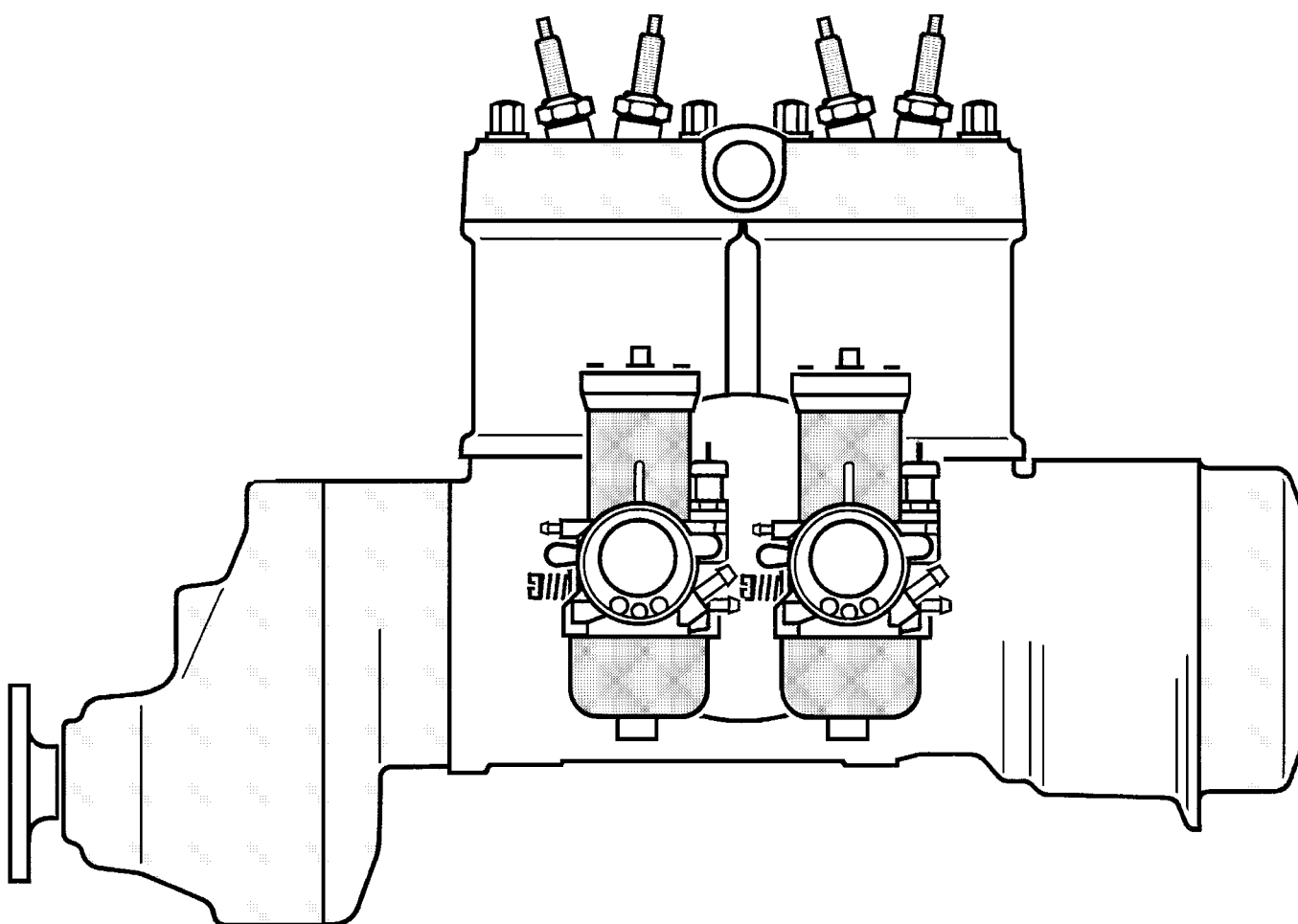




# ROTAX®

# ***Repair Manual***

## ***for engine type 462 - 532 - 582 UL***



***Edition: 10 1994***



**Bombardier-Rotax GmbH**

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Part no: 899 081

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## 1) Introduction:

This Repair Manual covers the ROTAX 2-cycle-, 2-cylinder-, water-cooled ULTRALIGHT AIRCRAFT ENGINES, Type 462, 532 and 582 UL. The manual has been prepared as a guide to help to service and repair these engines correctly. It is supplemented by the corresponding Operator's Manual and a current Spare Parts List.

For installing the engine into the aircraft, consult the Installation Instructions. In the event of questions or problems, please, contact your local authorized ROTAX distributor or Service Partner.

This manual was published primarily to be used by qualified mechanics who are already familiar with ROTAX engines.

The Repair Manual deals with

- Disassembly of engine
- Inspection and judgement of components
- Table of tightening torques
- Table of wear limits
- Chart about carburetor calibration.

The ROTAX design incorporates the latest technical developments. We reserve the right to make modifications without prior notice in the case of further development. If considered necessary, modifications will be dealt with Service Informations, consecutively numbered.

This manual emphasizes particular information denoted by the following wording or symbols:

- ▲ **WARNING:** Identifies an instruction which, if not followed, could cause personal injury.
- **ATTENTION:** Denotes an instruction which, if not followed, could severely damage engine components.
- ◆ **NOTE:** Indicates supplementary information needed to fully complete an instruction.

Although the mere reading of such information does not eliminate the hazard, compliance with the given information is strongly advised.

### 1.1) Engine number:

On inquiries and spare part orders always state engine number, because of possible running changes. The engine number is located on top half of crankcase, magneto side.

## 1.2) General notes:

- ▲■ To warrant proper repair, use genuine ROTAX spares only. It is a necessity to utilize special tools, fixtures and to use service products (see Chapter "Tools and supplementary means").
- ▲■ Repair work to be carried out by skilled persons only.
- ▲■ Use clean screws and nuts only and check face of nuts and thread for damage.
- Once loosened, **always** renew self-securing nuts.
- Meet the specific tightening torque without fail (Chapter "Essential tightening torques").
- At the re-assembly renew all sealing rings, gaskets, securing rings, O-rings and oil-seals.

## 2) Technical data:

### 2.1) Technical data ROTAX engine type 462 UL:

DESCRIPTION:	Two-cycle, two-cylinder rotary valve engine, oil-in-fuel lubrication, liquid-cooled, with integrated water pump
BORE:	69,5 mm (2,736 in.)
STROKE:	61,0 mm (2,401 in.)
DISPLACEMENT:	462,8 c.c. (28,242 cu.in.)
COMPRESSION RATIO:	theoretical: 11,5 effective: 6,7
POWER OUTPUT:	28 kW (38 hp) at 5500 rpm (low performance version = extra silent version), performance sheet Lb. 278 38 kW (52 hp) at 6500 rpm (standard version), performance sheet Lb. 278
TORQUE MAX.:	52 Nm (38 ft.lb.) at 5250 rpm, performance sheet Lb. 278 56 Nm (40 ft.lb.) at 6000 rpm, performance sheet Lb. 278
MAX. PERMISSIBLE RPM:	5800 1/min. (low performance version) 6800 1/min. (standard version)
DIRECTION OF ROTATION:	counter-clockwise, viewed towards p.t.o. (without reduction gear-box)
CYLINDER:	2 light alloy cylinders with cast iron sleeve
PISTON:	Aluminum, cast piston with 2 piston rings
PISTON/CYL. CLEARANCE:	0,08 - 0,10 mm (.00315 - .00394 in.)
IGNITION SYSTEM:	flywheel magneto generator SCP2 with contact breakers
GENERATOR OUTPUT:	AC 12V 110W + 30W
RECTIFIER REGULATOR, (OPTIONAL):	a) 866 080 requires minimum load 12 W (1 A) to regulate b) 264 870 - no minimum load required
IGNITION TIMING:	1,86 mm $\pm$ 0,25 mm = .0732 in. $\pm$ .01 in. (18 °) B.T.D.C. max. difference between cylinders 0,1 mm (.004 in.)
CONTACT BREAKER GAP:	0,3 mm - 0,4 mm (.012 - .016 in.)
BREAK-AWAY GAP:	13 - 17 mm (.51 - .67 in.)
SPARK PLUG:	14 mm, B8ES
ELECTRODE GAP:	0,5 mm (.02 in.)
RADIO FREQUENCY INTERFER- ENCE SUPPRESSION:	optional for AC or DC



ROTARY VALVE:	cut off section	Low performance version:	924 202	117 °
		Standard version:	924 205	147 °
ROTARY VALVE TIMING:	Low performance version:	rotary valve opens:	120 °	B.T.D.C.
		rotary valve closes:	40 °	A.T.D.C.
	Standard version:	rotary valve opens:	140 °	B.T.D.C.
		rotary valve closes:	51 °	A.T.D.C.
	referring to inlet port in crankcase, +/- 4° tolerance			
LUBRICATION OF ROTARY VALVE DRIVE:	oil bath, Super 2-stroke oil as used for engine lubrication			
CARBURETOR:	1 x BING 36 mm (1,42 in.), hand lever choke or cable choke			
FUEL PUMP:	pneumatic fuel pump DF 52			
FUEL:	regular gasoline, octane number not below MON 83 or RON 91 (unleaded allowed)			
LUBRICATION OF ENGINE:	oil-in-fuel SUPER 2-stroke oil, ASTM/CEC standards API-TC specification) e. g. Castrol TTS, mixing ratio 1:50 (2%)			
STARTER:	Rewind starter optional: a) rewind starter and electric starter, p.t.o. side (for engine without reduction gearbox) or b) electric starter, magneto side, without rewind starter (gearbox is possible)			
REDUCTION GEAR BOX, (optional):	with torsional shock absorber ratios available: i = 2,0 / 2,24 / 2,58 / 3,0 (i = 3,0 for extra silent version only and supplied only installed on engine).			
LUBRICATION OF GEARBOX:	Gear oil API-GL5 or GL6, SAE 140 EP or 85W-140 EP			
DIRECTION OF PROP. SHAFT:	clockwise, viewed towards propeller flange			
COOLING SYSTEM:	liquid-cooled optional: a) 2 radiator kit, integrated 0,6 l =. 160 gal.US complete cooling system 2,3 l =. 610 gal.US b) 1 radiator kit 0,8 l =. 211 gal.US			
WEIGHTS:	Engine without: carburetor, exhaust system, intake silencer, radiator, fuel pump ..... 26,00 kg (57,3 lb.)			
ADDITIONAL WEIGHTS:	Carburetor with rubber flange and clamps: ..... 0,90 kg ( 2,0 lb.) Exhaust system assy. .... approx. 3,90 kg ( 8,6 lb.) Intake silencer with air filter..... 0,84 kg ( 1,9 lb.) Integrated radiator kit ..... approx. 2,10 kg ( 4,6 lb.) Electric starter kit, p.t.o. side ..... 3,42 kg ( 7,5 lb.) Electric starter kit, magneto side ..... 3,50 kg ( 6,6 lb.) Reduction gearbox "A" , dry ..... 4,50 kg ( 9,9 lb.)			

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## 2.2) Technical data ROTAX engine type 532 UL:

DESCRIPTION:	Two-cycle, two-cylinder rotary valve engine, oil-in-fuel lubrication, liquid-cooled, with integrated water pump
BORE:	72 mm (2,835 in.)
STROKE:	64 mm (2,52 in.)
DISPLACEMENT:	521,2 c.c. (31,806 cu.in.)
COMPRESSION RATIO:	theoretical: 11,5 - effective: 6,3
POWER OUTPUT:	47 kW (64 hp) at 6600 rpm, performance sheet Lb. 267
TORQUE MAX.:	71 Nm (60 ft.lb.) at 6200 rpm, performance sheet Lb. 267
MAX. PERMISSIBLE RPM:	6800 rpm
DIRECTION OF ROTATION:	counter-clockwise, viewed towards p.t.o. (without reduct. gear-box)
CYLINDER:	2 light alloy cylinders with cast iron sleeve
PISTON:	Aluminum, cast piston with 2 piston rings
PISTON/CYLINDER	0,07 - 0,09 mm (.00276 - .00354 in.)
IGNITION SYSTEM:	flywheel magneto generator with contact breakers
GENERATOR OUTPUT:	AC 12V 110W + 30W
RECTIFIER REGULATOR	a) 866 080 requires minimum load 12 W (1 Amp.) to regulate b) 264 870 - no minimum load required
IGNITION TIMING:	1,96 mm $\pm$ 0,25 mm = .077 in. $\pm$ .01 in. (18 °) B.T.D.C. difference between cylinders 0,1 mm (.004 in.)
CONTACT BREAKER GAP:	0,3 mm - 0,4 mm (.012 - .016 in.)
BREAK-AWAY GAP:	13 - 17 mm (.51 - .67 in.)
SPARK PLUG:	14 mm, B8ES
ELECTRODE GAP:	0,5 mm (.02 in.)
RADIO FREQU. INTERFERENCE SUPPRESSION:	optional for AC or DC
ROTARY VALVE:	924 504, cut off section angle 132 °
ROTARY VALVE TIMING:	opens: 132 ° B.T.D.C. closes: 52 ° A.T.D.C. referring to inlet port in crankcase, +/- 4° tolerance
LUBRICATION OF ROTARY VALVE DRIVE:	oil bath, Super 2-stroke oil as used for engine lubrication

CARBURETOR:	1 x BING 36, hand lever or cable choke 2 x BING 36, hand lever or cable choke
FUEL PUMP:	pneumatic fuel pump DF 52
FUEL:	Premium gasoline, octane number not below MON 87 or RON 96, leaded or unleaded
LUBRICATION OF ENGINE:	oil-in-fuel SUPER 2-stroke oil (for high performance air cooled 2-cycle engines, proposed ASTM/CEC standard API-TC specification) e. g. Castrol TTS, mixing ratio 1:50 (2%)
STARTER:	Rewind starter optional: a) Rewind starter with electric starter, p.t.o. side (for engine without reduction gearbox) or b) electric starter, magneto side, without rewind starter (gear-box is possible).
REDUCTION GEARBOX, optional:	with torsional shock absorber, ratios available: $i = 2,0 / 2,24 / 2,58$
LUBRICATION OF GEARBOX:	Gear oil, API-GL5 or GL6 SAE 140 EP or 85 W-140 EP
DIRECTION OF PROP. SHAFT:	clockwise, viewed towards propeller flange
COOLING:	liquid-cooled optional: a) 2 radiator kit, integrated 0,6 l. = 0,16 gal US complete cooling system 2,4 l. = 0,62 gal US b) 1 radiator kit 0,8 l. = 0,21 gal US
WEIGHTS:	Engine without carburetors, air filters, fuel pump, exhaust system, radiator ..... 28,4 kg (62,6 lb.)
ADDITIONAL WEIGHT:	1 Carburetors with rubber flange and clamps: .... 0,9 kg ( 2,0 lb.) 2 Carburetors with rubber flange and clamps: .... 1,8 kg ( 4,0 lb.) Exhaust system ass'y. .... approx. 5,1 kg (11,2 lb.) 1 air filter ..... 0,2 kg ( 0,3 lb.) 2 air filters ..... 0,3 kg ( 0,6 lb.) 1 double air filter ..... 0,5 kg ( 1,1 lb.) Integrated 2-radiator kit, ..... approx. 2,1 kg ( 4,6 lb.) Electric starter kit, p.t.o. side ..... 3,4 kg ( 7,5 lb.) Electric starter kit, magneto side ..... 3,5 kg ( 7,7 lb.) Reduction gearbox "B", dry..... 4,5 kg ( 9,9 lb.) Reduction gearbox "C", dry..... 8,0 kg (17,6 lb.)

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## 2.3) Technical data ROTAX engine type 582 UL:

DESCRIPTION:	Two-cycle, two-cylinder-, rotary valve engine, oil-in-fuel lubrication or by oil pump, liquid cooled, with integrated water pump.		
ENGINE CONFIGURATIONS:	<b>a) 582</b>	<b>b) 582/40</b>	<b>c) 582/32</b>
	dual ignition, 1-carburetor	no	no
	dual ignition, 2-carburetors	yes	yes
	dual ignition, 2-carburetors with oil pump	yes	no
BORE:	76,0 mm (2,99 in.)		
STROKE:	64,0 mm (2.52 in.)		
DISPLACEMENT:	580,7 cm <sup>3</sup> (35,44 cu.in.)		
COMPRESSION RATIO:	theoretical: 11,5 - effective: 5,75		
POWER OUTPUT:	<b>a)</b> 48 kW (64,4 hp SAE) at 6500 1/min., perform. sheet Lb. 362 <b>b)</b> 40 kW (53,6 hp SAE) at 6000 1/min., perform. sheet Lb. 363 <b>c)</b> 32,5 kW (43,6 hp SAE) at 5100 1/min., perform. sheet Lb. 364 Match propeller to achieve above indicated full load r.p.m. as per engine version.		
TORQUE:	<b>a)</b> 75 Nm (55,3 ft.lb.) at 6000 1/min., perform. sheet Lb. 362 <b>b)</b> 68 Nm (50,1 ft.lb.) at 5500 1/min., perform. sheet Lb. 363 <b>c)</b> 63 Nm (46,5 ft.lb.) at 4700 1/min., perform. sheet Lb. 364		
MAX. PERMISSIBLE RPM.:	<b>a)</b> 6800 1/min. <b>b)</b> 6400 1/min. <b>c)</b> 5500 1/min.		
DIRECTION OF ROTATION:	counter-clockwise, viewed towards p.t.o. (without reduction gearbox)		
CYLINDER:	2 light alloy cylinders with cast iron sleeve		
PISTON:	aluminium, cast piston with 2 piston rings		
PISTON/CYLINDER CLEARANCE:	0,06 mm (.00236 in.) - 0,08 mm (.00315 in.) for engine type 582 and 582/40 0,05 mm (.00197 in.) - 0,07 (.00276 in.) for engine type 582/32		
IGNITION SYSTEM:	breakerless DUCATI capacitor discharge dual ignition with magneto generator		
GENERATOR OUTPUT:	170W AC at 6000 1/min. and 13,5V RMS		
IGNITION TIMING:	1,96 mm ± 0,2 mm = .077 in. ± .008 in. (18 °) BTDC		
SPARK PLUG:	14 mm, B8ES		
ELECTRODE GAP:	0,5 mm ± 0,05 mm (.02 in. ± .002 in.)		

ROTARY VALVE:	configuration <b>a+b</b> ): 924 504, cut-off section 132 ° configuration <b>c</b> ): 924 506, cut-off section 117 °
ROTARY VALVE TIMING:	for <b>a+b</b> ) opens: 130 ° BTDC - closes: 50 ° ATDC for <b>c</b> ) opens: 120 ° BTDC - closes: 45 ° ATDC referring to inlet port of crankcase, $\pm 4^\circ$ tolerance
CARBURETOR:	1 x BING 36, hand lever or cable choke - or 2 x BING 36, hand lever or cable choke
FUEL PUMP:	pneumatic fuel pump DF 52
FUEL:	regular gasoline, octane number not below MON 83 or RON 91 (leaded or unleaded)
LUBRICATION OF ENGINE:	1) oil-in-fuel SUPER 2-stroke oil, ASTM/CEC standards, API-TC specification) e. g. Castrol TTS, mixing ratio 1:50 (2%) 2) by oil pump (optional) with the same oil ATTENTION: pour point at least 10 ° C below ambient temperat.
LUBRICATION OF REDUCTION GEAR:	gear oil, API GL5 or GL6, SAE 140 EP, or 85 W-140 EP
DIRECTION OF PROPELLER SHAFT:	clockwise, viewed towards propeller flange
STARTER:	rewind starter
STANDARD VERSION INCLUDES:	engine with — 2 carburetors with clamps — fuel pump — exhaust system
WEIGHTS:	engine: ..... 27,4 kg (60,4 lb.) (without: exhaust system, carburetor, intake silencer, fuel pump, radiator)
ADDITIONAL WEIGHT:	2 carburetors with carburetor flanges and clamps 1,8 kg ( 4,0 lb.) exhaust system ass'y. .... approx. 5,1 kg (11,2 lb.) 2 air filters ..... 0,3 kg ( 0,6 lb.) 1 double air filter ..... 0,5 kg ( 1,1 lb.) 1 intake silencer with filter, for single carb., ..... 0,8 kg ( 1,8 lb.) 1 intake silencer with filter, for dual carb., ..... 1,1 kg ( 2,4 lb.) integrated 2-radiators kit ..... approx. 2,1 kg ( 4,6 lb.) electric starter kit, p.t.o. side ..... 3,4 kg ( 7,5 lb.) electric starter kit, magneto side ..... 3,5 kg ( 7,7 lb.) reduction gear box „B“ , dry ..... 4,5 kg ( 9,9 lb.) reduction gear box „C“ , dry ..... 8,0 kg (17,6 lb.)

## OPTIONAL FEATURES:

### Oil pump

**lubrication:** The engine is lubricated by an oil pump fitted to the engine. The carburetor is fed with pure gasoline.

### Intake

**silencer:** 1) for 1-carburetor engine version  
2) for 2-carburetor engine version

ATTENTION: If engine was supplied without intake silencer, the carburetor calibration has to be modified for use with intake silencer.

### After-

**muffler:** Special after-muffler to be fitted in addition to the exhaust muffler.

**Air filter:** 1) to be fitted directly on carburetor  
2) to be fitted in the intake silencer  
3) double filter (one filter for both carburetors).

### High altitude

#### compensation:

Automatic high altitude adjustment of carburetor calibration, with modified carburetor and high altitude compensator, HAC, (on request).

### Electric

**starter:** 1) rewind starter and electric starter, p.t.o. side, for engine without gearbox,  
2) electric starter, magneto side, without rewind starter (gear box is possible),  
3) electric starter integrated in reduction gear E.

### Rectifier-

**regulator:** 1) 866 080 requires minimum load of 12 W (1 Amp) to regulate  
2) 264 870 no minimum load is required

### Reduction

**gearbox:** with torsional shock absorber  
configuration „B“: ratios available:  $i = 2,0 / 2,24 / 2,58$   
configuration „C“: ratios available:  $i = 2,62 / 3,0 / 3,47 / 4,0$   
configuration "E": ratios available,  $i = 2,62 / 3,0 / 3,47 / 4,0$

### Cooling

**system:** 1) 2-radiator kit, fitted on engine (with gearbox) 0,6 lt. = .16 gal US (cooling system 2,35 lt. = .621 gal US)  
2) 1-radiator kit, not fitted on engine 0,8 lt. (.21 gal US)

SUBJECT TO MODIFICATION WITHOUT NOTICE.

### 3) Tools and supplementary means:

#### 3.1) Standard tools:

The following standard tools are needed:

Open end spanner: ..... A/F 8, 9, 13, 17, 19, 22, 24 mm

Ring spanner: ..... A/F 8, 9, 10, 13, 17, 19, 22, 27 and 30 mm

Sockets: ..... A/F 8, 10, 11, 13, 17, 19, 27 and 30 mm

Sockets for Allen keys: ..... A/F 4, 5, 6, 8 and 10 mm

Torque wrench 1/2": ..... for torques up to 30 Nm (270 in. lb.)

for torques up to 300 Nm (2650 in. lb.)

Allen key: ..... A/F 4, 5, 6, 8 and 10 mm

Screw driver: ..... size 3, 4, 7 and 9

Phillips screw driver: ..... size 3 and 4

Mallet: ..... plastic or wood

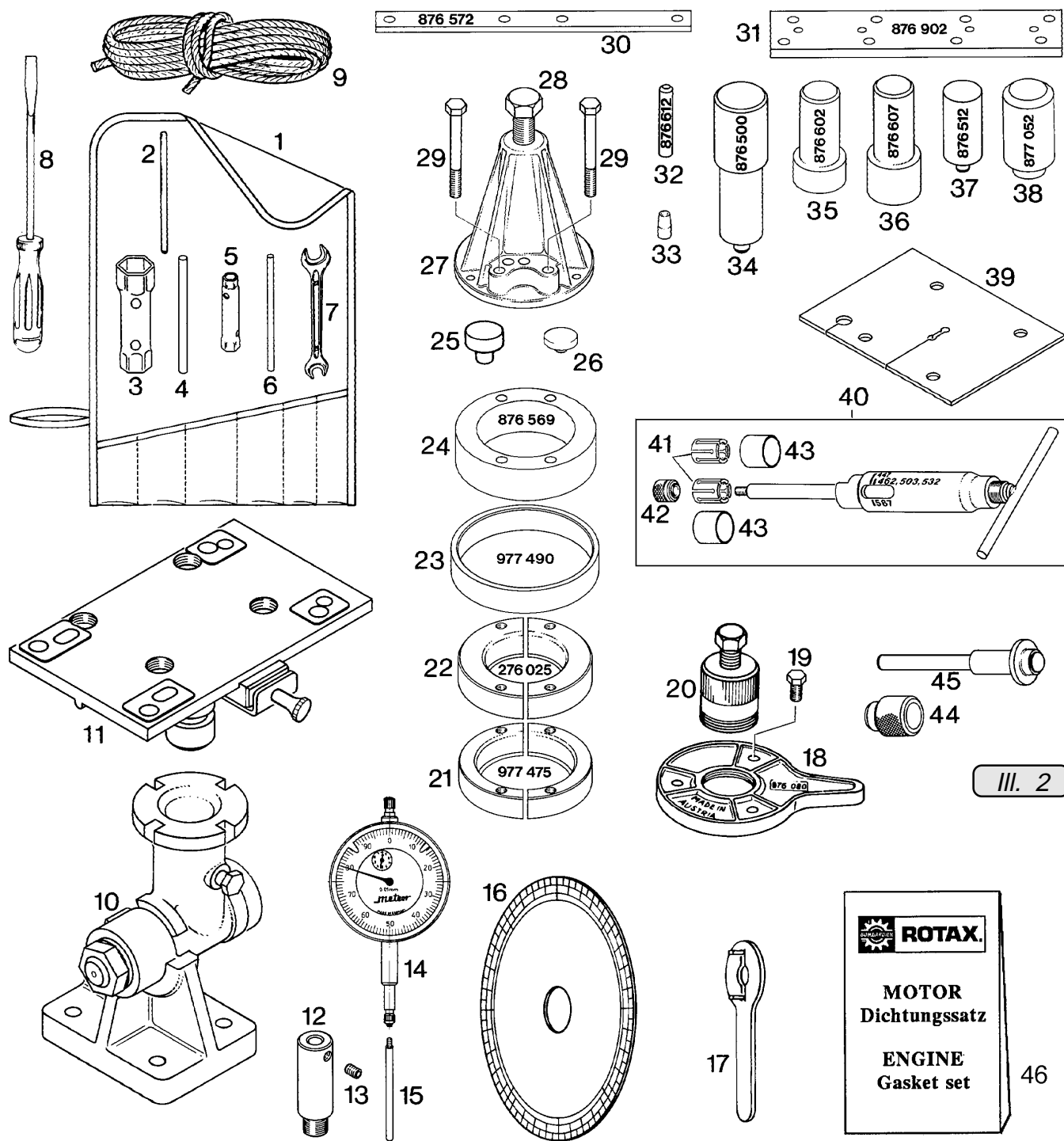
Hammer: ..... c. 500 g

Circlip pliers: ..... one each for inside and outside

piston ring pliers: ..... for piston diameter 69 ÷ 76 mm

Apart from these standard tools, the following special service tools, fixtures and service products are required:

### 3.2) Special service tools for the engine:

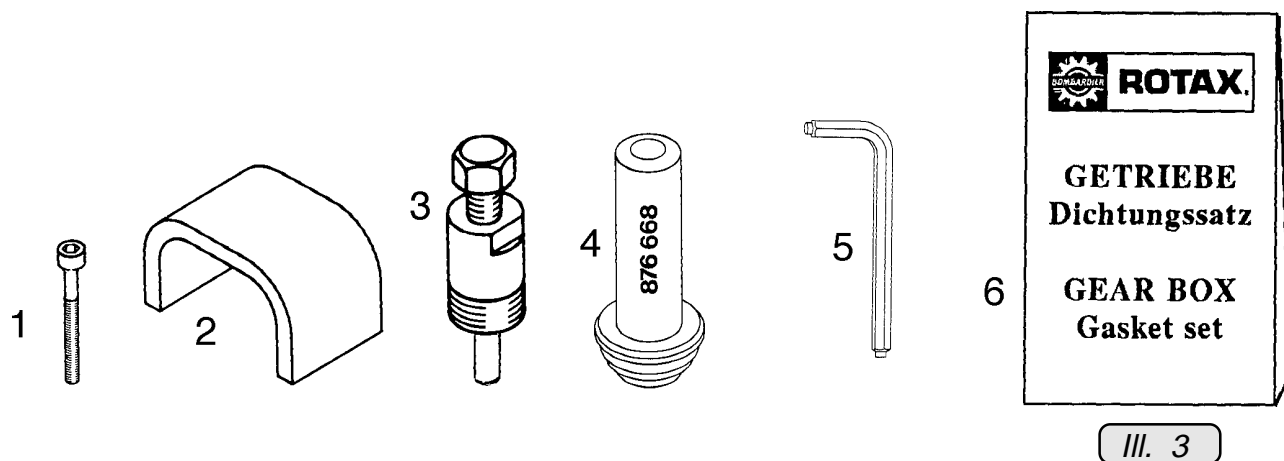




III. no	Part no.	Description	Qty.
1 - 9	876 932	Repair tools .....	1
1	876 195	Tool bag .....	1
2	876 640	Crankshaft fixation bolt .....	1
		<i>for crankshaft</i>	
3	876 210	Socket wrench (box spanner) 21x26 .....	1
4	977 420	Bolt (Tommy bar) 8x130-10 .....	1
		<i>for socket wrench</i>	
5	876 227	socket wrench (box spanner) 10X13 .....	1
6	977 425	Bolt (Tommy bar) 6X130-10 .....	1
		<i>for socket wrench 10x13 MM</i>	
7	276 065	Fork wrench (open end spanner) 10X13 .....	1
8	876 200	Screw driver .....	1
9	852 091	Starter rope 5,5x2110 .....	1
10-11	876 740	Trestle assembly .....	1
11	876 746	Mounting plate with detent .....	1
12	876 940	Gauge adapter .....	1
13	841 771	Set screw M6x8 .....	1
14	876 950	Precision gauge .....	1
15	876 945	Gauge pin .....	1
16	277 150	Degree disk .....	1
		<i>for rotary valve timing</i>	
17	277 905	Wrench .....	1
18	876 080	Puller plate .....	1
		<i>to hold the magneto flywheel</i>	
19	940 591	Hex. screw M8x20 DIN 933 .....	3
		<i>for magneto flywheel</i>	
20	876 065	Puller M42x1,5 assy., .....	1
		<i>for magneto flywheel</i>	
21	977 475	Ring half .....	2
		<i>for ball bearing 6207, crankshaft p.t.o. side</i>	
22	276 025	Ring half .....	2
		<i>for ball bearing 6206, crankshaft magneto side</i>	
23	977 490	Ring .....	1
		<i>for ring halves</i>	
24	876 569	Distance ring 72/105/28 .....	1
		<i>for puller</i>	
25	876 552	Protection mushroom .....	1
		<i>for crankshaft p.t.o. side</i>	
26	876 557	Protection mushroom .....	1
		<i>for crankshaft magneto side</i>	
27 - 28	876 298	Puller assembly .....	1
		<i>for ball bearings</i>	

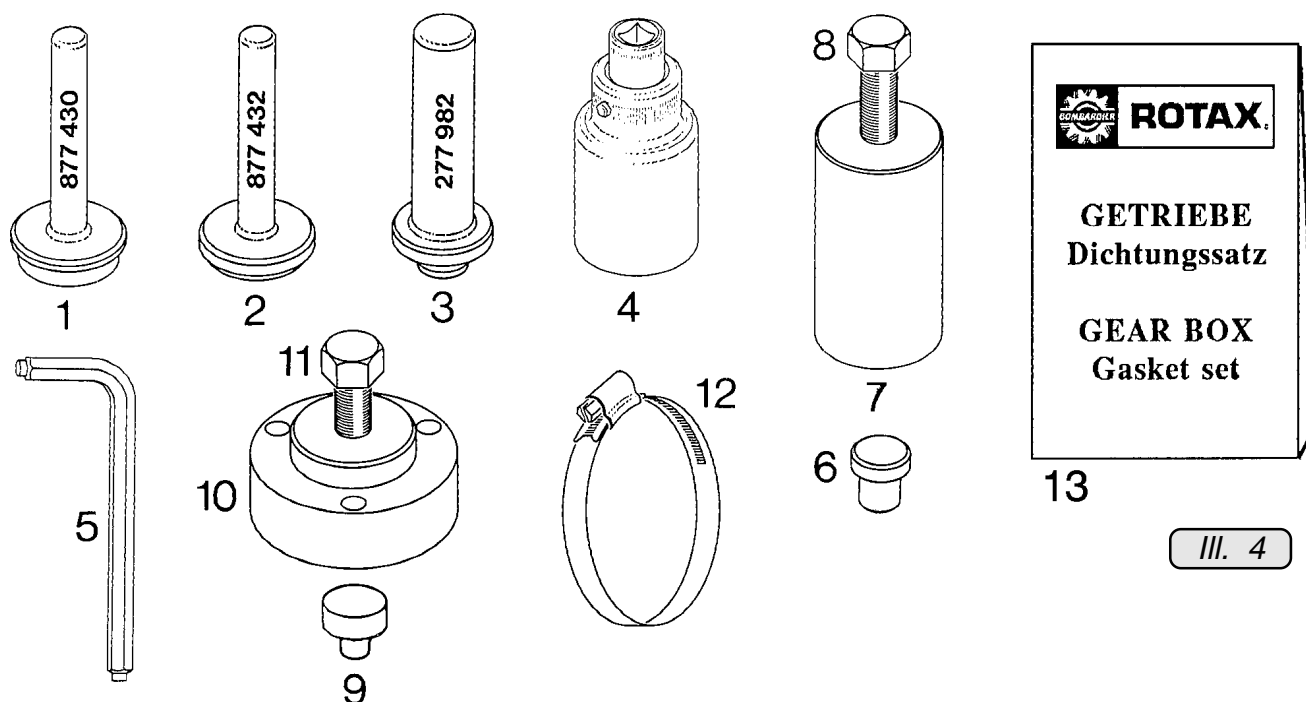
Ill. no	Part no.	Description .....	Qty.
28	940 755	Hex. screw M16x1,5x150 .....	1
29	841 201	Hex. screw M8X70 .....	4
30	876 572	Aligning tool ..... <i>for cylinder</i>	1
31	876 902	Aligning tool ..... <i>for cylinder exhaust flange</i>	1
32	876 612	Extrusion jig ..... <i>for rotary valve shaft 937 962, 10 mm</i>	1
33	876 980	Guide sleeve ..... <i>for rotary valve shaft 937 962, 10 mm</i>	1
34	876 500	Insertion jig ..... <i>for ball bearing, rotary valve shaft</i>	1
35	876 602	insertion jig for oil seal 930 580, ..... <i>rotary valve shaft and supporting plate 827 975</i>	1
36	876 607	Insertion jig ..... <i>for oil seal 930 580, rotary valve shaft with oil pump drive and supporting plate 827 975.</i>	1
37	876 512	Insertion jig ..... <i>for inner oil seal 850 710, rotary valve shaft 10 mm (0,4 in.)</i>	1
38	877 052	Insertion jig ..... <i>for outer oil seal 850 710, rotary valve shaft 10 mm (0,4 in.)</i>	1
39	877 030	Rubber protection mat. .... <i>for crankcase</i>	1
40-43	877 090	Piston pin extractor assembly .....	1
41	877 040	Expansion sleeve .....	2
42	877 155	Extracting nut assembly. ....	1
43	877 180	Locating sleeve .....	2
44-45	877 015	Circlip installation tool assembly ..... <i>for fitting of piston pin circlip 18 mm (0,71 in.)</i>	1
44	877 020	Circlip installation sleeve .....	1
45	877 010	Circlip installation pusher .....	1
46	994 428	Gasket set, <i>for the engine 462 UL</i> .....	1
46	994 436	Gasket set, <i>for the engine 532 UL</i> .....	1
46	886 230	Gasket set, <i>for the engine 582 UL</i> .....	1

### 3.3) Special service tools and gasket set for reduction gearbox "A" and "B":



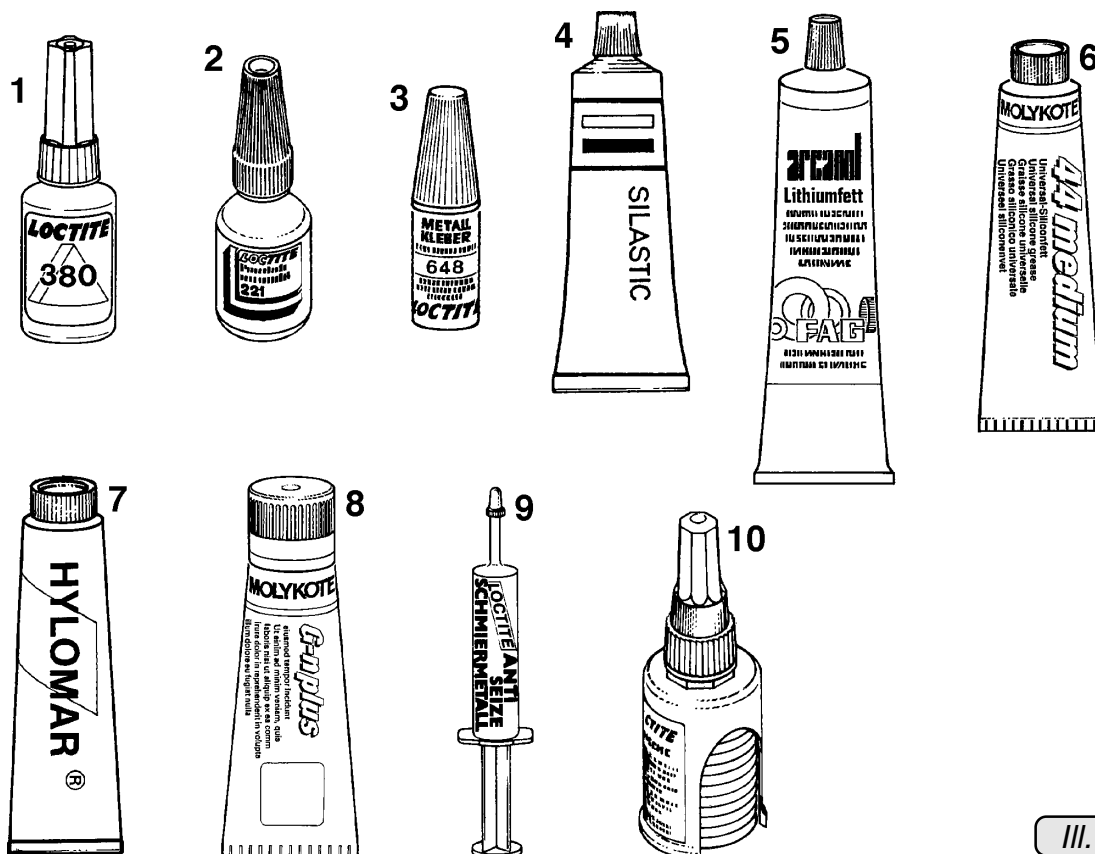
III. no	Part no.	Description	Qty.
1	241 875	Allen screw M6x70/45 ..... <i>to remove the gear cover</i>	1
2	876 880	Mounting bracket <i>to compress the dog gear</i> .....	1
3	276 808	Puller assy. M 28x1 ..... <i>for drive gear, for l=2,00, l=2,24 and l=2,58</i>	1
4	876 668	Insertion jig assembly ..... <i>for oil seal 850 055, propeller shaft</i>	1
5	277 817	Allen key 8 .....	1
6	995 781	Gasket set <i>for the reduction gearbox</i> .....	1

### 3.4) Special service tools and gasket set for the reduction gearbox "C":



III. no	Part no.	Description	Qty.
1	877 430	Insertion jig assembly ..... <i>for oil seal 35x47x7 930 715, on propeller-shaft</i>	1
2	877 432	Insertion jig assembly ..... <i>for oil seal 32X47X7 950 080 in gearbox-housing</i>	1
3	277 982	Insertion jig assembly ..... <i>for oil seal 35x47x7 930 675 in gearbox-housing</i>	1
4	877 445	Socket wrench assy. (41 mm) <i>for hex. nut M30X1,5 842 575</i> .....	1
5	277 817	Allen key with pilot, 8 mm .....	1
6	877 415	Protection mushroom, <i>for propeller-shaft</i> .....	1
7 - 8	877 375	Puller assembly..... <i>to remove the lay shaft-gear thread 46x1,5</i>	1
8	940 755	Hex. screw M16X1,5X150 DIN 961 .....	1
9	876 552	Protection mushroom for <i>crankshaft p.t.o.-side</i> .....	1
10 - 11	877 425	Flywheel puller assembly .....	1
11	941 680	Hex. screw M16x1,5x56.....	1
12	851 160	Clamp 90-110 .....	1
		<i>for mounting the rubber coupling 958 960</i>	
13	995 775	Gasket set, <i>for the reduction-gearbox "C"</i> .....	1

### 3.5) Lubricating-, securing- and sealing agents:



III. 5

III. no	Part no.	Description	Qty.
1	897 511	LOCTITE 380 black ..... 20 g., for securing of ignition cable	1
2	899 785	LOCTITE 221 violet, 10 cc ..... <i>Low strength bond</i>	1
3	899 788	LOCTITE 648 green, 5 g. .... <i>High strength bond</i>	1
4	297 386	SILASTIC 732 RTV, 100 g. ....	1
5	897 330	LITHIUM-base grease, 250 g. .... <i>to prevent leakage current</i>	1
6	897 166	MOLYKOTE 44 medium, 100 g. .... <i>silicone grease</i>	1
7	897 241	PERMANENT PLASTIC SEALING COMP., 100 g. ....	1
8	297 433	MOLYKOTE G-N, 100 g. .... <i>slide paste</i> .....	1
9	297 431	LOCTITE Anti-seize 10 g. .... <i>to prevent fretting corrosion</i>	1
10	899 784	LOCTITE 574 orange, 50 cc ..... <i>sealing compound</i>	1

## 4) Powerplant in aircraft:

### 4.1) Removal of engine from the aircraft:

Prior to removing engine from aircraft, carry out the following:

- Cool down engine first
- Disconnect battery
- Drain cooling system, detach coolant hoses if necessary and remove radiator

▲ **WARNING:** Never drain or refill cooling system when engine is hot!

- If rewind starter is fitted, detach starter rope guides.
- Remove exhaust system along with support.
- Remove throttle control.
- Block fuel line from tank to pump (close fuel tap), pull off fuel line from pump and carburetor.
- Disconnect oil supply- and oil return line, if oil container for rotary valve drive is not attached to engine.
- Disconnect oil supply line for engines with fresh oil lubrication (applicable only on Type 582 UL with fresh-oil lubrication).
- Mark and disconnect electrical wiring, where necessary.
- Remove air filter and/or intake silencer.
- Lift out engine from bulkhead.

■ **REMEMBER:** Sever wire on every wire-secured bolt before removal!

### 4.2) Re-installation of engine into aircraft:

Generally, reverse removal procedures. However, pay attention to the following:

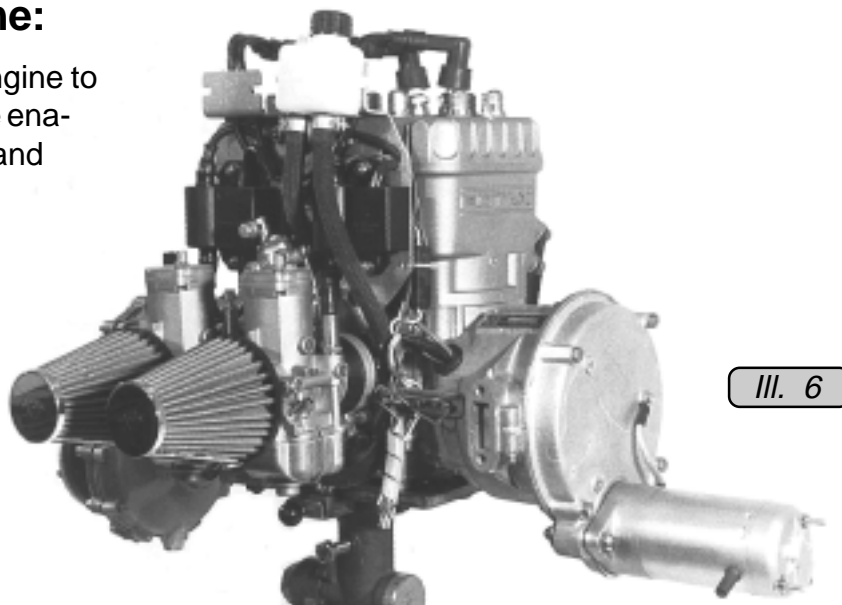
- Check carburetor Bowden cables for easy movement.
- Check throttle and starting carburetor control.
- Synchronize setting of carburetor pistons.
- Connect and check electrical wiring.
- Check condition and tight connections of oil- and coolant lines.
- Check oil- and coolant level.
- Vent oil- and cooling circuit.
- Check routing of fuel lines.
- Check condition and tightness of fuel lines and connections.
- Check radiator support.
- Ensure tight suspension of engine and exhaust system.
- Trial run or running-in period per operator's Manual, in case top end of engines or other parts in need of breaking-in, have been renewed.

■ **ATTENTION:** Ensure that all the suspension screws are tightened and wire-secured where applicable. Don't connect battery before all the installation is complete and ensure that ignition switch is in „OFF“ position.

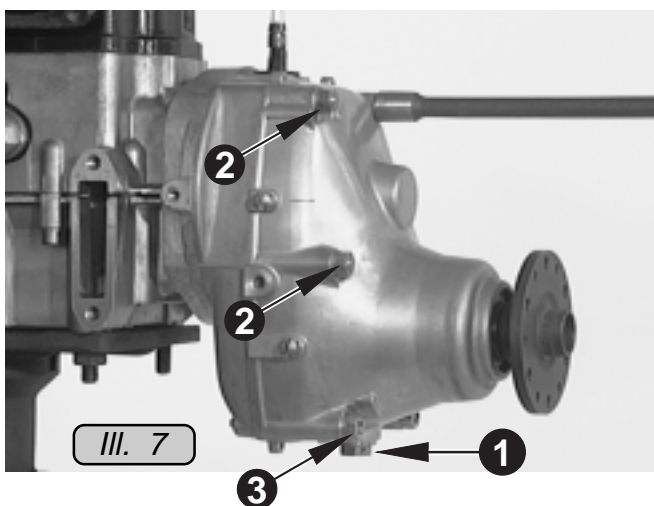
## 5) Disassembly of engine:

Attach drained and cleaned engine to trestle by M10 nuts. This trestle enables the engine to be turned and tilted during engine repair.

Remove carburetor after marking position as fitted and slackening of hose clamps.



### 5.1) Removal of reduction gearbox „A“:



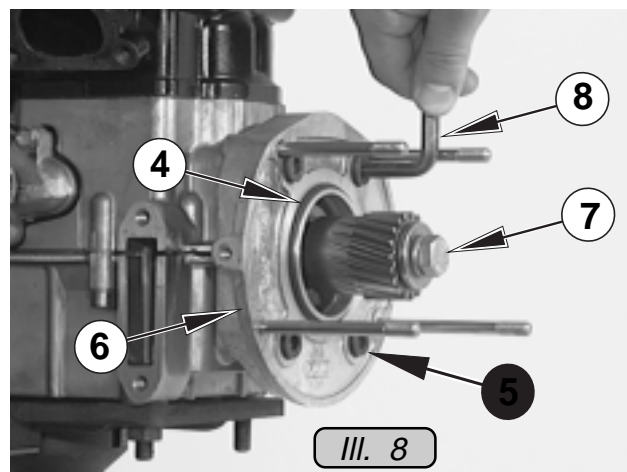
Open drain plug ❶ and drain gear oil into suitable tray (0,5 l). Remove the 4 nuts ❷ M8 holding the gearbox in position on adaptor.

The two lower nuts M8 ❸ may remain for the time being.

Carefully pull off gearbox ass'y, take out O-ring ❹ from groove in adaptor, undo the 4 Allen screws ❺ M10x45 and remove adaptor ❻. Lock crankshaft by locking pin 876 640 ❸. Remove hex. hd. screw ❹ 1/2"-20 UNF x 50 along with lock washer and washer, fit puller ass'y 276 808 and pull off drive gear.

◆ NOTE:

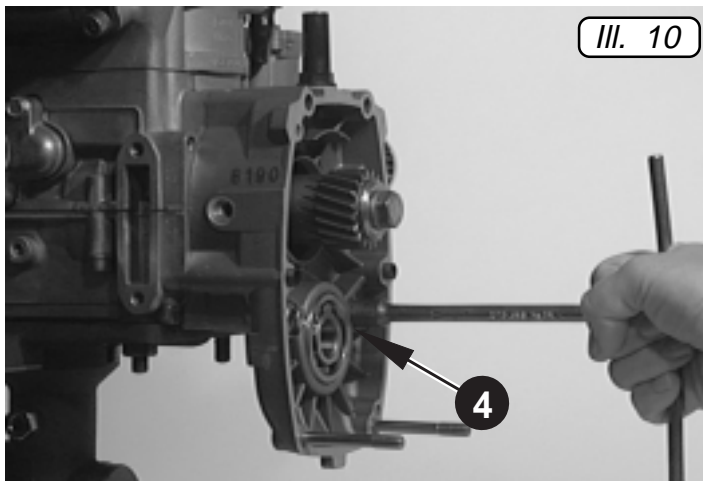
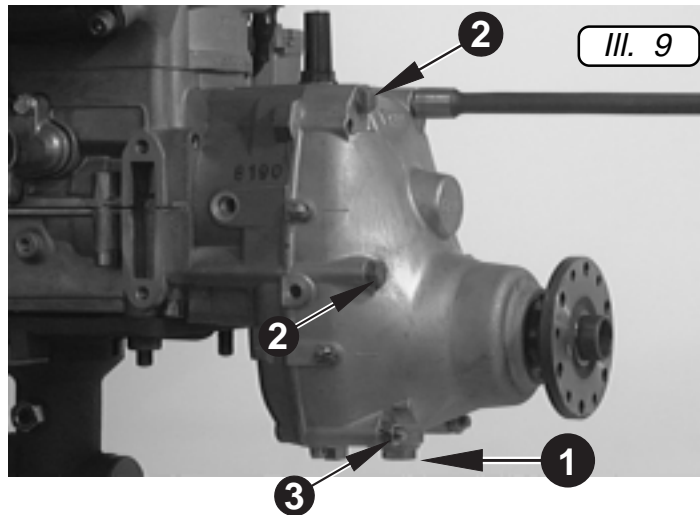
If required, preheat Allen screws ❺ locally with hot air gun. Use Allen key ❽ 277 817.



## 5.2) Removal of reduction gearbox „B“:

Remove drain plug ❶ and drain gear oil into suitable tray (0,5 l).

Remove 4 hex. hd. screws ❷ M8 and 2 hex. nuts ❸ M8, or 2 hex. hd. screws and 4 nuts along with lock washers. Withdraw gear cover assembly. If need be, tap carefully, using a mallet to remove cover.



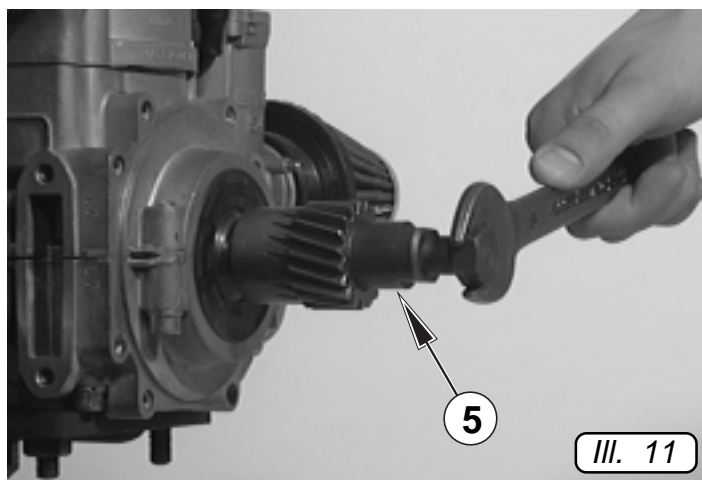
■ **ATTENTION:** If gear housing is attached with 6 fasteners, remove gear cover first.

Remove both inside located hex. hd. collar screws ❹ M8x65 (A/F 11). Take off gear housing and take out O-ring from groove.

Lock crankshaft by inserting locking pin 876 640 into pulse hose nipple and turning crankshaft until pin engages in crank blade recess.

Remove hex. hd. screw 1/2-20 UNF x 50 along with lock washer and washer. Place protection piece 876 552 on crankshaft, fit the puller ass'y ❺ 276 808 and pull off drive gear.

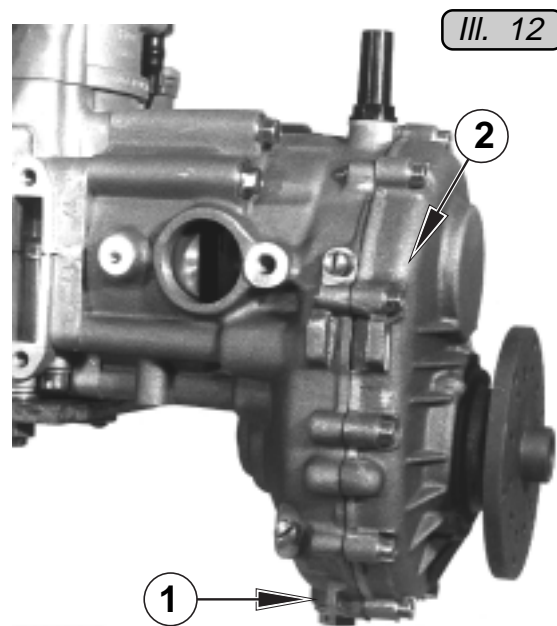
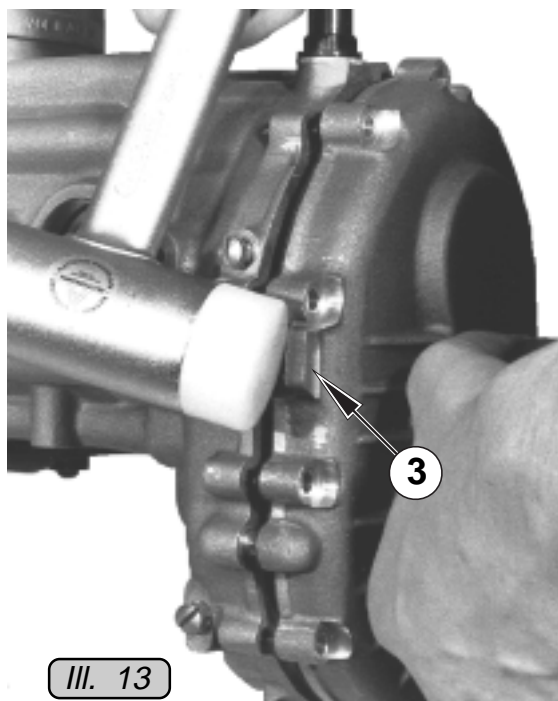
◆ **NOTE:** On a real tight fit, facilitate with a smart blow of the hammer to the puller screw. If necessary carefully pre-heat drive pinion by hot air gun.





### 5.3) Disassembly of reduction gearbox „C“:

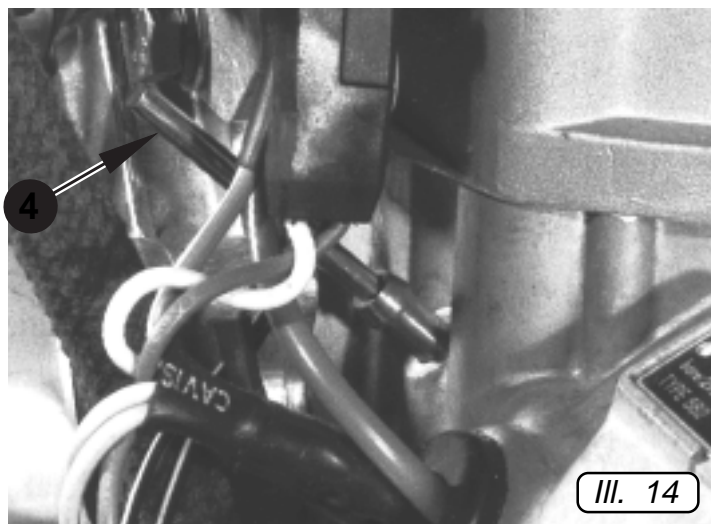
Undo drain plug ❶ and drain gear oil, c. 0,2 l.  
I. Remove 11 Allen screws ❷ M6x30 attaching gear cover to the gear housing.



Remove gear cover by tapping cover on the lugs ❸, using a mallet. Gear cover is kept in position by 2 dowel pins.

Lock crankshaft by inserting locking pin 876 640 ❹ into pulse hose nipple and turning crankshaft until pin engages in crank blade recess. With crankshaft locked in this manner, all attachment nuts and screws can be slackened or tightened.

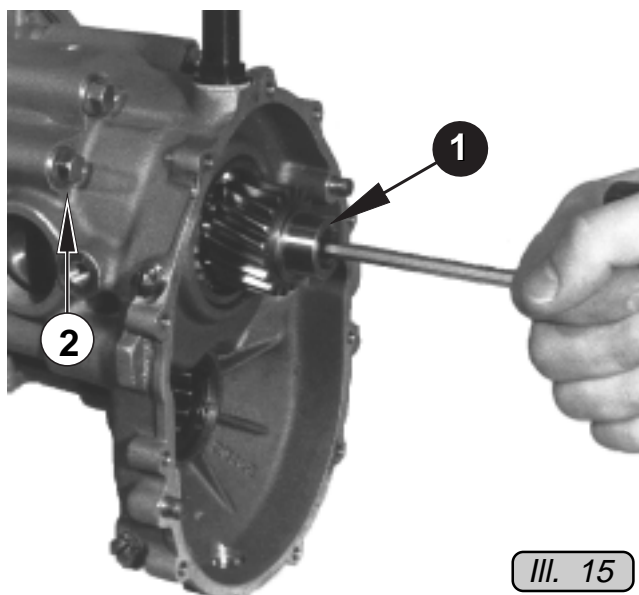
■ **ATTENTION:** Use genuine locking pin only, to prevent any damage to crankcase.



Remove Allen screw M8 x 35 and withdraw pinion shaft ❶.

◆ NOTE: Placed on the back-side of the pinion are the shims for proper axial distance of pinion shaft.

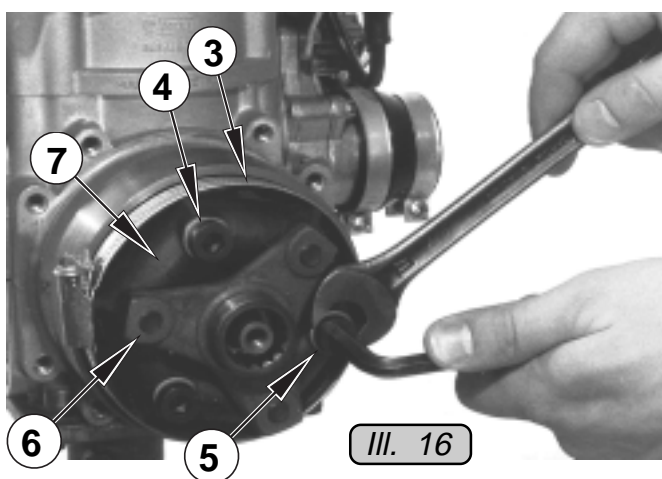
Remove the 8 hex. collar screws ❷, 4 of them inside the gearbox housing, using socket spanner 11 A/F and pull off gearbox housing.



III. 15

Fit worm-thread hose clamp 851 160 ❸ tight around rubber coupling and remove 3 Allen screws M10 x 45 ❹ using Allen key 8.

◆ NOTE: To prevent any damage to rubber coupling ❷, hold washer with flats ❺ in position, using open end spanner 17 A/F.

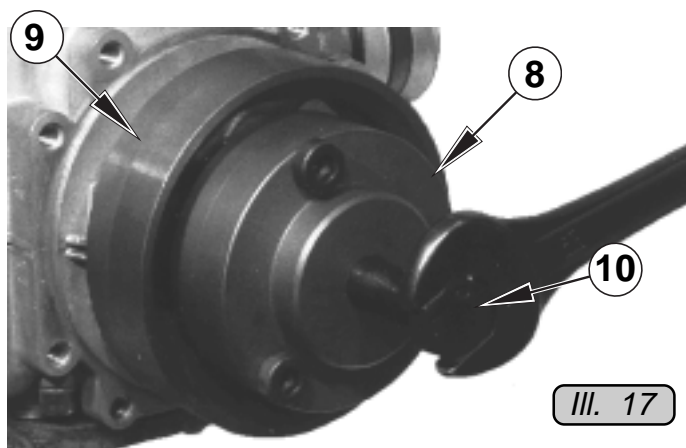


III. 16

Remove coupling flange ❹ together with the rubber coupling ❷ and afterwards hex. hd. screw 1/2-20 UNF x 30 along with washer. Slightly grease mushroom shaped protection piece 877 415, place it onto crankshaft and fit fly wheel puller ❸ 877 425 using hex. screws M10x45 and pull off fly-wheel ❹ by turning-in hex. hd. screw M16.

◆ NOTE: If need be, facilitate with a smart blow of the hammer to screw ❿.

Put aside flywheel and protection piece.



