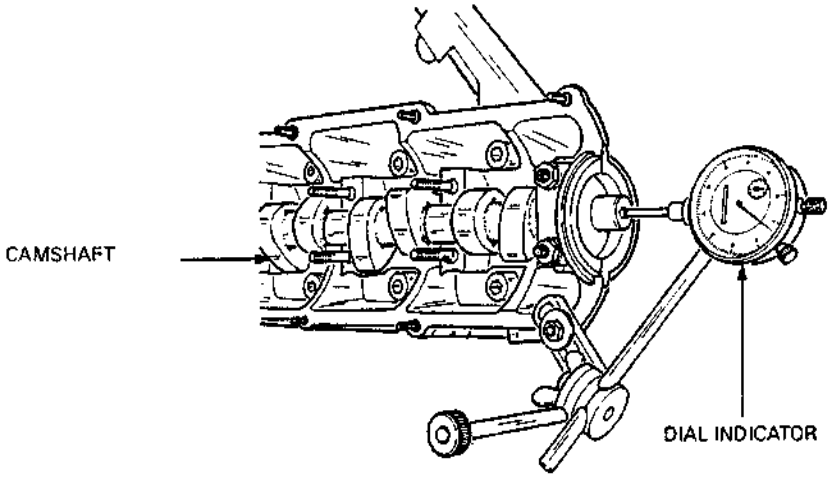


Figure 4 Measurement of camshaft axial clearance

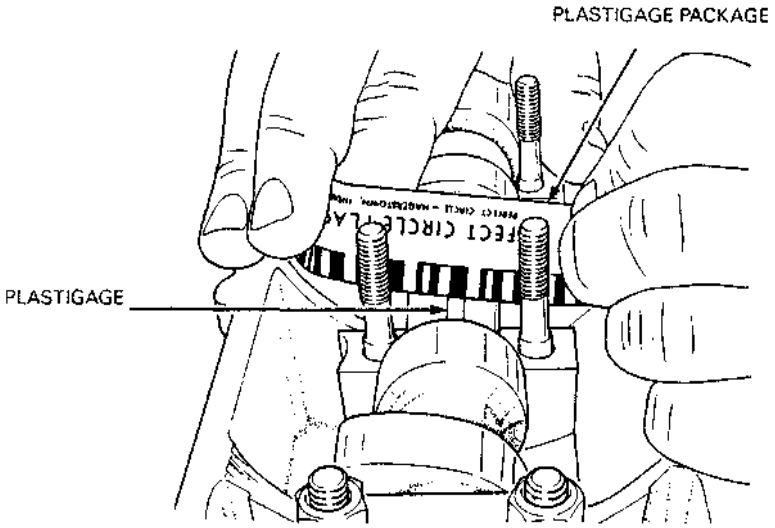


Figure 5 Measurement of camshaft bearing clearance

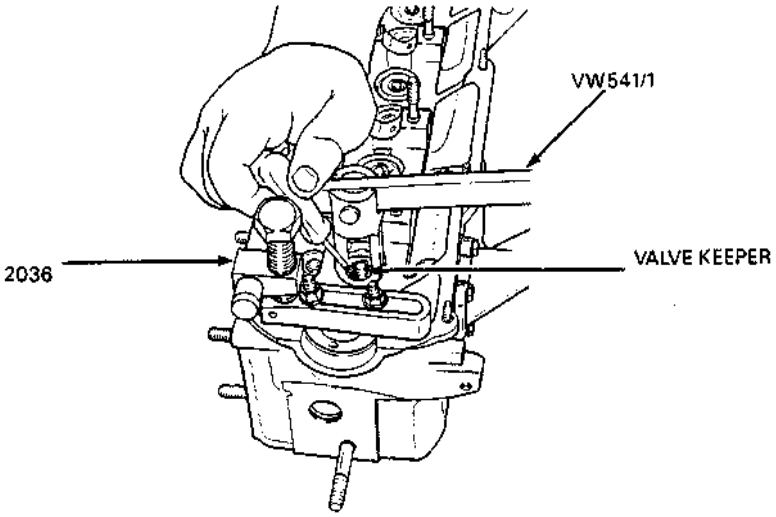


Figure 6 Removal of valve keepers

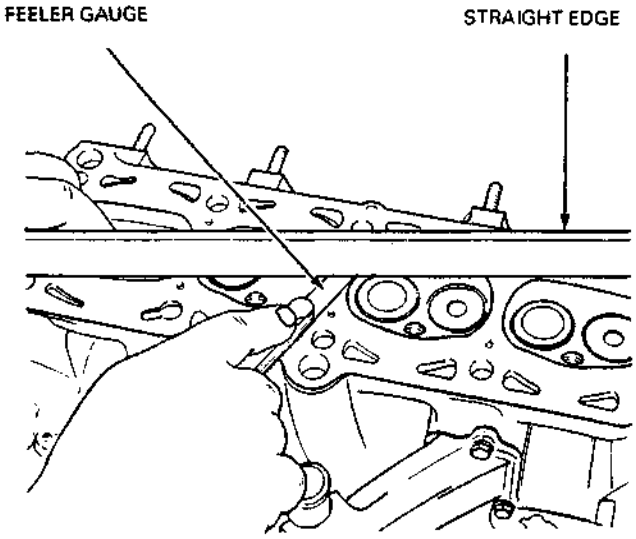


Figure 7 Cylinder head distortion check

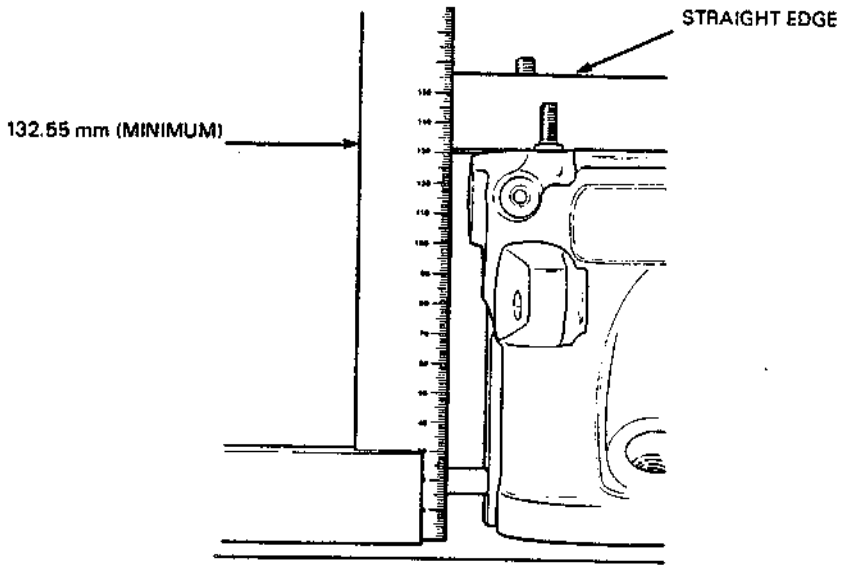


Figure 8 Measurement of cylinder head thickness

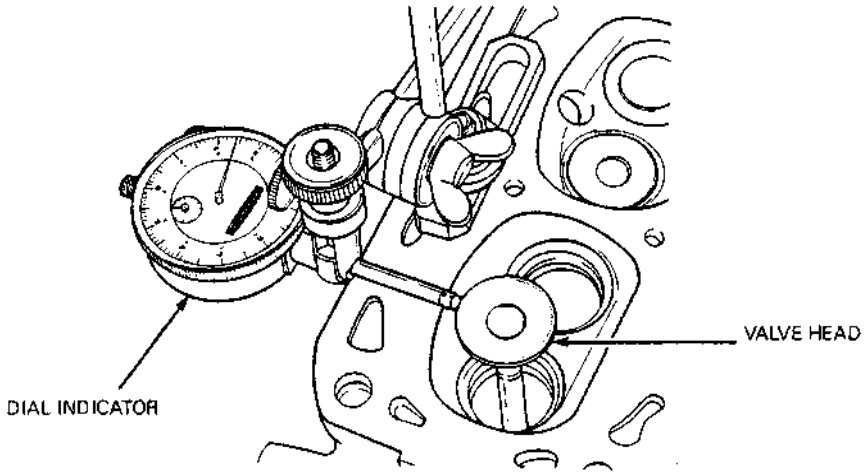


Figure 9 Measurement of valve rocking play

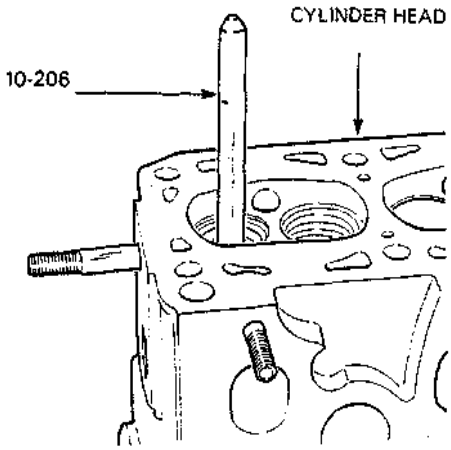


Figure 10 Removal of valve guide

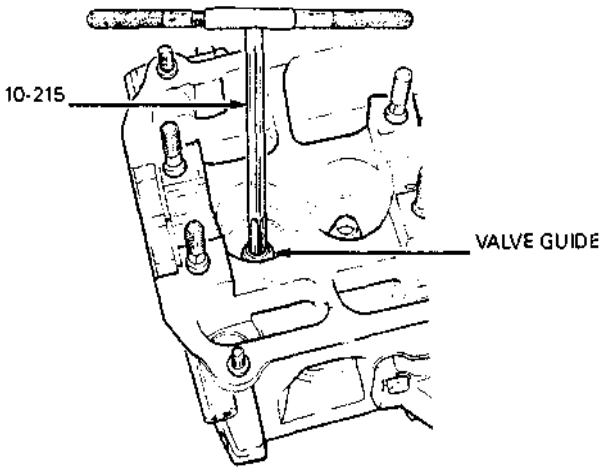


Figure 11 Reaming valve guide

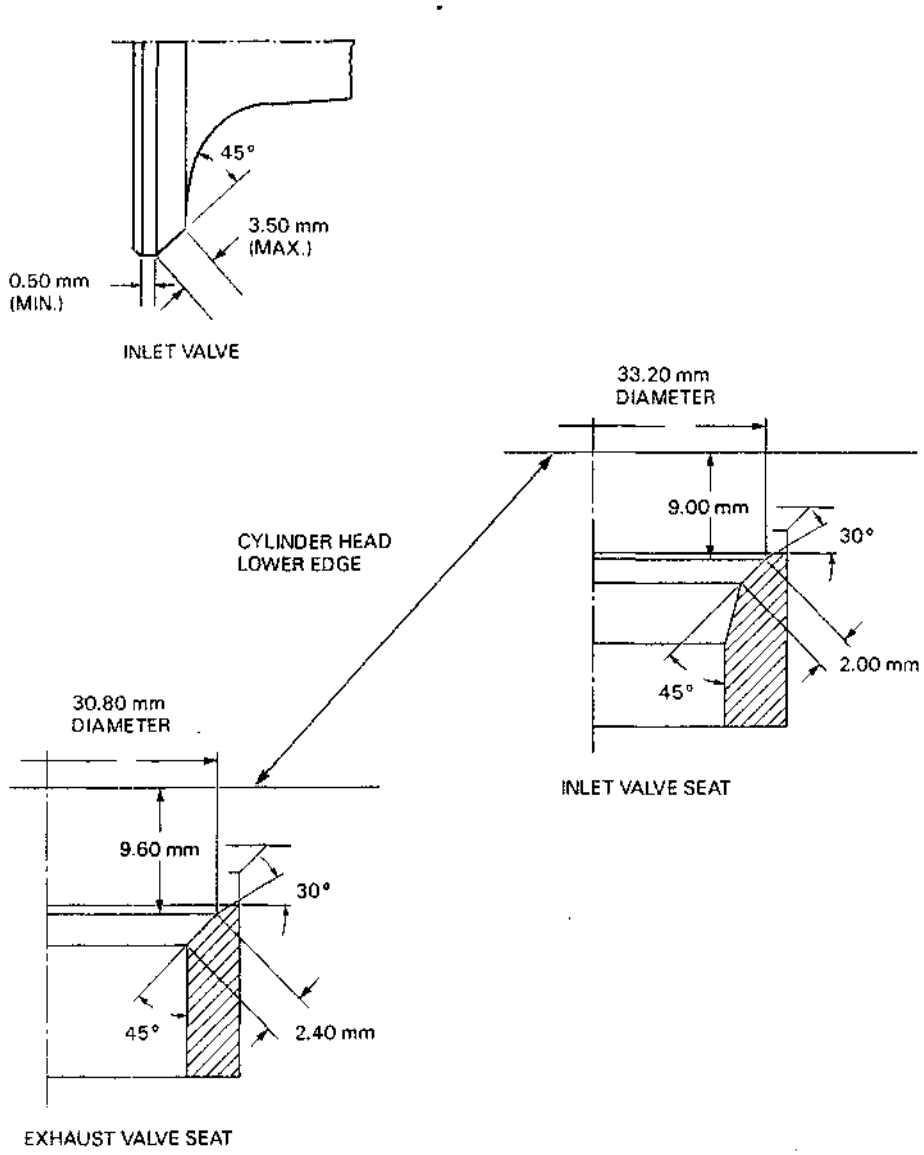


Figure 12 Standards for inlet valve, inlet valve seats and exhaust valve seats

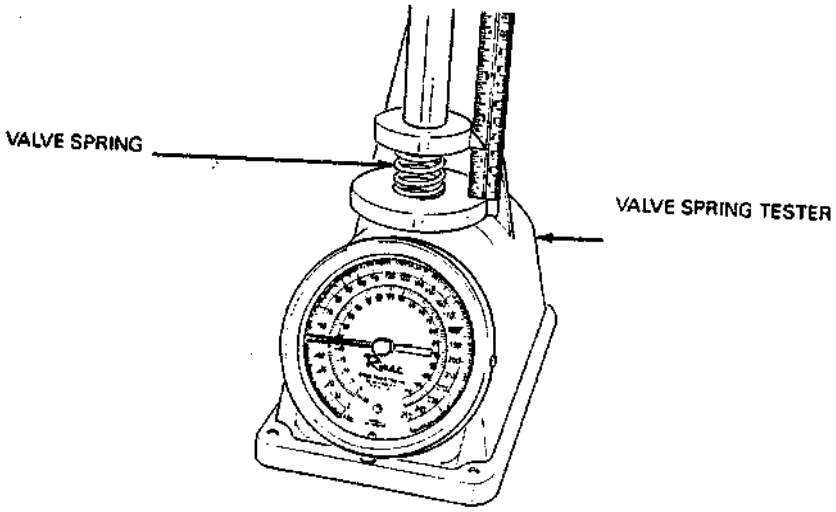


Figure 13 Valve spring compression test

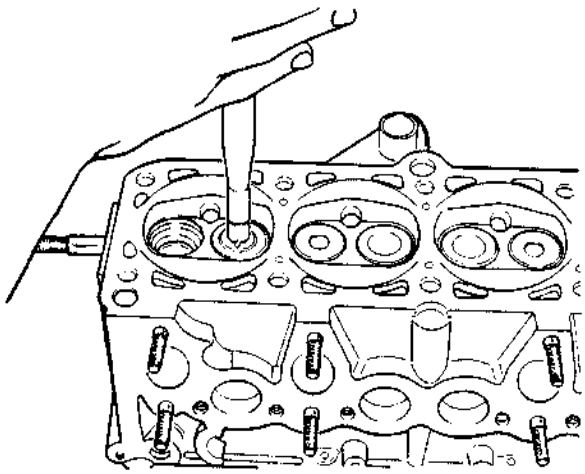


Figure 14 Valve lapping

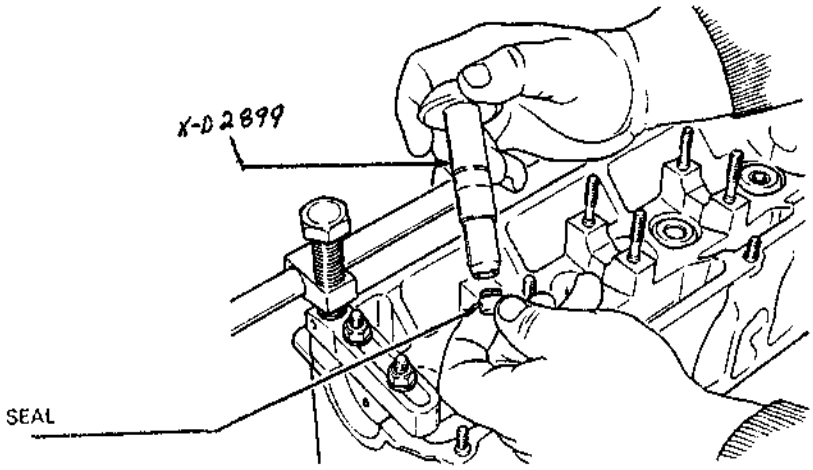


Figure 15 Installation of valve stem seal

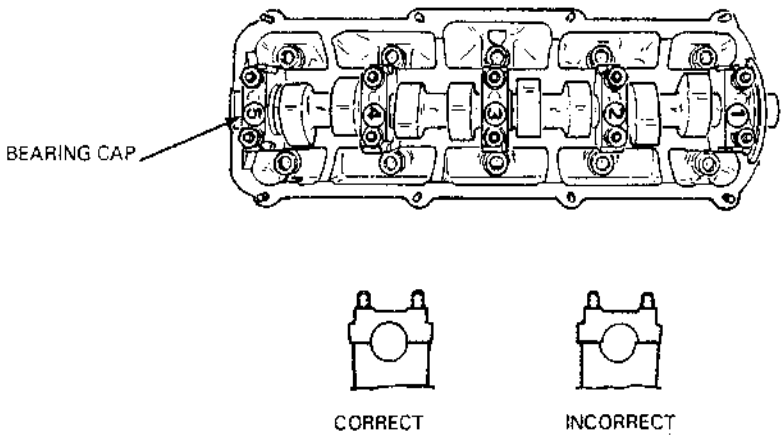


Figure 16 Camshaft bearing caps

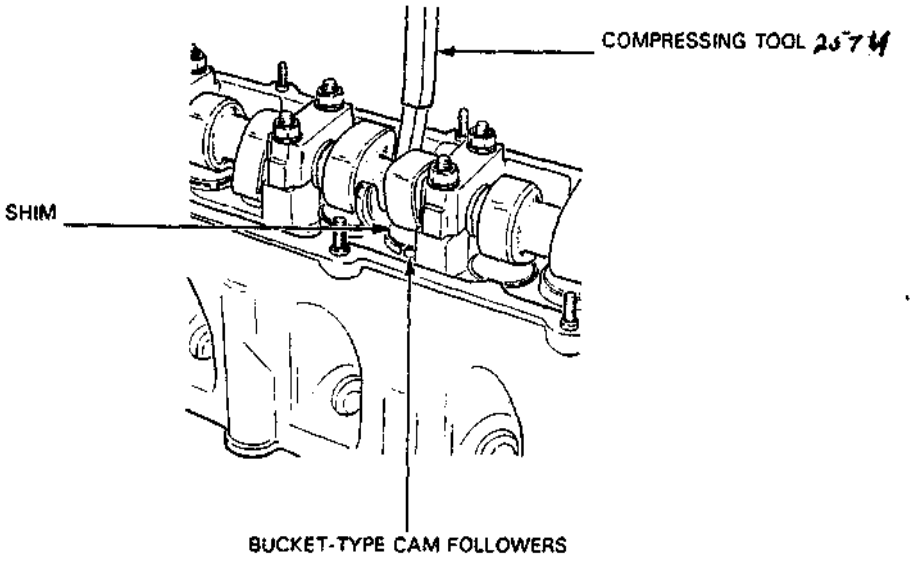


Figure 17 Pressing bucket-type cam followers

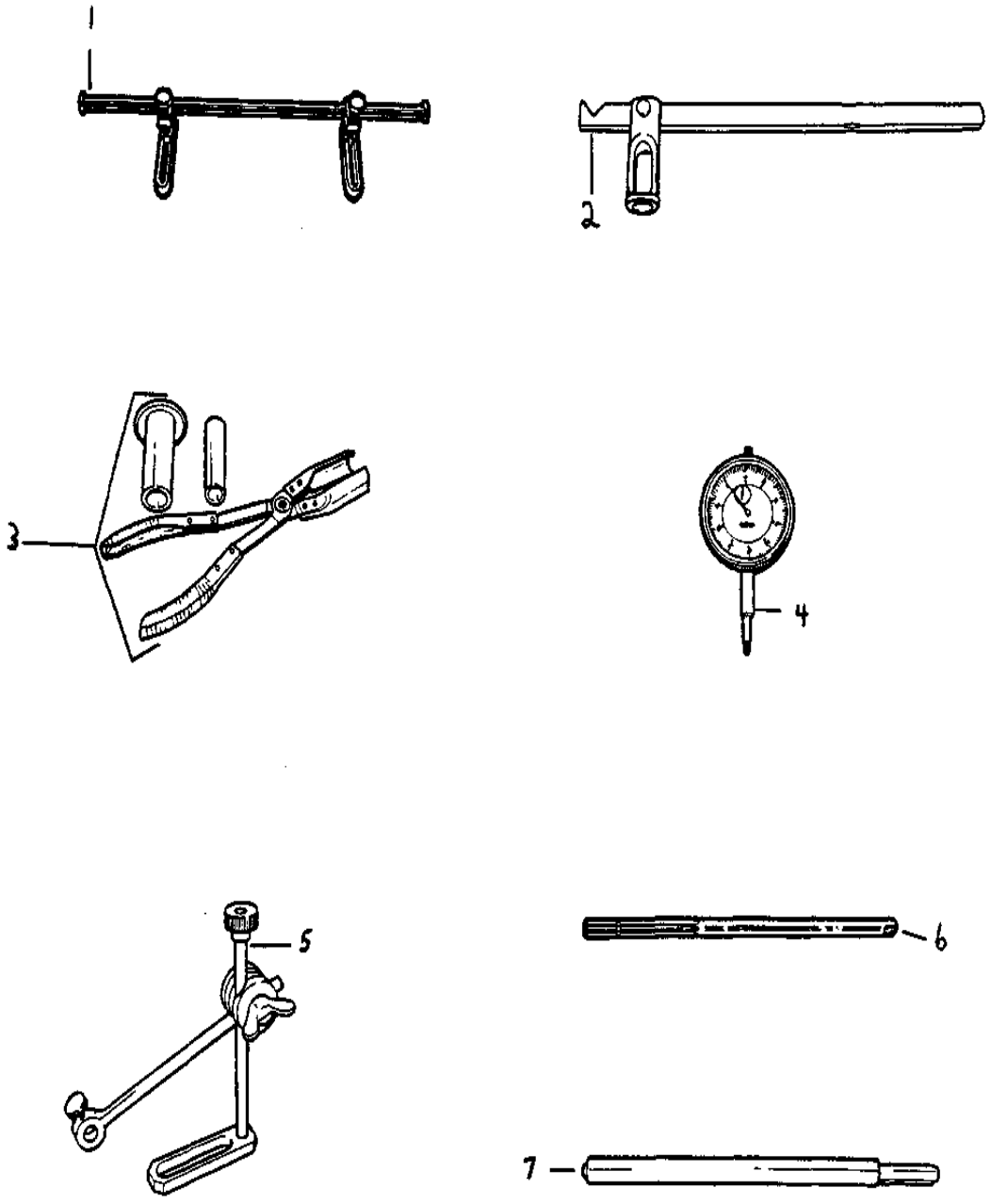


Figure 18 Special tools

Annex B

SPECIFICATION

FOR

REBUILDING THE VW 1.7 LITRE ENGINE OIL PUMP USED IN

TRUCKS, UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2805-12-175-1912

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the oil pump of the VW 1.7 litre engine used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, packaging, and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the oil pumps to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
MIL-L-2104	Lubricating Oil, Internal Combustion Engine, Tactical Service
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A 0S9

CAN2-3.8-M	Dry Cleaning Solvent
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant

3. **REQUIREMENTS**

3.1 General.- The contractor shall rebuild each oil pump supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.4 and 3.5.

