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ASSEMBLY AND
REPAIR MANUAL
GROB 2500
POWER GLIDER AIRCRAFT ENGINE

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1. Introduction

This Assembly and Repair Manual comprises all the necessary information required for the repair and overhaul of the Grob 2500 aircraft engine and its accessory equipment - insofar as these are not replacement items.

The manual comprises information pertaining to the cleaning and rating of parts, assembly of the short block engine, attachment of all accessory equipment and engine testing.

Special Tools

Special tools required for assembly/disassembly are listed in Chapter 14 of the manual and can be procured from the engine manufacturer.

Parts Catalog/Parts List

In order to perform proper assembly, a parts list is mandatory.

An illustrated parts list is not available at this time.

Note that parts not procured from the manufacturer can differ considerably from original parts in quality, dimensions and material. This can result in serious damage to the engine.

When ordering parts, state the engine serial number, and if possible, the accumulated operating hours.

Authorized Firms

Workshops desiring to perform overhaul or repair work require the written permission of the manufacturer. Furthermore, they must comply with the applicable aviation regulations.

Repair or overhaul of the engine outside the manufacturer's plant voids all warranty and liability claims against the manufacturer.



2. Technical Description

Air cooled, four-stroke, gasoline engine

Horizontally opposed four cylinder arrangement

Pressure lubrication with gear-type pump

Magneto ignition

Direct propeller drive

Electrical starter

AC generator

Mechanical fuel pump

Two carburetors

Type designation:

Grob	2500	E	1	/	V
1	2	3	4		5

1 = Manufacturer Grob

2 = Displacement in cc

3 = E = single spark plug ignition

D = dual spark plug ignition

4 = Flange for variable pitch propeller Hoffmann HO V 62

5 = V = Additional accessory equipment, here, vacuum pump.



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Design Characteristics

Model Grob 2500	E 1	D 1
Displacement in cc	2450	2450
Bore	100	100
Stroke (mm)		
Compression ratio	8.9:1	8.9:1
Propeller flange	HO-V 62	HO-V 62
Dry mass (kg)	95	99
Direction of rotation	CCW	CCW

Operating limits:

Power and performance data at ICAO or ARDC standard atmosphere and MSL

Takeoff power (kW/PS)	70/95
(5 min.) at 3400 rpm	
max. continuous power (kW/PS)	64/87
at 3000 rpm	
Oil pressure during normal operation	1.0 to 5.0
warm engine (bar)	
Oil temperature max. (°C)	120
Cylinder head temperature max. (°C)	250

Valve settings:

Intake valve opens	8 deg. before TDC
Intake valve closes	40 deg. before TDC
Exhaust valve opens	43 deg. before BDC
Exhaust valve closes	4 deg. after TDC

Gear ratios:

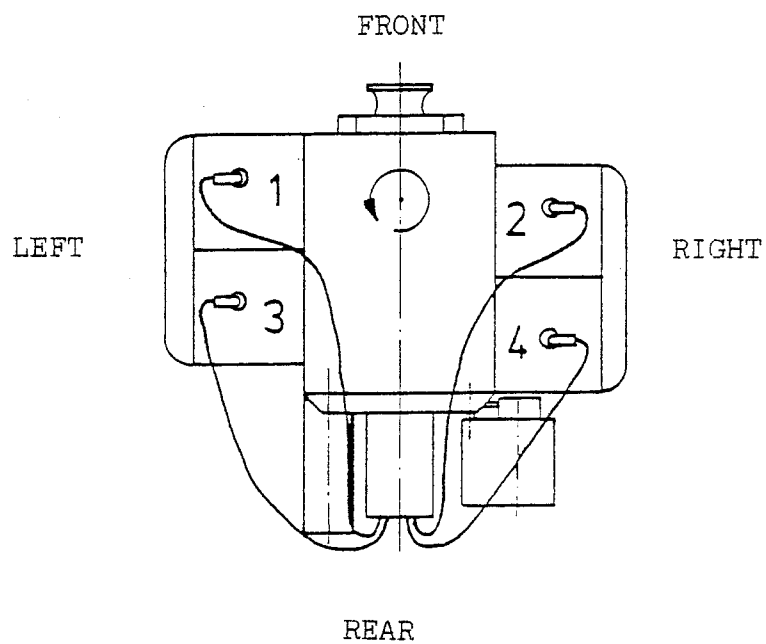
Crankshaft speed/generator	1:1.78
Crankshaft speed/magneto	1:1



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Cylinder designation GROB 2500 E1



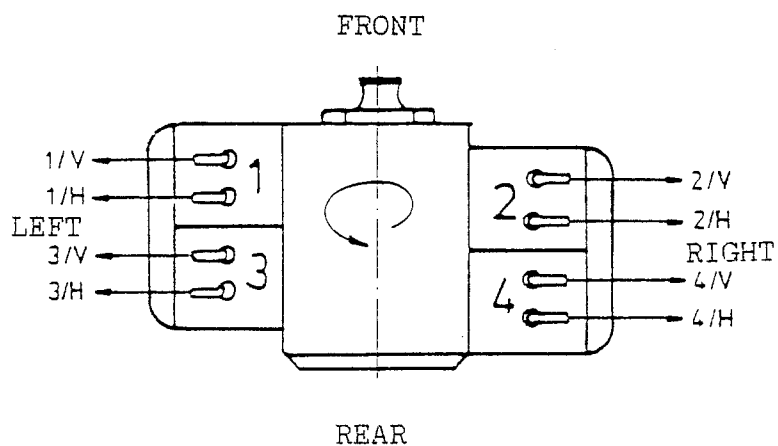


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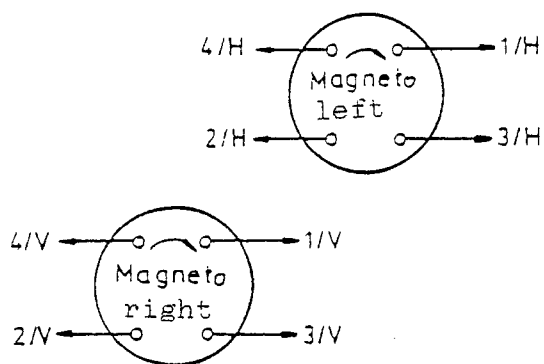
GROB 2500

Cylinder designation GROB 2500 D1

(Dual spark plug ignition)



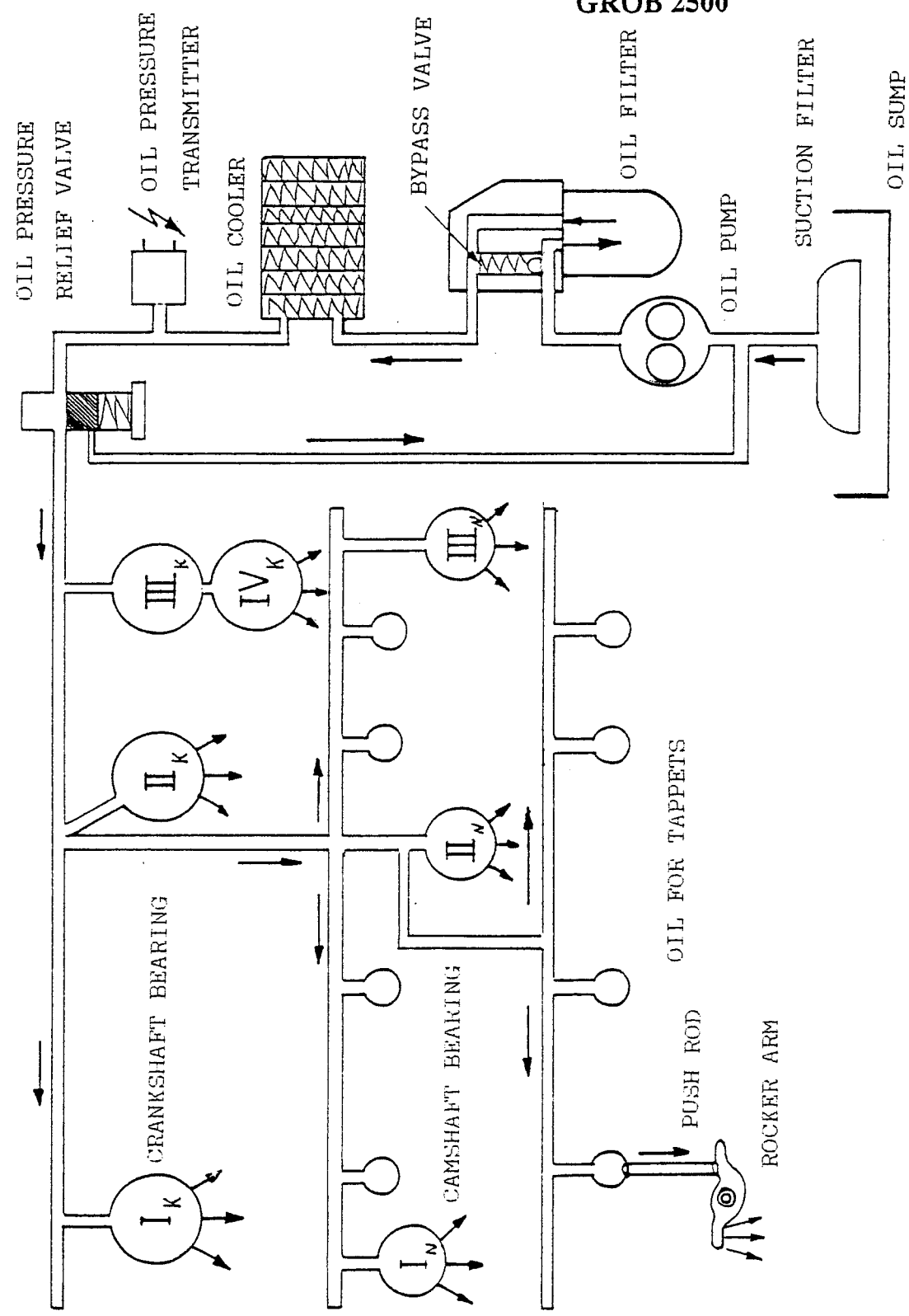
WIRING



VIEW IN FLIGHT DIRECTION



OIL SCHEMATIC





3. Engine Disassembly

The engine can be disassembled with commercially available tools. For such areas where this is not the case, for example, where special tools are required, or where disassembly requires special skills, the procedures are described in the following.

The various parts must be marked prior to, or after removal, to ensure that they will be installed in the same position and location.

Parts can be marked with an electrical or with normal scribe needle.

Accessory equipment mount

The most promising method is to start with the removal of the accessory equipment and the accessory equipment mount. The short block engine can then be clamped into an assembly jig (VW 307 a), which ensures accessibility from all sides.

Push rod protection tubes

Draw the push rod protection tubes outward using polygrip pliers, prior to cylinder head removal. Withdrawal of the protection tubes may require a slight twisting motion.

Propeller flange

Before the central screw can be loosened, remove the safety bushing.

Subsequently jam the crankshaft at the flywheel, using special tool (VW 215 c), or with a wooden wedge at the crankshaft webs, if the cylinders and pistons have already been removed.

Loosen the central screw approx. 2 - 3 turns.

Attach special tool G 2500 W 610 to the propeller flange. Tighten the screws symmetrically. From time to time tap the front side of the special tool with a hammer. A slight jerk indicates that the flange has come free. Remove the special tool, completely remove the central screw.

Remove the propeller flange in a forward direction.



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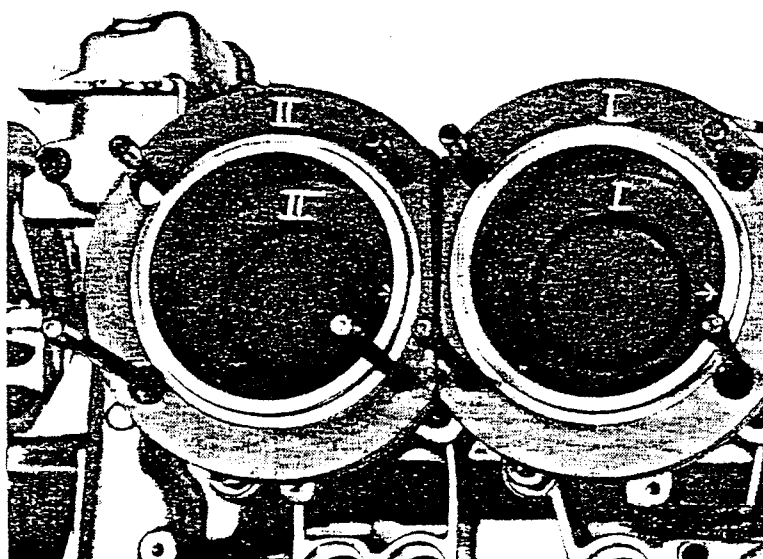
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Pistons - piston pins

The piston pins are held in position in the piston with a spring ring. Remove the spring ring using a marking tool or a small screwdriver. Push piston pin out of piston using special tool VW 207. Mark installation position.

CAUTION

If the piston pin is tight, heat the piston slightly. Excessive force with the hammer could cause con-rod bending.



Piston marking

Arrow points to flywheel

Mark mating cylinder



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Front flange (front bearing)

Remove the four hex socket screws. Loosen the upper and lower housing screw connection. Pull the flange off in a forward direction, using a twisting motion.

