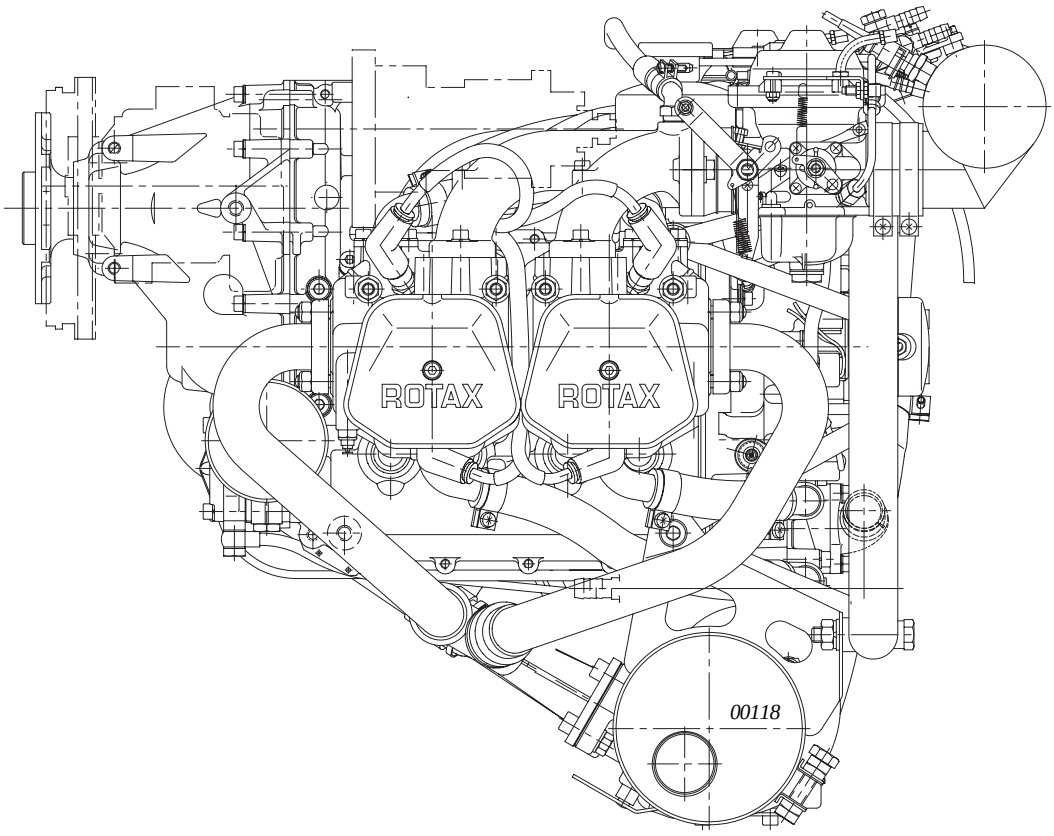
ROTAX®
AIRCRAFT ENGINES

Maintenance Manual

for

ROTAX Engine

Type 914 F



⚠ WARNING

Before starting any maintenance work, please, read the Maintenance Manual completely as it contains important safety relevant information.

Edition: 0 of 1997 02 01

Recommended price : ATS 900,--
Part no. 897 812 DM 125,--

2) Index

3) Introduction

We are pleased you decided for a ROTAX aircraft engine.

Before carrying out maintenance work on the engine, carefully read the Maintenance Manual. It provides you basic information on safe operation of the engine.

If any passages of the Manual are not understood or in case of any questions, please, contact an authorized Distribution- or Service Partner for ROTAX aircraft engines.

3.1) Remarks

This Maintenance Manual is to acquaint maintenance service staff approved by the local aviation authorities with some basic maintenance and safety information for service works.

For competent maintenance and servicing, please, refer to the documentation provided in the Operator's Manual, Installation Instructions and Spare Parts List.

For additional engine-, maintenance- and parts information you may also contact the nearest BOMBARDIER-ROTAX aircraft engine distribution partner.