3.1.1 If the oil pump is being rebuilt as part of an engine assembly rebuild, it shall be installed in the rebuilt engine.

3.1.2 If the oil pump is being rebuilt as a component only it shall be preserved and packaged as specified herein and returned to DND as a complete drop-in assembly.

3.1.3 The oil pump shall be completely disassembled and all components shall be thoroughly cleaned with dry cleaning solvent CAN2-3.8 or commercial equivalent and dried before being inspected for condition and wear.

3.1.4 The contractor shall record all measurements required to determine component wear and condition. These measurements shall be recorded on data sheets designed and provided by the contractor and compared to the standards listed in 3.5. Components that do not meet the minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices. If the serviceability of a component is in doubt, the component shall be replaced. Quality Assurance Authority shall be consulted in all such cases.

3.1.5 Components listed in Table II - Mandatory Parts Replacement shall be replaced with new OEM parts during rebuild.

3.1.6 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.7 The contractor shall ensure that the pump cover is secured to the body as per the Torque Standard listed in Table III.

3.1.8 Upon completion of rebuild, the oil pump shall consist of all the components listed in Table I. Figure 1 is provided for component identification and location within the pump.

3.2 Oil pump components. - The following Table lists all of the components comprising the VW 1.7 litre engine oil pump; refer to Figure 1 for component identification and location within the oil pump.

Table I Oil pump components

Item	NSN	MRN	Description	Qty
1		049 115 151 B	Cover Assy	1
2		049 115 158	Plate - Base	1
3		056 115 181 B	Seat - Spring Stop	1
4	5305-12-142-0188	222 060 855	Scr - Hex Hd (M6 X 22)	2
5	5310-21-896-2645	224 880 025	Washer - Spring (B8 X 15 X 0.8)	2
6		068 115 421	Spring	1
7		068 115 123 A	Gear - Oil Pump	1
8		026 115 115	Shaft - Drive c/w Gear	1
9		068 115 107 A	Body - Oil Pump	1
10	3120-21-897-8931	056 115 167	Sleeve - Centering (Oil Pump)	1

3.3 Mandatory parts replacement.- Table II lists parts that shall be replaced with new OEM components during oil pump rebuild; see Figure 1 for component identification and location within the oil pump.

Table II Mandatory parts replacement

Item	NSN	MRN	Description	Qty
4	5305-12-142-0188	222 060 855	Scr Hex Hd (M6 X 22)	2
5	5310-21-896-2645	224 880 025	Washer - Spring (B8 X 15 X 0.8)	2
6		068 115 421	Spring	1
10	3120-21-897-8931	056 115 167	Sleeve - Centering (Oil Pump)	1

3.4 Oil pump rebuild procedures.- The following provides the step by step procedures for rebuilding the VW 1.7 litre engine oil pump assembly.

3.4.1 Disassemble

(a) Remove the two cap screws and spring washers and remove the cover assembly from the pump body.

(b) Remove the pump gears from the body.

(c) Remove the spring stop, spring and plunger from the cover.

(d) Pry the base plate from the cover and remove the screen.

3.4.2 Clean and inspect

(a) Clean all components in dry cleaning solvent and blow dry with compressed air.

(b) Inspect all components for damage and replace as necessary.

(c) Reinstall the gears and place a straight edge across the bottom of the pump body to measure the axial play, see Figure 2. If axial play exceeds 0.15 mm, replace the pump body.

(d) Remove the gears and press the bushing from the pump body.

(e) Using a tap, clean the capscrew holes in the body.

(f) Press a new bushing into place. If required, heat the body to 80°C.

(g) Reinstall the gears and measure the gear backlash, see Figure 3. If clearance is less than 0.05 mm or greater than 0.20 mm, replace the gears.

3.4.3 Reassemble

(a) Coat the plunger, spring and plunger bore with oil and install the plunger, spring and spring stop in the cover.

(b) Install the screen and base plate on the cover.

(c) Coat the gears and bushing with oil and install the gears in the body.

(d) Install the cover assembly to the body with the two capscrews and spring washers and torque to 10 Nm (7 ft lb).

3.5 Standards.- The following lists the standards for the VW 1.7 litre engine oil pump. These standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of the component. If the serviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Description	Standards
Pump Gears to Body - Axial Play	0.15 mm maximum
Pump Gears - Backlash	0.05 minimum 0.20 maximum

3.6 Torque standards.- The following Table lists the torque standards that shall be used when rebuilding the VW 1.7 litre engine oil pump, see Figure 1 for component identification.

Table III Torque standards

Item	Description	Nm	FT LB
4	Cover Assy to Body Capscrews	10	7

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspection and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractors system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PRESERVATION, PACKAGING AND MARKING

5.1 A legible stamped or engraved metal plate shall be attached to the oil pump in an approved location showing the following information.

(a) Name of the firm or workshop that rebuilt the oil pump.

(b) Day, month and year of oil pump rebuild.

(c) Firm or workshop order number.

(d) Axial play.

(e) Gear backlash.

5.1.1 The oil pump shall be properly supplied with:

(a) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(b) CF 2248 - NSN 7530-21-870-3866 - Lubrication Record for Shipment and Preservation Tag.

(c) NSN for the oil pump.

5.1.2 The oil pump assembly shall be wrapped in barrier material MIL-B-131 and sealed with tape pressure sensitive 43-GP-3M.

5.2 Packaging.- The wrapped pump shall be placed in a polyurethane bag with sufficient new desiccant bags to prevent condensation and sealed.

5.3 Marking.- The polyurethane bag shall contain a clearly marked label visible from the outside with the following information.

(a) Name of rebuild contractor or workshop.

(b) Work order number of pump rebuild contractor or workshop.

(c) Date of pump rebuild.

(d) Oil pump NSN.

5.3.1 Any other packaging requirements will be specified in the contract.

6. **NOTES**

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through Quality Assurance Authority.

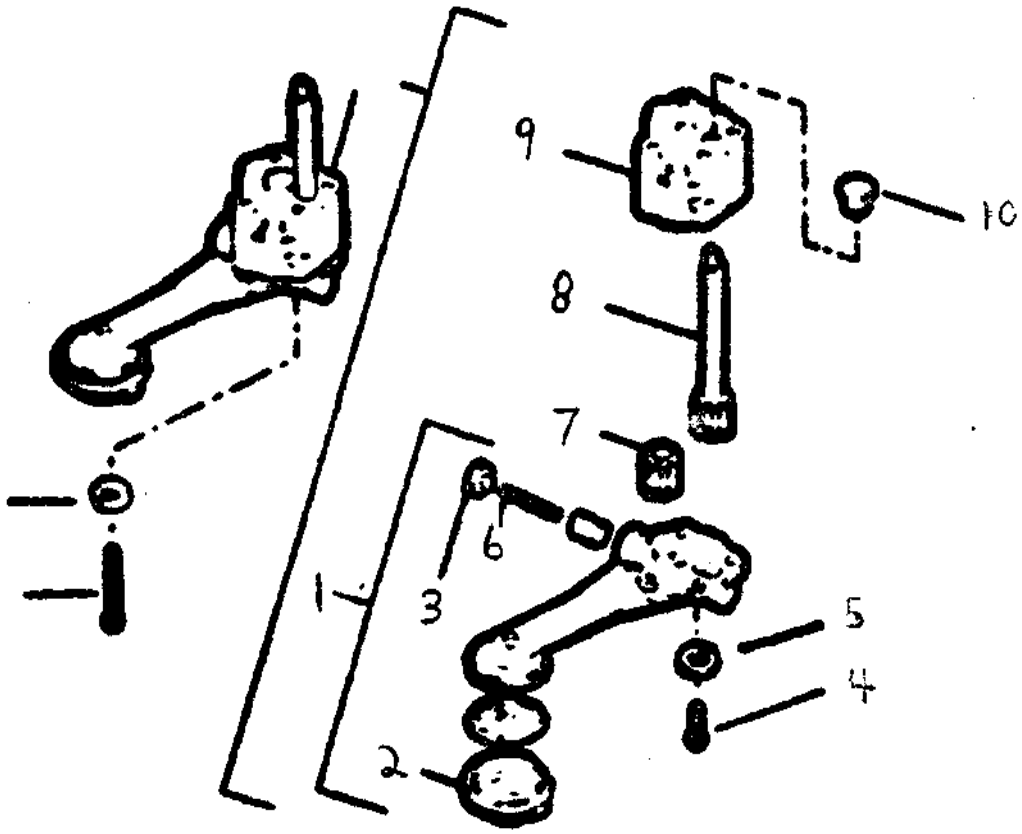


Figure 1 Oil pump assembly

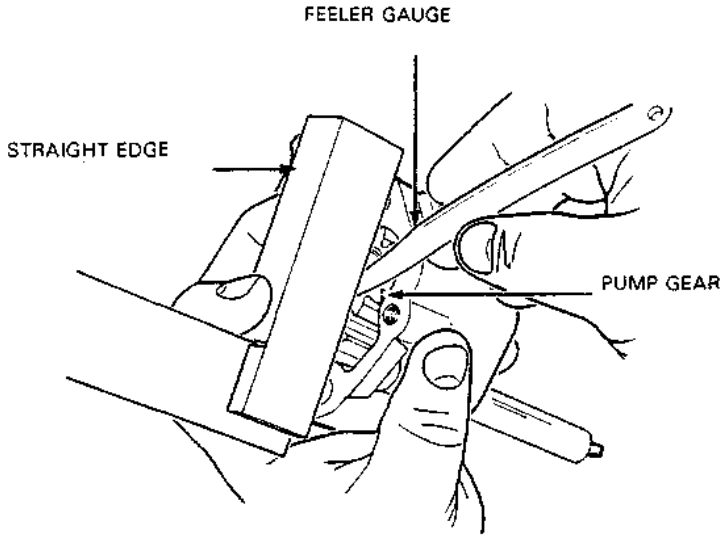


Figure 2 Measurement of oil pump gears axial play

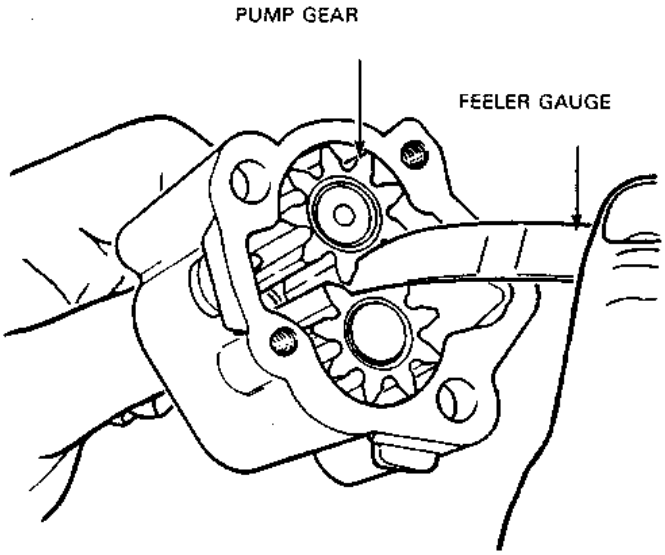


Figure 3 Measurements of oil pump gears backlash clearance

Annex C

SPECIFICATION

FOR

REBUILDING THE VW 1.7 LITRE ENGINE COOLANT PUMP USED IN TRUCKS,

UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2930-12-179-2203

1. SCOPE

1.1 Scope.- This specification covers the requirements for rebuilding the VW 1.7 litre engine coolant pump used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the coolant pumps to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components.
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll).

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario K1A 0S9

CAN2-3.8M	Dry Cleaning Solvent
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant.

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each coolant pump supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.5 and 3.6.

3.1.1 If the pump is being rebuilt as part of an engine assembly rebuild, it shall be installed on the rebuilt engine.

3.1.2 If the pump is being rebuilt as a component only, it shall be preserved and packaged as specified herein and returned to DND as a complete drop-in assembly.

3.1.3 The coolant pump shall be completely disassembled and all components shall be thoroughly cleaned and dried before being inspected for condition and wear.

3.1.4 The contractor shall record all measurements required to determine component condition and wear. These measurements shall be recorded on data sheets designed and provided by the contractor and compared to the standards listed in 3.6. Components that do not meet the minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum SAE Standards and Practices. If the serviceability of a component is in doubt, the component shall be replaced. Quality Assurance Authority shall be consulted in all such cases.

3.1.5 Components listed in Table II - Mandatory Parts Replacement shall be replaced with new OEM parts during rebuild.

3.1.6 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.7 The contractor shall ensure that components are secured as per Torque Standards listed in Table IV.

3.1.8 Any components missing from the pump at time of disassembly shall be replaced with new or serviceable OEM components. A list of Possible Missing Components can be found at Table III.

3.1.9 Upon completion of rebuild, the coolant pump shall consist of all the components listed in Table I. Figure 1 is provided for component identification and location within the pump.

3.2 Coolant pump components.- Table I lists all of the components comprising the VW 1.7 litre engine coolant pump, refer to Figure 1 for component identification and location within the coolant pump.

3.3 Mandatory parts replacement.- Table II lists parts that shall be replaced with new OEM components during coolant pump rebuild, refer to Figure 1 for component identification and location within the coolant pump.

3.4 Possible missing components.- Table III lists components that may be missing from the coolant pump at time of disassembly. Missing components other than Mandatory Parts Replacement will be replaced with new or serviceable OEM components, refer to Figure 1 for component identification and location within the coolant pump.

3.5 Coolant pump rebuild procedures.- The following provides the step by step procedures for rebuilding the VW 1.7 litre engine coolant pump.

3.5.1 Disassembly

(a) Remove the three hex head screws with washers and remove the pulley.

(b) Remove the two cap screws and spring washers and remove the thermostat housing, O Ring, and thermostat.

(c) Remove the eight cap screws and spring washers and remove the bearing housing and gasket from the pump housing.

3.5.2 Cleaning and inspection

CAUTION

Do not clean the bearing housing with dry cleaning solvent.

(a) Thoroughly clean the pump housing, bearing housing, thermostat housing and thermostat of all scale.

Table I coolant pump components

Item	NSN	MRN	Description	Qty
1	5310-21-896-2646	N 122 418	Washer - Spring (B8 X 15 X 0.8)	4
- 2	5305-21-897-8248	N 102 441 1	Scr - Hex Hd (M8 X 30)	2
3	5306-21-893-8763	N 103 508	Scr - Hex Hd (M8 X 50)	2
4	2930-12-179-2203	B 026 121 010 A	Pump Assy Coolant	1
5	5330-12-147-5526	B 059 121 119	Seal	2
6	5330-21-896-7458	049 121 041 B	Gasket	1
7	2930-21-896-1454	026 121 005 A	Housing Assy Bearing	1
8	5310-12-142-8171	N 122 261	Washer - Spring (B6 X 12 X 0.5)	8
9	5305-12-142-0188	222 060 855	Scr - Hex Hd (M6 X 22)	8
10	6680-12-173-3415	B 056 121 113 D	Thermostat	1
11	2930-21-892-4558	056 121 121 B	Housing - Thermostat	1
12	5310-12-142-8171	N 122 261	Washer - Spring (B6 X 12 X 0.5)	2
13	5305-12-142-0188	222 060 855	Scr - Hex Hd (M6 X 22)	2
14	3020-21-897-6988	8482006-1	Pulley	1
15	5305-12-301-6834	N 090 286 1	Scr w/Washer (M8 X 12)	3

Table II Mandatory parts replacement

Item	NSN	MRN	Description	Qty
1	5310-21-896-2646	N 122 418	Washer - Spring (B8 X 15 X 0.8)	4
2	5305-21-897-8248	N 102 441 1	Scr - Hex Hd (M8 X 30)	2
3	5306-21-893-8763	N 103 508	Scr - Hex Hd (M8 X 50)	2
5	5330-12-147-5526	B 059 121 119	Seal	2
6	5330-21-896-7458	049 121 041 B	Seal	1
8	5310-12-142-8171	N 122 261	Washer - Spring (B6 X 12 X 0.5)	8
9	5305-12-142-0188	222 060 855	Scr - Hex Hd (M6 X 22)	8
15	5305-12-301-6834	N 090 286 1	Scr w/Washer (M8 X 12)	3

(b) Inspect the impeller for chipped or broken blades, binding or excessive looseness in the bearing. Replace the bearing housing if any of these conditions exist.

(c) Ensure all mating surfaces are smooth and free of nicks, draw file if necessary.

(d) Using a thread chaser or tap clean all threaded holes.

(e) Check the thermostat operation by the following:

i Measure the distance between the underside of the top flange and the bottom of the valve, see Figure 2. If the distance is greater than 31 mm, the valve is not closing completely.

ii Place the thermostat and a thermometer in water and heat the water.

Table III Possible missing components

Item	NSN	MRN	Description	Qty
1	5310-21-896-2646	N 122 418	Washer - Spring (B8 X 15 X 0.8)	4
2	5305-21-897-8248	N 102 441 1	Scr - Hex Hd (M8 X 30)	2
3	5306-21-893-8763	N 103 508	Scr - Hex Hd (M8 X 50)	2
5	5330-12-147-5526	B 059 121 119	Seal	2
10	6680-12-173-3415	B 056 121 113 D	Thermostat	1
11	2930-21-892-4558	056 121 121 B	Housing - Thermostat	1
12	5310-12-142-8171	N 122 261	Washer - Spring (B6 X 12 X 0.5)	2
13	5305-12-142-0188	222 060 855	Scr - Hex Hd (M6 X 22)	2
14	3020-21-897-6988	8482006-1	Pulley	1
15	5305-12-301-6834	N 090 286 1	Scr w/Washer (M8 X 12)	3

iii When the thermostat starts to open, check the water temperature. The thermostat should begin to open at approximately 87°C (188°F) and should be fully open at approximately 102°C (215°F).

iv With the thermostat fully open, measure the distance the valve is opened, see Figure 2. This distance should be a minimum of 38 mm. Replace the thermostat if it does not meet these specifications.

3.5.3 Reassemble

(a) Place a new gasket on the pump housing and install the bearing housing. Secure the two housings with eight cap screws and spring

washers. Tighten the cap screws evenly a little at a time and torque to 10 Nm (7 ft lb).

(b) Place a new O Ring on the thermostat housing and install the thermostat and the thermostat housing to the pump housing with two cap screws and spring washers. Torque to 10 Nm (7 ft lb).

(c) Install the pulley with three cap screws with washers and torque to 20 Nm (15 ft lb).

3.6 Standards.- The following lists the standards for the VW 1.7 litre engine coolant pump. These standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of the component. If the serviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Description	Standards
THERMOSTAT - Distance underside of top flange to bottom of valve with valve closed	31 mm maximum
Valve Opening Distance	7 mm minimum
Opening Temperature - Begin	87°C (188°F)
- Fully Open	102°C (215°F)

3.7 Torque standards.- Table IV lists the torque standards that shall be used when rebuilding the VW 1.7 litre coolant pump, refer to Figure 1 for component identification.

Table IV Torque standards

Item	Description	Nm	FT LB
9	Bearing Housing to Pump Housing Capscrews	10	7
13	Thermostat Housing to Pump Housing	10	7
15	Pulley to Pump Capscrews	20	15

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PRESERVATION, PACKAGING AND MARKING

5.1 Preservation.- A legible stamped or engraved metal plate shall be attached to the coolant pump in an approved location showing the following information.

(a) Name of the firm or workshop that rebuilt the pump.

(b) Day, month and year of pump rebuild.

(c) Firm or workshop order number.

5.1.1 The coolant pump shall be properly supplied with:

(a) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(b) CF 2248 - NSN 7530-21-870-3866 - Lubrication Record for Shipment and Preservation Tag.

(c) The applicable NSN for the coolant pump.

5.1.2 The coolant pump assembly shall be wrapped in barrier material NSN 8135-21-550-5745 and sealed with tape pressure sensitive.

5.2 Packaging.- The wrapped pump shall be placed in a polyurethane bag with sufficient new desiccant bags to prevent condensation and sealed.

5.3 Marking.- The polyurethane bag shall contain a clearly marked label visible from the outside with the following information:

(a) Name of rebuild contractor or workshop.

(b) Work order number of pump rebuild contractor or workshop.

(c) Date of pump rebuild.

(d) Coolant Pump NSN.

5.3.1 Any other packaging requirements will be specified in the contract.

6. **NOTES**

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through Quality Assurance Authority.