Disassembly

Tap out the sealing ring from the rear using a punch, or bend it to an oval by tapping with a screwdriver from the front. Remove the hex socket screw prior to removing the bearing. Then press out the bearing from the rear using uniform force with a punch or a press.

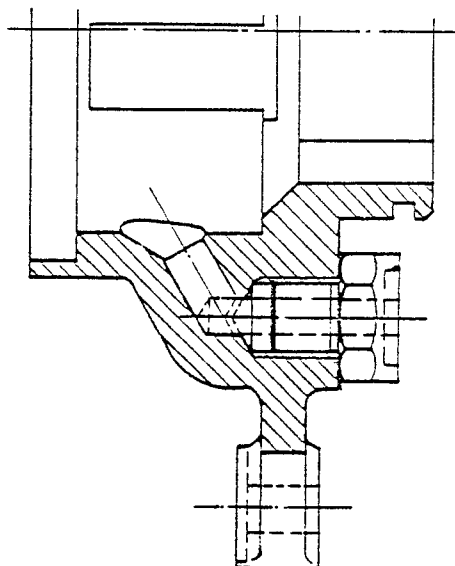
WARNING

Do not allow the bearing to tilt as this could cause an excessive widening of the bearing seat.

On earlier models (identified by a separate land at the hex socket screw) check the oil port bore is completely free with the bearing in place. If this is not the case, rework the casing with a milling tool.

NOTE

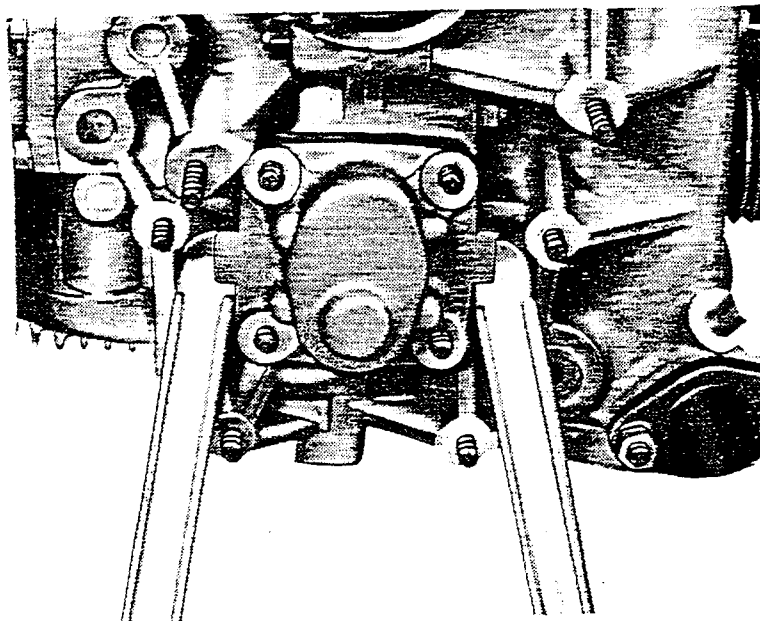
It is not necessary to remove the connection fitting for the oil port bore.





Oil Pump

Remove nuts. Remove the upper and lower housing screw connections. Press off pump from housing using two screwdrivers.



Remove Oil Pump Housing

Housing

Loosen all screw connections. Lay housing on its righthand side and open using a plastic hammer and hardwood wedges.



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Crank gear Disassembly

Remove the con-rods by removing the nuts and gently tapping the screw ends.

NOTE

It is not necessary to remove the screws.

Timing gear

Pull timing gear off the crankshaft using a puller.

WARNING

Do not damage the threads of the propeller flange screw connections.
Reworking of the threads is only permissible if the damage is slight.



4. Cleaning the Engine

Prior to rating and reassembly, clean all parts thoroughly.

First clean all parts of oil and grease residue. This can be achieved using commercially available cold degreaser or with water-detergent solutions. In the latter case, take care that the parts are rinsed well with water.

It is important that no detergent residue remain on the parts, as this could lead to foaming and decomposition of the oil during engine operation.

If the parts are not assembled immediately, perform corrosion protection measures.

Removal of solid residue

Solid residue, such as carbon residue and lead oxide deposits are best removed by placing the parts in a decarbonisation bath (usually heated) for several hours. Observe the applicable processing regulations.

Subsequently remove the loose particles by brushing.

If a blasting process is used, the preference is to organic agents, such as rice husks, nut shells or plastic granulate over sand or steel scrap.

Do not blast treat bearing surfaces or seats.

After blasting, take care that no residue remains in oil ports, thread pocket holes or corners.

The crankcase can be externally polished with steel brushes rotating at high speed.



5. Painting

Such cast components as the front flange and the accessory equipment mount are painted in a silvery tone by the manufacturer.

The lower air deflection panels and the valve covers are painted black.

Oil filler neck and the ring of the dipstick are painted yellow.

The stud bolts holding the cylinder heads are surface treated. If signs of corrosion are found, the stud bolts must be replaced.

6. Replacement of Stud Bolts

Bent and broken stud bolts, and those with damaged threads must be replaced.

This can be achieved by countering two nuts and subsequent loosening of the stud bolts, or by using a stud bolt remover.

During stud bolt replacement make sure that sufficient binding strength is available. If necessary use the locking agent Loctite.

Interior threads in aluminum parts may be repaired using Heli-Coil inserts. The stud bolt threads are an exception to this rule. If these threads are damaged, both housing halves must be replaced.



7. Component Inspection and Rating

Component dimensions and permissible tolerances are listed in Chapter 13 of this Manual.

Crack Inspection

After each propeller ground contact and during overhaul, the disassembled crankshaft must be inspected for cracks using the Magna-Flux process.

Current dissipation must be set to 2000 Amps.

If cracks are identified that cannot be polished away, the crankshaft must be scrapped.

Cracks in the oil port holes can be reworked.

The same procedure as for the crankshaft also applies to the propeller flange.

After propeller ground contact, inspect the front flange (cast aluminum component) for cracks using the Dye-Check process or by X-ray.

Con-rod

Con-rods must be paired such that the weight difference does not exceed 3 grams.

Angular conformity can be checked using alignment arbors (special tool W-Ä 039 105 401). If this is not available, rate the con-rods such that the parallelism deviation between the two holes does not exceed 0.05 mm and the distortion towards each other does not exceed 0.3 mm.

Crankshaft

Set the crankshaft on prisms and check for run-out in accordance with the Figure.

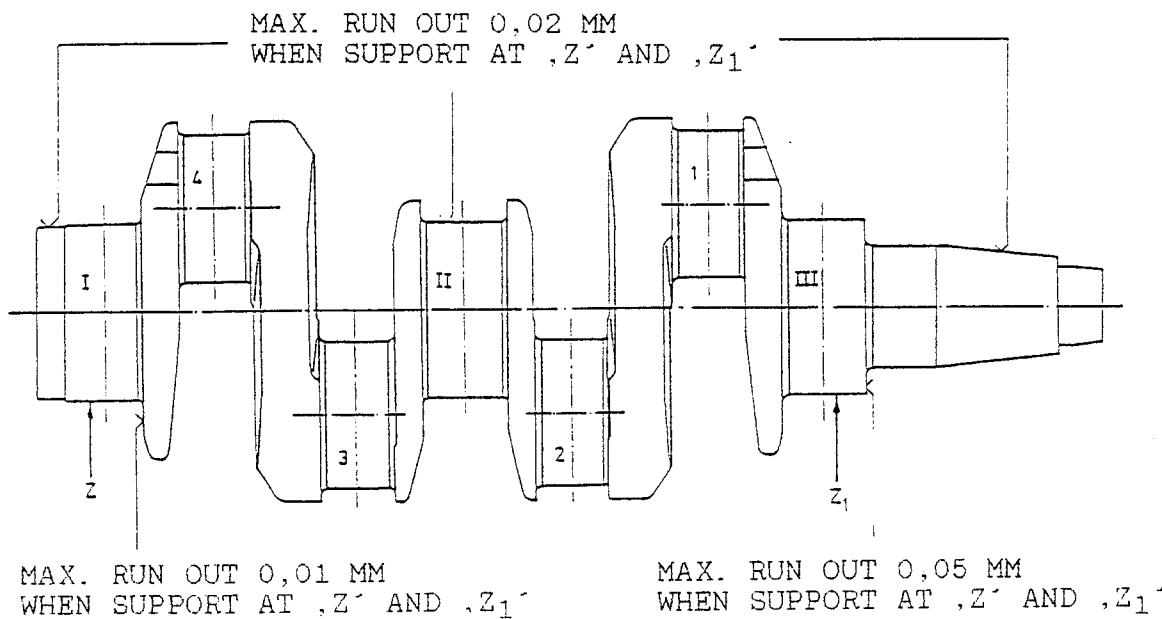
Subsequently assemble the shaft and the propeller flange and also check for run-out.

In both cases, do not exceed the tolerances listed in Chapter 13.

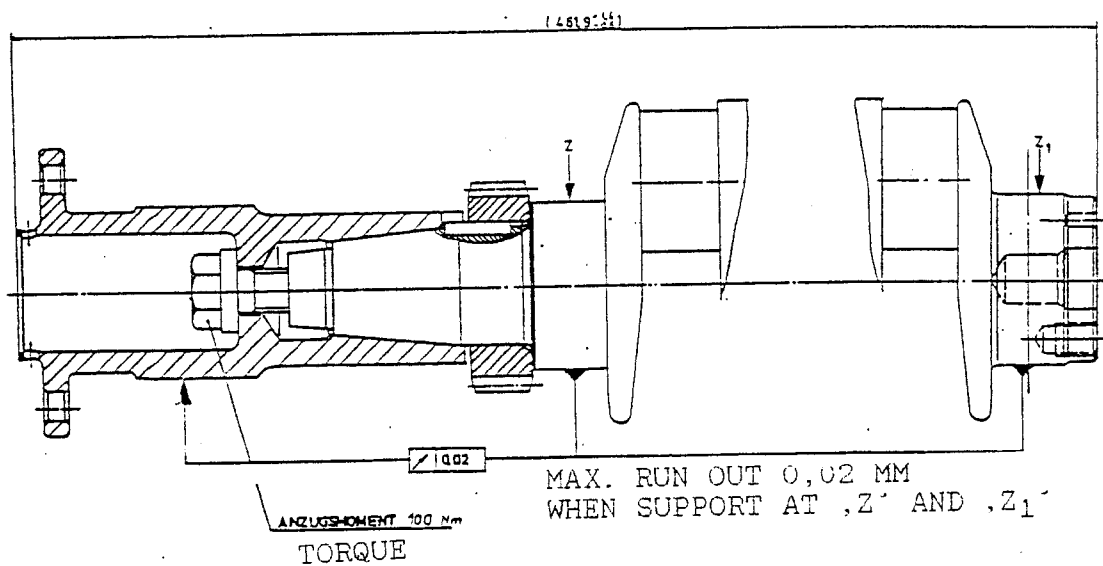


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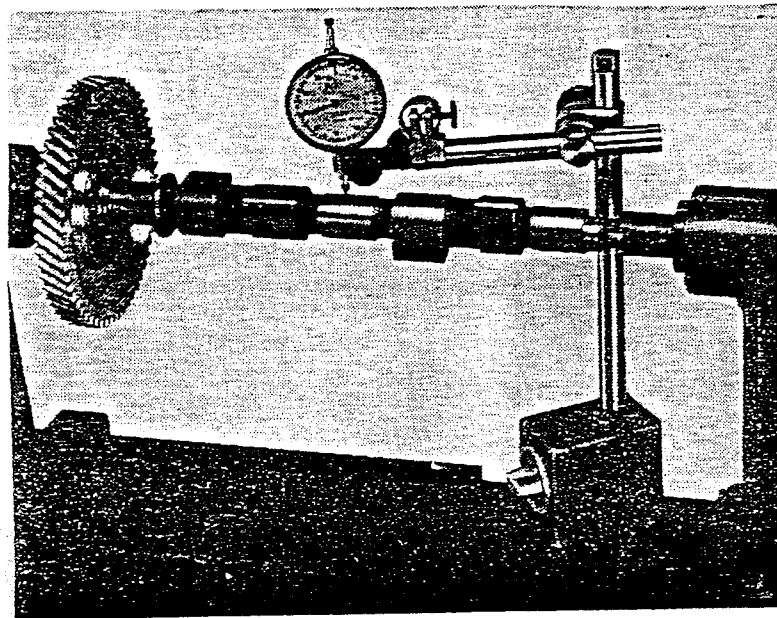


G 2500-510.01



Camshaft

Check the camshaft for sagging. The max. permissible run-out at the central bearing is 0.04 mm



Check Camshaft Run-out

Rate the cam heights according to the dimension Table. Reworking of the camshaft is not permissible.

NOTE

The exterior cams belong to the exhaust valves (A1 - A2), the interior cams belong to the intake valves (E1 - E2).