III. 17

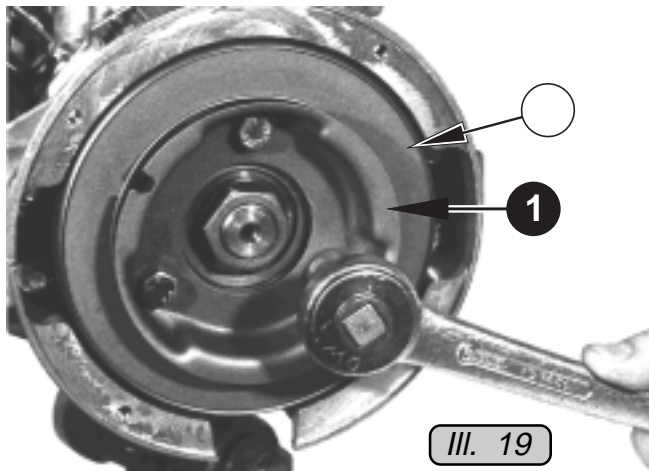
#### 5.4) Removal of rewind starter:

Note position of rewind starter. Remove 4 hex. hd. screws M6 x 14 along with lock washer and take off rewind starter ass'y. Detach the starter pulley ❶ by removal of the 3 hex. hd. screws M8x16 together with lock washer.

◆ NOTE: Crankshaft still locked!



III. 18

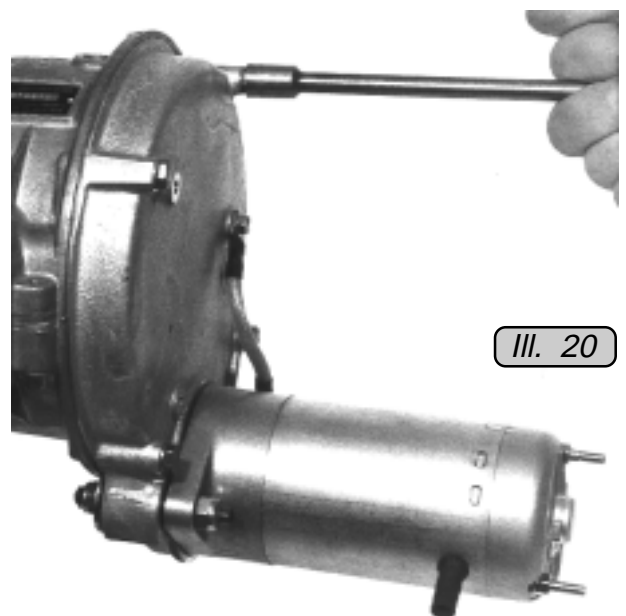


On engine type 582 UL, starting with engine no. 4,015.239 a hydraulic damper ❷ is fitted between magneto housing and starter pulley ❶, to suppress bending- and torsional vibration of crankshaft. Remove this damper if fitted.

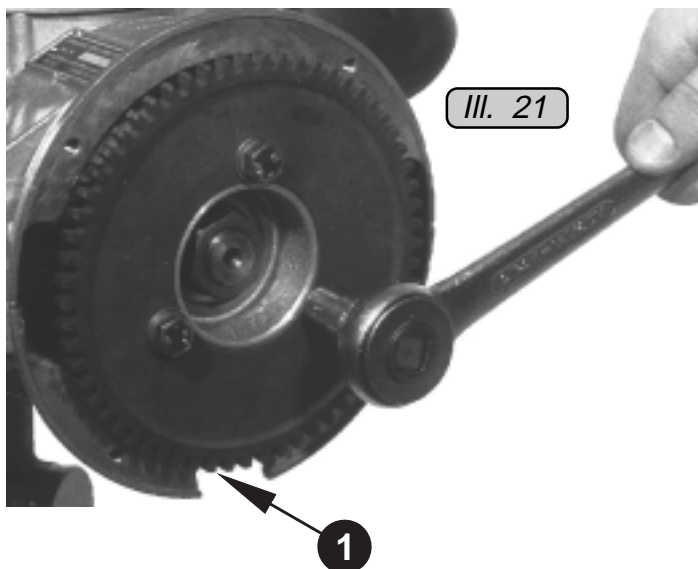
III. 19

#### 5.5) Dismantling of electric starter:

Before removing electric starter, record its position. Take off starter after removal of 4 hex. hd. screws M6 x 40 along with lock washer.



III. 20



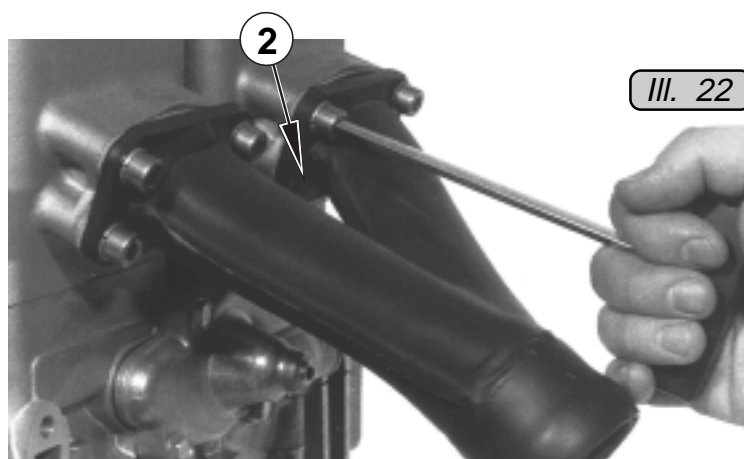
Loosen 3 hex. hd. screws M8 x 40 and remove starter gear ① and starter adaptor placed behind.

On engine type 582 UL, starting with engine no. 4,015.239 a hydraulic damper is fitted between magneto housing and starter gear adapter, to suppress bending- and torsional vibration of crankshaft. Remove this damper if fitted.

## 5.6) Removal of exhaust manifold:

Note position of exhaust manifold.

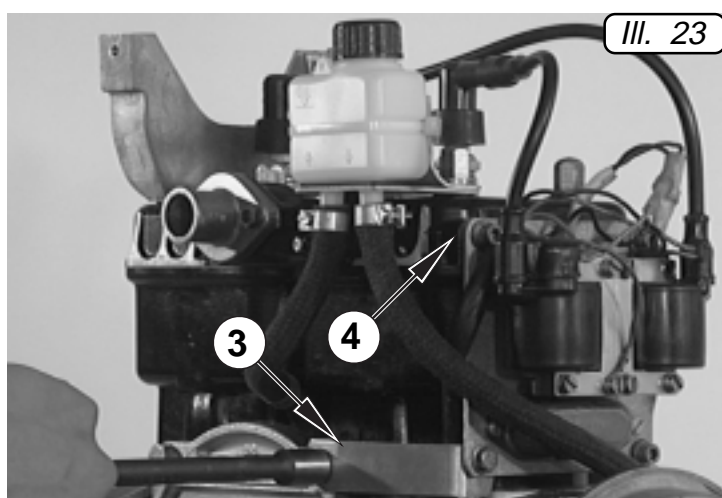
Undo Allen screws M8x30 and remove manifold along with gaskets. No screw fitted in position ② .



## 5.7) Removal of ignition coils support plate and disassembly of rotary valve:

### 5.7.1) Engine type 462 UL:

Undo hex. hd. screw M8 x 25, common for support tie ③ and rotary valve cover.



Mark wiring from charging coil to ignition coils prior to opening of connection and take off resistor-spark plug connectors, or shielded spark plug connectors.

Remove the 3 hex. hd. screws M6 x 22 and take off support plate ass'y with ignition coils and ignition damping box.

◆ NOTE: Take care of the spacers ④ behind the support plate.

Slacken clamp and remove oil supply hose.

◆ NOTE: Drain oil of rotary valve drive into suitable container.

Take off water outlet socket or water outlet bend by removing the 2 M6 hex. nuts along with lock washers and washers.

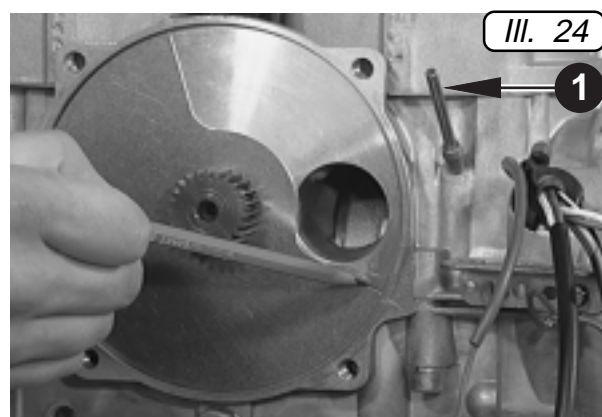
◆ NOTE: A thermostat might be fitted between water outlet piece and cylinder head (see Ill. 27).

Remove all 4 hex. hd. screws and washers attaching rotary valve cover on crankcase.

Remove all spark plugs and crankshaft locking pin ❶ and turn crankshaft into T.D.C. position of magneto side piston. Mark position of rotary valve as depicted and take off rotary valve.

■ ATTENTION:

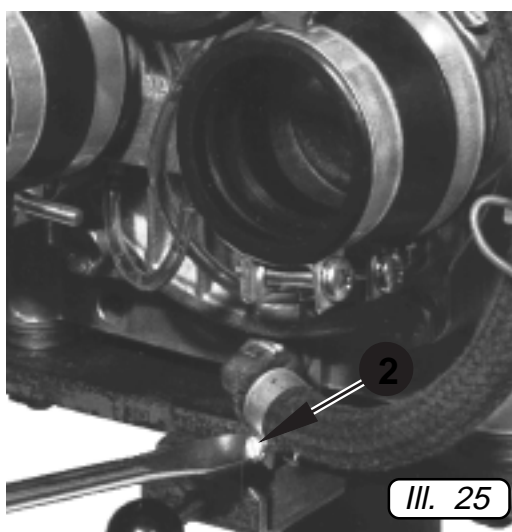
While removing rotary valve cover, hold rotary valve with a pencil for instance, in position ensuring it will remain on shaft, thus enabling to check if rotary valve timing was correct.



◆ NOTE: If locking pin is used on engine type 462 UL, position magneto side piston on T.D.C. On Engine type 532 UL and 582 UL, set piston to T.D.C on power take off side.

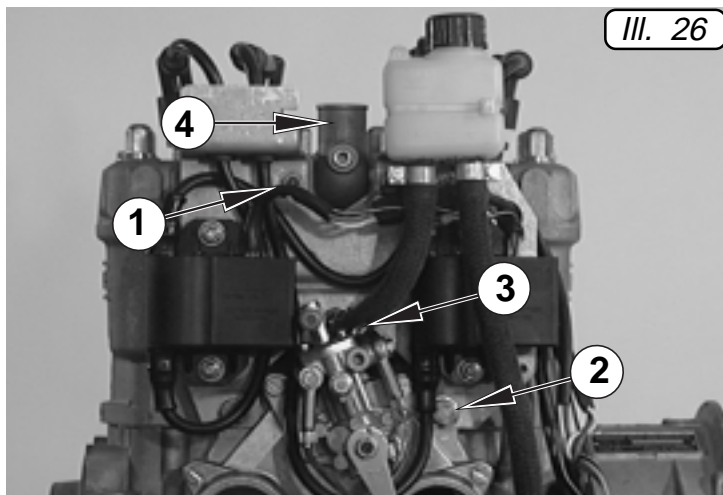
### 5.7.2) Engine type 532 and 582 UL:

Slacken hose clamp ❷ and remove oil supply line to rotary valve drive.



◆ NOTE: Drain oil of rotary valve drive (c. 0,3 l) into suitable container.





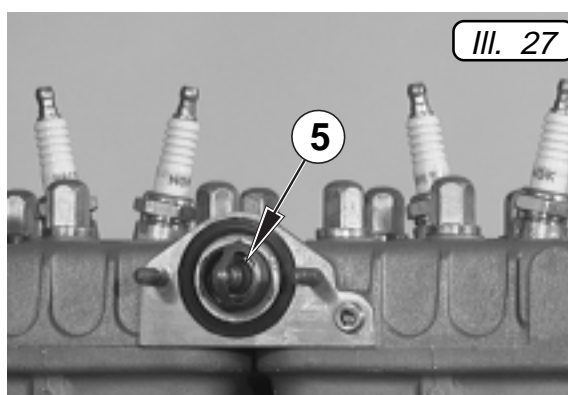
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It is advisable to detach supporting plate of ignition coils prior to the removal of oil hoses. For that undo the 2 nuts ❶ M6 and both hex. hd. screws ❷ M8x25 along with washers.

Sever all tie straps on oil lines and cables and open all wiring connections to electronic boxes or ignition coils. Take off all 4 spark plug connec-

tors, tilt ignition coils support assembly forward, slacken hose clamps and remove electronic boxes assembly together with oil tank and hoses. Remove water outlet socket or water outlet bend ❸ along with gaskets from cylinder head.

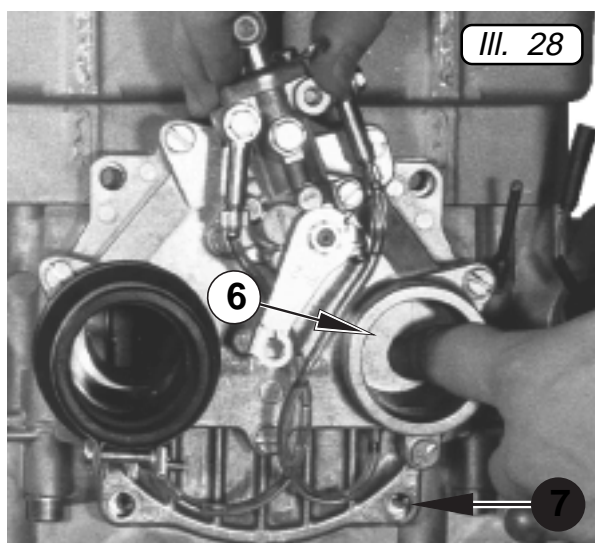
◆ NOTE: A thermostat ❺ might be fitted between water outlet piece ❹ and cylinder.



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Remove the last 2 hex. hd. screws ❷ and washers attaching rotary valve cover on crankcase.

Remove all spark plugs and crankshaft locking pin. Turn crankshaft into T.D.C. position of magneto side piston, mark position of rotary valve as shown on illustration 24 and take off rotary valve.



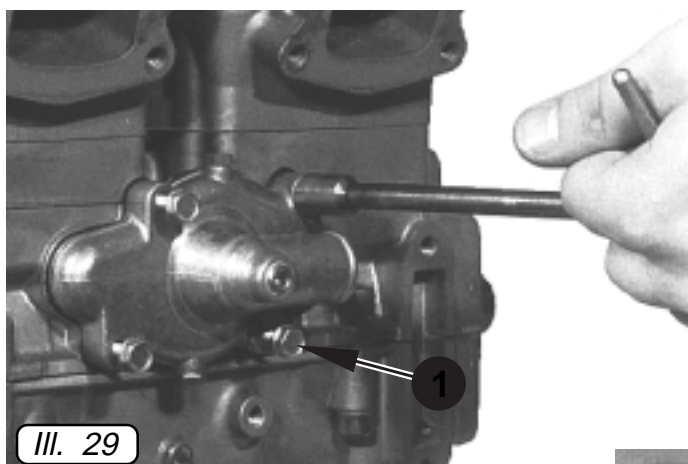
III. 28

■ ATTENTION: At removal of rotary valve cover hold rotary valve ❻ in position with a appropriate tool, thus ensuring that valve will stay on shaft enabling to check if rotary valve timing was correct.

▲ WARNING: "Do not" use finger to apply pressure on rotary valve, as injury may result.

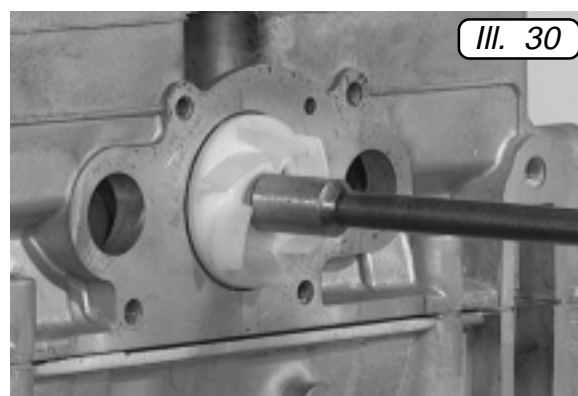
## 5.8) Disassembly of water pump:

Turn engine on trestle to face water pump, remove 4 TAPTITE screws ❶ M6 x 25 and take off water pump housing along with gasket.



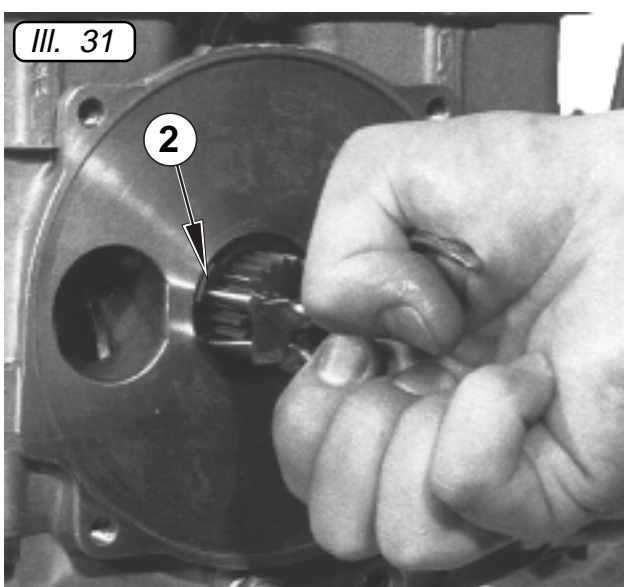
◆ NOTE: As pump housing can be fitted in two possible ways, mark position to ease re-assembly.

Lock crankshaft again by locking pin and remove lock nut followed by washer and impeller along with the friction washer and thrust washer placed behind impeller.



## 5.9) Disassembly of rotary valve shaft:

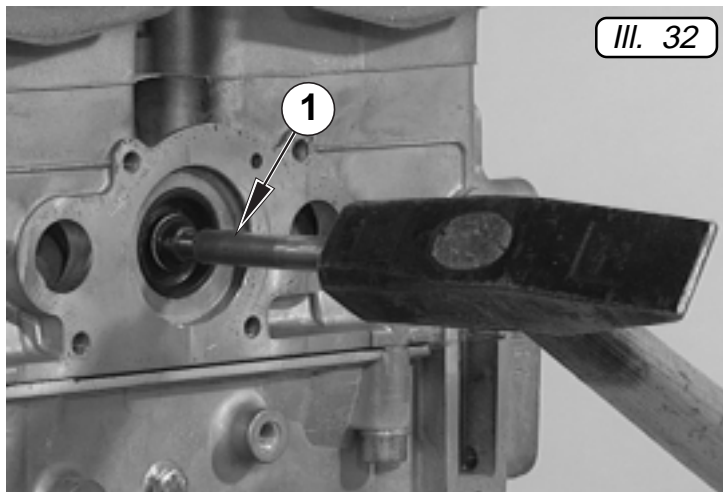
Prior to disassembly check backlash of rotary valve drive. Nominal backlash is 0,3 mm (.012 in.) but not exceeding 0,9 mm (.035 in.). See chapter "Assembly of rotary valve shaft".



There is no need to disassemble the engine completely if the removal of the rotary shaft only is necessary.

First extract the circlip ❷ 40x1,75 on the rotary valve side.

III. 32



Fit extrusion punch ❶ 876 612 (or 876 610 for the 12 mm valve shaft) to rotary valve shaft on water pump side.

Heat crankcase up to 60 - 70° C (140 - 160° F) around rotary valve and tap out rotary valve shaft ass'y.

◆ NOTE: Never use open flame to heat up crankcase!

If need be, the 2 oil seals on the water pump side could be exchanged now. If fitted remove first supporting plate, rubber washer and shim.

■ ATTENTION: Whilst tapping out the shaft, ensure to maintain vanishing line to prevent bending of the rotary valve shaft.

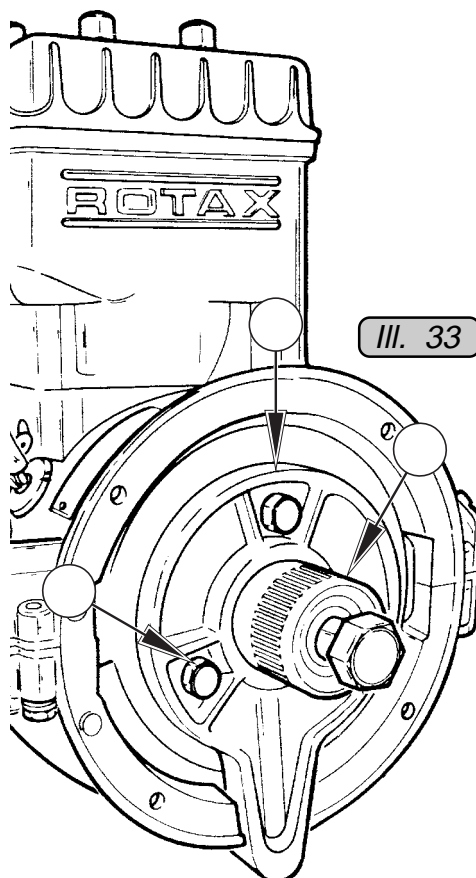
### 5.10) Disassembly of BOSCH ignition unit:

With crankshaft locking pin in position, remove hex. nut M22 x 1,5 by ring spanner (30 A/F). Take off hex. nut along with spring washer A 22 and withdraw crankshaft locking pin. Slightly grease mushroom-shaped protection piece 876 557 and place on crankshaft end. Attach puller plate ❷ 876 080 to magneto housing, using 3 hex. hd. screws ❸ M8x20.

■ ATTENTION: Don't use any longer screws because they would damage coils.

Fit the puller ❹ 876 065 right to the end of the thread into puller plate ❷ 876 080, and pull off magneto housing by turning in puller screw, using spanner 24 A/F. On a really tight fit, a blow with a hammer might be effective.

If it won't come off even then, help to break LOCTITE bond by heating up evenly and carefully, using a hot-air gun, being careful not to apply too much heat and damaging stator assy.

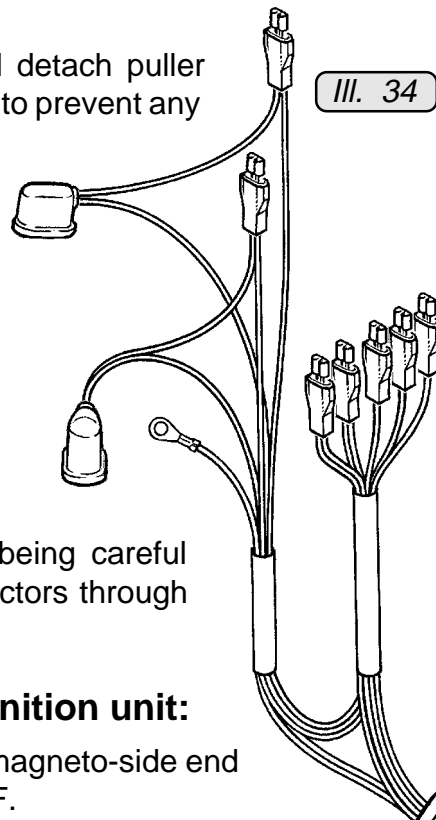




Take off flywheel assembly and detach puller plate. Put aside flywheel in a way to prevent any metallic matter to collect on magnets. Remove Woodruff key from crankshaft end.

Mark stator plate assembly to crankcase, so there won't be any need for a new adjustment, at reassembly.

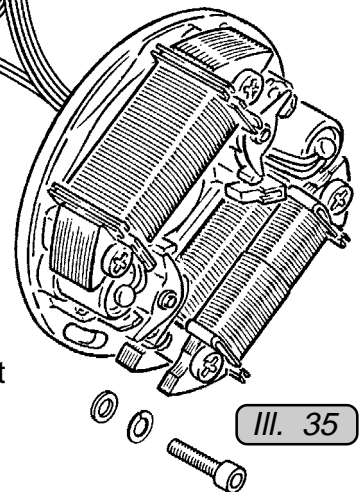
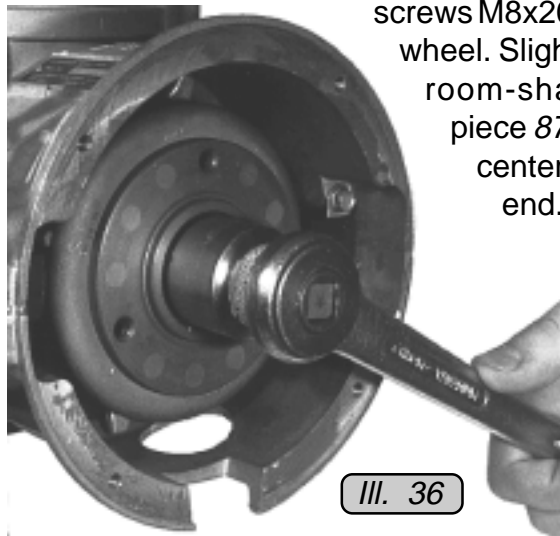
Remove both Allen screws M5 x 8 attaching stator plate to crankcase, remove cable grommet and pull out stator plate assembly, being careful when passing cables and connectors through the opening in crankcase.



### 5.11) Disassembly of DUCATI ignition unit:

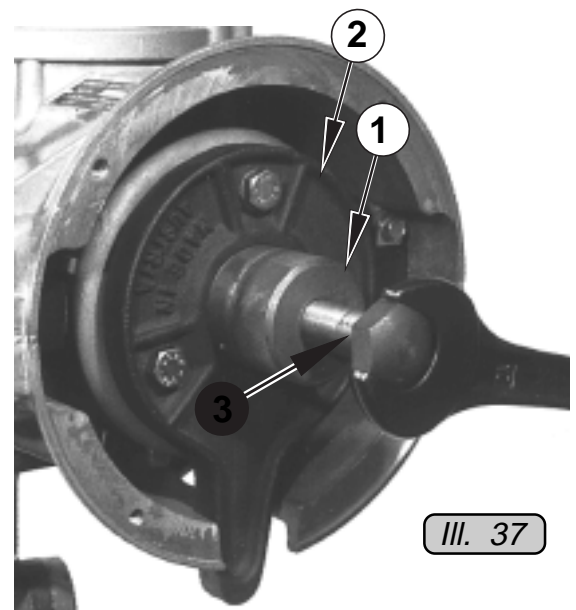
Detach hex. nut M22 x 1,5 from magneto-side end of crankshaft using socket 30 A/F.

Withdraw crankshaft locking pin and attach puller plate 876 080 with 3 hex. hd. screws M8x20 to magneto flywheel. Slightly grease mushroom-shaped protection piece 876 557 and place in centering on crankshaft end.



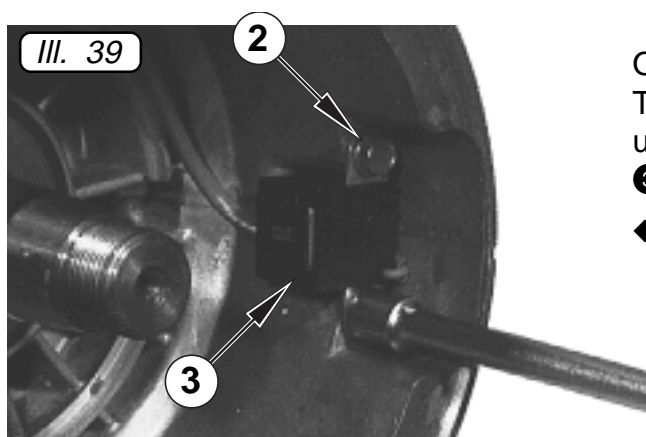
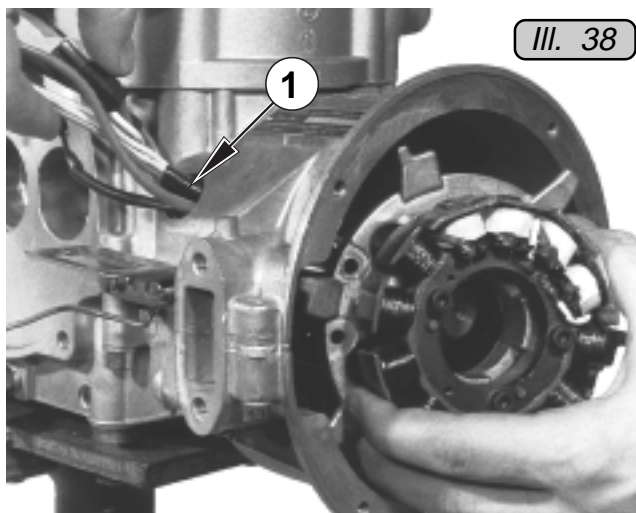
Fit the puller ① 876 065 right to the end of the thread into puller plate ② 876 080. Pull off flywheel by turning puller screw ③ clockwise assembly and detach puller ass'y.

■ **ATTENTION:** Put down magneto flywheel in a manner to ensure that no chips or other metallic matter will collect on the magnets.



Remove cable grommet ❶ from crankcase. After marking stator plate to crankcase and removal of both Allen screws M5 x 18 along with washers, pull out stator plate together with coil kit.

■ **ATTENTION:** Be careful when passing the cables and the connectors through opening in crankcase.



On engine type 582 UL: Loosen both TAPTITE screws ❷ M5x16 attaching pick-ups to crankcase and remove pick-ups ❸.

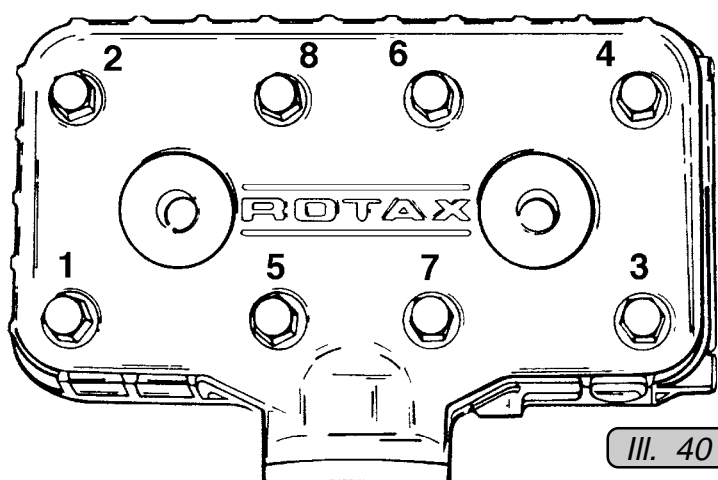
◆ **NOTE:** Both pick-up assemblies are identical, except for the cable length.

## 5.12) Removal of cylinder head (type 462):

Slacken all 8 cap nuts crosswise from outer to inner nuts according to sketch and take off cylinder head along with O-rings for combustion chamber and rubber ring for water jacket.

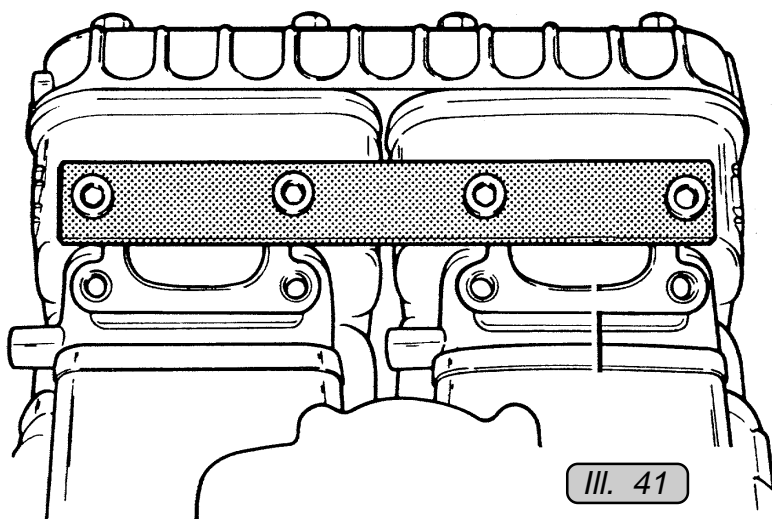
Only on type 462 UL, common studs are used to attach both, the cylinder head and the cylinder.

■ **ATTENTION:** Slacken cylinder head nuts on cold engine only.



◆ NOTE:

Once the cylinder head has been loosened, the cylinders have to be re-aligned by applying aligning tool on exhaust flanges, prior to further reassembly.

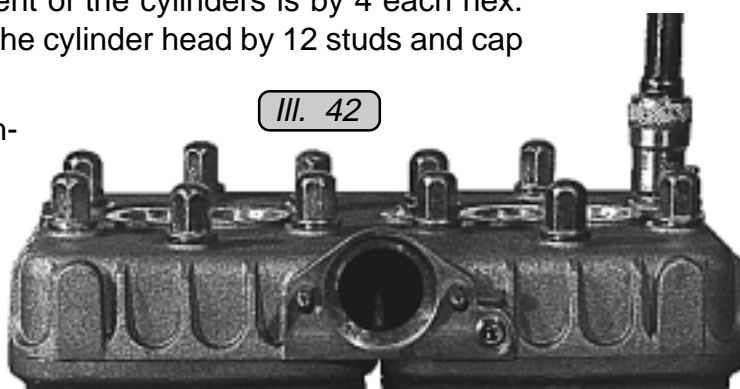


### 5.13) Removal of cylinder head (type 532 and 582):

Contrary to type 462 UL, on the type 532 UL beginning with engine serial no. 3,722.454 and type 582 UL the attachment of the cylinders is by 4 each hex. collar screws and securing of the cylinder head by 12 studs and cap nuts.

Slacken cylinder head attachment nuts crosswise, beginning with the outer towards the inner nuts. Lift off cylinder head. Take off O-rings at compression chamber and rubber rings for water jacket.

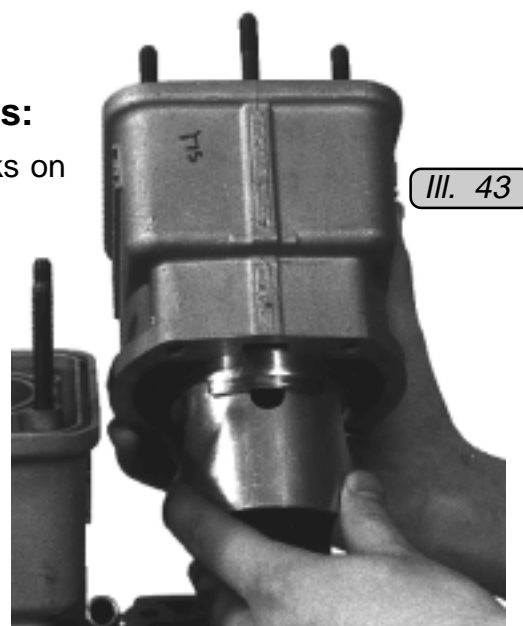
On engine type 582/32 kW version only: Take off gasket for water jacket.



### 5.14) Disassembly of cylinders and pistons:

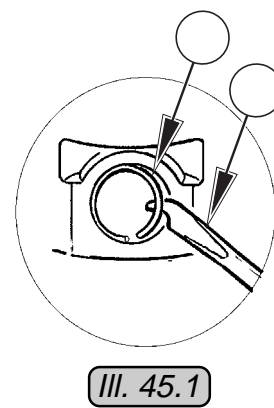
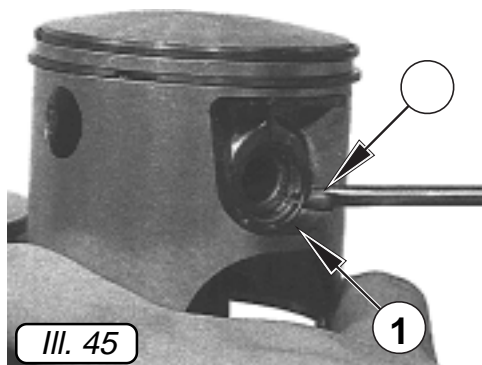
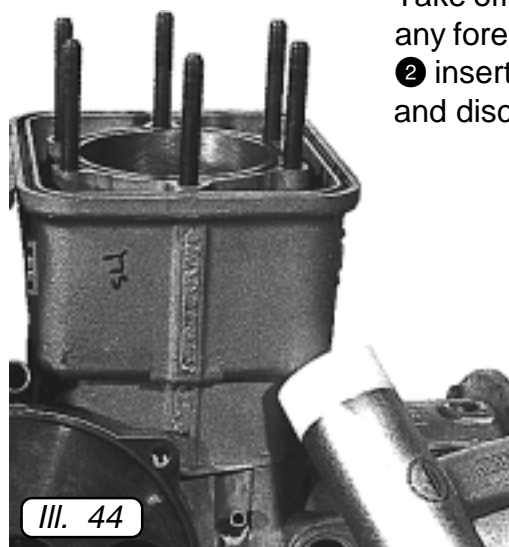
Prior to disassembly place coordination marks on cylinder and piston to ensure their matched running in case of re-use.

Remove 4 cap nuts and washers, or beginning with engine no. 3,722.454 four hex. collar screws per cylinder and lift off cylinder. Whilst removing cylinder, support piston by hand to make sure that a tilting piston won't damage crankcase sealing face.



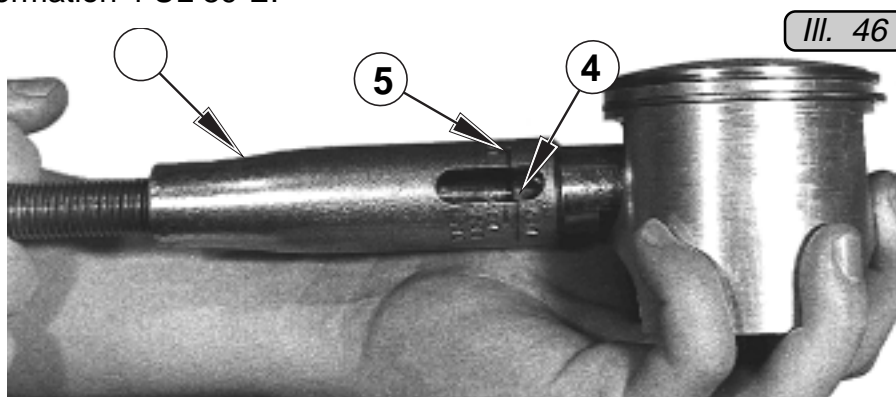
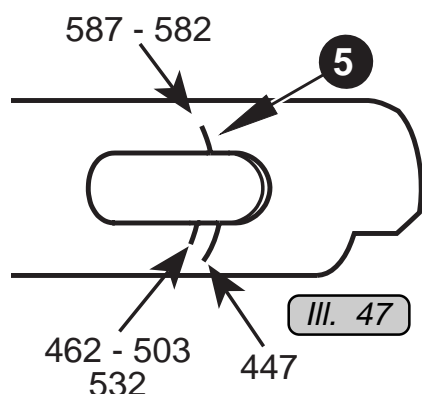
◆ NOTE: If need be, slacken cylinder by mallet.

Take off cylinder base gasket. Cover crankcase completely to avoid any foreign matter from dropping into crankcase. With a pointed tool ② inserted in piston notch, remove piston pin circlips ① from piston and discard them.



◆ NOTE: Disassembling the pistons from one side only renders the removal of both piston pin circlips unnecessary.

Insert the piston pin extractor tool ③ 877 090 into piston pin and fit expansion sleeve and extracting nut onto extractor spindle. By turning the spindle, pull out piston pin until its end ④ aligns with the engine-specific mark ⑤ on extractor sleeve. For further details consult Service Information 4 UL 89-E.



◆ NOTE: When pulling out piston pin, end of pin ④ will be clearly visible in window of extractor sleeve.

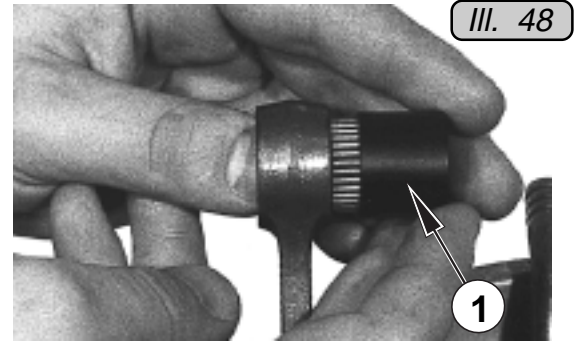
In the window of the extractor sleeve, 3 engine-specific marks are engraved. When pulling out the piston pin, the expansion sleeve will be pulled in instead, thus keeping bearing needles as well as thrust washers in position in conrod.

Once the piston pin is pulled out, remove extracting nut and withdraw extraction tool. Finally, take off piston.

◆ NOTE: Make absolutely sure not to drop any bearing needle or thrust washer into crankcase.

The needles, thrust washers and expansion sleeve located in the small end of the conrod can be pushed out into a plastic tube ❶ (as supplied with new bearing) and stored this way for further use. Repeat procedure on second piston.

- **ATTENTION:** Store needle bearing without fail coordinated with piston.



### 5.15) Disassembly of crankcase:

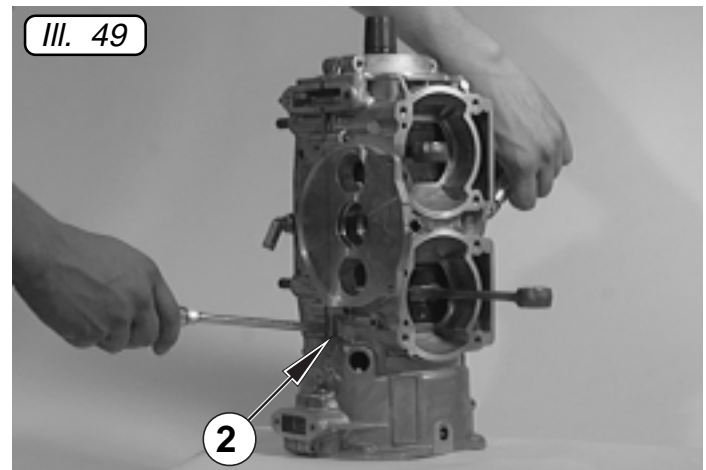
Remove bottom end of engine from trestle and put it down on magneto side.

Loosen all fasteners, starting from outside towards inside. Split crankcase in its 2 halves by twisting with 2 large screwdrivers between the reinforcement ribs ❷ at joint face. Remove one crankcase half carefully. After that, hold crankshaft at both ends with somebody tapping loose the remaining half, but without hitting sealing face.

- ◆ **NOTE:** Don't place crankshaft halves on sealing face, it could get scratched or damaged.

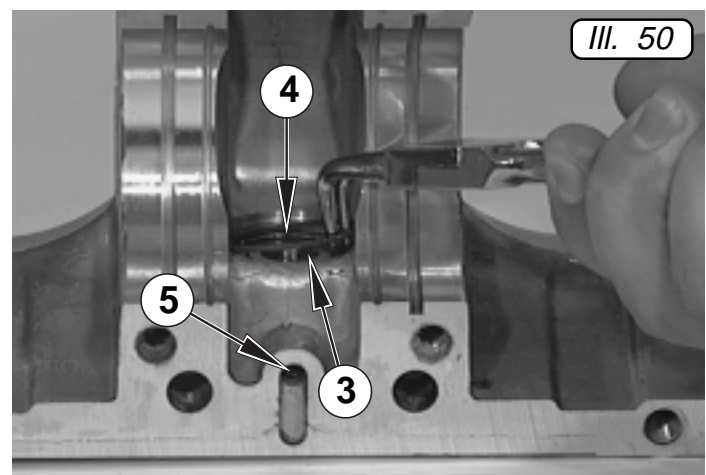
Remove the retaining ring ❸ at rotary valve shaft bearing (fitted in engine type 532 beginning with engine serial no. 3,877.848 and on type 582 starting with engine serial no. 3,957.335).

Heat up top half of crankcase in the vicinity of rotary valve shaft bearing to  $60 \div 70^{\circ} \text{C}$  ( $140 \div 160^{\circ} \text{F}$ ) and push out bearing ❹ using punch 877 052.



The leakage bore ❺ of waterpump is plugged by a threaded pin, thus enabling to fill the free space between oil seals with grease.

On the type 462 a grease nipple is fitted additionally facilitating to grease installed oil seals.



## 6) Cleaning of engine components:

▲ **WARNING:** Caution - be aware of vapours when handling with gasoline or solvent. Inhalation of these vapours is injurious to your health.

Generally, clean all metal components except the crankshaft with cleaning agent or kerosene. Remove remains of LOCTITE from sealing faces like crankcase halves with sealant stripper. Don't use cold cleaning- or degreasing agents. Pay special attention to the cleaning of oil ducts in crankcase. Take extra care cleaning the crankshaft and ensure that it won't get soiled, as normally the crankshaft won't be taken to pieces.

■ **ATTENTION:** Never use a sharp metal tool to remove remains of sealant from mating faces as score marks are detrimental to sealing faces.

Renew all gaskets, O-rings and oil seals.

Scrape off carbon formation from exhaust port in cylinder, cylinder head and piston dome and remove residue from piston ring grooves by using a piece of a broken piston ring.

Remove calcareous deposits on coolant side of cylinder walls. Deposits would reduce the heat transfer.

◆ **NOTE:** The word „AUS“ or the arrow on piston dome must be clearly visible after cleaning.

■ **ATTENTION:** Dust off ignition components by compressed air or cleaning rag.

For cleaning of used K & N filter see chapter "Air filter".



## 7) Inspection and judgement of components:

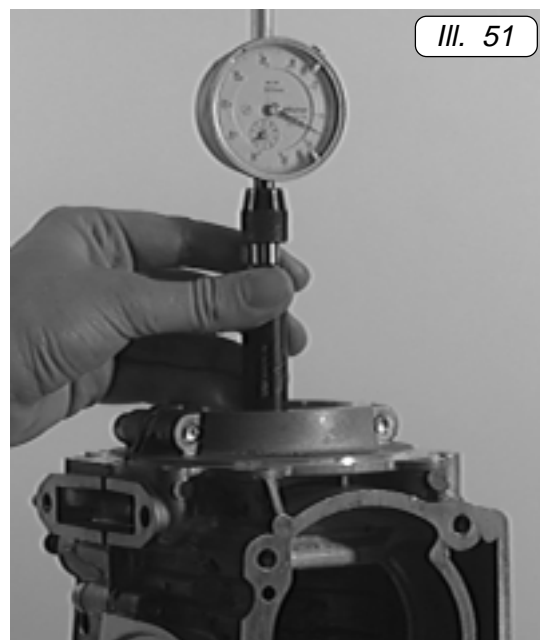
### 7.1) Crankcase:

- Clean crankcase. See Chapter "Cleaning of engine components".
- Check all tapped holes.
- Inspect mating face of rotary valve for wear and score marks.
- Visual check for cracks and traces for wear on bearing seats.
- Look for marks indicating that any of the bearing outer races had been rotating during engine operation.

#### 7.1.1) Measuring of crankcase:

For taking dimensions of the bearing seats, join crankcase halves, align with ball bearings and tighten screws as specified (M8 to 24 Nm, M6 to 10 Nm). Take readings in cylinder axis on all 3 bearing locations.

■ **ATTENTION:** All crankcase fasteners to be tightened, otherwise readings will be false.



Dimension	new mm	(in.)	wear limit mm (in.)
Bearing seat 72 Ø .....	71,94 ÷ 71,958	(2,832 ÷ 2,833)	71,96 (2,833)
Bearing seat 62 Ø .....	61,94 ÷ 61,958	(2,438 ÷ 2,439)	61,96 (2,439)
Ball bearing 6206 .....	61,987 ÷ 62,000	(2,440 ÷ 2,441)	61,987 (2,440)
Ball bearing 6207 .....	71,987 ÷ 72,000	(2,834 ÷ 2,835)	71,987 (2,834)
Interference .....	0,029 ÷ 0,060	(0,0011 ÷ 0,002)	0,027 (0,001)

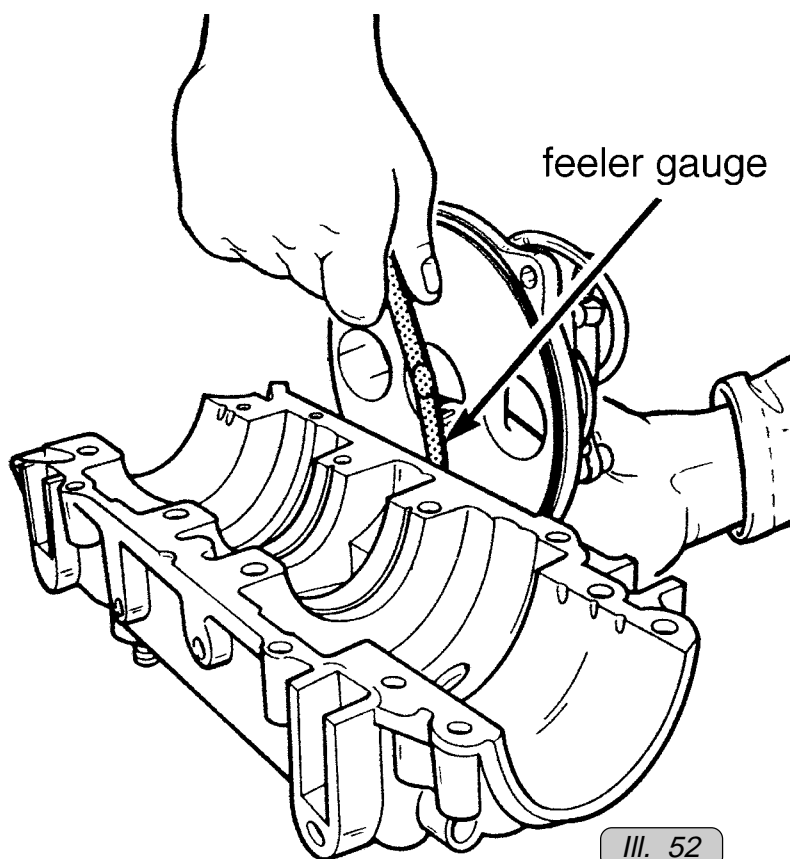
## Rotary valve clearance:

The clearance of rotary valve between cover and crankcase is decisive for starting behaviour. The bigger the clearance, the higher the starting speed

needed to compensate for losses. To determine the actual clearance at different spots, place putty evenly over face of crankcase and fit rotary valve and cover.

After removal of cover and valve, the thickness of the compressed putty represents the actual clearance. Wear occurs mainly in the vicinity of intake openings ❶.

Illustration 52 depicts another method to determine the clearance by feeler gauge.

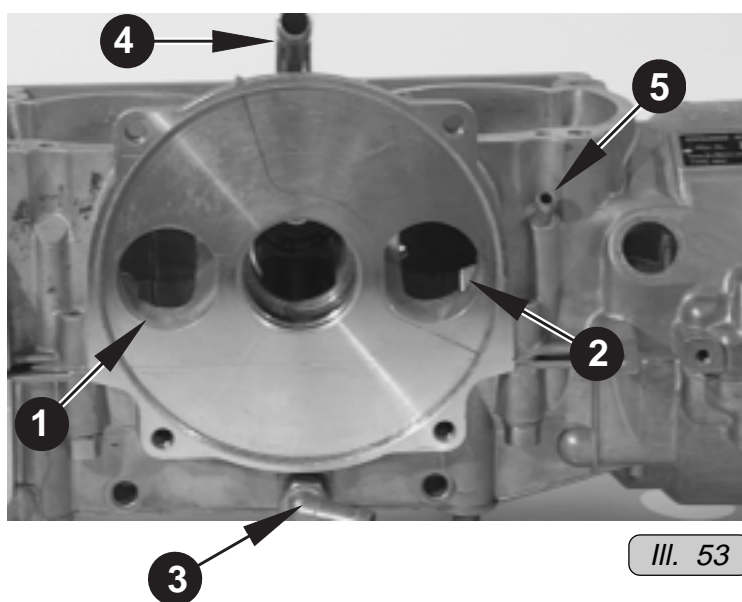


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Dimension	new	(in.)	wear limit mm (in.)
Rotary valve clearance (valve/crankcase)	0,25 ÷ 0,35	(0,010 ÷ 0,014)	0,45 (0,177)

◆ NOTE: In both intake ducts a cast deviation vane ❷ will prevent scavenging oil out of conrod bearing. Never cut off this vane.

Ensure tight fitting of oil supply and return line connection ❸ + ❹, and pulse nipple ❺. In case of a loose oil supply connection ❸ remove angular tube and re-fit properly sealed.

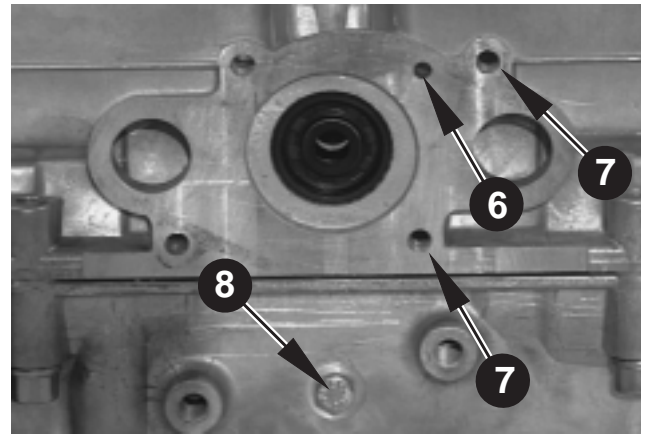


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Pay attention to free passage of venting bore ⑥ at water pump side. Check thread of tapped holes M6 ⑦ for attaching water pump housing. If need be, repair by using Heli-Coil inserts.

On the bottom crankcase half the vent screw M6 ⑧ for the rotary valve drive is located.



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## 7.2) Crankshaft:

The crankshaft, a built-up design with single components connected by pressfit is supported on 6 bearings (on 532 and 582), and on 5 bearings (on 462).

Remove both oil seals. Check outer bearings on p.t.o. side and magneto side for pitting. Renew as necessary.

### 7.2.1) Removal and inspection of crankshaft bearings:

Remove all O-rings from main bearings and labyrinth sleeve.

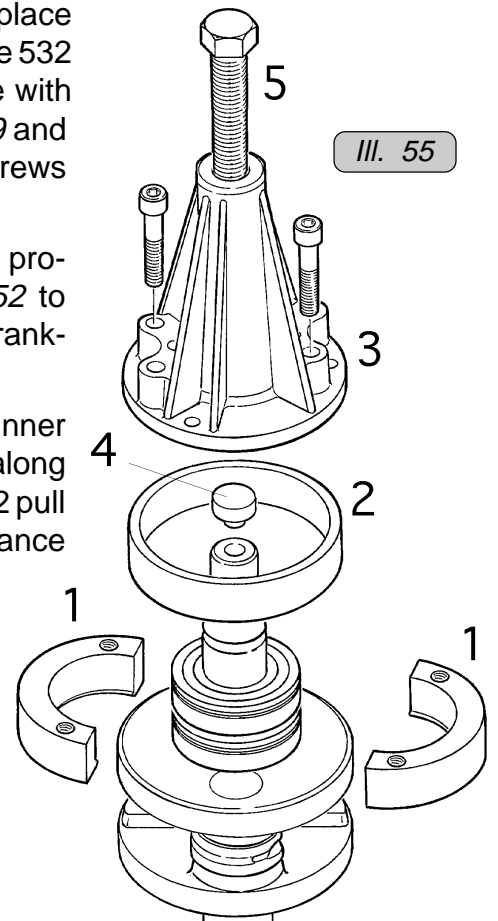
#### a) Power Take Off - side (PTO):

It is advisable to pull off both bearings together. Support crankshaft on magneto side and place the 2 ring halves ① 977 445 (for engine type 532 and 582) on the inner bearing and centre with ring ② 977 490. Fit distance ring 876 569 and puller ass'y ③ 876 298 using 4 hex. hd. screws M8 x 70.

■ **ATTENTION:** Use mushroom shaped protection piece ④ 876 552 to protect centering on crankshaft end.

On engine type 462 pull off outer and inner bearing separately. Take off distance tube along with retaining washer. On type 532 and 582 pull off both bearings together along with distance sleeve by turning hex. hd. screw ⑤ clock wise.

◆ **NOTE:** On engine type 462 different types of bearings may have been fitted; store them separately.



### b) Magneto side (MS):

Support crankshaft on PTO end and place the 2 ring halves 276 025 on the inner bearing (on engine 462 one bearing only) and centre with ring 977 490. Fit distance ring 876 569 and puller assembly 876 298 using 4 hex. hd. screws M8 x 70.

■ **ATTENTION:** Use mushroom shaped protection piece 876 557 for protection of centering on crankshaft end. To attach the ring halves use always 4 screws to avoid tilting of these halves.

Pull off bearing by turning in M16 hex. hd. screw until bearing can be taken off by hand.

Clean all taken off bearings in gasoline or kerosene. Check every bearing for smooth running.

It is advisable to renew a bearing even with only slight traces of wear or pitting. It is an advantage to renew all ball bearings in the course of an engine repair.

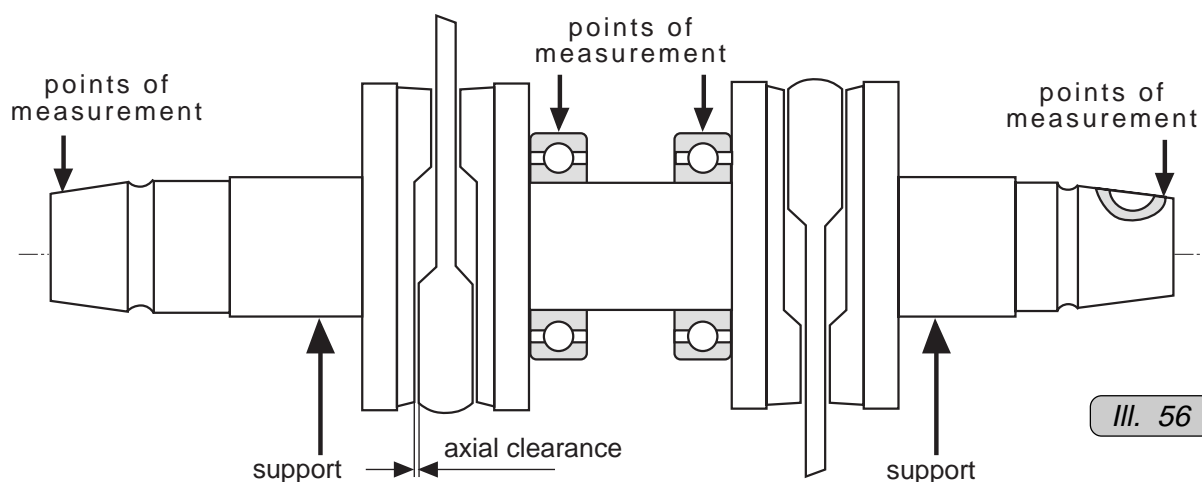
### c) Centre:

In case of faulty inner oil seals or bearings, renew crankshaft. If the oil consumption of the rotary valve drive is above 1 cc/hour, the possible reason could be leaking inner oil seals, allowing oil to reach the crank space, and it is burnt during combustion process. More likely reason would be leaking at crank case sealing.

Rebuilding of a crankshaft is carried out at ROTAX only. Look for and remove from the drive gear for rotary valve possible abrasion of the mating bronze gear.

### 7.2.2) Checking of crankshaft alignment:

With crankshaft supported on the outer bearing seats, concentricity at the inner bearings to be within 0,08 mm (.003 in.) on a used crankshaft. On a new crankshaft excentricity is limited to 0,05 mm (.002 in.). Readings may be taken with bearings fitted.



### 7.2.3) Radial- and axial clearance of conrod:

Examine big end of conrod for wear (pitting, discoloration etc.).

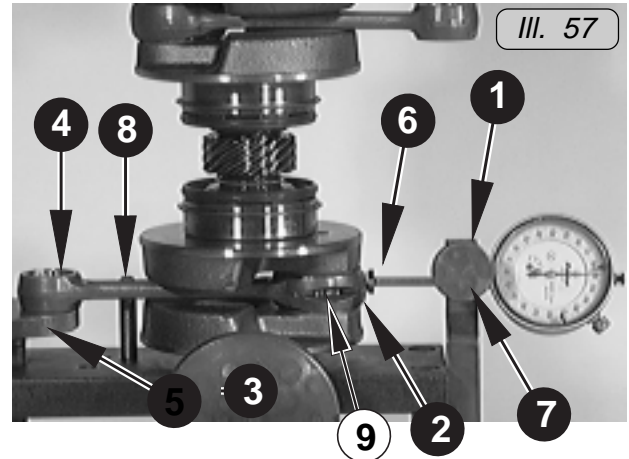
Check axial clearance by feeler gauge.

To check radial clearance utilize dial gauge and suitable fixture. Prior to check, clean conrod bearing in gasoline and blow out. Place crankshaft assembly in measuring fixture ①, turn crankshaft to set big end of conrod ② to B.T.C. and clamp shaft by screw ③. To have conrod positioned parallel to crankblade and to avoid tilting, lift small conrod end ④ by the adjustment screw ⑤.

This set up is important for proper checking of the max. radial clearance.

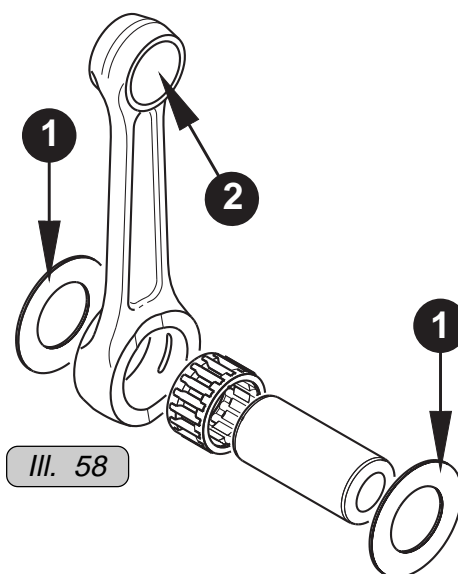
Fit dial gauge ⑥ and clamp with screw ⑦. Press conrod to the right and set dial gauge to 0. Subsequently move conrod to the left, along stop pin ⑧ and observe dial gauge.