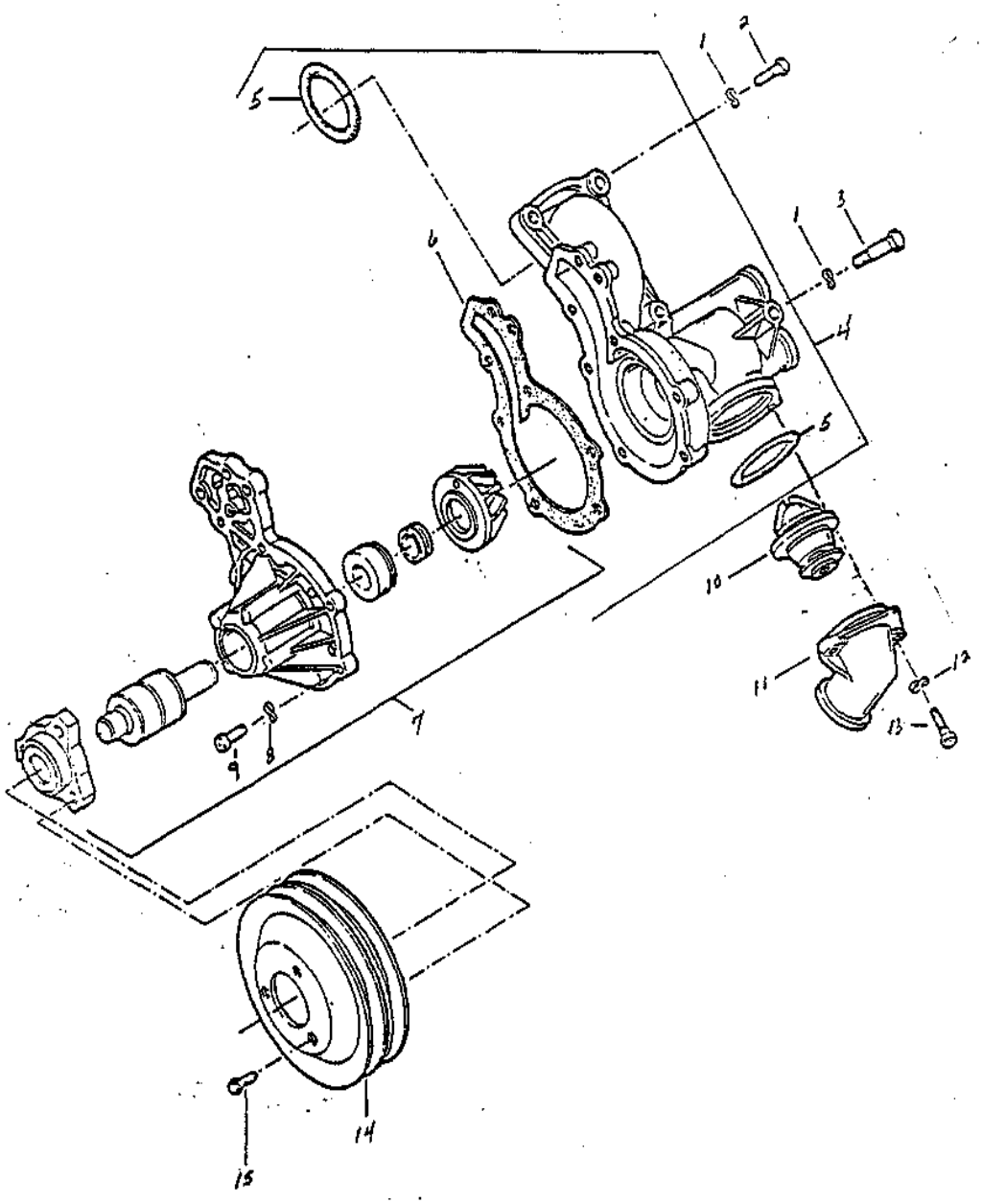


Figure 1 Water pump and thermostat

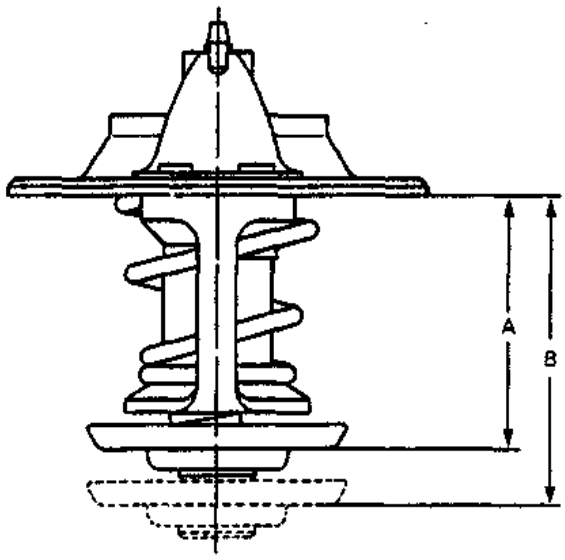


Figure 2 Coolant thermostat measurements

Annex D

SPECIFICATION

FOR

REBUILDING BOSCH 24 VOLT TRANSISTORIZED DISTRIBUTOR USED IN TRUCKS,

UTILITY, LIGHT, 4 BY A, MILITARY DESIGN ILTIS CDN SERIES

NSN 2920-21-896-1885

1. SCOPE

1.1 Scope.- This specification covers the requirements for rebuilding the Bosch 24 Volt transistorized distributor used on the VW 1.7 litre engine used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the distributor.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Materiel, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A 0S9

43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant.

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each distributor supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.5 and 3.6.

3.1.1 If the distributor is being rebuilt as part of an engine assembly rebuild, it shall be installed in the rebuilt engine.

3.1.2 If the distributor is being rebuilt as a component only, it shall be preserved and packaged as specified herein and returned to DND as a complete drop-in assembly.

3.1.3 The distributor shall be tested to determine the extent of repairs required and then disassembled to the extent specified herein.

3.1.4 All components shall be thoroughly cleaned and dried prior to being inspected for condition and wear.

3.1.5 The contractor shall record all test results on data sheets designed and provided by the contractor and compare these results to the standards listed in 3.6. Components that do not meet the minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices. If the serviceability of a component is in doubt, the component shall be replaced. Quality Assurance Authority shall be consulted in all such cases.

3.1.6 Components listed in Table II - Mandatory Parts Replacement shall be replaced with new OEM parts during rebuild.

3.1.7 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.8 Any components missing from the distributor at time of disassembly shall be replaced with new or serviceable OEM components. Table III lists all possible missing components.

3.1.9 Upon completion of rebuild, the distributor shall consist of all the components listed in Table I. Figure 1 is provided for component identification and location within the distributor.

3.2 Distributor components.- Table I lists all of the components comprising the Bosch 24 V transistorized distributor; Refer to Figure 1 for component identification and location within the distributor.

3.3 Mandatory parts replacement.- Table II lists parts that shall be replaced with new OEM components during distributor rebuild; refer to Figure 1 for component identification and location within the distributor.

3.4 Possible missing components.- Table III lists components that may be missing from the distributor at time of disassembly. Missing components other than Mandatory Parts Replacement will be replaced with new or serviceable OEM components, refer to Figure 1 for component identification and location within the distributor.

3.5 Distributor rebuild procedures.- The following provides the step by step procedures for rebuilding the Bosch 24 V transistorized distributor.

3.5.1 Distributor tests.- The following tests and inspection should be carried out prior to disassembly of the distributor to determine the scope of repair.

(a) Distributor shaft play

i Remove the distributor cap.

ii Grasp the drive gear or the rotor and check for side movement (play) between the shaft and the distributor body.

iii If there is noticeable movement, either the shaft or the bushings are worn and the distributor must be replaced.

(b) Distributor cap

i Check the distributor cap for cracks and signs of carbon tracking, if the cap is cracked, it must be replaced.

ii Clean any carbon from the contacts and check the carbon brush and spring for wear and freedom of movement, replace the

distributor cap if the brush is worn or the spring tension is weak.

(c) Distributor pick-up coil test

i Using an ohmmeter, measure the resistance of the TCI wire connector.

ii If resistance is not within standards .990 to 1.210 K ohms, replace the pick-up coil (Item 12, Figure 1).

(d) Distributor induction sender

i Using non-ferrous feeler gauges, check the gap between the stator and the trigger wheel at all contact lugs.

ii Adjust the gap if necessary to 0.25 mm (0.010 in.) by the trigger wheel or stator lugs.

iii Check all the gaps with the trigger wheel in various positions.

NOTE

If there is a difference in gap between any one stator lug and several trigger wheel lugs, it could indicate a bent shaft or worn bushings.

(e) Rotor resistor test

i Using an ohmmeter, measure the resistance between the rotor centre contact and the rotor arm outer contact; resistance should be approximately 5 K ohm.

ii If the resistance is much more or less than 5 K ohm, replace the rotor.

(f) Rotor speed limiter test

i Install the rotor on a distributor in a test stand,

ii Operate the distributor and note the cut-out RPM.

iii If cut-out RPM is not within standards (6160 to 6540 RPM), replace the rotor.

(g) Centrifugal advance test

i Hold the distributor drive gear and turn the rotor clockwise, when released it should turn automatically to its original position.

ii If it does not, the advance mechanism is dirty or worn and must be further inspected.

iii Operate the distributor in a proper test stand and compare the spark advance curve to the standards listed in 3.6.

iv If the distributor does not meet standards, it must be disassembled, cleaned and tested again.

(h) Vacuum advance and vacuum retard test

i Turn the breaker plate counter-clockwise, it should move without grittiness and spring back solidly to its original position when released.

ii To check the vacuum unit for leaks turn the breaker plate as far as it will go counter-clockwise and cover the hose connections with your fingers, vacuum should keep the breaker plate from returning fully to its original position until you uncover the hose connections.

iii If the breaker plate returns fully, there is a leak in the diaphragm or the unit housing and it must be replaced.

iv Operate the distributor on a proper test stand and compare the vacuum advance range to the standards in 3.6.

v Test the vacuum retard and compare the retard range to the standards in 3.6.

vi If the distributor does not meet standards and there are irregularities in the spark advance curve, clean and lubricate the moving parts of the distributor and retest.

vii If the vacuum advance still fails to conform to standards, install a new vacuum advance unit and retest.

viii If retesting reveals discrepancies in the centrifugal advance curve, it indicates worn parts and the distributor must be replaced.

3.5.2 Disassemble the distributor

(a) Remove the fibre washer and O Ring from the bottom of the distributor housing.

(b) Loosen the three screws on the distributor cap and remove the cap.

(c) Remove the rubber seal from the groove in the top of the distributor housing.

(d) Remove the speed limiting rotor from the distributor shaft.

(e) Remove the two screws and flat washers from the vacuum advance unit and remove the unit.

(f) Remove the four screws and flat washers from the TC1 connector and remove the connector and seal.

(g) Remove the circlip above the trigger wheel.

CAUTION

To prevent damage to the trigger wheel, ensure the legs of the universal puller are far enough under the wheel to pull on the reinforced portions of the wheel.

(h) Using a universal puller, remove the trigger wheel from the distributor shaft, see Figure 2. Do not loose the small dowel pin located above the wheel.

(j) Remove the second circlip from the distributor shaft.

(k) Remove the three screws and lock washers from the stator assembly and remove the pick-up coil and stator assembly from the shaft.

(m) Remove the dowel pin from the drive gear and the gear from the shaft.

(n) Pull the shaft and centrifugal advance unit from the housing.

(p) Remove the felt pad from the top of the shaft.

(q) Remove the shim from the shaft under the centrifugal advance unit.

3.5.3 Cleaning.- Clean all components with the exception of Mandatory Parts Replacement, distributor cap, rotor, pick-up coil and vacuum advance unit in dry cleaning solvent and blow dry with compressed air.

3.5.4 Inspection.- Inspect the following:

(a) Inspect the trigger wheel lugs for damage and replace if necessary.

(b) Inspect the stator lugs for damage and replace if necessary.

(c) Place the shaft on a flat surface and roll it to check for a bent shaft, replace the distributor if the shaft is bent.

(d) Apply a drop of oil to each of the hinge pins on the centrifugal advance.

(e) While holding the bottom shaft, rotate the top shaft.

(f) The weights should move out without binding and the springs should return the weights to the centre position when the upper shaft is released.

(g) If there is binding or the weights do not return, replace the distributor.

(h) Inspect the distributor housing bushings for grooves and signs of excessive wear.

(j) Inspect the two nipples for damage and replace if necessary.

(k) If when checking the trigger wheel to stator lug gaps, there was a difference between anyone stator lug and several trigger wheel lug gaps, and the shaft was not bent, recheck the play between the shaft and the bushings.

(m) If the bushings are grooved or worn, replace the distributor.

(n) Inspect the drive gear for chipped or worn teeth and replace if necessary.

3.5.5 Assemble the distributor

(a) Install the shim on the lower shaft.

(b) Lubricate the housing bushings and the lower shaft with engine oil and install the shaft and centrifugal advance unit into the housing.

(c) Press the drive gear onto the shaft ensuring the gear is aligned with the dowel pin hole in the shaft.

(d) Drive a new dowel pin through the drive gear and shaft from the countersunk side of the gear.

(e) Install the retainer, seal, and vacuum advance unit on the housing and secure with two screws w/washers.

(f) Secure the stator assembly to the pick-up coil with three countersunk screws.

(g) Place the pick-up coil and stator assembly over the shaft, ensuring the pick-up coil electrical contacts are not bent and engage the stator pin with the vacuum advance unit arm.

(h) Secure the pick-up coil and stator assembly with three cheese head screws.

(j) Install the TC1 connector and gasket and secure with four cheese head screws and lock washers, ensuring the two contacts of the connector are at the top.

(k) Install a circlip in the groove above the stator assembly.

(m) Install the dowel pin in the shaft and place the trigger wheel over the shaft and dowel pin, press the trigger wheel down until it contacts the circlip and install the circlip into the groove above the trigger wheel.

(n) Check the gap between the trigger wheel lugs and the stator lugs and adjust as necessary to 0.25 mm (0.010 in.).

(p) Saturate the felt with engine oil and place it in the top of the shaft.

(q) Install the rotor on the shaft, ensuring the lug fits into the slot in the shaft and push it down until it is flush with the trigger wheel.

(r) Install the rubber O ring in the groove on top of the housing.

(s) Install the distributor cap on the distributor housing and secure with the three screws.

NOTE

If distributor is going to be placed on a rebuilt engine, install the cap later.

(t) Install a new O Ring and fibre washer on the bottom of the distributor housing.

(u) Perform centrifugal advance, vacuum advance, vacuum retard and rotor speed limiter tests again.

3.6 Standards.- The following lists the standards for the Bosch 24 V transistorized distributor. These standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of the component. If the serviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Description	Standards
Distributor Shaft	No noticeable side play
Pick-Up Coil Resistance	.990 to 1.210 K ohms
Induction Sender Lug Gap	0.25 mm (0.010 in.)
Rotor Resistance	5 K ohms approximately
Rotor Speed Limiter Cut-out	6160 to 6540 RPM
Centrifugal Advance Curve	Crankshaft degrees and RPM
- Begins	RPM 1000-1600
	RPM 3000 Degrees 12°-17°
- Ends	RPM 4200 Degrees 23°-27°

Vacuum Advance		Crankshaft degrees
	- Begins	260-340 mbar (195-250 mm Hg)
	- Ends	450 mbar (340 mm Hg) 11-15°
Vacuum Retard		Crankshaft degrees
	- Begins	140-280 mbar (105-210 mm Hg)
	- Ends	320-420 mbar (240-315 mm Hg) 8-10°

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to ensure that material and services conform to specified and contractual requirements.

5. PRESERVATION, PACKAGING AND MARKING

5.1 Preservation.- A legible stamped or engraved metal plate shall be attached to the distributor in an approved location showing the following information:

(a) Name of firm or workshop that rebuilt the distributor.

(b) Day, month and year of distributor rebuild.

(c) Firm or workshop order number.

5.1.1 The distributor shall be properly supplied with:

(a) CF 2248 - NSN 7530-21-870-3866 - Lubrication Record for Shipment and Preservation Tag.

(b) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(c) The NSN for the distributor.

5.1.2 All openings shall be covered with plastic caps or tape pressure sensitive.

5.1.3 The distributor shall be wrapped in barrier paper, NSN 8135-21-550-5745 and sealed with tape pressure sensitive.

5.2 Packaging.- The wrapped distributor shall be placed in a polyurethane bag with sufficient new desiccant bags to prevent condensation and sealed.

5.3 Marking.- The polyurethane bag shall contain a clearly marked label visible from the outside with the following information:

(a) Name of rebuild contractor or workshop.

(b) Work order number of distributor rebuild contractor or workshop.

(c) Date of distributor rebuild.

(d) Distributor NSN.

5.4 Any other packaging requirements will be specified in the contract.

6. **NOTES**

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through the Quality Assurance Authority.

Table I Distributor components

Item	NSN	MRN	Description	Qty
4		VM 34-181	Nipple	2
5	2920-12-179-2700	1 235 522 314	Cap - Distributor Assy	1
6	2920-12-179-2206	1 234 332 281	Rotor - Speed Limiting	1
7	2920-21-896-1654	8481989	Seal - Distributor Cap EMI	1
8	5315-12-179-6757	1 233 101 035	Pin - Dowel	1
9	5365-12-179-3690	1 230 118 002	Circlip	2
10	2920-12-179-2207	1 231 328 028	Wheel - Trigger	1
11	2920-12-179-2701	1 237 031 038	Stator Assy	1
12	2920-12-179-2702	1 234 211 009	Coil - Pick-Up	1
13		2 910 371 122	Scr Cheese Hd (M4 X 12)	3
14		2 910 782 048	Scr Countersunk (M3 X 6)	3
15		2 910 001 886	Scr Cheese Hd (AM2.5 X 8)	4
16	5935-12-179-9925	1 234 482 006	Connector	1
17	5999-21-900-6929	82-61415	Seal - Flange EMI	1
18	2920-12-179-2208	1 230 583 017	Retainer	
19	5999-21-900-6930	8481980	Seal - Vacuum Unit EMI	1
20	2920-12-179-2209	1 237 122 719	Unit - Vacuum	1
21	5305-12-179-5061	1 233 410 014	Scr w /Washer	2

Table I Distributor components (con't)

Item	NSN	MEN	Description	Qty
22		1 230 210 006	O Ring - Distributor Shaft	1
23	2920-21-896-1261	1 006 209 412	Gear - Drive	1
24	53-12-130-8855	2 917 560 101	Pin	1

Table II Mandatory parts replacement

Item	NSN	MRN	Description	Qty
7	2920-21-896-1654	8481989	Seal - Distributor Cap EMI	1
8	5315-12-179-6757	1 233 101 035	Pin - Dowel	1
9	5365-12-179-3690	1 230 118 002	Circlip	2
13		2 910 371 122	Scr - Cheese Hd (M4 X 12)	3
14		2 910 782 048	Scr - Countersunk (M3 X 6)	3
15		2 910 001 886	Scr - Cheese Hd (AM2.5 X 8)	4
17	5999-21-900-6929	82-61415	Seal - Flange EMI	1
19	5999-21-900-6930	8481980	Seal - Vacuum Unit EMI	1

Table II Mandatory parts replacement (cont'd)

Item	NSN	MRN	Description	Qty
21	5305-12-179-5061	1 233 410 014	Scr w/Washer	2
22		1 230 210 006	O Ring -Distributor Shaft	1
24	5315-12-130-8855	2 917 560 101	Pin	1

Table III Possible missing components

Item	NSN	MRN	Description	Qty
5	2920-12-179-2700	1 235 522 314	Cap - Distributor Assy	1
6	2920-12-179-2206	1 234 332 281	Rotor - Speed Limiting	1
7	2920-21-896-1654	8481989	Seal - Distributor Cap EMI	1
22		1 230 210 006	O Ring -Distributor Shaft	1

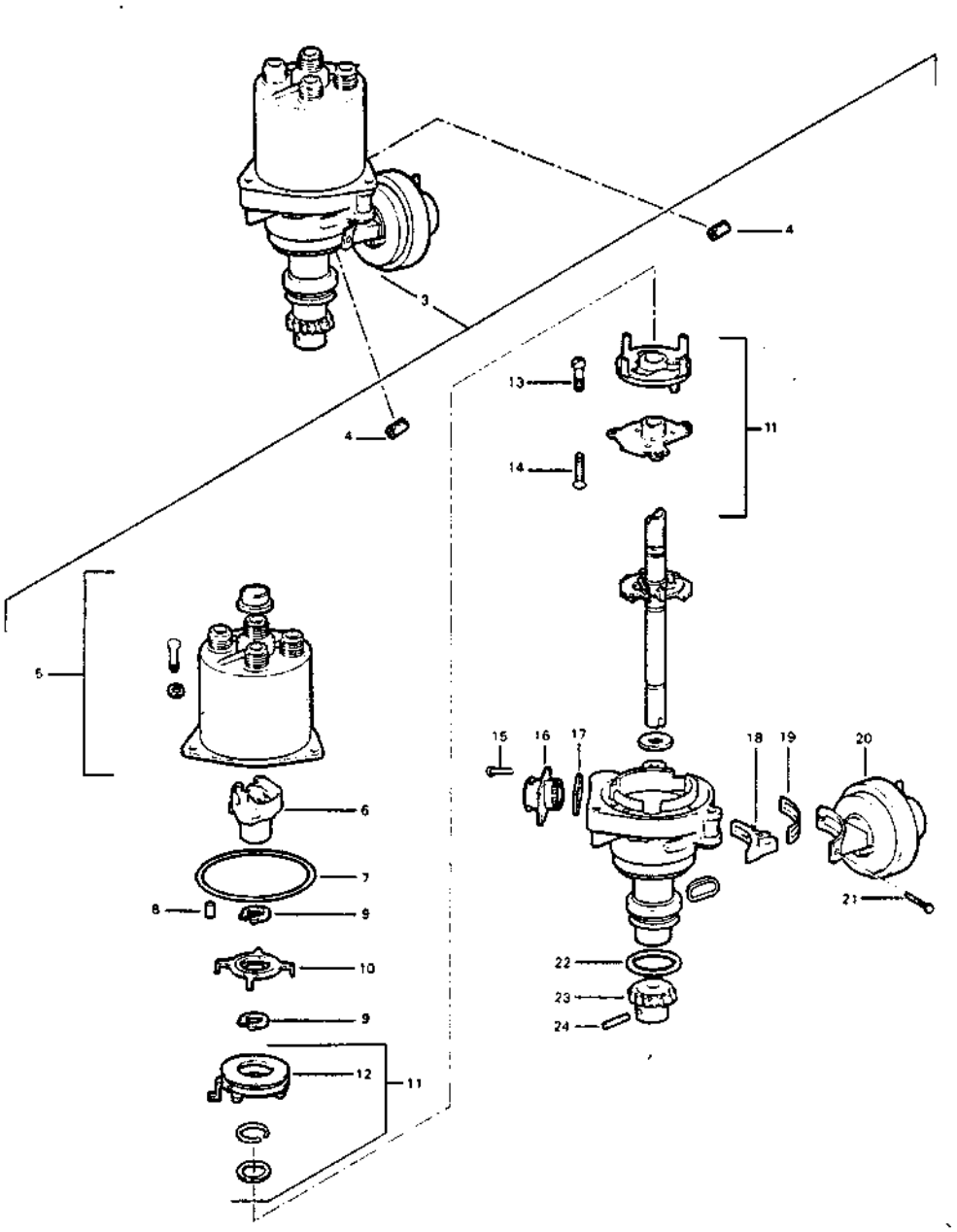


Figure 1 Distributor assembly

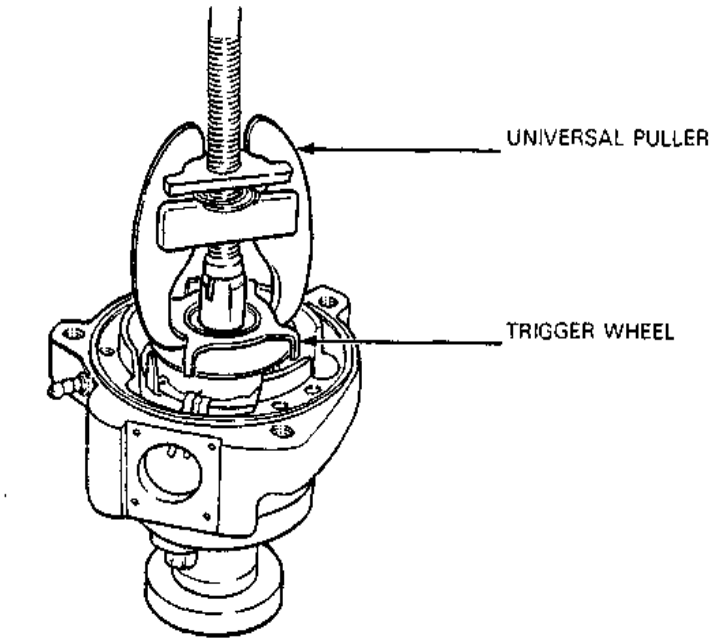


Figure 2 Removal of distributor trigger wheel

Annex E

SPECIFICATION

FOR

REBUILDING THE SOLEX 1-B-l CARBURETOR USED IN TRUCKS,

UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2910-12-172-8352

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the Solex 1-B-l carburetor used on the VW 1.7 litre engine in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, packaging and preservation and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the carburetor to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)
MIL-C-16173(1)	Gasoline, Automotive

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A.0S9

20-GP-ll	Coating, Material, Protective for Rubber Surfaces
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each carburetor supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.4 and 3.5.