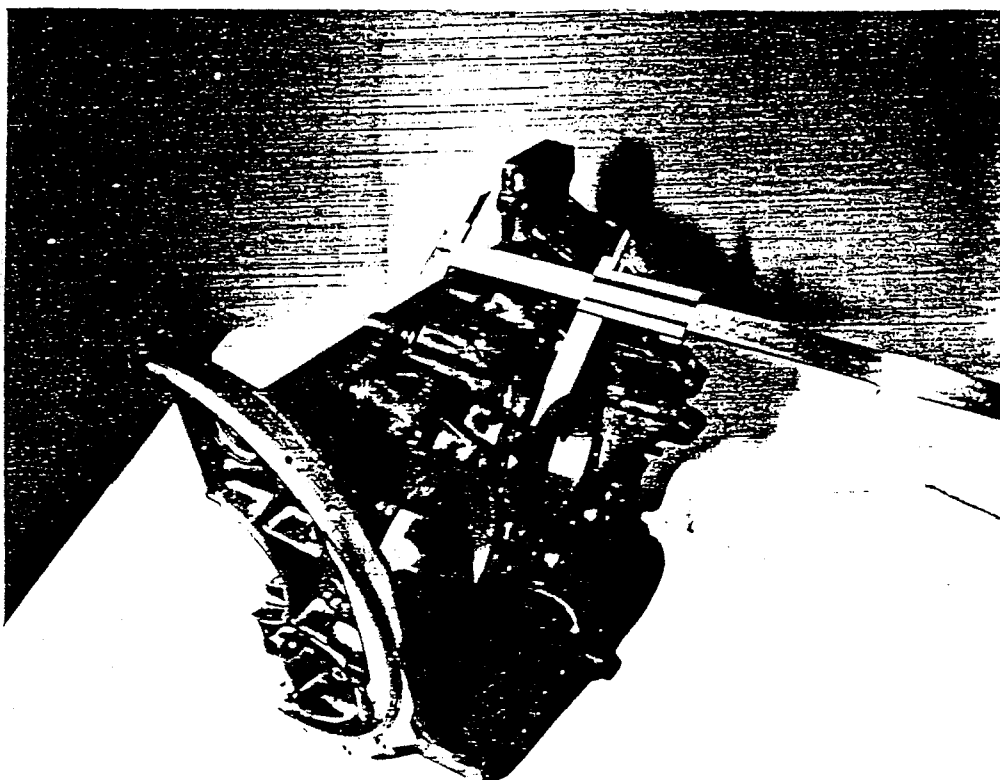
Crankcase

For rating purposes, bolt the crankcase together using the 6 crankcase screws (Torque values see Table).

Measure the crankshaft main bearing holes and the holes of the camshaft using an inside micrometer at points 90° apart. Always use the highest result for evaluation.

Check the crankcase separation seam for sag (thickness gauge).

Additionally, measure the distance from the cylinder seating surface to the separation seam with the crankcase open.





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Pistons

During piston rating, note that the pistons are available in three fit sizes, and that the piston shape is conical and oval.

Fit sizes

Pistons are produced in the sizes +1, 0 and -1. New parts carry a stamp showing the size.

Dimensions measured across the piston axis:

Size marking	D1	Piston diameter DN	D3
+1	99.980	99.860	99.490
0	99.970	99.850	99.480
-1	99.960	99.840	99.470

Dimensions measured parallel to the piston axis:

Size marking	D1	Piston diameter DN	D3
+1	99.530	99.510	99.430
0	99.520	99.500	99.420
-1	99.510	99.490	99.410

The replacement limits are:

for D1:	specified diameter ± 0.015
for DN:	specified diameter ± 0.050
for D3:	specified diameter ± 0.200

All dimensions in millimeters.

Piston ring play

Only the height play is measured, and must not exceed 0.10 mm.

Do not measure the piston ring gap.



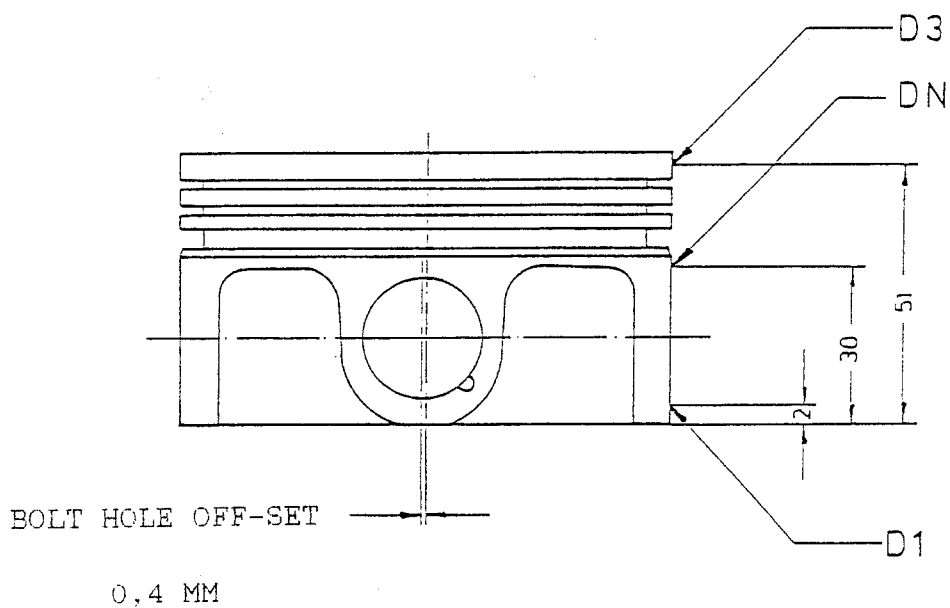
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Piston pin holes

Rate the piston pin holes using an internal micrometer or an internal cylindrical gauge.

Weigh the pistons prior to installation. The weight difference must not be more than 3 grams.





Cylinders

Check the cylinders for grooving prior to rating. If grooves are found, that can be determined using a fingernail, replace the cylinder. As the cylinders are surface treated, honing is not possible.

Crusting and residue at the cylinder collet can be removed using a 320 grain grinding cloth.

In order to achieve a level collet surface, the cylinders can also be turned. This however, should in no case exceed 0.2 mm.

The cylinders are available in three different fit sizes respectively stamped at the base.

Size marking	+1	=	100,010	rated diameter
	0	=	100.000	rated diameter
	-1	=	99.990	rated diameter
Production tolerance	= 0.010 mm			

Measure cylinder bore at 90° intervals and at three different levels.

- Level 1: 12 mm from the top, replacement limit at rated diameter + 0.05 mm
- Level 2: 55 mm from the top, replacement limit at rated diameter + 0.03 mm
- Level 3: 110 mm from the top, replacement limit at rated diameter + 0.03 mm

Piston pins

Check the pins for discoloration. Pins with a blue discoloration must be replaced.

The surface must show no grooves. Rate the piston pins using a micrometer.



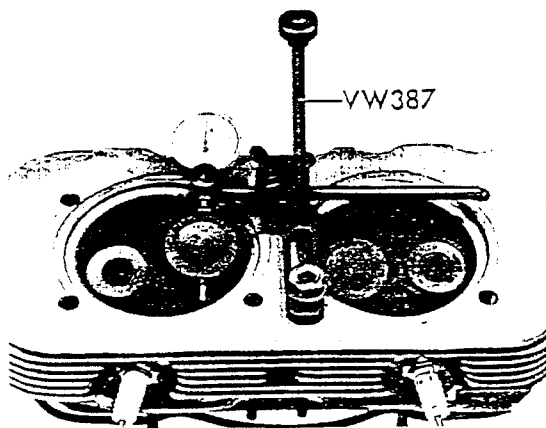
Cylinder Heads

After thorough cleaning and removal of the valves, inspect the cylinder head for cracks. Rate the valve guides using an internal cylindrical gauge. If no internal cylindrical gauges are available, rate the valve guides using a new valve and a measuring gauge as shown in the Figure.

Valve Guide Inspection

During the repair of engines with leaky valves it is not sufficient to rework or replace the valve seats and the valves. It is additionally necessary to inspect the valve guides for wear. This inspection is particularly important for engines with high operating hours.

- Remove residue using a cleaning reamer.
- Insert a new valve into the valve guide. Valve shaft end must reach the end of the guide.



- Determine tilt play.
Wear tolerance limit: 1.2 mm



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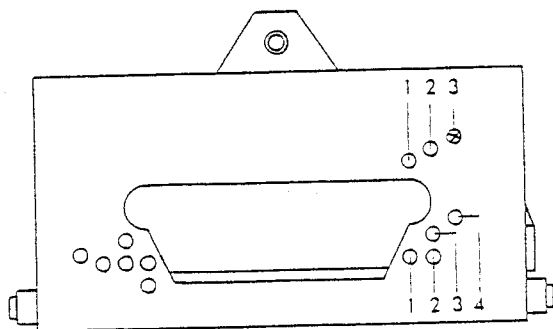
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Valve Guide Replacement

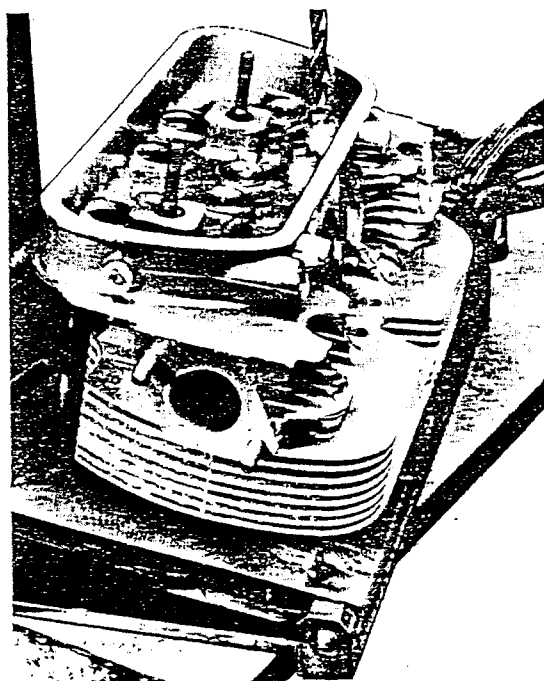
Replace worn or damaged valve guides using the Universal Cylinder Head Repair Tool VW 1224.

Oversize valve guides with shoulder are available for this repair.

- Clean and inspect cylinder head. Cylinder heads with cracks, and such having valve seat rings that can no longer be reworked, are not suited for valve guide replacement.



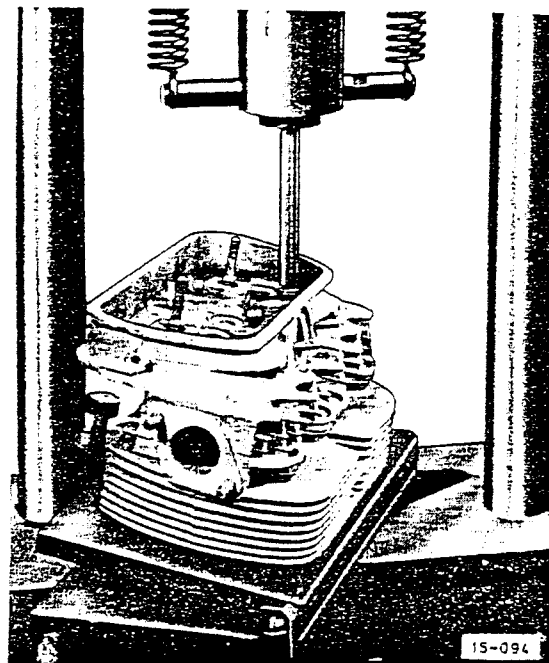
- Fasten cylinder head to jig plate with the combustion chamber facing the jig plate. Set short fitting pin in hole 3 (Figure) and use short fastening screws.
- Set plate angle to 13°.



- Drill out valve guide to a depth of 40-50 mm with offset drill (drill speed approx. 100 rpm).



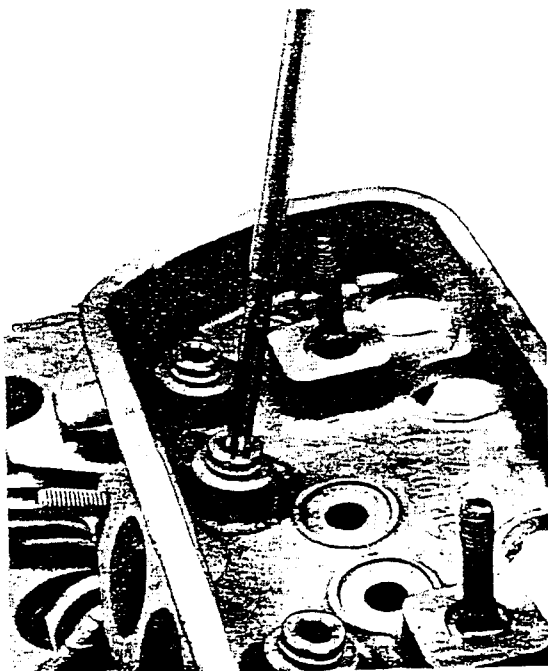
- Remove drilled valve guide using a punch.



- Coat valve guide with oil and press in fully.

CAUTION

Press pressure between 1.0 t and 2.0 t.



- Ream valve guide using a hand reamer. It is mandatory that diluted soluble oil be used during reaming.
- Rework valve seats.