Repeat readings a few times and note radial clearance.



If axial- or radial clearance exceeds wear limit or at indication of pitting, detectable through lubrication slot ⑨, exchange crankshaft or have it rebuilt at Rotax.

Dimensions	new mm	(in.)	wear limit mm (in.)
Conrod, big end .....	30,014 ÷ 30,023	(1,1816 ÷ 1,1820)	..... 30,03 (1,1823)
Crank pin .....	23,994 ÷ 23,997	(0,9446 ÷ 0,9448)	..... 23,99 (0,9445)
Radial clearance .....	0,020 ÷ 0,033	(0,00079 ÷ 0,0013)	..... 0,05 (0,00197)
Axial clearance .....	0,400 ÷ 0,727	(0,0157 ÷ 0,0286)	..... 1,00 (0,0394)

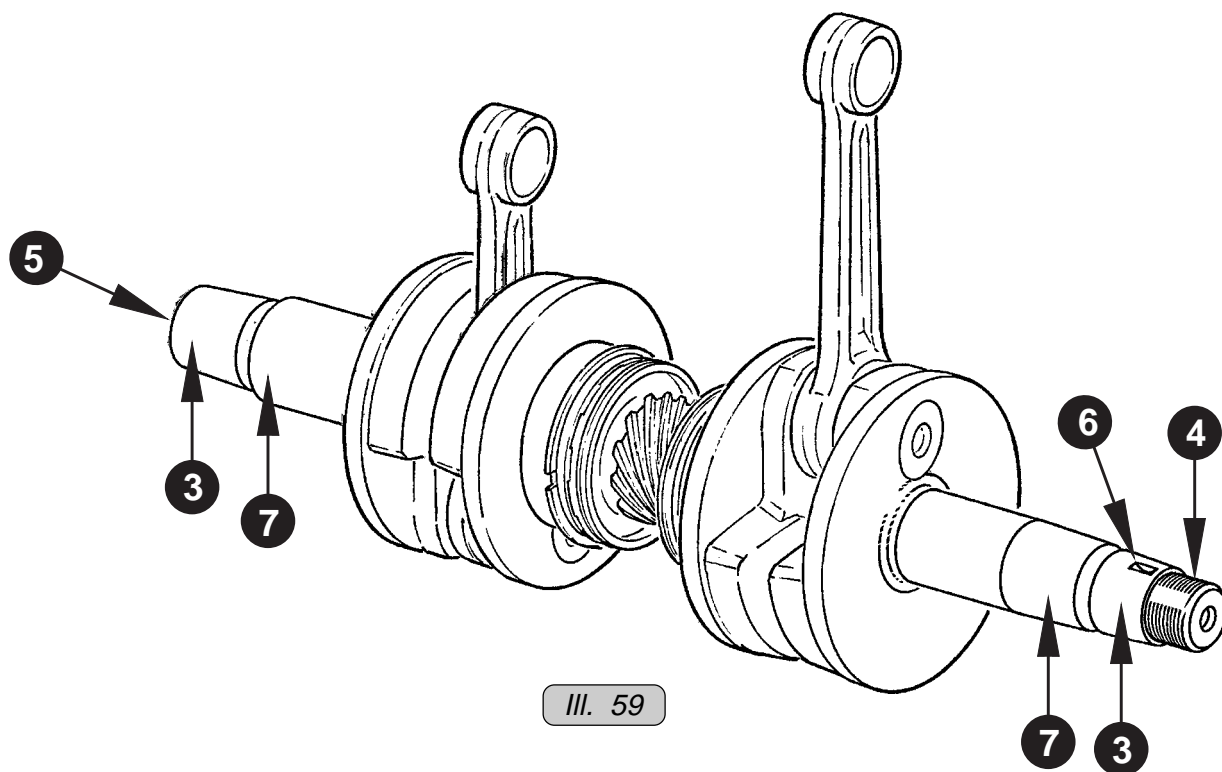


A likely reason for badly worn thrust washers ① could be a not exactly true running conrod. Visual check of the small end ② of conrod.

There are some ways to check a conrod for true running. An easy and quick way, on the condition that the crankshaft is still fitted in the crankcase, is the following:

Remove the piston rings and fit cylinder. Move piston along piston pin to both sides of cylinderwall. A spring-back resilience indicates a not true running conrod and asks for exchange of the crankshaft.

- Check taper ③ on both ends of crankshaft.
- Check external ④ and internal ⑤ thread.
- Check groove ⑥ for Woodruff key on magneto-side.
- Inspect oil seal contact surface ⑦.
- Check crankshaft for concentricity.
- Check for adequate axial- and radial clearance of labyrinth sleeve.



Dimensions	new mm	(in.)	wear limit mm	(in.)
Conrod, small end .....	21,997 ÷ 22,005	(0,866 ÷ 0,866)	22,01	(0,867)
Piston pin .....	17,997 ÷ 18,000	(0,708 ÷ 0,709)	17,97	(0,707)
Radial clearance, piston pin .....	0,003 ÷ 0,012	(0,0001÷ 0,0005)	0,03	(0,001)
Crankshaft Ø, P.T.O. side .....	35,003 ÷ 35,013	(1,378 ÷ 1,379)	35,00	(1,378)
Ball bearing Ø, P.T.O., 6201 .....	34,988 ÷ 35,000	(1,377 ÷ 1,378)	35,00	(1,378)
Bearing clearance .....	0,015 ÷ 0,033	(0,0006÷ 0,0013)	0,05	(0,002)
Crankshaft Ø, magneto side .....	30,003 ÷ 30,013	(1,181 ÷ 1,182)	30,00	(1,181)
Ball bearing Ø, magneto side, 6206 .....	29,990 ÷ 30,000	(1,181 ÷ 1,181)	30,00	(1,181)
Bearing clearance .....	0,023 ÷ 0,041	(0,001 ÷ 0,0016)	0,06	(0,002)
Labyrinth sleeve clearance, radial .....	0,187 ÷ 0,257	(0,0074÷ 0,010)	0,40	(0,016)
Labyrinth sleeve clearance, axial .....	0,400 ÷ 0,600	(0,016 ÷ 0,024)	0,70	(0,028)

### 7.3) Cylinder:

Light alloy cylinder with shrink fitted cast iron liner. The use of a cast-iron liner allows rework for use of an oversize piston. An exchange of the liner is not planned.

#### 7.3.1) Inspection of the cylinder:

Clean and inspect all sealing faces. Clean both O-ring grooves and ensure tightly fitted cylinder head studs (tightening torque 7 Nm (62 in.lb.)). Remove carbon deposits from exhaust port.

Visual check of cylinder bore for scratches and seizing marks. Remove traces of a seizure and rests of aluminium and re-hone, but pay attention to maintain correct diameter. If out of tolerance, rebore and hone to next oversize.

◆ **NOTE:** On engine 462 UL one oversize and for engine types 532 UL and 582 UL a 1<sup>st</sup> and 2<sup>nd</sup> oversize is available. The increase of diameter is by 0,25 mm each time. For these oversize diameters, the suitable piston is readily available. Consult respective spare parts list.

### 7.3.2) Cylinder bore:

Cylinders are machined to 2 tolerance groups, marked on the spigot either red or green. The difference in bore dia. is 0,01 mm. Suitable pistons are available in the same colour code.

Dimension	new mm	(in.)	wear limit mm (in.)
out of round .....	0,00 ÷ 0,02	(0,00÷ 0,0008)	0,05 (0,002)
conicity .....	0,00 ÷ 0,03	(0,00÷ 0,0012)	0,08 (0,0032)

#### Type 462 UL

Cylinder (standard, red) .....	69,50 ÷ 69,51	(2,7362 ÷ 2,7366)	69,60 (2,74)
Cylinder (standard, green) .....	69,51 ÷ 69,52	(2,7366 ÷ 2,7370)	69,60 (2,74)
Cylinder (1 <sup>st</sup> oversize, red) .....	69,75 ÷ 69,76	(2,7460 ÷ 2,7464)	69,85 (2,75)
Cylinder (1 <sup>st</sup> oversize, green) .....	69,76 ÷ 69,77	(2,7465 ÷ 2,7469)	69,85 (2,75)

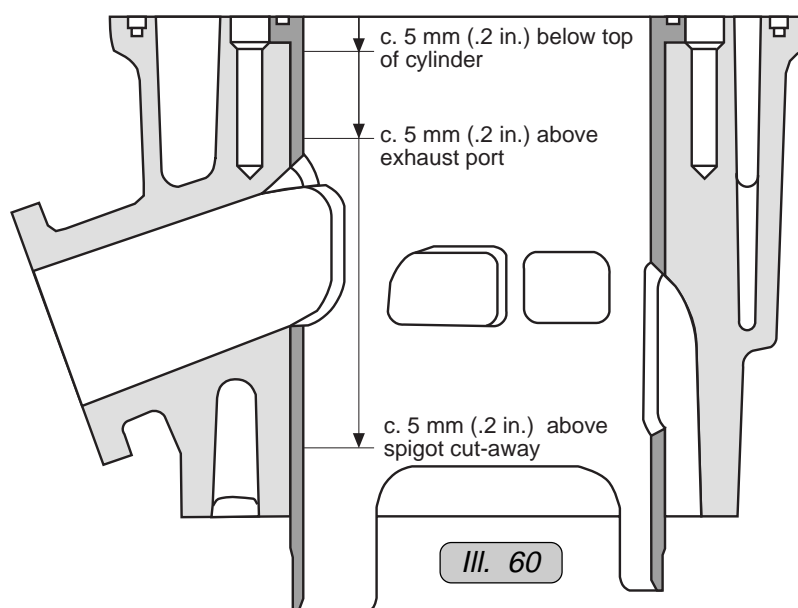
#### Type 532 UL

(standard, red) .....	72,00 ÷ 72,01	(2,835 ÷ 2,836)	72,10 (2,8385)
Cylinder (standard, green) .....	72,01 ÷ 72,02	(2,8350 ÷ 2,8354)	72,10 (2,8385)
Cylinder (1 <sup>st</sup> oversize, red) .....	72,25 ÷ 72,26	(2,8444 ÷ 2,8448)	72,35 (2,848)
Cylinder (1 <sup>st</sup> oversize, green) .....	72,26 ÷ 72,27	(2,8448 ÷ 2,8452)	72,35 (2,848)
Cylinder (2 <sup>nd</sup> oversize, red) .....	72,50 ÷ 72,51	(2,8543 ÷ 2,8547)	72,60 (2,858)
Cylinder (2 <sup>nd</sup> oversize, green) .....	72,51 ÷ 72,52	(2,8547 ÷ 2,8551)	72,60 (2,858)

#### Type 582 UL

Cylinder (standard, red) .....	76,01 ÷ 76,02	(2,9925 ÷ 2,9929)	76,10 (2,996)
Cylinder (standard, green) .....	76,02 ÷ 76,03	(2,9929 ÷ 2,9933)	76,10 (2,996)
Cylinder (1 <sup>st</sup> oversize, red) .....	76,26 ÷ 76,27	(3,0023 ÷ 3,0027)	76,35 (3,006)
Cylinder (1 <sup>st</sup> oversize, green) .....	76,27 ÷ 76,28	(3,0027 ÷ 3,0031)	76,35 (3,006)
Cylinder (2 <sup>nd</sup> oversize, red) .....	76,51 ÷ 76,52	(3,0122 ÷ 3,0129)	76,60 (3,016)
Cylinder (2 <sup>nd</sup> oversize, green) .....	76,52 ÷ 76,53	(3,0123 ÷ 3,013)	76,60 (3,016)

◆ **NOTE:** Diameter readings are taken in crankshaft axis and 90° across.



## 7.4) Piston:

Remove all piston rings by a pair of piston ring pliers and make sure to put them aside co-ordinated to piston inclusive position of top side of rings. Remove carbon deposits from piston crown and from the underside of piston, using a blunt tool. Clean ring grooves by a piece of a piston ring.

Check pistons for cracks, seizure or scuffing marks. Visual control of ring securing pins and of groove for piston pin circlip. Take readings of piston pin bore.

On the pistons for type 532 and 582 a hole of c. 14 mm dia. is in the piston skirt. Pre-compressed gases from the crankcase pass this hole and enter the combustion chamber via the boost port, thus increasing the volumetric efficiency and creating the cooling of the piston pin bearing.

◆ **NOTE:** On the piston crown the nominal dia, an arrow indicating the installation position and the code of the manufacturer are imprinted as well as a clearly visible colour mark for tolerance group.

### 7.4.1) Piston-to-wall clearance:

#### Type 462 UL

Dimension	new mm	(in.)	wear limit mm	(in.)
Cylinder bore, red .....	69,50 ÷ 69,51	(2,736 ÷ 2,737)	69,60	(2,74)
Cylinder bore, green .....	69,51 ÷ 69,52	(2,7366 ÷ 2,737)	69,60	(2,74)
piston dia., red .....	69,41 ÷ 69,42	(2,7326 ÷ 2,733)	69,32	(2,729)
piston dia., green .....	69,42 ÷ 69,43	(2,733 ÷ 2,7334)	69,32	(2,729)
piston-to-wall clearance .....	0,08 ÷ 0,10	(0,0315 ÷ 0,039)	0,20	(0,008)

#### Type 532 UL

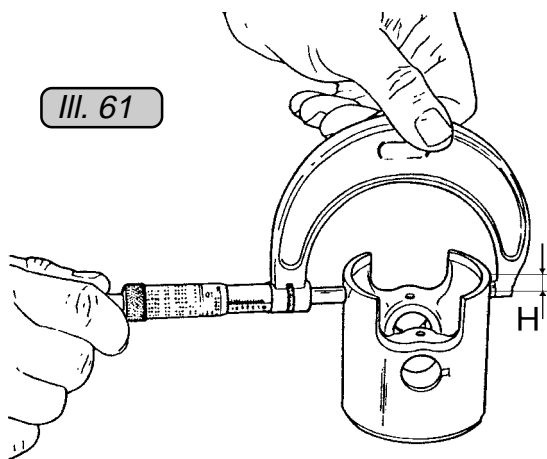
Dimension	new mm	(in.)	wear limit mm	(in.)
Cylinder bore, red .....	72,00 ÷ 72,01	(2,8347 ÷ 2,835)	72,10	(2,8385)
Cylinder bore, green .....	72,01 ÷ 72,02	(2,835 ÷ 2,8354)	72,10	(2,8385)
piston dia., red .....	71,92 ÷ 71,93	(2,831 ÷ 2,832)	71,85	(2,8287)
piston dia., green .....	71,93 ÷ 71,94	(2,828 ÷ 2,832)	71,85	(2,8287)
piston-to-wall clearance .....	0,07 ÷ 0,09	(0,0027 ÷ 0,0035)	0,20	(0,008)

#### Type 582 UL

Dimension	new mm	(in.)	wear limit mm	(in.)
Cylinder bore, red .....	76,01 ÷ 76,02	(2,992 ÷ 2,993)	76,10	(2,996)
Cylinder bore, green .....	76,02 ÷ 76,03	(2,993 ÷ 2,994)	76,10	(2,996)
piston dia., red .....	75,94 ÷ 75,95	(2,989 ÷ 2,99)	75,87	(2,987)
piston dia., green .....	75,95 ÷ 75,96	(2,9901 ÷ 2,9905)	75,87	(2,987)
piston-to-wall clearance .....	0,06 ÷ 0,08	(0,002 ÷ 0,003)	0,15	(0,006)

On oversize pistons add 0,25 mm per oversize.





Diameter of a new piston is measured at distance "H" from end of piston skirt (See SI 5 UL 94-E).

"H" for

Type 462 UL 23,0 mm (0,90 in.)

Type 532 UL 18,0 mm (0,70 in.)

Type 582 UL 20,5 mm (0,80 in.)

On a used piston the biggest diameter is always noted.

Piston and cylinder to be renewed if the piston-to-wall clearance exceeds wear limit.

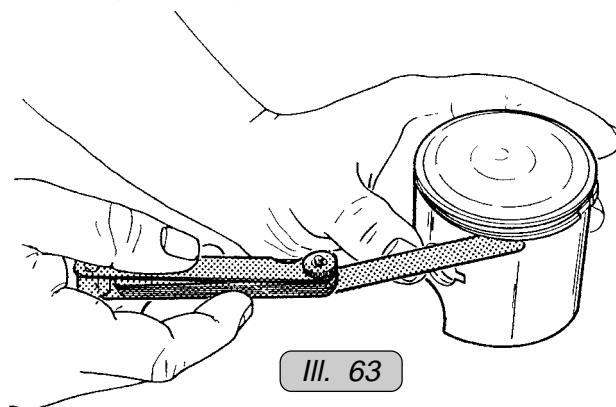
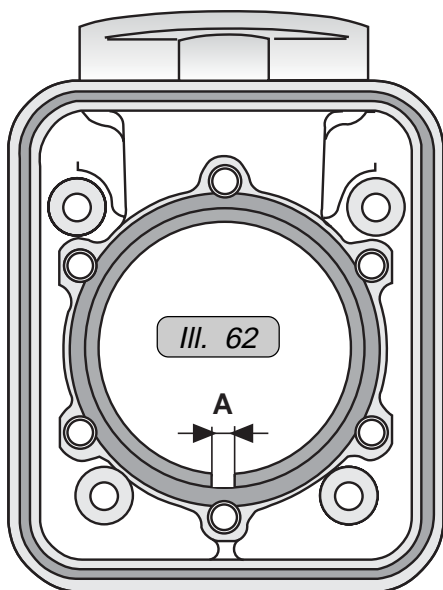
To determine the piston-to-wall clearance, deduct biggest piston diameter from smallest cylinder bore diameter.

### On type 462 UL / 532 UL / 582 UL

Dimension	new mm	(in.)	wear limit mm	(in.)
Piston pin bore in piston: .....	18,001÷ 18,005	(0,709 ÷ 0,709)	18,04	(0,71)
Piston pin: .....	17,997÷ 18,000	(0,7085 ÷ 0,7087)	17,97	(0,70)
Clearance of pin in piston .....	0,001÷ 0,008	(0,000 ÷ 0,0003)	0,05	(0,002)

### 7.4.2) Piston rings:

Remove piston rings, using piston ring pliers. Never overtension rings, otherwise ring loses its pretension, or Molybdenum coating might break off. Ensure to refit used piston rings into same location and position as before removal. A new rectangular ring may be fitted either way up.



Piston rings are checked for end gap and flank clearance. With ring fitted, clearance of flank can be checked by feeler gauge.

To measure the end gap "A" of a piston ring, position ring in a new cylinder using piston as pusher and check gap by feeler gauge. To check the end gap on a used ring for wear limit, position ring in the corresponding cylinder.

Dimension	new mm	(in.)	wear limit mm	(in.)
<b>1<sup>st</sup> ring (semi-trapeze)</b>				
End gap, type 462 UL .....	0,1 ÷ 0,25	(0,004 ÷ 0,009)	1,00	(0,04)
End gap, type 532 UL .....	0,2 ÷ 0,35	(0,078 ÷ 0,140)	1,00	(0,04)
End gap, type 582 UL .....	0,3 ÷ 0,45	(0,012 ÷ 0,017)	1,00	(0,04)
The flank clearance of a semi-trapeze ring cannot be measured reasonably.				



Dimension	new mm	(in.)	wear limit mm (in.)
<b>2<sup>nd</sup> ring (rectangular), for type 462 UL</b>			
Height of groove .....	1,54 ÷ 1,56	(0,606 ÷ 0,614)	1,65 (0,65)
Height of ring .....	1,478 ÷ 1,49	(0,058 ÷ 0,059)	1,40 (0,55)
Flank clearance .....	0,05 ÷ 0,082	(0,002 ÷ 0,003)	0,20 (0,008)
End gap .....	0,2 ÷ 0,35	(0,008 ÷ 0,014)	1,00 (0,039)

#### **2<sup>nd</sup> ring (rectangular), for type 532 UL**

Height of groove .....	2,04 ÷ 2,06	(0,08 ÷ 0,081)	2,15 (0,85)
Height of ring .....	1,978 ÷ 1,99	(0,77 ÷ 0,78)	1,90 (0,75)
Flank clearance .....	0,05 ÷ 0,082	(0,002 ÷ 0,003)	0,20 (0,008)
End gap .....	0,2 ÷ 0,35	(0,008 ÷ 0,014)	1,00 (0,039)

#### **2<sup>nd</sup> ring (rectangular), for type 582 UL**

Height of groove .....	2,04 ÷ 2,06	(0,080 ÷ 0,081)	2,15 (0,85)
Height of ring .....	1,978 ÷ 1,99	(0,77 ÷ 0,78)	1,90 (0,75)
Flank clearance .....	0,05 ÷ 0,082	(0,002 ÷ 0,003)	0,20 (0,008)
End gap .....	0,3 ÷ 0,45	(0,012 ÷ 0,017)	1,00 (0,039)

### **7.4.3) Piston pin:**

Check piston pin for wear and pitting at bearing contact surface and take diameter readings.

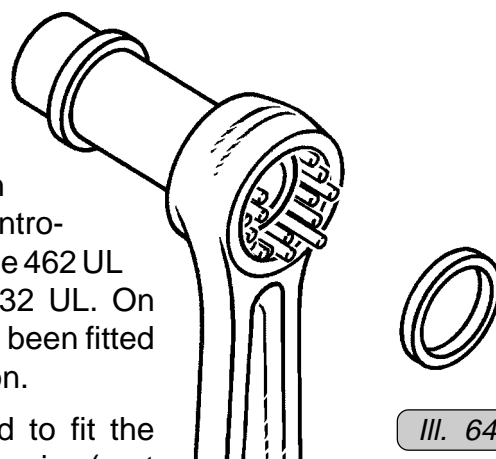
Dimension	new mm	(in.)	wear limit mm (in.)
Piston pin .....	17,997 ÷ 18,0	(0,7085 ÷ 0,709)	17,97 (0,707)

■ **ATTENTION:** Renew piston pin at detection of perceptible traces of wear, even if dimensions are correct, at beginnings of pitting or discoloration. Always renew piston pin circlips after every removal.

### **7.4.4) Piston pin bearing:**

The needle cage has been superseded by a cageless needle bearing, increasing life-span essentially due to higher load capacity. The cageless needle bearing is a needle bearing with 31 needles and 2 thrust washers, introduced with engine no. 3,642.858 on type 462 UL and engine no. 3,722.250 on type 532 UL. On engine 582 UL this needle bearing has been fitted since the beginning of serial production.

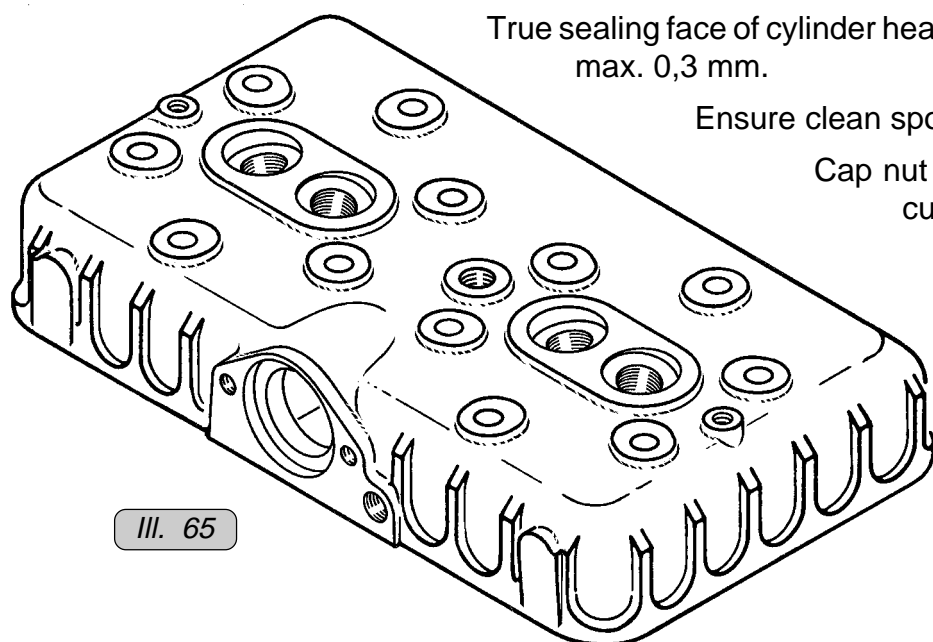
◆ **NOTE:** It is strongly advised to fit the cageless piston pin bearing (part no. 832 020) at an engine repair.



Inspect needles for wear and pitting. With one needle visibly damaged, renew the whole lot (all 31 needles).

## 7.5) Cylinder head:

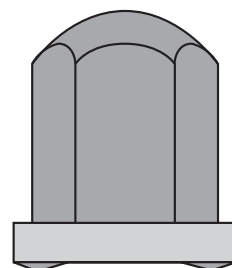
Remove carbon deposits from the combustion chambers, using a blunt tool. Visual check of sealing face for cracks and distortion. Inspect thread and sealing face of spark plug holes. For safety's sake, do not repair tapped holes for spark plugs, exchange the cylinder head instead.



True sealing face of cylinder head. If necessary, rework up to max. 0,3 mm.

Ensure clean spotfaces for nuts.

Cap nut seals the water space by a cutting edge.



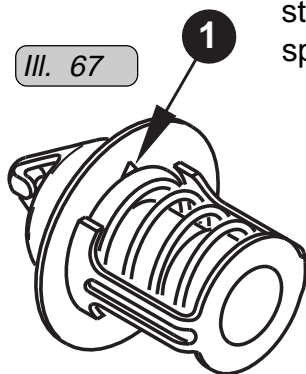
◆ NOTE:

On both ends of the cylinder head is a tapped hole M6 for connection of a vent line.

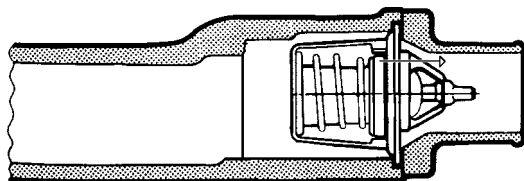
## 7.6) Thermostat:

To make an operational test, drop thermostat into a glass filled with water, heat it up and watch at which temperature it starts opening (standard opening temperature 55 - 60° C (130 - 140° F).

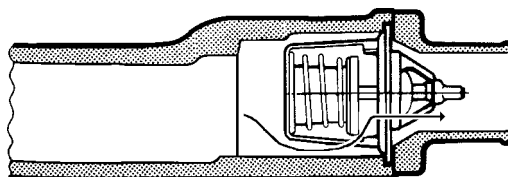
The by-pass bore ❶ in the thermostat ensures safe operation with thermostat closed. Install thermostat with by-pass bore ❶ towards top (direction spark plugs).



*thermostat closed*



*thermostat open*



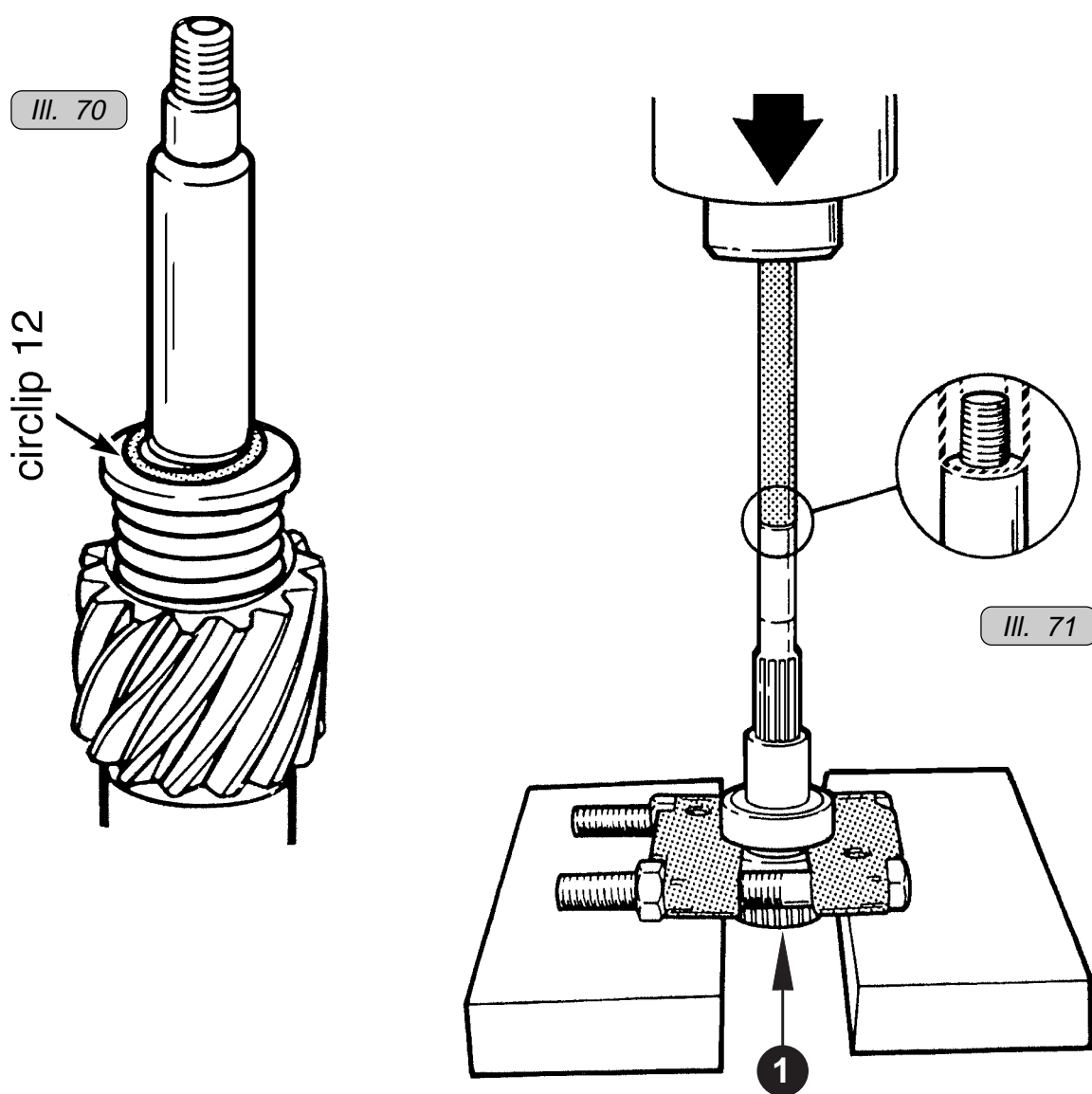
## 7.7) Rotary valve shaft:

Two versions of rotary valve shaft are in production. The one with longer gear ❶ is used on engine type with fresh oil lubrication, as beside the rotary valve the oil pump is driven from this gear, too. Drive of the integrated water pump from the other end of shaft.

### 7.7.1) Disassembly of rotary valve shaft:

Depress spring cup and remove circlips, followed by all the components. The spacer is glued into position and can be pressed off along with ball bearing. Clean shaft and remove rests of LOCTITE.

■ ATTENTION: Always use punch 876 612 to avoid any damage to shaft.



### 7.7.2) Inspection of the single components:

Check shaft for max. deflection of 0,05 mm, not between centres but on rollers, and check thread. Visual inspection of contact face for oil seals. At traces of wear above 0,05 mm renew rotary valve shaft.

Check shaft splines for bronze gear. This gear needs easy axial movement for troublefree operation. Inspect helical toothing of bronze gear. Reason for damage of gear could be a broken compression spring. Pay attention to free length of spring (25,1 mm) and possible discoloration. Renew as required. The O-ring behind bronze gear serves as damping element and should be renewed at an engine repair.

Check both ball bearings. The bearing next to water pump can be exchanged only when crankcase is in pieces.

◆ NOTE: Brown shading on the mating face of crankcase for rotary valve indicates a faulty oil seal and oil consumption.

Dimension	new mm	(in.)	wear limit mm	(in.)
Backlash (rotary valve gear) .....	0,084÷ 0,164	(0,003 ÷ 0,006)	0,40	(0,016)

◆ NOTE: To increase durability of rotary valve shaft and oil seals, the shaft diameter has been reduced from 12 to 10 mm Ø, thus reducing circumferential speed.

Change was carried out on engine type

462 UL starting with engine no. 3,642.690 and on engine type

532 UL with engine no. 3,722.150. See Service Information 2 UL 88-E.

### 7.7.3) Sealing of rotary valve shaft:

To further improve the sealing of the rotary valve shaft, the leakage bore is plugged now by a threaded pin M5 x 6, to enable to fill the space between the two water pump oil seals completely with grease (c. 6 cc MOLYKOTE 44, medium). See Service Info 1 UL 91-E. Axial fixing of the bearing next to water pump by retaining ring. Change to this type of sealing started on engine type

462 UL with engine no. 3,804.223

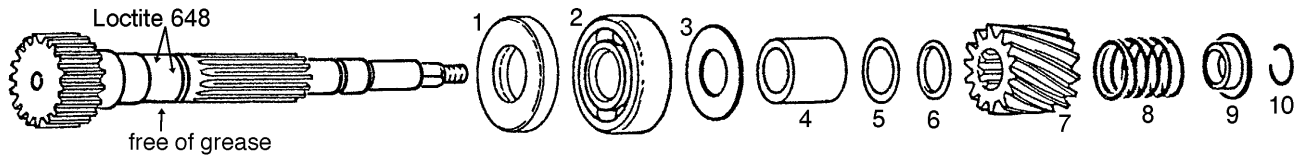
532 UL with engine no. 3,887.848

582 UL with engine no. 3,957.335.

◆ NOTE: It is advisable to convert to this type of sealing at an engine repair.

#### 7.7.4) Reassembly of rotary valve shaft:

Grease oil seal ❶ and fit with open side towards inside on rotary valve shaft, add ball bearing ❷ and shim ❸. Moisten rotary valve shaft with LOCTITE 648. Heat up spacer ❹ to 70 - 80° C (160 ÷ 180° F), slide on shaft and hold in position until Loctite cures hard and spacer keeps tight on shaft. Slide on shim ❺, new O-ring ❻ and bronze gear ❼, followed by spring ❽ and spring cup ❾.



III. 72

Depress spring via spring cup and fit circlip ❿. Rotary valve gear must be movable to compress spring.

■ NOTE: A spacer ❹ shifting during engine run causes damage to rotary valve gear ❼.

## 7.8) Contact breaker ignition unit:

### 7.8.1) BOSCH magneto generator SCP2 on ROTAX 462 UL and 532 UL:

ROTAX engines type 462 UL and 532 UL are equipped with the BOSCH contact breaker ignition unit and integrated generator 12V 140W.

The charging coil located on stator plate generates the ignition current needed.

The ignition unit consists of stator plate with charging coil, 2 lighting coils (110W + 30W), 2 capacitors and 2 breaker sets as well as magneto ring, 2 ignition coils, a damping box, 2 spark plugs with connectors (standard or shielded) and ignition cables. If needed, a complete unit for radio interference suppression is readily available.

### 7.8.2) Stator plate:

Clean stator plate and check visually. Check resistance of coils and capacity of capacitors by relevant instrument (resistance measuring bridge resp. multimeter for ohmic resistance and capacity). Readings must be within the stated values:

Charging coil (bottom) .....  $3,20 \div 3,70 \Omega$

Lighting coil 30W (top) .....  $2,38 \div 0,25 \Omega$

Lighting coil 110W .....  $0,40 \div 0,10 \Omega$

Capacitor .....  $0,24 \div 0,30 \mu F$

Inspect breaker contacts for wear (burn-up). If burn-up is excessive, exchange breaker set. Breaker contacts are platin coated, therefore it is not sensible to grind them. Check capacitors for tight fit, if need be, pull them out and re-glue with LOCTITE 648, but on three spots only to maintain electric contact. Repeat greasing of lubricating felt.

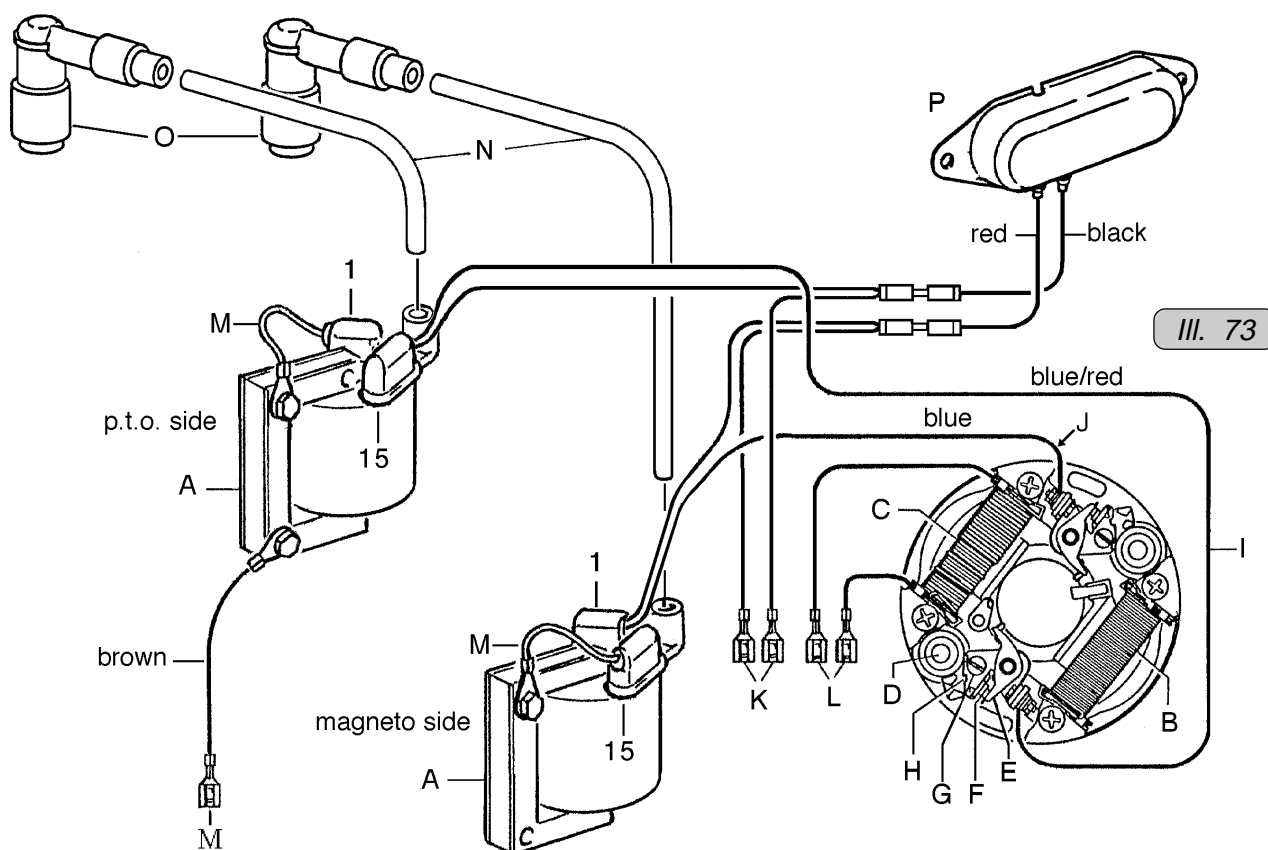
◆ NOTE: When fitting a capacitor, apply pressure on shoulder of capacitor case only, and use LOCTITE 648.

If one of the coils has been slackened or renewed, always utilize a centring ring. Place centring ring over coils on stator plate, press coils against centring ring and tighten screws. Remove centring ring. Apply LOCTITE 221 to the fixation screws.

In serial production the two lighting coils are connected parallel (yellow to green cable and yellow/black to green/black cable). But, if need be, they can be used separate, like e.g. for supply of a revs-counter and simultaneously to a rectifier-regulator. Check all wiring for damage, renew as necessary. Don't repair any cable by just adding a bit.

◆ NOTE: For reason of overheating don't use the 30 Watt coil on its own for charging the battery.

### 7.8.3) Wiring diagram:



- |   |  |   |  |
|---|--|---|--|
| A | ignition coils   | I | charging cable (blue/red)              |
| B | charging coil (bottom)   | J | charging cable (blue)                  |
| C | lighting coil 30W (top, green - green/black)<br>lighting coil 110W | K | shortening cable (black)               |
| D | capacitor  | L | lighting cable (yellow - yellow/black) |
| E | contact breaker lever  | M | ground cables (blue)                   |
| F | breaker contacts   | N | ignition cable                         |
| G | fixing screw   | O | spark plug connector                   |
| H | adjusting groove   | P | damping box                            |

Pay special attention to good connection of charging wires (I, J) and ground cables (M) with ignition coils (A) (see ill.).

◆ **NOTE:** Ensure correct connection of damping box. Red cable to magneto-side ignition coil. On air-cooled engines the connection is reversed!

### 7.8.4) Flywheel:

The magneto ring is attached to the magneto housing by 4 Allen screws with spring washer. If this unit was separated, apply LOCTITE 648 to mating face and centring of magneto ring and secure screws with LOCTITE 221. Remove cured rests of LOCTITE from magneto housing and clean contact faces.

- ◆ **NOTE:** Separate magneto ring from magneto housing by hitting magneto housing with a mallet. Mating face to be thoroughly clean to assure true running of magneto ring.

The hole pattern is asymmetrical, therefore magneto ring can be fitted in one position only. Clean and check taper and groove for Woodruff key. Check the 4 permanent magnets for tight fit and possible cracks, renew if necessary.

- **ATTENTION:** Even with only a small crack in one of the magnets exchange the complete magneto ring.

#### 7.8.5) Ignition damping box:

Because of the nature of the magneto flywheel ignition, due to magnetic flux, a second but unwanted spark is generated after the regular one. Combined with increased deposits in the combustion chamber it can lead to uncontrolled ignitions which could cause damage to the piston. The use of the damping box will prevent the second spark.

##### **Wiring diagram for damping box 866 572:**

When connecting damping box, make absolutely sure of correct polarity,

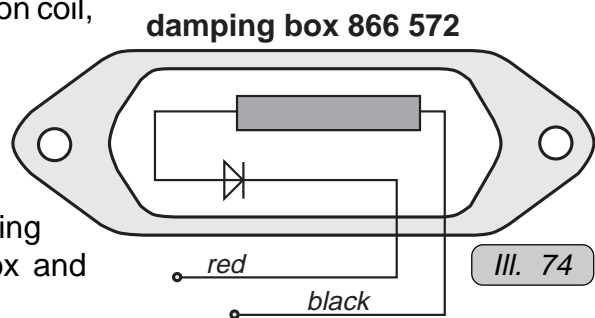
- black cable to P.T.O. ignition coil, terminal 15
- red cable to magneto side ignition coil, terminal 1

##### **Operational test of damping box:**

With damping box connected false, spark must not occur on any cylinder when cranking engine. Sparking would indicate faulty damping box and makes renewal necessary.

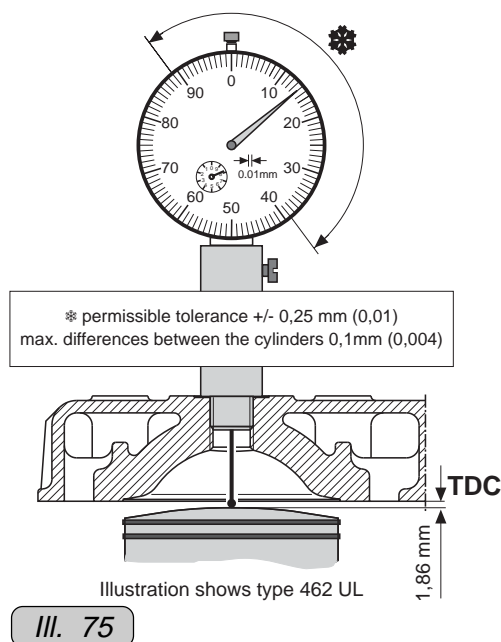
No spark with damping box connected could be caused by the following:

- Faulty or falsely connected damping box
- Breakaway gap not within tolerance (see chapter „pole shoe breakaway gap“)
- Damaged Woodruff key
- Badly positioned stator plate





### 7.8.6) Adjusting of ignition timing:



To check ignition timing, use test lamp or buzzer, connected to shorting cable of respective cylinder and ground. Timing marks are placed on crankcase and magneto housing.

The ignition marks ❶ must align at the moment of ignition, that is when breaker contact begins to open and the brightness of the lamp and/or the sound of the buzzer changes.

- 1) Set stator plate ass'y to mid position and tighten screws.
- 2) Adjust contact breaker to open at ignition timing (see chapter: „Technical Data“)
- 3) Check of the max. breaker gap (nominal 0,3 ÷ 0,4 mm) (0,012 ÷ 0,016 in.).

If breaker gap is not within these values, re-adjust by turning stator plate accordingly and repeat setting of ignition timing.

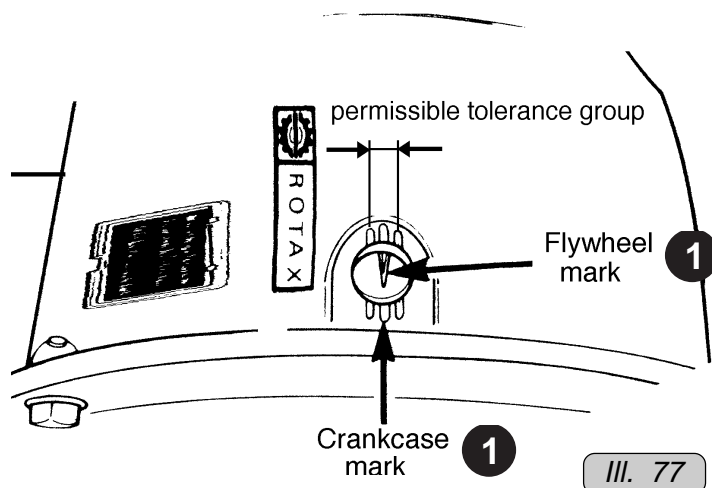
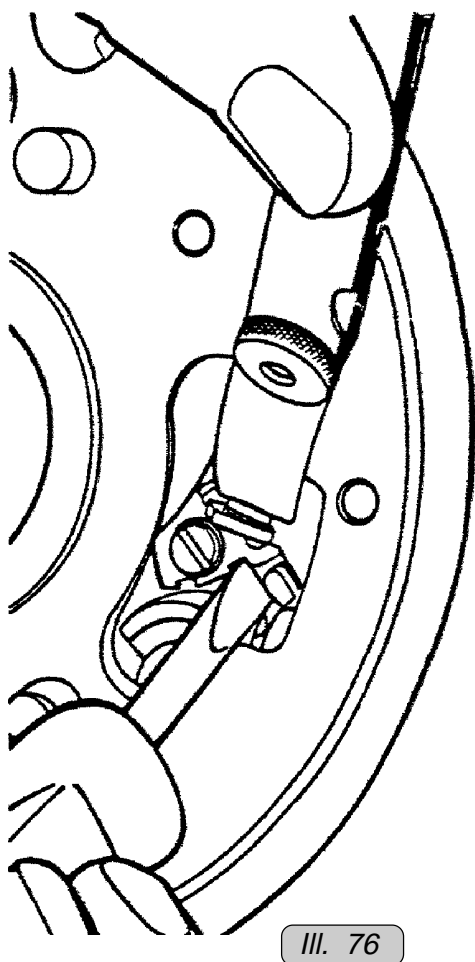
- **Breaker gap too small:**

Turn stator plate in direction of engine rotation.

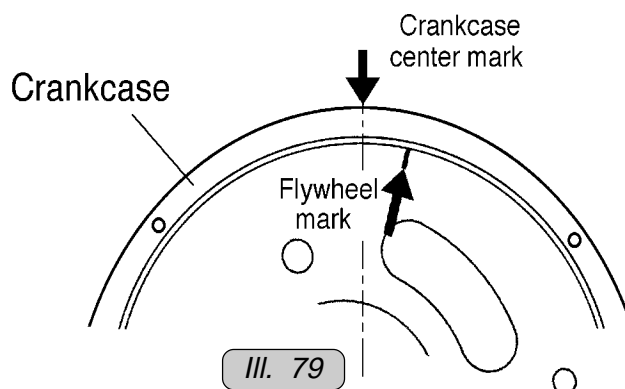
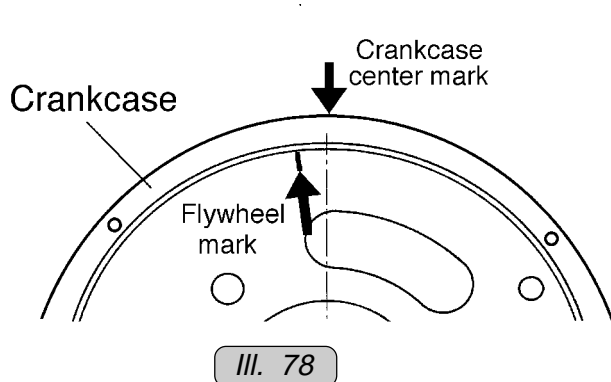
- **Breaker gap too big:**

Turn stator plate against engine rotation.

Repeat adjusting of ignition time to point 2 and 3.



Accordingly, stator plate can be turned, too.



### **Ignition advance too much:**

Turn stator plate clockwise, or reduce breaker gap down to min. 0,3 mm

### **Ignition advance not enough:**

Turn stator plate anti-clockwise or enlarge breaker gap up to max. 0,4 mm

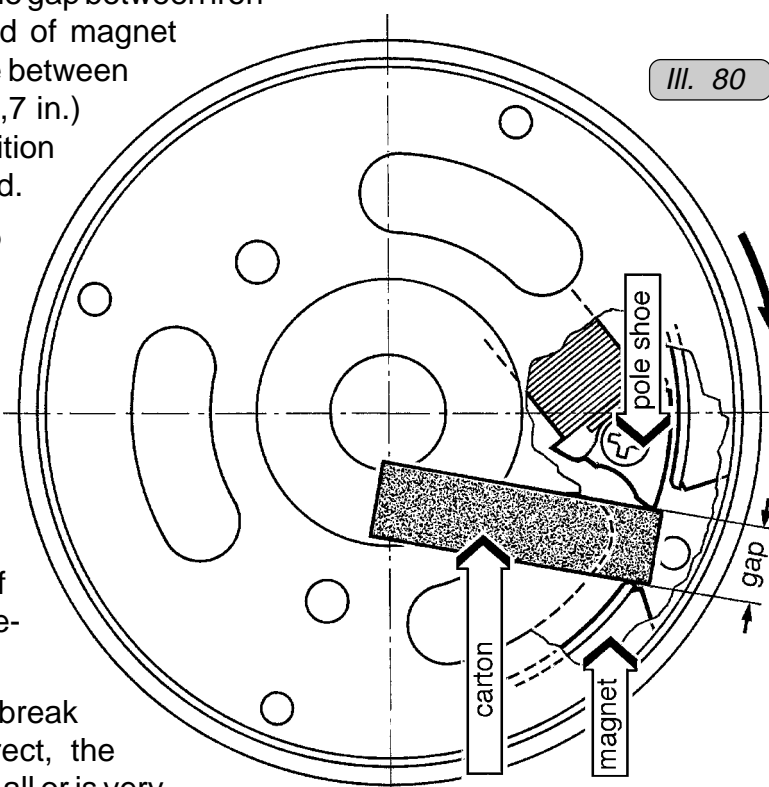
### **7.8.7) Pole shoe breakaway gap:**

Once the correct ignition timing is adjusted, the pole shoe breakaway gap must be checked. The gap between iron core of coil and end of magnet must be in the range between 13 - 17 mm (0,5 - 0,7 in.) (see ill. 68) with ignition timing marks aligned.

If the breakaway gap is not within the above stated limits, it is likely that the position of the flywheel on the crankshaft has changed. Pull off flywheel and inspect taper and Woodruff key. If need be, repair.

With a pole shoe break away gap not correct, the engine won't start at all or is very hard to start, or misfires.

Adjusting of the ignition timing and repair of ignition unit should best be carried out by an experienced mechanic.



## 7.9) ROTAX 582 UL with breakerless DUCATI dual ignition unit (DCDI):

### 7.9.1) Brief description:

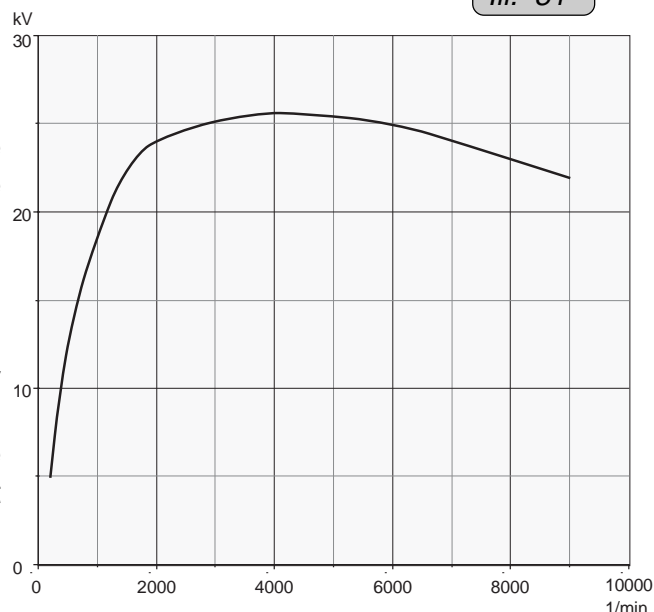
The engine 582 UL is equipped with a breakerless 12V 170W DUCATI capacitor discharge dual ignition. The unit consists of a flywheel magneto generator, 2 double ignition coils with integrated electronic control circuit and 2 external pick-ups.

The 12-pole flywheel generator is an outer rotor type with 12 permanent magnets. The stator is equipped with 12 coils, 8 of them used for feeding auxiliary equipment and 4 to supply current for the 2 ignition circuits.

### 7.9.2) Operation of the ignition unit:

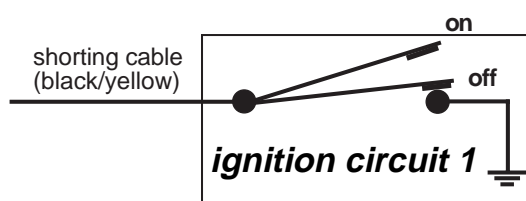
III. 81

Two pairs of charging coils fitted on the stator plate and independent from each other feed one ignition circuit each. The energy supplied is stored in the capacitor. At the moment of ignition the external pick-ups trigger the discharge of the capacitors via the primary winding in the ignition coil. The secondary winding supplies the high voltage for the ignition spark. The ignition voltage is c. 25 kV at 6000 r.p.m. and a load of 50 pF.

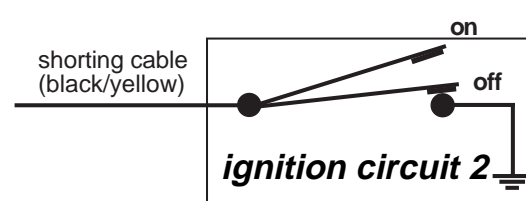


### 7.9.3) Ignition switches:

Each of the two ignition switches needs its own grounding switch. Both grounding cables connected to one switch only would render both circuits grounded and ineffective.



III. 82



III. 82

■ **ATTENTION:** With the engine running, the trigger cable (red) must not be disconnected from the electronic box. Interruption could destroy the electronic box.

#### **7.9.4) Magneto flywheel:**

Clean flywheel and inspect magneto ring for cracks. Visual check of taper, key groove and of trigger piece.

■ **ATTENTION:** Even with only a small crack in the magneto ring, the flywheel has to be exchanged.

#### **7.9.5) Electronic box:**

Visual inspection of electronic box. Pay attention to neat connections. It is not possible to repair the electronic box. For fault-tracing it is advisable to switch electronic box from one circuit to the other. If trouble stays with box, renew it.

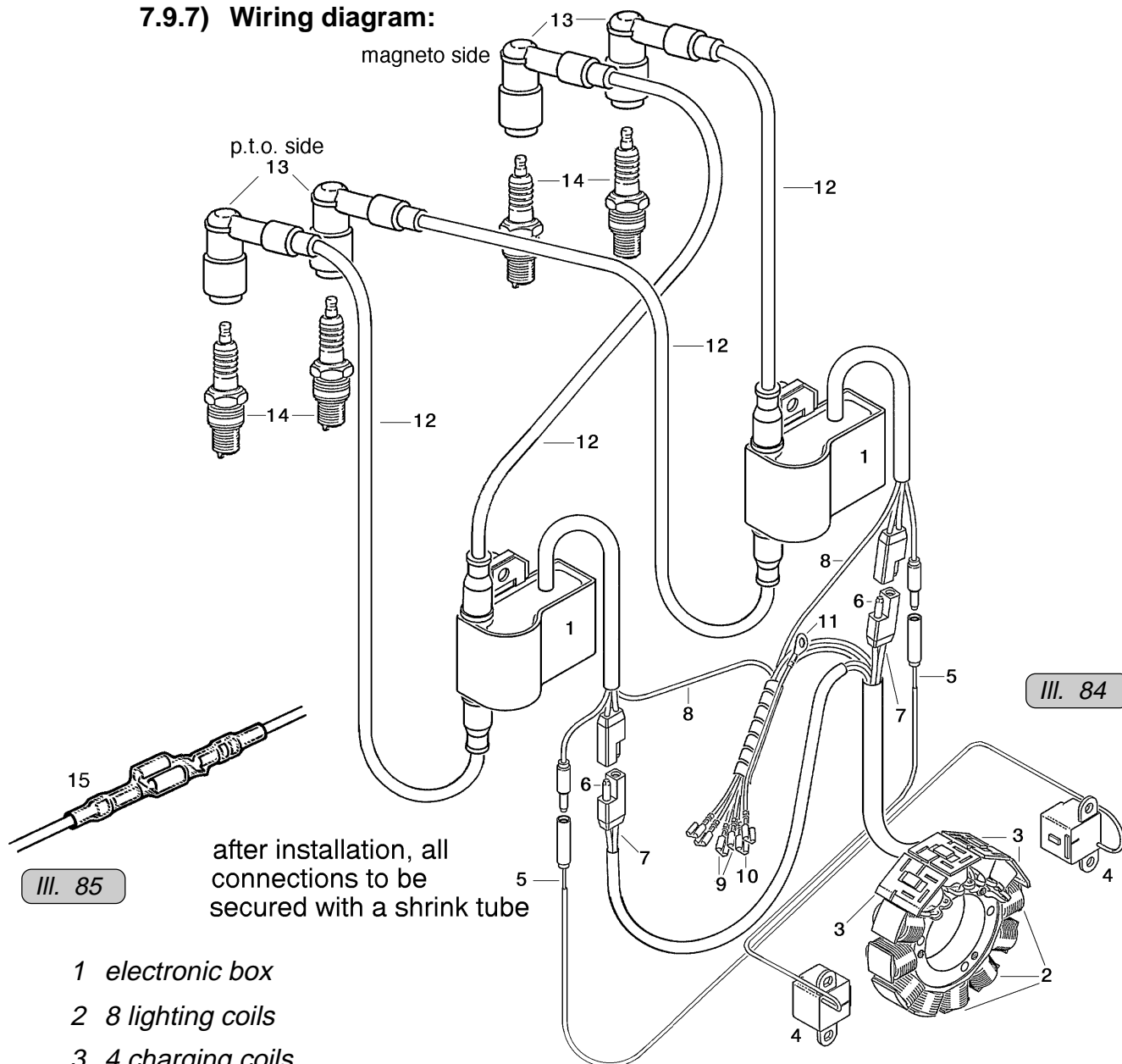
The ignition cables have to be fitted tight on electronic box. If the threaded prong is no adequate anchorage, use LOCTITE 380 for additional support.