3.1.1 If the carburetor is being rebuilt as part of an engine assembly rebuild, it shall be installed on the rebuilt engine.

3.1.2 If the carburetor is being rebuilt as a component only, it shall be preserved and packaged as specified herein and returned to DND.

3.1.3 The carburetor shall be completely disassembled and cleaned before being inspected for condition. The contractor shall use a commercial carburetor cleaner and dry with compressed air.

3.1.4 The contractor shall inspect all components not included in the overhaul kit for wear and condition. If in the judgement of the contractor the component is unserviceable it shall be replaced with a new or serviceable OEM component. Table II - Mandatory Parts Replacement lists all the components found in the kit.

3.1.5 If the serviceability of a component is in doubt, it shall be replaced with a new or serviceable OEM component. Quality Assurance shall be consulted in all such cases.

3.1.6 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.7 Upon completion of rebuild, the carburetor shall consist of all components listed in Table I. Figure 1 and 2 are provided for component identification and location within the carburetor.

3.2 Carburetor components.- Table I lists all the components of the Solex 1-B-1 carburetor; refer to Figures 1 and 2 for component identification and location within the carburetor.

3.3 Mandatory parts replacement.- Table II lists parts that are contained in the carburetor overhaul kit and shall be installed in the carburetor at time of rebuild; refer to Figures 1 and 2 for component identification and location within the carburetor.

3.4 Solex 1-B-l rebuild procedures.- The following provides the step by step procedures for rebuilding the Solex 1-B-l carburetor.

3.4.1 Disassemble the carburetor into sub-assemblies (see Figure 3)

(a) Remove the socket head screw (5) and spring washer from the accelerator cable bracket (6).

(b) Remove the two socket heads through bolts (1) and spring washers and remove the intermediate flange (7) and cable bracket (6) from the body (8).

(c) Remove the elastic nuts (2), flat washers and spacers from the studs nearest the staged pulldown unit and the jets.

(d) Pull the staged pulldown hose (9) from the body.

(e) Remove the four Phillips-head screws (4) and lock washers and carefully lift the top (3) from the body (8).

3.4.2 Disassemble the body (See Figure 4)

(a) Remove the gasket (1) from the body.

(b) valve (11) and gasket (12).

(c) Pry the guide ring (21) from the accelerator pump (20) and remove the pump piston and spring (19).

(d) Using a small hooked tool, pull the suction valve retaining cap (18) from the bottom of the pump chamber.

(e) Turn the body over and remove the suction valve (17).

(f) Carefully pry or pull the pump injection tube (2) from the body.

(g) Remove the nylon plug (6) and the CO adjusting screw (5).

(h) Remove the nylon plug (15) from the throttle valve adjusting screw (16).

(j) Remove the idle adjusting screw (13).

(k) Remove the air/fuel cut-off valve (9).

(m) Remove the plastic washer (7) from the vacuum advance tube (8).

3.4.3 Disassemble the top half of the carburetor (See Figure 5)

(a) Remove the three Phillips-head screws (11) and lock washers and remove the choke body (16) from the carburetor.

(b) Using a small pin punch, drive the hinge pin (19) outward and remove the float (20) and needle valve (18).

(c) Remove the needle valve from the float.

(d) Remove the idle (2) and auxiliary (1) fuel jets.

(e) Remove the main jet (7).

(f) Remove the screw (5) and pull the accelerator pump shaft (4) from the top of the pump lever (6). Remove the seal from the shaft.

(g) Remove the pump lever.

3.4.4 Disassemble the choke (See Figure 5)

(a) Using a small pin punch, drive the roll pin (9) and the brass pin (17) from the choke body (16).

(b) Pry the staged pulldown unit (10) from the choke body.

(c) Remove the three Phillips-head screws (13) and washers and remove the choke cover (12) from the body.

3.4.5 Cleaning and inspection.- To clean and inspect, proceed as follows:

(a) Place the top, body, choke housing and cover, accelerator pump shaft and lever in a wire basket and submerge in a carburetor cleaning solution.

(b) Inspect the float for leakage and for wear at the needle valve contact point.

(c) Clean and inspect the intermediate flange for damage. Ensure the rubber has not deteriorated.

(d) Clean and inspect the jets and ensure the passages are clear.

(e) Remove the O Ring seals from the CO adjusting screw, the idle adjusting screw and the pump injection tube.

(f) Clean and inspect The adjusting screws to ensure their tapered ends are not damaged and ensure the opening through the injection tube is clear.

(g) Apply suction to the staged pulldown hose to check the operation of the diaphragm.

(h) Remove the parts from the cleaning solution and blow dry with compressed air. Ensure all passages are clear.

(j) Lubricate the bell crank shaft, see Figure 5, Item 15, with a light smear of lithium grease and check that it operates freely.

3.4.6 Assemble the top half of the carburetor, using the carburetor kit (See Figure 5)

(a) Install the main jet (7) in the underside of the top.

(b) Install the auxiliary (1) and idle (2) jets in the top.

NOTE

The auxiliary jet will fit in the idle jet port, but the idle jet will not fit in the auxiliary jet port.

(c) Install a new seal on the accelerator pump shaft (4) with the lip facing the carburetor.

(d) Install the lever (6) in the top and push the shaft through the top and into the lever. Secure with the screw (5).

(e) Hook the spring of the needle valve (18) over the float arm.

(f) Install the float (20) in the top, ensuring the needle valve fits in the seat.

(g) Install the hinge pin (19) to secure the float to the top.

(h) Lubricate the choke bell crank (15) with lithium-based grease and ensure it operates freely.

(j) Place the choke cover (12) on the choke body (16). Ensure the spring fits over the bell crank (15), the operating lever (14) is to the left of the bell crank and the notch on the cover is aligned with the notch on the body.

(k) Install the three Phillips-head screws (13) and flat washers and tighten (Check to ensure there is spring tension on the operating lever when rotated clockwise).

(m) Hold the operating lever fully clockwise and install the pulldown unit (10) on the choke body.

(n) Install the roll pin (9) and the brass pin (17) to secure the pulldown to the body.

(p) Position the choke on the carburetor top, ensuring the linkage rod (8) goes into the nylon connector of the bell crank (15).

(q) Secure the choke with three Phillips-head screws (11) and lock washers.

(r) Measure the distance between the end of the enrichment tube (3) and the top of the atomizer, see Figure 6. The distance should be 24 mm (If necessary, bend the tube up or down until the distance between the tube and atomizer is correct).

3.4.7 Assemble the body (See Figure 4)

(a) Place the O ring (3) on the injection tube (2) and insert the tube into the chamber.

(b) Insert the suction valve (17) into the accelerator pump chamber and install the retaining cap (18). Press the cap into place over the valve.

(c) Place the spring (19) in the pump chamber.

(d) Lightly lubricate the pump piston cup with oil and place it in the chamber.

(e) Secure the pump in the chamber with the guide ring (21).

(f) Install gasket (12) on the part load enrichment valve (11) and secure it to the body with two Phillips-head screws (10) and flat washers. (Ensure the boss with the hole faces up).

(g) Place O ring (4) on the CO adjusting screw (5) and install the screw into the body (Screw it all the way in and then unscrew it five full turns). **NOTE:** This is only an approximate adjustment.

(h) Install the nylon plug (6).

NOTE

If the carburetor is to be installed on the vehicle immediately after rekitting, install the plug after the final CO adjustment has been completed.

(j) Place O ring (14) on the idle adjustment screw (13) and install the screw (Screw it all the way in and then unscrew it two full turns) . NOTE: This is only an approximate adjustment.

(k) Install the cut-off valve (9).

(m) Install the plastic washer (7) on the vacuum advance tube (8).

(n) Using a wire feeler gauge or drill bit, measure the gap between the throttle valve and the throat wall with the throttle valve in the fully closed position, see Figure 7. The gap should be 0.065 to 0.075 mm (If necessary, turn the screw (16) until the gap is within the specified limits). Install a new nylon plug (15).

(p) Install the gasket (1) on top of the body.

3.4.8 Assemble the sub-assemblies (See Figure 3)

(a) Place the top of the carburetor on the body and secure with four Phillips-head screws (4) and lock washers.

NOTE

Operate the accelerator pump to ensure the lever is acting on the top of the pump piston.

(b) Install the intermediate flange (7) to the body and loosely install the socket head screw (5) and spring washer through the accelerator cable bracket.

(c) Install the two, socket head through bolts (1) and spring washers through the top, body and into the intermediate flange. Tighten all three screws.

(d) Install the spacers, flat washers and elastic nuts (2) on the two studs.

(e) Connect the staged pulldown hose (9) to the body.

(f) Connect the carburetor to a source of fuel and hold the carburetor over a funnel and measuring glass VW 119, see Figure 8.

(g) Turn the choke operating lever so that the choke is fully open and slowly open the throttle valve lever to the fully open position ten times (a minimum of three seconds per stroke). The amount of fuel collected should be 8.5 to 11.5 ml (0.299 to 0.404 oz).

(h) If the fuel collected is not within the specific limits, loosen the clamping screw on the throttle cam and turn the cam clockwise to increase the fuel injection capacity or counter-clockwise to decrease injection capacity, see Figure 9. Tighten the clamping screw.

3.5 Standards.- The following lists the standards for the Solex 1-B-1 carburetor.

Description	Standards
Distance from end of Enrichment tube to top of Atomizer	24 mm
Throttle Valve gap	0.065 to 0.075 mm

Injection Capacity	8.5 to 11.5 ml (0.299 to 0.404 oz)
Choke Valve gap	3.85 to 4.15 mm
Cold Idling speed	3000 to 3600 RPM
Normal Idling speed	900 to 1000 RPM
CO content	0.5 to 1.5% by volume

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PRESERVATION, PACKAGING AND MARKING

5.1 Preservation.- A legible stamped or engraved metal plate shall be attached to the carburetor in an approved location showing the following information:

(a) Name of the firm or workshop that rebuilt the carburetor.

(b) Day, month and year of the carburetor rebuild.

(c) Firm or workshop.

5.1.1 The carburetor shall be properly supplied with:

(a) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(b) CF 2248 - NSN 7530-21-870-3866 - Lubrication Record for Shipment and Preservation Tag.

(c) The NSN for the carburetor.

5.1.2 The carburetor shall be completely drained of all fuel and wrapped in barrier paper material, NSN 8135-21-550-5745 and sealed with tape pressure sensitive.

5.2 Packaging.- The wrapped pump shall be placed in a polyurethane bag with sufficient new desiccant bags to prevent condensation and sealed.

5.3 Marking.- The polyurethane bag shall contain a clearly marked label visible from the outside with the following information:

(a) Name of rebuild contractor or workshop.

(b) Work order number of rebuild contractor or workshop.

(c) Carburetor NSN.

5.4 Any other packaging requirements will be specified in the contract.

6. **NOTES**

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components considered unserviceable for reuse shall be returned to DND through the Quality Assurance Authority.

Table I Carburetor components

Figure	Item	NSN	MRN	Description	Qty
1	1	5305-21-896-2218	N 019 908 1	Scr Socket Hd (M6 X 100)	2
1	2	5310-12-142-8157	N 012 227 3	Washer - Spring (A6 X 11 X 0.5)	2
1	4	5305-12-179-6755	B 049 129 189 A	Scr Cheese Hd	2
1	5		5.18491.05	Jet - Auxiliary Fuel	1
1	6		5.18492.04	Jet - Idle	1
1	7		3.36045.00	Nut - Lock	3
1	8		3.36046.00	Washer	3
1	9		3.18788.00	Washer	6
1	10		5.19587.01	Cover - Choke	1
1	11		5.18579.00	Lever - Choke	1
1	12		3.33880.01	Roller	1
1	13	5365-12-156-4731	N 012 437 3	Circlip (7)	1
1	14		3.36669.12	Scr - Oval Hd	1
1	15		3.32308.00	Washer - Lock	1
1	16		3.3669.04	Scr - Oval Hd	1
1	17		3.3686.00	Washer - Lock	1
1	18		052 129 233	Nut - Hex	1
1	19	5305-21-896-2230	B 049 129 340	Scr - Oval Hd	3
1	20	5310-21-896-2240	B 111 129 147 A	Washer	3

Table I Carburetor components (cont'd)

Figure	Item	NSN	MRN	Description	Qty
1	21		5.17985.02	Cover - Complete Carburetor	1
1	22		3.36669.12	Scr - Oval Hd	1
1	23		3.33792.00	Clip	1
1	24	5305-12-179-6754	B 049 129 189	Scr Cheese Hd	3
1	25		5.18583.01	Body - Choke	1
1	26		3.34752.00	Stud	1
1	27		5.18770.02	Unit - Pulldown	1
1	28		3.35900.00	Guard - Hose	1
1	29		3.32109.00	Pin	1
1	30		055 129 201 F	Float w/Needle Valve	1
1	31		036 129 189	Scr - Oval Hd	1
1	32		5.18597.00	Shaft - Pump	1
1	33		3.35180.00	Ring - V	1
1	34		3.35085.01	Pump - Lever	1
1	35		N 020 353 5	Hose	1
1	36	5305-12-179-6754	B 049 129 189	Scr - Cheese Hd	2
1	37	2910-12-179-6926	B 055 129 288 A	Connector	1
1	38		3.33124.42	Jet - Main	1
2	1		3.36047.02	Gasket - Carburetor Cover	1
2	2		3.36010.01	Ring - Guide	1

Table I Carburetor components (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	3		4.07246.03	Piston - Pump	1
2	4		3.35847.00	Spring	1
2	5		3.35099.00	Cap	1
2	6		3.27204.00	Ball	1
2	7		5.18811.00	Scr - Adjusting	1
2	8		5.11282.01	Scr - CO Adjusting	1
2	9		3.31598.00	Seal	1
2	10		3.34520.00	Plug	2
2	11		3.35741.01	Gasket	1
2	12		4.07248.07	Valve Assy – Part Load	1
2	13		5.18783.00	Scr - Cheese Hd	2
2	14	2915-12-179-3682	PE 20549	Valve - Cut-off	1
2	15		049 129 115 A	Scr - Idle Speed Adjust	1
2	16		K 32461	Seal	1
2	17		059 129 329 B	Scr - Throttle Plate Adj	1
2	18	2990-12-175-1914	049 129 761 E	Flange - Intermediate	1
2	21	5310-21-896-2239	B 049 129 157	Nut - Hex	1
2	22	5310-12-178-3673	3.25312.00	Washer - Lock	1
2	23	2910-21-896-1159	049 129 343 H	Plate - Sector	1

Table I Carburetor components (cont'd)

Figure	Item	NSN	MEN	Description	Qty
2	24		3.6669.04	Scr - Oval Hd	l
2	25		3.32308.00	Washer - Lock	1
2	26	2910-21-896-1157	B 049 129 272 B	Cam	I
2	27	5365-21-895-4659	3.29418.00	Spacer	I
2	28	2910-21-896-1160	B 049 129 351	Lever	1
2	29	5310-12-184-1891	3.24772.00	Washer - Spring	1
2	30	3120-21-896-3644	B 036 129 882 B	Bushing	1
2	31	5360-21-896-3518	B 049 129 371 A	Spring	1
2	32		3.1557.03	Ball	i
2	33		3.36163.00	Ring - Filter	i
2	34		3.18922.00	Spring	1
2	35		3.38699.00	Seal	1
2	36		5.18542.05	Tube – Injection Pump	1
2	37	5305-12-156-4864	N 102 380	Scr - Hex Hd (MS X 15)	1
2	38	5310-21-896-2646	N 012 241 8	Washer - Spring (B8 X 15 X 0.8)	1
2	39	2990-12-175-1913	049 103 573 D	Brkt – Accelerator Cable	1
2	40	5305-12-140-8266	N 014 702 5	Scr - Socket Hd (M6 X 15)	1
2	41	5310-12-142-8171	N 012 226 5	Washer - Spring (B6 X 12 X 0.5)	1

Table II Mandatory parts replacement

Figure	Item	NSN	MRN	Description	Qty
1	33		3.35180.00	Ring - V	1
1	30		055 129 201 F	Float w/Needle Valve	1
2	1		3.36047.02	Gasket Carburetor Cover	1
2	3		4.07246.03	Piston Pump	1
2	4		3.35847.00	Spring	1
2	5		3.35099.00	Cap	1
2	6		3.27204.00	3all	1
2	2		3.36010.01	ling, Guide	1
2	35		3.38699.00	Seal	1
2	34		3.18922.00	Spring	1
2	32		3.1557.03	3all	1
2	12		4.07248.07	Valve Assy	1
2	9		3.31598.00	Seal	1
2	10		3.34520.00	Plug	2
2	11		3.35741.01	Basket	1
2	16		K32461	Seal	1
		2910-21-900-2642	B 183 198 073	Kit Carburetor Overall	1
		2910-21-900-2949	049 198 571 B	Kit Carburetor Gasket Only	1