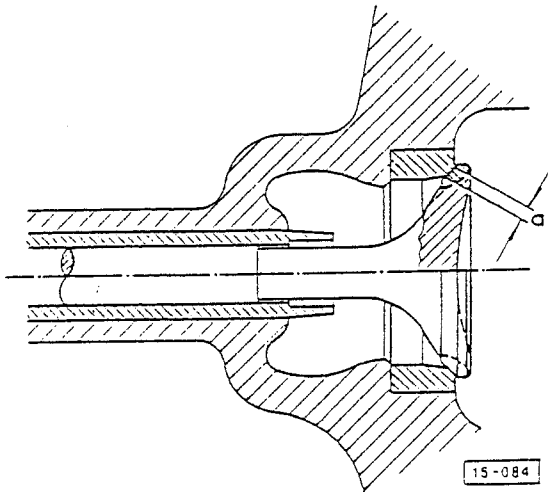


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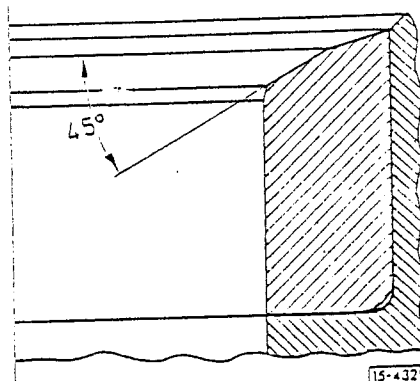
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Rework Valve Seats

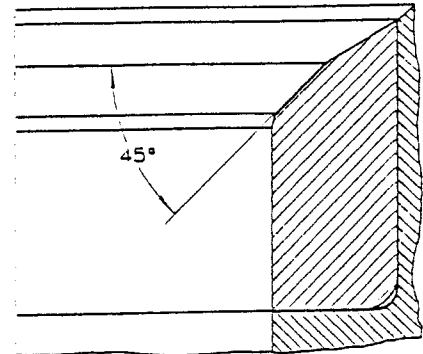
Valve seats showing wear or burn damage can be reworked, as long as the 15° milled surface at their outer circumference does not exceed the external diameter of the valve seat ring, while maintaining the permissible seat width. If this is not the case, replace the cylinder head. Replacement of the valve seat rings is not possible with normal workshop methods, as the rings are installed in a deep-cooled state.



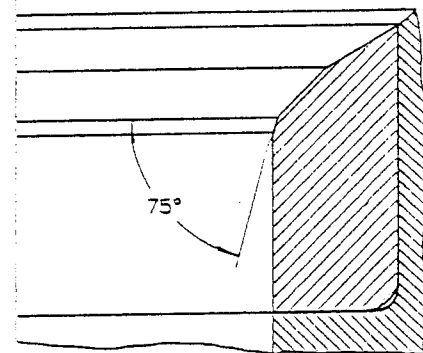
- Prescribed seat width:
 a = intake 1.8 ... 2.2 mm
 exhaust 2.0 ... 2.5 mm



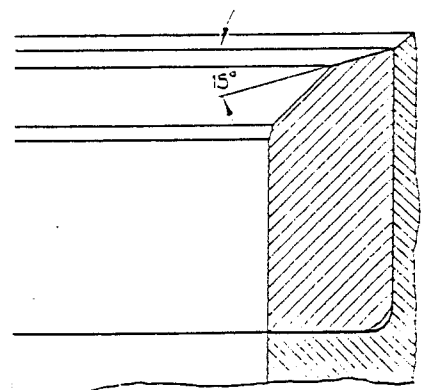
- Intake valve seat, rework 45° valve seat surface
 Rework is complete as soon as the total seat surface has been reworked.



- Exhaust valve seat, rework 45° valve seat surface
 Rework is complete as soon as the total seat surface has been reworked.



- Rework 75° surface
 Slightly break the lower edge of the seat ring.



- Rework 15° surface
 Chamfer the upper edge of the seat ring until reaching the prescribed seat width.



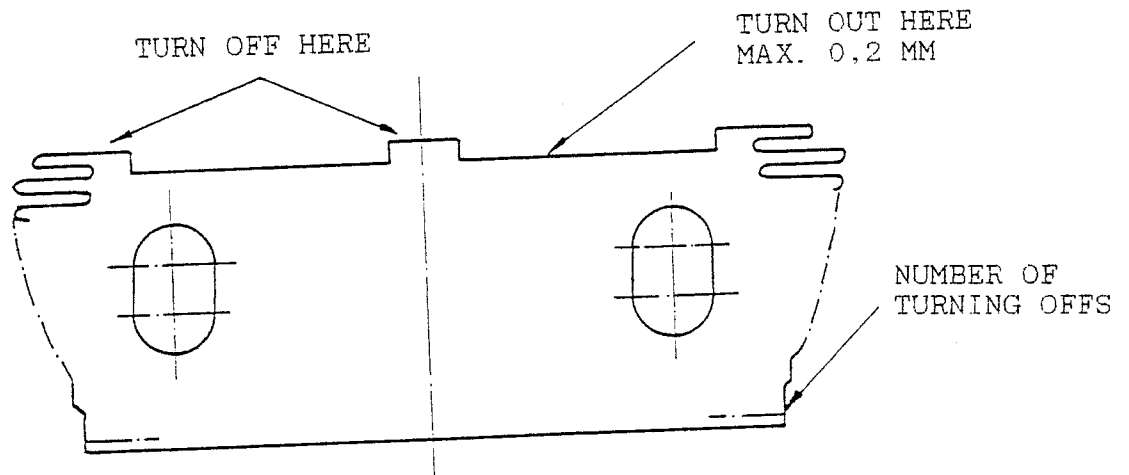
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Prior to cylinder head reinstallation, the head must be turned out a maximum of 0.2 mm. This is necessary to prevent possible head distortion and resultant leaks.

The exterior edge of the cylinder bore must also be turned off to ensure that the cylinder fits flush into the cylinder head bore and not just on the cylinder edge.

This turning out of the head is only permitted a total of three times. After turning stamp the number of the turn (1, 2 or 3) on the raised portion of the head (next to the valve cover latch).





Spark Plug Thread Inspection

Check the spark plug threads for proper condition - no threads may be broken. In case of heavy soiling, the thread can be cut with a size M 14 x 1.25 mm tap drill.

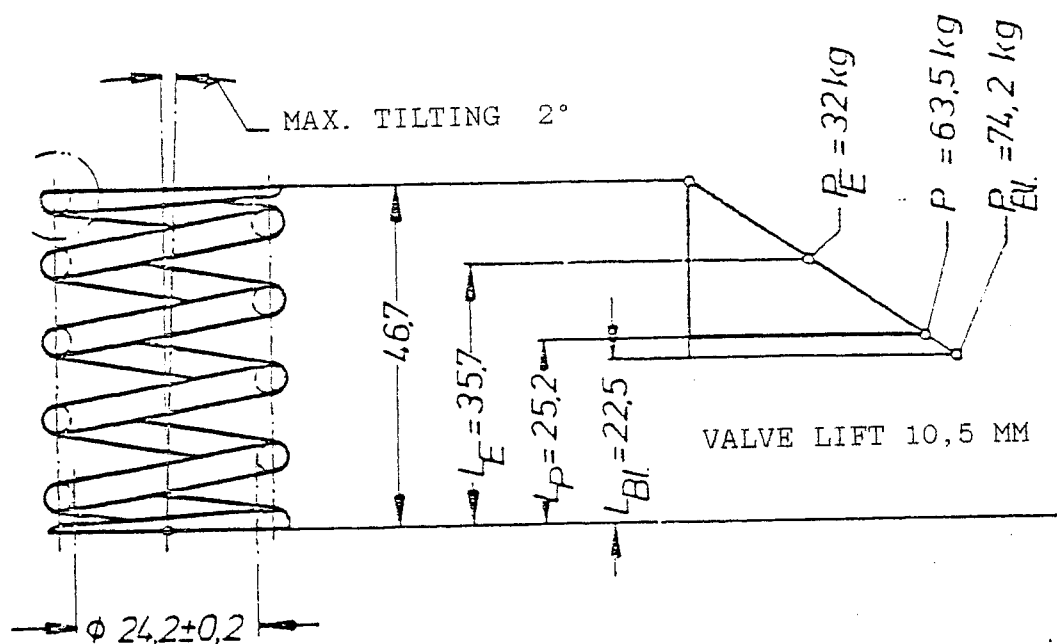
If threads are damaged, Heli-Coil inserts can be used for repair.

During overhaul this is not permissible.

Valve Spring

Check the springs with a spring tester.

Spring lengths and forces are shown in the drawing below.





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Valves

After cleaning, check the valve stem for grooves, especially in the upper third. Smaller grooves can be polished out, in case of deeper grooves, the valve must be replaced.

Valve Rotating System (Roto-Caps)

Valve rotation is caused by the use of Roto-Caps.

Manually check the cleaned Roto-Caps for freedom of movement.

In the case of tightness or sticking, replace the caps.

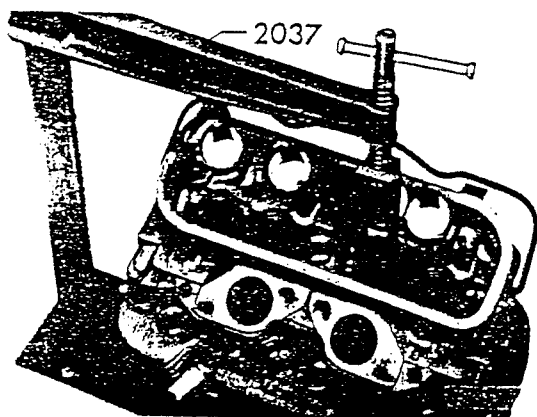
The caps must also be replaced during each overhaul.

NOTE

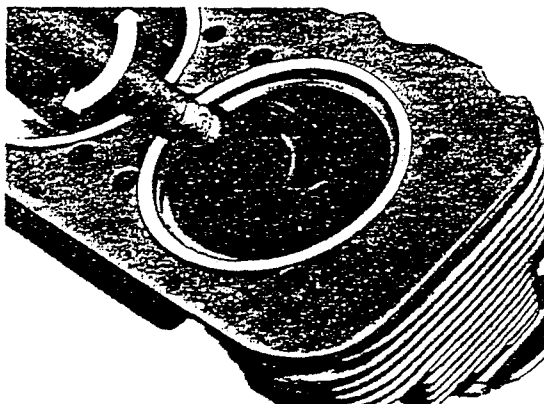
Older engines were not fitted with Roto-Caps.

These engines must be fitted with the Roto-Caps at the next opportunity.

In this case, the valve springs, which are now shorter, and the valve keys must also be replaced.



Valve spring removal and installation

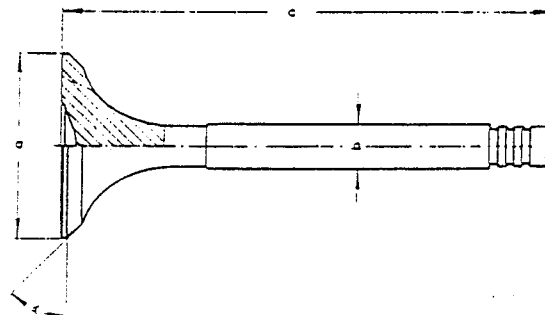


Valve Seat Grinding

Grind valve seat by raising and continuing uniform rotation.

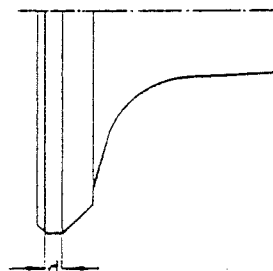
CAUTION

Carefully remove grinding paste after grinding.



Valve Dimensions

Intake valve	Exhaust valve
a - 39.3 mm	Ø 33.0 mm
b - Ø 7.95 mm	Ø 8.92 mm
c - 115.4 mm	115.4 mm
a - 45°	45°



Rework Intake Valve

When reworking valves, the dimension d must never be less than 0.5 mm.

CAUTION

Do not turn exhaust valves. Only grinding is permissible.

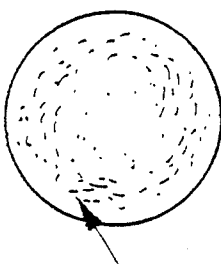


Rocker Arms

Check the rocker arm holes for deep grooves. Check the rocker arm axle for signs of wear. The bearing pieces require no special inspection. It is sufficient to check them for deformation. If damage is found, replace the respective part.

Tappets and Push Rods

Inspect the circumference of the tappets for grooves. Check the bottoms for material chipping and pitting. If these can be detected with a fingernail, replace the tappet.



PITTING AREAS

Underside of Tappet

Check the push rods for bowing. This is done by rolling them on a level surface. Bowing is not acceptable.

Check the fuel pump tappet in the same manner.



Starter Gear and Vibration Damper

Check the gear ring of the starter gear for broken teeth and firm seating on the wheel.

If the gear ring must be replaced, cut it with a saw.

Heat the new gear ring to 280°C and shrink to the wheel.