3.2) Engine serial number

On all enquiries or spare parts orders, always indicate the engine serial number, as the manufacturer makes modifications to the engine for further development. The engine serial number is on the top of the crankcase, magneto side (see Pic. 005).

4) Safety

Although the mere reading of such an instruction does not eliminate a hazard, the understanding and application of the information will promote correct use.

The information and components-/system descriptions contained in this Maintenance Manual are correct at the time of publication. BOMBARDIER-ROTAX, however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on its products previously manufactured.

BOMBARDIER-ROTAX reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

The illustrations in this Maintenance Manual show the typical construction. They may not represent in full detail or the exact shape of the parts which have the same or similar function.

Specifications are given in the SI metric system with the USA equivalent in parenthesis. Where precise accuracy is not required, some conversions are rounded off for easier use.

4.1) Repeating symbols

This Manual uses the following symbols to emphasize particular information. These indications are important and must be respected.

▲ **WARNING: Identifies an instruction which, if not followed, may cause serious injury including the possibility of death.**

■ **ATTENTION: Denotes an instruction which, if not followed, may severely damage the engine or other component.**

◆ **NOTE: Indicates supplementary information which may be needed to fully complete or understand an instruction.**

4.2) Safety information

▲ WARNING: Never fly the aircraft equipped with this engine at locations, air-speeds, altitudes, or other circumstances from which a successful no-power landing cannot be made, after sudden engine stoppage.

Aircraft equipped with this engine must only fly in DAYLIGHT VFR conditions.

☞ It should be clearly understood that the choice, selection and use *of this* particular engine on any aircraft is at the sole discretion and responsibility of the aircraft manufacturer, assembler and owner/user.

☞ Due to the varying designs, equipment and types of aircraft, BOMBARDIER-ROTAX makes no warranty or representation on the suitability of its engine's use on any particular aircraft. Further, BOMBARDIER-ROTAX makes no warranty or representation of this engine's suitability with any other part, component or system which may be selected by the aircraft manufacturer, assembler or user for aircraft application.

☞ You should be aware that any engine may seize or stall at any time. This could lead to a crash landing and possible severe injury or death. For this reason we recommend strict compliance to the maintenance, operation and any additional information which may be given to you by your dealer.

☞ Select and use proper aircraft instrumentation. This instrumentation is not included with the BOMBARDIER-ROTAX engine package. Only approved instrumentation can be installed.

☞ Unless in a run up area, never run the engine with the propeller turning while on the ground. Do not operate engine if bystanders are close.

☞ To prevent unauthorized use, never leave the aircraft unattended with the engine running.

☞ Keep an engine log and respect engine and aircraft maintenance schedules. Keep the engine in top operating condition at all times. Do not operate any aircraft which is not properly maintained or has engine operating irregularities which have not been corrected.

Since special tools and equipment may be required, engine servicing should only be performed by an authorized BOMBARDIER-ROTAX engine dealer or a qualified trained mechanic approved by the local airworthiness authority.

- ☞ To eliminate possible injury or damage, ensure any loose equipment or tools are properly secured before starting the engine.
- ☞ When in storage protect the engine and fuel system from contamination and exposure.
- ☞ Never operate the engine and gearbox without sufficient quantities of lubricating oil.
- ☞ Periodically verify level of coolant.
- ☞ Never exceed maximum rated speed and allow the engine to cool at idle for several minutes before turning off the engine.
- ☞ Operating the engine at high speed at low throttle position, for example during descent, may increase engine and exhaust temperatures and cause critical overheating. Always compensate and match engine speed with throttle position.
- ☞ This engine may be equipped with an Airborne air pump. The safety warning accompanying the air pump must be given to the owner/operator of the aircraft into which the air pump is installed.