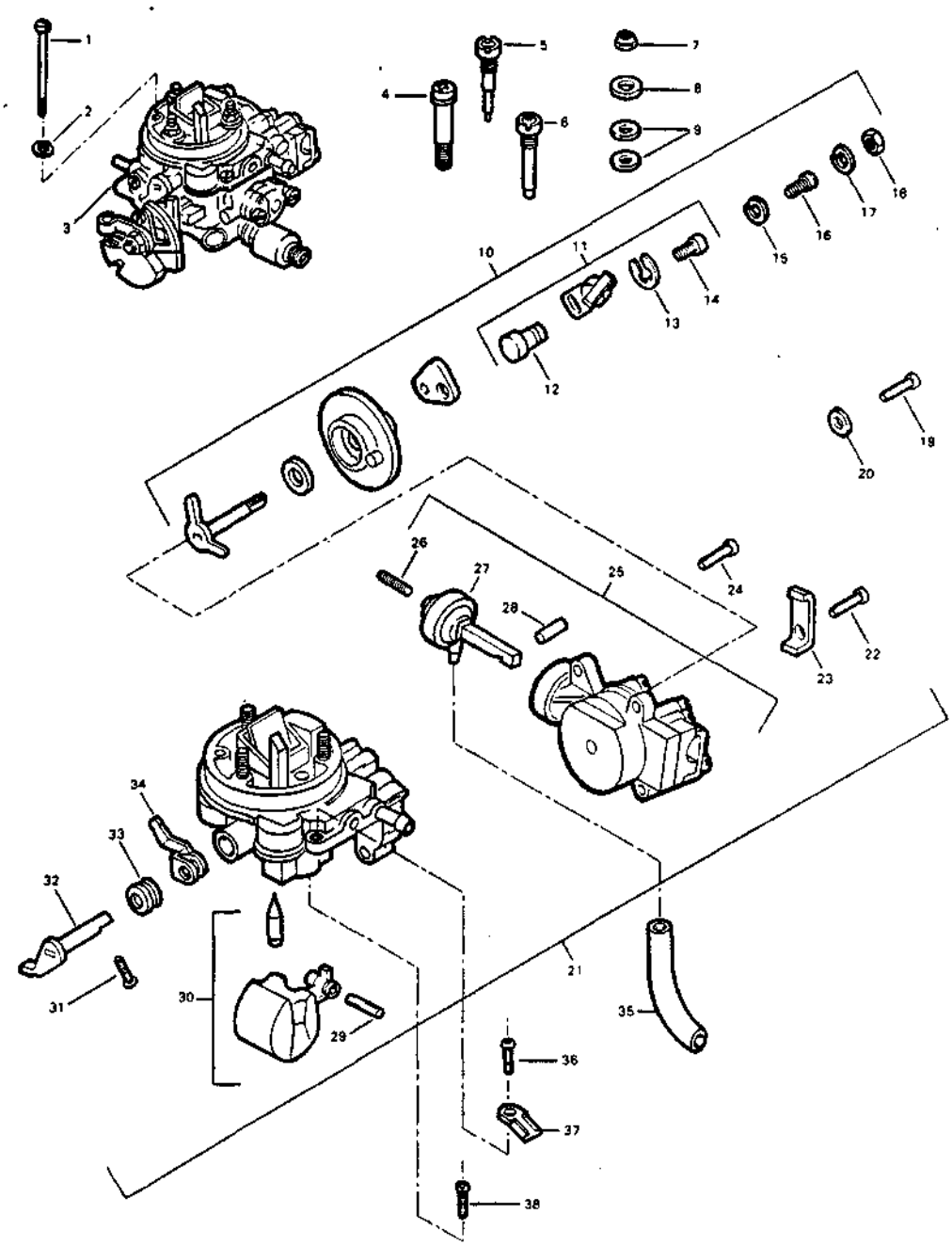


Figure 1 Carburetor and carburetor cover

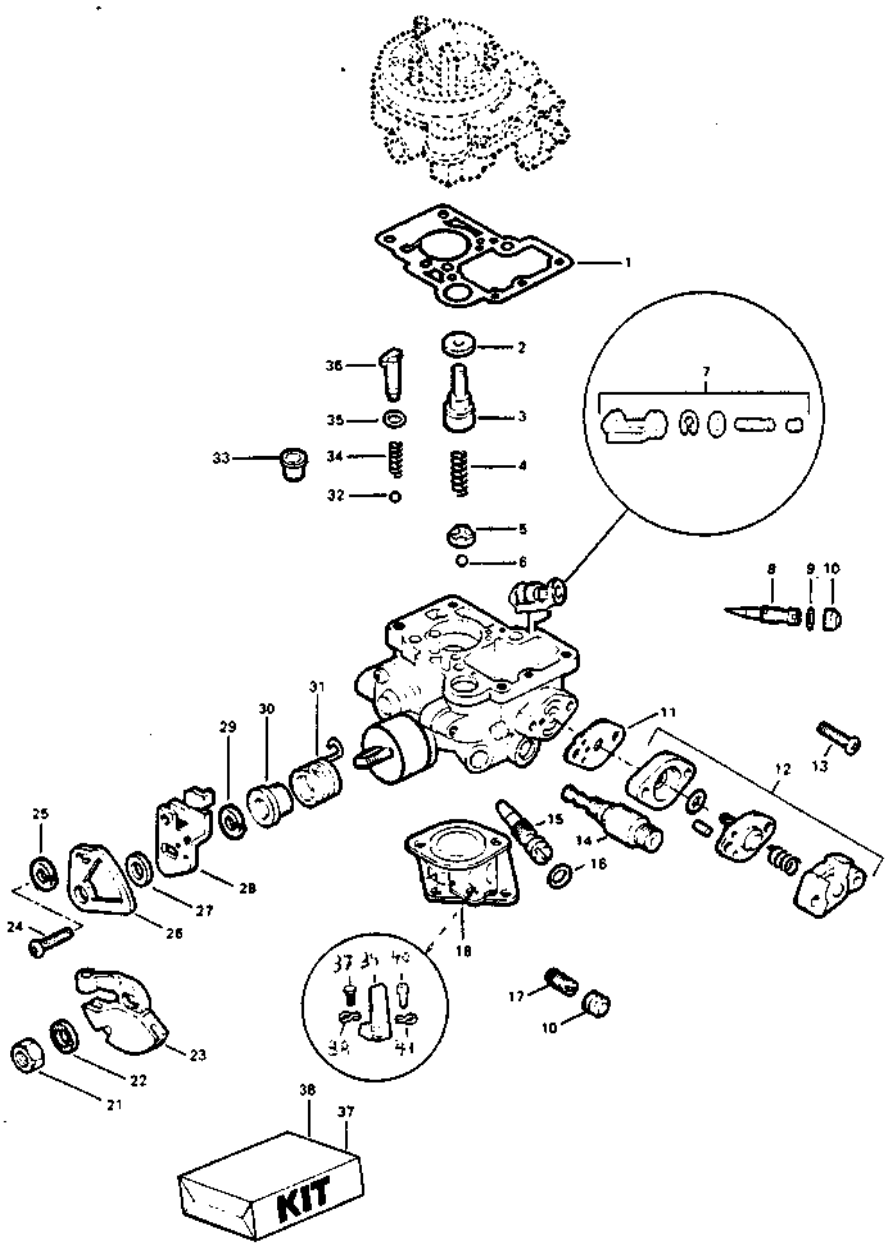
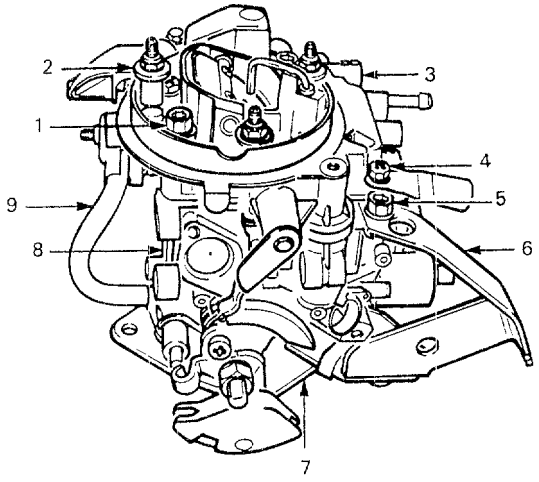
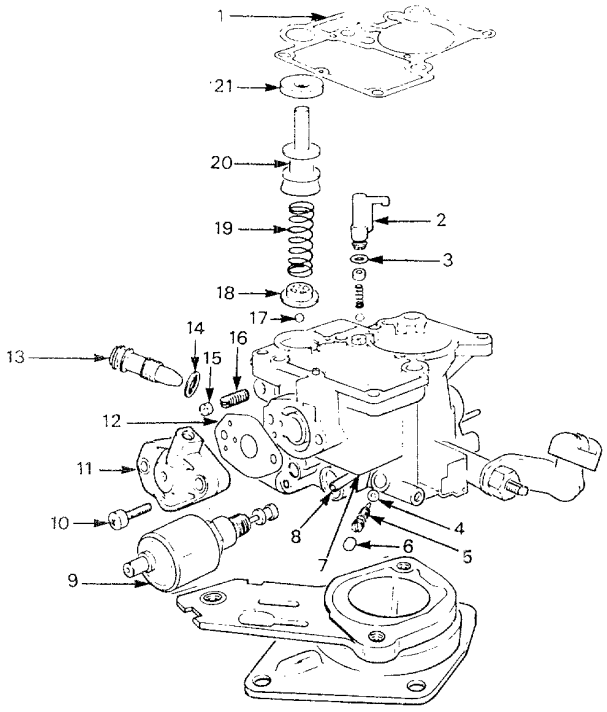


Figure 2 Carburetor housing parts



1. SOCKET HEAD THROUGH BOLT
2. ELASTIC NUT
3. TOP
4. PHILLIPS-HEAD SCREW
5. SOCKET HEAD SCREW
6. CABLE BRACKET
7. INTERMEDIATE FLANGE
8. BODY
9. PULLDOWN HOSE

Figure 3 Carburetor



1. GASKET
2. PUMP INJECTION TUBE
3. O-RING
4. O-RING
5. CO ADJUSTING SCREW
6. NYLON PLUG
7. PLASTIC WASHER
8. VACUUM ADVANCE TUBE
9. CUTOFF VALVE
10. PHILLIPS-HEAD SCREW
11. PART LOAD ENRICHMENT VALVE
12. GASKET
13. IDLE ADJUSTING SCREW
14. O-RING
15. NYLON PLUG
16. THROTTLE VALVE ADJUSTING SCREW
17. SUCTION BALL
18. RETAINING CAP
19. SPRING
20. ACCELERATOR PUMP
21. GUIDE RING

Figure 4 Carburetor body

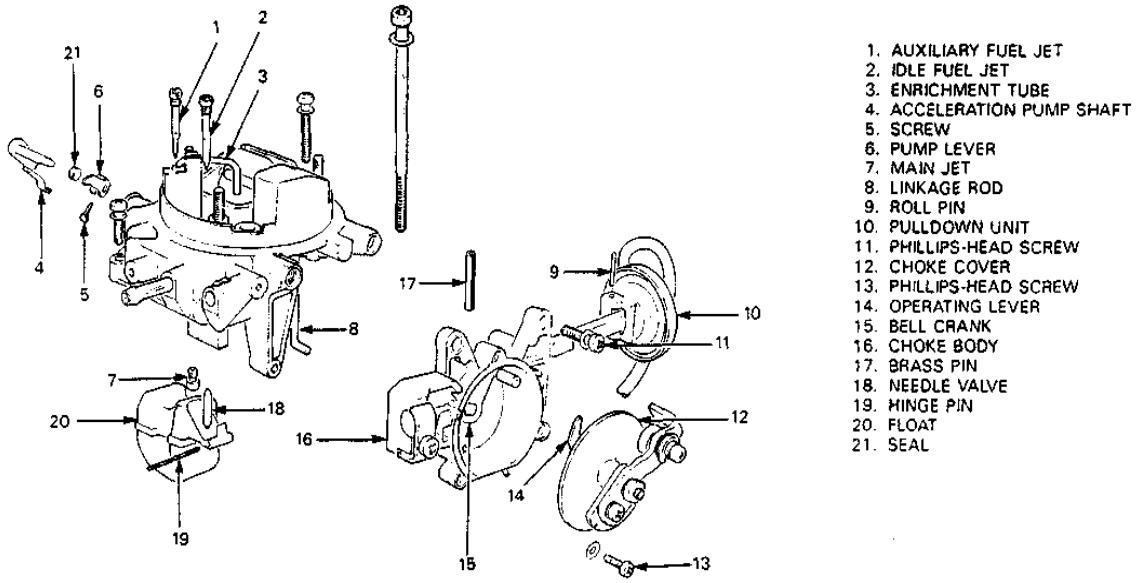


Figure 5 Top half of carburetor

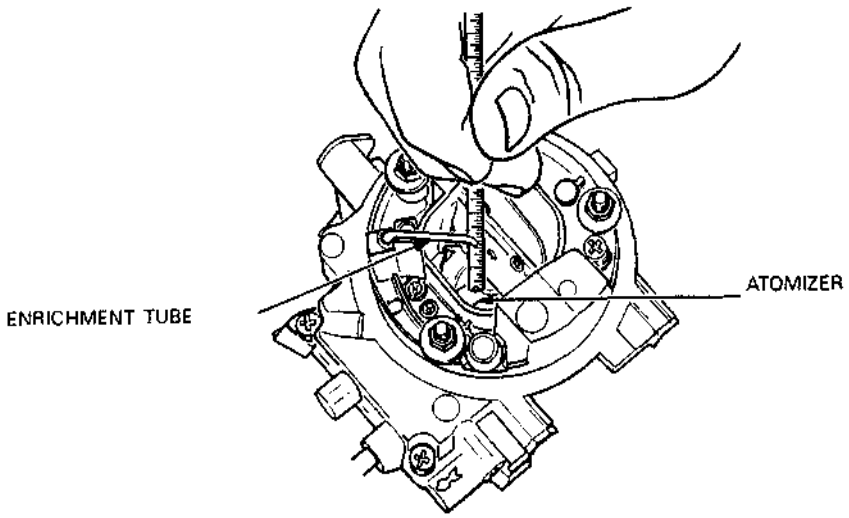


Figure 6 Carburetor enrichment tube measurement

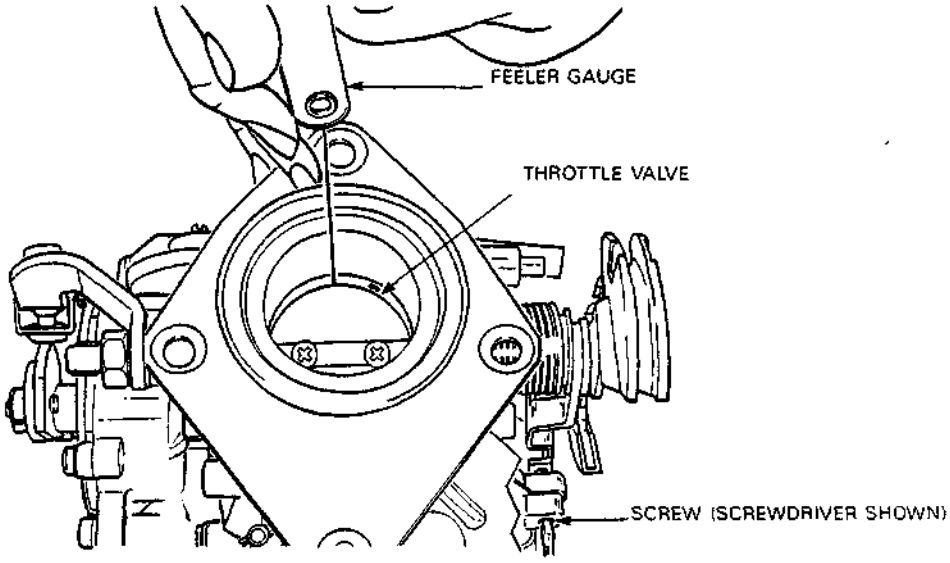


Figure 7 Carburetor throttle valve cap measurement

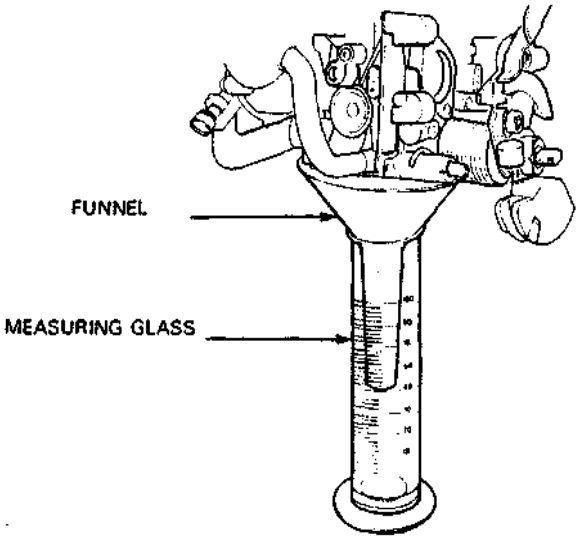


Figure 8 Carburetor injection capacity measurement

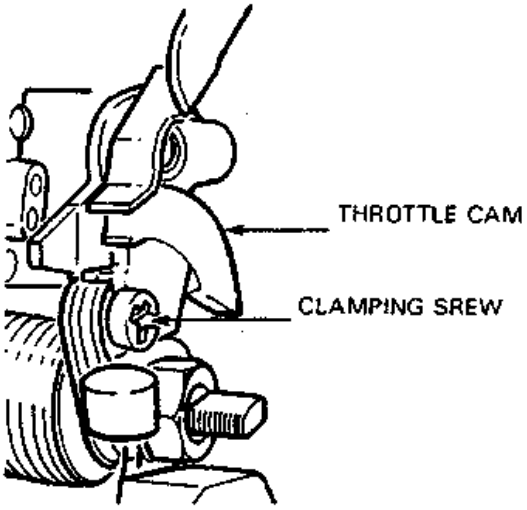


Figure 9 Carburetor throttle cam

Annex F

SPECIFICATION

FOR

REBUILDING THE LEECE NEVILLE 7518 JA 60 AND 100 AMP ALTERNATOR (USED IN TRUCKS, UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES)

NSN 2920-21-896-1329 AND NSN 2920-21-896-1386

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the Leece Neville 60 and 100 Amp alternators used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, testing, packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the alternators to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)
D-84-010-001/SF-001	Enamel, Alkyd, Lustreless, Infrared Reflective, Camouflage

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attentions DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A 0S9

CGSB M50	Primer, Flash Dry, Black, 50, TOTRUST
1-GP-84	Paint Primer
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each alternator supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.4 and 3.5.

3.1.1 If the alternator is being rebuild as part of an engine assembly rebuild, the rebuilt alternator shall be installed on the rebuilt engine assembly.

3.1.2 If the alternator is being rebuilt as a component only, it shall be preserved and packaged as detailed in 5.

3.1.3 The alternator shall be tested to determine N/S components and then completely disassembled and all components listed in Table III shall be thoroughly cleaned before being inspected for condition and wear.

3.1.4 Components listed in Table II - Mandatory Parts Replacement shall be replaced with new OEM parts during rebuild.

3.1.5 Any components missing from the alternator at time of disassembly will be replaced with new or serviceable OEM components at time of rebuild.

3.1.6 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.7 The contractor shall ensure that all components are secured as per Torque Standards listed in Table IV.

3.1.8 Upon completion of rebuild, the alternator shall consist of all the components listed in Table I. Figures 1, 2 and 3 are provided for component identification and location within the alternator.

3.1.9 Upon completion of rebuild, the alternator shall be tested and must perform to the standards as listed in 3.5.

3.2 Alternator components.- The following Table lists all of the components comprising the Leese Neville 60 and 100 Amp alternator; see Figures 1, 2 and 3 for component identification and location within the alternator assembly.

Table I Alternator components

Figure	Item	NSN	MRN	Description	Qty
1	1	2920-21-896-1329	B 183 998 001	Alternator Assy (60 Amp)	1
1	1	2920-21-896-1386	B 183 998 155	Alternator Assy (100 Amp)	1
2	1	5310-00-276-8631	2771	Nut (1/4-20)	2
2	2	5310-00-775-5182	2523	Washer - Lock (1/4)	2
2	3	2920-21-896-1394	96225	Regulator Assy	1
2	4	5340-01-109-9818	78527	Cap	2
2	5	5310-00-429-3135	4340	Nut - Hex (10-24)	1
2	6	5310-00-775-5139	2434	Washer - Lock (ND-10)	1
2	7	5340-01-107-7039	77976	Plug	1
2	8	5977-00-764-5530	77302	Brush	2
2	9	5305-00-450-0464	58432	Screw - Terminal	1
2	10	5305-01-024-2204	78337	Screw (10-32 X 3/4)	2

Table I Alternator components (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	11	5310-00-775-5139	2434	Washer - Lock (ND 10)	2
2	12	5310-00-361-9897	2385	Washer - Guard	2
2	13	5310-01-023-8927	52066	Washer - Insulation	2
2	14	5961-01-034-0828	71181	Rectifier Assy - Neg	1
2	15	5305-00-451-1623	73543	Screw - Hex (6-32)	3
2	16	5340-00-431-7066	73760	2 lamp	1
2	17	5910-00-112-8051	73541	Capacitor Assy	1
2	18	5961-01-034-0829	71180	Rectifier Assy - Pos	1
2	19	5970-21-897-0353	73547	Bushing - Insulation	2
2	20	5970-00-160-4001	73546	Bushing - Insulation	2
2	21	5310-21-896-9757	99133	Washer - Guard	4
2	22		78336	Screw - Terminal	1
2	23	5970-21-897-0354	97379	Bushing - Insulation	2
2	24		71098	Housing Assy - Slip Ring End	1
2	25	5330-00-019-0635	57597	O Ring	1
2	26	5305-00-777-2284	5179	Screw (10-32 X 1/2)	2
2	27	5310-00-429-3110	31587	Nut - Lock	3
2	28	5940-00-476-6763	73657	Jumper Assy	3
2	29	5310-00-429-3127	26175	Nut - Elastic (10-32)	3
2	30	5310-00-429-2686	73009	Hut (5/16-18)	1

Table I Alternator components (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	31	5310-00-032-1814	3231	Washer - Lock	1
2	32	5310-01-024-3109	2364	Nut (5/16-18)	1
2	33	5310-00-429-3156	59982	Nut (1/4-20)	1
2	34	5305-00-450-0461	73659	Screw - (10-32 X 1/2)	3
2	35	5970-00-472-4588	73635	Insulator	1
2	36	5961-01-129-1454	79026	Diode - Trio	1
2	37	5310-00-429-3453	75451	Washer - Belleville	3
2	38	5305-21-896-9749	96153	Screw - Pan Hd (10-32)	3
2	39	2920-21-896-1400	96235	Jumper	1
2	40	5940-01-103-8311	78705	Jumper	1
2	41	5330-00-406-0664	57611	Ring - Sealing	1
2	42	5977-01-105-2549	78524	Housing - Brush Holder	1
2	43	5305-00-984-6192	13622	Screw (8-32 X .44)	4
2	44	5310-01-024-3110	5622	Nut - Hex Hd (6-32)	2
2	45	5310-00-665-3803	Z 089 097 621	Washer - Lock (ND 6S Proof)	2
3	1	5310-21-896-9753	74107	Nut - Hex (1/2-20)	1
3	2	5315-00-616-5523	5399	Key - Woodruff	1
3	3	3020-21-897-5891	3482132-1	Pulley	1
3	4	2920-21-896-1385	75633	Fan Assy	1
3	5	5365-21-896-7218	59324	Spacer - Fan	1

Table I Alternator components (cont'd)

Figure	Item	NSN	MRN	Description	Qty
3	6	5310-00-429-3453	75451	Washer - Belleville	3
3	7	5305-00-450-0462	59972	Screw (10-32 X 5/8)	3
3	8	3120-21-897-5886	96224	Insert - Mounting	2
3	9	2920-21-896-1387	77773	Housing - Drive End	1
3	10	3110-00-464-2614	57166	Bearing - (304)	1
3	11	3110-00-451-1534	59234	Retainer - Bearing	1
3	12	5305-00-450-0463	58754	Screw (10-32 X 7/16)	4
3	13	2920-21-896-1390	96202	Rotor and Slip Ring	1
3	14	6150-00-504-1822	30300	Wedge - Slot	1
3	15	3110-00-108-9248	26853	Bearing - (203)	1
3	16	5310-01-106-3630	57626	Washer - Insulation	1
3	17	2920-00-462-2278	57462	Slip Ring Assy	1
3	18	6115-01-204-2830	78649	Stator Assy - w/Terminal 60 Amp	1
3	19	2920-21-896-1389	78751	Stator Assy - w/Terminal 100 Amp	1

3.3 Mandatory parts replacement.- The following Table lists parts that shall be replaced with new OEM components during alternator rebuild, see Figures 2 and 3 for component identification and location within the alternator assembly.