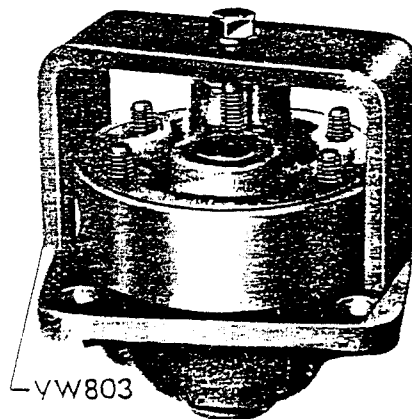
During overhaul, assemble the rear flange, the vibration damper and the flywheel and balance.
Permissible imbalance = 20 gcm.

Oil Pump

Disassemble the oil pump completely. Check the casing for grooves. If grooves deeper than 0.2 mm are found, replace the casing.

Check the gear flanks for cracks.

Check the drive wheel shaft for wear.



Pull off oil pump cover



Mechanical Fuel Pump

Only check the fuel pump for function by operating the drive lever.

Every 100 hours, clean the screen located behind the central cover.

In case of defect, replace the pump.

Dead Center Mark Transmitter (engine speed sensor)

Engines in which the engine speed is not obtained from the generator (terminal W) are fitted with a dead center mark transmitter pressed into the left half of the crankcase.

A dowel pin pressed into the flywheel is used as a marker pin.

The distance between the dead center mark transmitter and the dowel pin must be adjusted to 0.7 mm during assembly.

Oil Cooler

Check the oil cooler for such damage as cracks and dents. In both cases replace the oil cooler. Also replace the oil cooler if metal chips are found in the oil filter.

Generator

If the generator is found to be defective, it is advisable to replace it.

The carbon brushes can be checked by removing the attached regulator. Replace the brushes if their length is less than 4 mm.

Starter

The carbon brushes can be checked by removing the two casing screws and disconnecting the cable from the magnetic switch.

If the starter is found to be defective, it is advisable to replace it.



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Magneto

Slick series 4230 or Bendix S4RN 21 magnetos can be used with this engine.

It is mandatory that you observe the applicable documentation of the respective manufacturer when maintaining or overhauling these parts.



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Components to be replaced during overhaul:

all gaskets
 o-rings
 self-locking nuts
 lockwashers
 bearings and bearing shells
 vibration damper for bearing block screw connection
 spring dowel sleeves
 safety bushings in the propeller flange
 propeller flange screw
 pistons with rings and circlips
 cylinders
 V2A cylinder head gasket
 Roto-Caps and valve keys
 tappets
 oil filter
 air filter
 V-belt
 V-belt for vacuum pump and magnetos
 claw dog on magneto
 ignition harness(es)
 spark plugs

Components to be overhauled or replaced during overhaul:

 starter
 generator
 magneto(es)
 fuel pump
 carburettor

Parts must be replaced with original spare parts that correspond to the parts in the parts list.



8. Engine Assembly

Crankshaft

During con-rod assembly ensure that all the identifying numbers are on the same side.

WARNING

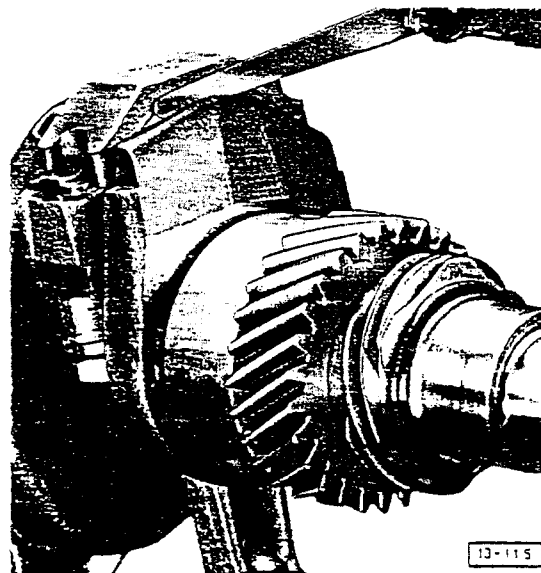
The con-rods have numbers on the side.
These are: a) the production lot numbers (identifying number)
b) the respective cylinder number (1 - 4)
both numbers must correspond.

After torqueing the nuts, continue to tighten them until the flat side forms one surface with the con-rod.

The con-rods must be mounted on the crankshaft without distortion. The axial play on the crankshaft must not exceed 0.7 mm.

Slide the front crankshaft bearing on to the crankshaft. Keyhole must point towards the crank web!

Heat the timing gear to 80°C and slide on to the crankshaft. Note that the punch markings must point towards the front.



Con-rod - check axial play



Front Flange

Shrink the bearing into the crankcase. Heat the crankcase to approx. 140°C. Locate special tool G 2500 W 602 in the crankcase, mark hole for locating pin on bearing and slide bearing into crankcase. Immediately align hole for locating pin with thread hole of crankcase.

Coat threaded pin with Loctite and screw in all the way. Loosen one half turn.

Remove special tool from the crankcase and press in shaft sealing ring using special tool G 2500 W 602.1.

Crankcase

Stud bolt installation

Install the cylinder stud bolts using a commercially available M 10 stud bolt installation tool, after coating the threads with sealing compound to prevent crankcase leaks.

The crankcase stud bolts are installed with a washer from the one side and fastened at the crankcase separation seam with plastic parts (vibration damping). Apply sealing compound to the washers before installation.

Installation of parts in the crankcase (right half)

Install locating pins into the crankcase. Set center bearing shell into the crankcase.

Slide crankshaft bearing 1 on to the crankshaft, ensuring that the locating pin hole points towards the flywheel.

The component crankshaft/propeller flange can be laid into the crankcase as they were rated. It is not necessary to disassemble them after rating. Prior to installing the crankcase front flange however, the propeller flange must be removed.

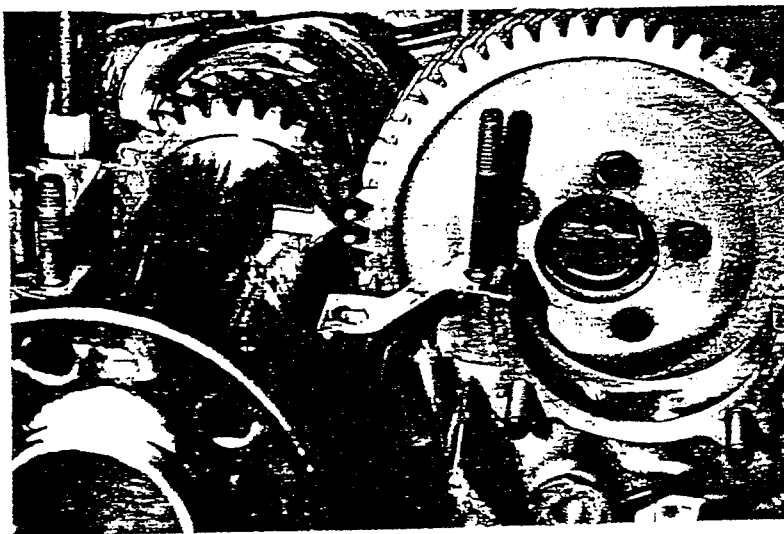
CAUTION

Check for holding pin engagement in the front main crankshaft bearing by rotating the bearing by hand.

Additionally, check the uniform distance between bearing and bearing seat.



Install the camshaft so that the camshaft marking lies between the crankshaft markings.



Prior to closing the crankcase install the axial disks (normally 3 with a total thickness of 0.96 mm) and the crankshaft sealing ring.

Check of the gear flank play

The gear flank play between camshaft and crankshaft timing gear is 0.00 - 0.05 mm.

The camshaft timing gear has the correct size if there is noticeable play and the camshaft is not lifted up when the crankshaft is turned opposite to the operating direction of rotation.

In order to facilitate the adjustment of the prescribed play, the camshaft timing gear is available in several sizes. These sizes are identified below the teeth by a grease pencil marking, e.g. 1, 0, +1, +2 etc.

The number indicates by how many 1/100 mm the radius differs from the drawing size 0.

There is no difference in size for the crankshaft timing gear, and no markings.



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Installation of parts in the crankcase (left half)

Oil Suction Pipe

Slide a new o-ring on to the pipe. Mount pipe in the crankcase.

NOTE

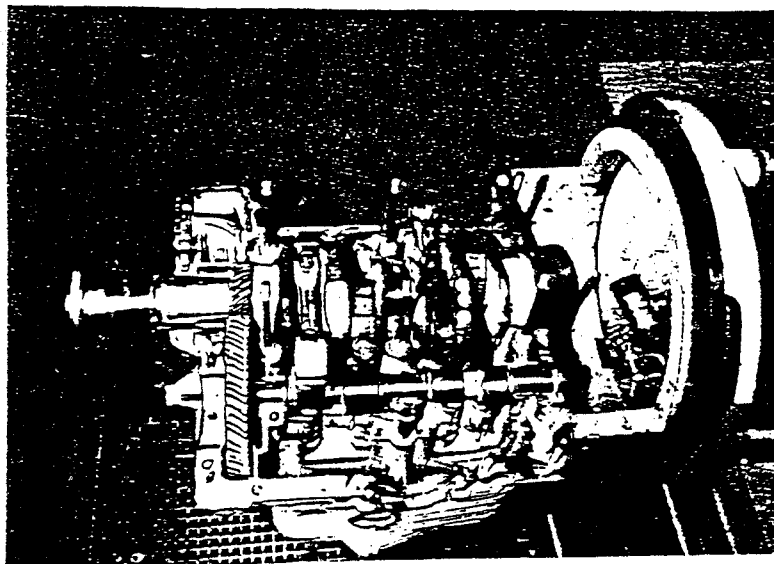
The screw eye of the suction Pipe must be aligned with the thread hole in the crankcase.

Oil baffle plate

Locate the rubber lip to the baffle plate with adhesive. Slide the plate into the crankcase, taking care not to move the oil suction pipe. Make the screw connection between baffle plate and oil suction pipe.

Joining the two crankcase halves

Prior to joining the two crankcase halves, carefully check that all the components are in the correct position and that all crankcase separation levels are coated with sealing compound. Make especially sure that sufficient sealing compound has been applied around the stud bolts of the crankcase screw connections.





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Crankcase Assembly

Lay the left half on top of the right half. Lightly fasten attaching screw for oil suction pipe with new o-ring. Subsequently coat main screw connection washers with sealing compound.

Install M 10 x 1.25 nuts and tighten crosswise beginning with the lower middle nut. Tighten all the remaining nuts of the edge screw connection.

Install all covers and attaching parts.

Install fuel pump tappet with MoS₂ grease. Lubricate fuel pump base with universal grease.

Install front flange in the crankcase with new o-rings. Install locating bushings at top right and bottom left. Install flange screws with Loctite.

Install vibration damper with the low side towards the flywheel. Install flywheel. Install screws with Loctite.

Measure crankshaft axial play as follows:

Attach measuring gauge holder with measuring gauge to the crankcase. Move crankshaft back and forth in the axial direction. Read off the axial play from the measuring gauge.

The axial play should lie between 0.07 and 0.13 mm.

If this play is not measured, remove the flywheel and the rear flange, remove the sealing ring and change the three spacer washers.

The spacer washers are available in thicknesses of 0.30, 0.32 and 0.34 mm.

After correction, recheck the axial play.

Install the sealing ring using special tool VW 191.



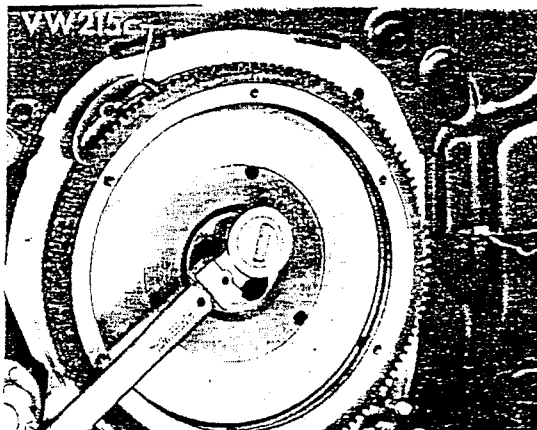
Propeller Flange and Crankshaft Assembly

After installation of the front flange, the propeller flange is installed on the crankshaft by sliding the propeller flange through the front flange on to the crankshaft. Turn the propeller flange to check alignment of the groove with the wedge on the crankshaft until the propeller flange slides into place.

Install a new screw and washer and tighten.

WARNING

The plastic agent on the screw threads must not be damaged or worn.
The screw must only be subjected to this high torque once. Repeated use is prohibited!



Hold the flywheel in place, e.g. using special tool VW 215 c.

After the screw has been torqued, install the safety bushing. Drill holes using a 5.0 mm drill and secure with the split sleeve pin.

NOTE

The propeller flange can also be removed and installed with the engine mounted in the aircraft.



Pistons and Cylinders

If pistons and cylinders must be replaced, they must first be paired.

Pistons and cylinders must always be of the same size.

New pistons are rubber-stamped with their size, cylinders have the size stamped near their foot.

In exceptional cases pistons with a fit size smaller than the cylinder may be installed, e.g.

cylinder = +1, piston = 0

but under no circumstances may the piston fit size be larger than that of the cylinder.