### 7.9.6) Wiring diagram of electronic box:

III. 83

<i>GEN</i> .....	<i>12-pole generator</i>
<i>LA</i> .....	<i>lighting coil</i>
<i>LC1</i> .....	<i>charging coil</i>
<i>LC2</i> .....	<i>charging coil</i>
<i>P1/P2</i> .....	<i>pick-up</i>
<i>D</i> .....	<i>charging control diode</i>
<i>C</i> .....	<i>capacitor</i>
<i>S</i> .....	<i>control SCR</i>
<i>H1</i> .....	<i>primary coil</i>
<i>H2</i> .....	<i>secondary coil</i>
<i>K</i> .....	<i>ignition switch</i>

### 7.9.7) Wiring diagram:



after installation, all connections to be secured with a shrink tube

III. 84

III. 85

1 electronic box

2 8 lighting coils

3 4 charging coils

4 pick-up

5 trigger cable, red/white

6 charging cable, green

7 charging cable, white

8 2 shortening cables, black/yellow, 0,75 mm²

9 lighting cable, yellow/black

10 rev-counter cable, grey

11 ground cable, brown

12 ignition cable

13 spark plug connector

14 spark plugs

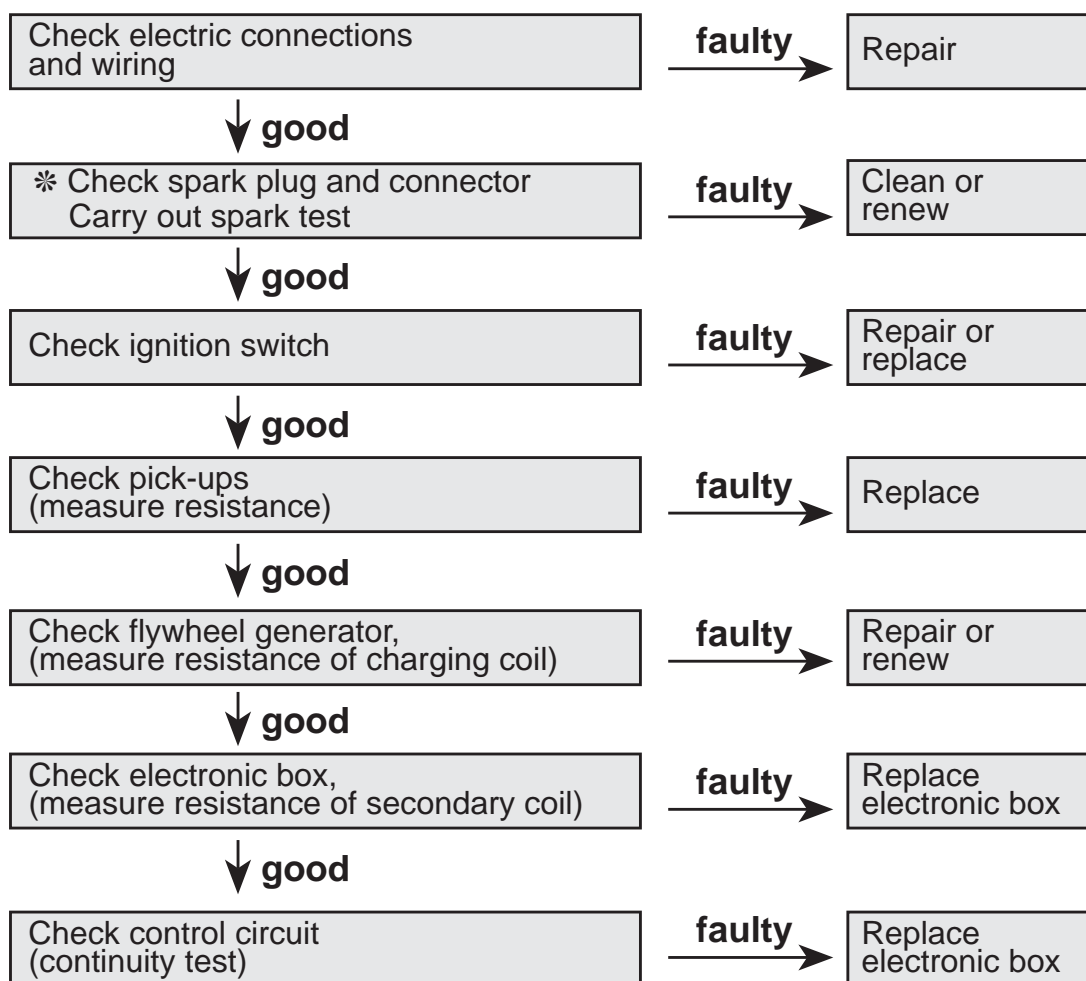
15 shrink tube

### 7.9.8) Stator repair kit:

The harness assembly is available as spare part, but further repair on the kit is not possible.

### 7.9.9) Trouble shooting:

If engine trouble is thought to be caused by faults in the ignition system, proceed as follows:



#### \* Spark test

III. 86

Remove spark plug connector from ignition cable, allow a gap of 5 - 6 mm (0,2 - 0,23 in.) to engine ground and crank engine.

If sparks flash over, ignition system is considered to be in good condition.

### 7.9.10) Fault-tracing schedule:

Possible cause Trouble	Flywheel generator				Electronic-Box	
	Charging coil	Rev.-counter branch	Lighting coil	Pick-up	Primary circuit	Secondary coil
Engine does not start	Interruption or short circuit	X	X	Interruption or short circuit	Short circuit between green - white or red - white	Interruption or short circuit
Engine misfires at low speeds	Short circuit	X	X	X	Faulty charging coil control	Short circuit
Engine runs erratic at low speed	Short circuit	X	X	Air gap not correct	X	Short circuit
Engine runs erratic at high speed	Short circuit	X	X	X	Faulty charging coil control	Short circuit
Rev-counter does not work	Short circuit	Interruption or short circuit	X	X	X	X
No supply of lighting current	X	X	Interruption or short circuit	X	X	X

III. 87

Prior to control of single items, always check connections, wiring and ignition switch first.

### 7.9.11) Resistance values of DUCATI ignition unit:

Ignition coil:	Secondary coil in E-box	5,1 ÷ 6,3 kΩ
Stator:	Lighting coil (yellow - yellow/black)	0,3 ÷ 0,35 Ω
	Charging coil (green - white)	230 ÷ 280 Ω
Rev-counter		
Pick-up:	(grey - white)	30 ÷ 35 Ω
Pick-up:	<b>old type</b> (red - engine ground)	50 ÷ 70 Ω
Pick-up:	<b>new type</b> , starting with s/n 4.017.191	
	(red/white - engine ground)	140 ÷ 180 Ω
Ignition „OFF“:	black/yellow - brown (ground)	closed circuit
Ignition „ON“:	black/yellow - brown (ground)	open circuit
◆ NOTE:	All readings to be taken at room temperature!	

### 7.9.12) Sundry data of DUCATI ignition system:

Air gap at pick-up: ..... 0,4 - 0,5 mm (0,016 - 0,02 in.)  
cut-in speed: ..... 300 r.p.m.  
Lighting output: ..... 140 W AC at 3000 r.p.m.  
160 W AC at 6000 r.p.m.

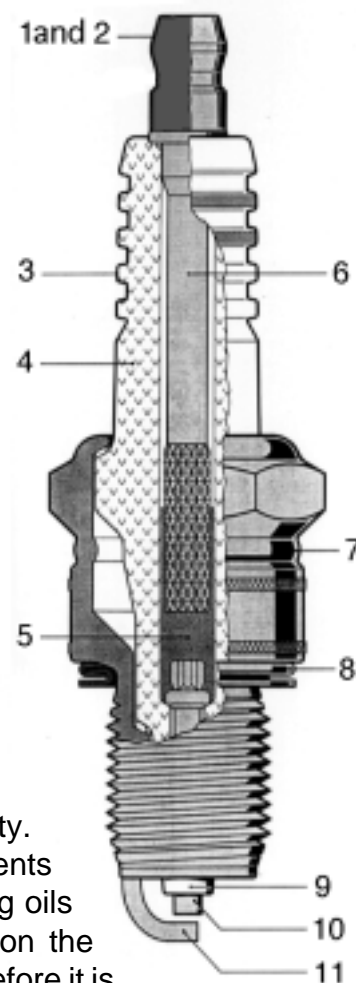


## 7.10) Spark plugs:

On all the engine types dealt with in this manual, the same spark plug is used.  
Specified spark plug: 14 mm thread size, ROTAX part no. 897 050

### Spark plug design:

- 1 Terminal nut inseparable on connection thread
- 2 Connection thread
- 3 Leakage current barrier
- 4 Insulator ( $\text{Al}_2\text{O}_3$ )
- 5 Conductive enamel
- 6 Terminal stud
- 7 Upset- and heat-shrinkage zone
- 8 Captive sealing ring
- 9 Insulator nose
- 10 Centre electrode
- 11 Ground electrode



Plugs have to meet extreme demands. A plug is exposed to periodically changing processes in the combustion chamber as well as to the ambient climatic conditions.

The heat range of a plug is a measure of the thermal loadability. This plug has been selected as it suits the specific requirements of these engines and their application. Fuel and lubricating oils contain partly aggressive ingredients which will deposit on the electrodes at conditions below point of condensation. Therefore it is important to stick to type and heat range of plug as specified by the engine manufacturer.

III. 88

### Correlation between electrode gap and ignition voltage demand:

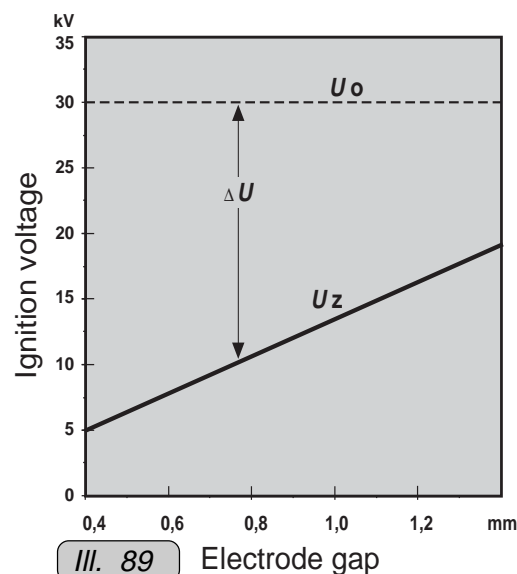
$U_o$  Ignition voltage supply

$U_z$  Ignition voltage demand

$\Delta U$  Ignition voltage surplus

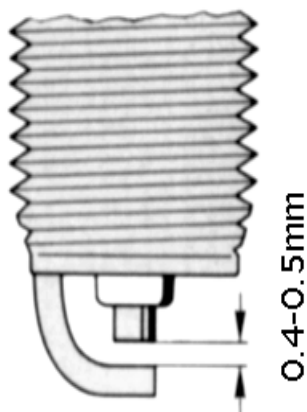
Voltage surplus is reduced by wear of electrodes.

Due to continuous wear of the electrodes the gap increases steadily. Therefore, as wear of electrodes progresses, the demand of ignition voltage rises.



III. 89

Electrode gap



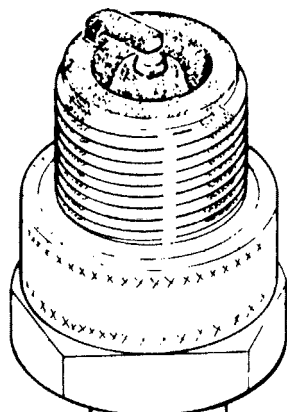
III. 90

Check electrode gap by feeler gauge. If need be, adjust. Gap should be between 0,4 ÷ 0,5 mm (0,016 ÷ 0,020 in).

Preferably exchange plugs on both cylinders and avoid to switch plug from one cylinder to the other. Use only spark plugs with inseparable terminal nut. For safety's sake renew plugs every 25 hours of operation. Tighten plugs on the cold engine to 27 Nm (238 in.lb.).

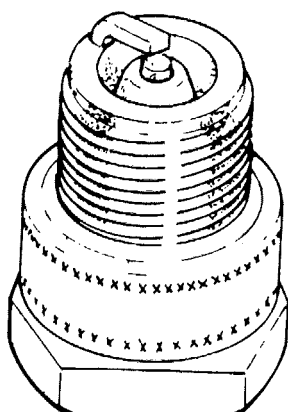
If engine won't start or runs on one cylinder only, check

- if spark plug connectors are in good order; renew as required. Ensure there are no spark punctures in ignition cables,
- if ignition cables are undamaged and fitted tightly to spark plug connector and ignition coil,
- if contacts on ignition wiring are in good condition,
- if spark plugs are in good order (not fouled, deposits or electrodes bridged),
- if spark plug heat range is as specified.



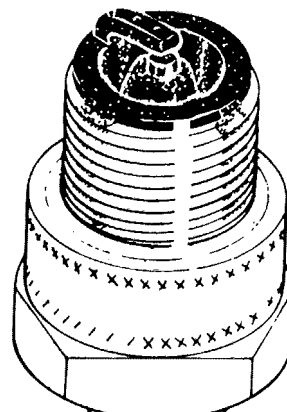
III. 91

*With heat range of plug as specified and correct carb calibration, the colour of face ought to be brownish.*



III. 92

*With heat range of plug too low (hot plug) or carb calibration too lean, the plug face is white and electrodes might be covered with melt beads.*



III. 93

*With heat range of plug too high (cold plug) and carb calibration too rich, plug appearance is black and sooty.*

■ **ATTENTION:** Heavy oil deposits on electrodes and insulator may cause engine troubles.

If the ignition problem remains after cleaning or changing spark plugs, check spark plug connectors, ignition cables, ignition coil and finally the complete ignition system.

### 7.11) Spark plug connector:

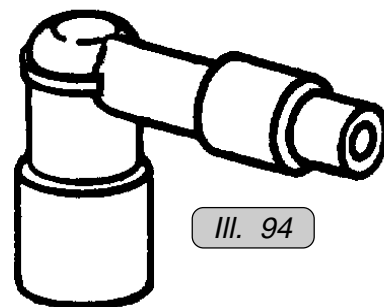
Inspect spark plug connector for cracks, burn-off, dampness and fouling. Check connection with ignition cable and fitting of rain protection cover. The resistance value of the standard spark plug connector is  $4,5 \div 5,5 \text{ kW}$ .

For various applications radio interference suppression plug connectors have to be used according to respective regulations. But these are more prone to troubles than the standard resistor type connector, due to the metal shielding.

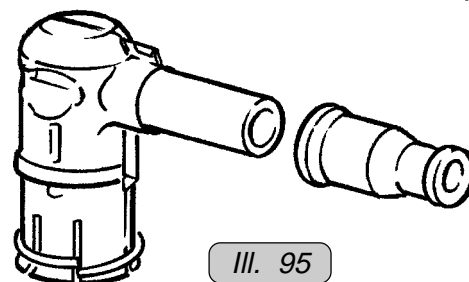
On engine installation with spark plugs down, it is highly recommended to secure spark plugs additionally.

Resistance of these connectors is  $0,8 \div 1,2 \text{ k}\Omega$ .

Never pull off spark plug connector on a running engine.



III. 94



III. 95

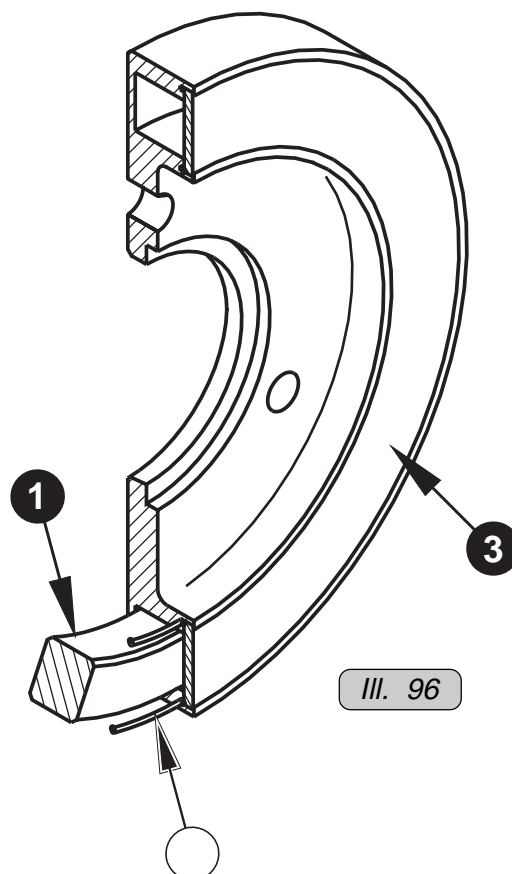
### 7.12) Hydro-damper:

The hydro-damper was planned to reduce crankshaft vibrations on engine type 582 UL. The inside of the damper consists of a steel ring ❶ floating in oil. The damper case ❸ is sealed by 2 O-rings ❷ and cannot be taken apart. In case of leakage, the damper assembly has to be renewed.

The freely moving damper ring inside the case transforms vibration energy into heat.

◆ NOTE: The amount of oil inside is ca. 5 cc.

On engines prior to engine no. 4,015.235 no hydro damper is installed, but it can be fitted afterwards. For that, besides the damper, the starting pulley and 3 attachment screws M8 x 20 instead of M8 x 16, and if with electric starter, a different starter gear adapter will be necessary.



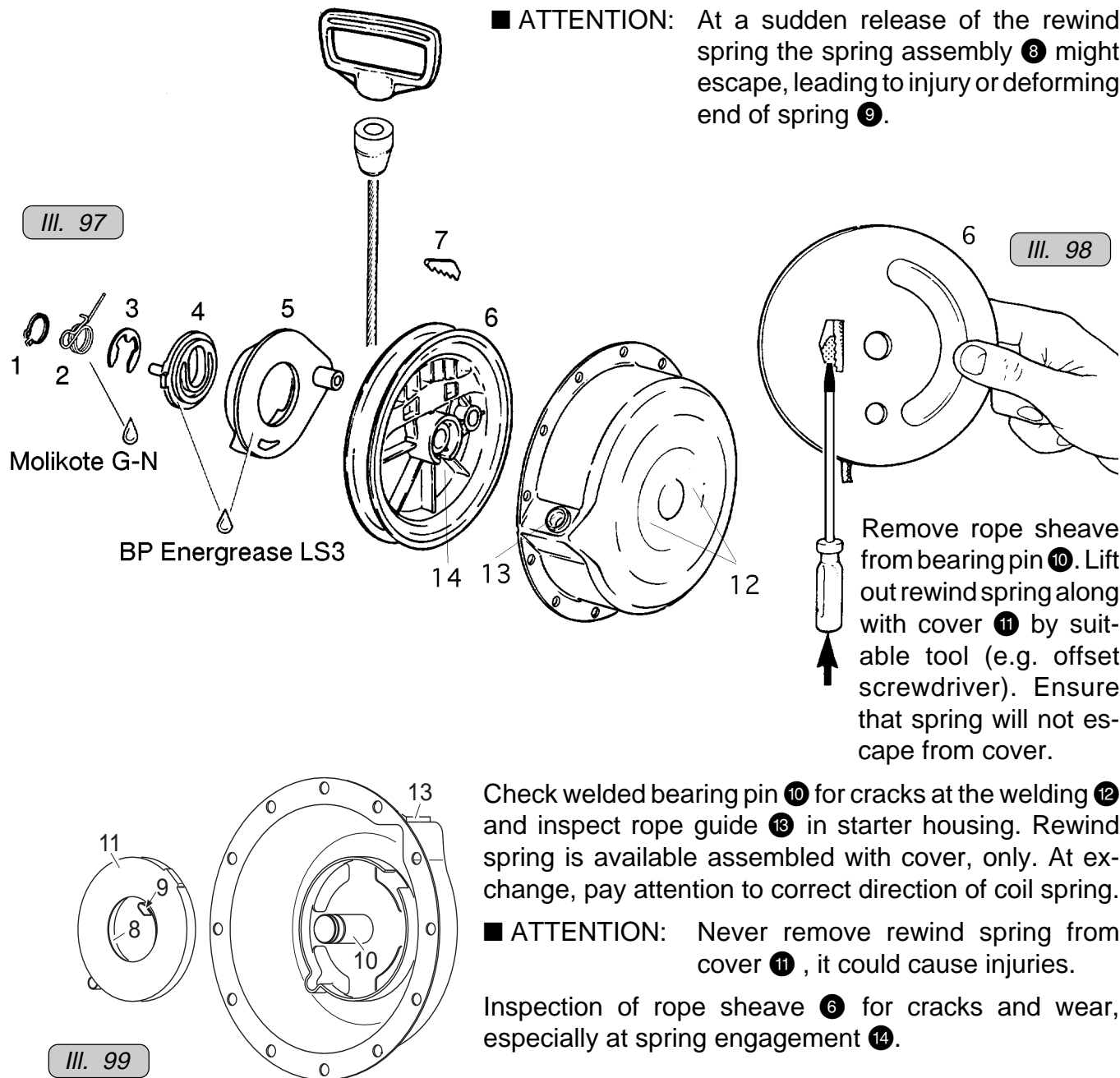
III. 96

## 7.13) Rewind starter:

### 7.13.1) Disassembly of rewind starter:

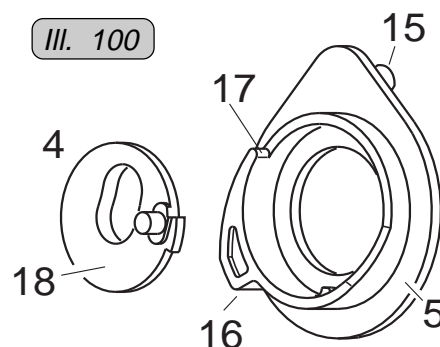
Remove snap ring ①, locking spring ② and retaining ring ③, followed by pawl lock ④ and pawl ⑤. Pull out starter rope fully to the end and hold sheave ⑥ by thumb in this position, push out rope clamp ⑦ by screwdriver and withdraw rope. Slowly release rewind spring by easing of thumb pressure on sheave.

■ **ATTENTION:** At a sudden release of the rewind spring the spring assembly ⑧ might escape, leading to injury or deforming end of spring ⑨.



Inspect guide pin 15, engaging nose 16 and supporting edge 17 for locking spring of the pawl 5 for cracks and wear.

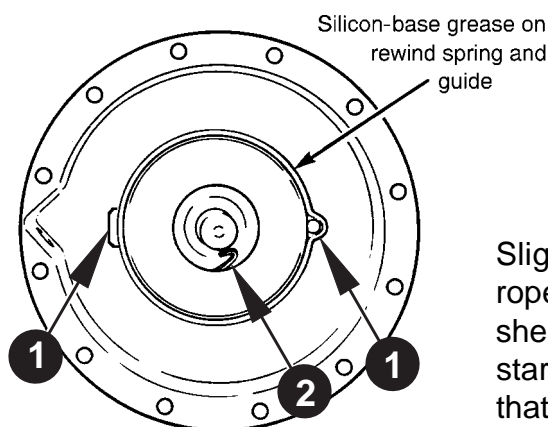
Check guide pin for locking spring and gliding face 18 of pawl lock 4. Inspect locking spring and starter rope for wear.



### 7.13.2) Reassembly of rewind starter:

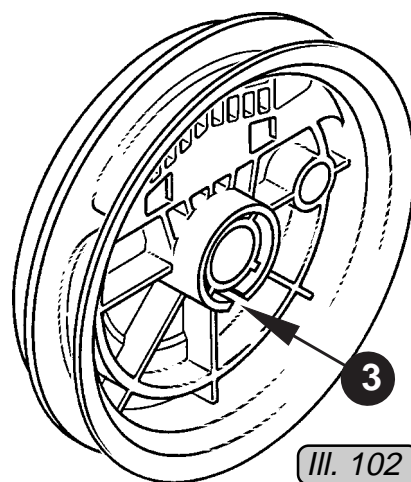
Always grease rewind spring with silicone base grease to prevent corrosion and to keep friction low and to provide additional damping at rewinding of starter rope. Fit rewind spring, assembled in cover, into starter housing until positive stop. Ensure engagement of both lugs 1 in recess of housing.

◆ NOTE: Fitting of spring assembly should be done on a hand press to prevent any damage to spring and cover.



III. 101

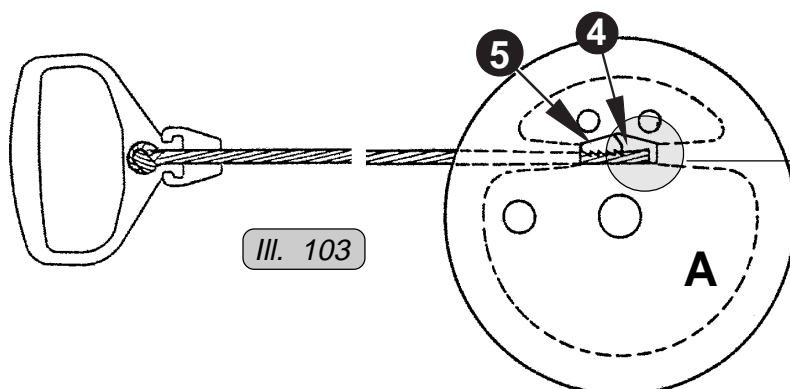
Slightly grease hub of rope sheave and place sheave on bearing pin in starter housing. Ensure that bent inside end 2 of rewind spring engages in assigned recess 3 in rope sheave.



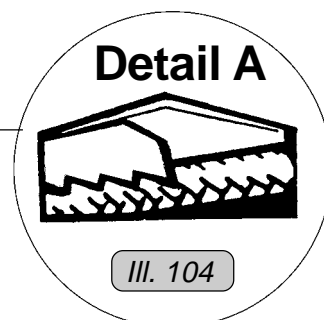
III. 102

Turn rope sheave anti-clockwise right to its stop, and then turn back to the point where the rope can be fed into the rope sheave via the guide in the starter housing.

Feed in rope until end is visible in clamp pocket 4 of sheave and insert key clamp 5 in such a way that by pulling the rope it will be clamped. See detail A. Slowly let the rope go, thus winding rope back on sheave.



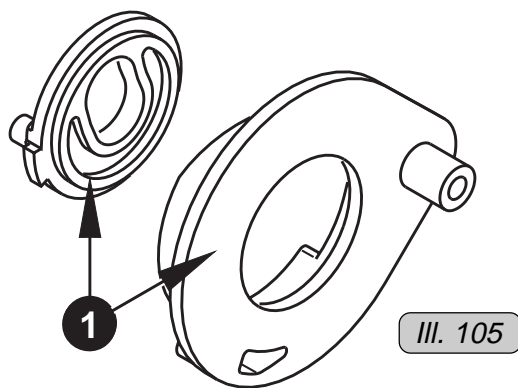
III. 103



III. 104

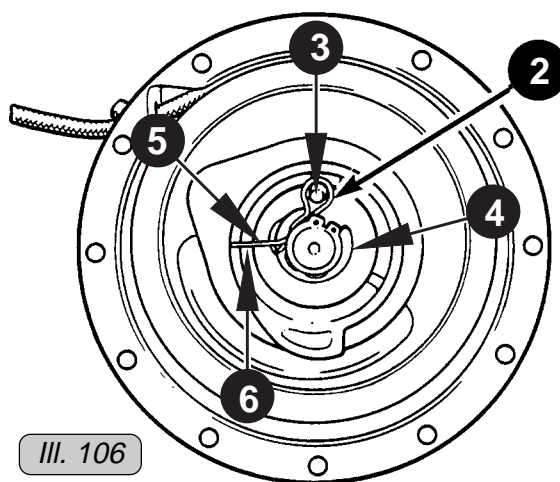
Grease contact face ❶ of pawl (pin side) and pawl lock with BP Energ grease LS3.

■ **IMPORTANT:** It is necessary to grease both of these faces to avoid excessive wear of plastic parts.



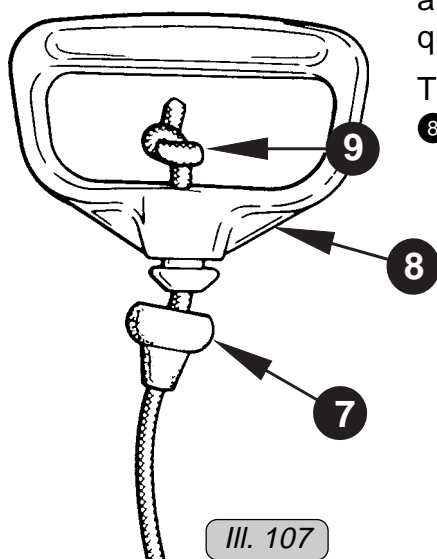
Place pawl and pawl lock in position and secure with retaining ring. Sharp edge of retaining ring has to point towards outside.

Grease inside diameter of locking spring with MOLYKOTE G-N and fit on bearing pin by compressing the ends of spring so that looped spring end ❷ will encircle guide pin ❸ on pawl lock. Fit snap ring ❹ to secure locking spring in axial direction.



The straight end ❺ of the locking spring will rest after the initial pull on starter rope and subsequent rewinding, on supporting edge ❻ of pawl.

To exchange rubber buffer ❼ and starter grip ❽, pull out starter rope and open knot ❾.





## 7.14) Electric starter:

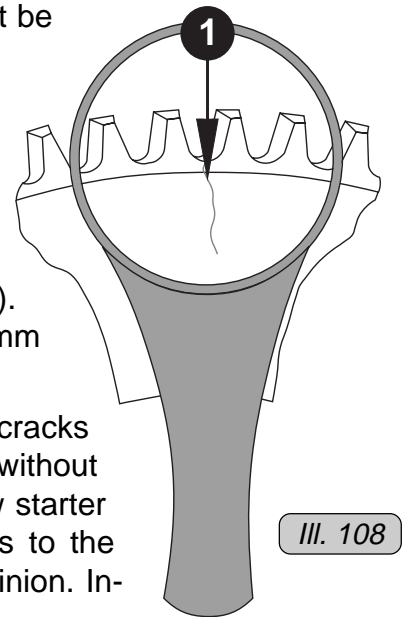
Besides the rewind starter fitted in serial production, an optional electric starter, possible either on P.T.O. side or magneto side, is offered.

### 7.14.1) Pinion starter on P.T.O. side:

In this case the ROTAX reduction gear cannot be fitted.

The starter is fitted to crankcase on exhaust side. The starter gear is attached to belt pulley used for belt drive reduction, via starter gear adaptor. Ensure required gear engagement. In resting position, the distance of pinion to starter gear must be 3 - 4,6 mm (0,118 - 0,18 in.). Backlash of gears must be between 0,3 - 0,6 mm (0,012 - 0,024 in.).

Clean starter gear and scrutinize both sides for cracks ❶, starting at root circle. Exchange starter gear without fail, at presence of cracks. When fitting a new starter gear, make sure that tooth chamfering points to the correct side, to facilitate engaging of starter pinion. Inspect also starter gear for true running.



III. 108

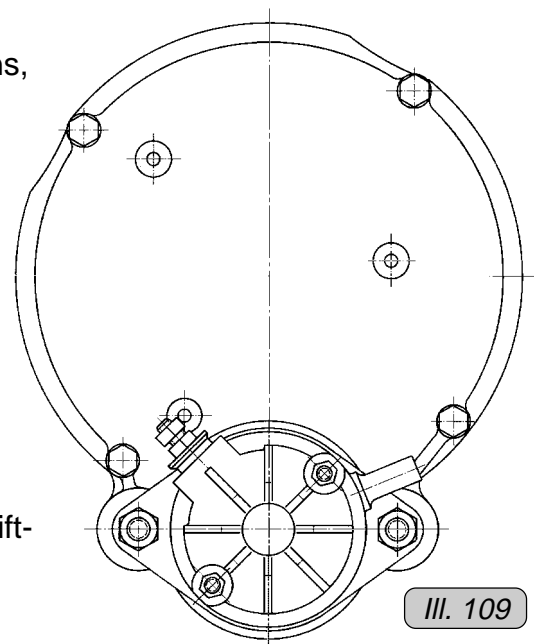
### 7.14.2) Pinion starter on magneto side:

The starter can be fitted in 2 positions, either

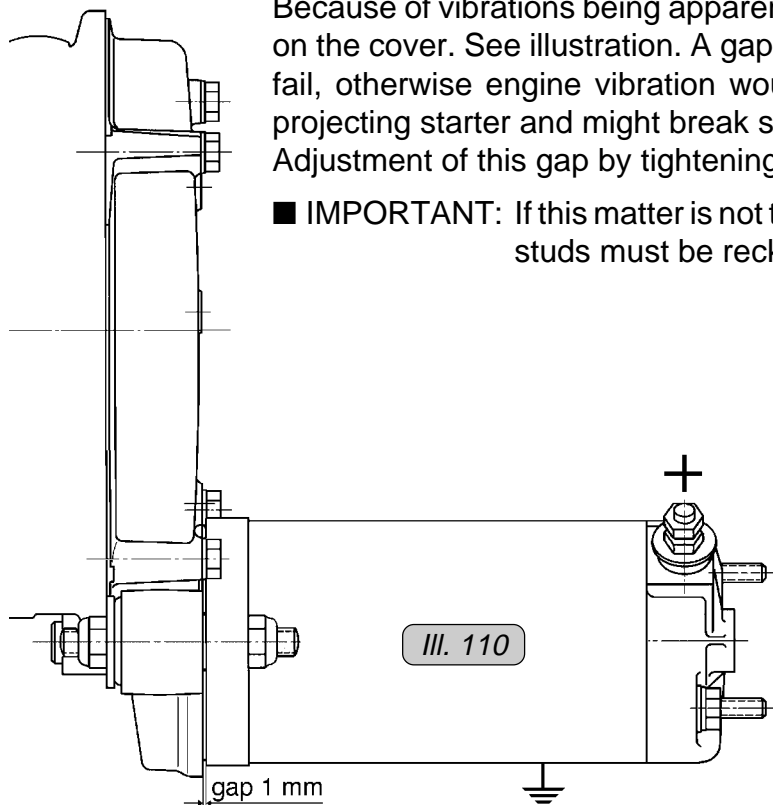
- towards base (as depicted), or
- towards cylinder.

◆ NOTE: On engine type 462 the starter can be fitted towards base, only.

Interference with crankcase bolting does not permit the staggering of starter by 90°. Furthermore this would influence vibration behaviour due to shifting of the centre of gravity.

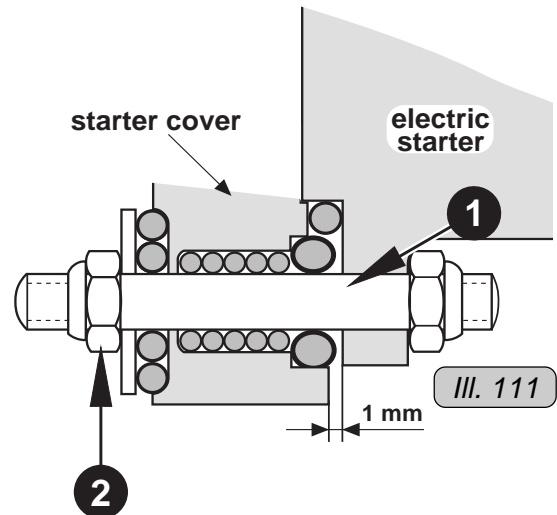


III. 109



Because of vibrations being apparent, the starter must not be attached rigidly on the cover. See illustration. A gap of 1 mm (0,04 in.) has to be kept without fail, otherwise engine vibration would be transferred on to the rather long projecting starter and might break studs ❶ or cover. Adjustment of this gap by tightening or loosening nuts ❷.

■ **IMPORTANT:** If this matter is not taken care of, breakage of the cover or the studs must be reckoned with.



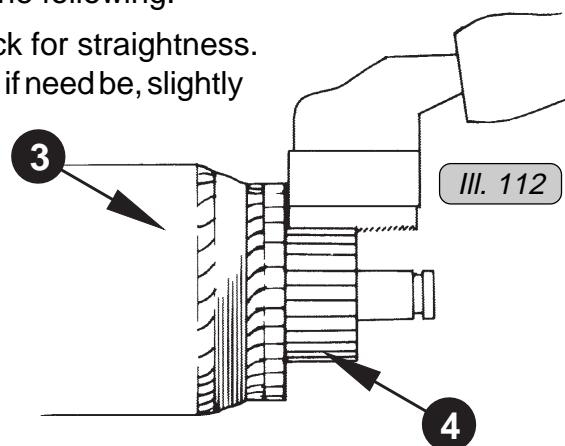
### 7.14.3) Check of electric starter:

After disassembly of starter check the following:

**Armature:** Visual inspection, check for straightness. Clean commutator, and if need be, slightly machine and undercut segments (see ill. beside). The insulation should start 0,5 mm (0,02") below face of segments.

Check armature using 12 or 24 V test lamp for short circuit between armature plates ❸ and commutator ❹. If lamp lights up, exchange armature.

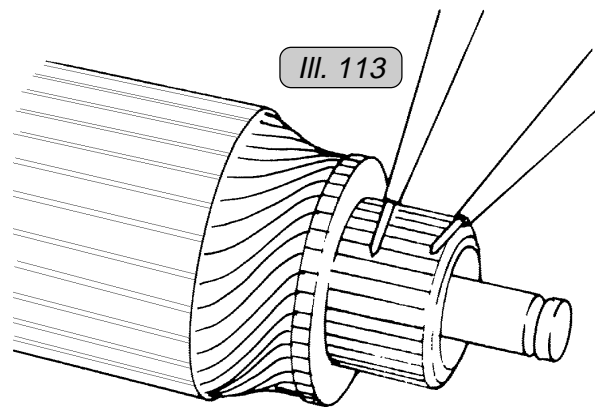
Check armature coils individually for interruption, utilizing c. 2 - 4 V supply and interconnected ampere-meter (60 A range) (see illustration overleaf). The armature has to be renewed if ampere readings differ essentially between single segments.





**Bearings:** Check bush of both bearings. Always exchange bush along with bearing bracket. It is sensible to rebush both bearings in one go.

**Carbon brushes:** Must be freely moving. Renew too short brushes (min. length 8 mm / 0,32 in.). Check spring pressure, renew hot-run springs (blue discoloration).



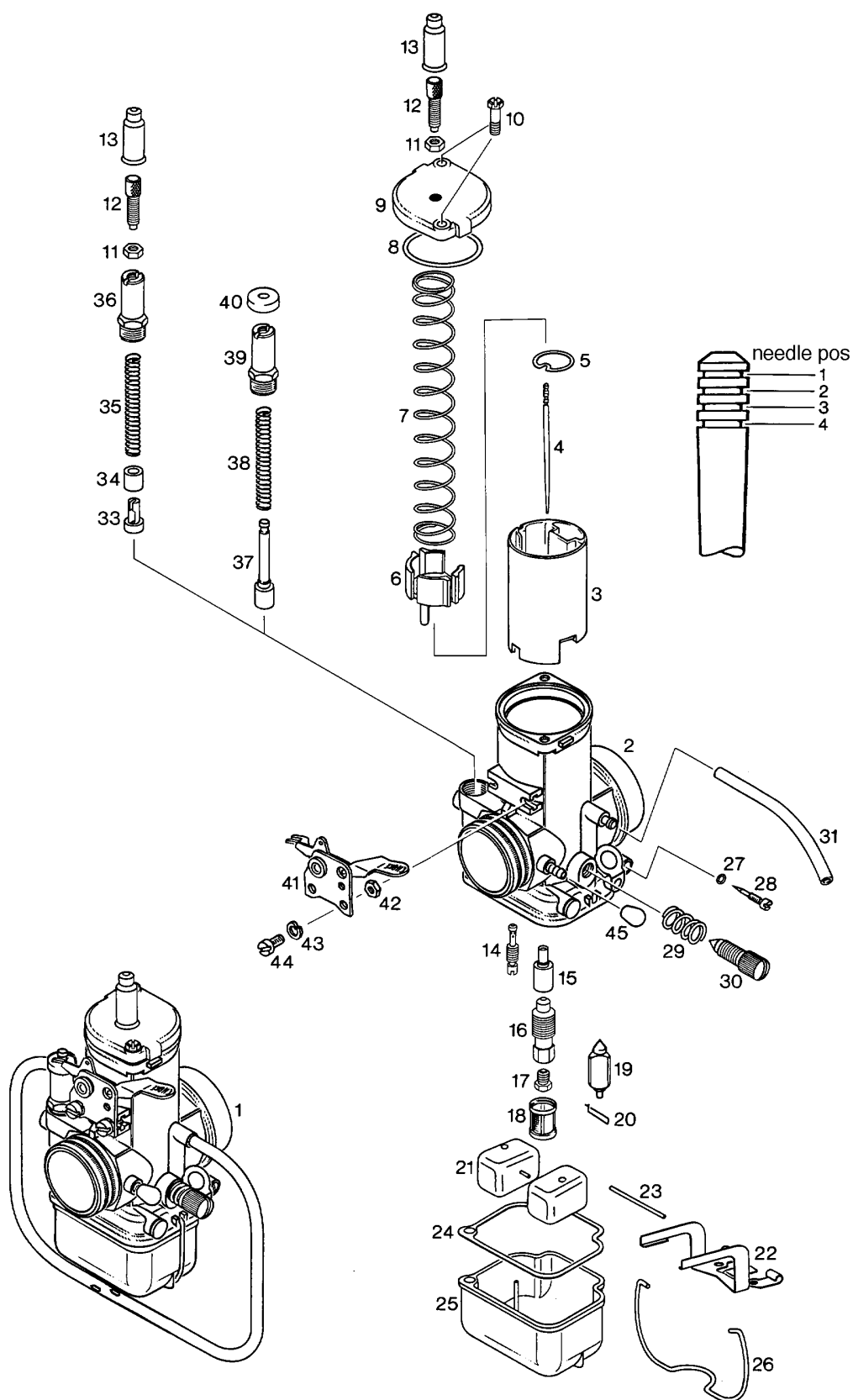
**Starter housing:** Inspect magnets placed inside for cracks.

**Starter pinion:** Inspect teeth and check free-wheeling of overrun clutch. Ensure neat fit of stop collar and circlip and proper shape of spring.

Check free movement of pinion on coarse thread.

**O-rings:** Renew if necessary.

## 7.15) Carburetor:



III. 114

The BING carburetor type 54 comprises a cross-draught slide carburetor with part load needle jet control, idling system and starting carburetor.

#### **7.15.1) Attachment:**

The carburetor is attached to the engine by a flexible socket pushed over the carburetor housing (43 Ø) and secured by a hose clamp. The carburetor is furnished with intake end of 52 Ø, c. 16 mm long, for connection of air filter or intake silencer.

#### **7.15.2) Fuel intake control:**

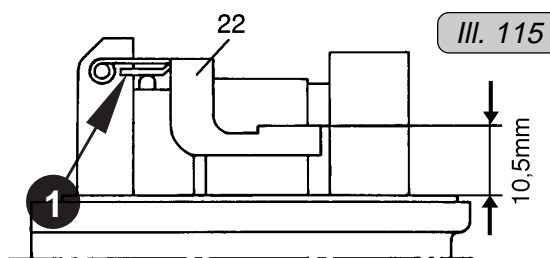
The float system ②① of the carburetor consists of 2 plastic float elements operating on a metal hinge. The floats are arranged each side of the carburetor venturi so that the carburetor can be tilted very far in all directions without impairing operation. The object of the float is to maintain the fuel level in the float chamber ②⑤ constant.

When the fuel has reached a specified level in the float chamber, the floats lift the hinge mounted on pin ②③ until the float needle ①⑨ is pressed against the seat of the float needle valve, thus preventing any further supply of fuel. When the engine draws fuel from the carburetor, the level in the float chamber ②⑤ drops and so does the float. The float needle opens the valve again and allows fuel to flow in from the tank.

The float needle valve regulates the fuel supply in conjunction with the floats, but it may not act as a positive stop valve when the engine is at a standstill. Minute foreign bodies may be deposited between the valve seat and the needle tip, thus preventing complete closure of the valve. When stopping the engine, therefore, the fuel cock on the tank should always be closed. A must, if the tank is located above the carburetor, but also recommended with the fuel tank in lower than carburetor position. In addition the fuel should be filtered before it reaches the carburetor. The filter should be selected so that foreign bodies greater than 0,1 mm are filtered out and the fuel supply is not impeded to too great an extent.

The float needle ①⑨ contains a spring-loaded plunger which contacts the float hinge. This absorbs vibrations of the float ②①. In addition the float needle ①⑨ is connected to the float hinge by the retaining spring ②④ to prevent it from moving between hinge and valve seat and thus reducing the fuel supply. Spring and retaining guide make a considerable contribution towards keeping the fuel level in the float chamber constant.

When fitting a new float valve, set the float hinge 22 parallel to float chamber by bending the hinge lobe accordingly 1. With the hinge parallel, the dimension shown, should be appr. 10,5 mm.



The float chamber 25 is secured to the carburetor housing by a spring clip 26. A seal 24 is provided between float chamber and carburetor housing. The space above the fuel level is connected to atmosphere by two ducts. If these ducts are blocked, an air cushion forms above the fuel level. The fuel will not lift the float sufficiently to close the needle valve, and the carburetor overflows.

The vent duct openings to atmosphere are provided with a hose 31 which prevents ingress of dust and water into the carburetor. Velocity pressure must never act upon venting ducts as it would influence pressure in float chamber, and therefore after the air/fuel mixture.

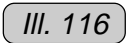
### 7.15.3) Main regulating system:

The amount of mixture drawn in by the engine and thus its performance is determined by the cross-sectional area of the venturi which is opened up by the throttle slide 3. This slide is lifted by a Bowden cable against the action of a return spring 7. The air flow produces a vacuum in the carburetor venturi which draws fuel from the float chamber through the jet system. On its way from the float chamber to the venturi the fuel passes through the main jet 17, mixing tube 16 and the needle jet 15; as it leaves the needle jet it is pre-mixed with air which is brought in from the filter connection via an air duct (Z) and the atomizer in an annular flow around the needle jet.

This air flow assists the atomizing process to form minute fuel droplets and thus favourably affects the fuel distribution in the intake manifold and combustion in the engine.

In the part-load range, in other words when the throttle slide is between one and three-quarters of its full stroke, less fuel is required than at full throttle. The fuel supply to the venturi is therefore reduced by a jet needle 4 which is connected with the throttle slide 3 and moves in the needle jet 15. Depending on the dimension of the taper of the jet needle, the annular gap between jet needle and needle jet is enlarged or decreased. For fine-adjustment the jet needle may be located in the throttle slide in various positions (needle positions) which, similarly to the taper, affect the amount of fuel drawn in.

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For example, a higher needle position results in a larger annular cross-section in the needle jet which allows more fuel to pass through and vice versa. For example, “needle position 2” means that the jet needle has been suspended from the spring retainer ⑤ with the second notch from the top.

When the throttle slide opening is reduced further, the amount of fuel supplied is affected also by the shape of the throttle slide at the lower end. With increasing height the cylindrical recess called air cushion results in the mixture becoming leaner. The recess on the filter side called “cut-away” has a similar effect but this extends up to a greater slide stroke.

The carburetor is adjusted using main jets and needle jets of various sizes and also atomizers, gas slides and jet needles of various types.

The jet needle ④ is located in the throttle slide ③ by the retainer ⑤. The slide spring ⑦ is located in a cup ⑥ in the throttle slide ③ in such a way that the retainer ⑤ is secured. In addition the pin at the lower end of the spring cup ⑥ provides a locking effect for the Bowden cable attachment hole in the throttle slide. A guide piece (no spare part) locates the throttle slide in the carburetor housing the correct way round.

The throttle slide movement is limited at the top by a sealing ring ⑧ and the cover plate ⑨ which is secured by two screws ⑩. The Bowden cable play is adjusted by means of an adjusting screw ⑫ and a lock nut ⑪. During idling the cable play should be at least 1 mm. The rubber bush ⑬ provides a seal between adjusting screw ⑫ and Bowden cable.

The main jet ⑰ is surrounded by a strainer ⑱. In particularly severe operating conditions this ensures that the fuel is not spun away from the main jet. The strainer does not act as a filter!

### 7.15.5) Idling system:

During idling the throttle slide is closed to such an extent that it touches the slide adjusting screw 30. This screw allows the idling speed to be changed. If it is turned in clock-wise direction the idling speed is increased and vice versa. The spring 29 ensures that the adjusting screw 30 cannot work loose.

In the idling position the vacuum at the needle jet outlet is so low that the main regulating system will no longer supply any fuel. This is then supplied via an auxiliary system, the idling system, which consists of the idling jet 14 and the mixture control screw 28 with sealing ring 27 which acts as a seal for the screw and also stops it from working loose.

The fuel passes through the idling jet 14 the bore of which determines the amount of fuel allowed through. Behind the jet bore the fuel mixes with air which is supplied via cross ducts in the jet throat from the atomizing air duct, the amount of air admitted being determined by the setting of the mixture control screw 28. This initial mixture then flows through the idling outlet bore (LA) and the bypass or transition passages (BP) into the venturi where it is mixed further with pure air.

Idling should always be adjusted with the engine at operating temperature. First the mixture control screw is turned in fully clock-wise and then backed off by the number of turns specified for the particular engine. Turning in anti-clockwise direction results in leaner mixture. The idling setting quoted serves as a guide only. The optimum will generally differ slightly. First select the desired idling speed by using the throttle slide adjusting screw 30. The mixture control screw is then opened (turned anti-clockwise) until the speed rises. Then turn the screw back by a quarter of a turn.

If the throttle slide is closed down to the idling position while the engine is running, then only the idling outlet bore (LA) is available between throttle slide and engine intake and it is thus exposed to the suction effect. When the throttle slide is in this position, air will enter through the bypass bore (BP) which will make the pre-mixture leaner until the idling speed is reached. If the throttle slide is then opened, the bypass bore will also be subject to the vacuum and will supply additional fuel to enrich the mixture in the transition range.

Idling may be adjusted only by turning the setting screw 30 and the mixture control screw 28 or by using idling jets of various size. Idling outlet bore (LA) and bypass bore (BP) are matched to the fuel requirements of any given engine and must not be changed.

### 7.15.6) Starting aid (starting carburetor):

#### Starting carburetor (choke)

The starting carburetor is a slide carburetor of simplest design which works in parallel to the main carburetor. When the slide consisting of the starting plunger 33 and the sleeve 34 located in the choke housing 36 is lifted by a Bowden cable against the spring 35, then the starting plunger opens the fuel outlet which was previously closed by the seal on the underside of the plunger. At the same time the sleeve 34 opens a duct which allows air from the filter side of the throttle slide 3 to reach the motor side. This starting air is mixed with fuel in the starting carburetor, the fuel having been drawn in through the starting jet in the float chamber 25 and the riser in the starting carburetor. During starting the throttle slide must be closed!

The riser is immersed into a vented compartment of the float chamber 25; with the engine at standstill and also during normal operation the fuel level in this compartment will be the same as in the float chamber. When starting with opened-up starting carburetor, the fuel will initially be drawn in from this compartment which forms a very rich mixture.

The fuel supplied subsequently will only be the amount allowed through by the starting jet in the float chamber. This ensures that, once the engine has started, it is not supplied with an excessively rich mixture and stalls. The starting carburetor is therefore matched to any given engine by modifying the starting jet and matching the space behind it.

The starting cable is adjusted by an adjusting screw 12 with lock nut 11. The seal between adjusting screw and cable is provided by a rubber bush 13.

The starting carburetor may also be operated by the lever 41. For this the plate on which it pivots is secured to the carburetor housing by means of screws 44, nuts 42 and lock washers 43. The fork at one end engages with the starting plunger 37 which replaces the starting plunger 33 with sleeve 34. It is located in the choke housing 39 and sealed against it by the rubber cap 40. When the engine is started from cold, the operating lever is depressed. This will open the starting carburetor against the spring 38.

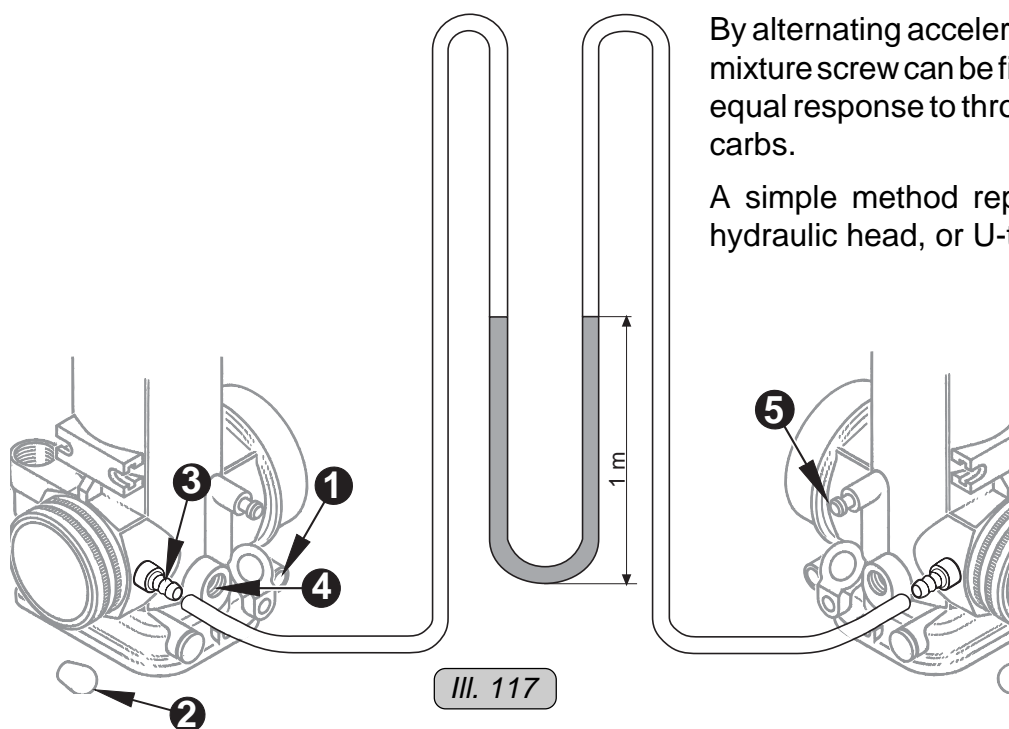
### 7.15.7) Check list for carburetor:

- Check all jets and fuel ducts for free passage.
- Inspect carburetor piston and needle jet for wear.
- Check float level (see illustration).
- When checking float valve consult the detail “fitting of the carburetors” in engine assembly chapter.
- Check jet needle for wear, especially at grooves for clip.
- Inspect floats for crumbling of plastic at guide pin, and for wear of guide tube. Replace both needles and clip if worn.
- Check calibration.



## 7.16) Pneumatic synchronization of a 2-carb installation:

With suitable flow meters (synchro tester) or depression gauges (see carb description) both carbs are adjusted to equal flow rate at idling. The rubber cap (45) plugs the connection for pneumatic synchronization.



By alternating acceleration on each carb, the mixture screw can be fine-adjusted to achieve equal response to throttle movement on both carbs.

A simple method represents the use of a hydraulic head, or U-tube pressure gauge.

- Support and attach 5 - 6 m of transparent tube, suitably routed. Fill tube with water approx. 1 m high. Close mixture control screw ❶ completely first on both carbs and re-open screws by 3/4 of a turn.
- Run engine warm and stop. Remove rubber cap ❷ from primer nipple ❸ and connect the ends of U-tube pressure gauge to nipples.
- Start engine, kink hose to prevent that the water in the tube is sucked into engine. Let engine idle and allow free passage of hose.
- At idling, the water head on both sides of U-tube has to be of equal height. If head is higher on one side, adjust with idle screw ❹ on respective carb, i.e. turn adjustment screw clockwise.
- If idle speed is too high, turn idle screw ❹ on both carburetors anti-clockwise and re-adjust if necessary as per point d).
- Check mixture composition. When turning air regulating screw to either direction, idle speed ought to decrease. If not, try to find best adjustment. Finally, re-adjust again to point d).
- Slowly accelerate. Rising of the water on one side of U-tube indicates too much clearance of the Bowden cable on this carb. Re-adjust Bowden cable to the minimum clearance of 1 mm.
- Remove pressure gauge hose and plug nipples again. ❺ = Nipple for float chamber venting

### 7.16.1) Mechanical synchronization:

Turn back adjustment screw ③ on both carbs, so that throttle slide ③ closes completely. After that turn in again adjustment screw, until it just touches the slide. From this basic position, turn adjustment screw on both carbs till reaching the idle speed wanted.

To adjust the idle air mixture screws proceed as above. Turn in resp. out until the max. idle r.p.m. is reached. Subsequently, adjust Bowden cables for simultaneous opening of the throttles, but always maintain a minimum clearance of 1 mm.

## 7.17) Matching of the carburetor to specific climatic conditions:

(valid for BING carburetors only)

Carb calibration was carried out conscientiously at ROTAX for the prevailing ambient conditions there. Density of the air decreases with decline of atmospheric pressure and rise of temperature. With engine operation at higher altitude, the weight of the aspirated air decreases, whereas the quantity of fuel consumed remains practically unchanged. This results generally in richer fuel/air mixture than with operation at lower altitudes.

It is advisable to match carb calibration according to engine reaction, for operation in higher altitudes, to re-establish the original composition of the fuel/air mixture.

◆ NOTE: With flying in higher altitudes at lower atmospheric pressure, the portion of oxygen in the air is reduced, too, resulting in loss of performance. This drop of performance cannot be compensated by matching the carb calibration. To match the carb to changes of atmospheric conditions a change of the main jet is generally sufficient.

		Altitude of base (metres above M.S.L.)								
		0	500	1000	1500	2000	2500	3000	3500	4000
ambient temp. on airfield (°C)	-30	104	103	101	100	98	97	95	94	93
	-20	103	102	100	99	97	96	95	93	92
	-10	102	101	99	98	96	95	94	92	91
	0	101	100	98	97	95	94	93	91	90
	+10	100	99	97	96	95	93	92	91	89
	+15	100	99	97	96	94	93	92	90	89
	+20	100	98	97	95	94	93	91	90	88
	+30	99	97	96	94	93	92	90	89	88
	+40	98	96	95	94	92	91	90	88	87
	+50	97	96	94	93	92	90	89	88	86

Find standard calibration as listed in spare parts list or from your local Rotax dealer. Only in special cases a change of jet needle and needle jet and/or a different idle jet will be necessary, too.

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Determination of jet size  $D_2$ , for a specific altitude of operation, based on the jet size  $D_1$  of a standard calibration:

$$D_2 = \frac{d_2 \times D_1}{d_1}$$

Find correction factor  $d_1$  (standard calibration) and  $d_2$  (base of operation) in the stated table.

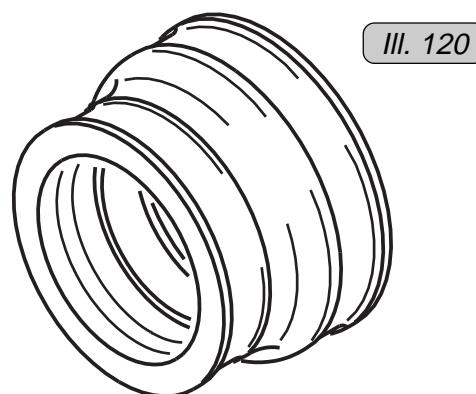
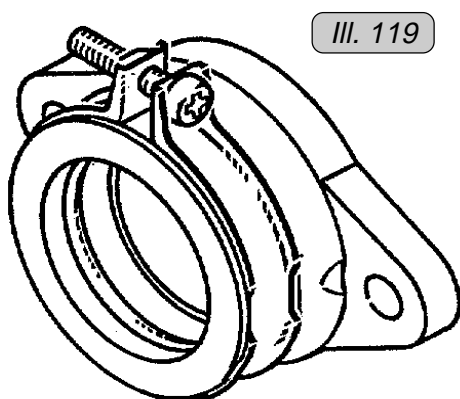
**Example:** An engine optimally calibrated with main jet 150 at an ambient temperature of 20°C at c. 500 m above sea level should be calibrated for operation on 2500 m above sea level at a temperature of 0°C:

$$D_2 = \frac{d_2 \times D_1}{d_1} = \frac{94 \times 150}{98} = \underline{\underline{144}}$$

Operation with a main jet of 144 would result in the same composition of the fuel/air mixture.

### 7.18) Rubber carburetor-adaptor:

Two types of carburetor adaptors are used. The regular one is with a flange, connected by 2 hex. hd. screws with washer. On type 582, version with fresh oil lubrication, a rubber adaptor with hose clamp is used.



The carburetor adaptor has to meet high demands due to exposure to fuels, oils, different temperatures and solar radiation. Therefore check carburetor adaptors thoroughly for tightness, cracks, cuts or other physical damage. Squeezing the rubber body helps to detect beginnings of cracks.

At the slightest signs of damage exchange carburetor adaptor. Otherwise pressure conditions in carburetor will be changed, additional air will be taken in, possibly leading to engine damage. To attach carburetor, use clamps without sharp edges, only.

Carburetor has to be checked and adjusted after every 25 hours of operation. Badly adjustable idling on a carburetor could be caused by a damaged intake flange. For further information see SI 6 UL 93-E.

## 7.19) Air filter:

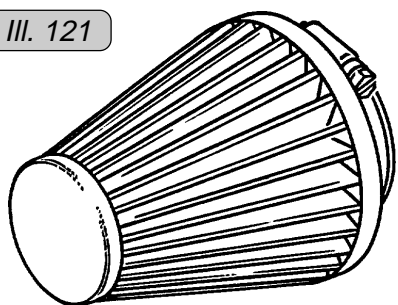
Only air filters approved by ROTAX are permitted for use. The air filters specified by ROTAX are special K & N air filters. Dry filter elements of paper are not allowed for humid operating conditions, as they absorb water, thus reducing the air intake leading to enrichment of the fuel/air mixture.

Two kinds of filter design are applied on these engines:

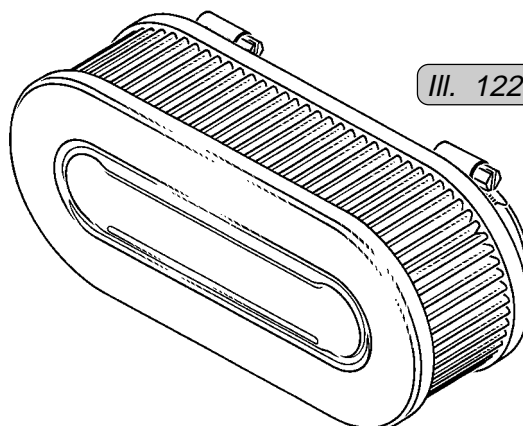
- Single air filter
- Double air filter

With 2 carburetors on engine, either 2 single air filters or 1 double air filter may be fitted.

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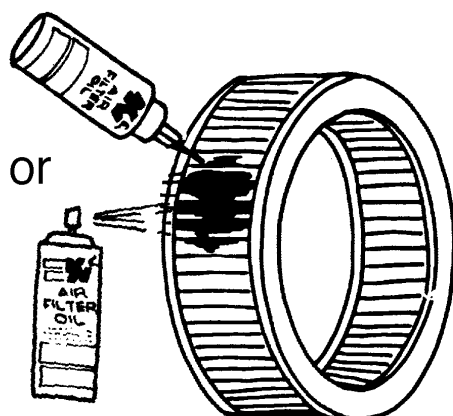
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■ **WARNING:** Always secure air filters against loss.

### 7.19.1) Application of new air filters:

For a higher life-span and optimal engine protection the filter corrugations have to be wetted with oil. Un-oiled filters lose their effectiveness against dirt and dust.



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Every corrugation of the filter has to be sprayed with oil. After 5 - 10 minutes the filter mat will be soaked with oil, noticeable on the uniform red colouring.

Never use gear oil, diesel, 2-stroke oil or motor oil as they attract water.

If necessary, apply filter grease on sealing face, but don't grease clamp connection of filter.

### 7.19.2) Cleaning of used air filters:

First, lightly tap off surface dirt and wet with cold water. Roll filter in filter cleaning- and degreasing fluid.