4.3) General operating and safety instructions

- ☞ Please, observe besides the instructions in our documentation also the generally valid safety- and accident preventive prescriptions and legal regulations as well as the relevant regulations by the competent aeronautical authorities.
- ☞ The information contained in the Maintenance Manual is based on data and experience and is considered to be applicable for a professional technician under normal working conditions. The instructions given in the Maintenance Manual are useful and necessary supplements to personal instruction, but can by no means substitute theoretical and practical personal instruction.
- ☞ The manufacturer or supplier has no influence on the personnel and operational conditions of the buyer and assumes no responsibility for sustaining effect of the personal instructions.
- ☞ We point to the fact that spare parts and accessories not supplied as genuine ROTAX parts are not tested and therefore not released by ROTAX. Installation and/or use of such products may change and negatively affect the constructive properties of the engine. For damages due to use of non-genuine parts and accessories ROTAX refuses any liability.
- ☞ Unauthorized modifications and use of components or accessories not corresponding with the installation instructions exclude any liability of the manufacturer.
- ☞ The engine is accurately tested before delivery, this however does not exclude hazards in case of incompetent handling.
- ☞ Before taking the engine into operation, make yourself acquainted with the respective controls and their function. Searching during operation is too late! In case of vibrations or unusual noise, stop the engine and remedy the cause.
- ☞ Attention when draining hot oil: Danger of scalds!
- ☞ Disposal of used oil, fuels and filters as per local regulations.
- ☞ Liquids emerged (fuel or acids) can penetrate the skin and cause bad caustic injury. In case of accident immediately consult a doctor as bad infections may be engendered.

- ☞ Cleaning the engine with lye or alkaline solutions is forbidden, as a matter of principle. Use of a high pressure cleaner may cause engine failures and rust formation.
- ☞ When working on the electric system and on the engine, first detach the cable of the minus-pole and then of the plus-pole of the battery! When connecting the cables, first connect the plus- and then the minus-pole.
- ☞ Firmly attach engine removed from aircraft on an assembly trestle.
- ☞ Do not let the engine run in a closed room (poisoning hazard)!
- ☞ Always observe the engine while running from a secure place.
- ☞ When stopping the engine, switch ignition off and remove ignition key.
- ☞ Before refuelling, always stop the engine and remove ignition key. Do not refuel in closed rooms. Immediately clean off spilt fuel.
- ☞ At handling of fuel be very careful - increased fire danger! Never refuel in the vicinity of open flames or sparks able to ignite. Do not smoke when refuelling.
- ☞ Only use oil and fuel of the specified quality and store them in approved containers only.

4.4) Technical documentation

The information given in the

- ☞ Installation Manual
- ☞ Operator's Manual
- ☞ Maintenance Manual
- ☞ General Overhaul Manual
- ☞ Spare Parts List
- ☞ Technical Bulletins
- ☞ Service Informations

is based on data and experience that are considered applicable for professionals under normal conditions.

■ ATTENTION: Due to the fast technical progress and fulfilment of particular specifications of the customers it may occur that existing laws, safety prescriptions, constructional and operational regulations cannot be transferred completely to the object bought, in particular for special constructions, or may not be sufficient

◆ NOTE: The illustrations in this Maintenance Manual are stored in a graphic data file and are provided with a consecutive irrelevant number.

This number (e.g.*00277*) is of no significance for the content.

4.4.1) Use for intended purpose

- ☞ The engine ROTAX 914 F is intended for use in certified aircraft. In case of doubt the regulations of the national authorities or the respective sportive federations have to be observed.
- ☞ This is a certified aircraft engine tested as per aeronautical standards for safety and lifetime. It was developed to the latest state of the art and intensively tested.
- ☞ Use for intended purpose also means respecting the prescribed operational- maintenance- and repair conditions. This also increases the engine lifetime.
- ☞ **Never** run the engine without propeller, this causes inevitably engine damage and hazard of explosion.

4.4.2) Instruction

Engines require instructions regarding their application, use, operation, maintenance and repair.

Technical documentation and directions are useful and necessary complementary elements for personal instruction, but can by no means substitute theoretical and practical instructions. These instructions should cover explanation of the technical context, advice for operation, maintenance, use and operational safety of the engine.