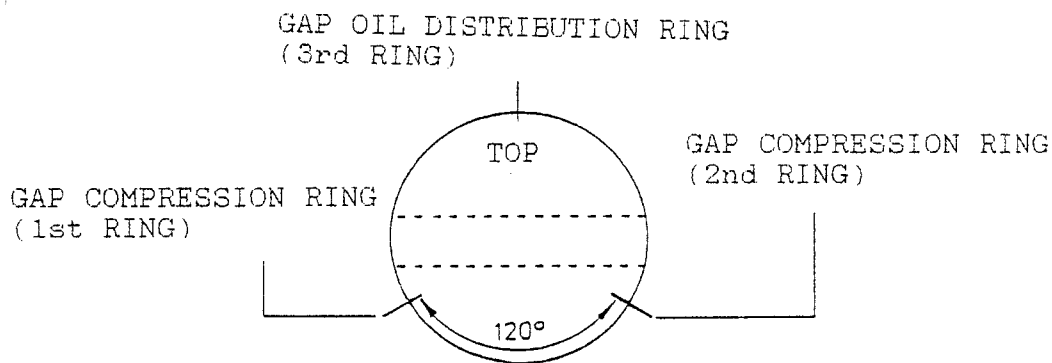
When installing new pistons take care that the stamped arrow points towards the starter gear.

After repair install the piston as it was removed.

Install piston pin and secure with circlip.

Make especially sure that the circlip is seated properly!

Piston ring Installation:





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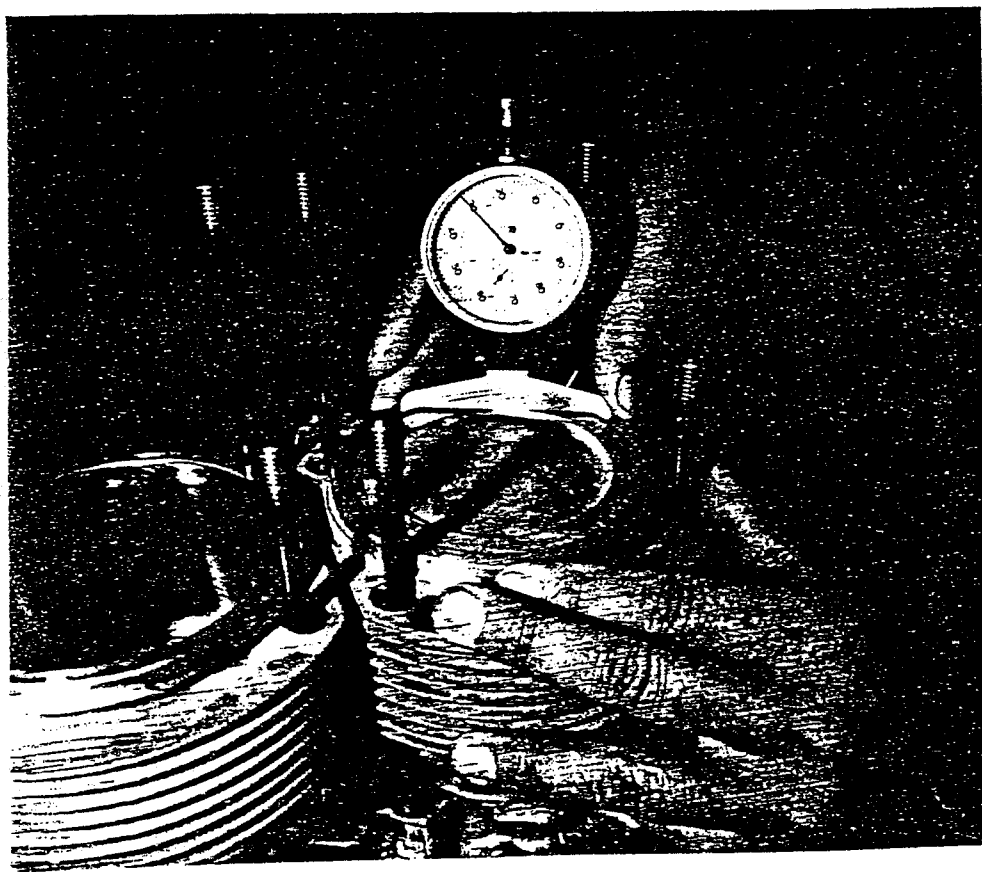
Cylinder installation is normal, using a piston ring clamping tool. Coat the cylinder foot with sealing compound.

Red: RTV

After the cylinder is installed, measure the piston set back distance, turning the cylinder slightly and pressing it against the crankcase.

Specified distance: 0.7 - 1.1 mm

If this distance is not achieved, check the cylinder or piston rating.





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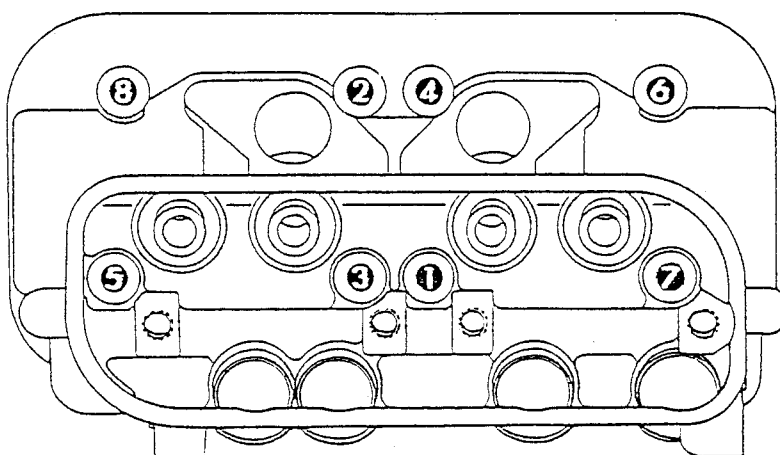
Cylinder Head Installation

Prior to cylinder head installation, install sealing rings made of V2A material.

Observe Technical Bulletin 4601 - 4 dated 18.01.1988.

Tighten the cylinder head screws in the sequence shown below, and in steps of 10, 20 and 27 Nm to avoid distortion.

Coat the cap screws in the rocker arm area with sealing compound, oil the nuts located above.

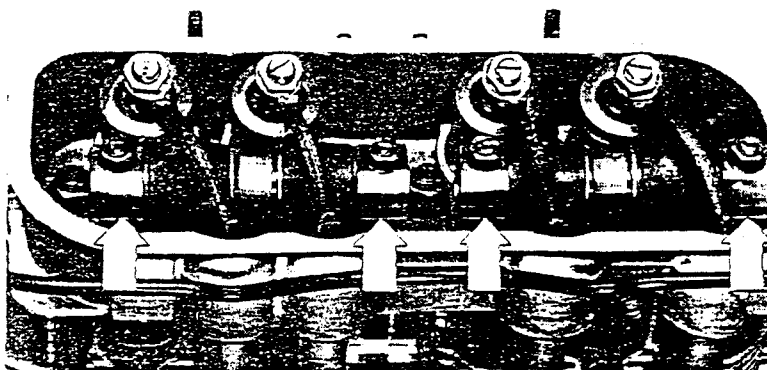


Install cooling baffles, push rods and tappets. Slide the push rod protection tubes through the cylinder head from the outside.

Install the rocker arms together with spring, axle and bearing pieces.

NOTE

The bearing pieces are chamfered on one side. These sides point towards the outside. The slits in the bearing pieces point downward.



The cylinder heads have to be tightened within the first 25 operating hours.

Work Description:

First, removal of the front and lateral air baffles.

Loosening of inlet manifolds on the cylinder head.

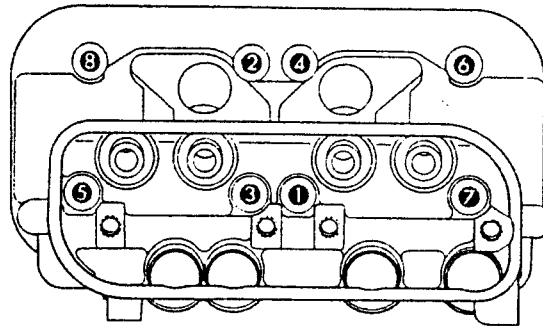
Dismounting of valve cover and rocker arm.

Then loosening of all nuts of the cylinder head attachment.

Subsequently tightening of nuts with torque.

Tightening torque: in steps of **10 Nm**, **20 Nm** and **27 Nm**.

Sequence as per the picture.



Note: Exhaust, push-rods and protective tubes need not be dismounted. The cylinder head does not have to be dismounted either.

Tip : So as to prevent the falling apart of the rocker arm assy, just put a screw through the holes on the end pieces.

Effect the remaining assembly in reverse order.

Tightening torque of the nuts rocker arm shaft: 15 Nm

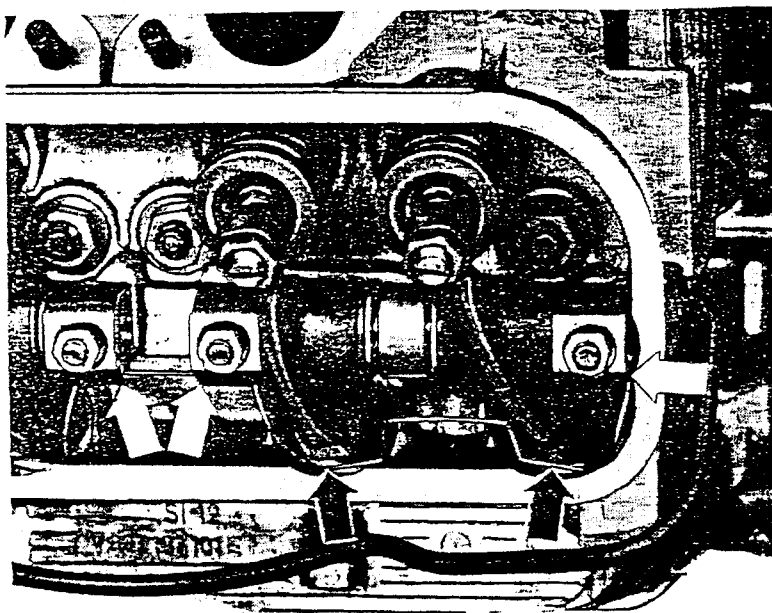
Adjusting of the valves after the assembly to 0,2 mm play.

Tightening torque of the lock nut 20 Nm

Secure the push rod protection tubes against falling out with a safety clip.

This clip must engage the bearing pieces and lie on top of the protection tubes.

Observe that rocker arms and push rods are not obstructed in any way.



Valve Clearance Adjustment

In the normal case adjust the valve clearance to 0.2 mm. It is recommended, however, to set the valve clearance to 0.4 mm prior to the first run after an overhaul. A settling of valves and valve seats must be expected.

Set the valve clearance with the piston at the top during the compression stroke, cylinder head cold.



Accessory Equipment

Starter

No special points must be observed during starter installation.

Generator

Install the V-belt around the flywheel prior to generator installation. Tension the V-belt such that it can still be twisted through at least 45°.

Tighten and secure the screws.

Magneto

Install drive claw in magneto. Tighten nut with specified torque. If the splint hole is not reached, grind down the underside of the nut.

Secure the nut with a split pin.

Installation and adjustment of the magnetos is covered in detail in the Operating Manual.

Intake Duct

Check the plastic parts located in the intake duct (turbolators) for secure seating. If this is not the case, replace the defective parts.