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Never use gasoline, steam, caustic liquids, detergents or high pressure cleaning.

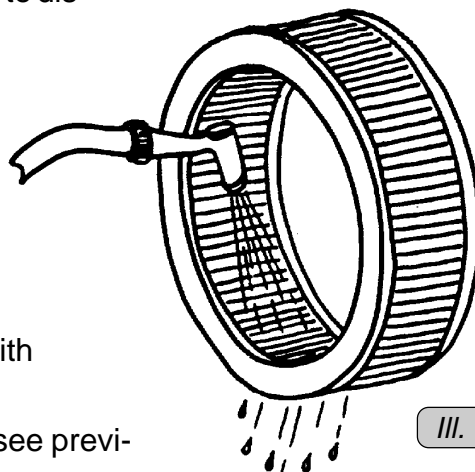
The level of the cleaning fluid ought to be approx. 3/4 of the height of corrugations. Dirty cleaning fluid must not run over inside of filter. Allow at least 5 minutes to dissolve the dirt.

After that, rinse filter with cold water

from inside to outside. Shake off and let it dry in free air. Don't dry with compressed air, over naked flame or with hot air fan.

Prior to installation, wet filter with oil (see previous chapter).

Filter due for renewal depends on territory of deployment, but at the latest after 300 hours of operation.



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### 7.20) Intake silencer:

Depending on engine version, two different intake silencer designs are employed:

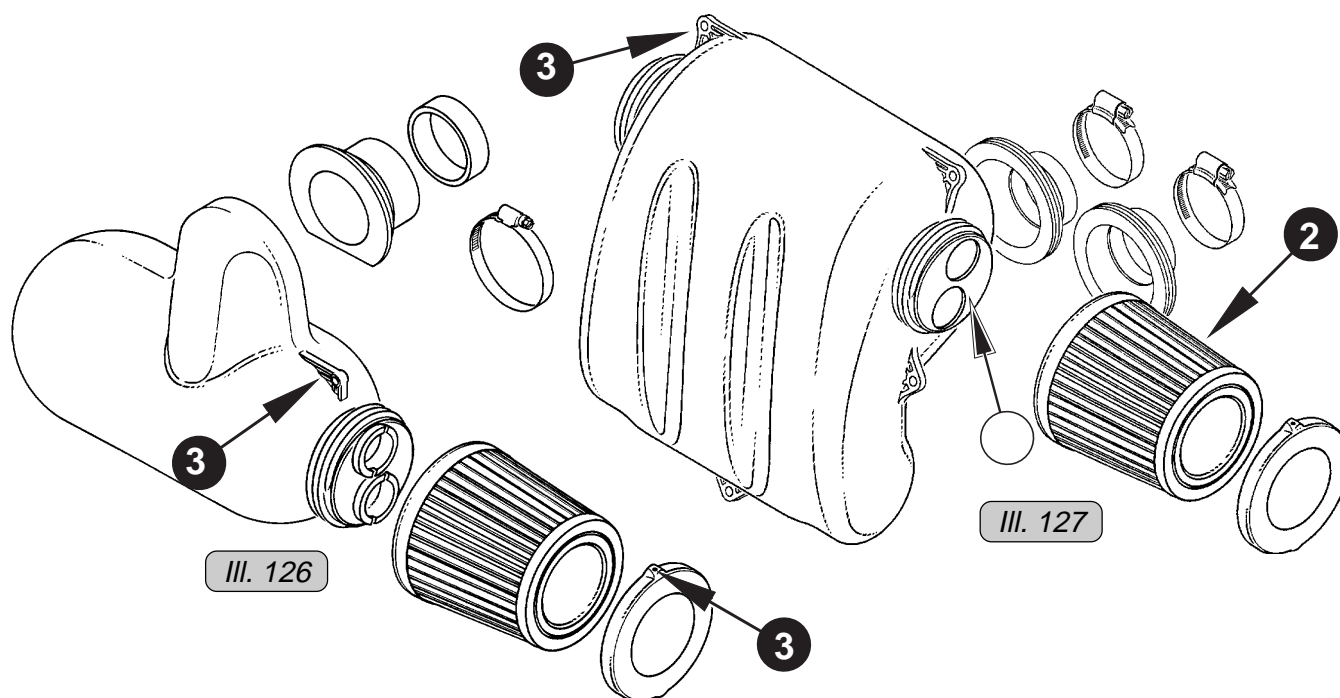
- Intake silencer for engine with single carburetor
- Intake silencer for engine with two carburetors

Visual inspection of silencer

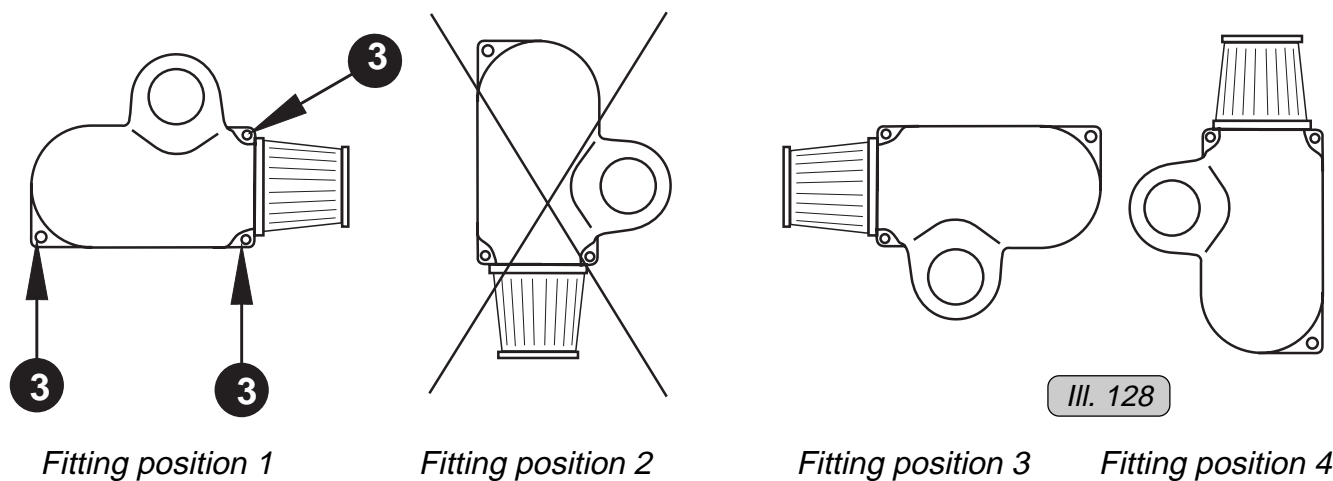
Renew damaged and cracked silencer. Check silencer socket for proper fit. Check interior of silencer, if necessary clean it.

■ **ATTENTION:** Weight of silencer must not influence position of carburetor. If need be, support silencer accordingly.

Fit silencer parallel to crankshaft axis with screw-on filter ❷ not pointing towards propeller. The double intake silencer is available with either left- or right hand side inlet opening ❶, to suit respective fitting position.



With the silencer on a single carburetor engine, pay special attention when fitting it, as with an inclined silencer the intake situation is unsymmetrical, thus badly influencing mixture distribution possibly leaning down one cylinder, leading to a rise of combustion temperature and finally to piston seizure.

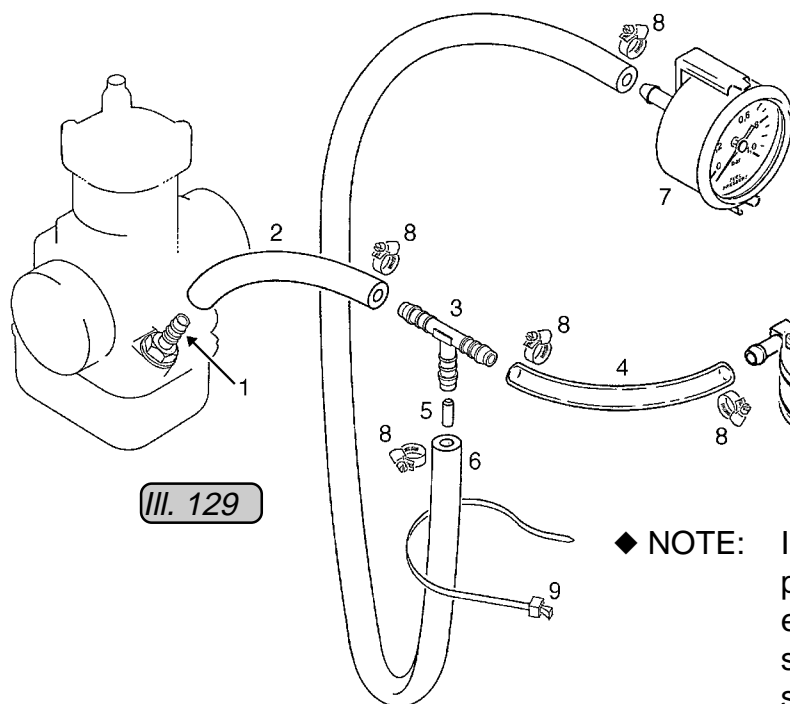


Position 1 would be best. Positions 3 and 4 are also acceptable, but avoid unfavourable position 2.

▲ **WARNING:** Screw-on filter and silencer have to be wire-secured against slackening and loss on the assigned lug ❸.

## 7.21) Fuel pressure testing:

The majority of engine failures are caused by fuel system faults.



Many problems can be prevented by regularly checking the operation of the fuel system. The fuel pressure tester is a valuable tool for checking whether the fuel system is functioning correctly. This tester can either be used during engine maintenance or permanently installed on the aircraft with the gauge mounted on the instrument panel.

◆ **NOTE:** In case of permanent installation approval must be sought from the relevant Aviation Authority, and the description of function and application should be included in the aircraft operator's manual. Any gauge installation should be done to acceptable aircraft standards.

### 7.21.1) Fitting the fuel pressure tester:

▲ **WARNING:** Before working on the engine, always set the ignition switch to "OFF" position and disconnect high tension leads from the spark plugs.

Remove fuel hose from carburetor inlet ❶, fit the short hose ❷ attached to T-piece ❸ on tester to the carburetor. Connect the fuel hose ❹ originally fitted to the carburetor to the free end of the T-piece. Insert the restrictor ❺ into the tube ❻ to the pressure gauge ❼. The restrictor is to damp out pressure pulsations to the gauge. Secure all tube connections with clamps ❽. Secure the pressure gauge in a position where it can be seen easily by the operator when ground-running the engine. Make sure there is no possibility of the gauge and its hose getting drawn into the propeller. If necessary secure the hose temporarily to the airframe using the cable ties ❾ provided.

Procedure for permanent fixing of the fuel pressure tester to the aircraft:

- The gauge should be positioned such that the pilot has a good direct view of it,
- fitted in such a place that in the event of a fuel leakage at the gauge, fuel will not fall onto the pilot or passenger.
- The hose should be routed to the carburetor in such a way that it is unlikely to be chafed or otherwise damaged.



### 7.21.2) Test procedure:

- ▲ **WARNING:** For testing secure the aircraft firmly to prevent it from moving when run at full throttle. Make sure that bystanders are kept at a safe distance.

Visually check the connections for fuel leaks. Allow a minute or so for the pressure reading to stabilize initially. Then run the engine at various speeds throughout its range, from idle to full throttle, and observe the pressure gauge. The pressure should be between the 2 red marks, i.e. within 0,2 to 0,5 bar (2.9 - 7.3 psi). If during testing a lower pressure is indicated, stop the engine and trace the cause. See fault finding section.

- ▲ **WARNING:** Don't start the aircraft before an apparent fault has been found and eliminated.

### 7.21.3) Fault finding:

Guide for fault finding if the fuel pressure is not within the indicative values 0,2 - 0,5 bar (2.9 - 7.3 psi).

Symptom	Possible cause	Remarks & Rectification
Fuel pressure normal for first minutes of operation, but then falling.	Blocked fuel tank vent	Check and clear vent
	Debris in fuel tank or pipeline, gradually restricting flow	Clean system and re-test
Low fuel pressure	Blockage at fuel tank outlet	Check fuel tank outlet. A strainer in the tank is recommended. Clean tank thoroughly and keep clean.
	Restricted fuel connections	Check for the possibility of hose clamps crushing the items they are clamping - particularly plastic fuel filters whose inlets and outlets can be closed down by excessive pressure on hose clamps.
	Kinked fuel hoses	Check and ensure installation will not allow kinks to form.



Symptom	Possible cause	Remarks & Rectification
Low fuel pressure (continued)	Blocked pipelines and fittings	Any change of pipe section may allow debris to collect and gradually block the pipe. Look particularly at inlets of fuel taps, bulb primers, quick release connectors, fuel filters and other fittings.  It is possible for a 'flap' of rubber from the inside of the fuel hose to partially block the pipe when the hose is pushed onto a connection. Such a fault is not obvious when the hose is removed. Check carefully. Clean system and renew all suspect components.
	Restrictive pipe lines & fittings	Check that the flow passages are all large enough. Some aircraft may have systems that are too restrictive. Check that fuel tap is fully turned on and bore is of sufficient size. Minimum recommended size of all pipework, taps and fittings is 5 mm dia. between fuel pump, tank and carburetor.
	Blocked fuel filter	The flow through the filter may be restricted due to the long term build up of dirt. A more serious type of blockage, which can occur quite rapidly is caused by a reaction between detergents in certain two-stroke oils and water in the fuel.  Both types of blockage may be difficult to detect visually. If blockage is suspected, renew fuel filter or filter element. Subsequently avoid water contamination of fuel.
	Pulse pipe from crankcase to fuel pump of incorrect length or material	Pipe must be stiff hose of max. length 500 mm for two-stroke engines. A hose too soft or too long will reduce pump capacity. If hose is outside requirements, consult Aircraft manufacturer regarding modification.
	Pulse pipe from crankcase to fuel pump damaged or restricted	Check hose for kinks, cuts and other damage. Check that a 'flap' of rubber is not partially blocking pipe at 'push on' connections. Renew as necessary.
	Fuel pump faulty	Fuel pump diaphragm may be punctured. One way valves in fuel pump may be faulty. Tiny breather hole in fuel pump may be blocked. Strip fuel pump clean, inspect and renew components as necessary.
	Fuel leak between fuel pump and carburetor	Check visually, repair as necessary.

Possible cause	Possible cause	Remarks & Rectification
Low fuel pressure combined with air bubbles in transparent section of pipe	Air leak between fuel pump and fuel tank	Air drawn into pipeline on suction side of pump will reduce its capacity. Carefully check all hose connections and fittings. Some hose clamps do not grip evenly all round the hose and encourage air leaks. A restriction or blockage on the suction side will also encourage air leaks, so check for more than one fault. Renew faulty parts.
Low fuel pressure combined with rich mixture on the cylinder which provides the pulse for the fuel pump (black spark plug on this cylinder plus uneven running) AND/OR fuel mist spraying from fuel pump breather	Fuel pump diaphragm ruptured	Strip fuel pump and replace diaphragm.
High fuel pressure	Blockage just inside carburetor	If fuel pressure is above 0,5 bar (7.3 psi) at any engine speed, suspect a blockage just inside the carburetor, between the fuel inlet and the needle valve that controls the flow into the float chamber. Such a blockage may be caused by a small sliver of rubber, sliced off the fuel hose when it was pushed onto the carburetor connection. Remove float lever and needle valve, and blow backwards through carb inlet with an air line or hand pump to clear the obstruction.
	Partially blocked main jet	Remove float chamber and main jet. Clean jet by blowing through it. Replace.
Fuel pressure falls rapidly when engine is stopped	Inlet needle controlling flow into float chamber not sealing properly	Remove float lever and needle valve. Check for foreign matter on valve seat, check condition of needle valve tip. Renew as necessary.
	One way valves in fuel pump ineffective	Strip fuel pump. Renew components or fuel pump as necessary.
	External fuel leaks	Renew components or fuel pump as necessary.

**The above does not constitute a complete list of possible faults, but is based on experience in servicing and trouble shooting.**

## 7.22) Cooling system of engine:

Forced coolant flow by integrated water pump from radiator to suction side of pump, and pumped via cylinders and cylinder head back to radiator. Cooling system has to be arranged in a way that enables vapour to escape from cylinders and cylinder head to the header of radiator or expansion chamber. Therefore it is necessary to locate expansion chamber at the highest point of the cooling system.

To provide extra lubrication for the water pump oil seal and to avoid corrosion, use coolant with anti-freeze for -10° C (4° F), even at operation in summer, but ensure to add anti-freeze compatible with aluminium.

- Check coolant for level and anti-freeze, prior to take-off, replenish or renew as required.
- Cooling effect of water is diminished by admixture of anti-freeze, even substantially under certain circumstances. Consider this fact at determination of radiator. Not every anti-freeze is suitable. Besides the danger of being aggressive, it might thicken, thus reducing heat transfer.
- The mean temperature of the coolant should be between 60 - 80° C (140 ÷ 180° F). If coolant temperature rises too high, reason has to be traced. Likely reasons are not enough coolant, blockage in radiator or hoses, damage on pump or pump impeller, air pockets in cooling system, too much anti-freeze, etc.

▲ **WARNING:** Never remove radiator cap on the hot cooling system. For safety's sake cover with cloth and open cap slowly. Sudden opening of cap could lead to discharge of boiling water, possibly causing scalds.

### 7.22.1) Venting of the cylinder head:

- When installing the engine in upright position, with spark plugs on top, the cylinder head must be vented. Two venting bores M6 are provided, one on p.t.o. side and the other one on magneto side.
- Fit venting nipple along with sealing ring into the venting bore which is during flight normally in the higher position. Plug the second venting bore with screw M6 x 8 and sealing ring.
- On engine version with twin radiator set, venting bore on p.t.o. side is plugged at serial production. The venting bore on magneto side is connected via a 335 mm long venting hose 14 into the cooling system. This arrangement is basically used with propeller in pusher configuration.
- With propeller in tractor arrangement, venting- and plug screw are switched and the shortened venting hose 14 is connected on p.t.o. side.
- If radiator is located below cylinder head it is absolutely necessary to use expansion chamber furnished with radiator cap 12, but radiator itself to be closed without pressure- and return valve.

### 7.22.2) Operation of radiator cap and overflow bottle:

To achieve a well performing, closed circuit cooling system, a radiator cap with excessive pressure- and return valve and a vented overflow bottle have to be incorporated. The excessive pressure valve opens at 0,9 bar.

At engine installation fill-up cooling system to the cap with coolant inclusive expansion tank.

The overflow line ⑩ from the radiator cap is to be fed into a vented overflow bottle ⑪, approx. one third full with coolant. Overflow line must submerge in coolant. Overflow bottle to be located max. 250 mm (10 in.) below radiator cap.

At engine run coolant expands and some coolant will be displaced into lower overflow bottle.

At cooling down of cooling system, the formerly displaced coolant is drawn back again via the return valve. If coolant won't return, cooling system is leaking and must be checked.

### 7.22.3) Temperature of coolant:

Radiator size and air stream to radiator must be adequate to warrant that coolant temperature rises not above max. allowable 80° C (176° F) even at highest ambient temperature and peak take-off performance. The mean coolant temperature ought to be around 65° C (150° F).

Radiator surface must not be sheltered by any engine components. For instance, only insufficient airstream will occur in the vicinity of propeller hub. On installation with propeller in pusher arrangement, pay special attention to flow rate of cooling air through radiator.

The max. temperature difference of coolant between inlet and outlet of radiator must not exceed 6° C (11° F) but ought to be around 4° C (7° F).

Exceeding of temperature limits or reduction of cooling airstream because of too high flow resistance could generate steam in the cylinder head, causing loss of cooling and leading to engine failure due to overheating.

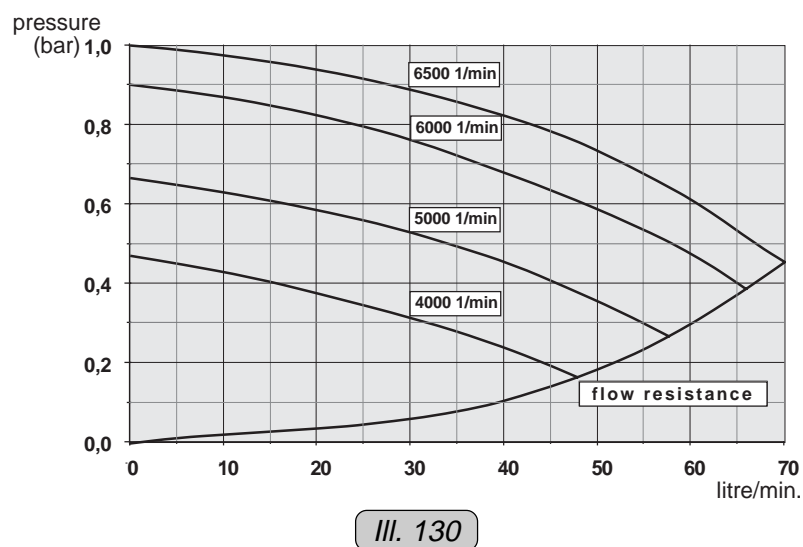
#### 7.22.4) Checking of the single components:

Inspect radiator for physical damage and check for tightness. Clean dirty radiator elements. Check hoses for cracks and porosity. On suspicion of damage or at the 300 hours overhaul at the latest, renew all cooling hoses. Check gasket and both valves in radiator cap. Inspect rubber mountings and brackets of radiator suspension.

#### 7.22.5) Flowrate of coolant:

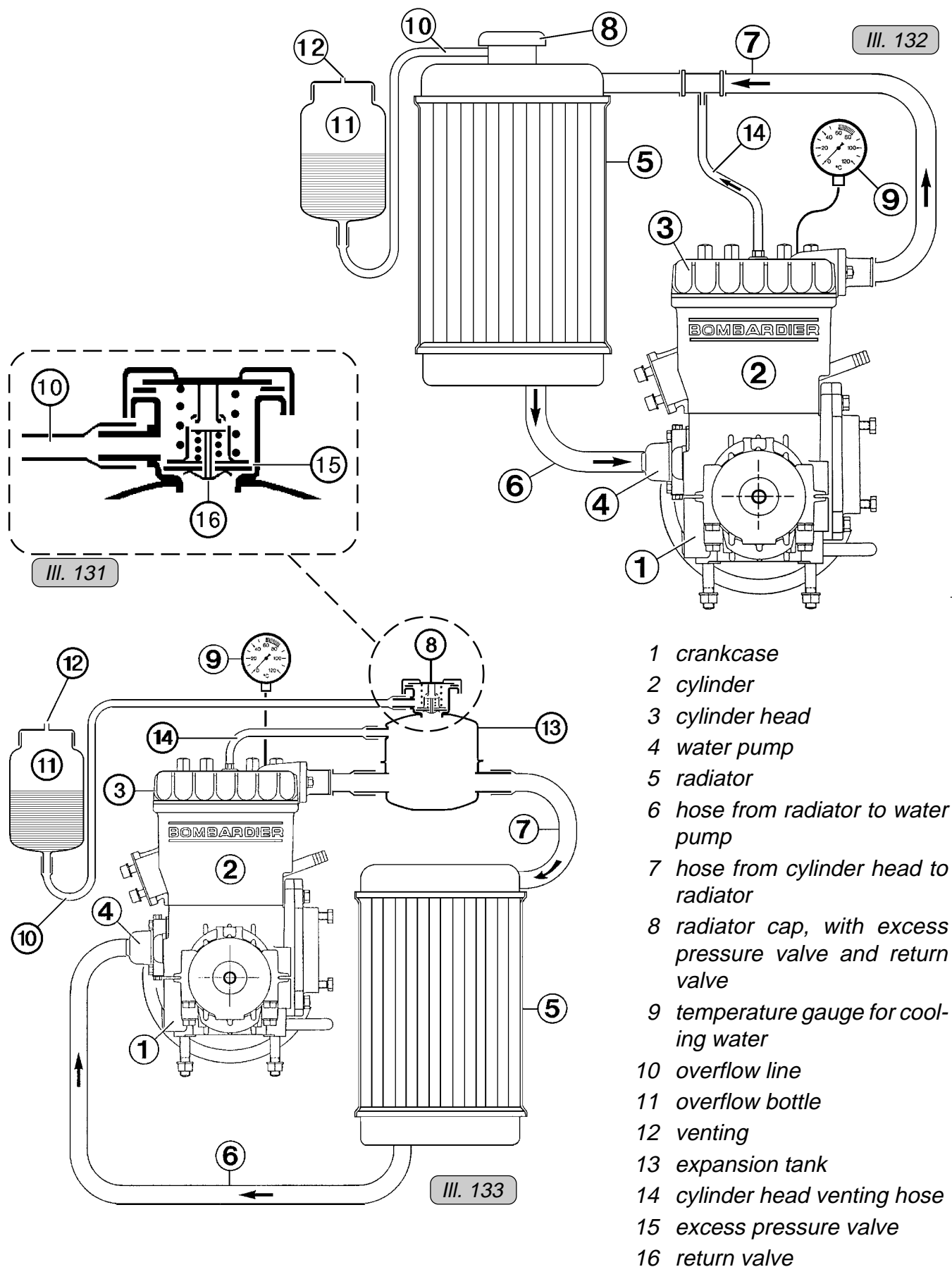
In order not to impair efficiency of water pump, avoid any needless flow resistance.

Flow rate of coolant has to be in the range of 60 - 75 litres per minute at engine speed 6500 r.p.m. (see graph).



Readings taken are valid for water pump installed by ROTAX (basis for evaluation only).

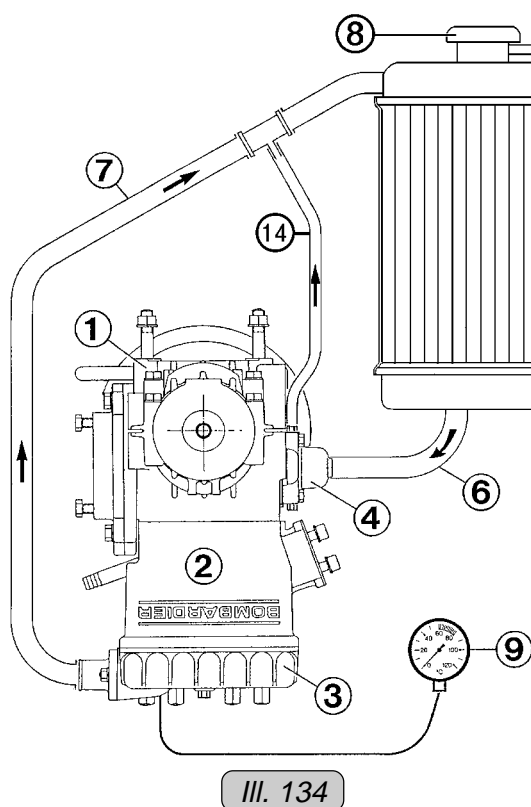
## 7.22.6) Cooling circuit for engine installation with spark plugs up:



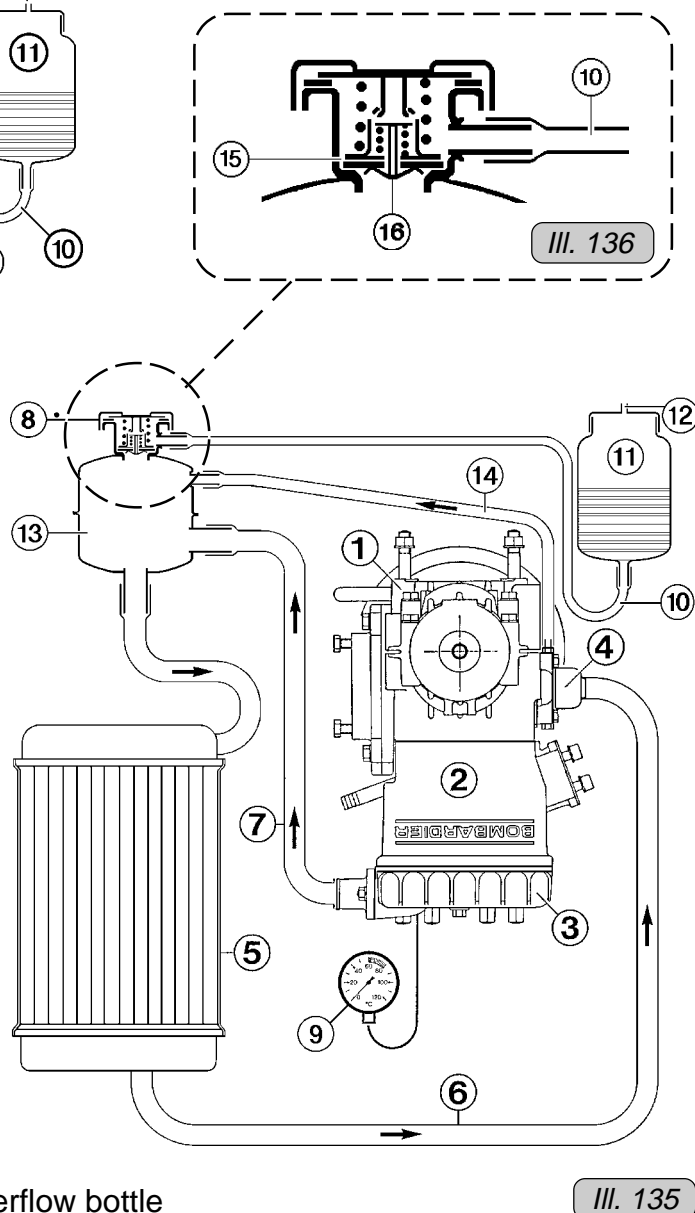
### 7.22.7) Cooling circuit for engine installation with spark plugs down:

For this installation, a vent hose has to be connected on top of the water pump housing ④ leading to the expansion tank ⑬ or to the header of the radiator. The cooling system has to be vented well, to be checked after a short period, and coolant has to be replenished if necessary.

Only a perfectly vented cooling system will work satisfactorily.



- 1 crankcase
- 2 cylinder
- 3 cylinder head
- 4 water pump
- 5 radiator
- 6 hose from radiator to water pump
- 7 hose from cylinder head to radiator
- 8 radiator cap, with excess pressure valve and return valve
- 9 temperature gauge for cooling water
- 10 overflow line



- 11 overflow bottle
- 12 venting of overflow bottle
- 13 expansion tank
- 14 water pump venting hose
- 15 excess pressure valve
- 16 return valve

### 7.23) Oil circuit for rotary valve- and water pump drive:

The 90° spiral gear situated in crankcase centre and running in oil bath drives the rotary valve and water pump. For lubrication of this drive SUPER 2-stroke oil as for engine lubrication is used.

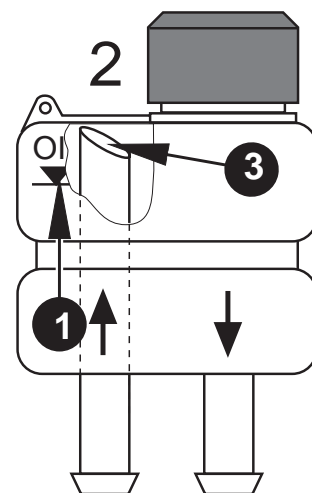
◆ **NOTE:** As this is no closed oil circuit, oil passes back to oil tank sporadically only.

Oil supply from oil tank via hose to the bottom half of crankcase and return line (venting line) from angular nipple on top half of crankcase back to oil tank. If oil tank has been shifted from its initial location, fit it always above level of rotary valve shaft. Pay attention to correct connection of oil lines; it differs on engine installation with spark plugs down.

Before every operation check oil level. Level should be up to mark ① on transparent oil tank ②. Top of vent line has to be always above oil level in tank. Further check oil lines and connections for tightness and good condition. In case of notable oil consumption, of more than 1 c.c./hour, check installation for tightness.

At loss of oil and no visible signs of leakage, inspect oil seals of rotary valve drive.

- a) At crankshaft centre, the rotary valve drive is sealed on both sides by oil seals. Bluish exhaust gases, despite a correct fuel-to-oil mixture of 50 : 1, indicate faulty crankshaft oil seals. Oil flows into crankcase, passes via transfer ports to combustion chamber where it is burnt.



With faulty oil seals, disassemble crankcase and send crankshaft to ROTAX or to an authorized Service Centre.

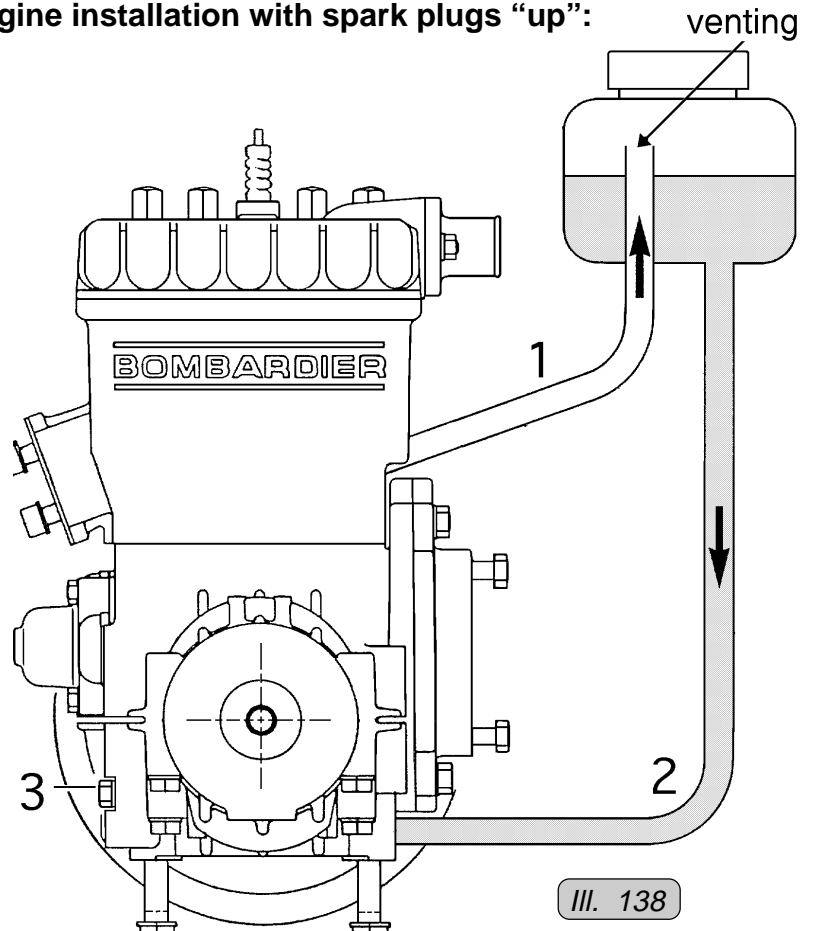
- b) On the water pump side, 2 oil seals are fitted. The outer one seals the water space to water pump and the inner one the oil space of rotary valve drive. At whitish discoloration of the oil in the tank (formation of oil/water emulsion) the oil seals are defective and have to be renewed. For renewal, remove rotary valve shaft.
- c) Brownish discolouring of the face behind the rotary valve indicates defective oil seal next to rotary valve. Here too, oil is drawn through intake ports and burnt. Remedy by removal of rotary valve shaft and renewal of oil seal.

Exact instructions in the respective chapters.



### 7.23.1) Oil circuit for engine installation with spark plugs “up”:

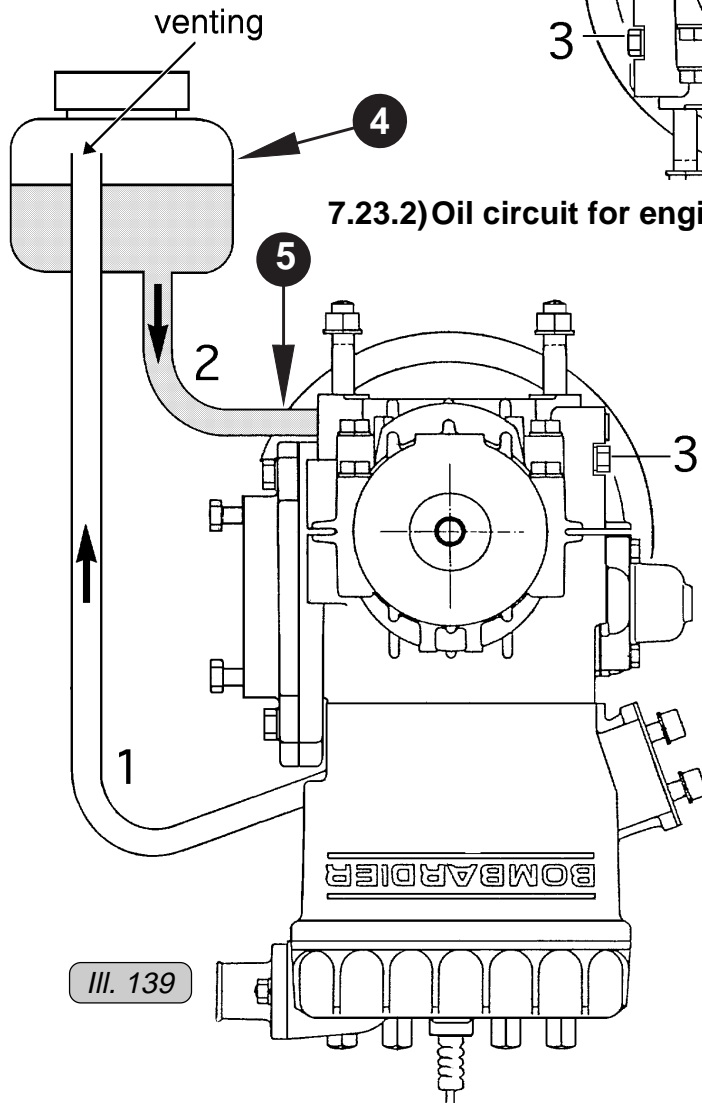
- 1 Oil return line
- 2 Oil supply line
- 3 Vent plug



### 7.23.2) Oil circuit for engine installation with spark plugs “down”:

In this case the oil circuit for rotary valve and water pump drive has to be modified by the aircraft manufacturer as per the illustration on the left. The oil tank installation ④ should not be below oil supply line ⑤.

■ **ATTENTION:** For this inverted engine installation, the oil tank must be removed from the bracket and installed in a suitable location above the engine. Vent system by removing plug ③ when filling the oil tank.



- 1 Oil return line
- 2 Oil supply line
- 3 Vent plug

## 7.24) Oil pump for fresh oil engine lubrication (ROTAX 582 DCDI):

### 7.24.1) Description:

In this case the engine is equipped with an oil pump, gear driven from rotary valve shaft via a plastic gear, and supplies the exact quantity of Super 2-stroke oil to each cylinder via one each atomizer jet in rotary valve cover. The pump used is a plunger pump with proportioning system. The amount of oil is determined by engine speed and pump lever position. This lever is actuated by a Bowden cable connected with the throttle cable. The oil pump is gravity fed from an oil tank.

▲ **WARNING:** In case of oil pump lubrication, the carburetors are fed with pure gasoline (no mixture).

### 7.24.2) Technical data, characteristics:

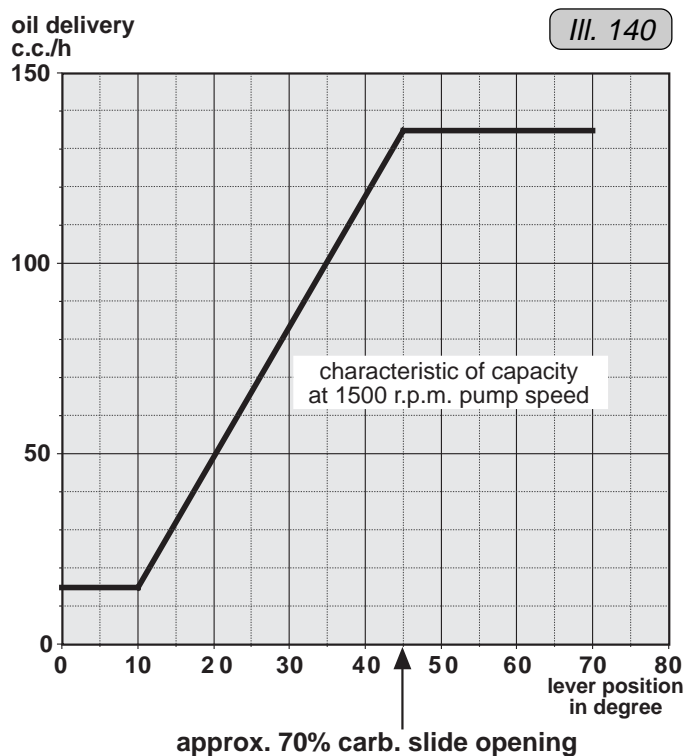
Oil delivery: Max. 135 cc/h per discharge port at 1500 r.p.m.

Oil: Super 2-stroke oil with a pour point 10° below lowest ambient temperature to be expected.

- one oil inlet nipple
- two oil exit nipples with integrated check valve

### 7.24.3) Installation:

Oil tank size at least bigger than 5 % of the fuel tank capacity. Oil tank with bottom outlet not lower than the pump inlet nipple (i.e. Hs must be larger than zero, see chapter "directions for installation").



Use only stiff and oil resistant suction tube, routed and attached with kinkproof clamps. Adequate oil filter (e.g. ROTAX part no. 956 330) between oil tank and oil pump is necessary. Bowden cable to actuate the pump lever simultaneously with the carburetors is feasible by use of cable branching.

▲ **WARNING:** With a torn or disengaged Bowden cable the capacity of oil pump will drop to minimum rate. In this case reduce engine performance to the minimum required, till your safe landing.

#### 7.24.4) Disassembly of oil pump:

At disassembly of oil pump remove first both banjo bolts of oil pressure lines, along with sealing rings. Remove 7 Allen screws M6x20 and pump mounting flange with oil pump and rubber ring.

Remove lock nut and pump gear along with one washer each side. During this operation hold unit with wrench as shown. After removal of both Allen screws M5 x 16 and lock washers the oil pump can be detached.

Inspect rubber ring, oil pump drive gear, oil lines and pump mounting flange; renew as required. Both check valves have to block the flow in direction to oil pump and provide free passage to rotary valve cover. Check atomizing jets in rotary

cover valve cover for free passage. It helps to heat up rotary valve to c. 70 - 80° C (160 — 180° F) when fitting new atomizing jets.

If the oil pump is not working perfectly, the complete pump ass'y has to be exchanged. Taking the pump to pieces or repair of pump is not planned.

When fitting the oil pump, use new O-ring and attach to pump mounting flange with 2 Allen screws. Tightening torque 5 Nm (44 in.lb). Fit pump drive gear, one washer on each side, new lock nut and secure with LOCTITE 221. To tighten lock nut utilize again wrench (Rotax part no. 277 905). Check pump for free rotation.

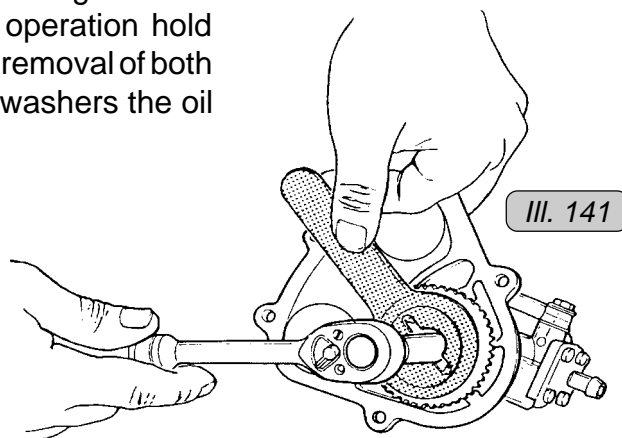
Place new rubber ring in rotary valve cover, grease teeth of pump drive gear and attach pump mounting flange complete with pump, with 7 Allen screws and lock washers on rotary valve cover. Tightening torque 10 Nm (88 in.lb).

In case oil lines are renewed, attach to atomizer jet or to check valve by O-clips. To prevent vibrating oil tubes, route them crossed. Use new sealing rings on both sides of check valve and attach them to oil pump with banjo bolt. Tightening torque 8 Nm.

◆ NOTE:

If for some reason fresh oil lubrication is not utilized, then it is absolutely necessary to connect oil supply line to pump and warrant adequate oil quantity, otherwise oil pump would seize.

The better alternative would be to remove the pump gear assembly.

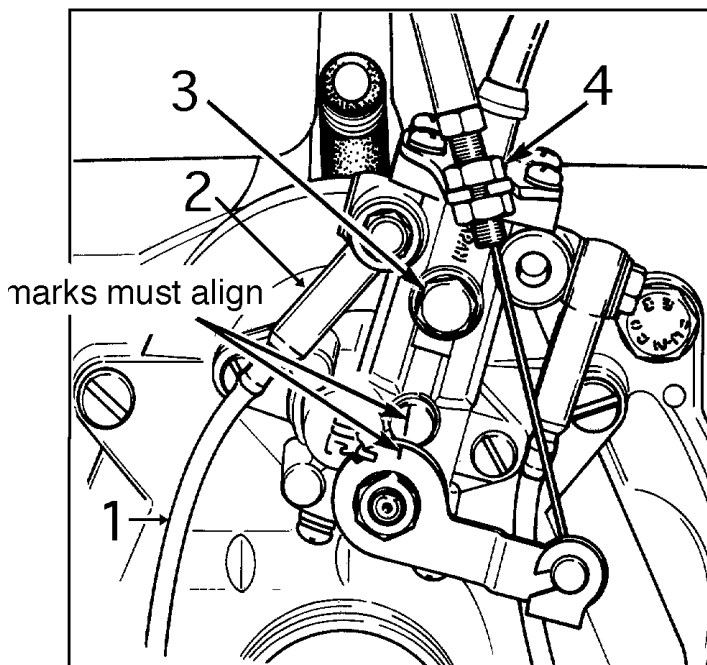


### 7.24.5) Adjustment on oil pump installation:

Adjustment of alignment marks: With throttle lever in idle position, the marks on pump housing and pump lever must align. See illustration.

When filling the system for fresh oil lubrication, vent suction hose before engine start by opening the vent plug ③. Oil supply line must be completely free of air (check transparent oil line for air bubbles). Close vent plug thoroughly afterwards.

For safety reasons it is recommended to fill the fuel tank the first time not with pure gasoline but with a gasoline/oil mixture of 100 : 1, to warrant proper engine lubrication. Nevertheless, vent system properly as pump won't vent automatically.



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1 Pressure line

2 Check valve

3 Vent plug

4 Adjustment nuts

### 7.24.6) Maintenance:

Check oil level before every flight and replenish if necessary. Further check oil lines, connections, joints and pump lever position for tightness and for flawless operation.

Ensure that oil consumption is between 1 : 70 to 1 : 50 of fuel consumption.

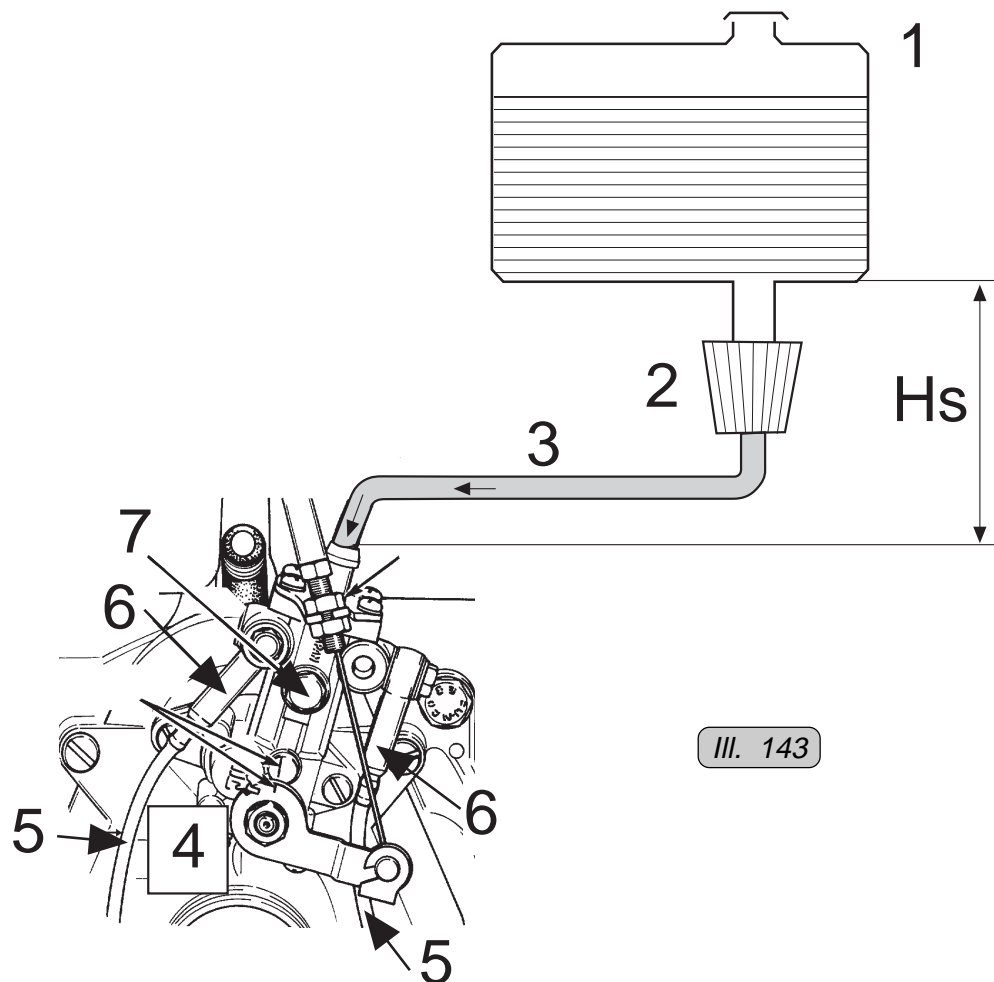
■ **ATTENTION:** Fresh oil lubrication is no substitute nor does it influence lubrication of rotary valve drive or of propeller reduction gear.

### 7.24.7) Directions for installation:

At the installation or on a retro-fit kit for fresh oil lubrication pay attention to location of oil tank. Install oil tank as free as possible of vibrations and with the oil level in tank not below crankshaft axis.

Install suitable oil filter (part no. 965 330) in front of oil pump and route oil supply line protected against damage.

- |                 |                  |                |
|-----------------|------------------|----------------|
| 1 oil tank      | 2 oil filter     | 3 suction line |
| 4 oil pump      | 5 discharge line | 6 check valve  |
| 7 venting screw |                  |                |



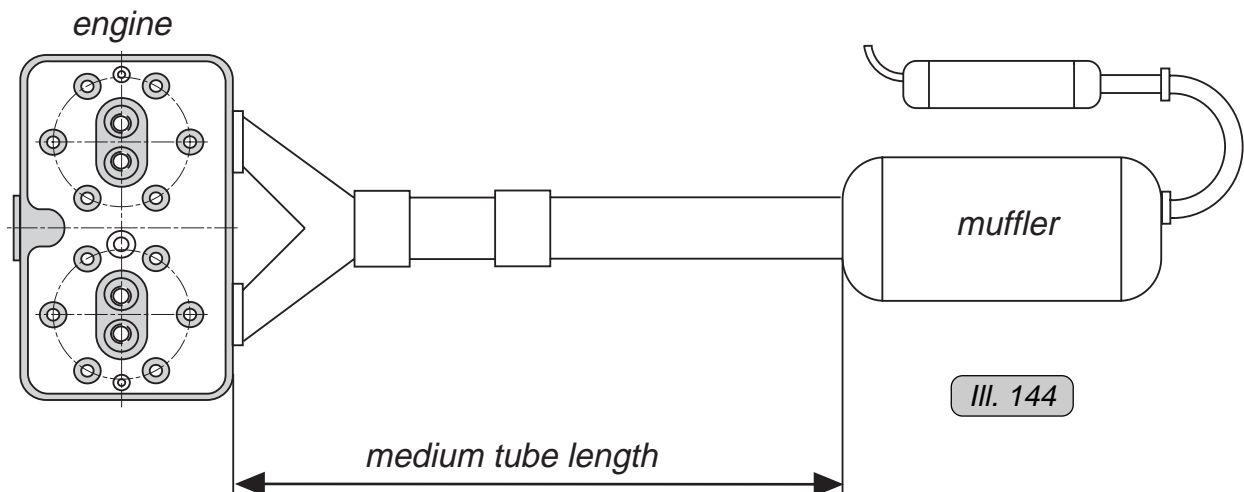
◆ NOTE: "Hs" minimum must be larger than zero (also at climbing and descending)

## 7.25) Exhaust system:

Considerable effort has gone into the design of the ROTAX exhaust system. Any changes to the original system may severely deteriorate performance, reliability, engine life, fuel economy and ability of noise reduction. Improper handling or modification of the exhaust system as supplied could ruin the engine.

■ **ATTENTION:** Beware of any accessory systems that advertise an improvement over stock components.

The exhaust system is tuned for the respective engine and performance and must not be changed. If modifications are inevitable, then the mid length of inlet tube between exhaust flange and muffler has to be maintained without fail (see ill.). For modifications necessary, ask for manufacturer's approval in writing. Check engine performance with serial exhaust system, prior to any modification.



For engine type 462 UL and 582 UL with reduced performance and noise emission an exhaust is offered that consists of items to be fitted by the craft manufacturer to suit the aircraft. Consult the respective spare parts list for parts needed.

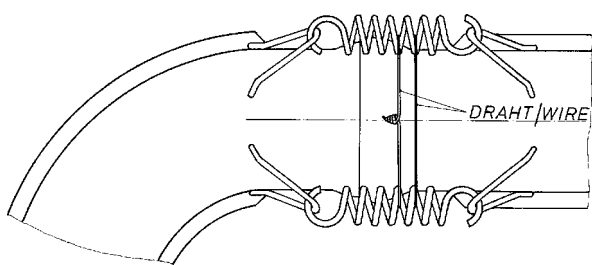
Pay special attention to maintain medium length of tubes. When using bent tubes, refer to length of centre line.

Engine type	medium length of tube
ROTAX 462, 28 kW	700 - 750 mm (27,5 ÷ 29,5")
ROTAX 582, 32 kW	760 mm (30")
ROTAX 582, 40 kW	660 mm (26")

Check exhaust system prior to every flight for tightness, physical damage or changes in sound pattern. Especially inspect springs and hooks.

### 7.25.1) Installation of the exhaust system:

The muffler has to be supported on vibration damping blocks. All ball joints have to be greased regularly with heat resistant lubricant (e.g. LOCTITE Anti-Seize, 297 431) to avoid gripping or seizing of joints and consequent breaking of exhaust components.



Springs used on exhaust system have to be secured against loss and vibration (see Service Information 11 UL 87-E, page 5).

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■ **ATTENTION:** Vibration due to improper suspension is by far the most common reason for damage to exhaust system.

▲ **WARNING:** Don't use any sharp tool for removal of the tension spring for reason of possible damage of spring wire. A hook bent out of a 5 mm Ø bar is the most suitable tool.

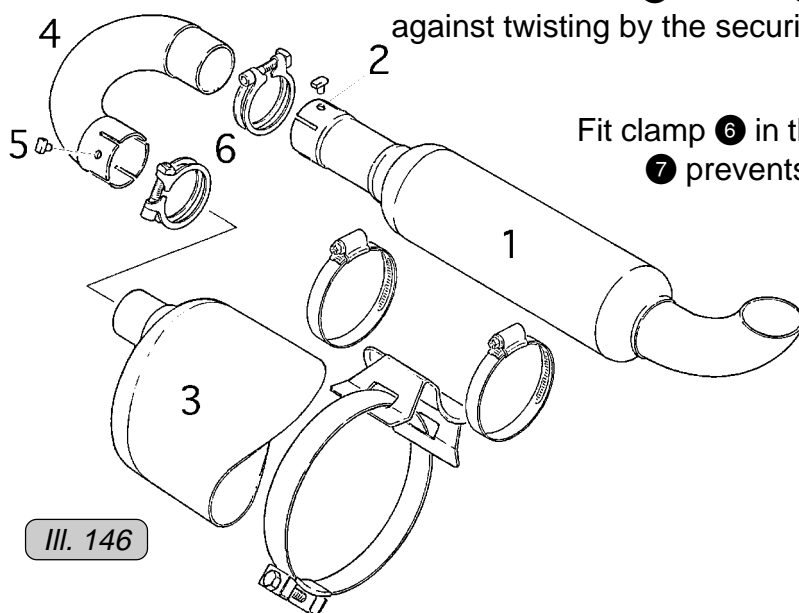
A properly supported and maintained exhaust system will last for a long time.

### 7.25.2) After-muffler system:

For noise reduction at the tail pipe, an after-muffler can be fitted. This after-muffler will hardly affect engine performance and can be clamped to tail pipe of muffler.

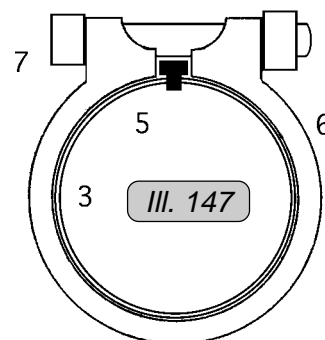
At the installation with after-muffler ❶ in final position, drill the two 5,7 mm Ø holes in the bend and muffler end-pipe, for securing pin ❷. The outer situated holes ❸ have been already machined on the serial production line. Remove accumulated chips from the exhaust system.

To ensure lasting fixed position of the after-muffler during engine operation, the connections of muffler ❸ to bend ❹ and after-muffler ❶ are to be secured against twisting by the securing pin ❷.



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Fit clamp ❹ in the specific position that the Allen screw ❺ prevents the securing pin ❷ from dropping out.



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## 7.26) Propeller reduction gears type “A” and “B”:

### 7.26.1) General information:

As stated at disassembly of the engine, 3 different types of propeller reduction gears are in use.

#### Reduction gear type “A”

This was the first reduction unit produced and offered for ROTAX UL engines. It was applied on all UL engines, from 277 to 532 UL. With this execution it was necessary to utilize an adapter flange ② to attach gearbox ① on crankcase. With the new crankcase design for type 532 UL, beginning with engine no. 3,722.454, the reduction gear can be fitted without adapter flange. The new crankcase is easy recognizable with the flange on p.t.o. end, machined accordingly.

**Available gear ratios:**  $i = 2,00 / 2,24 / 2,58$  and 3,00

■ ATTENTION: Gear ratio  $i = 3,00$  is only allowed for engines up to max. 30 kW output

#### Reduction gear type “B”

This gearbox is installed on the engine type 532 UL, beginning with engine no. 3,722.454 and on type 582 UL from the start of serial production.

The difference to type “A”: No need for an adapter flange.

**Available gear ratios:**  $i = 2,00 / 2,24 / 2,58$

### 7.26.2) Moment of inertia:

At use of ROTAX propeller **reduction gears type “A” or “B”** the moment of inertia of the propeller must not exceed **3.000 kg cm<sup>2</sup>**.

At use of ROTAX propeller **reduction gears type “C”** the moment of inertia of the propeller must not exceed **6.000 kg cm<sup>2</sup>**.

This restriction avoids overload on gearbox by the propeller. Exceeding the permitted moment of inertia might lead to problems with the integrated torsional shock absorber. Moment of inertia of propeller has to be obtained from and confirmed by the prop manufacturer. Another way to determine the mass moment of inertia is by the bifilar pendulum equation (see Service Information 11 UL 91-E).