- ☞ This engine must only be operated with accessories supplied, recommended and released by ROTAX. Modifications are only allowed after consent by the engine manufacturer.
- ☞ Before longer standstill (longer than 2 months) observe without fail the instructions for engine "out of use". Protect fuel- and carburetor system against contamination.

■ ATTENTION: Spare parts must meet with the requirements defined by the engine manufacturer. This is only warranted by use of GENUINE ROTAX spare parts and/or accessories (see spare parts list).

They are available only at the authorized ROTAX Distribution- and Service partners.

If using other than GENUINE ROTAX spare parts and/or accessories, any warranty by ROTAX gets void (see Warranty Conditions).

5) List of the current pages

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6) Table of amendments

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7) Description of design

Basically the engine consists of several main components and auxiliary units as detailed below:

4-stroke, 4 cylinder horizontally opposed, spark ignition engine,with turbo charger and electronic control of boost pressure (TCU = turbocharge control unit), one central camshaft - push-rods - OHV

Liquid cooled cylinder heads

Ram air cooled cylinders

Dry sump forced lubrication

Dual breakerless capacitor discharge ignition

2 constant depression carburetors

2 electric fuel pumps (12V DC)

Prop drive via reduction gear with integrated shock absorber and overload clutch

Stainless steel exhaust system

Engine suspension frame

Electric starter (12V 0,6 kW)

Integrated AC generator with ext. rectifier-regulator (12V 20A DC)

External alternator (12V 40A DC), **optional**

Vacuum pump: (only for F2 and F4 possible), **optional**

Hydraulic constant speed propeller governor: (for F3 only), **optional**

7.1) Type description

e.g. ROTAX 914 F 2

F 2: Prop shaft with flange for fixed pitch prop

F 3: Prop shaft with flange for constant speed propeller and drive for hydraulic governor for constant speed propeller

F 4: Prop flange for fixed pitch propeller and prepared for retrofit of hydraulic governor for constant speed propeller.

7.2) Engine versions

See Pic.004.

Configuration no. Description

ROTAX 914 F2

37.914.0120.06 ..... without mechanical rev counter
37.914.0121.06 ..... without mechanical rev counter, with vacuum pump
37.914.0122.06 ..... with mechanical rev counter
37.914.0123.06 ..... with mechanical rev counter, with vacuum pump
37.914.1120.06 ..... without mechanical rev counter, with external alternator
37.914.1121.06 ..... without mechanical rev counter, with vacuum pump, with external alternator
37.914.1122.06 ..... with mechanical rev counter, with external alternator
37.914.1123.06 ..... with mechanical rev counter, with vacuum pump, with external alternator

ROTAX 914 F3

37.914.0130.06 ..... without mechanical rev counter
37.914.0132.06 ..... with mechanical rev counter
37.914.1130.06 ..... without mechanical rev counter, with external alternator
37.914.1132.06 ..... with mechanical rev counter, with external alternator

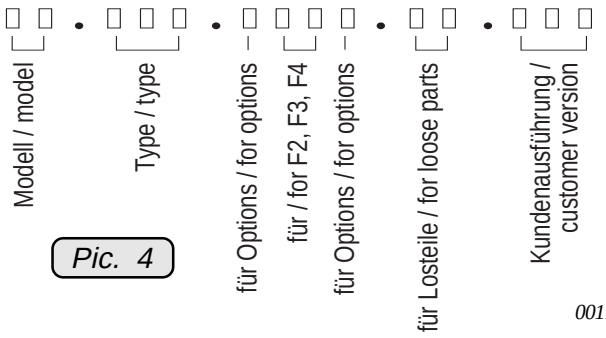
ROTAX 914 F4

37.914.0140.06 ..... without mechanical rev counter
37.914.0141.06 ..... without mechanical rev counter, with vacuum pump
37.914.0142.06 ..... with mechanical rev counter
37.914.0143.06 ..... with mechanical rev counter, with vacuum pump
37.914.1140.06 ..... without mechanical rev counter, with external alternator
37.914.1141.06 ..... without mechanical rev counter, with vacuum pump, with external alternator
37.914.1142.06 ..... with mechanical rev counter, with external alternator
37.914.1143.06 ..... with mechanical rev counter, with vacuum pump, with external alternator

Loose parts

37.914.0000.06 ..... loose parts (parts not fitted on the engine by the manufacturer, e.g. electric fuel pumps)

◆ NOTE: The configuration number is composed as follows:



Pic. 4

7.3) Engine components, engine views, numbering of cylinders, definition of main axes

See illustration Pic. 5/6/7/8 and 9.