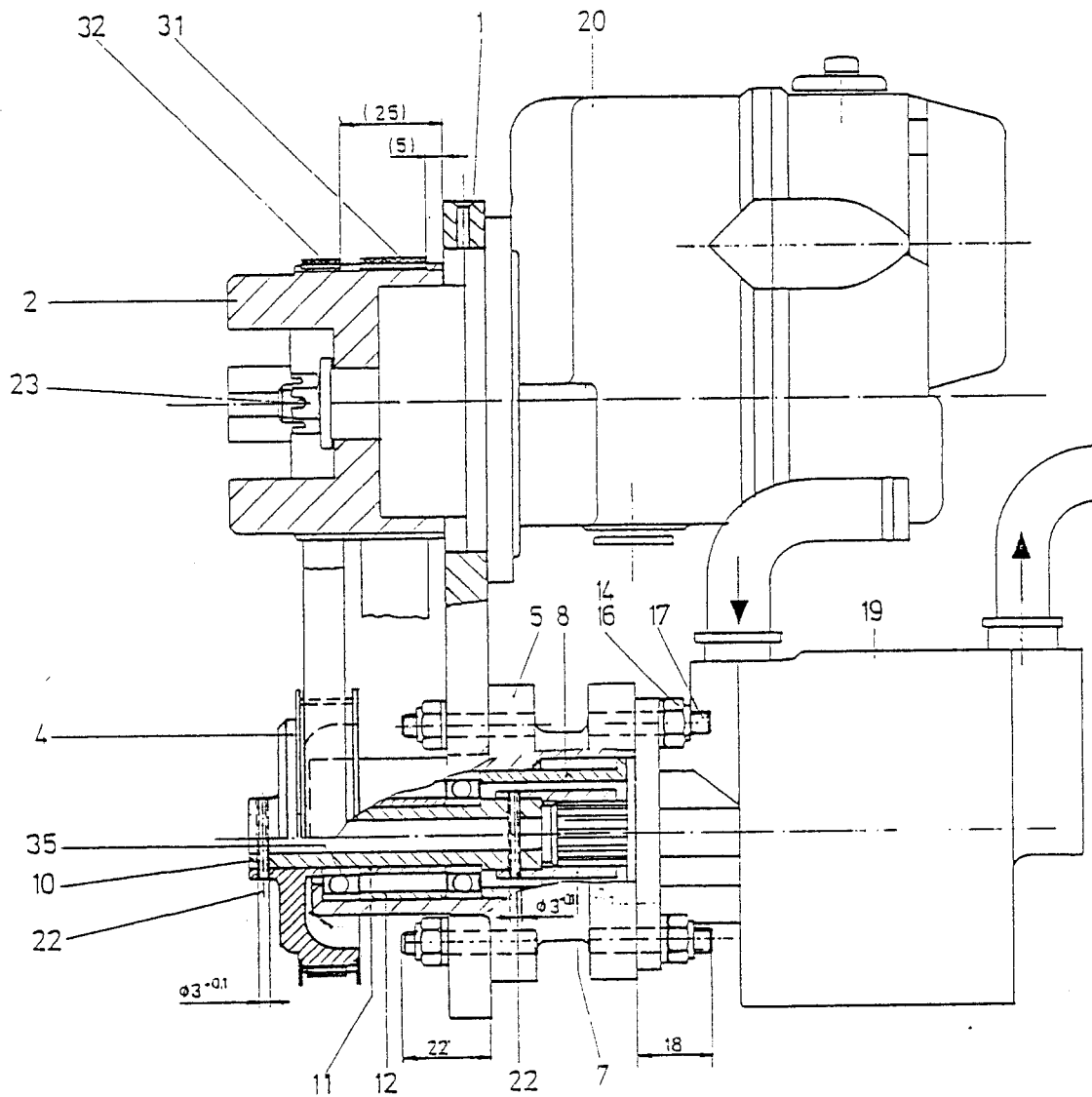
The remote side (lower part) must point towards the carburettor. Proper opening of the throttle valve must be ensured.

Vacuum Pump and Vacuum Pump Drive

First mount the drive on the plate.

Subsequently install the toothed belt on the drive wheel of the upper magneto.

Now install the vacuum pump according to the manufacturer instructions.





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Fuel pump

Coat fuel pump tappet with MoS₂ grease and install.

Fill fuel pump base with universal grease, install fuel pump with internal polygon head screws.

Oil Pressure Relief Valve

Install piston with the flat side up. Install spring on closure screw and close.

NOTE

If the oil pressure in the engine should prove to be too high, it is possible to install a shorter closure screw.

Oil Screen

Install seal on the upper and lower sides of the oil suction screen. Slide oil screen into the oil sump.

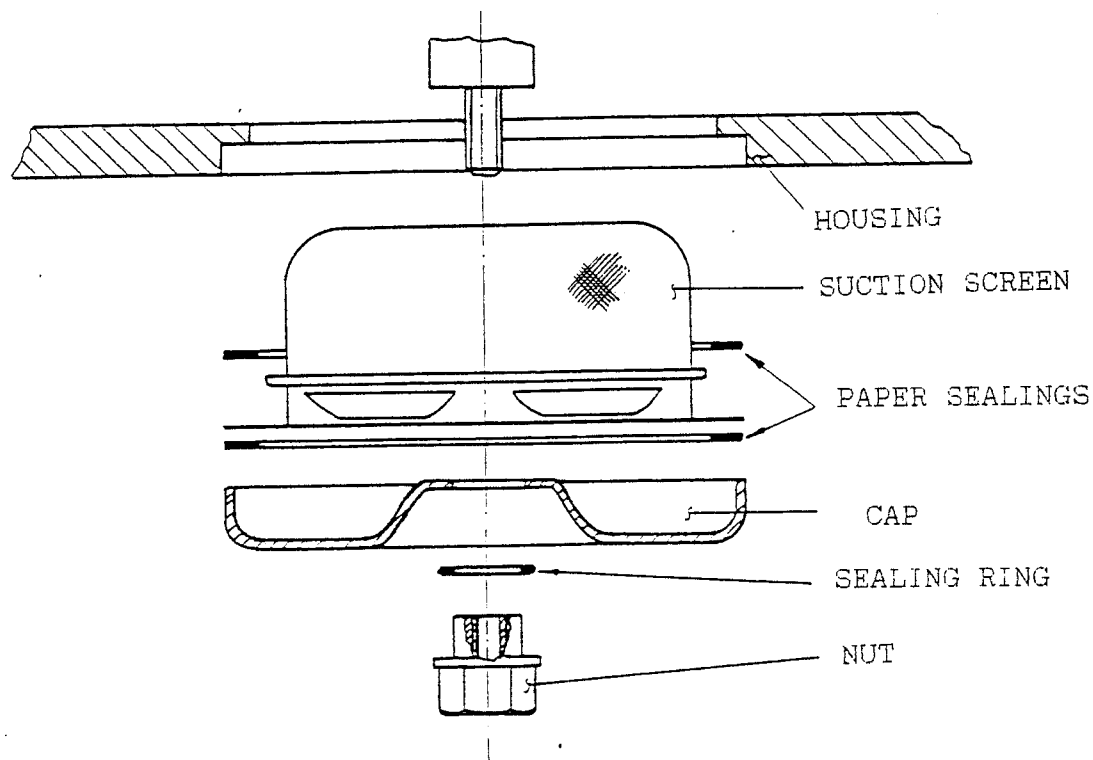
Close oil sump with cover, install seal and nuts and torque.

NOTE

Strictly observe the specified torque of 13 Nm, as otherwise cover distortion and associated leaks are possible.



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Oil Suction Screen Assembly



Ignition Harness

The ignition harness is produced in the conventional manner using Slick ignition harness parts.

The only exception is that there are no insulators at the spark plug ends, but a shrink hose.

This serves to make the ignition harness less stiff, due to the lack of space at the cooling baffles.

Ignition harness lengths (In mm)

Single spark plug system: all cylinders 820 mm

Double spark plug system:

	Cylinder			
	1	2	3	4
Spark plug				
front	935	925	825	825
rear	795	810	705	710

The specified lengths refer to lengths of cable without springs.

Complete the assembly and check of the finished ignition cable in accordance with the Slick Ignition Lead Assembly & Installation Manual.



9. Carburettor

Description

The Solex CD carburettor operates according to the equal pressure principle. (CD = constant depression). The fuel nozzles change dependent upon throttle valve and engine speed. The carburettor is fitted with a cold start device, which can be adjusted to any setting using a linkage.

Function

Fuel flows through a line to a float needle valve. The fuel level is regulated by the float and the needle valve. The fuel then rises through suction pipe 19 to nozzle 23. There the fuel is atomized by the vacuum.

Cold Start:

Pulling the choke causes a disk 30 in the cold start device to rotate. This disk is fitted with several different diameter holes. In the "full rich" position, the biggest diameter hole is open. This allows fuel to flow directly from the float chamber via the disk to the throttle valve.

Idle:

The carburettor is not fitted with a special idle device. Fuel is metered only by the main nozzle. Engine idle speed is adjusted by means of the throttle valve stop.

Fuel quantity can however, be adjusted at the main nozzle with adjustment screw 12 using special tool B 20379.

Normal Operation:

Opening the throttle valve causes a vacuum to be created in chamber 24 by way of hole 25. Chamber 24 is isolated from the rest of the housing by means of membrane 16.

The pressure difference between chamber 24 and intake duct 26 causes a lifting of control piston 18. An increase in engine speed or torque causes the control piston to be lifted as long as the control piston weight is the same as the weight of the air passing through throttle valve 27.

As soon as control piston 18 rises, it causes the conical needle 29 in the main nozzle to rise also. This allows more fuel to reach the intake system.



Acceleration:

If the throttle valve is opened suddenly, a "richer" fuel mixture is required for a brief period. For this reason the carburettor is fitted with a hydraulic damper (14), located in a tube filled with oil.

At the moment when the throttle valve is opened, this damper prevents quick rising of the control piston. For a short period of time the vacuum at the fuel nozzle increases, causing more fuel to be metered.

Under normal conditions SAE 20 oil is sufficient for the damper.

The downward movement of control piston 18 is achieved by a spring and by the piston's own weight.

Settings:

There are two possible settings:

- idle speed
- idle mixture

Idle speed is set to 750 to 900 rpm by adjusting the throttle valve stop screw. (Turn screw approx. 1 1/2 turns in from the fully closed position of the throttle valve.)

Idle mixture is set with adjusting screw 12 using special tool B 20379.

Turning the screw in a clockwise direction causes the mixture to become "RICHER", rotation in an anticlockwise direction causes the mixture to become "LEANER".

Changing the idle speed mixture causes the mixture for all speeds to be changed.

Synchronisation:

Set the idle speed with the engine warm. Loosen the throttle linkage of one carburettor and determine the smoothest operation by moving the throttle valve. If necessary adjust the linkage length and reconnect.

Subsequently check idle speed and readjust if necessary.

Shut engine down, check throttle valve stop in full throttle position. Both throttle valve levers must be against the stop.



Disassembly and Reassembly

The carburettor can be disassembled without special tools. It can be disassembled into all its parts, except for the main nozzle. This is press-fitted and cannot be removed.

Adjustment screw 12 can be pressed upwards only after removal of the conical needle.

During overhaul replace all o-rings and seals, the conical needle, the float needle valve, membrane and the piston damper.

During reassembly first install the shaft and the throttle valve. The throttle valve attaching screws must be caulked after installation, or else installed with Loctite.

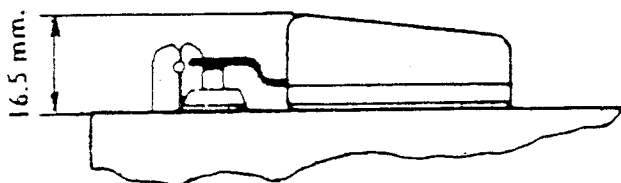
The remaining assembly is in the opposite sequence as disassembly.

Carefully check that the holding screw mounted on the side of the control piston is fully tightened.

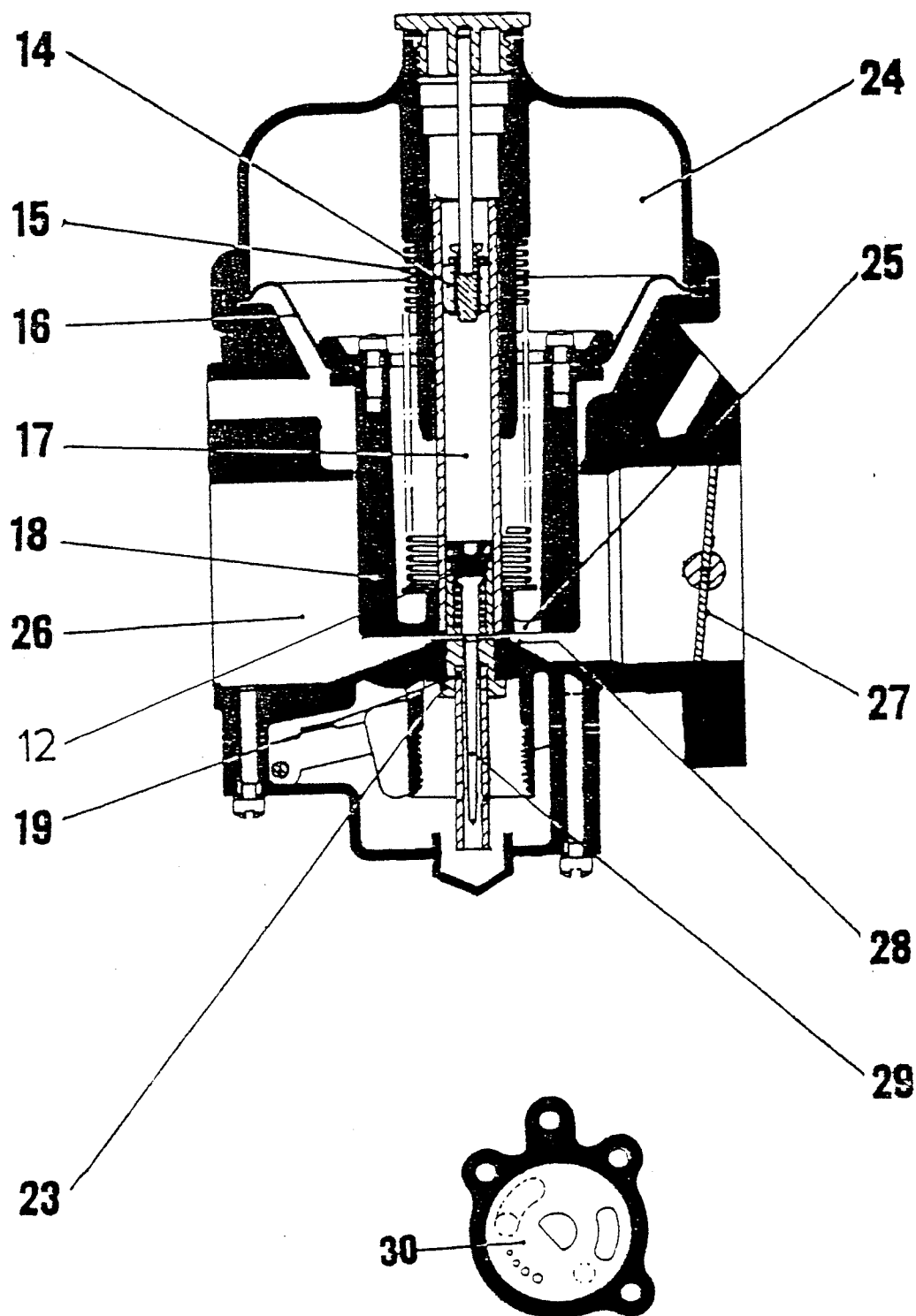
NOTE

The membrane is fitted with projections on its outer edge. These must fit into the groove of control piston 18 and the groove in the carburettor casing. If this is observed, a wrong installation of the control piston is not possible.