### 7.26.3) Fitting position of powerplant:

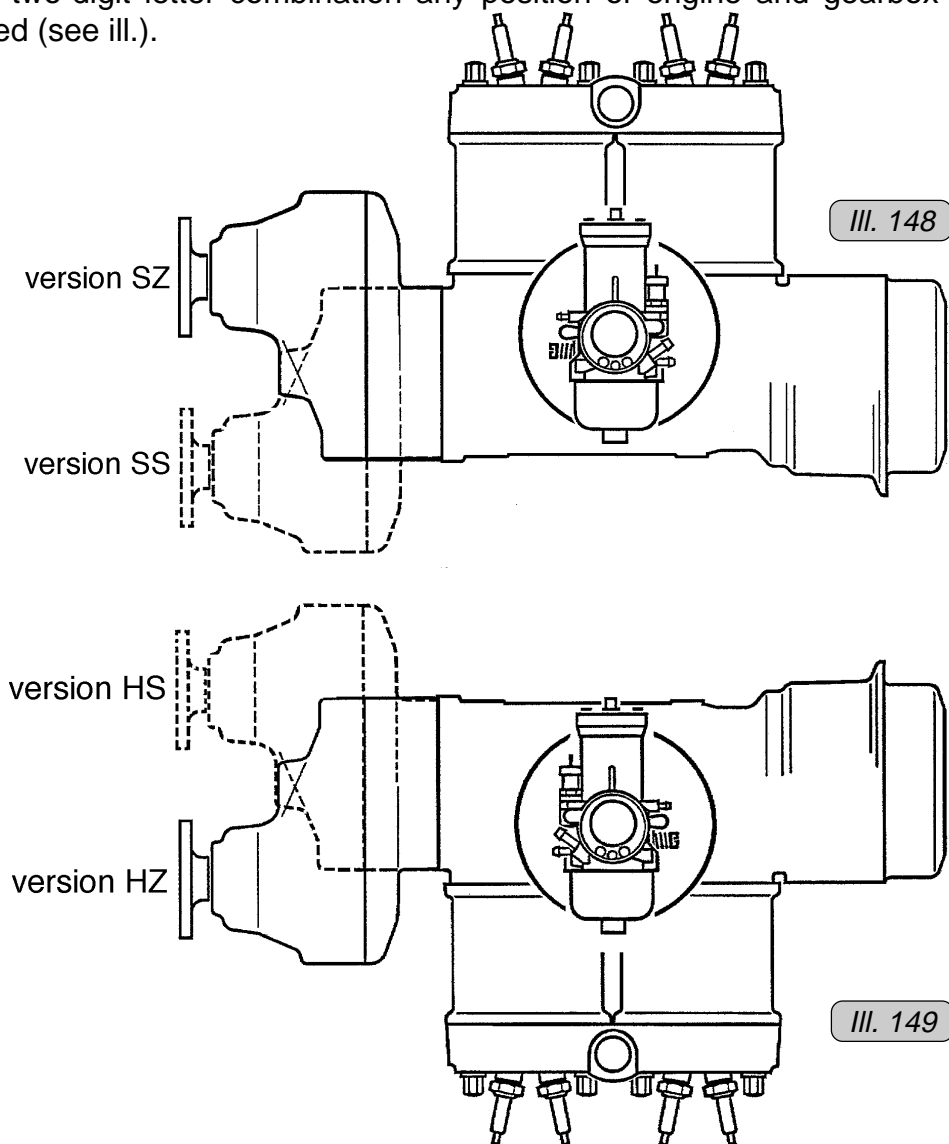
The engine can be installed in two basic positions:

- Upright, with spark plugs up (standard installation) ..... S
- Inverted, with spark plugs down ..... H

Additionally there are two possible positions how to fit the reduction gear:

- With prop shaft towards cylinder ..... Z
- With prop shaft towards engine base ..... S

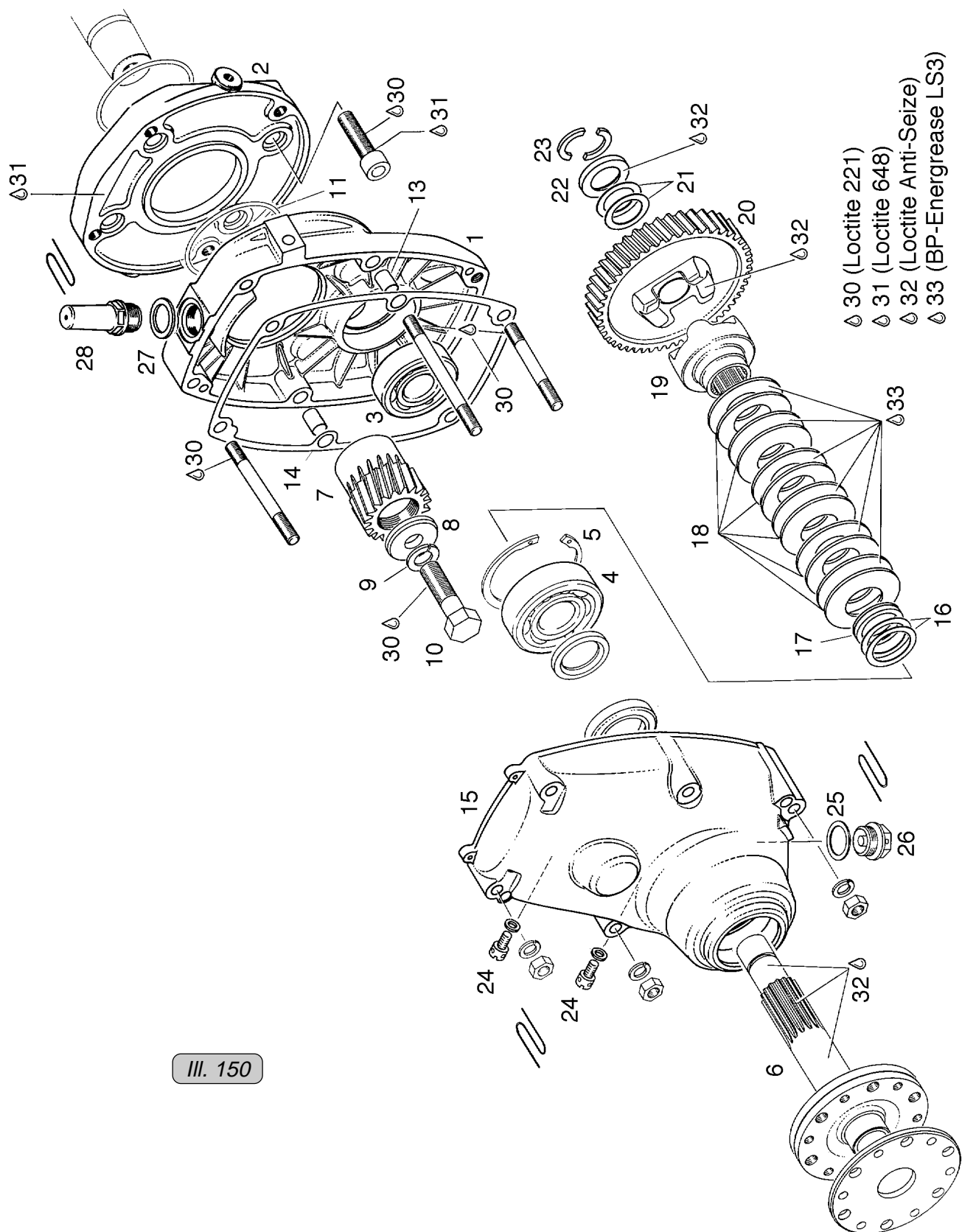
With a two-digit letter combination any position of engine and gearbox is specified (see ill.).



■ **ATTENTION:** The reduction gear must not be fitted turned around by 90° from the two stated positions Z and S.

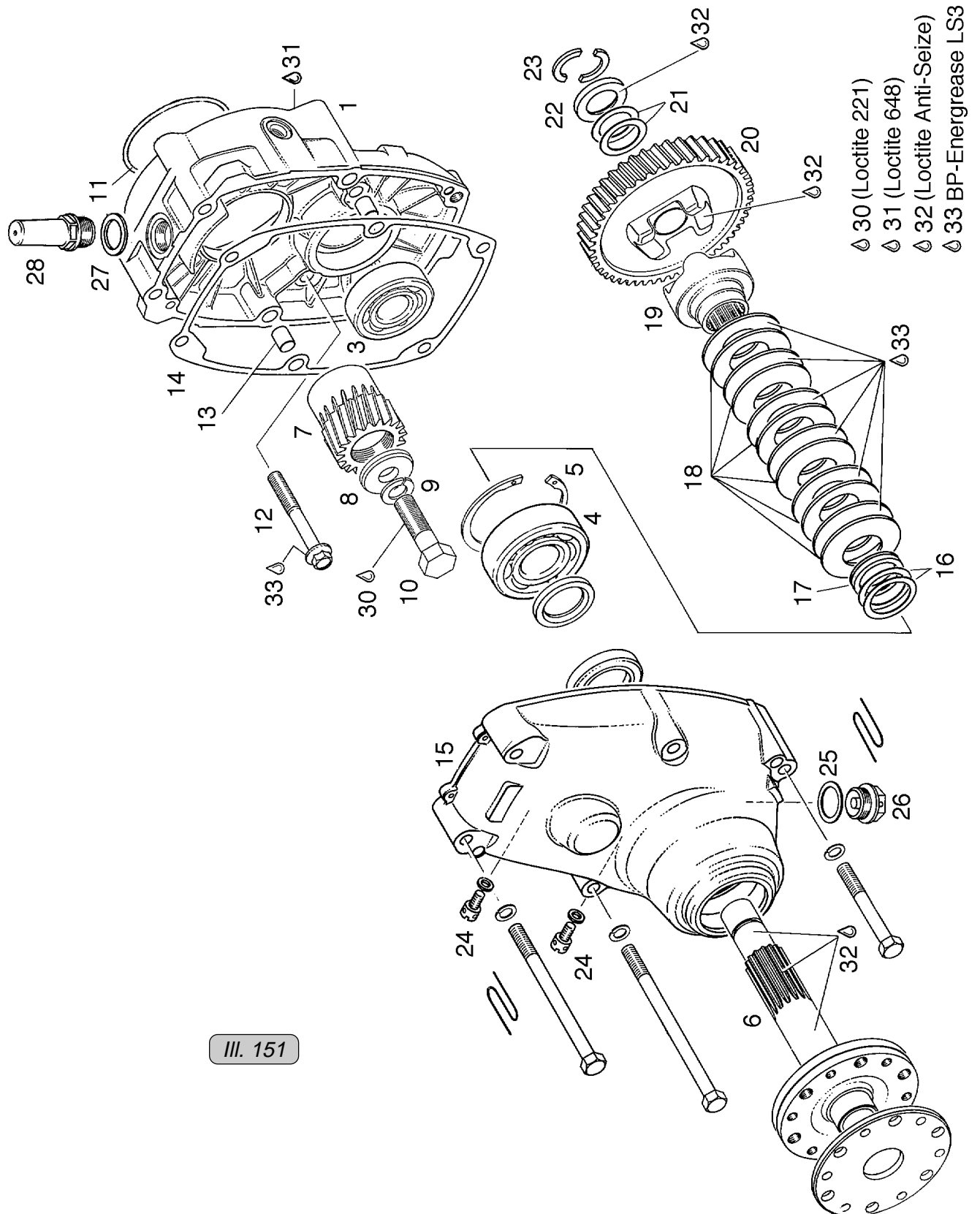
Ensure correct position of oil drain plug and vent screw by changing their position, according to reduction gear installation.

## 7.26.4) Reduction gear type "A":



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## 7.26.5) Reduction gear type "B":



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### 7.26.6) Disassembly and judgement (reduction gears "A" and "B"):

Since the only difference between the two types lies in the use or non-use of an adapter flange, both units are dealt with in this chapter.

After disassembly and cleaning, examine single components for physical damage and wear.

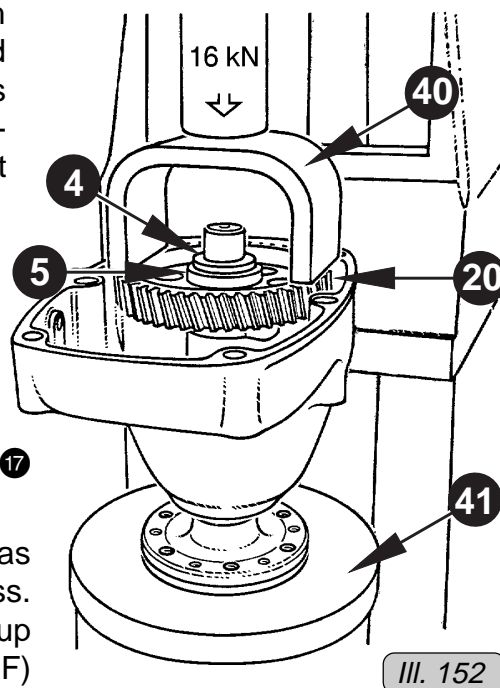
Place reduction gear assembly on suitable support ④① under handpress or device and apply a load of 16 kN (3600 lbs) on the dog gear ②① via the mounting yoke ② 876 880. Take away ring halves ②③, slowly relieve springs and remove mounting yoke.

■ **ATTENTION:** Take care not to damage gear cover with yoke, and that the load applied is not in excess of 16 kN (3600 lbs), otherwise dog gear might crack.

Referring to exploded view of reduction gear "A" and "B"; withdraw angular ring ②②, 2 thrust washers ②①, dog gear ②① along with dog hub ①⑨ placed behind, disk spring package ①⑧, distance ring ①⑦ and shims ①⑥ from the prop shaft.

For examination of the prop shaft ⑥ it has to be pressed out of cover on a hand press. Don't knock out! Remove snap ring, heat up gear cover to c. 60 ÷ 70° C (140 ÷ 160° F) and press out ball bearing inwards, along with oil seal and distance ring.

◆ **NOTE:** With proper pre-heating, bearings can be pushed out easily.



Propeller shaft dimensions	new mm	(in.)	wear limit mm (in.)
Bearing seat, ball bearing ③	19,993÷19,998	(0,7871 ÷ 0,7873)	..... 20,00 (.7874)
Bearing seat, ball bearing ④	24,993÷ 25,009	(0,9840 ÷ 0,9878)	..... 25,01 (.9882)
Out of round .....			0,05 (.002)
Face of prop shaft out of true .....			0,05 (.002)

Inspect propeller shaft and check for cracks (by Magnaflux). Especially examine groove for ring halves ②③. At excessive wear of oil seal mating surface and distinct score marks on shaft splines caused by the disk springs, renew propeller shaft.

Examine disk springs for physical damage and wear of support faces.

In case of renewal, exchange all 12 springs. On earlier gearboxes, 8 springs only were applied; though, these gearboxes can be converted to the up-to-date version with 12 springs. Consult Service Information 6 UL 86 E.

Dimensions	new mm	(in.)	wear limit mm (in.)
Sleeve of dog gear, dia. ....	20,205 ÷ 20,215	(0,7953) ÷ (0,7959)	..... 20,27 (0,798)

Examine dogs and teeth of drive gear and dog gear. At distinct wear of dogs restricting trouble-free operation, dog hub and dog gear ought to be exchanged. Inspect sleeve in dog gear. If need be, exchange matched pair of gears. Dog hub 19 has to slide smoothly on the prop shaft. At noticeable wear of splines and dogs, exchange hub. Examine gear housing and cover and check for cracks by colour penetration method.

#### **Test procedure for crack detection by “Met-I-check” (Dye penetrant)**

Test method with 2 colour components. Clean and dry housing is sprayed with red dye. After 15 ÷ 20 min. reaction time it is rinsed with water. Dried housing is sprayed finally white. Any cracks will appear red, clearly visible.

Ball bearing with press fit in housing. If taking of readings reveals that press fit conditions are not given any more, facilitate with LOCTITE 648 gluing, up to an actual diameter of 52,05 mm (2,05 in.).

■ **ATTENTION:** Handle adhesive carefully and economically. At any contact of adhesive with bearing inside, immediately clean thoroughly with solvent. If adhesive has cured hard already, exchange bearing.

#### **7.26.7) Reassembly of propeller reduction gear (type “A” and “B”):**

Preheat gear cover to c. 60° C (140° F), grease lips of new oil seal and press into position with sealing lip towards inside, by insertion punch 876 668. Add distance ring, chamfering towards prop flange, press ball bearing 6305 into cover and fit snap ring 19 62 x 2. Apply LOCTITE Anti-seize on bearing seats of prop shaft, put shaft into the still warm gear cover and press it into position with inner race of bearing resting on a support.

■ **ATTENTION:** When fitting propeller shaft, take care of oil seal.

**7.26.8) Determination of the proper preload setting of the springs (gearboxes type “A” and “B”):**

With prop shaft **6** fitted in gear cover, place distance ring **17** with tapered side, and identification groove **B** towards springs, add 12 ungreased springs **18** in pairs, dog hub **19**, dog gear **20**, and the 2 thrust washers **21** 0,8 mm on propeller shaft. Don't fit any shims **16** at this stage (see ill.).

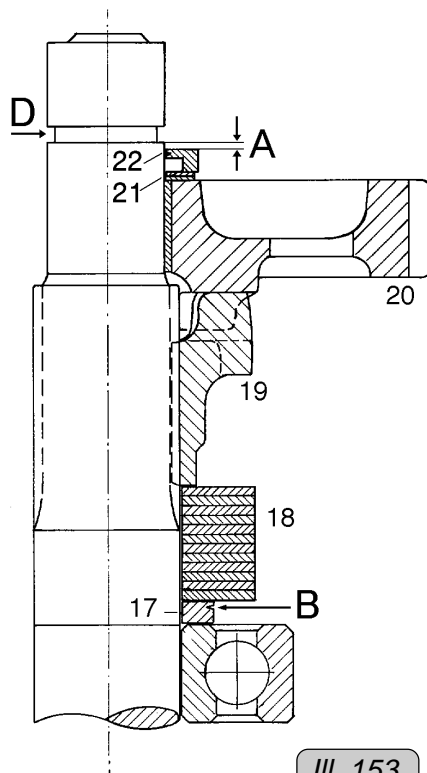
■ **ATTENTION:** Fit disk springs in pairs towards each other (see detail ).

Put gearbox on suitable support under hand press. Place the mounting yoke, part no. 876 880 on the dog gear 20 (see “disassembly and judgement”). Place angular ring 22 upside down (with “L” shape downwards (see ill.) on prop shaft to facilitate reading of the distance A. Apply a load of 16 kN (3600 lbs) on the dog gear via the mounting yoke. With this load, disk springs will be completely compressed.

■ **ATTENTION:** Don't exceed load of 16 kN (3600 lbs), otherwise cover or dog gear might crack.

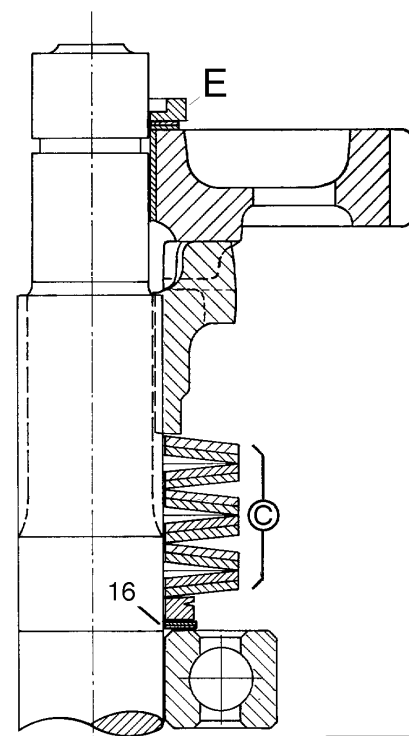
With springs in compressed state, measure **A**, the distance from top side of angular ring to lower edge of groove (see illustration). Relieve pressure, remove all items from prop shaft and compensate distance **A** by placing appropriate shims **16** under distance ring **17**. Shims are available as spare parts in the sizes 0,1 / 0,2 / 0,3 / 0,5 and 1,0 mm.

LOADED



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RELIEVED



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### Resumption of reduction gear assembly:

To prevent formation of fretting corrosion, apply LOCTITE Anti-seize to bearing seats of prop shaft. Place shims as determined ⑩ and distance ring ⑪ with identification groove ⑫ towards springs on shaft. Grease all 12 springs ⑬ and arrange on shaft as depicted.

Grease also dogs on dog gear and dog hub with LOCTITE Anti-seize and place them along with the 2 thrust washers 0,8 mm on shaft. Apply LOCTITE Anti-seize on support face of angular ring and put on shaft with this face towards thrust washers (see detail ⑭).

Now place mounting yoke again on dog gear, depress on handpress sufficiently to enable the insertion of the two ring halves ⑮ into the grooves on prop shaft, but don't exceed the force of 16 kN (3600 lbs). Lift angular ring over ring halves and relieve disk springs. Check propeller shaft for free rotation.

■ ATTENTION: Pay attention to neat fitting of ring halves.

### 7.26.9) Fitting of gear to engine (type "A" and "B"):

The "B" gearbox dealt with is the version currently produced. Main difference is the use of other fasteners, i.e. hex. hd. screws instead of studs and nuts.

#### Valid for gearbox "A" only:

Place O-ring 75-2,5 on adapter flange and attach flange by 4 Allen screws M10 x 45. Apply LOCTITE 221 on thread and LOCTITE 648 on support face of screw head and tighten screws to 55 Nm (487 in.lb.). Thoroughly degrease taper of crankshaft end and drive gear as well as 1/2" screw ⑩ and tapped hole in crankshaft.

#### On gearbox "A" and "B":

Lock crankshaft with locking pin and attach drive gear ⑦ by 1/2" screw ⑩ along with washer ⑧ and lock washer ⑨, applying LOCTITE 648 on thread only, but not on taper. Tighten screws to 60 Nm (530 in.lb.). Withdraw crankshaft locking pin.

Apply LOCTITE 648 on mating faces of gearbox ① and adapter flange, and on crankcase. Insert O-ring ⑪ 67,95 x 2,62, or 75 x 2,5 on Type B into groove and fit gear housing on centering of adapter flange, and crankcase. Attach gear housing with the two hex. collar screws ⑫ located inside and tighten to 24 Nm (210 in.lb.). Lubricate support face of collar screw, to minimize friction. Fit both dowel sleeves ⑬ on gear housing and place new gasket ⑭ in position.

◆ NOTE: Since production March 1990 the two inside located hx. hd. collar screws ⑫ M 8 x 65 were adapted.



Fit gear cover assembly ⑮ to gear housing ① with dog gear ⑳ engaging in drive gear ⑦. Attach cover with 6 hex. hd. screws M8 and spring washer and tighten crosswise to 24 Nm (210 in.lb). Crank engine and check for backlash of gears.

◆ **NOTE:** In some gearboxes studs and nuts are used instead of screws.

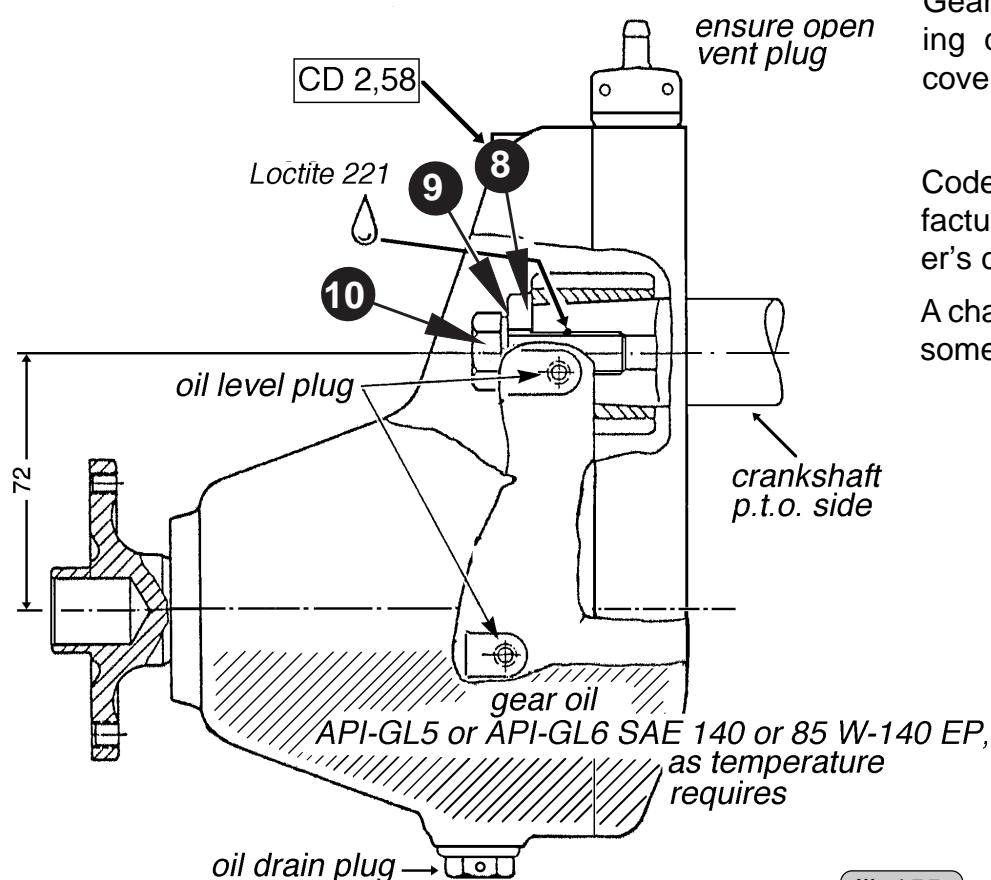
■ **ATTENTION:** Time between tightening of gear housing and gear cover to be as short as practicable, to achieve most simultaneous curing periods of the sealing compound on crankcase and gearbox.

The prop flange is furnished with 6 tapped holes M8 and 6 holes 6,5 mm Ø. Suitable bolts are not supplied by ROTAX.

Fit oil drain plug ⑳ with sealing ring ㉕ and fill gearbox with oil up to the lower level plug ㉑ of the particular engine installation. Use gear oil SAE 140 EP or SAE 85 W - 140 EP to API standards GL5 or GL6 as stated on ill. 149. Fit vent screw along with sealing ring.

Oil quantity: "SS" and "HS" prop shaft towards base: c. 300 cm<sup>3</sup> (0,63 liq.pt.)  
"SZ" and "HZ" prop shaft towards cyl.: c. 330 cm<sup>3</sup> (0,70 liq.pt.)

■ **ATTENTION:** Wire secure oil level plug, oil drain plug and vent screw.



Gear ratio and manufacturing code are stamped on cover, e. g. CD 2,58.

Code indicates date of manufacture and gear ratio for user's convenience.

A change of the gear ratio for some specific reasons has to be marked on the cover to avoid possible mistakes.

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## 7.27) Reduction gear type “C”:

### 7.27.1) General information:

This gearbox is used like Type “B” on engine 532 UL too, starting with engine no. 3,722.454 and on type 582 UL from beginning of serial production. No need with this gearbox for an adapter flange, either. Gearbox is attached to engine with 8 hex. collar screws, 4 inside gearbox and 4 outside. Essentially higher gear ratios are possible to be realized by this gearbox.

**Available gear ratios:**  $i = 2,62 / 3,00 / 3,47$  and  $4,00$

### 7.27.2) Disassembly of gear cover:

Fix gear cover assembly with prop flange ❶ down on suitable fixture, thus prop shaft locked against rotation. Never clamp prop shaft or flange directly in a vice.

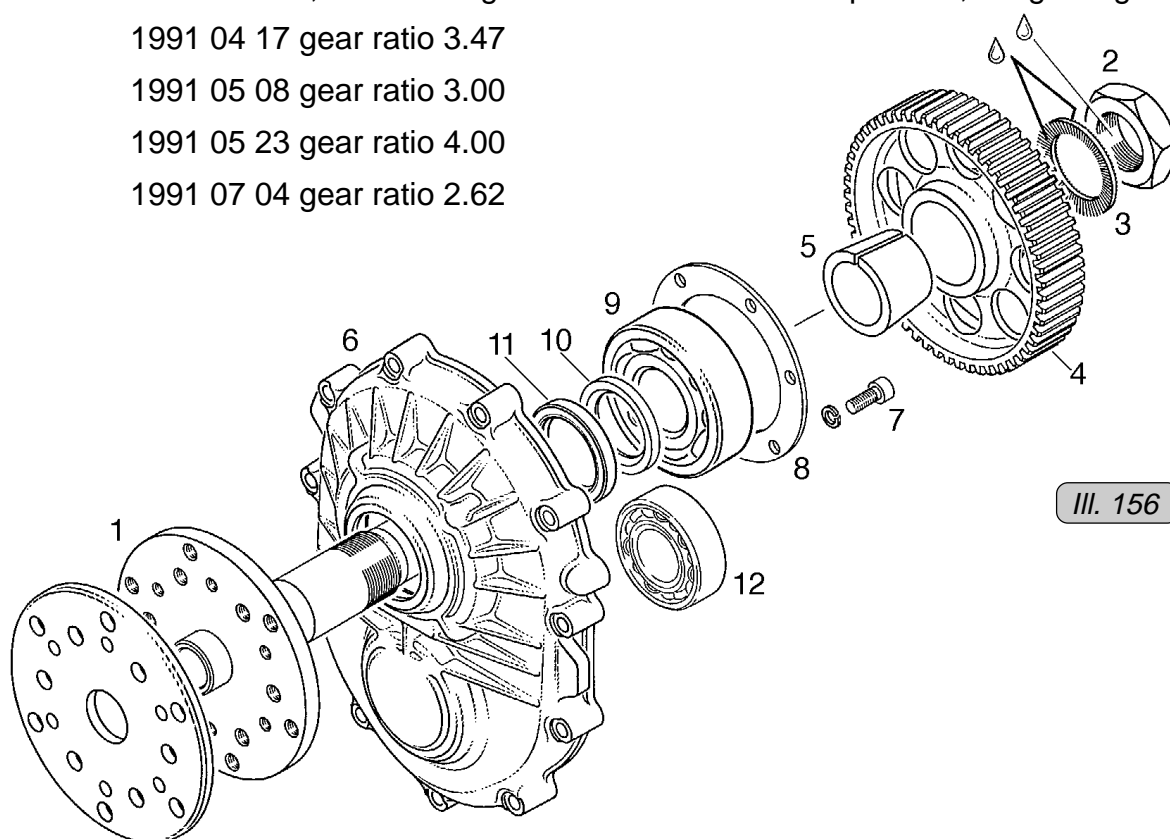
Undo hex. nut M30 x 1,5 ❷ by socket 41 A/F by turning clockwise (left hand thread). Remove friction washer ❸, place protection piece 877 415 on centring of prop shaft and pull off layshaft gear ❹ utilizing puller 877 375. Remove taper sleeve ❺. As taper connection 1 : 5 was not good enough for power transmission, it was changed into connection with taper 1 : 7,5 beginning with:

1991 04 17 gear ratio 3.47

1991 05 08 gear ratio 3.00

1991 05 23 gear ratio 4.00

1991 07 04 gear ratio 2.62



◆ **NOTE:**

Taper sleeve is not glued on shaft, but may stick very tight, especially after the change into taper 1 : 7,5! It is advisable to spray with rust solvent (e.g. Mo S<sub>2</sub>) and after adequate reaction time, slacken by expanding the sleeve with a screwdriver.

■ **ATTENTION:** At a conversion from taper 1:5 to 1:7,5 layshaft gear as well as taper sleeve have to be changed.

Now, prop shaft can be pressed out of cover. Examine prop shaft for physical damage and cracks by Magnaflux. Renew as required. Check surface of taper sleeve and internal taper bore of gear for fretting corrosion and inspect set of gears for pitting.

Dimensions:	new mm (in.)		wear limit mm (in.)	
Bearing seat, roller brg. (11) .....	26,480÷	26,493 (1,042 - 1,043) .....	26,45	(1,041)
Bearing seat, roller brg. (26) .....	30,008÷	30,021 (1,181 - 1,182) .....	30,02	(1,182)
Out of round .....	0,0	÷ 0,050 .....	0,05	(0,002)
*Face of prop flange out of true ...	0,0	÷ 0,050 .....	0,05	(0,002)

Remove 6 Allen screws ⑦ M6x16 along with lock washers and retaining plate ⑧ for fixation of bearing. If still in position, pull out dowel sleeves and heat up cover to c. 60 - 70° C (140 - 160° F). Remove both ball bearings ⑨ and ⑫, distance ring ⑩ and oil seal ⑪. Examine both ball bearings as well as sealing face and bearing seats in cover. Clean all parts thoroughly.

■ **ATTENTION:** In case of ground contact of propeller, disassemble prop shaft without fail and examine for possible cracks.

### 7.27.3) Reassembly of gear cover:

Preheat gear cover to c. 70 ÷ 80° C (160 ÷ 175° F), grease lips of new oil seal and press into position by insertion punch 877 430. Add distance ring, chamfering towards prop flange, and fit both ball bearings in the still warm cover. If need be, push bearing to positive stop by suitable punch.

■ **ATTENTION:** Apply force on outer race only, never on inner race.

Fit retaining plate and attach with 6 Allen screws M6 x 16 and lock washer. Carefully feed in prop shaft and push it into position. If necessary, support inner race of ball bearing and press-in prop shaft, never knock it into position.

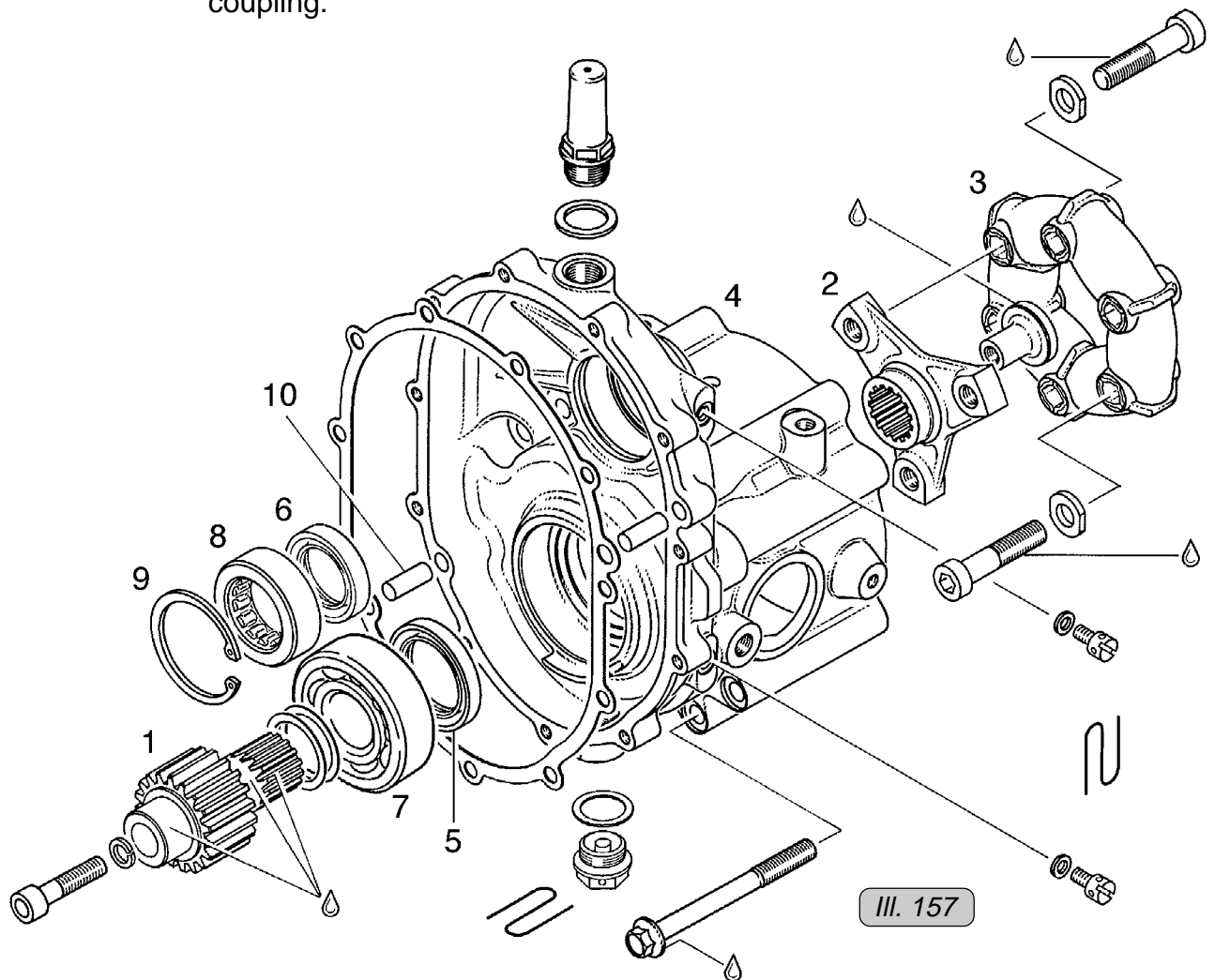
Degrease taper sleeve, cone of layshaft gear and friction washer. Slide taper sleeve and layshaft gear on prop shaft. Moisten both sides of friction washer with LOCTITE 648, position with crowning towards nut. Apply LOCTITE 221 on nut and tighten to 300 Nm (2650 in.lb).

◆ **NOTE:** Hex. nut with L.H. (left hand) thread!

#### 7.27.4) Inspection of gear housing and reassembly:

Check bearing seats and tothing of pinion shaft ❶ for pitting. Coupling flange ❷ must be easy to move on pinion shaft. At distinct wear of tothing, renew coupling flange and pinion shaft.

Examine rubber coupling ❸ for physical damage and cracks. Ensure the use of a rubber coupling marked with "75". This number specifies the Shore hardness. If hardness of the rubber used does not comply, exchange rubber coupling.



Visual inspection of gear housing. The two large holes serve for inspection and cooling of the rubber coupling and must not be closed, but screened at the most, and screen must be secured against loss.

Heat up gear housing ❹ to  $70 \div 80^{\circ} \text{C}$  ( $160 \div 175^{\circ} \text{F}$ ), grease both oil seals ❺ and ❻ and fit by insertion jig 877 432 resp. 277 982 into housing, with sealing lip towards inside. Fit ball bearing ❼ 6305 as well as roller bearing ❽ in housing and secure axially with retaining ring ❾. Fit both alignment pins ❿ and check axial clearance as follows overleaf.

### 7.27.5) Adjusting axial clearance on reduction gear “C”:

First, axial clearance is shimmed to “zero”. The necessary clearance of 0,4 mm is given by fitting the gasket between housing and cover.

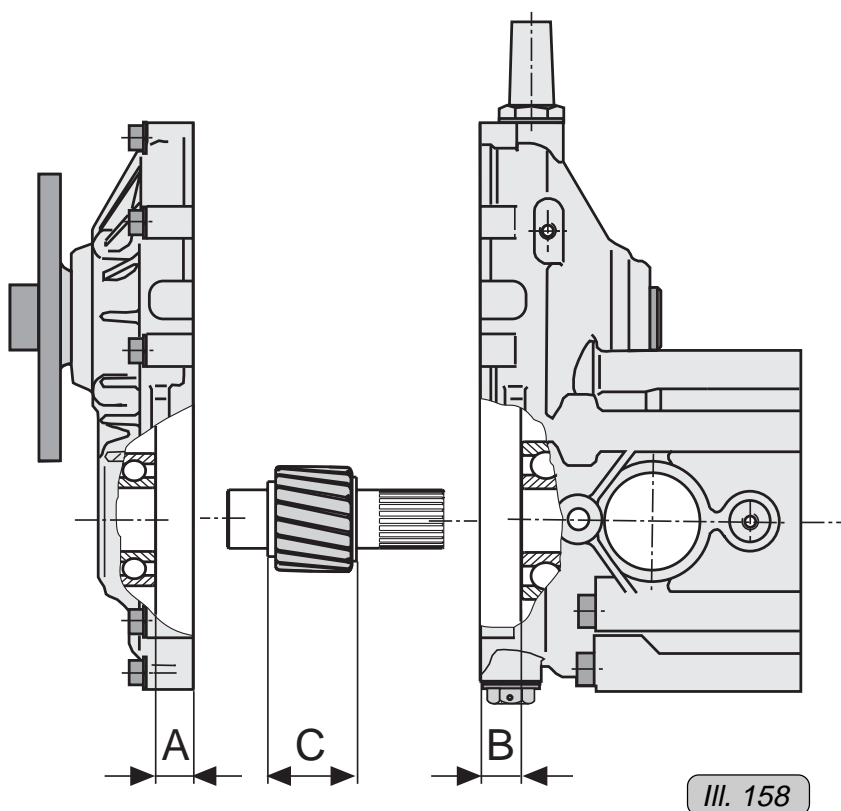
To determine shims needed, take dimension by depth gauge from jointing plane of housing and cover to bearing. Add dimensions A and B and compare with dimension C of pinion shaft. Compensate the difference by shims to zero, placed between pinion shaft and gear housing. The gasket used will warrant the axial clearance needed.

**Dim. A:** from jointing plane of cover to ball bearing, P.T.O. side

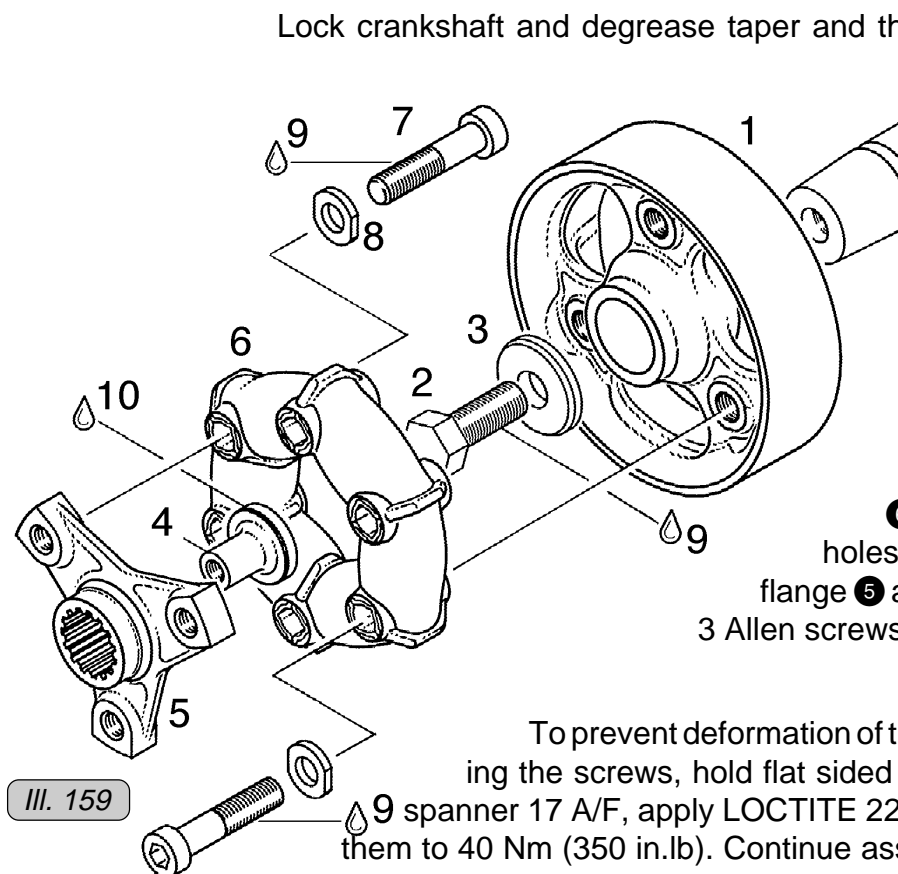
**Dim. B:** from jointing plane of housing to ball bearing, engine side

**Dim. C:** length of pinion shaft between bearings

$$\text{Dim. A} + \text{Dim. B} - \text{Dim. C} = \text{thickness of shimming}$$



### 7.27.6) Assembly of reduction gear Type "C":



Lock crankshaft and degrease taper and thread in crankshaft and cone of flywheel ①. Apply LOCTITE 221 ⑨ on hex. screw ② 1/2"-20 UNF and fit flywheel along with washer ③ on taper of P.T.O. end of crankshaft. Tightening torque 60 Nm.

Apply LOCTITE 648 ⑩ on circumference of collar nut ④ and press into coupling flange ⑤. Compress rubber coupling ⑥ by clamp 851 160 to align the holes with hole pattern in coupling flange ⑤ and attach coupling to flange with 3 Allen screws ⑦ and flat sided washer ⑧.

To prevent deformation of the rubber coupling whilst tightening the screws, hold flat sided washer in position by open end ⑨ spanner 17 A/F, apply LOCTITE 221 ⑨ on Allen screws and torque them to 40 Nm (350 in.lb). Continue assembly by fitting coupling flange assembly in the same manner on flywheel.

■ **ATTENTION:** Don't forget to remove clamp strap from rubber coupling ⑥ after assembly is complete.

With gearbox positioned properly, the prop shaft either down or up, fit gearbox to engine, attaching it first with the 4 collar screws placed outside, but tighten screws only finger tight. Apply LOCTITE Antiseize to toothing and bearing seat of pinion shaft and fit along with the number of shims determined, through ball bearing into coupling flange. To ease engagement of toothing, turn slightly. Fit Allen screw M8 x 35 and lock washer into collar nut and tighten to 24 Nm (212 in.lb).

Fit the 4 inside located collar screws. To minimize friction, grease support face of screw heads. Tighten now all 8 collar screws to 24 Nm (212 in.lb.)

Place dry gasket on gear housing and carefully fit gear cover, paying attention to proper engagement of dowel pins and not to damage oil seal. Attach gear cover with 11 Allen screws M6 x 30 tightened to 10 Nm (90 in.lb).

Withdraw crankshaft locking pin, crank engine and check for existence of backlash on gears.

Fit oil drain magnetic plug along with sealing ring at bottom of gear housing and tighten to 24 Nm (212 in.lb.).

Fit top oil level plug (cross hole screw) and fill gearbox with oil up to lower oil level plug. Fit vent screw.

◆ **NOTE:** Independent of prop shaft location, for oil level check the lower level plug is always decisive.

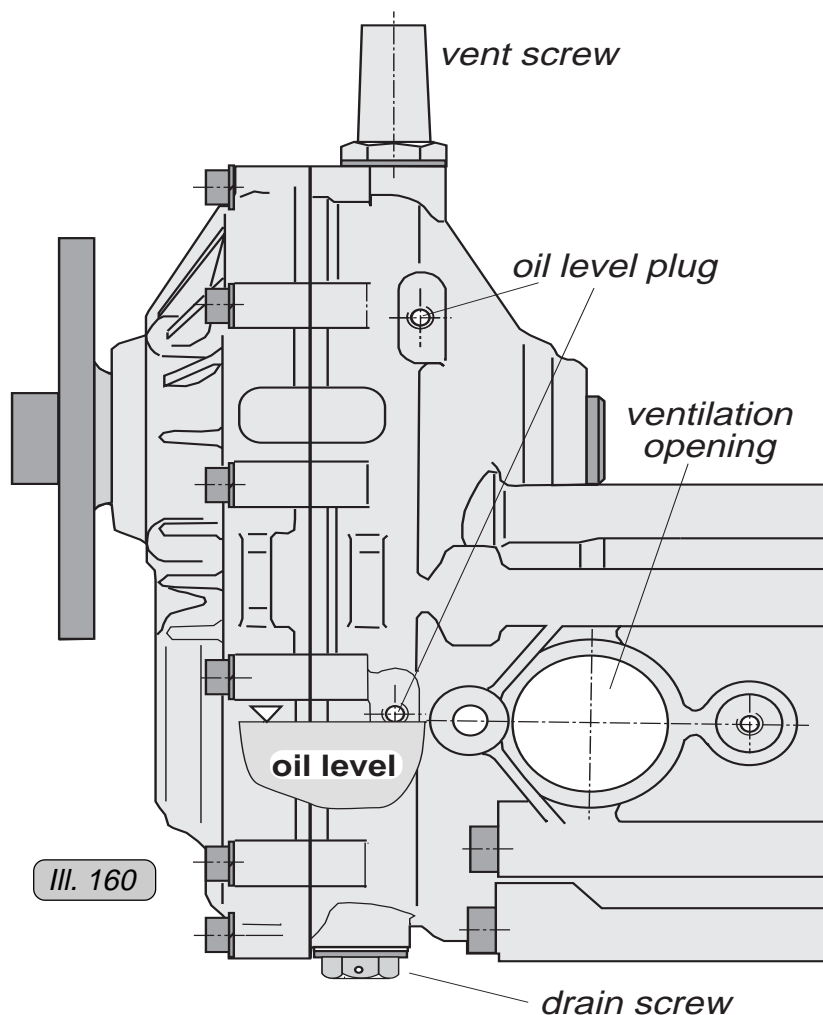
**Oil quantity:** with prop shaft down: c. 120 c.c. (.25 lig. pt)

with prop shaft up: c. 200 c.c. (.42 lig. pt)

**Oil quality:** SAE 140 EP or SAE 85 W - 140 EP  
(API standards GL5 or GL6)

▲ **WARNING:** Wire secure drain plug, level plugs (crosshole screws) and vent screw.

The propeller flange is furnished with 6 tapped holes M6 and 6 holes each with 6,5 and 8,2 dia. but no bolts are supplied by Rotax.



*gear oil: API-GL5 or API-GL6,  
SAE 140 EP or 85 W-140 EP,  
depending on temperature requirements*

## 7.28) General notes and maintenance of reduction gear:

(valid for all types)

■ **ATTENTION:** Gearbox will be delivered always “dry”, i.e. without oil, even on a gearbox fitted to engine prior to delivery.

The max. permitted out-of-balance on a propeller is 1 g m. If gear set was changed during the course of a repair, oil change will be necessary after the first 10<sup>h</sup> of operation. Any change of the gear ratio to be marked on gear cover.

### 25 hours check:

- Check of oil level always on the lower oil level plug.
- Check for free rotation of propeller.
- Control of propeller track.
- Inspection of prop bearings for excessive clearance.

### 100 hours or biennial control:

Oil change after every 100 hours or 2 years, whatever comes first. Check magnetic pin in drain plug for tight fit and clean at every oil change.

Check of preload setting of disk springs (gearbox type "A" and "B") adjust as necessary.

Safety is everyone's business. Contribute for safe and trouble-free operation by observing all stated advices. In case of doubts, contact an authorized ROTAX distributor or Service Centre.

▲ **WARNING:** For safety's sake, fitting and maintenance work to be carried out by trained specialists only.

## 8) Assembly of the engine:

Generally, always pay attention to absolute cleanliness. Small amount of foreign matter in the oil circuit could cause severe damage or reduce the lifespan of the engine essentially. Lubricate all bearings and moving parts in the course of assembly.

◆ NOTE: All O-rings, oil seals and gaskets have to be renewed at re-assembly.

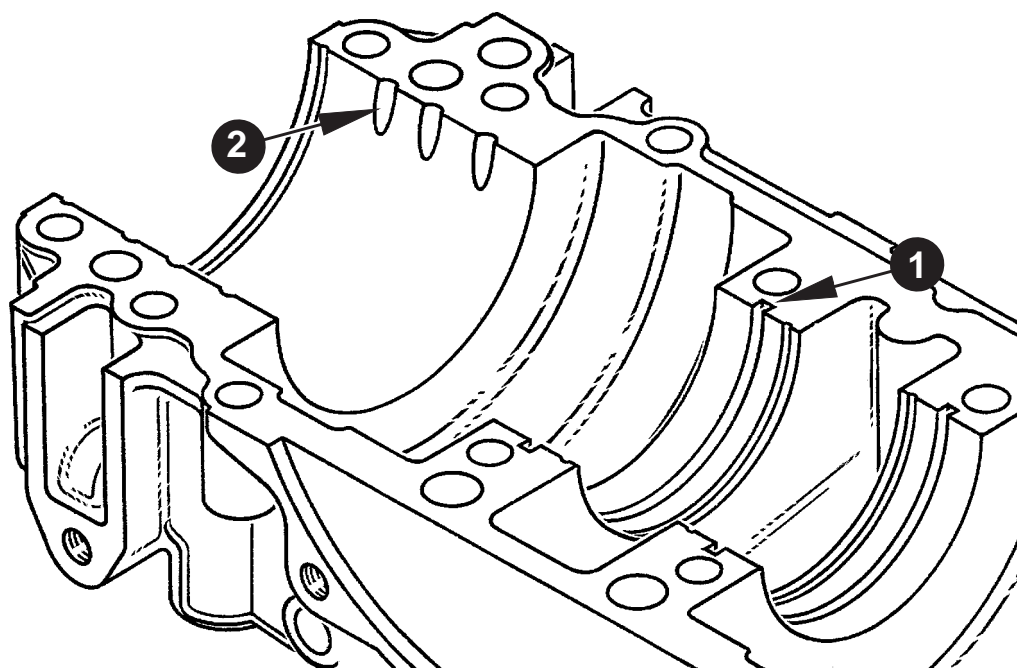
### 8.1) Crankshaft:

The axial position of crankshaft is predetermined by the two ball bearings at crankshaft centre with one each locating ring engaging in groove ❶ of crankcase.

Fitting and completing of crankshaft assembly generally in reverse sequence to disassembly. Clean and degrease all bearing seats. For correct arrangement of ball bearings, distance rings and oil seals, consult illustrations in the respective spare parts list.

The ball bearings are furnished with an O-ring on the circumference, to avoid possible rotation of the outer race in the crankcase. To prevent squeezing of the O-rings when joining the crankcase halves, clearances ❷ are provided on jointing face of crankcase. Place bearings on crankshaft with the O-rings located in clearances.

Warm up ball bearings to c.  $70 \div 80^{\circ}\text{C}$  ( $160 \div 180^{\circ}\text{F}$ ). Properly pre-heated bearings can be fitted easily onto journals of crankshaft.



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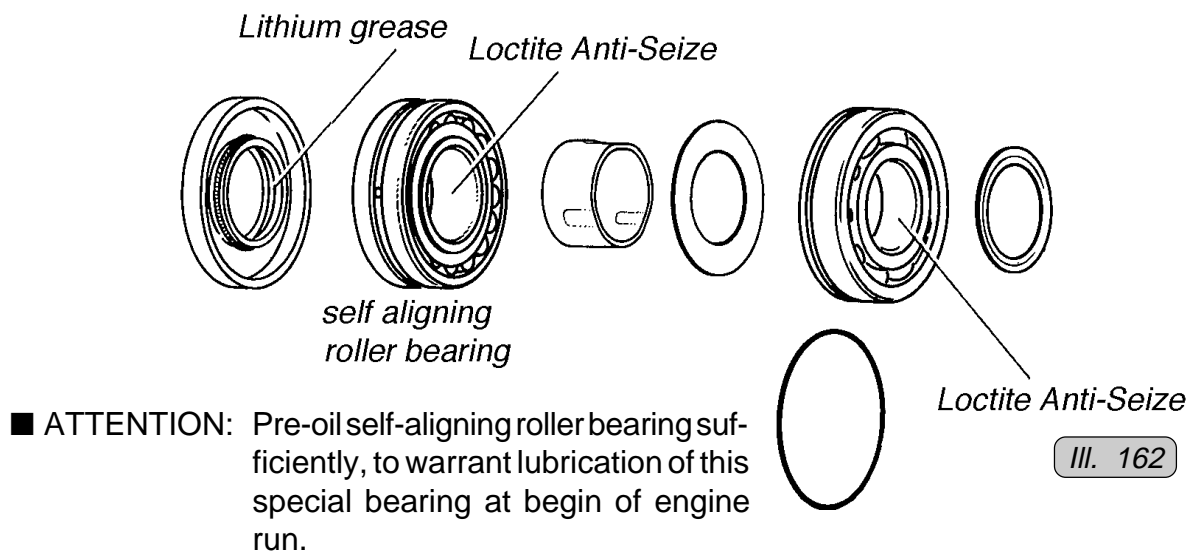


### Type 462 UL, magneto side:

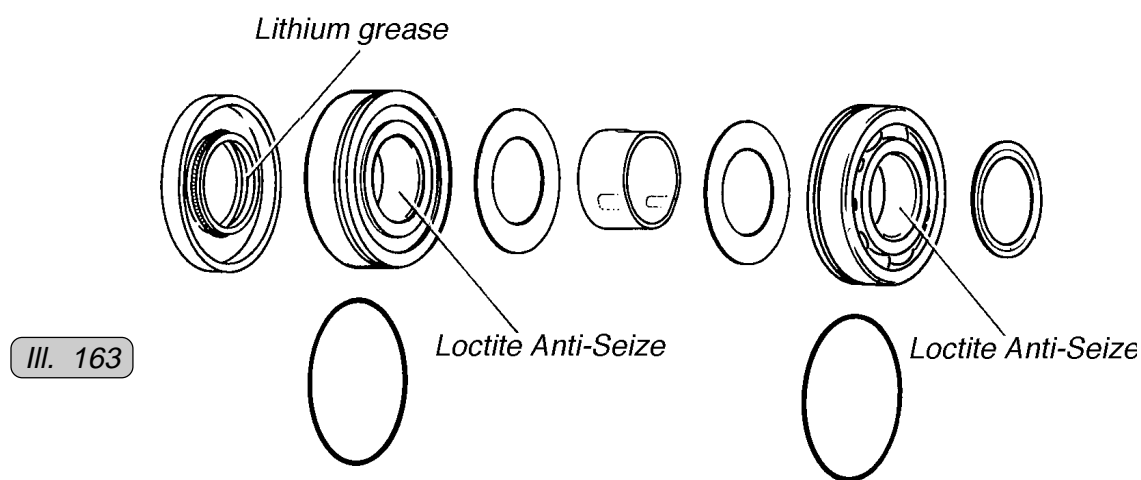
Place distance ring with rounded side towards crankblade; pre-heat ball bearing and push it, with O-ring groove towards crankblade, on crankshaft.

### Type 462 UL, p.t.o. side:

Place distance ring with rounded side towards crankblade; pre-heat ball bearing and slide ball bearing 6206 with O-ring outwards onto crankshaft. Add shim and stop tube 20 mm, pre-heat self-aligning roller bearing and slide on shaft.



Alternatively the ball bearing 6206 with a steel cage is fitted, instead of the self-aligning roller bearing. Pay attention to different arrangement of items.



◆ **NOTE:** To prevent fretting corrosion, apply LOCTITE Anti-seize on all bearing seats.

Fit O-ring on every ball bearing and slide greased oil seal on crankshaft ends.

### Type 532 UL and 582 UL, magneto side:

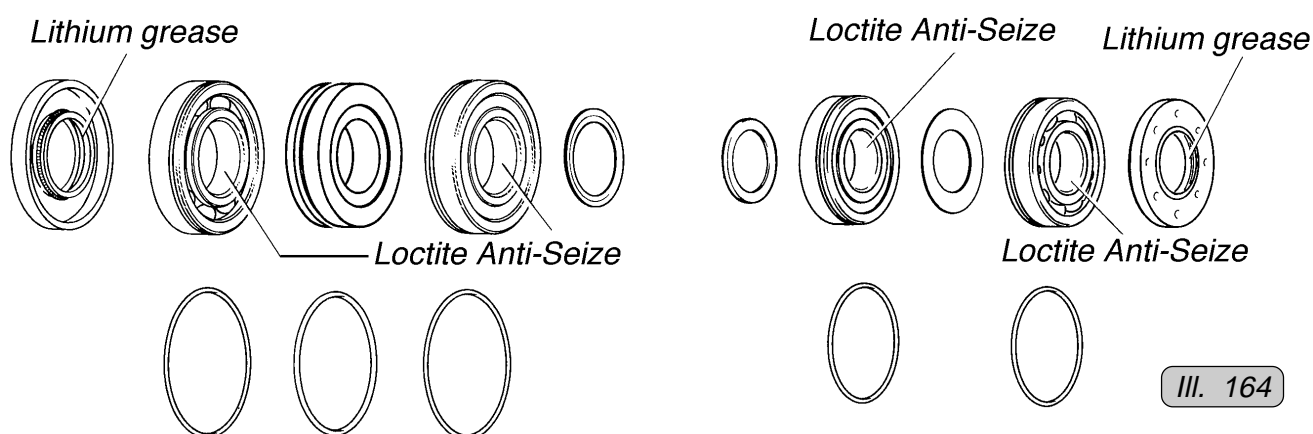
Place distance ring with rounded side towards crankblade, pre-heat ball bearing 6206 and slide on crankshaft with O-ring groove outwards. Fit stop shim and pre-heated outer ball bearing 6206, with O-ring groove inwards, on crankshaft.

### Type 532 UL and 582 UL, p.t.o. side:

Place distance ring with rounded side towards crankblade, pre-heat ball bearing 6207 and slide it, with O-ring groove outwards, on crankshaft. Fit labyrinth sleeve with O-ring groove outwards and add pre-heated outer ball bearing with O-ring groove inwards.

■ **ATTENTION:** The labyrinth sleeve must not be clamped by the two bearings. Ensure axial clearance of c. 0,5 mm by suitable shimming. Remove shims from both sides of labyrinth after bearings have cooled down.

◆ **NOTE:** To prevent fretting corrosion, apply LOCTITE Anti-Seize on bearing seats.



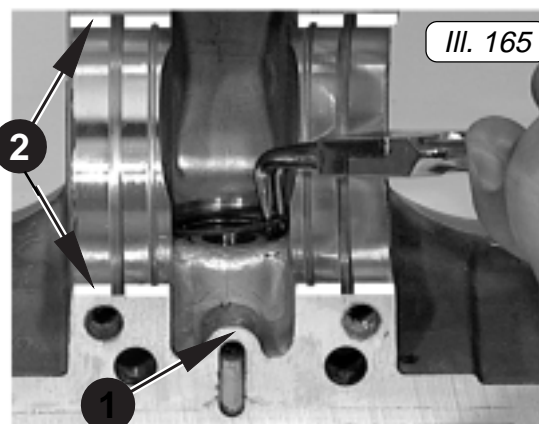
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Fit O-rings on ball bearings and slide greased oil seal on crankshaft ends.

## 8.2) Crankcase:

Take apart crankcase again, still assembled for taking readings of dimensions.

Pre-heat crankcase to c. 70 - 80° C (160 - 175° F). Press bearing for rotary valve shaft on waterpump side into position, using punch 876 500 and secure bearing with retaining ring 32 x 1,2. Closed side of ball bearing to point towards inside. This retaining ring is not used on engine 462 UL, but is fitted on type 532 UL starting with engine no. 3,877.848 and on type 582 UL from engine no. 3,957.335 onwards.



**On engine type 462 UL**, put upper half of crankcase on the studs and place crankshaft with conrods down into crankcase. Push both oil seals at crankshaft centre outwards onto ball bearing. Ensure that the retaining bead comes to rest in the assigned groove in crankcase. Push outer oil seals as well against ball bearing. Evenly apply a thin coat of sealing compound LOCTITE 574 orange on lower half of crankcase and join with top half. Ensure that narrow bridge area ❶ adjacent to drain hole is coated with sealant.

■ **ATTENTION:** Keep a 1 - 2 mm (0,04 - 0,08") wide strip ❷ free of sealing compound along bearings to prevent sealant from entering in bearing.

Ensure when fitting crankshaft into crankcase that none of the spacing legs on the oil seal will cover the oil bore in top half of crankcase.

In isolated cases, because of porosity of the casting, oil might diffuse to tapped holes.

Therefore, apply sealing compound LOCTITE 574 on the 4 inside located hex. hd. screws M8 x 70 at pos. 1 ÷ 4.