Table II Mandatory parts replacement

Figure	Item	NSN	MRN	Description	Qty
2	1	5310-00-276-8631	2771	Nut (1/4-20)	2
2	2	5310-00-775-5182	2523	Washer - Lock (1/4)	2
2	4	5340-01-109-9818	78527	Cap	2
2	5	5310-00-429-3135	4340	Nut - Hex (10-24)	1
2	6	5310-00-775-5139	2434	Washer - Lock (ND-10)	1
2	7	5340-01-107-7039	77976	Plug	1
2	8	5977-00-764-5530	77302	Brush	2
2	9	5305-00-450-0464	58432	Screw - Terminal	1
2	10	5305-01-024-2204	78337	Screw (10-32 X 3/4)	2
2	11	5310-00-775-5139	2434	Washer - Lock (ND-10)	2
2	12	5310-00-361-9897	2385	Washer - Guard	2
2	13	5310-01-023-8927	52066	Washer - Insulation	2
2	15	5305-00-451-1623	73543	Screw - Hex (6-32)	3
2	16	5340-00-431-7066	73760	Clamp	1
2	19	5970-21-897-0353	73547	Bushing - Insulation	2
2	20	5970-00-160-4001	73546	Bushing - Insulation	2
2	21	5310-21-896-9757	99133	Washer - Guard	4
2	22		78336	Screw - Terminal	1
2	23	5970-21-897-0354	97379	Bushing - Insulation	2
2	25	5330-00-019-0635	57597	O Ring	1
2	26	5305-00-777-2284	5179	Screw - (10-32 X 1/2)	2

Table II Mandatory parts replacement (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	27	5310-00-429-3110	31587	Nut - Lock	3
2	29	5310-00-429-3127	26175	Nut - Elastic (10-32)	3
2	30	5310-00-429-2686	73009	Nut (5/16 X 18)	1
2	31	5310-00-032-1814	3231	Washer - Lock	1
2	32	5310-01-024-3109	2364	Nut - (5/16-18)	1
2	33	5310-00-429-3156	59982	Nut - (1/4-20)	1
2	34	5305-00-450-0461	73659	Screw - (10-32 X 1/2)	3
2	35	5970-00-472-4588	73635	Insulator	1
2	12	5310-00-361-9897	2385	Washer - Guard	2
2	13	5310-01-023-8927	52066	Washer - Insulation	2
2	15	5305-00-451-1623	73543	Screw - Hex (6-32)	3
2	16	5340-00-431-7066	73760	Clamp	1
2	19	5970-21-897-0353	73547	Bushing - Insulation	2
2	20	5970-00-160-4001	73546	Bushing - Insulation	2
2	21	5310-21-896-9757	99133	Washer - Guard	4
2	22		78336	Screw - Terminal	1
2	23	5970-21-897-0354	97379	Bushing - Insulation	2
2	25	5330-00-019-0635	57597	O Ring	1
2	26	5305-00-777-2284	5179	Screw - (10-32 X 1/2)	2
2	27	5310-00-429-3110	31587	Nut - Lock	3
2	29	5310-00-429-3127	26175	Nut - Elastic (10-32)	3

Table II Mandatory parts replacement (cont'd)

Figure	Item	NSN	MRN	Description	Qty
2	30	5310-00-429-2686	73009	Nut (5/16 X 18)	1
2	31	5310-00-032-1814	3231	Washer - Lock	1
	32	5310-01-024-3109	2364	Nut - (5/16-18)	1
2	33	5310-00-429-3156	59982	Nut - (1/4-20)	1
2	34	5305-00-450-0461	73659	Screw - (10-32 X 1/2)	3
2	35	5970-00-472-4588	73635	Insulator	1
2	37	5310-00-429-3453	75451	Washer - Belleville	3
2	38	5305-21-896-9749	96153	Screw - Pan Hd (10-32)	3
2	41	5330-00-406-0664	57611	Ring - Sealing	1
2	43	5305-00-984-6192	13622	Screw - (8-32 X .44)	4
2	44	5310-01-024-3110	5622	Nut - Hex Hd (6-32)	2
2	45	5310-00-665-3803	Z 089 097 621	Washer - Lock (ND 6S Proof)	2
3	1	5310-21-896-9753	74107	Nut - Hex (1/2-20)	1
3	2	5315-00-616-5523	6399	Key - Woodruff	1
3	6	5310-00-429-3453	75451	Washer - Belleville	3
3	7	5305-00-450-0462	59972	Screw - (10-32 X 5/8)	3
3	8	3120-21-897-5886	96224	Insert - Mounting	2
3	10	3110-00-464-2614	57166	Bearing - (304)	1
3	12	5305-00-450-0463	58754	Screw - (10-32 x 7/16)	4
3	14	6150-00-504-1822	30300	Wedge - Slot	1

Table II Mandatory parts replacement (cont'd)

Figure	Item	NSN	MRN	Description	Qty
3	15	3110-00-108-9248	26853	Bearing - (203)	1
3	16	5310-01-106-3630	57626	Washer - Insulation	

3.4 Rebuild procedures.- The following provides the step-by-step procedures to be used in the rebuild of the alternator assembly.

3.4.1 Pre-disassembly tests.- Prior to disassembly of the alternator, perform the following tests to determine which components are unserviceable and must be replaced. Complete the tests in the order presented.

(a) Output voltage test

i Place the alternator in a test stand and run it at approximately 1200 RPM.

ii Measure the output voltage, it should be 27.9 to 28.1 Vdc.

CAUTION

Do not turn the adjusting screw too far in either direction as you may break the stop.

iii If output voltage is not within the specified limits, adjust the voltage by removing nylon plug (7) Figure 2 and turning the adjusting screw clockwise to increase voltage and counter-clockwise to decrease voltage.

iv If output voltage is nil or too low and cannot be increased, either the alternator, regulator or diode trio are at fault; perform alternator ouptut voltage test.

v If output voltage is too high and cannot be decreased, the regulator must be replaced.

vi If output voltage is within specified limits or can be adjusted to specified limits; perform the load test.

(b) Output voltage load test

i Run the alternator at approximately 3000 RPM with a load not exceeding output rating placed on it.

ii Measure the output voltage; it should be a minimum of 27 Vdc.

iii If output voltage is less than 27 volts, perform the alternator full-fielded output voltage test.

iv If output voltage is 27 volts or higher, all major components of the alternator are serviceable; disassemble, clean, and rebuild the alternator using mandatory replacement parts only.

(c) Alternator full-fielded output voltage test

i Connect a jumper wire to the alternator negative terminal.

ii Attach a short piece of wire (eg, a paper clip) to the other end of the jumper cable and insert the wire into the small hole in the end of the brush holder so that the wire contacts the outer brush terminal, see Figure 4.

iii Run the alternator at approximately 1200 RPM and observe the output voltage.

iv If the voltage does not rise, the fault is within, the alternator and further tests must be conducted at time of disassembly.

v If the voltage rises, the voltage regulator or diode trio are at fault and must be tested.

3.4.2 Disassembly.- To disassemble the alternator, see Figure 5 and proceed as follows.

NOTE

All nuts and bolts are standard size.

(a) Hold the pulley (22) with a strap wrench and remove the shaft nut (19) and washer (20).

(b) Remove the pulley, fan (23), woodruff key (21), and fan spacer (26).

(c) Remove the nuts and spring (1 and 45) from the negative alternator output terminal and the regulator terminal to free the copper jumper and remove copper jumper.

(d) Remove the three screws (6) and lock washers from the terminal board and remove the diode trio (7).

(e) Remove the nut (2) and lock washer (3) that secure the diode trio lead to the regulator (4).

(f) Remove the nuts (47), lock washers (48), negative jumper (43) and sealing washers (49) and remove the regulator and brushes.

(g) Remove the four screws (50) from the holder (51) and carefully remove the holder.

NOTE

Because of the application of Loctite to the holder screws, it may be necessary to apply heat to the screw heads with a large soldering iron. After heating the screws, remove them immediately.

(h) Mark the drive end housing (27) and slip ring end housing (36) to ensure correct assembly. Do not mark the stator (14).

(j) Remove the self-locking nuts (37), through bolts (24) and washers (25).

CAUTION

If the drive end housing binds on the stator, tap gently on the mounting ear with a fibre hammer to loosen. Ensure that the drive end housing separates from the stator and the stator remains attached to the slip ring end housing to avoid damage to the stator leads.

(k) Remove the rotor (31) and drive end housing assembly (27) from the stator (14) and slip ring end housing assembly (36).

(m) Remove the three nuts (9) that secure the stator leads to the terminal and remove the stator.

(n) Remove the nut (39) from the positive output terminal bolt (17) and remove the bolt (17) and insulating bushings (38).

(p) Remove the nut from the negative output terminal bolt (13) and remove the bolt, two guard washers (41) and two fibre bushings (40).

(q) Remove the capacitor (16) connected between the positive rectifier (11) and the negative rectifier (12).

(r) Remove the two screws, lock washers, guard washers and insulating washers (15) that retain the lower end of the heat sinks.

(s) Remove the heat sinks and note the location of the insulating washers.

(t) Using a press or puller, remove the drive end housing (27) and bearing assembly (28) from the rotor (31).

(u) Remove the four screws (30) and bearing retainer (29).

(v) Press the bearing (28) from the drive end housing.

3.4.3 Tests and inspections.- If during pre-disassembly tests, the alternator proved to be faulty, carry out the following tests.

(a) Positive and negative rectifier diode tests

NOTE

It is not necessary to remove the rectifier assemblies from the end housing or disconnect the rectifier leads in order to test the assemblies. If the assemblies are not removed, ensure the stator is removed. Ensure the diode trio has been removed from the terminal board and disconnect the capacitor connected between the lower end of the rectifier assemblies. Rectifier diodes are tested to ensure that the diodes pass current in one direction only. Diodes should be tested with a diode tester, but an analog ohmmeter or batter-powered test light can be used as a substitute. Diodes that allow current to flow in either direction are shorted. Diodes that do not allow current to flow in one direction Only are open.

i Connect one lead of the test device to a diode lead and the other lead to the heat sink of that diode, see Figure 6. Note the reading.

ii Reverse the test leads on that same diode and heat sink and note the reading. The ohmmeter or test light must indicate

current flow in one test and no current flow in the other test. Replace the rectifier if necessary.

iii Repeat steps i and ii for each of the five remaining diodes and their corresponding heat sinks.

(b) Capacitor test

NOTE

The capacitor can be tested with either a capacitor tester or an ohmmeter.

i Connect the positive and negative leads of a tester to each end of the capacitor leads.

ii If the capacitor does not indicate 0.5 MFD and 200 working volts DC it must be replaced.

iii To test using an ohmmeter, connect the positive and negative test leads to each of the capacitor leads.

iv If a high resistance . is indicated, the capacitor is serviceable.

v If a low resistance is indicated, the capacitor is shorted or leaking and must be replaced.

(c) Rotor grounding test

i Connect one test lead of an ohmmeter to the rotor shaft.

ii Touch the other lead to each of the two slip rings.

iii If a zero or close to zero reading is obtained, the rotor assembly is grounded and must be replaced.

(d) Rotor coil resistance test

i Touch the negative and positive leads of an ohmmeter to the two slip rings.

ii If resistance is not within the specified range of 7.2 to 7.8 ohms, connect the test leads to the rotor coil soldered connections of the two slip rings.

iii If resistance is now within the specified range, resolder the rotor coil solder connections.

iv If resistance is still not within the specified range, replace the rotor assembly.

(e) Stator grounding test

NOTE

If the stator windings appear to be charred, burned, or insulation is missing and bare copper wire is visible, replace the stator.

i Using an ohmmeter, check for grounds between the stator frame and each of the stator leads.

ii If grounding is indicated, replace the stator.

(f) Stator phase resistance test

i Using an ohmmeter that is capable of reading 1/1000 of an ohm or a Wheatstone Bridge, check the stator phase resistance across pairs of terminals checking the three possible combinations.

ii Resistance should be about the same for each of the three phases, replace the stator if there is much variation in the resistance.

(g) Regulator test

i If during pre-disassembly tests, it was indicated that the regulator may be faulty, install it in a known serviceable alternator and perform voltage output tests.

ii If test results indicate that the regulator is faulty, replace the regulator.

(h) Diode trio test

i If during pre-disassembly tests, it was indicated that the diode trio was faulty, test the diode trio with an ohmmeter set on the RX1 ohm scale.

ii Connect the meter negative lead to the diode trio output lead.

iii Touch the positive meter lead to each of the three diode trio terminal pads, see Figure 7.

iv If there is needle deflection for any of the terminal pads, replace the diode trio.

v Connect the meter positive lead to the diode trio output lead.

vi Touch the negative lead to each of the three terminal pads.

vii Needle deflection of the meter should be approximately the same for all three pads.

viii If there is no needle deflection or a great difference in deflection on any one of the three pads, replace the diode trio.

3.4.4 Inspection

(a) Clean and inspect the following components listed in Table I for wear and damage and replace as necessary.

Table III Components requiring inspection

Figure	Item	NSN	MRN	Description	Qty
2	24		71098	Housing Assy - Slip Ring End	1
2	28	5940-00-476-6763	73657	Jumper Assy	3
2	39	2920-21-896-1400	96235	Jumper	1
2	40	5940-01-103-8311	78705	Jumper	1
2	42	5977-01-105-2549	78524	Housing - Brush Holder	1
3	3	3020-21-897-5891	8482132-1	Pulley	1
3	4	2920-21-896-1385	75633	Fan Assy	1
3	5	5365-21-896-7218	59324	Spacer - Fan	1
3	9	2920-21-896-1387	77773	Housing - Drive End	1

Table III Components requiring Inspection (cont'd)

Figure	Item	NSN	MRN	Description	Qty
3	11	3110-00-451-1534	59234	Retainer - Bearing	1

3.4.5 Assembly.- To assemble, proceed as follows:

(a) Replace the slip ring and bearing.

NOTE

Place the new slip ring in a warm place so that it will press on easily without cracking.

i Using a soldering iron, remove the wire that connects the rotor to the outside slip ring.

ii Bend the unsoldered wire until it is parallel to the shaft.

iii Unsolder the wire from the inside slip ring.

iv Using a gear puller or arbor press, remove the slip ring assembly and the insulation washer.

v Using a gear puller or an arbor press with fixture plates behind the bearing, remove the bearing from the rotor shaft. Do not lose the slot wedge.

vi Install the slot wedge in the shaft slot and place the new bearing over the rotor shaft. Using a sleeve that contacts the inner bearing race, press the bearing on, ensuring the wedge remains in place.

vii Place a new insulation washer and slip ring assembly on the rotor shaft. Ensure the wire slots align with the slot in the shaft.

NOTE

When installing the slip ring assembly, use only enough pressure to prevent the insulation washer from turning.

viii Press the slip ring assembly all the way onto the shoulder.

ix Solder the rotor coil leads to the new slip ring assembly and test the resistance of the soldered connections.

x Place the rotor assembly on a lathe and take a slight cut from the circumference of the slip rings to ensure the rings are concentric with the rotor shaft. The concentricity of the slip rings to the bearing surfaces of the shaft must not exceed 0.002 inches total indicator reading.

(b) Using an arbor press, press the drive end housing bearing into the housing as far as possible.

(c) Install the bearing retainer with four screws.

(d) Place the slip ring end of the rotor shaft on an arbor press, ensuring that the slip rings are not damaged, and press the drive end housing onto the rotor shaft. Use a sleeve to ensure pressure is applied only the inner race of the drive end bearing.

(e) Install the terminal board and two screws.

(f) Place the positive and negative rectifier assemblies in the slip ring end housing.

(g) Install the insulation bushing (1) in the underside of the mounting hole and install the screw (5) with the lock washer (4), guard washer (3) and insulation washer (2) through the insulation bushing and mounting hole, see Figure 8. Do not tighten the screws at this time.

(h) Install an insulation bushing (1) on each side of the end housing (4). Install the positive terminal bolt (3) in the top of the positive rectifier assembly (2) and install a nut (5), see Figure 9. Tighten the nut and screw.

(j) Install the negative terminal bolt (3) with two fibre bushings (1) between the four guard washers (5) [two guard washers on each side of the end housing (4)], through the negative rectifier assembly (2) and end housing. Install a nut (6) on the bolt, see Figure 10. Tighten the nut and screw.

(k) Install the capacitor and capacitor terminals on the bottom of the rectifier assemblies with self-tapping screws. Remove the paint from around the holes before installing the leads.

(m) Place a rectifier terminal on each of the three terminal screws of the terminal board. When installing replacement rectifiers, remove paint from the terminals and install a positive and negative rectifier terminal on each terminal board screw.

(n) Install a new O ring in the bearing bore of the slip ring end housing.

(p) Remove the paint from the terminals and install the stator on the slip ring end housing. Place the stator leads on the three terminal board screws. Ensure the assembly screw holes in the stator and the slip ring end housing are aligned.

(q) Ensure there is clearance between the rotor and rectifier and clearance between the rotor and stator leads.

(r) Secure the rectifier and stator leads with self-locking nuts.

(s) Support the slip ring end housing on flat plates in an arbor press, ensuring clearance is provided for the slip ring to pass through the housing, and press the slip ring end bearing into the slip ring end housing by pressing on the rotor shaft.

NOTE

Ensure the housing marks and the assembly screw holes are aligned in the slip ring end housing, stator and drive end housing.

(t) Install the three through bolts and washers through the slip ring end housing, stator and drive end housing.

(u) Install the elastic lock nuts on the through bolts and torque to 565 to 678 Ncm (50 to 60 in lb).

(v) Ensure the sealing ring is properly installed in the brush holder housing.

(w) Apply Loctite No. 242 to the threads and install the brush holder housing with the four No. 8 round head screws. Remove the tape from the housing.

(x) Insert the outer brush and spring assembly into the housing and compress the brush spring with a small screwdriver. While holding the spring compressed, insert a stiff piece of wire through the top hole in the rear of the housing so that the spring will be held in the compressed position.

(y) Install and compress the second brush and spring and push the wire farther into the brush housing to hold the second brush in the compressed position also.

(z) Carefully push the regulator into the brush housing until the regulator contacts the brushes.

(aa) On the positive side of the regulator, install a sealing washer, jumper, spring washer and nut. Hand tighten the nut while firmly holding the regulator in position.

(ab) On the negative side, install a sealing washer, jumper, lock washer and nut on the negative output terminal. Hand tighten the nut.

(ac) Install the copper jumper wire on the negative output terminal and the regulator terminal.

(ad) Install a nut on each terminal and tighten.

CAUTION

To prevent damage to the regulator, ensure the wire that compresses the springs is removed before torquing the nuts.

(ae) Remove the wire that compresses the springs and torque the nuts to 113 to 136 Ncm (10 to 12 in lb).

(af) Install the diode trio with the three screws and washers.

(ag) Install the diode trio lead to the terminal on the regulator and install the lock washer and nut.

(ah) Install a strip of tape over the two holes in the brush holder housing.

(aj) Install the fan spacer on the shaft and install the woodruff key, fan, pulley, washer and nut.

(ak) Hold the pulley with a strap wrench and torque the nut between 60 and 70 Nm (45 to 50 ft lb).

(am) Test the alternator on a proper test block or by means of a test set-up. After the battery has been connected, flash the field by connecting a jumper wire to the diode trio terminal pad on top of the regulator and momentarily touching the other end of the wire to the alternator positive (+) terminal.

3.5 Rebuild standards.- The following standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices. If the serviceability of a component is in doubt, the component shall be replaced and held for QA inspection and decision.

Description	Standards
Rectifier Assy - Negative	Pass current in one direction only
Rectifier Assy - Positive	Pass current in one direction only
Capacitor Assy	Minimum 0.5 MFD and 200 working volts DC
Rotor and Slip Rings	Not Grounded
Rotor Coil	7.2 to 7.8 ohms resistance
Stator Assy	Not Grounded
Resistance	Approximately the same for all three phases
Regulator Assy - Brush Length	Minimum 4.7 mm (3/16 in.)
Diode Trio	Pass current in one direction only Approx same resistance in all three diodes
Slip Ring to Bearing Surface Concentricity	Max 0.002 in.

3.6 Torque standards.- The following Table lists the torque standards that shall be used when rebuilding the alternator assembly.

Table IV Torque standards

Fig	Item	Description	Nm	FT LB
3	7	Through Bolts	565-678 Ncm	50-60 in lb
2	44	Regulator Terminal Nuts	113-136 Ncm	10-12 in lb
3	2	Pulley Nut	60-70 Nm	45-50 ft lb

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PAINTING, PRESERVATION, PACKAGING AND MARKING

5.1 Painting.- The pulley and fan shall be painted in accordance with CGSB M50, Primer, flash dry, black, 50, "TOTRUST". The alternator shall not be painted.

5.2 Preservation.- After final acceptance by Quality Assurance Authority, the contractor shall affix a legible, stamped or engraved metal plate to the alternator in an approved location showing the following information.

(a) Name of the firm or workshop that rebuilt the alternator.

(b) Day, month and year of alternator rebuild.

(c) Firm or workshop order number.

5.2.1 The alternator shall be properly supplied with:

(a) CF 942 - NSN 8135-21-872-2435 - Identity and Condition Tag.

(b) The applicable NSN for the alternator.

5.2.2 The alternator shall be wrapped in barrier material MIL-B-131 and sealed with tape pressure sensitive 43-GP-3M.

5.3 Packaging.- The wrapped alternator shall then be placed in its shipping and storage container and sealed.

5.3.1 The shipping and storage container shall contain sufficient packing material to prevent movement and damage to the alternator and sufficient new dessicant bags to prevent condensation.

5.3.2 Prior to use, the container shall be placed in Class "S" condition by replacing hardware for the lid, patching holes as required, and applying one coat of primer to l-GP-84 and one coat of enamel paint to D-84-010-001/SF-001, the colour shall conform to 1-GP-12C olive drab No. 503-321.

5.4 Marking.- The shipping and storage container shall have the following stencilled on each end.

(a) The applicable NSN for the alternator.

(b) The description.

(c) The applicable MRN.

(d) Qty.

(e) Weight.

(f) Date of rebuild.

5.4.1 The following shall be stencilled on both sides:

"REUSABLE CONTAINER DO NOT DESTROY CF PROPERTY".

5.4.2 A CF 941A, NSN 7690-21-868-6739, Identity and Condition Label properly filled out will be stapled to the container.

5.5 Any further preservation, packaging or marking instructions will be stipulated in the contract.

6. NOTES

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through the Quality Assurance Authority.