After installation of the float needle valve and the float, set the height to 16.5 mm measured from the upper edge of the float to the edge of the casing without the gasket.



Prior to installing the control piston, set the nozzle needle into its start position. This is reached when the plastic disk of the nozzle needle is at the same height as the control piston. Fill the damper piston tube with oil to approx. 6 mm from the upper edge.





Carburettor Membrane Inspection

Inspect the carburettor membrane every 100 hours. This inspection does not require removal of the carburettor. Carburettor adjustment is not changed.

1. Remove the carburettor upper cover.
2. Remove the control piston spring.
3. Carefully pull out the control piston together with the carburettor membrane, taking care not to bend the nozzle needle.
4. Slightly stretch the membrane and check for cracks and embrittlement. If defects are found, replace the membrane.

To replace the membrane remove the inner ring of the control piston.

During installation take care that the membrane projections come to lie in the correct grooves.

Installation in the opposite sequence as the removal.

**10. Running In and Engine Test Instructions**

Engine assembly must always be followed by an engine test run, during which a performance check must be carried out. The results must correspond to the diagram and the rating sheet.

The engine test run can be carried out on a propeller test stand or on a test stand having a fluid friction dynamometer.

Ensure proper cooling is available at all times.

Running In Program

Start engine - perform quick stop check.

Start engine and allow to warm up at approx. 1000 rpm until the oil temperature is in the green range.

- check oil pressure
- perform pressure tightness check at crankshaft sealing ring, at propeller flange, crankcase seams, oil temperature and oil pressure sensors, oil cooler system
- synchronize carburettors

Total running time : 30 minutes

Cover the entire engine speed range as follows:

1400 rpm	10 min
1600 rpm	10 min
1800 rpm	10 min
2000 rpm	10 min
2200 rpm	10 min
2400 rpm	10 min
2600 rpm	10 min
2800 rpm	10 min
3000 rpm	10 min
3200 rpm	5 min
3000 rpm	10 min
3400 rpm	5 min
1000 rpm	5 min

Partial load range!
adjust engine to run at optimum
operating conditions (oil 90°C,
cylinder head 180°C).

Cooling run

Stop engine

Perform visual inspection



Perform adjustment work:

- set valve clearance with the engine cold
- Start engine and warm up at 1000 rpm
- 3000 rpm 5 min - full load operation
 - record and evaluate performance and consumption values
- 2400 rpm 10 min - partial load operation
 - for engine with dual ignition system, perform magneto check. Rpm drop must not exceed 30 rpm.
- 3400 rpm 5 min - full load operation
 - record and evaluate performance and consumption values
- 1000 rpm 5 min - cooling run
- if necessary, correct carburettor adjustment and repeat measurements.

Engine Test Run - Program

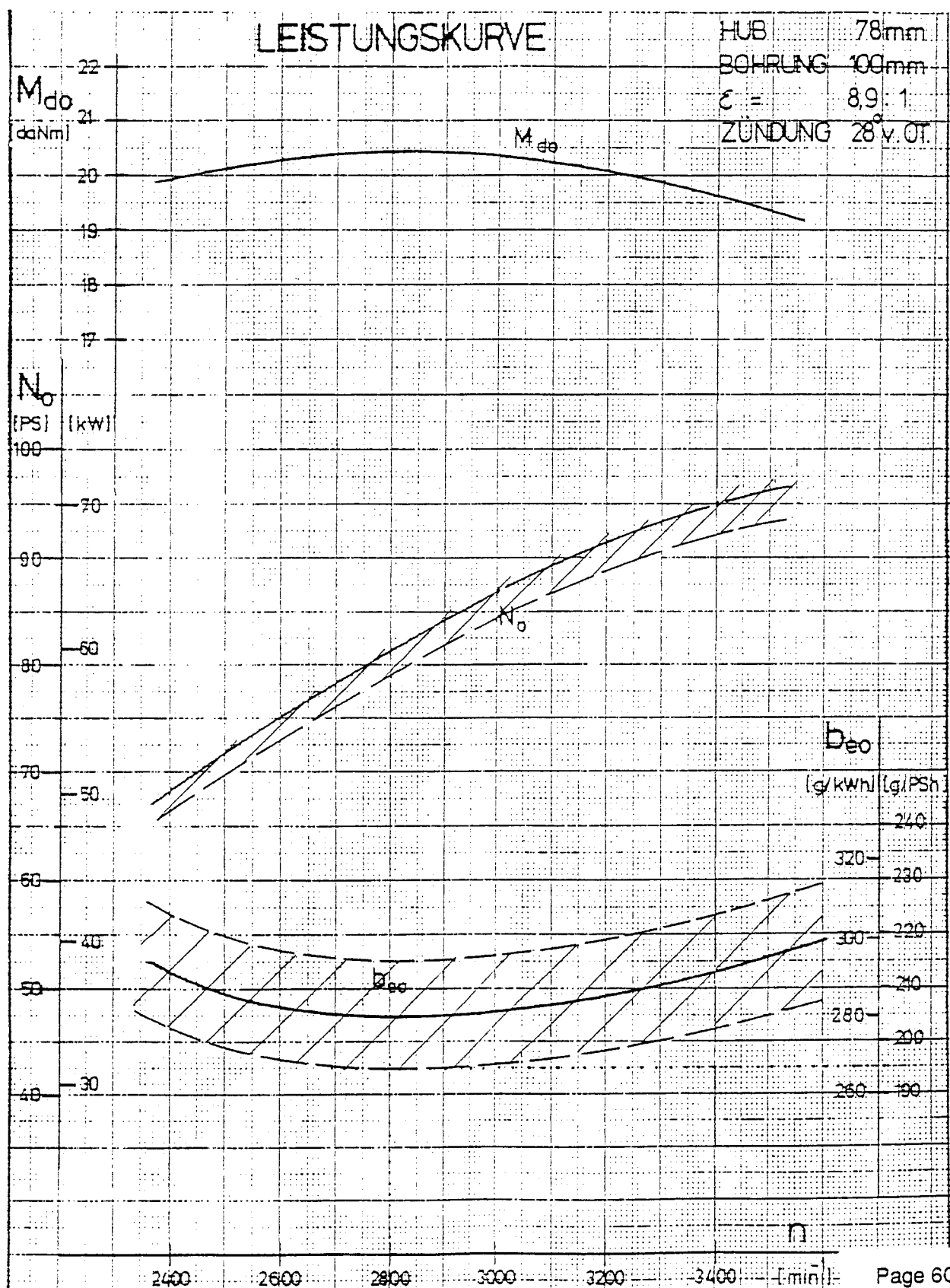
Cover the engine speed range from 3400 rpm to 2400 rpm with full load as follows. Measure performance and fuel consumption as soon as the steady state has been achieved. Record measurements and enter in the log.

- 3400 rpm 5 min
- 3000 rpm 10 min
- 3200 rpm 5 min
- 2800 rpm 10 min
- 2600 rpm 10 min
- 2400 rpm 10 min
- 3400rpm 5 min
- idle 5 min

As soon as oil temperature and/or cylinder head temperature approach their max. permissible values, insert a cooling run, shut engine down, check for and cure the fault, then continue the test run, respectively repeat it.

Shut Down Engine

- perform visual inspection
- perform leak test
- perform filter check
- adjust valve clearance to 0.2mm for engine cold.





11. Conservation, Storage and Packaging

Conservation

All engines that have completed a test run, may not be stored for more than 14 days without conservation. In case of longer storage, or prior to transportation, perform conservation according to the following procedure.

- Pour 3.0 l of corrosion protection oil into the engine.
- Remove spark plugs and spray corrosion protection oil into the combustion chambers so that the upper half of the cylinder liner is coated, do not fill.
- Turn engine several turns by hand or crank using starter
- Spray spark plugs with corrosion protection oil, install and tighten, or install drying plugs.
- Close all openings - exhaust pipe, vent pipe and air filter - tight against dirt and moist air.
- Spray engine exterior with corrosion protection oil. Prior to spraying, thoroughly clean all parts to be conserved. Make sure that rubber parts - V-belts, hoses, lines - do not come into contact with the corrosion protection oil under any conditions.
- Fit engine with a label showing the conservation date. Do not conserve the carburettor.

Repeat the conservation measures every three months.

Storage

The engine must be stored in a heated dry room. Do not allow the engine to stand directly on the floor, but set them on a wooden base and cover them. In case of storage in wooden boxes allow the box to stand on wooden blocks with the lid slightly open for better ventilation.

Packaging

Shipment of an engine must be done in a wooden box, which allows proper fastening of the engine and excludes damage of any kind during shipment. The engine is subjected to exterior conservation. Drain the corrosion protection oil from the engine.

Protect the ignition cable and generator connections from oil and grease.



Accessories which are packed separately but shipped in the same box as the engine must be especially protected against shock.

Deconservation

Drain corrosion protection. Remove spark plugs and clean. Remove all covers and closures. Crank engine several times.

Allow oil to run out.

Install drain screw and screen.

Install spark plugs, replenish engine oil.

Engine operational.



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12. Table of Screw Torque Values (In Nm)

Screw crankshaft/prop. flange M16 x 1.5
to measure run-out
during installation

100, +20

300, +10

-30

Con-rod reduced shaft screws, nuts oiled

35

Main screw connection crankcase M10

35

Edge screw connections crankcase M8

20

Oil drain screw

25

Oil screen screw

13

Cover for oil temperature sensor

5

Flange for oil filter insert

25

Assembly oil pump

6

Oil pump to crankcase

30

Front flange on crankcase

18

Polygon screws rear flange

90

Interior hex head screws flywheel

20

Fuel pump on crankcase

15

Oil pressure relief valve

20

Cylinder head attachment

10, 20, 27 in steps

Nuts rocker arm shaft

15

Set screws valve clearance

15

Spark plugs

20

Oil cooler to counter plate

10

Accessory equipment mount to engine

20

Starter to accessory equipment mount

20

Generator to accessory equipment mount bottom
top

30

25

Magneto to accessory equipment mount

20

Magnetic claw to magneto

14, +7

V-belt pulley to Lima

35, +10

Intake duct to cylinder head

20

Carburettor to intake duct

20

Exhaust system to cylinder head

25

Ignition cable to spark plug

to the stop, then 1/16 - 1/8 turn

Nm

10 =

15 =

20 =

27 =

25 =

35 =

90 =

15

Ind 16

10

15

20

25

30

65

**13. Dimension Table**

1.	Crankshaft	
	Main bearing locations	59.990
		59.971
	Con-rod bearing locations	49.971
		49.983
	Bearing location for timing gear	42.006
		41.995
2.	Propeller flange	
	Bearing location	59.990
		59.971
	Propeller receiver	47.000
		46.950
3.	Front flange	
	Bearing hole	70.050
		70.000
	Sealing ring hole	80.046
		80.000
	Receiver into housing	65.000
		64.981
4.	Con-rods	
	Hole crankshaft	52.800
		52.813
	Hole piston pin	24.015
		24.024
5.	Crankcase	
	Crankshaft hole	70.019
		70.000
	Camshaft hole	27.521
		27.500
	Hole rear sealing ring	95.054
		95.000
	Receiver front flange	65.000
		65.019



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	Distance cylinder seat surface to separation seam	110.850
		110.750
	after Serial No. 201	110.800
		110.700
6.	Camshaft	
	Bearing locations	25.000
		24.987
	Cam height exhaust (exterior cams)	38.560
		37.960
	Cam height intake (interior cams)	39.010
		38.410
7.	Pistons	
	Hole piston pin	24.000
		24.005
	further dimensions see page ...	
8.	Piston pin	
	Diameter	24.000
		23.995
9.	Cylinders	
	Dimensions see page ...	
10.	Cylinder head	
	Valve guide exhaust	8.000
		8.030
	Valve guide intake	8.975
		9.000
	see also page ...	
11.	Valves	
	Stem exhaust	7.950
		7.935
	Stem intake	8.920
		8.905
	further dimensions see page ...	



12. Rear flange	
Shaft sealing ring diameter	75.100
	74.900

14. Special Tools

VW 191	Assembly tool for rear sealing ring
VW 215 c	Holding tool for flywheel
VW 207	Removal punch for piston pin
G 2500 - W 602	Adjusting tool for front bearing
G 2500 - W 602.1	Installation tool for front shaft sealing ring
G 2500 - WÄ 039105401	Aligning tool for con-rods
B 20379	Adjusting tool for carburettor