Subsequently, fit the following screws along with lock washers:

6 Allen screws M8 x 40, at pos. 5 ÷ 8, 15 and 13

2 hex. hd.screws M8 x 70, at pos. 10 and 12,

2 Allen screws M8 x 75, at pos. 9 and 11

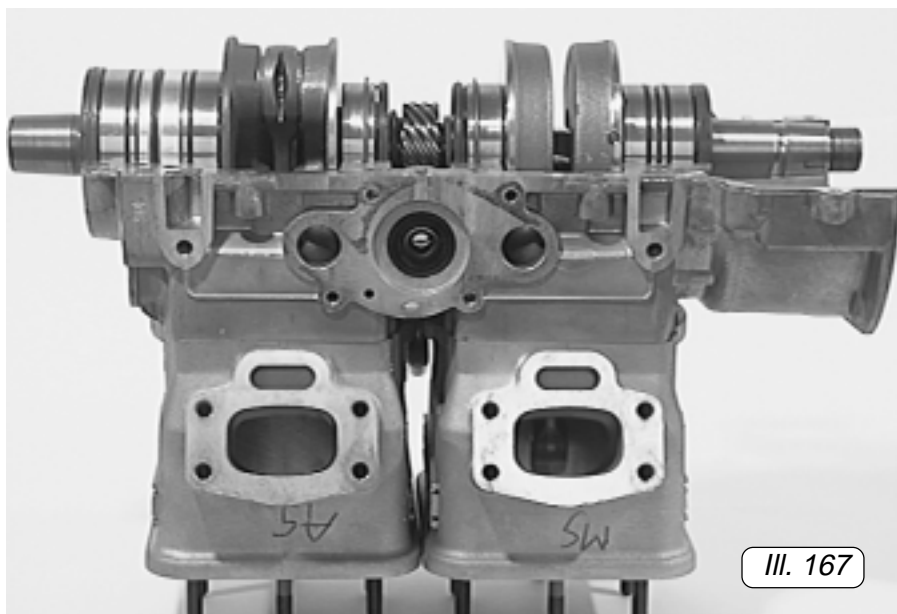
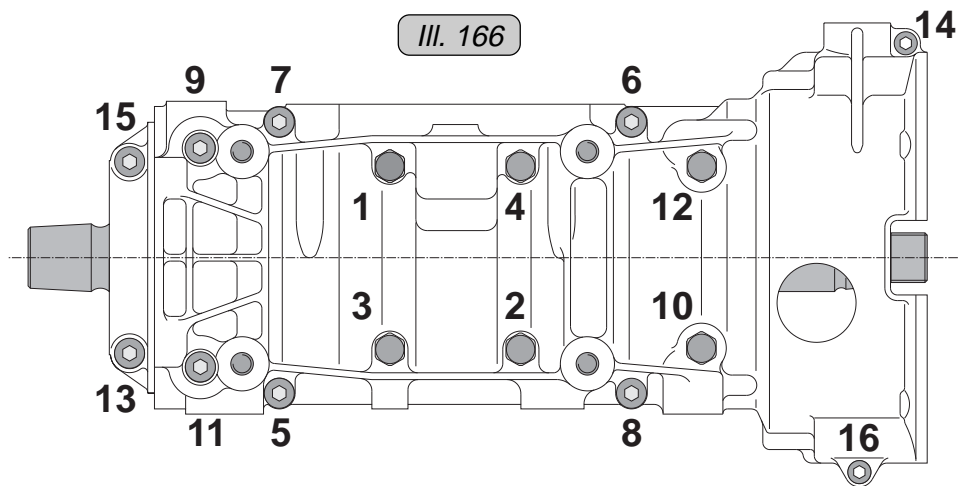
2 hex. hd. screws M6 x 35, at pos. 14 and 16.

Prior to tightening of crankcase screws, align the two halves on the face at p.t.o. side, utilizing a straightedge or by running a finger across joint at p.t.o. end and also across rotary valve face. If need be, align by mallet.

◆ **NOTE:** Tighten screws crosswise, beginning at centre as per the following sketch, to prevent any locking up of stresses in the crankcase assembly.

tightening torque for M6 screws 10 Nm ( 90 in.lb)

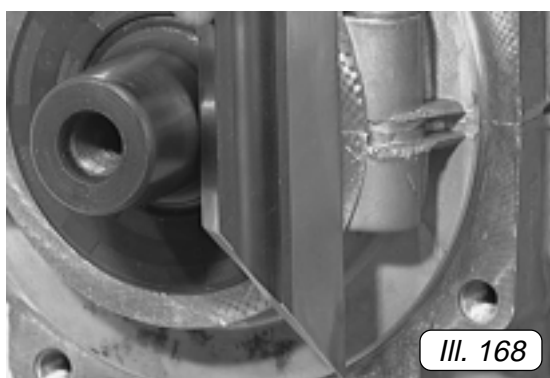
tightening torque for M8 screws 24 Nm (210 in.lb)



### Engine type 532 UL and 582

**UL:** To facilitate assembly, support upper half of crankcase on cylinders with the sleeve spigots projecting into crankcase half.

Place crankshaft with conrods down into crankcase. Push oil seals at crankshaft centre outwards onto ball bearings. Ensure that the retaining bead comes to rest in the assigned groove in the crankcase. Push outer oil seals also against ball bearing. The retaining bead of the oil seal on p.t.o. side has to fit into the provided groove in crankcase.



Joining of crankcase halves as stated previously. The following fasteners along with lockwashers are used on **532 UL and 582 UL** engines:

6 hex. hd. screws M8 x 65, at pos. 1 ÷ 4, 10 and 12  
 6 Allen screws M8 x 45, at pos. 5 ÷ 8, 13 and 15,  
 2 Allen screws M8 x 75, at pos. 9 and 11,  
 (532): 2 hex.hd. screws M6 x 35, at pos. 14 and 16  
 (582): 2 Allen screws M6 x 35, at pos. 14 and 16

Prior to tightening of crankcase screws, align the two halves on the face at p.t.o. side, utilizing a straightedge or by running a finger across the joint. If need be, align by mallet.

◆ **NOTE:** tightening torque for M6 screws ..... 10 Nm ( 90 in.lb)  
 tightening torque for M8 screws ..... 24 Nm (210 in.lb)

Finally, lift crankcase ass'y from support, turn upright and relieve stress in the bearings by a blow with a mallet. Crankshaft must turn freely now. Check with a few rotations cranking on conrods.

■ **ATTENTION:** If crankshaft won't run freely, disassemble crankcase again, find reason and rectify.

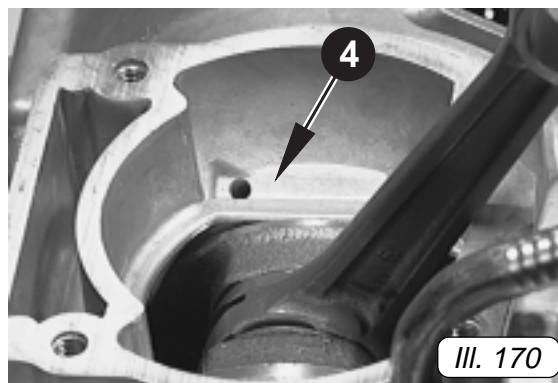
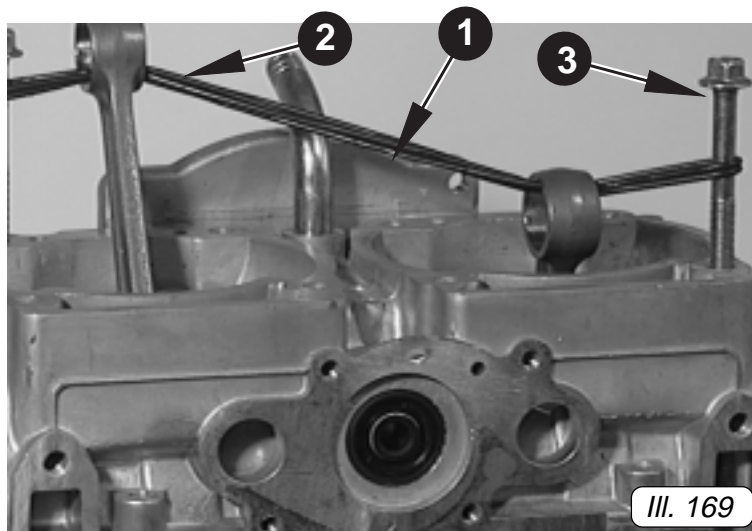
Once crankcase is assembled, ensure that sealing face won't get damaged by the conrods. To facilitate, feed an O-ring ❶ through small end ❷ of both conrods and attach ring on 2 hex. hd. screws ❸.

This measure prevents that the conrod hits the crankcase when crankshaft is turned. Place crankcase assembly on trestle 876 740 and attach it with 2 hex. nuts M10 on mounting plate 876 746.

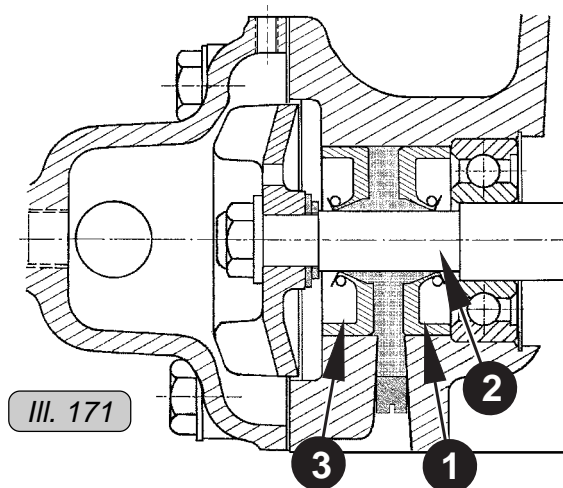
Lubricate all bearings of crankshaft and the spiral gear drive of rotary valve sufficiently with 2-stroke oil. Apply oil to oil ducts ❹ in crankcase as well.

This warrants lubrication at beginning of engine run and a long life of the newly assembled engine.

■ **ATTENTION:** Crankshaft must be checked for correct alignment prior to case assy (see section "Checking of crankshaft alignment").



### 8.3) Assembly of the rotary valve shaft:

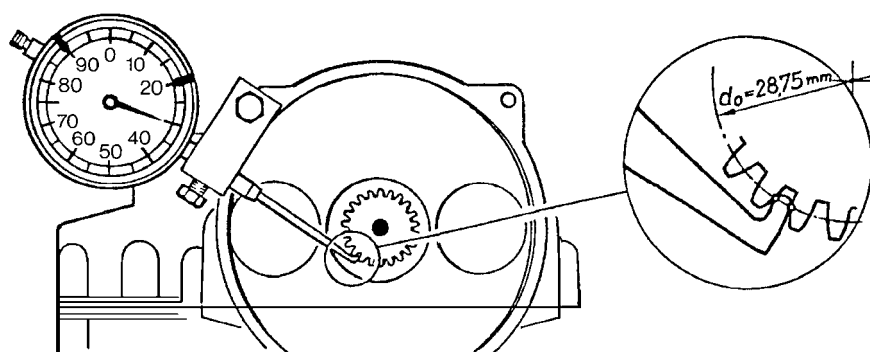


Tap pre-lubricated oil seal ❶ 10 mm (or 12 mm for the earlier rotary valve shaft version), with back of seal outwards, into crankcase, utilizing punch 876 512 (or 876 510). Fit guide sleeve 876 980 (or 876 490) on rotary valve shaft ❷ and tap shaft using punch 876 602 (or 876 600) into locally pre-heated crankcase to positive stop. This punch is used also to push oil seal into correct position. Take care of easy engagement of the rotary valve gear with mating gear on crankshaft. Fit snap-ring 40 x 1,75 on rotary valve side.

◆ NOTE: On engines with fresh oil lubrication (oil pump) the gear section with teeth is longer. To fit this shaft, use punch 876 607.

■ ATTENTION: Snap-ring to be fully engaged in groove.

Crank engine and check backlash on rotary valve drive according to the following sketch:



Dimension	new mm	(in.)	wear limit
backlash .....	0,3 ÷ 0,5	(0,012 ÷ 0,02 )	0,90 (0,036)

Apply Molykote 44 medium on sealing lip of outer oil seal. Fill space between the two oil seals with Molykote 44 medium (c. 6 cc.) (0,36 in<sup>3</sup>). Fit outer oil seal ❸ with back of seal facing inwards, using insertion jig 877 054. Closed side of oil seals are facing each other.

Remove forced-out surplus Molykote. Remove guide sleeve. Check crankshaft for easy rotation.

◆ NOTE: On engine 462 UL grease can be filled between the two oil seals on an assembled engine, too, via a grease nipple located on crankcase top half.

◆ NOTE: On earlier models the sealing between water- and oil side was accomplished differently. The sealing shown here is the one used currently in the serial production.

## 8.4) Assembly of the water pump:

Lock crankshaft with assigned pin, thus also locking rotary valve shaft.

Place thrust washer 8,1/15/0,5 and friction washer with serration towards impeller on shaft. Make sure to use new impeller with 5 mm passage hole, and fit it corresponding to flat on shaft. Apply LOCTITE 648 on thread and attach with washer and a new lock nut. Tighten with 7 Nm (62 in.lb.). Withdraw crankshaft locking pin and check crankshaft for easy rotation.

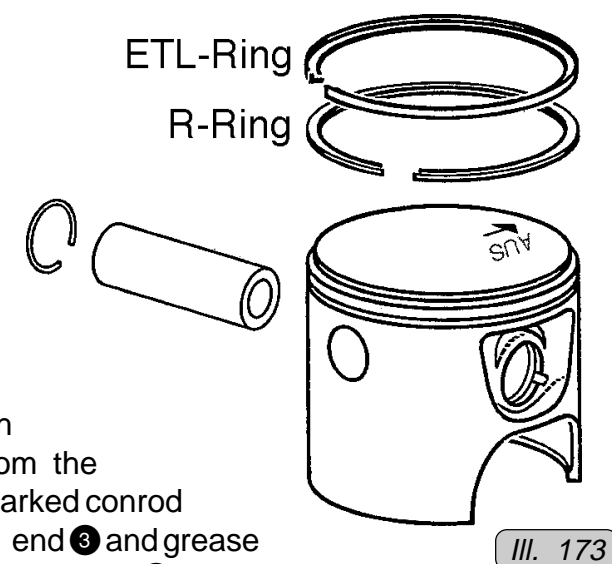
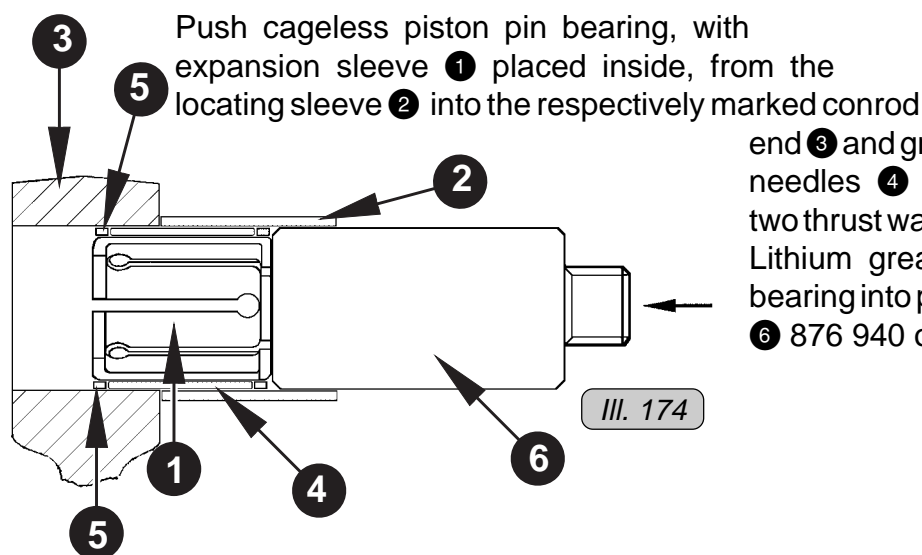
Place new gasket in position and fit water pump housing to correspond with existing marking by 4 Taptite screws (self-cutting). Standard fitting position is with water feed pipe towards p.t.o. side.

◆ **NOTE:** Secure Taptite screws with LOCTITE 221. Keep to specified tightening torque 8 Nm (71 in.lb.) without fail. Otherwise threads in crankcase could be damaged.

## 8.5) Fitting of the pistons:

Prior to fitting the pistons, complete piston assembly with the two respective piston rings, R-ring in lower groove and ETL-ring at piston crown.

Cover crankcase apertures with protection sheet 877 030, and on type 462 with a clean rag, to prevent foreign matter from dropping into crankcase.

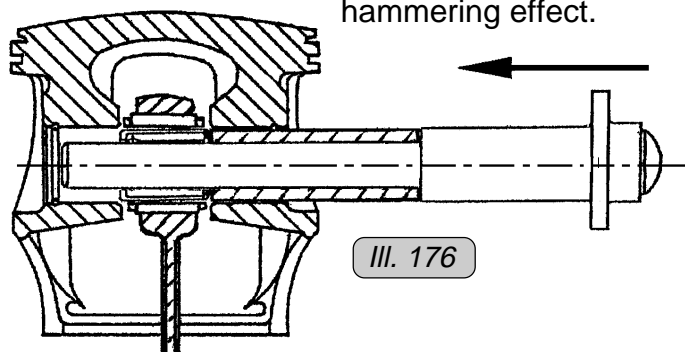


end ③ and grease needles ④ and the two thrust washers ⑤ with Lithium grease. To facilitate pushing the bearing into position, use dial gauge adapter ⑥ 876 940 or a pin with  $\varnothing$  21 mm (0,826").

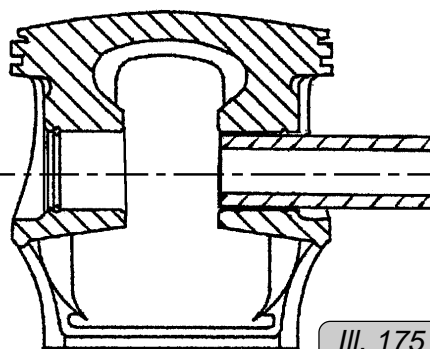
◆ **NOTE:** If a needle bearing with cage is installed, it is advisable to change to a cageless bearing.



Pre-fit piston pin circlip on the less accessible side of piston. Always fit new piston pin circlip and use circlip installation tool 877 015 to maintain tangential stress and to avoid deformation of circlip beyond yield point. Gap of circlip to point downwards, in 6 o'clock position, to prevent deformation of groove by hammering effect.



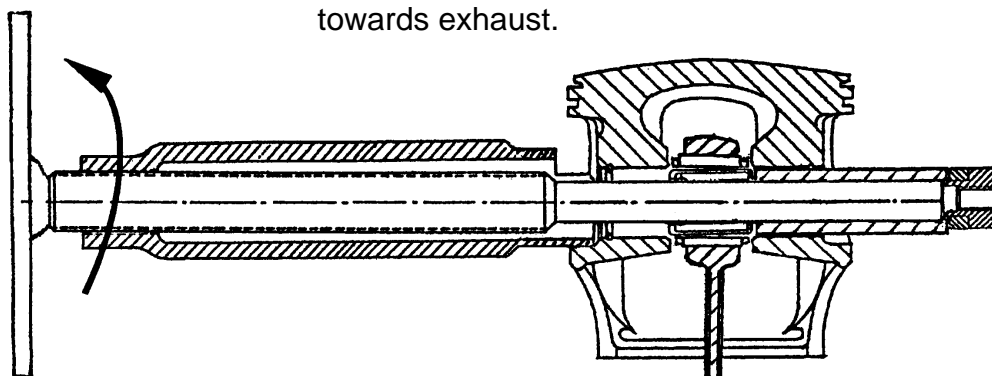
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Pre-heat piston to c. 50° - 60° C (120° - 140° F). Oil piston pin and push into piston to end level with face of pin boss. Place piston with one circlip fitted and pin pushed in on one side, over conrod and push pin into final position, using punch 877 010.

■ ATTENTION: Arrow and the word „AUS“ imprinted on piston crown have to point towards exhaust.



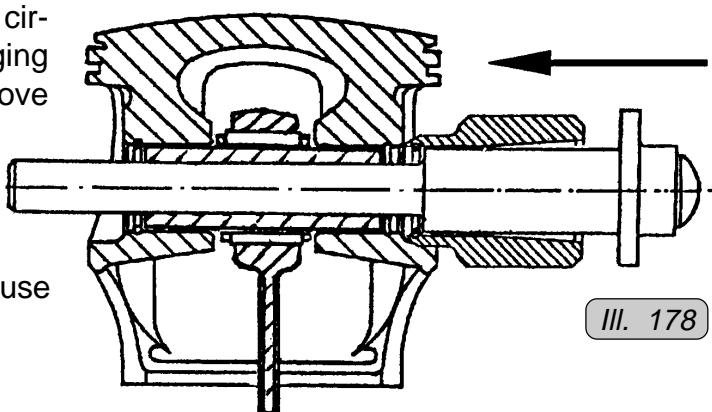
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On a piston pin difficult to push in, the use of piston pin extractor (877 090) facilitates the procedure. Insert spindle of extractor into piston pin, screw on extracting nut, and by turning extractor spindle, pull piston pin carefully into piston to stop on circlip. Turn spindle backwards some turns, remove extracting nut and withdraw extractor.

Fit second circlip properly, using circlip installation tool 877 015. Whilst fitting piston pin, support conrod to avoid bending moment on rod. Install circlips with gap down at 6 o'clock position to maintain tangential stress of circlip.

■ ATTENTION: Ensure that all circlips are engaging properly in groove and fitted in correct position.

A non-secured piston pin would cause severe engine damage.



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- ◆ **NOTE:** Pistons, assembled with rings, piston pin and piston pin bearing were run as a unit. If these items are not renewed, fit them in their initial position.

Make sure not to drop any needles or thrust washers into crankcase. But if it should happen, turn over crankcase and count the needles found. If less than 31, disassemble crankcase.

For more information on fitting and removal of cageless piston pin bearing and handling of piston pin extractor, consult Service Information 4 UL 89-E.

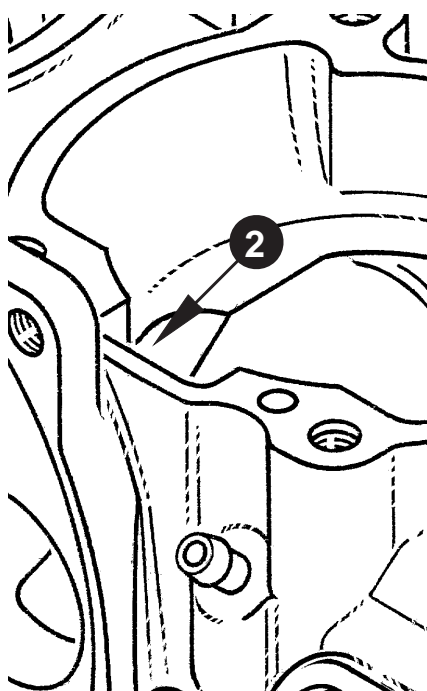
### 8.5.1) Assembly of piston on Type 532 and 582 UL:

Starting with engine no. 3,722.437 on the type 532 and on type 582 since beginning of serial production the cageless piston pin bearing was introduced. On engines assembled prior to this engine number, exchange piston pin bearing to the cageless version when engine is on repair.

From engine no. 3,722.454 onwards on the type 532, and on type 582 since beginning of serial production, pistons with a boost bore are fitted. Through this bore, pre-compressed fuel/air mixture enters and passes on to combustion chamber via boost port, thus adding to lubrication and cooling of the piston pin bearing.

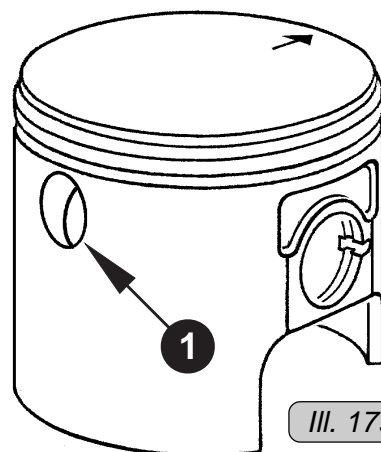
- ▲ **WARNING:** If fitting pistons with a boost bore on an engine prior to the stated engine number, the new cylinder with 8 Allen screws has to be used, too. Combination of piston with boost bore and old type cylinder is not permissible.

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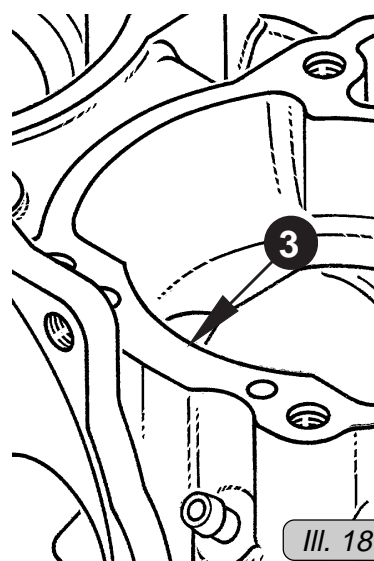


Crankcase with transfer recess ② may be continued for use in these cases, but on the new model crankcase without the transfer recess ③ also introduced with engine no. 3,722.454, the old version of cylinder cannot be used. See also the following chapter "Assembly of the cylinders".

The same cylinder base gasket is used on both versions, but from engine no. 3,798.566 a common gasket for both cylinders is fitted.



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## 8.6) Re-assembly of the cylinders:

Place cylinder base gasket on crankcase. On engine type 462 a single gasket per cylinder is used, on engine types 532 and 582 UL a common gasket for the two cylinders is fitted. Renew cylinder base gasket without fail at every inspection and repair.

◆ NOTE: In case of renewal of one cylinder only, cut a common gasket apart.

In both piston ring grooves, securing pins are pressed in. Install piston ring with ring gap engaging on securing pins, thus positioning piston ring. Apply oil to cylinder wall and position piston to T.D.C.

### Engine type 462 UL:

If cylinder studs were removed, refit them on crankcase and tighten to 7 Nm (62 in.lb).

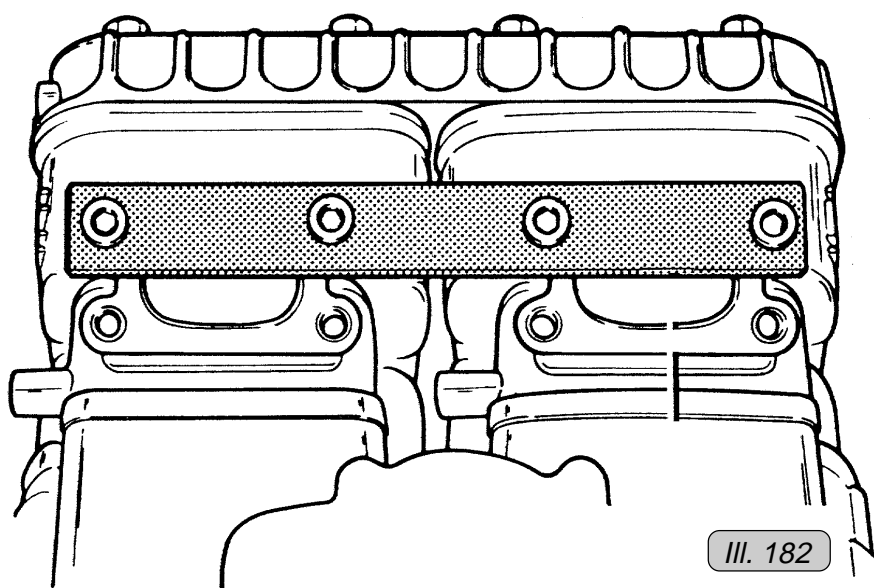
Put piston ring clamp 876 974 over piston and piston ring so that none of the piston ring gaps will be visible in the slot of the clamp.

Draw cylinder over piston, slightly pulling and turning.

◆ NOTE: Cylinder must move easy onto piston, without too much turning. Otherwise one of the ring ends could engage on the edge of a port, causing ring breakage.

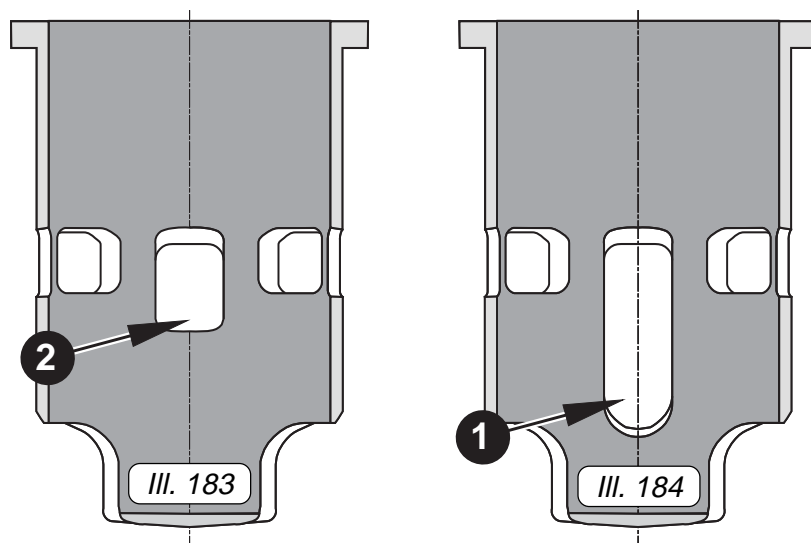
Remove piston ring clamp and put cylinder to rest on crankcase. Set second piston to T.D.C. and repeat procedure.

On engine type 462, cylinders and cylinder head are attached to crankcase with joint studs. Prior to tightening the cylinder head nuts, align cylinders by fitting of the alignment tool 876 175 to both exhaust flanges.



## Engine type 532 UL:

From engine no. 3,722.454 onwards with introduction of boost-bore piston, a cylinder with boost port ❶ was fitted, too. This cylinder is attached by 4 Allen screws plus washer instead of studs. In a cylinder with boost port, only a piston with boost hole can be fitted. Cylinders without boost port ❷ were installed in engines up to no. 3,722.453.



## Engine types 532 UL and 582 UL:

On engine types 532 UL and 582 UL, the piston ring clamp cannot be used because of different length on liner lobes. That means, when fitting the cylinder, position piston rings, depress with your fingers and draw cylinder, correctly positioned, over piston.

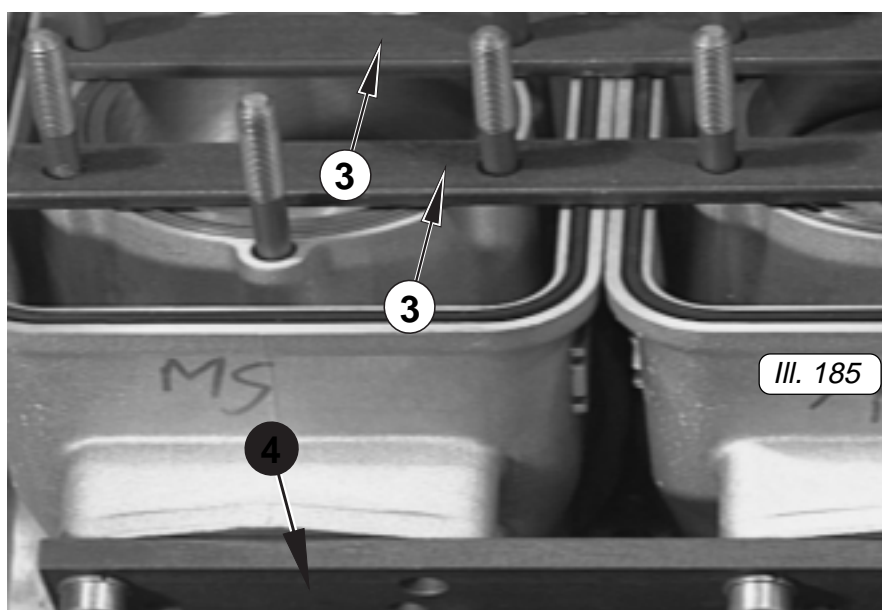
To enable the subsequent assembly of cylinder head, the two cylinders have to be aligned. The two aligning tools ❸ provide correct distance between cylinders, and the aligning tool ❹ ensures plane face of exhaust flanges.

**Type 532 UL:** 2 x aligning tool 876 570 + 1 x aligning tool 876 900

**Type 582 UL:** 2 x aligning tool 876 572 + 1 x aligning tool 876 902

Afterwards tighten fasteners crosswise and evenly with 24 Nm (212 in.lb).

**On type 532 UL** use 8 Allen screws M8x70 and one each washer 8,4. For sealing apply lasting flexible sealing compound on both sides of all washers.



**On type 582 UL** apply BP Energrease LS3 on bearing area of the 8 hex. collar screws M8 x 68,5 and tighten crosswise. The grease minimizes friction loss of tightening torque.

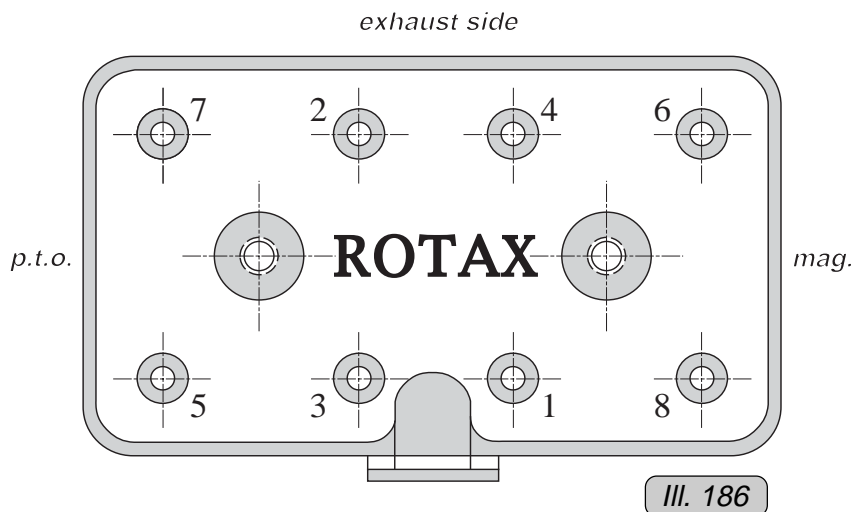
◆ **NOTE:** Tighten screws crosswise with 22 Nm (195 in.lb).

Finally, remove aligning tools.

## 8.7) Assembly of the cylinder head:

### Engine type 462 UL:

For use of a 2-piece radiator set, exchange the two studs M8 x 175 on p.t.o. side for two longer studs M8 x 187 and seal both sides of the radiator brackets with Silastic 732.

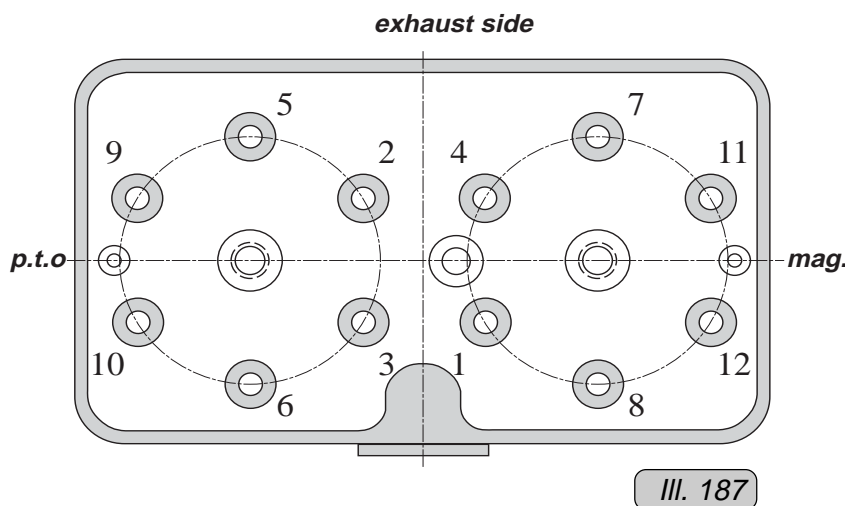


Insert one each O-ring 139-3 at water jacket and O-ring 78-2 at combustion chamber in aligned cylinder, and put on cylinder head with water outlet flange to rotary valve side. Place mounting plate and bracket for oil tank in position 1 and 8 (see chapter 8.12) and attach cylinder head along with oil tank- and radiator support, with 8 hex. cap nuts.

Grease cutting edge of cap nuts with BP Energrease LS3 and tighten to 22 Nm (195 in.lb) in the depicted sequence.

### Engine type 532 up to engine no. 3,722.553:

Two different cylinder heads are used. On the **older** version up to engine no. 3,722.553 the cylinder head is attached with 12 studs M8 x 50. For use of a 2-piece radiator set, the two studs M8 x 50 on p.t.o. side have to be exchanged for two longer studs M8 x 96. This version of cylinder head can be recognized by the spotfacing at attachment nuts and spark plug threads.

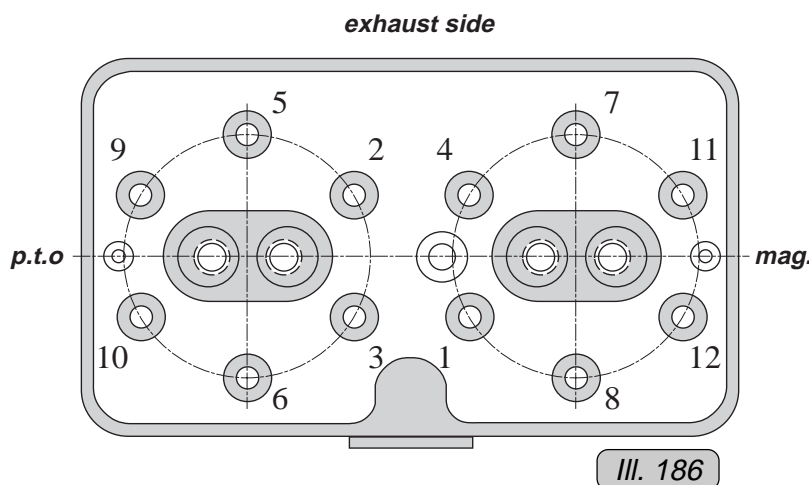


Insert one rubber ring 152,5 x 2,5 x 5 and one O-ring 78-2 on each cylinder. Put on cylinder head with water outlet flange to rotary valve side and attach with 12 hex. cap nuts M8. Apply BP Energrease LS3 on cutting edge of cap nuts and tighten with 22 Nm (195 in.lb) in sequence as shown. When using the 2-piece radiator set, seal both distance sleeves 8,4/18/10 and contact face of radiator brackets with Silastic 732.

### Engine type 532 UL from engine no. 3,722.554 onwards and type 582 UL

The cylinder head is attached with 12 studs M8 x 79. For use of a 2-piece radiator set, both studs M8 x 79 on p.t.o. side have to be exchanged for the longer studs M8 x 96.

◆ NOTE: On this cylinder head the faces for nuts and spark plug threads are raised.



Insert in both cylinders one each of rubber ring 152,5 x 2,5 x 5 and O-ring 78-2. Put on cylinder head and attach with 12 cap nuts M8. Grease cutting edge of cap nuts with BP Energrease LS3 and tighten with 22 Nm (195 in.lb) in the depicted sequence.

For use of a 2-piece radiator set, seal radiator support brackets with Silastic 732.

◆ NOTE: Use the correct studs without fail and screw-in the correct end. On too far projecting studs, the cap nuts would not press on cylinder head, but rest on stud end, thus causing leaks on cylinder head joint. The max. projecting length must not exceed 14 mm (0,55 in.).

When exchanging studs, use 2 nuts locked head-on and remove stud. On fitting new studs, ensure specified projecting length. Tighten studs with 7 Nm (62 in.lb).

Secure studs for water outlet socket with LOCTITE 221 and tighten with 3 Nm (27 in.lb).

## 8.8) Fitting and setting of rotary valve:

Prior to final installation of rotary valve, determine valve timing. It is easier if timing marks were made at disassembly. Even with marks existing, timing has to be checked.

Find the relevant rotary valve timing in the Technical Data List:

- rotary valve opening at  $\angle\alpha$  B.T.D.C.
- rotary valve closing at  $\angle\beta$  A.T.D.C.
- rotary valve cut-away portion

Utilizing an angle template, mark ③  $\angle\beta$  on face of crankcase from closing edge ① of magneto side inlet port ②, e.g.  $50^\circ$  on type 582, 48 kW version.

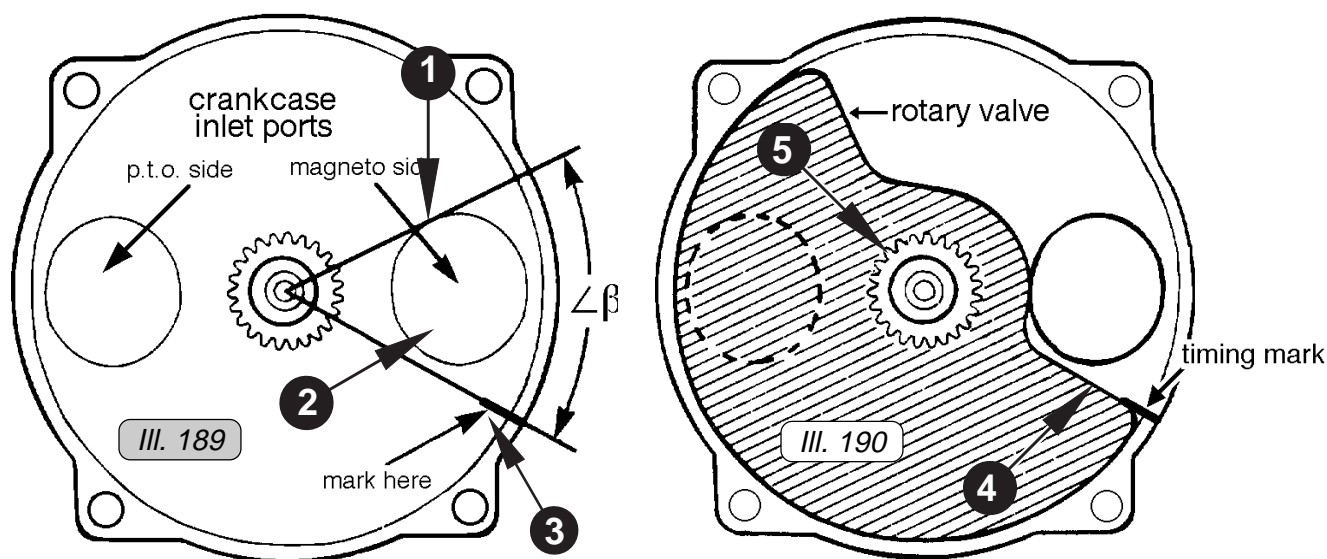
Fit dial gauge into magneto side spark plug thread and turn crankshaft against direction of operation to T.D.C. of magneto side piston.

◆ NOTE: By turning against direction of operation, the backlash of rotary valve drive will be eliminated.

Check flatness and cut-away portion of rotary valve, e.g.  $132^\circ$  on 582 UL, 48 kW version. Place rotary valve on gear of rotary shaft, trying to align the closing edge ④ of rotary valve as exactly as possible with marking on crankcase ③. Max. allowance  $\pm 4^\circ$ .

◆ NOTE: The toothing ⑤ of the rotary valve is asymmetrical respective to closing edge. Therefore, at assembly, try by turning over best possible installation.

Apply oil on both sides of the rotary valve for reasons of adequate lubrication at beginning of engine run.

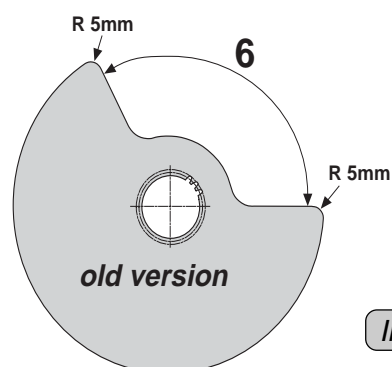


### 8.8.1) Rotary valve timing:

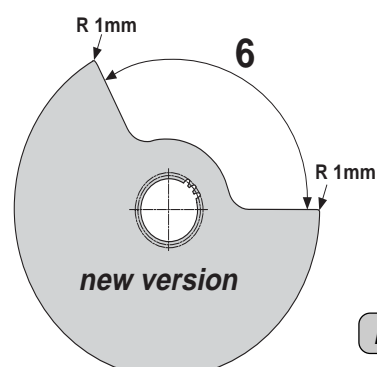
Engine type	opens B.T.D.C.	closes A.T.D.C.	cut-away portion ⑥
462 UL (28 kW) .....	120° .....	40° .....	117°
462 UL (38 kW) .....	140° .....	51° .....	147°
532 UL (47 kW) .....	132° .....	52° .....	132°
582 UL (32 kW) .....	120° .....	45° .....	117°
582 UL (40 kW) .....	130° .....	50° .....	132°
582 UL (48 kW) .....	130° .....	50° .....	132°

To minimize the wear around inlet port in crankcase, the ends of the rotary valve have been optimized by changing the radius **5 mm** into radius **1 mm**, at rotary valve

with cut-away portion 147° from engine no. 3,804.481 onwards  
 with cut-away portion 132° from engine no. 3,934.361 onwards  
 with cut-away portion 117° in planning



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*Timing and cut-away portion remain unchanged.*

### 8.8.2) Fitting of the rotary valve cover:

At fitting of rotary valve cover, pay attention to correct axial clearance as stated in chapter "7.1 Crankcase". Place O-ring on rotary valve cover and ensure it will remain in position. Facilitate if necessary by twisting O-ring for a better hold in groove. Fit rotary valve cover in centering of crankcase and attach for the time being with the two lower hex. hd. screws M8 x 20. With the fitting of the supporting plate for electronic boxes, the final attachment of rotary valve cover is taken care of, too.

■ **ATTENTION:** Make absolutely sure that the length of the screws used is correct. A screw too long stops at cylinder and breaks attachment lug, making a new crankcase necessary.

## 8.9) Installation of the ignition unit:

### 8.9.1) Fitting of stator plate assembly on engines 462 UL and 532 UL:

Turn engine on trestle into suitable position. Insert Woodruff key 3 x 3,7 into groove on crankshaft with straight side parallel to taper. Apply Lithium grease on lubrication wick of breaker set. Feed cable assembly through opening in crankcase and fit stator plate into centering in crankcase. If position marks are existing, align with marking, otherwise fit stator plate in mid-position and attach with 2 Allen screws M5 x 18 plus washer and lock washer. Secure Allen screws with LOCTITE 221 and tighten to 6 Nm (53 in.lb).

■ **ATTENTION:** Don't squeeze cables behind stator plate. Check by slight to and fro movements of harness.

Place cable grommet over harness and fit in crankcase for protection of cables against damage and spray water.

Degrease taper of crankshaft and cone in magneto housing, moisten cone with LOCTITE 221 and fit flywheel on crankshaft taper. Ensure that Woodruff key remains in groove and won't be pushed out backwards. The Woodruff key warrants correct position of the magneto housing. A magneto housing in a wrong position changes break-away gap to the worse, leading to ignition problems.

◆ **NOTE:** LOCTITE 221 applied on the taper helps to prevent cold-welding caused by vibration and oscillation.

Secure hex. nut M22 x 15 with LOCTITE 221, fit along with lock washer and tighten to 90 Nm (800 in.lb).

### 8.9.2) Ignition timing:

#### Position of piston at point of ignition

Engine type .....	mm B.T.D.C. ....	degrees B.T.D.C. ....
Type 462 UL .....	1,82 ± 0,25 .....	18 ± 1° .....
Type 532 UL .....	1,96 ± 0,25 .....	18 ± 1° .....

### 8.9.3) Adjustment of ignition timing:

Consult chapter "Contact breaker ignition unit"

### 8.9.4) Break-away gap:

See chapter "Contact breaker ignition unit"



### 8.9.5) Fitting of the stator plate assembly on Type 582 UL:

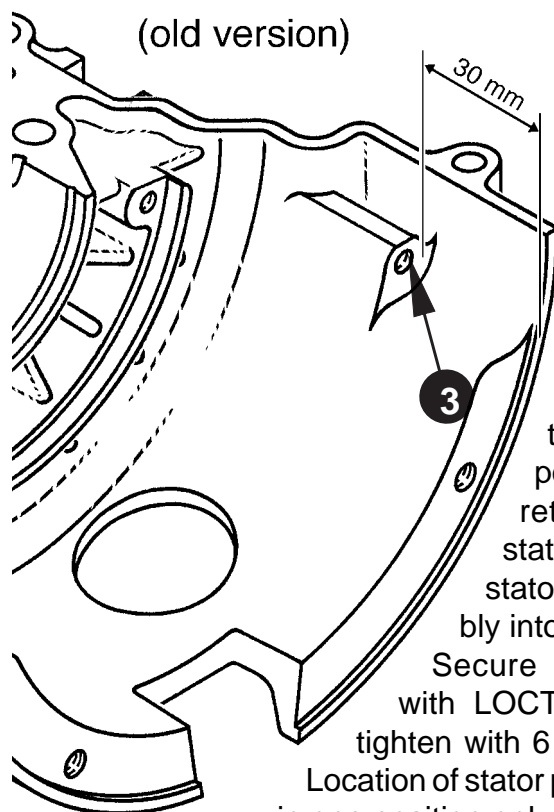
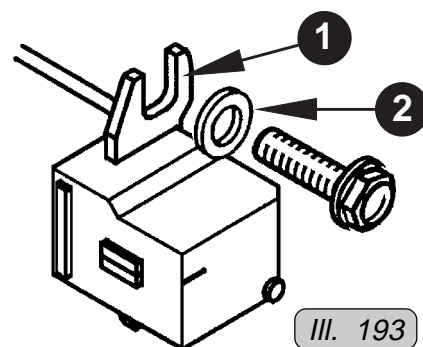
Turn engine on trestle into suitable position. Insert Woodruff key into groove on crankshaft, with straight side parallel to taper.

Feed both pick-up lines through crankcase opening and attach pick-ups with two each Taptite screws M5 x 16 in pick-up recess of crankcase.

Push each pick-up outwards before temporarily tightening the Taptite screws. This is to ensure that the triggers do not hit the pick-ups when the magneto housing is first fitted and the crankshaft is turned.

From engine no. 4,017.191 onwards new pick-ups with open attachment lugs ❶ are installed. To attach these pick-ups one each washer 5,5 ❷ is needed additionally.

Starting with engine no. 4,084.219 onwards, at introduction of the new crankcase, pick-ups with cable connected on the inside are fitted, thus eliminating the risk of squeezing the cable.



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The support ❸ of the pick-up was shifted from 30 mm to 55,8 mm. New position of pick-ups requires also repositioning of trigger ❹ towards inside from 17 mm to 14,5 mm.

◆ NOTE: Dimensions stated in illustrations are for previous pick-up position.

If coil kit had been disassembled, refit with 3 Allen screws M5 x 30 on stator plate.

Secure screws with LOC-

TITE 221 and tighten with

6 Nm (53 in.lb). Feed

cable assembly

through opening,

position behind the

retaining lugs of

stator plate and fit

stator plate assembly

into centering.

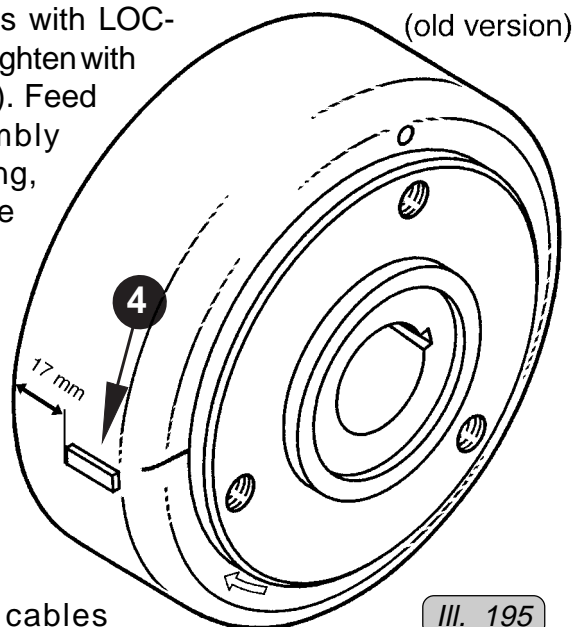
Secure Allen screws

with LOCTITE 221 and

tighten with 6 Nm (53 in.lb).

Location of stator plate is possible

in one position only.



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■ ATTENTION: Don't squeeze cables routed behind stator plate. Check by slight to and from movements of harness.

Place cable grommet over harness and fit in crankcase for protection of cables against damage and spray water. Wind spiral hose over harness.

Degrease taper of crankshaft and cone in magneto housing, moisten cone in magneto housing with LOCTITE 221 and fit flywheel on crankshaft. Ensure that Woodruff key remains in groove and will not be pushed out backwards. The Woodruff key warrants correct position of the magneto housing. A wrong position of magneto housing changes time of ignition.

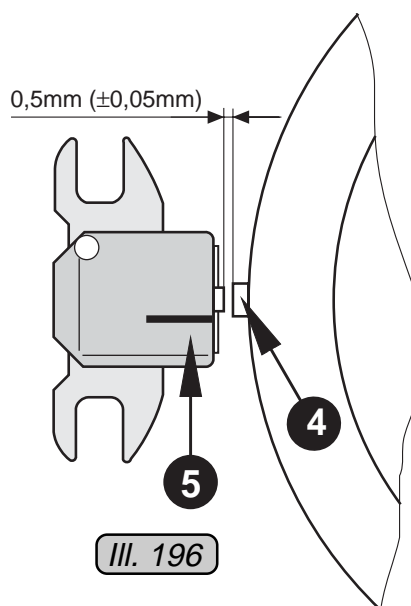
◆ **NOTE:** LOCTITE 221 applied on the taper helps to prevent cold-welding caused by vibrations and oscillation.

Secure hex. nut M22 x 1,5 with LOCTITE 221, fit along with lockwasher and tighten to 90 Nm (800 in.lb).

#### 8.9.6) Adjustment of trigger gap:

Turn crankshaft until trigger is adjacent to pick-up. Slacken the two Taptite screws and using feeler gauge adjust trigger gap to .45 - .55 mm (0,018 - 0,022 in.).

Tighten Taptite screws to 6 Nm (53 in.lb). Re-check trigger gap and adjust for the other pick-up.

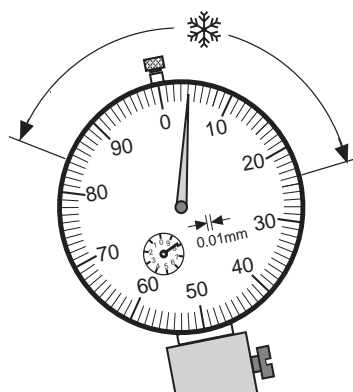


### 8.9.7) Setting of the ignition timing

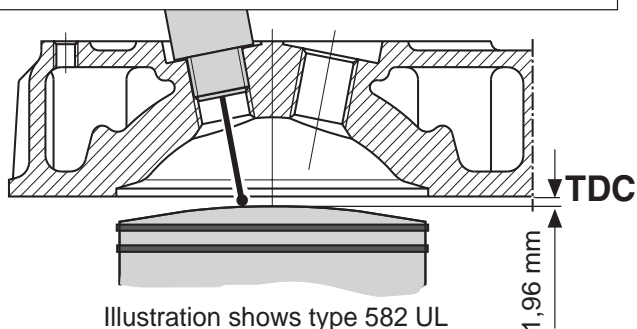
◆ NOTE:

If the older type pick-ups are used the ignition timing is fixed and should need no adjustment. With the new type of pick-ups which have slots instead of holes the timing must also be set at the same time as the trigger gap is adjusted.

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\* permissible tolerance  $\pm 0,20$  mm (0,008)  
max. differences between the cylinders 0,1mm (0,004)



Ignition timing is set by aligning mark on pick-up 7 with mark on magneto housing 8 and measuring distance before TDC using a dial gauge in a spark plug hole.

Set ignition timing to value stated in Technical Data.

◆ NOTE: Error of measurement caused by the slightly inclined spark plug is minimal and can be ignored therefore.

Adjust pick-up to achieve correct timing as well as correct trigger gap. Torque Taptite screws to 6 Nm (53 in. lb) and re-check timing and trigger gap.

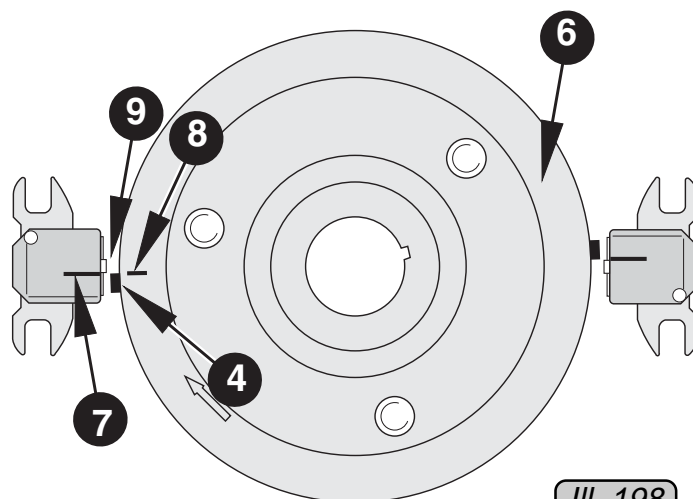
The illustration shows the magneto flywheel 6 and the two pick-ups at the time of ignition.

It represents an easy and quick way of a static check of the ignition timing.

The actual triggering is always by the leading edge of the core of pick-up 9 and the trigger piece 4.

The second pick-up is staggered by 180 degrees.

A dynamic check of the ignition timing is possible only by utilizing a stroboscopic lamp.



## 8.10) Fitting of the rewind starter:

Place starting pulley on centering of magneto flywheel and attach with 3 hex. screws M8 x 16, tighten to 22 Nm (195 in.lb).

Beginning with engine no. 3,853.830 a starting pulley pressed from 1,75 mm sheet metal is fitted on the 462 UL engine. For type 532 UL it was changed with engine no. 3,887.946.

To improve crankshaft vibration behaviour, a hydro-damper is used on engine type 582 from engine no. 4,015.239 onwards. In this context hex. screws had to be changed to M8x20 and height of starting pulley was reduced from 30 mm to 22 mm. Secure hydro-damper with LOCTITE 648.

Fit pre-assembled rewind starter according to the marking made at disassembly and tighten the 4 hex. screws M6 x 14 plus lockwasher to 10 Nm (90 in.lb).

## 8.11) Fitting of the electric starter:

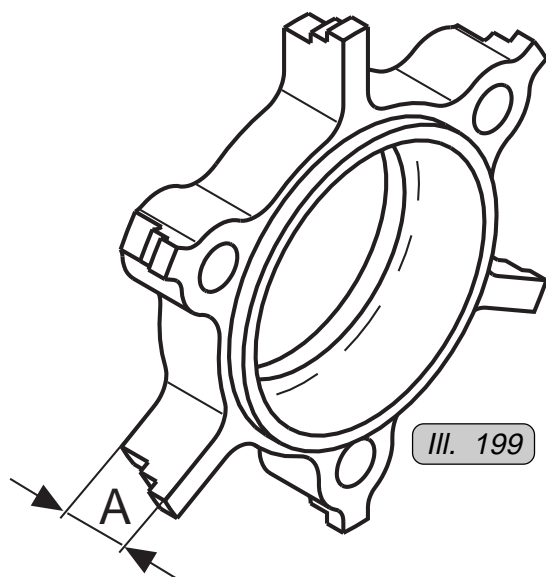
### 8.11.1) Electric starter on p.t.o. side:

■ ATTENTION: With this electric starter used, the ROTAX reduction gear cannot be fitted.

Fit starter gear. Fasteners are not in the Rotax supply scope. Fit starter bracket, attachment web towards magneto side, with 2 Allen screws M8 x 25 plus lockwasher. Attach pinion starter with 2 hex. screws M8 x 25 and lockwashers and nuts. Attach starter support by hex. screw along with lockwasher and washer on crankcase, and starter on support with Taptite screw. Tightening torque of all M8 screws is 22 Nm (195 in.lb). Apply grease on pinion of starter.

### 8.11.2) Electric starter on magneto side:

On type 582 UL, beginning with engine no. 4,015.239 a hydro-damper is used to improve vibration behaviour. In this context only dimension "A", length without centering, of starter gear adapter was reduced from 22,5 to 14,5 mm.



The hydro-damper is on the magneto side, the contact face of starter gear adapter on both sides secured by LOCTITE 648.

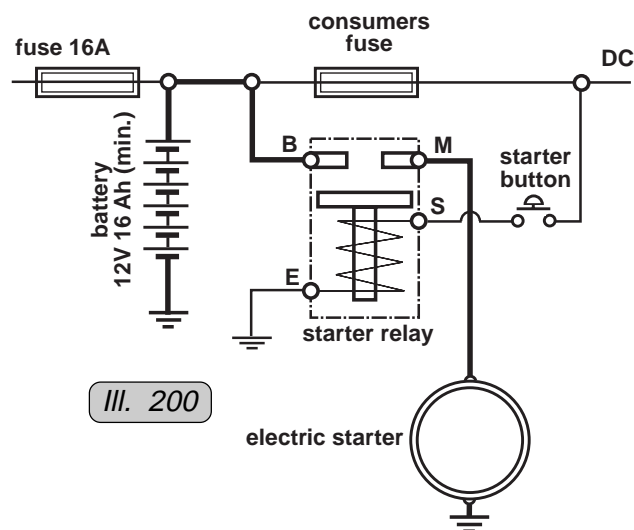
On engines without hydro-damper the contact face of starter gear adapter to starter gear is secured by LOCTITE 648.

Fit starter gear with plane side towards starter gear adapter, and attach with 3 hex. screws M8 x 40 with lockwasher, secured by LOCTITE 221 and tightened to 22 Nm (195 in.lb). Apply grease on pinion of starter.

Fit starter cover with pre-assembled pinion starter (see chapter "electric starter") according to the marking made at disassembly and tighten the 4 hex. screws M6 x 40 along with lock washers to 10 Nm (90 in.lb).

### 8.11.3) Power supply to electric starter:

A 16 A fuse must be installed between charging circuit of battery and power source. The power supply line and grounding connection should be at least a 10 mm<sup>2</sup> cable. Ensure neat electric connections, where necessary, grease terminals.



## 8.12) Installation of the thermostat:

In case a thermostat is used, it can be installed on type 462 UL prior to fitting of mounting plate for ignition coils.

Place thermostat, gasket and water outlet socket in position.