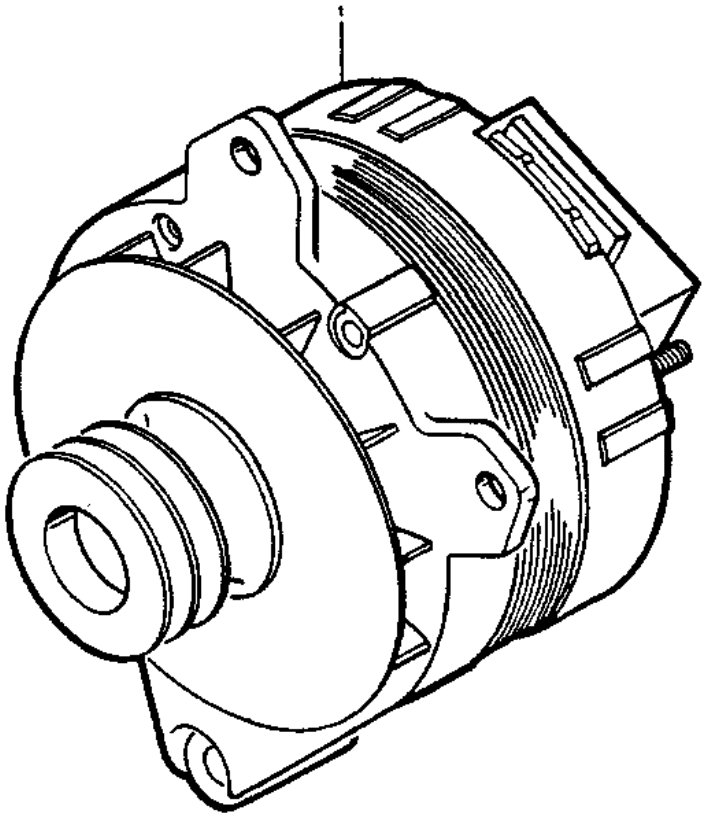


Figure 1 Alternator assembly

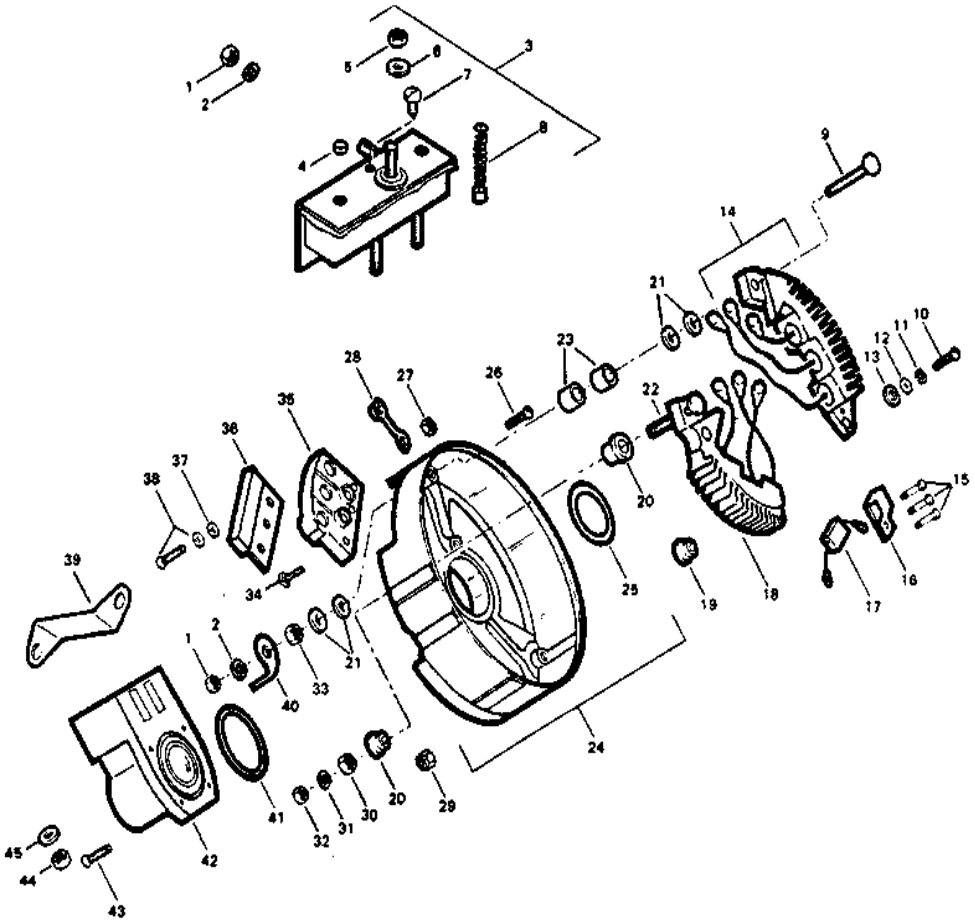


Figure 2 Alternator parts

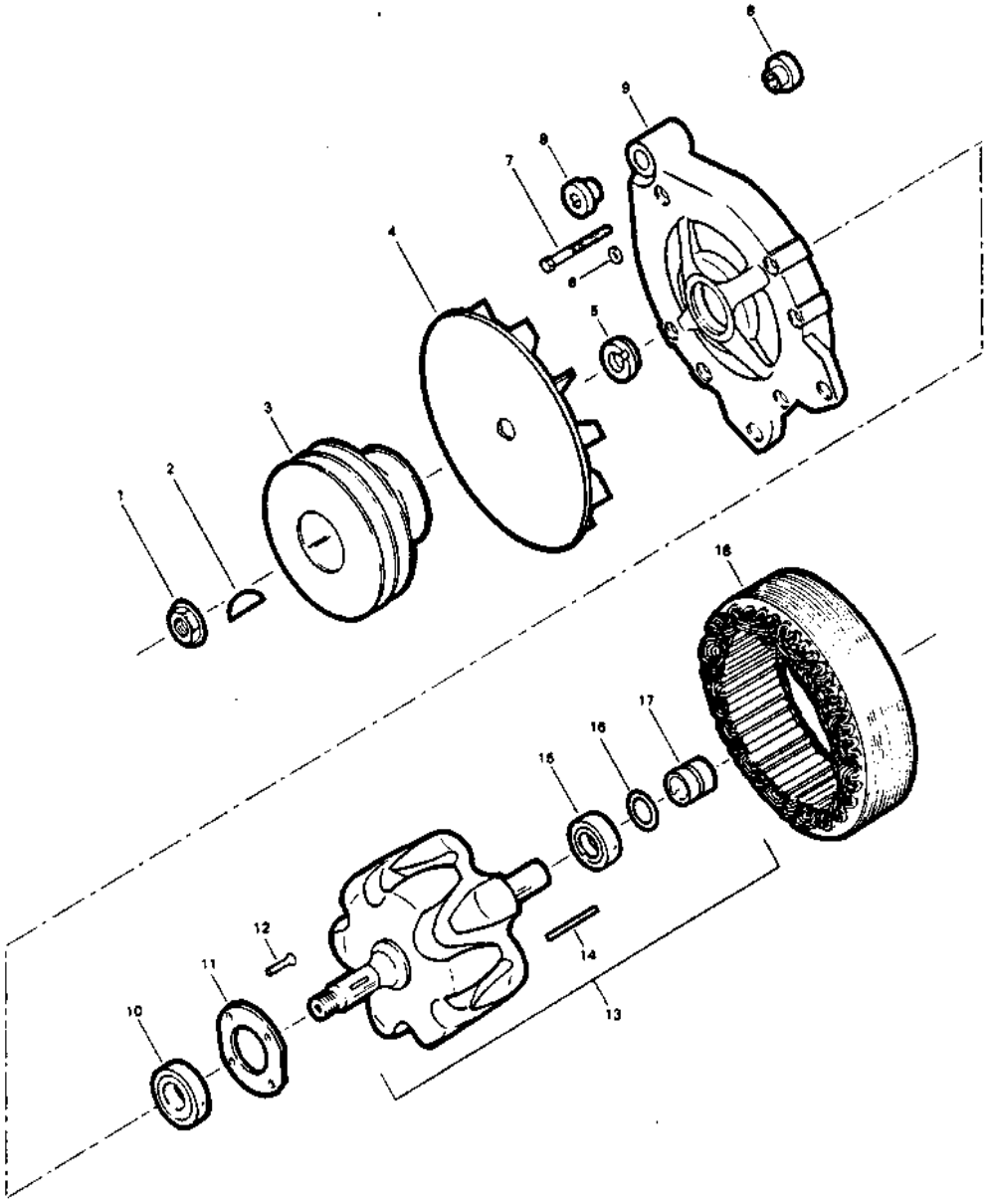


Figure 3 Alternator parts

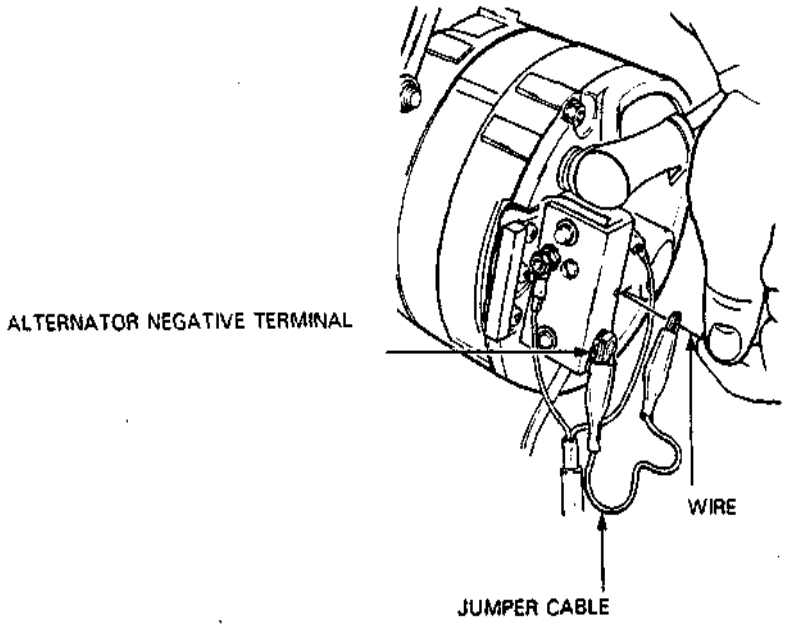
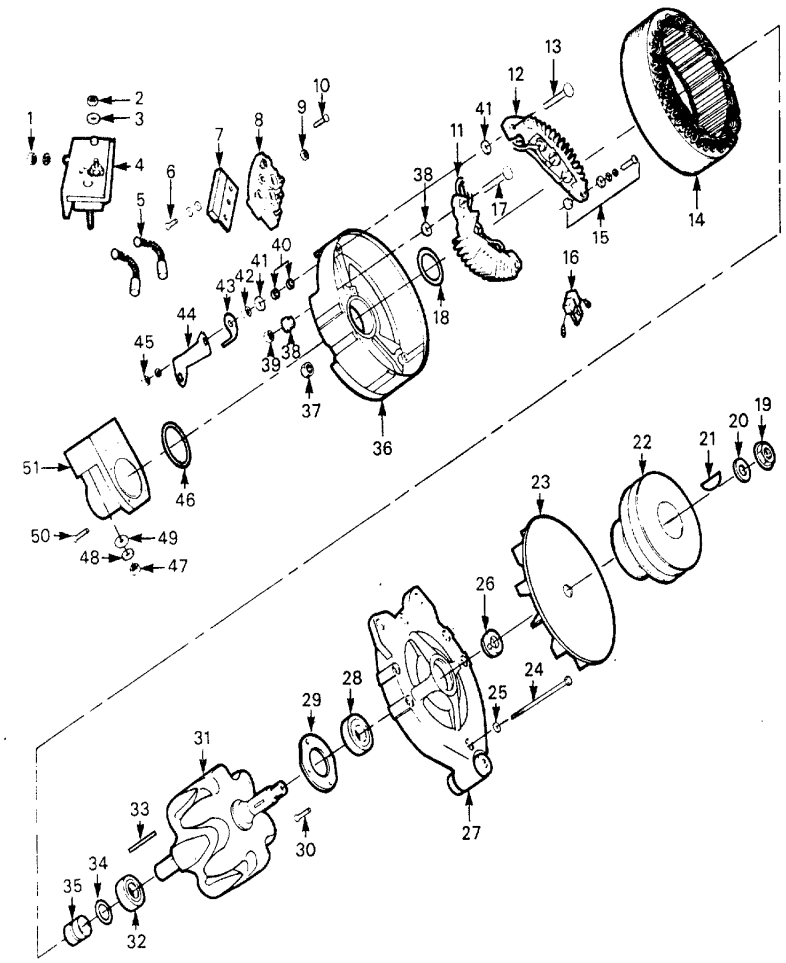


Figure 4 Full fielding the alternator



1. NUT (1/4-20)
2. NUT
3. LOCK WASHER
4. REGULATOR
5. BRUSHES
6. SCREW
7. DIODE TRIO
8. TERMINAL BOARD
9. SELF-LOCKING NUT
10. SCREW
11. POSITIVE RECTIFIER
12. NEGATIVE RECTIFIER
13. NEGATIVE TERMINAL OUTPUT BOLT
14. STATOR
15. SCREW, LOCK WASHER GUARD WASHER, INSULATING WASHER
16. CAPACITOR
17. POSITIVE OUTPUT TERMINAL BOLT
18. O-RING
19. SHAFT NUT
20. WASHER
21. WOODRUFF KEY
22. PULLEY
23. FAN
24. THROUGH BOLT
25. WASHER
26. FAN SPACER
27. DRIVE END HOUSING
28. BEARING
29. BEARING RETAINER
30. SCREW
31. ROTOR
32. DRIVE END HOUSING BEARING
33. SLOT WEDGE
34. INSULATION WASHER
35. SLIP RING ASSEMBLY
36. SLIP RING END HOUSING
37. SELF-LOCKING NUT
38. INSULATING BUSHING
39. NUT
40. FIBRE BUSHINGS
41. GUARD WASHERS
42. NUT
43. NEGATIVE JUMPER
44. COPPER JUMPER
45. NUT (1/4-20)
46. O-RING
47. NUT (6-32)
48. LOCK WASHER
49. SEALING WASHER
50. SCREW (8-32)
51. HOLDER

Figure 5 Alternator

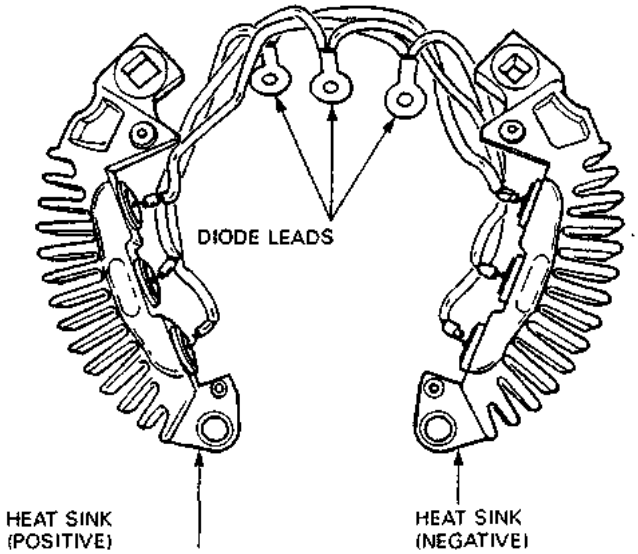


Figure 6 Rectifier test points

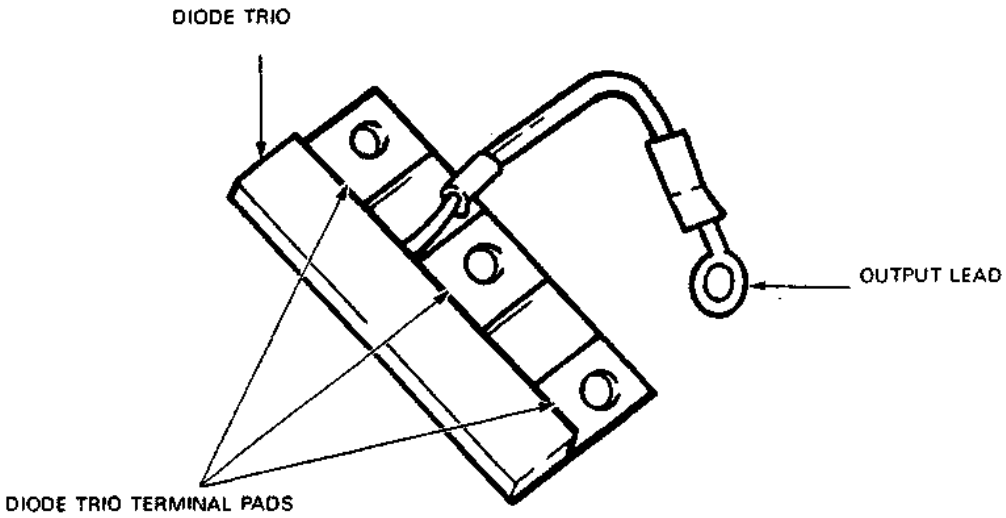
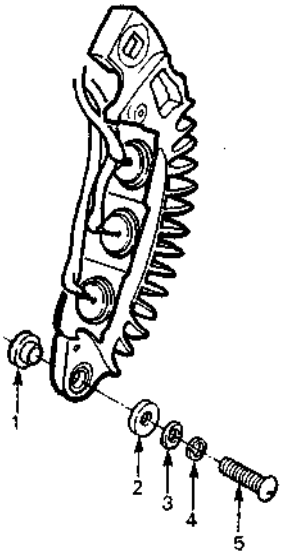
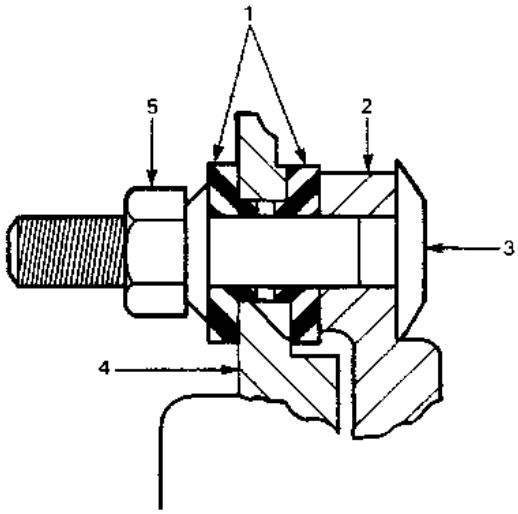


Figure 7 Diode trio



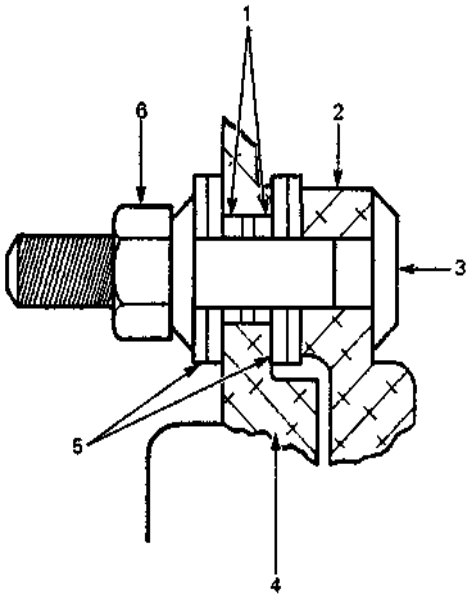
1. INSULATION BUSHING
2. INSULATION WASHER
3. GUARD WASHER
4. LOCK WASHER
5. SCREW

Figure 8 Installation of rectifier assembly



1. INSULATION BUSHINGS
2. POSITIVE RECTIFIER ASSEMBLY
3. POSITIVE TERMINAL BOLT
4. END HOUSING
5. NUT

Figure 9 Positive terminal assembly



1. FIBRE BUSHINGS
2. NEGATIVE RECTIFIER ASSEMBLY
3. NEGATIVE TERMINAL BOLT
4. END HOUSING
5. GUARD WASHERS
6. NUT

Figure 10 Negative terminal assembly

Annex G

SPECIFICATION

FOR

REBUILDING THE VW 1.7 LITRE ENGINE FLYWHEEL ASSEMBLY

USED IN TRUCKS, UTILITY, LIGHT, 4 BY 4 MILITARY DESIGN ILTIS CDN SERIES

NSN 2805-12-172-8349

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the flywheel of the VW 1.7 litre engine used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, preservation and packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the flywheel.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A 0S9

1-GP-105	Primer, Quick Drying
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant.
CAN2-3.8M	Dry Cleaning Solvent

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each flywheel supplied by DND in accordance with the requirements of this specification using the procedures specified in 3.3.

3.1.1 If the flywheel is being rebuilt as part of an engine assembly rebuild, it shall be installed on the rebuilt engine assembly for engine testing and then preserved and packaged as specified herein and placed in the container with the engine.

3.1.2 If the flywheel is being rebuilt as a component only, it shall be preserved and packaged as detailed in 5.

3.1.3 The flywheel shall be thoroughly cleaned with dry cleaning solvent CAN2-3.8M or commercial equivalent and dried with compressed air before being inspected for condition and wear.

3.1.4 If in the judgement of the contractor, the flywheel is considered unserviceable, it shall be replaced with a new or serviceable OEM flywheel. The Quality Assurance Authority shall be consulted in all such cases.

3.1.5 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.6 Upon completion of rebuild, the flywheel shall consist of all the components listed in Table I.

3.2 Flywheel components.- The following Table lists the components comprising the VW 1.7 litre engine flywheel; refer to Figure 1 for component identification.

Table I Flywheel components

Item	NSN	MRN	Description	Qty
1	2805-12-172-8349	056 105 269 N	Flywheel Assy	1
2		056 105 275 A	Gear - Starter Ring	1
3	5315-21-896-2456	N 043 205 1	Pin - Dowel (4H8 X 24)	2
4	5315-12-124-0017	N 013 210 1	Pin - Dowel (6M6 X 16)	3
5	5305-12-179-5384	N 900 720 02	Scr - c/w Washer (M10 X 1 X 20)	6

3.3 Flywheel rebuild procedures.- The following provides the step by step procedures for reconditioning the VW 1.7 litre engine flywheel.

3.3.1 Cleaning and inspection

(a) Clean the flywheel in dry cleaning solvent and blow dry with compressed air.

(b) Inspect the flywheel clutch surface for signs of heat cracks and burns. Replace the flywheel if these conditions exist.

(c) Inspect the dowels to ensure they are tight and not bent. Replace as required.

(d) Inspect the ring gear for broken or chipped teeth and replace the ring gear if necessary.