### Engine type 462 UL

Fit water outlet socket, with 2 each washers, lockwashers and hex. nuts M6. Tighten to 10 Nm (90 in.lb).

### Engine types 532 UL and 582 UL

After assembling of the supporting plate of ignition coils fit water outlet socket in one go with supporting plate assembly. Attachment of socket as on type 462 UL.

## 8.13) Fitting and assembly of ignition components supporting plate:

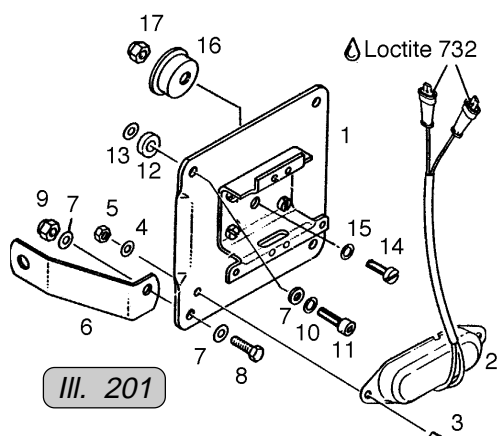
Connect oil hoses to oil supply and return tube on crankcase and secure hoses by clamp. Connected hoses will facilitate fitting of supporting plate. Only on type 462, connecting the hoses is possible at a later phase, too. Fitting of the supporting plate generally in reversed sequence to disassembly (see chapter "Removal of ignition coils support plate and disassembly of rotary valve").

Tightening torques, if not stated otherwise:

M5 .....	6 Nm ..... (53 in.lb)
M6 .....	10 Nm .... (90 in.lb)
M8 .....	22 Nm .. (195 in.lb)

### Type 462 UL

If supporting plate ① has been removed, re-assemble again. Attach ignition damping box ② with 2 cheese-hd. screws M5 x 10 ③ plus washer ④ and lock nuts ⑤. Feed cables from below through oblong holes in supporting plate. Connect support link ⑥ by hex. screw M6x14 ⑧, washers ⑦, and locknut M6 ⑨.



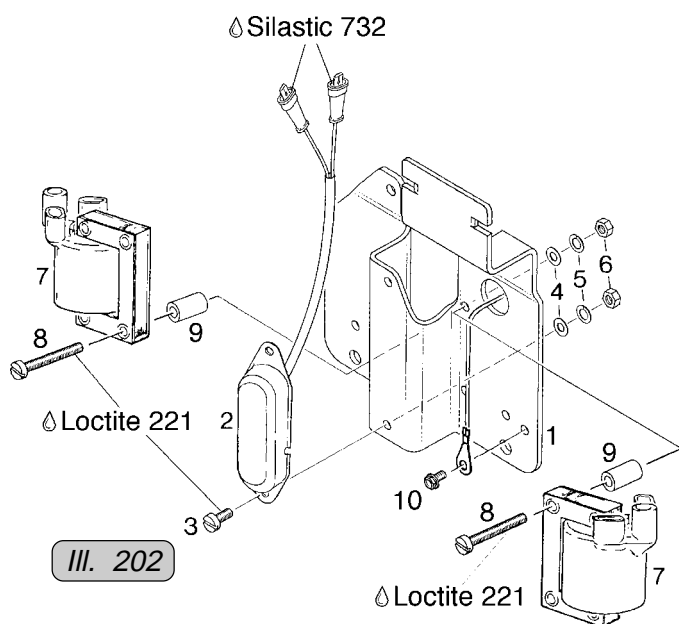
Attach supporting plate ① with 3 each Allen screws M6x22 ⑪, lock washers ⑩, washers ⑦ spacers ⑫ and washers ⑬ on backside.

Fit support link ⑥ with hex. screws M8x25 and washer to rotary valve cover. Finally fit the two ignition coils with 3 each Allen screws M5x20 plus washer.

◆ NOTE: From production run Oct. 1990 onwards the distance washer ⑯ is fitted to the backside of supporting plate for prevention of vibrations. Attachment by cheese hd. screw M5 x 16 ⑭, washer 5,3 ⑮ and stop nut ⑰.

### Type 532 UL

If supporting plate ① assembly has been removed, re-assemble again. Attach ignition damping box ② with 2 cheese-hd. screws M5 x 10 ③, washers ④, lock washers ⑤ and lock nuts ⑥. Feed cables behind supporting plate to the top. Fit the 2 ignition coils ⑦ with 3 each cheese hd. screws M5 x 40 ⑧, spacers ⑨, washers ④, lock washers ⑤ and nuts M5 ⑥. Attach grounding cable by Taptite screw M5 x 8 ⑩.

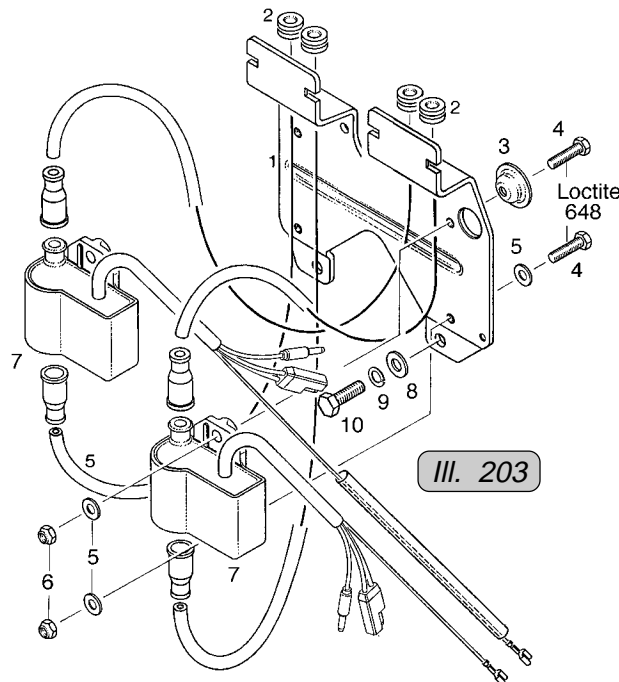


Fit support plate ① and rotary valve cover jointly with 2 Allen screws M8x25, and attach also other end of supporting plate ①, water outlet socket and grounding cables of ignition coils (blue) with 2 each washers, spring washers and hex. nuts M6.

## Type 582 UL

If supporting plate assembly ❶ has been removed, re-assemble again. Push the 4 cable grommets ❷ into position.

For the support of the electronic boxes ❷ fit the 4 hex. screws M6x25 ❹ and 2 each



washers ❺ and distance caps ❸ from the backside of supporting plate ❶ (see ill.). Tightening torque 5 Nm (44 in.lb). Secure these screws in supporting plate with LOCTITE 648, so it won't be necessary to remove the complete supporting plate assembly at a renewal of electronic boxes. Fit the two electronic boxes ❷ by 2 each washers ❹, lock washers ❺, and lock nuts M6 ❻. The installation of the electronic box can be done after fitting of the supporting plate, too.

Fit supporting plate ❶ along with rotary valve cover with 2 each Allen screws M8x25 ❿, lock washers ❾ and washers ❽, but don't tighten screws yet, because supporting plate should be still movable to feed in the required cable

assembly from the backside through the 20 mm Ø bore. Tighten screws afterwards.

Attach other end of supporting plate ❶ as well along with water outlet socket with 2 each washers, lock washers and hex. nuts M6.

Carefully connect electric components according to respective wiring diagram. Consult chapter "Breakerless dual ignition unit (DCDI)". The length of most of the cables renders wrong connection impossible.

Ensure routing of cables without being subject to abrasion, too high temperature ( $\geq 100^{\circ}\text{C}$  ( $214^{\circ}\text{F}$ ), tensile stress or squeezing.

Warrant tight fit of all connections, otherwise vibrations could loosen them. If necessary, expand or compress plug connections.

To prevent entry of water and corrosion, generally apply Lithium grease on all plug- and screw connections, with the exception of the protection caps at ignition damping box secured by SILASTIC 732.

Ensure tight fit of ignition cable in electronic box. If threaded prong in electronic box does not warrant adequate grip secure with LOCTITE 380.

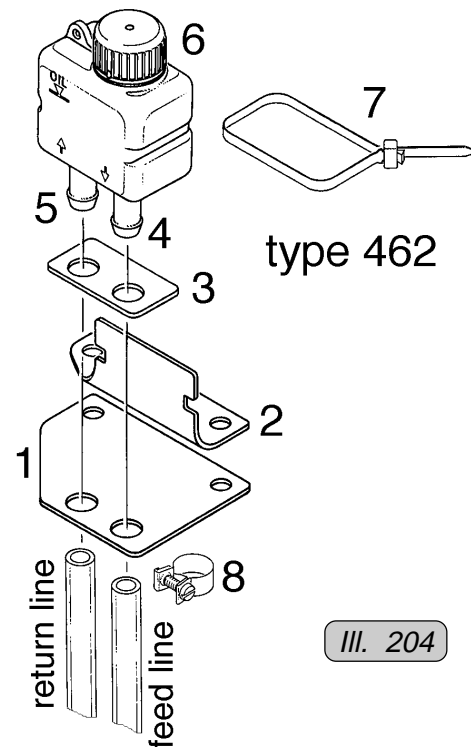
## 8.14) Installation of the oil tank:

(for lubrication of the rotary valve drive, n o t for engine lubrication by oil injection)

After fitting of supporting plate assembly and proper laying of cables, the oil tank ④ can be attached.

### Type 462 UL

With supporting plate ① and support link ② fitted already, place rubber pad ③ and oil tank ⑥ on supporting plate. Afterwards fit oil hoses for supply on connection ④, and for oil return on connection ⑤ with clamps ⑧. Secure oil container by cable strap 100 mm ⑦ against loss.



### Type 532 UL and 582 UL

Connection of oil hoses by clamp, in same fashion as on type 462 UL. Place rubber pad between attachment face of support plate and oil tank. Finally, secure all items by cable strap 100 mm ⑦ against loss.

■ **ATTENTION:** Stated locations of oil tank are valid only with engine in upright position, spark plugs on top. For other installations, oil tank location has to be determined by the aircraft manufacturer.

Fill the oil system to approx. half way up the tank with SUPER two-stroke oil of API - TC classification. For quantity see chapter "Operating fluids".

■ **ATTENTION:** Pay attention to notes in Chapter "Oil circuit for rotary valve and waterpump drive" regarding installation, venting, maintenance etc.

## 8.15) Installation of propeller reduction gear:

Installation of the different types of reduction gear as dealt with in Chapter "Propeller reduction gears".

## 8.16) Fitting of the exhaust manifold:

Fit exhaust manifold with 6 Allen screws M8 x 30 along with lockwashers and 2 gaskets.

◆ **NOTE:** On Type 462 UL, only 4 Allen screws M8 x 25 are used. Tightening torque 22 Nm (195 in.lb).

■ **ATTENTION:** Pay attention to notes in Chapter "Exhaust system" regarding installation, maintenance etc. of exhaust system.

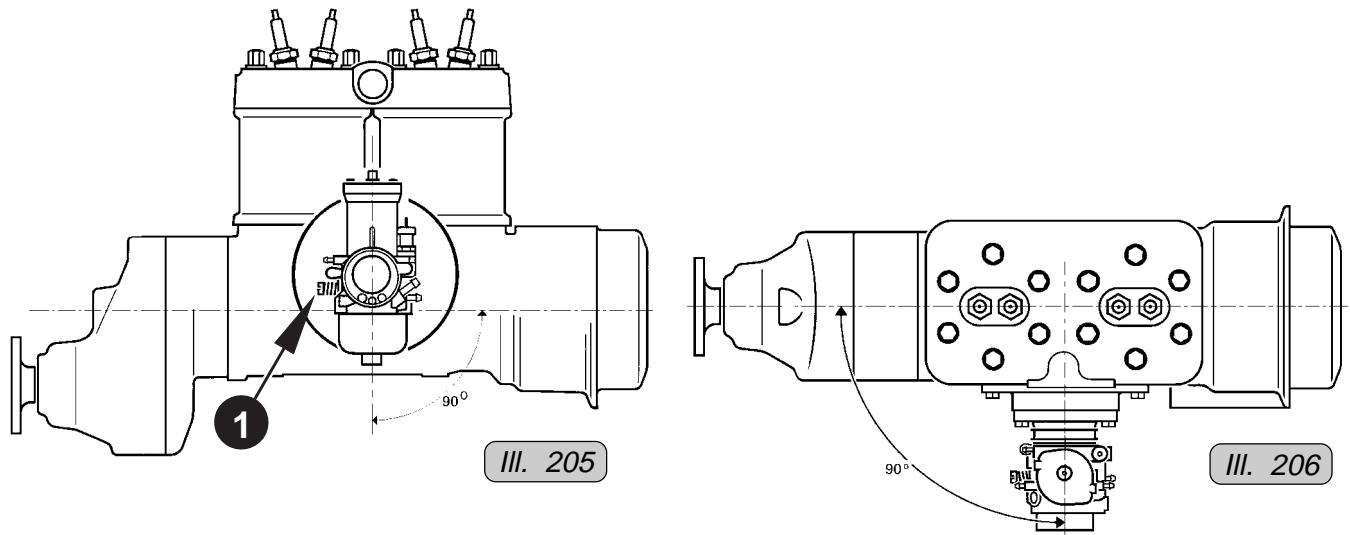


## 8.17) Fitting of the carburetors:

Each carburetor is connected to engine by means of a carb adapter. The carb adapter is attached to engine with 2 each screws M8 x 20 and washers. Secure screws with LOCTITE 221 and tighten to 14 Nm (124 in.lb.).

Exclusively on type 582 with oil injection lubrication, the carb adapters are fitted by clamps.

Each carburetor has to be positioned at right angle to the crankshaft in both views, from top as well as from intake side, to warrant equal mixture distribution to the cylinders.



Fit Bowden cable for carburetor and for oil injection pump, if installed. Ensure that throttle cable and linkage do not stick and carb piston can be opened and closed fully. The minimum opening is controlled by idle adjustment screw ❶. Minor adjustment can be made at Bowden cable.

■ **ATTENTION:** Bowden cable actuation must not be affected by any movement of engine or fuselage, because this could falsify throttle position.

Special operating conditions such as severe climate or altitude changes might require different carb calibration. Consult chapter "Carburetor" or contact your next authorized ROTAX-dealer or Service Centre.

### 8.17.1) Carburetor air intake:

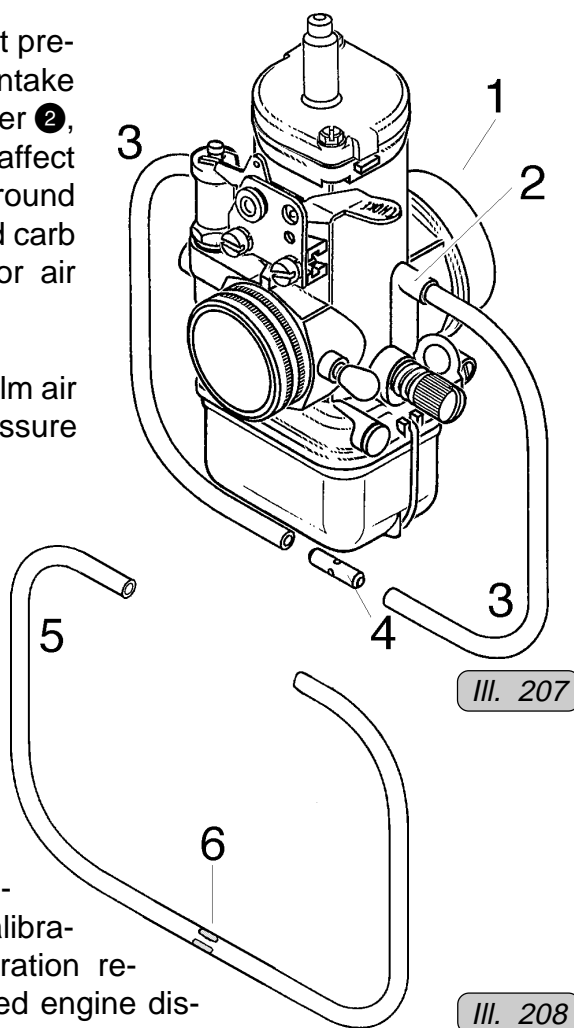
Air intake must be protected against ingestion of water, dirt and foreign matter. Avoid any filter material tending to absorb water or to swell (see chapter "Air filter").

The same pressure condition must prevail in the vicinity of carburetor air intake ❶ and venting tube of float chamber ❷, i. e. propeller air stream must not affect air flow- and pressure condition around carb air intake. If necessary, shield carb intake by a sheet metal shield or air intake box.

Route both venting lines ❸ to a calm air zone ❶ and join them with a pressure compensating tube ❹.

On newer engine models, carbs are provided with one single venting tube ❺ furnished with 2 pressure compensating holes ❻ thus eliminating the need of a compensating tube ❹.

Engines delivered with intake silencer must not be operated without it. Operation without intake silencer needs correction of carb calibration. Change of carburetor calibration requires written request to authorized engine distributor or engine manufacturer (ROTAX). Consult spare parts list for proper carb calibration.



## 9) Trouble shooting:

Basically, troublefree operation of a ROTAX engine requires an ignition spark at the right moment and ignitable fuel/air mixture.

The majority of all engine troubles is caused by shortcoming in one of the two systems.

### Fault-tracing schedule

### Possible fault

Open the fuel cock

Does fuel reach the carburetor?

yes  
↓

no ⇒

1. Fuel tank empty
2. Vent hole in tank blocked
3. Blockage in fuel cock
4. Blockage in fuel line
5. Float valve blocked
6. Inadequate supply of fuel pump

Does fuel reach the engine?

yes  
↓

no ⇒

Blockage in carburetor

Does the carburetor keep flooding

no  
↓

yes ⇒

1. Float stuck
2. Float leaks
3. Float valve does not seal properly, or dirt on valve

Is the spark plug wet with fuel?

no  
↓

yes ⇒

1. Too much use of choke, too long starting periods
2. Faulty ignition system
3. Incorrect fuel mixture
4. Wrongly connected ignition damping box (only 462 and 532 UL)
5. Dirty contact breaker (only 462 and 532 UL)

Any spark at the spark plug ?

yes  
↓

no ⇒

1. Poor contact of ignition cable in ignition coil
2. Ignition cable interrupted or shorted
3. Faulty ignition coils
4. Electrode gap too large
5. Bridging between electrodes
6. Insulator broken or wet with fuel
7. Spark plugs fouled
8. Defective spark plug connector

Is the engine hard to start?

no  
↓

yes ⇒

1. Wrong ignition timing
2. Float valve does not seal properly
3. Air filter clogged
4. Faulty carburetor
5. Defective spark plug
6. Loss of compression due to defective gasket
7. Too much clearance of rotary valve or incorrect rotary valve and / or valve timing.

Does the engine run well at idle speed?

yes  
↓

no ⇒

1. Bad idle adjustment
2. Wrong ignition timing
3. Faulty spark plugs
4. Wrong position of flywheel on crankshaft due to a sheared-off Woodruff key
5. Blocked idle jet

Does the engine reach nominal r.p.m.?

yes  
↓

no ⇒

1. Incorrect gear reduction ratio
2. Poor propeller matching (see Service Information 2 UL 89-E)
3. Insufficient pretension of spring pack in reduction gearbox (A + B type gearbox)

Is the engine running well at high speed?

yes  
↓

no ⇒

1. Engine "four-stroking"
  - a) Clogged airfilter element
  - b) Worn needle jet
  - c) Carb jets too large
  - d) Mixture too rich
  - e) Wrong ignition timing
  - f) Exhaust port or exhaust pipe blocked by deposits
  - g) Needle position too high
  - h) Choke activated
  - i) Float stuck or faulty

- no ⇒
2. Backfiring through carb
    - a) Fuel filter clogged
    - b) Dirt in carb
    - c) Dirt in float valve
    - d) Loose fitting of carburetor
    - e) Needle position too low
    - f) Wrong ignition timing
    - g) Loosely fitted spark plugs
    - h) Incorrect electrode gap
    - i) Wrong heat range of spark plugs
    - j) Badly connected or poorly insulated ignition cables
    - k) Sticking piston rings
    - l) Worn oilseals
    - m) Additional air intake due to loose fittings or leaks
    - n) Faulty fuel pump

- no ⇒
3. Prevailing pinking of engine
    - a) Wrong ignition timing
    - b) Insufficient fuel supply
    - c) Heavy carbon deposits in combustion chamber causing pre-ignition
    - d) Octane rating of gasoline too low

Excessive mechanical noise emission?

no  
↓

yes ⇒

1. Piston pin clearance too big
2. Wear at conrod big end bearing or cylinder bore
3. Piston skirt wear, piston tilting

Excessive engine vibration?

yes ⇒

1. Unbalance of propeller
2. Engine suspension damaged or loose
3. Loose flywheel
4. Worn or damaged bearings

REMEMBER TO WORK IN METHODICAL SEQUENCE WHEN TRACING FAULTS !

## 10) Extract from an article about power plants of UL aircraft by an expert:

(author: Mr. Nigel Beale, Cyclone Hovercraft, England)

Many engine installations and fuel systems are less than perfect, but aircraft manufacturers are rapidly improving in this respect. Owners should be aware, however, of any shortcomings of the installation on their aircraft, and be prepared to improve their maintenance and inspection procedures accordingly.

The most common problem is a loss of power or even complete failure when operating at full throttle. During take-off and initial climb out, the time when an engine failure is potentially very dangerous, the engine is operating under its most severe conditions, with high thermal and mechanical stresses, and demanding fuel at about three times the rate needed for a gentle cruise. It is not surprising therefore that most failures occur during this phase of flight.

In our experience it is very rare for such a failure to be due to a fault in the engine itself, but there are many other causes, generally due to failure to adequately maintain the engine and its systems, poor installation, weather conditions, incorrect fuel, oil or spark plugs, etc.

We will try to go through some of the problems we have found, and their solutions, but please do not think this is a complete list - we are learning all the time.

### 10.1) Carburetor icing:

Carburetor icing has always been a problem with aircraft engines. It can of course occur on a ROTAX engine given the right atmospheric conditions, but it is not as common as many people suggest - in our experience many of the failures blamed on carburetor icing have been due to other causes.

If you have an engine failure, you must find the cause before flying again. Do not assume it's carb icing and try again another day. If you have had an engine problem you suspect is carburetor icing, then immediately run the aircraft on the ground, after securely tying it to the nearest tree. Run it up to try to reproduce the failure using the hand throttle to hold the power steady.

If the engine problem returns, immediately switch off the ignition without closing the throttle, as soon as the propeller stops turning, quickly remove the intake silencer or air filter and inspect the carburetor throat for a build-up of ice.

If there is none or only a thin film, then the problem could lie elsewhere and must be traced. Some atmospheric conditions will produce icing to a small extent, but not enough to cause noticeable problems. However, a small amount of ice in the carburetor throat will melt when the engine is stopped and could subsequently trickle down into the float chamber, blocking the main jet and causing a complete engine failure on your next flight.

So, if you suspect marginal icing, frequently check the float chamber for water droplets - it only takes a few seconds, as the float chamber is only held on with a clip.

Carburetor icing is obviously more likely in winter when cold, damp weather is frequent. The problem is compounded by the fact that the fuel companies increase the volatility of petrol in winter, unseen and unannounced.

Some heating systems are available which should reduce the possibility of icing. They generally fall into two groups: those that heat the air going into the engine, and those that heat the body of the carburetor.

Heating the air is only effective under all conditions if the increase in temperature is very great, which in itself will produce considerable loss in power.

Heating the intake air a few degrees will not significantly reduce the power, but is unlikely to be effective in all conditions. Systems which heat the body of the carburetor will not prevent ice from forming in the air stream, but should prevent it from sticking to the carburetor walls, provided that the carburetor body temperature is kept above freezing point. In Great Britain many hundreds of carb body heaters are in Service, using either electric power from the generator, or more recently hot coolant (liquid cooled engines). Such systems have been proved very effective in combating carb icing. (See also Service Information 4 UL 94-D).

## 10.2) Fuel systems:

Fuel supply problems probably account for the majority of microlight engine failures. A complete, or near complete, blockage of the fuel system will cause the engine to stop very quickly, though normally without damage to the engine. Any fault that severely reduces the supply of fuel to the carburetor will cause a gradual decrease in the level of fuel in the float chamber when the engine is run on full throttle. This in turn will cause the engine to run leaner and leaner, and hotter and hotter, possibly causing a seizure or a holed piston before the engine finally stops.

All fuel systems on permit aircraft have been shown to be able to supply at least 125 % of the maximum fuel required by the engine, and if properly maintained, should continue to do so.

If you have a full throttle failure, stick to the following sequence and you should find the problem, if it is a fuel system fault.

### 10.2.1) Check the spark plug(s):

Ideally the electrodes should be a “milk chocolate” brown colour. If one or both plugs is whitish in colour, a lean mixture is indicated and further investigation is required. Plugs with burned electrodes, characterized by tiny “melt” droplets, indicate serious overheating. Immediate counter-measures are necessary! If the 2 plugs of a twin cylinder engine are substantially different in colour, a mixture distribution or local overheating problem is indicated. An engine failure due to a sudden fuel blockage is unlikely to change the normal colour of the plugs.

### **10.2.2) Check engine for seizure:**

A seized engine will frequently free itself instantly and can be started again immediately, but a smear of aluminium from the piston will most probably be left on the cylinder bore, and this could cause a further seizure whenever the engine is run under heavy load, even if the cause of the original seizure (for example, fuel starvation) has been cured.

To check for a seizure, switch off ignition and remove spark plugs. Remove the exhaust manifold and inspect the pistons and cylinder through the exhaust ports as you slowly turn the engine.

Any scuff marks on the pistons or bores indicate a seizure, and the top end must be dismantled. The seize marks on the pistons must be carefully cleaned off with emery cloth, the rings checked for damage and sticking, and the cylinder bores must have every trace of aluminium removed by scraping and then with emery cloth. It is sometimes difficult to see the aluminium, but it is important to completely remove it. If the damage is more than superficial, the piston should be replaced, and the cylinder rebored.

### **10.2.3) Inspection of the fuel system:**

Check the fuel tank vent; it must be clear, or the engine will gradually starve. Check the fuel tank itself - does the pick-up pipe in the tank have a strainer (mesh filter)? This is a fairly essential requirement, but many microlights still do not have one. If you cannot see for yourself - ask the aircraft manufacturer.

If there is no strainer, then you must thoroughly clean out the fuel tank, and always in future only fill through a filter funnel, taking the utmost care that no foreign matter enters the tank. A pick-up pipe without strainer can so easily be completely blocked by a single blade of grass in the fuel, or a flake of paint as so commonly appears from a jerrycan.

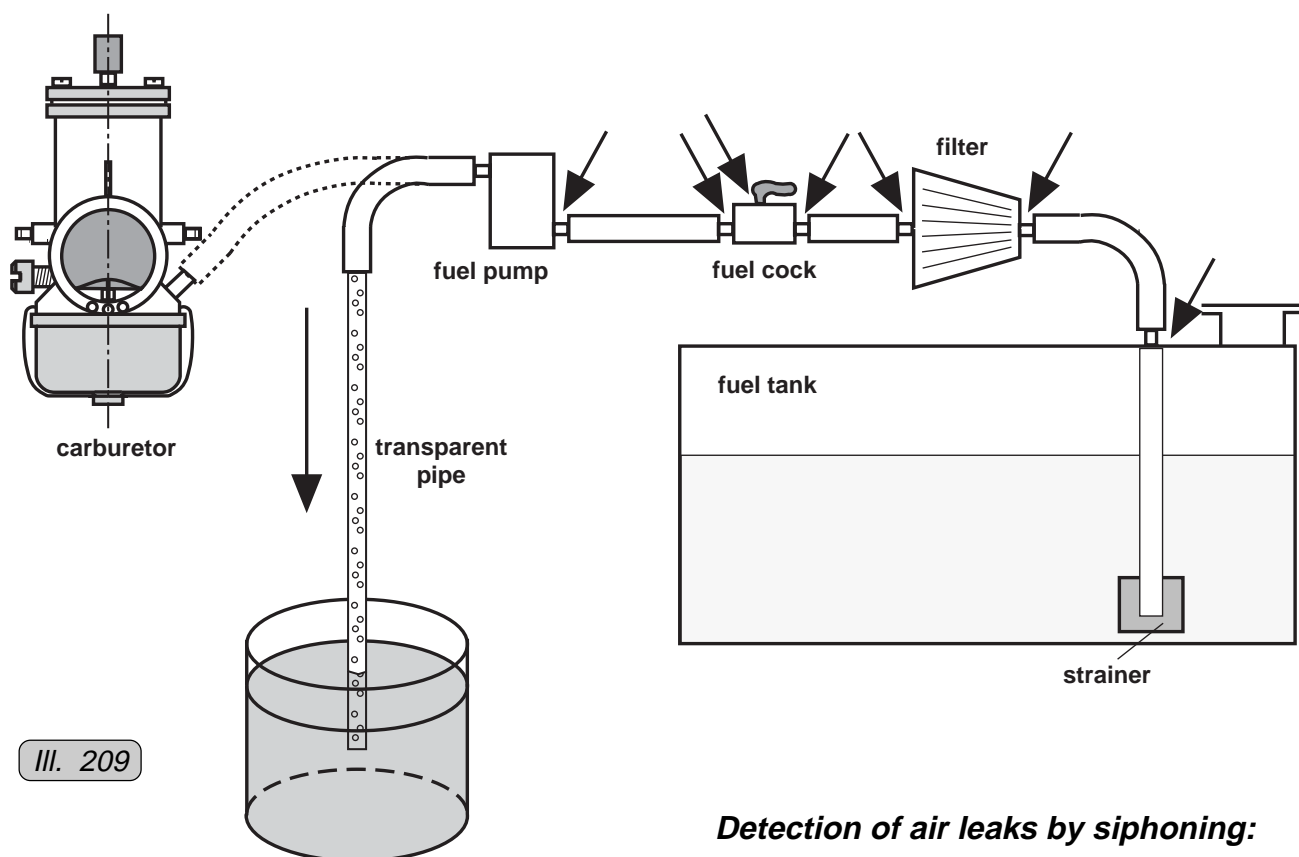
The offending blockage, having been sucked onto the tank outlet and stopped the engine dead, can, with the suction gone, float innocently back into the volume of the tank to cause the same problem again, maybe months later. Such a problem is almost impossible to trace afterwards - so don't let it happen to you, clean the tank and keep it clean.

### **10.2.4) Examination of fuel line between tank and fuel pump:**

This section of pipe is under considerable negative pressure when the engine is running hard, and the tiniest flaw in any joint will cause air to be sucked into the system, considerably reducing the capacity of the fuel pump. Air leaks are much more dangerous when the fuel tank is mounted below the fuel pump and carburetor.

Air leaks are obviously impossible to see, but the following checks will show whether they exist.





### ***Detection of air leaks by siphoning:***

Referring to Ill. 199, disconnect the fuel line from the carburetor and connect a length of transparent fuel pipe, making sure the connection is absolutely airtight. Take the transparent pipe down to ground level and start siphoning fuel from a tank to a container on the ground. All parts of the fuel system above the level in the tank will be below atmospheric pressure, and any air leaks in the system will show up as bubbles in the transparent pipe. Continue siphoning for a considerable period of time.

After an initial settling period there should be no bubbles in the fuel. If bubbles persist, find the location of the air leak(s) by process of elimination.

Another way of checking for air leaks is to replace the last portion of fuel line before the carburetor with a transparent piece. Ground run the engine and look for bubbles in the line - there should be virtually none after a few minutes settling down.

#### **◆ NOTE:**

Filter and fuel tap are shown on suction side of pump to illustrate air leakage sites possible. Though, it is recommended that these be installed on the pressure side of the pump.

### 10.2.5) Elimination of air leaks in the fuel line:

If air leaks are indicated, seek to eliminate them. The arrows on the diagram show possible air leakage points. Some commercial clips are often not very satisfactory on small pipes, as they tend to tighten up oval, creating a possible leak. "Crimp on" clips can be unsatisfactory if incorrectly applied, and are difficult to remove for servicing.

Replace all doubtful fuel line clips with good quality approved ones. Quick release type connectors can cause air leaks, and also produce flow restrictions and possible blockage sites - likewise fuel tap connections and glands. If the fuel tank is below the engine, it is best to leave the fuel tap turned on all the time - use it only in an emergency.

All connections on the suction side of the fuel pump are potential air leakage sites; the less there are, the less problems are likely to arise. It is far more satisfactory if the fuel tap and filter are fitted between the fuel pump and the carburetor, on the pressure side. On installations where this is not the case, extra care must be taken to eliminate air leaks.

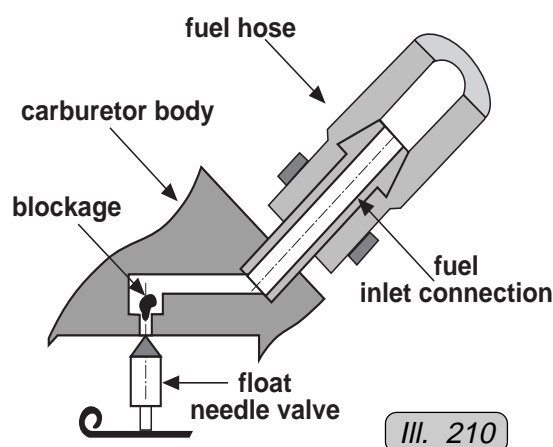
A useful way of checking the fuel system between tank and carburetor is to fit a pressure gauge in the fuel line just before the carburetor. At full throttle the pressure should be 0,2 - 0,5 bar (2.9 to 7.2 lb/in<sup>2</sup>). A pressure gauge and fitting kit is now available from Rotax and may be permanently fitted to the aircraft, or used as a fault finding tool.

A pressure lower than 0,2 bar indicates a serious problem. We have never found a faulty pump, so always look elsewhere first.

### 10.2.6) Fuel supply to float chamber:

The most likely place for a blockage is just inside the carb, between inlet nipple and float valve. This is shown on illustration, and it can be seen that, of necessity, there is a flow restriction just before the needle valve.

Fuel reaching this place should have been thoroughly filtered, but on a few occasions we found a blockage here, caused by a sliver of rubber, sliced off the fuel pipe when it was pushed carelessly onto the carburetor connection. Such a blockage can be intermittent, as the particle moves about, and can be disastrous. The blockage can only be cleared by blowing out backwards.



Preferably, put the fuel inlet connection into a transparent polythene bag, in order to catch any offending slivers of rubber and confirm the cause of the trouble. When refitting the fuel pipe onto the carburetor, take extra care not to create the problem again.

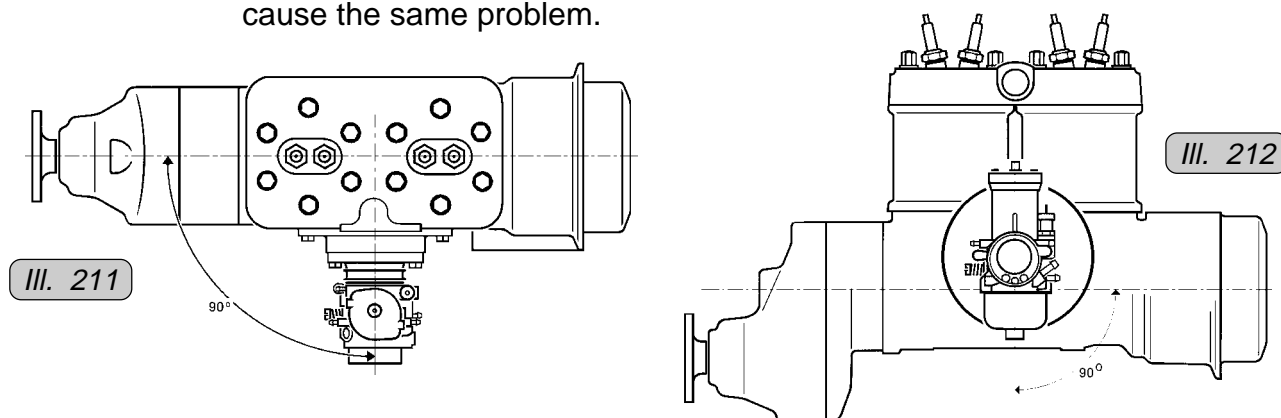
### 10.2.7) Float chamber and main jet:

The final place to inspect is the float chamber and main jet. Check float chamber for debris and water. Check sieve sleeve for damage and main jet for free passage.

Never fit a larger main jet to try to cure a full throttle fuel starvation problem; if there is a restriction in the fuel supply system, a larger main jet will do no good at all. The main jet should only be changed from that supplied with the engine, if an air intake silencer is substituted for an air filter or vice versa or when operating in extremes of temperature or altitude. Prior to any intended change of main jet, contact an authorized ROTAX dealer.

### 10.2.8) Problems related to fuel supply:

A full throttle power loss which occurs in the air, but cannot be repeated by ground running, may be due to frothing in the float chamber caused by vibration. Such a condition should not arise on a production aircraft which has been thoroughly tested, as the most likely solution would be to change the anti-vibration mountings of the engine. A badly unbalanced propeller can also cause the same problem.



With twin-cylinder engine it is important that the carburetor is mounted exactly square to the engine, both in vertical and horizontal view, as shown on illustrations.

Any deviation will cause a slight change in mixture distribution between the cylinders which could cause one cylinder to run lean, and overheat. Check that the brackets which support the intake silencer do not twist the carburetor out of square.

It is also important that the body of the intake silencer itself is parallel with the engine crankshaft. Ideally the intake silencer should have its weight supported by brackets, but if this is not the case, it is very important to frequently check the rubber adaptor between the carburetor and the intake manifold for any signs of splits, and for security of the clamps, as this adaptor will be carrying the full weight of the intake silencer as well as the carburetor.

Any air leak here will produce a lean mixture, with consequent overheating. Air leaks can also occur between the inlet manifold, rotary valve cover, cylinder and crankcase. The reason is in most cases an incorrectly fitted gasket.

### 10.2.9) Various effects on formation of the air/fuel mixture:

The pressure in the carburetor float chamber has a considerable effect on the air/fuel ratio supplied to the engine. If the float chamber is below atmospheric pressure, then the engine will run lean.

The pressure in the float chamber depends on the pressure at the end of the two plastic vent pipes from the carburetor. If they are both routed to the back of the carburetor, as is fairly common, then the depression in this area, caused by air flow, will weaken the mixture. The effect may not be significant in itself, but if coupled with another problem, say a carburetor considerably out of square, then overheating could occur.

Always make sure you use a suitable fuel. Some regular fuels may have just enough octane rating, but due to the permissible refining tolerances may in practice be below the recommended rating.

A fuel of too low a rating can lead to detonation or "pinking", a metallic tinkling sound. The likelihood of detonation is increased if the mixture is lean or if there is overheating due to other causes. Detonation can very quickly cause an engine to seize, or burn a hole through a piston. We recommend, therefore, that premium petrol is used at all times, to be on the safe side.

Unleaded fuels are becoming much more common and in general will lead to a cleaner engine, but in some countries may contain a high percentage of alcohol (more than 10 %), in order to maintain the octane rating. This can create a number of problems. The higher latent heat of alcohol can increase the risk of carburetor icing. Alcohol can absorb water, which may separate out, leading to blocked carburetor jets. Unleaded fuels are more prone to vapour lock at high altitude.

Alcohol can also adversely affect some plastic and rubber components used in fuel systems - it can extract the plasticiser from plastic fuel tanks, which will then harden and may crack, while the residue can turn gummy and block the fuel system. High quality unleaded fuels can reduce deposit formation and extend spark plug life, but make sure there is not a high alcohol content before using.

With any fuel, if you are not going to use your aircraft for a long period of time (say more than a month) then you should drain off all the fuel, including that in the float chamber, to avoid the problems mentioned above, and the evaporation of the light fractions of the fuel. Evaporation makes starting difficult, and increases the percentage of oil in the remaining fuel.

The oil used in your ROTAX should be a good quality two-stroke oil (API - TC classification, e. g. CASTROL TTS fully synthetic oil is strongly recommended) mixed at 50/1 (2 %). Too much oil can cause plug fouling, excessive carbon build-up, and sticking piston rings, and will reduce the octane rating of the fuel.

### 10.3) Ignition problems:

An engine failure at full throttle can also be caused by an ignition fault, or a combination of fuel and ignition faults. Firstly, check that the spark plugs are of the correct type. A “hotter” spark plug can cause pre-ignition, which is a recipe for a hole in the piston. A “colder” plug may oil up under cruise and idling conditions.

The contact breaker gap, ignition timing and pole shoe breakaway gap must be as specified in the ROTAX Operator’s Manual. Contact breaker points which have been set too wide will advance the ignition timing, which can result in overheating and possible detonation. Always check and, if necessary, adjust the ignition timing after adjusting the points.

If the ignition damping box is defective, there is a risk of pre-ignition. The damping box can be checked by exchanging the connections. There should then be no spark at either cylinder.

Excessive carbon build-up on spark plugs and on pistons and cylinder head, can cause pre-ignition and holed pistons. Spark plugs should be checked, cleaned and, if necessary, replaced regularly. Part throttle- and high altitude flying will carb up an engine more quickly than low altitude-, high power operation.

Carbon build-up in the combustion chamber can, as well as causing pre-ignition, be responsible for occasional misfiring, as particles of carbon break free and bridge the spark plug electrodes. Decarbonising at around 50 hours should prevent such problems.

### 10.4) Propeller matching:

The propeller should be selected to give the rated full power RPM at full throttle in a normal climb. This requirement is becoming more difficult to achieve as ultralight aircraft design speeds increase, but should be adhered to as far as possible. Underpropping (higher matching RPM) leads to lean mixtures, higher temperatures and the possibility of engine seizure. Overpropping (lower matching RPM) leads to power loss, unstable operation and rich mixture.

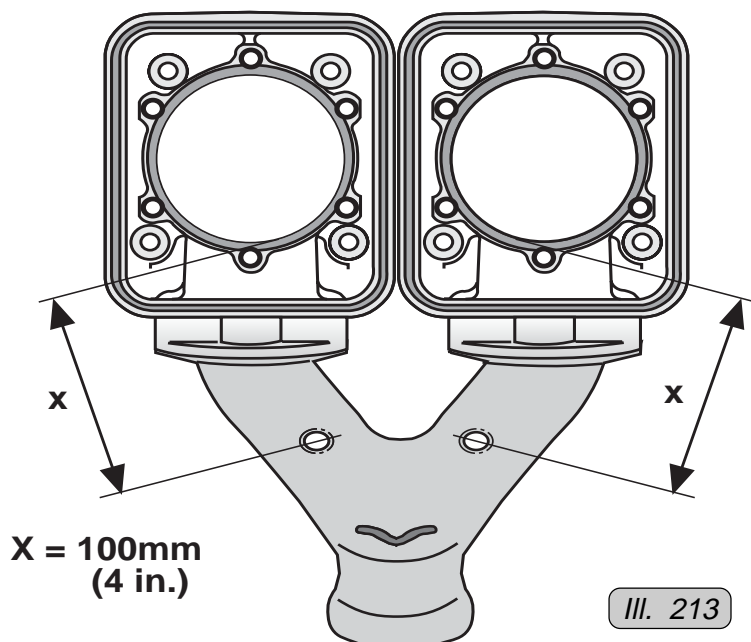
## 10.5) Prevention is better than cure:

Full throttle engine failures can be prevented by better maintenance and a more thorough understanding of the contributory factors. But some problems are impossible to foresee, which is where monitoring engine temperatures becomes very useful, because many failures are preceded by overheating. Exhaust gas temperature will give the most rapid response in the event of weak mixture, pre-ignition or detonation. Ideally the exhaust temperature should be measured about 100 mm (4 in.) from the

piston, with separate sensors for each cylinder of a twin.

A single sensor in the Y-junction is not effective. The exhaust temperature under full-throttle conditions should never exceed 650° C (1200° F). The difference between each cylinder on a twin should not exceed 20° C (36° F).

Cylinder head temperature, measured with a thermocouple under the spark plug seat, is also a useful indication for air-cooled engines (max. temperature 250° C / 480° F), though much less effective with water cooling (max. temperature 150° C / 300° F). Again any difference between cylinders of more than 20° C (36° F) needs investigating.



*recommended position of exhaust sensors*

With water-cooled engines the maximum water temperature is 80° C (180° F), although normal running temperature should be between 60° - 75° C (140 - 170° F).

There are reasons for engine failure other than those mentioned here, but in my experience they are not common.

## 11) Epilogue:

This manual has been prepared as guidance in conjunction with the Operator's Manual and Spare Parts List for maintenance and repair. In case of questions or doubts, please, contact your local dealer or ROTAX, Austria.

## 12) Maintenance plan

	Checks and work	2 h	10 h	12,5 h	25 h	50 h	75 h	100 h	125 h	150 h	175 h	200 h	225 h	250 h	275 h	300 h
1	Retorque exhaust manifold screws 1)	x														
2	Check rewind starter rope 11)			x												
3	Check electric starter gear				x		x	x	x	x	x	x	x	x		
4	Inspect spark plugs 11)			x												
5	Replace spark plugs				x	x	x	x	x	x	x	x	x	x	x	
6	Check and clean inside spark plug caps 11)			x												
7	Check ignition timing (only breaker ignition)		x 2)				x						x			
8	Check contact breaker gap		x 2)				x						x			
9	Check igniton damping box						x			x			x			
10	Replace contact breakers and condensor									x						
11	Lubricate ball joints				x	x	x	x	x	x	x	x	x	x	x	
12	Replace exhaust muffler springs						x			x			x			
13	Oil control cables				x	x	x	x	x	x	x	x	x	x	x	
14	Check propeller balance and tracking 3)				x	x	x	x	x	x	x	x	x	x	x	
15	Inspect propeller mounting bolts 4)															
16	Clean and oil air filter				x	x	x	x	x	x	x	x	x	x	x	
17	Check fuel filter				x	x	x		x	x	x		x	x	x	
18	Replace fuel filter							x								
19	Check carburetor(s) and re-adjust (idle speed, cable tension, ...)	x			x		x		x		x		x		x	
20	Clean carburetor(s) and check for wear					x		x	x		x		x			
21	Replace jet needle and needle jet								x							
22	Clean and check fuel pump						x		x				x			
23	Check gearbox oil level				x	x	x		x	x	x		x	x	x	
24	Replace gearbox oil		x					x				x				
25	Check and adjust gearbox, preload of washers (type A + B gearboxes)							x				x				
26	Check gearbox backplate screws (type A)							x				x				
27	Replace rotary valve lubrication oil							x								
28	Inspect cylinder head and piston crown 5)					x		x		x		x		x		
29	Inspect piston ring grooves 6)					x		x		x		x		x		
30	Check piston diameter 8)					x 7)		x 7)		x		x 7)		x		
31	Piston ring: check gap 8)					x 7)		x 7)		x		x 7)		x		
32	Piston ring: check axial play (rectang. ring) 8)					x 7)		x 7)		x		x 7)		x		
33	Check cylinder diameter 8)					x 7)		x 7)		x		x 7)		x		
34	Cylinder: check for roundness 8)					x 7)		x 7)		x		x 7)		x		
35	Replace cylinder head-, cylinder base- and exhaust-gasket 9)					x 7)		x 7)		x		x 7)		x		
36	Inspect piston pin and bearing									x						
37	Inspect crankshaft and replace outer seals									x						
38	General overhaul of engine 10)															x
	Checks and work	2 h	10 h	12,5 h	25 h	50 h	75 h	100 h	125 h	150 h	175 h	200 h	225 h	250 h	275 h	300 h

1) and at each change of the gaskets

2) and after every change of breaker contacts

3) and after damage

4) consider specifications of manufacturer

5) remove carbon deposits if thicker than 0,5 mm

6) clean or renew sticking piston rings

7) at deployment in badly contaminated, dusty areas

8) see table of wear limits

9) at exchange of cylinder

10) contact Rotax Distributor or Service Centre

### ■ ATTENTION

Basically all bearings and gaskets and the crankshaft is renewed at a general overhaul. All other parts which are subject to wear and 60 % of the wear limit is reached have to be renewed too.

### 11) ■ ATTENTION

to be examined after **every** 12,5 hours of operation.

III. 214



### 13) Essential tightening torques for engine types 462 - 532 - 582 UL:

Designation	thread	Nm	in. lbs
1) Crankcase screws .....	M 8 .....	24	210
2) Crankcase screws .....	M 6 .....	10	90
3) Crankcase nuts .....	M 10 .....	38	335
4) Engine base studs .....	M 10 .....	12	105
5) Cylinder hex. collar screws (not on 462) .....	M 8 .....	24	210
6) Cylinder head studs .....	M 8 .....	7	60
7) Cylinder head nuts .....	M 8 .....	22	195
8) Magneto flywheel nut .....	M 22x1,5 .....	90	800
9) Allen screws for starting pulley .....	M 8 .....	22	195
10) Hex. screws for rewind starter .....	M 6 .....	10	90
11) Screws for rotary valve cover .....	M 8 .....	22	195
12) Screws for rubber flange on intake .....	M 8 .....	14	125
13) Spark plugs (on cold engine) .....	M 14 .....	27	240
14) Cheese hd. screws for stator plate .....	M 5 .....	6	55
15) Hex. screws for starter gear .....	M 8 .....	22	195
16) Studs for water outlet socket .....	M 6 .....	3	25
17) Hex. nuts for water outlet socket .....	M 6 .....	10	90
18) Lock nut for water pump impeller .....	M 6 .....	7	60
19) Taptite screws .....	M 6 .....	8	70
20) Exhaust bolts .....	M 8 .....	22	195

#### Additional on type 582 UL:

1) Lock nut for oil pump gear .....	M 6 .....	7	60
2) Banjo bolt for oil pump .....	M 6 .....	8	70
3) Cheese hd. screw for oil pump .....	M 5 .....	5	45
4) Taptite screw for pick-ups .....	M 5 .....	6	55
5) Lock screw for ignition coil .....	M 6 .....	8	70
6) Hex. screw for supporting plate .....	M 6 .....	5	45



### Reduction gear "A"

	thread	Nm	in. lbs
1) Allen screw on adaptor flange .....	M 10 .....	55 .....	482
2) Studs.....	M 8 .....	8 .....	70
3) Hex. screw for drive gear .....	1/2"-20 UNF .....	60 .....	530
4) Hex. nuts.....	M 8 .....	22 .....	195

### Reduction gear "B"

1) Hex. collar screws.....	M 8 .....	24 .....	210
2) Hex. screw for drive gear .....	1/2"-20 UNF .....	60 .....	530
3) Hex. screws .....	M 8 .....	24 .....	210

### Reduction gear "C"

1) Hex. collar screws.....	M 8 .....	24 .....	210
2) Hex. screw for drive gear .....	1/2"-20 UNF .....	60 .....	530
3) Allen screws.....	M 6 .....	10 .....	90
4) Allen screw for drive gear .....	M 8 .....	24 .....	210
5) Allen screws for coupling flange .....	M 10 .....	40 .....	350
6) Hex. nut on prop shaft .....	M30x1,5 LH .....	300 ...	2650

SPECIFICATIONS ARE SUBJECT TO CHANGES WITHOUT NOTICE !

## 14) Table of wear limits:

Designation	dimens. new		mm	(in.)	wear limit mm (in.)	
<b>Crankcase</b>						
Bearing seat in crankcase, 72 mm	71,94	÷	71,958	(2,832 ÷ 2,833)	71,96	(2,833)
Bearing seat in crankcase, 62 mm	61,94	÷	61,958	(2,438 ÷ 2,439)	61,96	(2,439)
Ball bearing 6206	61,987	÷	62,000	(2,440 ÷ 2,441)	61,987	(2,440)
Ball bearing 6207	71,987	÷	72,000	(2,834 ÷ 2,835)	71,987	(2,834)
Interference of press fit	0,029	÷	0,06	(0,001 ÷ 0,002)		
<b>Crankshaft</b>						
Conrod, big end	30,014	÷	30,023	(1,1810 ÷ 1,1820)	30,03	(1,182)
Crank pin	23,994	÷	23,997	(0,9446 ÷ 0,9448)	23,99	(0,944)
Radial clearance, type 462+582	0,020	÷	0,033	(0,0008 ÷ 0,0013)	0,05	(0,002)
Radial clearance, type 532	0,038	÷	0,050	(0,0015 ÷ 0,0019)	0,07	(0,003)
Axial clearance	0,400	÷	0,727	(0,0200 ÷ 0,0300)	1,00	(0,400)
Conrod, small end	21,997	÷	22,005	(0,8660 ÷ 0,8660)	22,01	(0,867)
Piston pin	17,997	÷	18,000	(0,7080 ÷ 0,7090)	17,97	(0,707)
Radial clearance, piston pin	0,003	÷	0,012	(0,0001 ÷ 0,0005)	0,03	(0,001)
Crankshaft Ø, P.T.O. side	35,003	÷	35,013	(1,3780 ÷ 1,3790)	35,00	(1,378)
Ball bearing Ø, P.T.O., 6201	34,988	÷	35,000	(1,3770 ÷ 1,3780)	35,00	(1,378)
Bearing clearance	0,015	÷	0,033	(0,0006 ÷ 0,0013)	0,05	(,002)
Crankshaft Ø, magneto side	30,003	÷	30,013	(1,1810 ÷ 1,1820)	30,00	(1,181)
Ball bearing Ø, magneto side, 6206	29,990	÷	30,000	(1,1810 ÷ 1,1810)	30,00	(1,181)
Bearing clearance	0,023	÷	0,041	(0,0010 ÷ 0,0016)	0,06	(0,002)
<b>Rotary valve</b>						
Rotary valve clearance (valve in crankcase)	0,250	÷	0,350	(0,010 ÷ 0,014)	0,45	(0,177)
Backlash (rotary valve drive)	0,084	÷	0,164	(0,003 ÷ 0,006)	0,40	(0,016)
<b>Cylinder Type 462 UL</b>						
Cylinder (standard, red)	69,50	÷	69,51	(2,7362 ÷ 2,7366)	69,60	(2,740)
Cylinder (standard, green)	69,51	÷	69,52	(2,7366 ÷ 2,7370)	69,60	(2,740)
Cylinder (1 <sup>st</sup> oversize, red)	69,75	÷	69,76	(2,7460 ÷ 2,7464)	69,85	(2,750)
Cylinder (1 <sup>st</sup> oversize, green)	69,76	÷	69,77	(2,7465 ÷ 2,7469)	69,85	(2,750)
<b>Cylinder Type 532 UL</b>						
(standard, red)	72,00	÷	72,01	(2,8350 ÷ 2,8360)	72,10	(2,8385)
Cylinder (standard, green)	72,01	÷	72,02	(2,8350 ÷ 2,8354)	72,10	(2,8385)
Cylinder (1 <sup>st</sup> oversize, red)	72,25	÷	72,26	(2,8444 ÷ 2,8448)	72,35	(2,848)
Cylinder (1 <sup>st</sup> oversize, green)	72,26	÷	72,27	(2,8448 ÷ 2,8452)	72,35	(2,848)
Cylinder (2 <sup>nd</sup> oversize, red)	72,50	÷	72,51	(2,8543 ÷ 2,8547)	72,60	(2,858)
Cylinder (2 <sup>nd</sup> oversize, green)	72,51	÷	72,52	(2,8547 ÷ 2,8551)	72,60	(2,858)
<b>Cylinder Type 582 UL</b>						
Cylinder (standard, red)	76,01	÷	76,02	(2,9925 ÷ 2,9929)	76,10	(2,996)
Cylinder (standard, green)	76,02	÷	76,03	(2,9929 ÷ 2,9933)	76,10	(2,996)
Cylinder (1 <sup>st</sup> oversize, red)	76,26	÷	76,27	(3,0023 ÷ 3,0027)	76,35	(3,006)
Cylinder (1 <sup>st</sup> oversize, green)	76,27	÷	76,28	(3,0027 ÷ 3,0031)	76,35	(3,006)
Cylinder (2 <sup>nd</sup> oversize, red)	76,51	÷	76,52	(3,0122 ÷ 3,0129)	76,60	(3,016)
Cylinder (2 <sup>nd</sup> oversize, green)	76,52	÷	76,53	(3,0123 ÷ 3,0130)	76,60	(3,016)
<b>Piston to wall clearance 462 UL</b>						
Cylinder bore, red	69,50	÷	69,51	(2,7362 ÷ 2,737)	69,60	(2,740)
Cylinder bore, green	69,51	÷	69,52	(2,7366 ÷ 2,737)	69,60	(2,740)
Piston dia., red	69,41	÷	69,42	(2,7326 ÷ 2,733)	69,32	(2,729)
Piston dia., green	69,42	÷	69,43	(2,7331 ÷ 2,733)	69,32	(2,729)
Piston to cylinder wall clearance	0,08	÷	0,10	(0,0315 ÷ 0,039)	0,20	(0,008)

Designation	dimens. new		mm	(in.)	wear limit mm (in.)	
<b>Piston to wall clearance 532 UL</b>						
Cylinder bore, red .....	72,00	÷	72,01	(2,8347 ÷ 2,8350)	72,10	(2,8385)
Cylinder bore, green .....	72,01	÷	72,02	(2,8350 ÷ 2,8354)	72,10	(2,8385)
Piston dia., red .....	71,92	÷	71,93	(2,8310 ÷ 2,8320)	71,85	(2,8287)
Piston dia., green .....	71,93	÷	71,94	(2,8280 ÷ 2,8320)	71,85	(2,8287)
Piston to cylinder wall clearance .....	0,07	÷	0,09	(0,0027 ÷ 0,0035)	0,20	(0,0080)
<b>Piston to wall clearance 582 UL</b>						
Cylinder bore, red .....	76,01	÷	76,02	(2,992 ÷ 2,993)	76,10	(2,996)
Cylinder bore, green .....	76,02	÷	76,03	(2,993 ÷ 2,994)	76,10	(2,996)
Piston dia., red .....	75,94	÷	75,95	(2,989 ÷ 2,990)	75,87	(2,987)
Piston dia., green .....	75,95	÷	75,96	(2,990 ÷ 2,991)	75,87	(2,987)
Piston to cylinder wall clearance .....	0,06	÷	0,08	(0,002 ÷ 0,003)	0,15	(0,006)
<b>Piston pin</b>						
Piston pin bore in piston: .....	18,001	÷	18,005	(0,7090 ÷ 0,7090)	18,04	(0,710)
Piston pin: .....	17,997	÷	18,000	(0,7085 ÷ 0,7087)	17,97	(0,700)
Clearance of pin in piston .....	0,001	÷	0,008	(0,0000 ÷ 0,0003)	0,05	(0,002)
<b>Piston rings</b>						
<b>End gap for 1<sup>st</sup> ring (semi-trapeze ring)</b>						
End gap, type 462 UL .....	0,1	÷	0,25	(0,004 ÷ 0,009)	1,00	(0,04)
End gap, type 532 UL .....	0,2	÷	0,35	(0,078 ÷ 0,140)	1,00	(0,04)
End gap, type 582 UL .....	0,3	÷	0,45	(0,012 ÷ 0,017)	1,00	(0,04)
<b>2<sup>nd</sup> ring (rectangular), for type 462 UL</b>						
Height of groove .....	1,54	÷	1,56	(0,606 ÷ 0,614)	1,65	(0,649)
Height of ring .....	1,478	÷	1,49	(0,058 ÷ 0,059)	1,40	(0,551)
Flank clearance .....	0,05	÷	0,082	(0,002 ÷ 0,003)	0,20	(0,008)
End gap .....	0,2	÷	0,35	(0,008 ÷ 0,014)	1,00	(0,039)
<b>2<sup>nd</sup> ring (rectangular), for type 532 UL</b>						
Height of groove .....	2,04	÷	2,06	(0,08 ÷ 0,081)	2,15	(0,846)
Height of ring .....	1,978	÷	1,99	(0,77 ÷ 0,780)	1,90	(0,748)
Flank clearance .....	0,05	÷	0,082	(0,002 ÷ 0,003)	0,20	(0,008)
End gap .....	0,2	÷	0,35	(0,008 ÷ 0,014)	1,00	(0,039)
<b>2<sup>nd</sup> ring (rectangular), for type 582 UL</b>						
Height of groove .....	2,04	÷	2,06	(0,080 ÷ 0,081)	2,15	(0,846)
Height of ring .....	1,978	÷	1,99	(0,77 ÷ 0,780)	1,90	(0,748)
Flank clearance .....	0,05	÷	0,082	(0,002 ÷ 0,003)	0,20	(0,008)
End gap .....	0,3	÷	0,45	(0,012 ÷ 0,017)	1,00	(0,039)

## 15) Operational limits:

### Max. permissible speed

Type	r.p.m.
462 - 28 kW .....	5800
462 - 38 kW .....	6800
532 - 45 kW .....	6800
532 - 47 kW .....	6800
582 - 40 kW .....	6400
582 - 48 kW .....	6800

### Max. cylinder head temperature CHT

	°C	°F
on all types .....	150	300

### Max. exhaust gas temperature EGT

on all types .....	650	1200
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### Max. crankcase temperature

on all types .....	80	176
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### Max. cooling water temperature

on all types .....	80	176
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## 16) Operating liquids:

Oil for lubrication of rotary valve drive

Type 462 UL .....	c. 0,31 lt. ....	(0,082 gal US)
Type 532 UL .....	c. 0,27 lt. ....	(0,071 gal US)
Type 582 UL .....	c. 0,31 lt. ....	(0,082 gal US)

■ NOTE: Use Super 2-stroke oil only!

### Cooling water:

2-piece radiator set (low version) ....	c. 0,6 lt.(0,16 gal US)	installed c. 2,35 lt.(0,62 gal US)
2-piece radiator set (high version) ...	c. 0,8 lt.(0,21 gal US)	installed c. 2,55 lt.(0,67 gal US)
1-piece radiator set .....	c. 0,8 lt. (0,21 gal US)	

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Edition: 1997 01 01

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## 2) A M E R I C A

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