3.3.2 Replace flywheel ring gear

(a) Centre punch two holes on the ring gear, located 2.5 mm and 7.5 mm from the inside diameter of the gear and in line with the low part of a tooth, see Figure 2. Using a 3.5 mm drill, drill both holes to a depth of 6.5 mm.

(b) Cut through the remaining metal with a hacksaw and cold chisel until the ring gear breaks away from the flywheel.

(c) Ensure the flywheel surface and the inner circumference of the ring gear are free of dirt and rough spots.

(d) Place the flywheel on a wood surface with the clutch surface facing down.

(e) Place the ring gear on the flywheel with the bevel on the inside diameter facing towards the flywheel, see Figure 3.

(f) Place a piece of 50/50 solder on the upper face of the gear.

(g) Press the solder down and ensure it makes good contact with the gear.

(h) Hold the gear away from the flywheel with tongs and heat the gear with a welding torch, running the flame around the gear to obtain even heating. Do not direct the flame at the solder.

(j) When the solder begins to melt, approximately 200°C, brush off the solder and install the gear on the flywheel.

(k) Drive the gear evenly into position at diagonally opposite positions on the upper face, using a brass drift and hammer.

(m) Allow the gear to cool and check for tightness.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspections and processing to meet Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PAINTING, PRESERVATION, PACKAGING AND MARKING

5.1 Painting.- The complete flywheel shall be coated with a 0.0015 inch coat of red oxide primer, quick drying 1-GP-105.

5.2 Preservation.- After final rebuild acceptance by Quality Assurance Authority, the contractor shall place the flywheel in the following manner:

(a) The flywheel shall be wrapped in barrier material MIL-B-131 and sealed with tape pressure sensitive 43-GP-3M.

(b) The six mounting capscrews shall be kept in their original packaging or placed in a polyurethane bag with their Description and NSN and sealed.

5.3 Packaging.- A legible stamped or engraved metal plate shall be attached to the flywheel in an approved location showing the following information:

(a) Name of firm or workshop that rebuilt the flywheel.

(b) Day, month and year of rebuild.

(c) Firm or workshop order number.

(d) The flywheel NSN and description.

5.3.1 The flywheel shall be properly tagged with a CF 942, NSN 8135-21-872-2435, Identity and Condition Tag. The flywheel and mounting capscrews shall be placed in a cardboard box and sealed.

5.4 Marking.- The cardboard box shall have a label adhered to the outside containing the following information:

(a) NSN.

(b) Description - Flywheel VW 1.7 LITRE ENGINE.

(c) Qty - 1.

(d) NSN - 5305-12-179-5384.

(e) Scr c/w Washer (M10 X 1 X 20)

(f) Qty - 6.

(g) Wt.

5.4.1 The cardboard box shall be properly tagged with a CF 942 A, NSN 7690-21-868-6739, Identity and Condition Label.

6. NOTES

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance Authority.- The Quality Assurance Authority will be specified in the contract.

6.4 Returnable parts.- All unserviceable flywheels shall be returned to DND through Quality Assurance Authority.

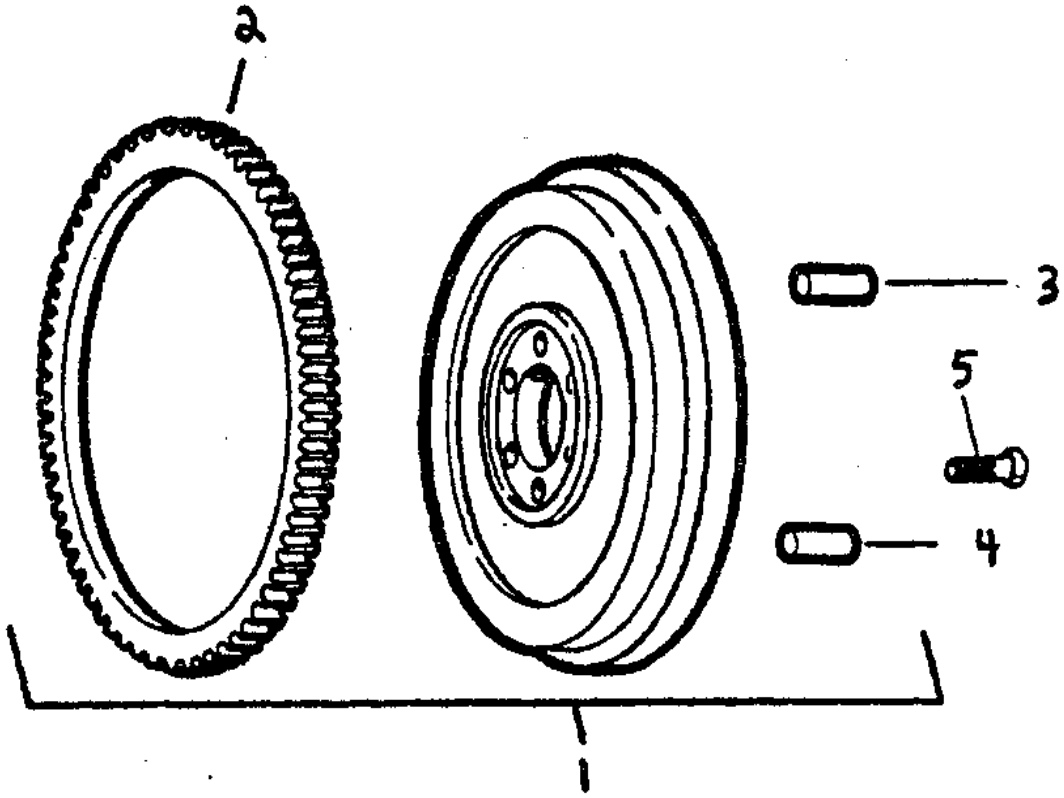


Figure 1 Flywheel assembly

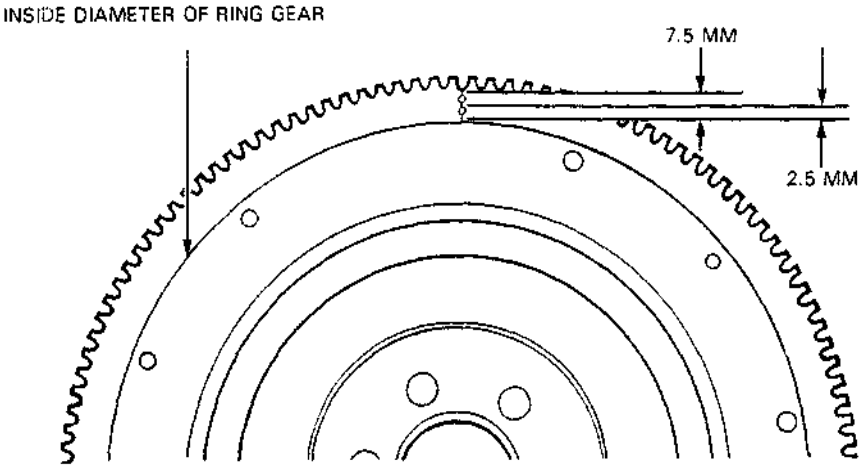


Figure 2 Location of centre punch holes on ring gear

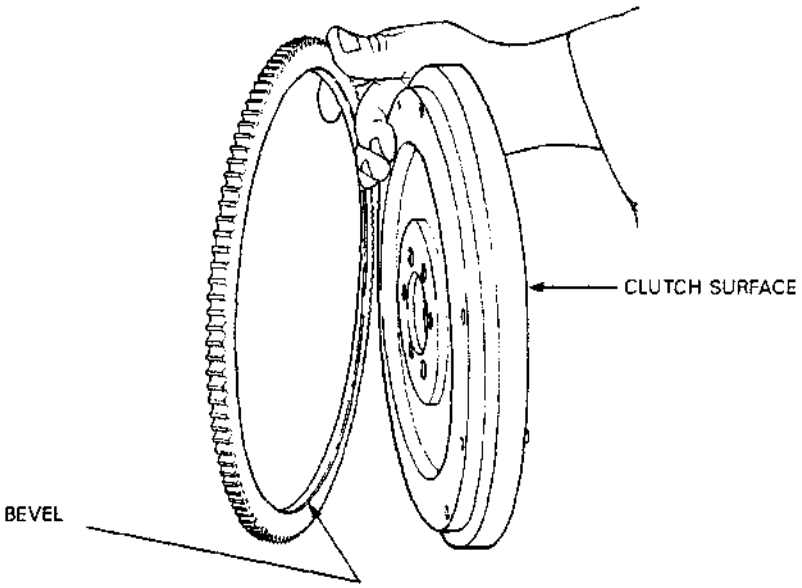


Figure 3 Ring gear

Annex H

SPECIFICATION

FOR

REBUILDING THE CLUTCH ASSEMBLY USED IN TRUCKS, UTILITY, LIGHT, 4 BY 4

MILITARY DESIGN ILTIS CDN SERIES

NSN

1. SCOPE

1.1 Scope.- This specification covers the requirement for rebuilding the clutch assembly used in Trucks, Utility, Light, 4 by 4 Military Design, Iltis Canadian Series used by the Canadian Forces. This specification includes rebuild standards, procedures, packaging and quality assurance provisions.

1.2 Purpose.- The purpose of this specification is to establish high-quality standards for rebuilding the clutch assembly to provide long trouble-free life.

1.3 Responsibility.- The contractor shall be responsible for meeting the requirements specified herein.

2. APPLICABLE DOCUMENTS

2.1 Government documents.- The following documents form part of this specification to the extent specified herein. Unless otherwise specified, the issue or amendment of documents effective for a particular contract shall be that in effect on the date of the request for proposal.

AQAP-4	NATO Inspection System Requirements for Industry
C-04-010-022/VP-001	Preservation for Storage and Shipment of Vehicles and Vehicular Components
MIL-B-131	Barrier Material, Water-Vapour Proof, Flexible, Heavy (36 inch wide roll)

Copies of this specification and the above documents may be obtained from the Department of National Defence, Ottawa, Ontario, K1A 0K2, Attention: DDDS 3-6.

2.2 Other publications.- The following documents form part of this specification to the extent specified herein. Effective dates shall be those in effect on the date of manufacture. Source is shown.

Canadian Government Publishing Centre.
Supply and Services Canada. Ottawa. Ontario. K1A 0S9

CAN2-3.8M	Dry cleaning Solvent
43-GP-3M	Standard for Tape, Adhesive, Pressure Sensitive, Water Resistant
1-GP-105	Paint, Primer, Quick Drying

3. REQUIREMENTS

3.1 General.- The contractor shall rebuild each clutch assembly supplied by DND in accordance with the requirements of this specification using the procedures and standards specified in 3.3 and 3.4.

3.1.1 If the clutch assembly is being rebuilt as part of an engine assembly rebuild, it shall be preserved and packaged as specified herein and placed in the engine container with the engine.

NOTE

When a clutch assembly is returned with an engine assembly for rebuild, check the condition of the preservation and packaging of the unused clutch assembly and place it back in the engine container.

3.1.2 If the clutch assembly is being rebuilt as a component only, it shall be preserved and packaged as specified herein and returned to DND as a complete drop-in assembly.

3.1.3 The clutch assembly shall be thoroughly cleaned before being inspected for condition and wear.

3.1.4 The contractor shall record all measurements required to determine component wear and condition. These measurements shall be recorded on data sheets designed and provided by the contractor and compared to the standards listed in 3.4. Components that do not meet the minimum standards shall be replaced with new or serviceable OEM components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices. If the serviceability of a

component is in doubt, the component shall be replaced. Quality Assurance Authority shall be consulted in all such cases.

3.1.5 The contractor shall use tools designed for the purpose of the operation to be performed.

3.1.6 Upon completion of rebuild, the clutch assembly shall consist of all the components listed in Table I. Figure 1 is provided for component identification.

3.1.7 The Release Bearing, Springs Right and Left, Clutch Disc Lining and the Scr Socket Hd (M8 X 16) shall be Manditory Parts Replacement.

3.2 Clutch assembly components.- The following Table lists the components of the Iltis clutch assembly; refer to Figure 1 for component identification.

Table I Clutch assembly components

Item	NSN	MRN	Description	Qty
1	2520-12-192-3595	A 302 101 501	Clutch - Disc	1
2	2520-12-192-3596	A 102 101 203	Pressure Plate - Clutch	1
3	2520-12-166-2743	113 141 165 B	Brg - Release	1
4	5360-12-175-6328	113 141 166 C	Spring - Left	1
4	5360-12-175-6327	113 141 178 C	Spring - Right	1
5	5305-12-169-6486	N 014 739 1	Scr Socket Hd (M8 X 16)	6

3.3 Clutch rebuild procedures.- The following provides the step by step procedures for rebuilding the Iltis clutch assembly.

3.3.1 Cleaning and inspection

(a) Clean the pressure plate and inspect the clutch disc contact surface for signs of heat discoloration and cracks.

(b) Using a straight edge and feeler gauge, inspect the contact surface of the pressure plate for wear and distortion, see Figure 2. If

inward taper or distortion exceeds 0.3 mm (0.012 in.), replace the pressure plate.

(c) Check the pressure plate cover for cracks and ensure the rivets are tight and undamaged. Replace the pressure plate, if necessary; see Figure 3.

(d) Check the diaphragm spring fingers at the location of the throw-out bearing contact for grooving. If grooving exceeds 0.3 mm (0.012 in.) in depth, replace the pressure plate, see Figure 3.

(e) Remove the old friction material from the clutch disc, clean and check the disc for cracks and loose rivets. Replace the disc if necessary.

(f) Rivet the new friction material to the clutch disc.

(g) Check the disc for run-out; measure 2.5 mm from the outer edge of the disc. The maximum run-out is 0.5 mm, see Figure 4.

3.4 Standards.- The following lists the standards for the Iltis clutch assembly. These standards will be strictly adhered to when determining the serviceability of the components. For standards not listed herein, the contractor shall use good judgement to the minimum of SAE Standards and Practices as to the serviceability of the component. If the serviceability of a component is in doubt, the component shall be replaced with a new or serviceable OEM component.

Pressure Plate	
- Inward taper or distortion	0.30 mm (0.012 in.) maximum
- Diaphragm spring fingers Grooving	0.30 mm (0.012 in.) depth maximum
Clutch Disc	
- New frictional material thickness	3.9 + 0.1 mm
- Clutch disc run-out	0.50 mm maximum

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection requirements.- DND Quality Assurance at source is required. The contractor is responsible for carrying out inspection and processing to meet quality assurance requirements acceptable to the Quality Assurance Authority.

4.1.1 The contractor's system of inspection shall meet the requirements of AQAP-4.

4.1.2 The Quality Assurance Authority reserves the right to perform any inspections considered necessary to ensure that material and services conform to specified and contractual requirements.

5. PAINTING, PRESERVATION, PACKAGING AND MARKING

5.1 Painting.- All metal surfaces of the clutch disc and the pressure plate shall be coated with a 0.0015 in. thick coat of red oxide primer, quick drying 1-GP-105. Do not paint the lining material of the clutch disc.

5.2 Preservation.- After final rebuild acceptance by Quality Assurance Authority, the contractor shall place the clutch assembly into preservation in the following manner:

(a) The pressure plate shall be wrapped in barrier material MIL-B-131 and sealed with tape pressure sensitive 43-GP-3M.

(b) The clutch disc shall be placed in a heavy paper bag and sealed.

(c) The release bearing shall be wrapped in barrier material and sealed with tape pressure sensitive.

(d) The clutch assembly mounting capscrews shall be kept in their original polyurethane bag.

5.3 Packaging.- A legible stamped or engraved metal plate shall be attached to the clutch assembly in an approved location showing the following information:

(a) Name of firm or workshop that rebuilt the clutch assembly.

(b) Day, month and year of rebuild.

(c) Firm or workshop order number.

(d) The clutch assembly NSN and description.

5.3.1 Clutch assembly shall be properly tagged with a CF 942, NSN 8135-21-872-2435, Identity and Condition Tag, and a CF 2248, NSN 7530-21-870-3866, Lubrication Record for Shipment and Preservation Tag.

5.3.2 The clutch disc, pressure plate, release bearing and mounting screws shall be placed in a cardboard box and sealed.

5.4 Marking.- The cardboard box shall have a label adhered to the outside containing the following information:

(a)	NSN 2520-12-192-3595	Clutch Disc	Qty 1
(b)	NSN 2502-12-192-3596	Pressure Plate - Clutch	Qty 1
(c)	NSN 2520-12-166-2743	Bearing - Release	Qty 1
(d)	NSN 5305-12-169-6486	Scr Soc Head - Mounting (M8 X 16)	Qty 6

(e) Rebuild date.

(f) Weight.

5.4.1 The cardboard box shall be properly tagged with a CF 942A, NSN 7690-21-868-6739 Identity and Condition Label, and a CF 2248, NSN 7530-21-870-3866 Lubrication Record for Shipment and Preservation Tag.

6. NOTES

6.1 Ordering data.- Procurement documents should specify the title, number and date of this specification.

6.2 Design Authority.- The Design Authority is the Director of Support Vehicles Engineering and Maintenance.

6.3 Quality Assurance.- The Quality Assurance Authority will be stipulated in the contract.

6.4 Returnable parts.- All components not meeting standards shall be returned to DND through the Quality Assurance Authority.

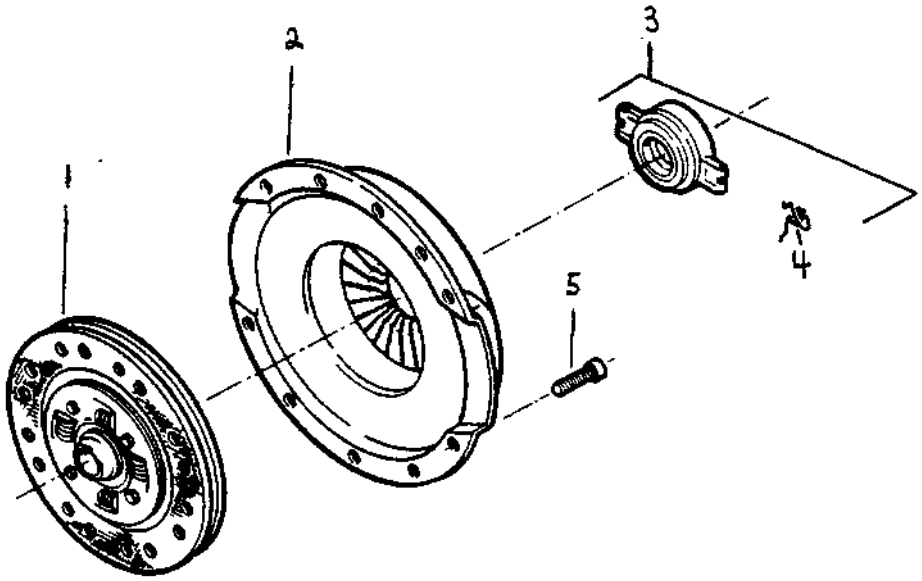


Figure 1 Clutch assembly

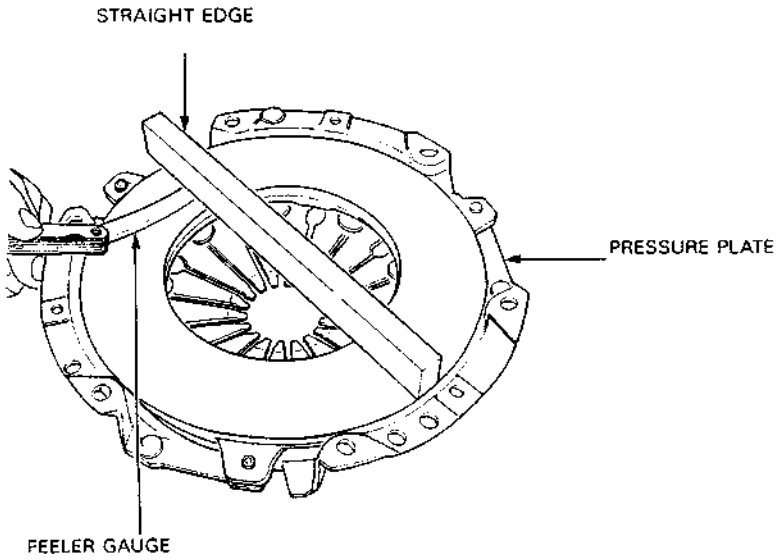


Figure 2 Pressure plate distortion check

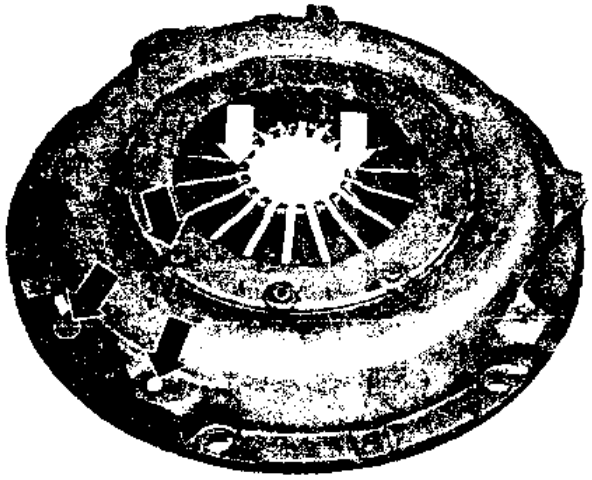


Figure 3 Checking diaphragm spring fingers and rivets

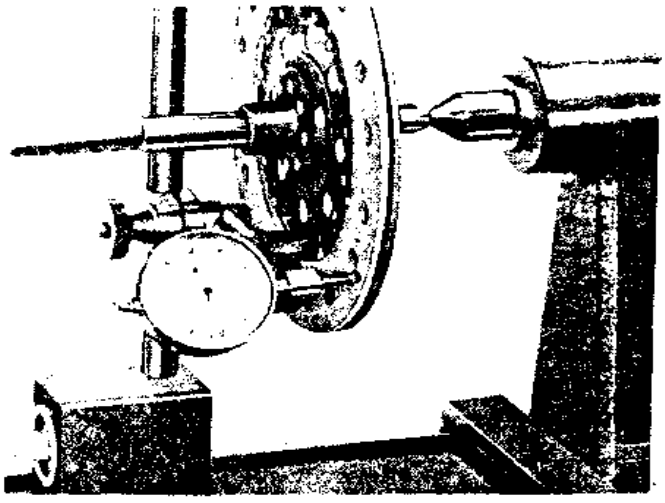


Figure 4 Checking clutch disc run-out