PTO power take off side

MS magneto side

A points of attachment for engine transport

⊕ centre of gravity

P zero reference point for all dimensions

◆ NOTE: Allow ±1 mm on all stated dimensions as manufacturing tolerance

x,y,z axes for system of coordinates

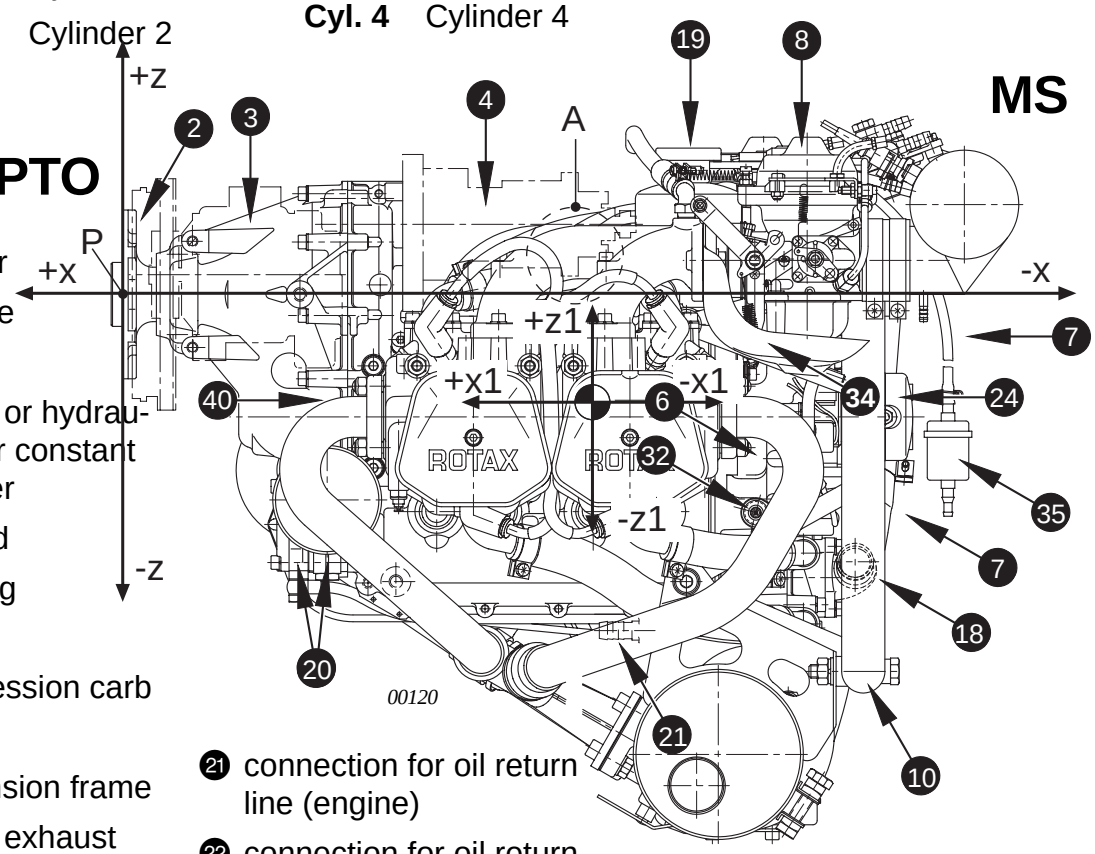
Cyl. 1 Cylinder 1

Cyl. 2 Cylinder 2

Cyl. 3 Cylinder 3

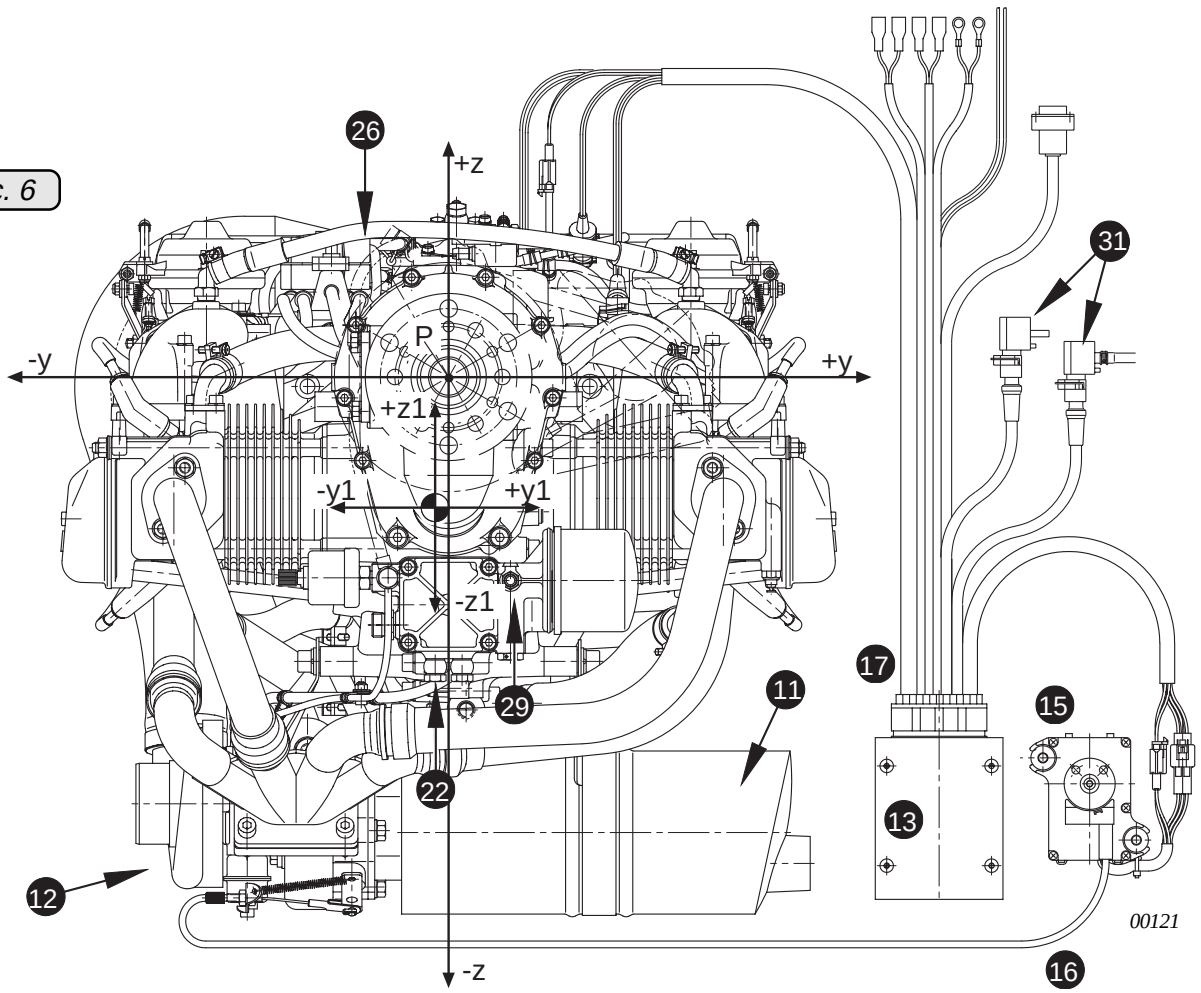
Cyl. 4 Cylinder 4

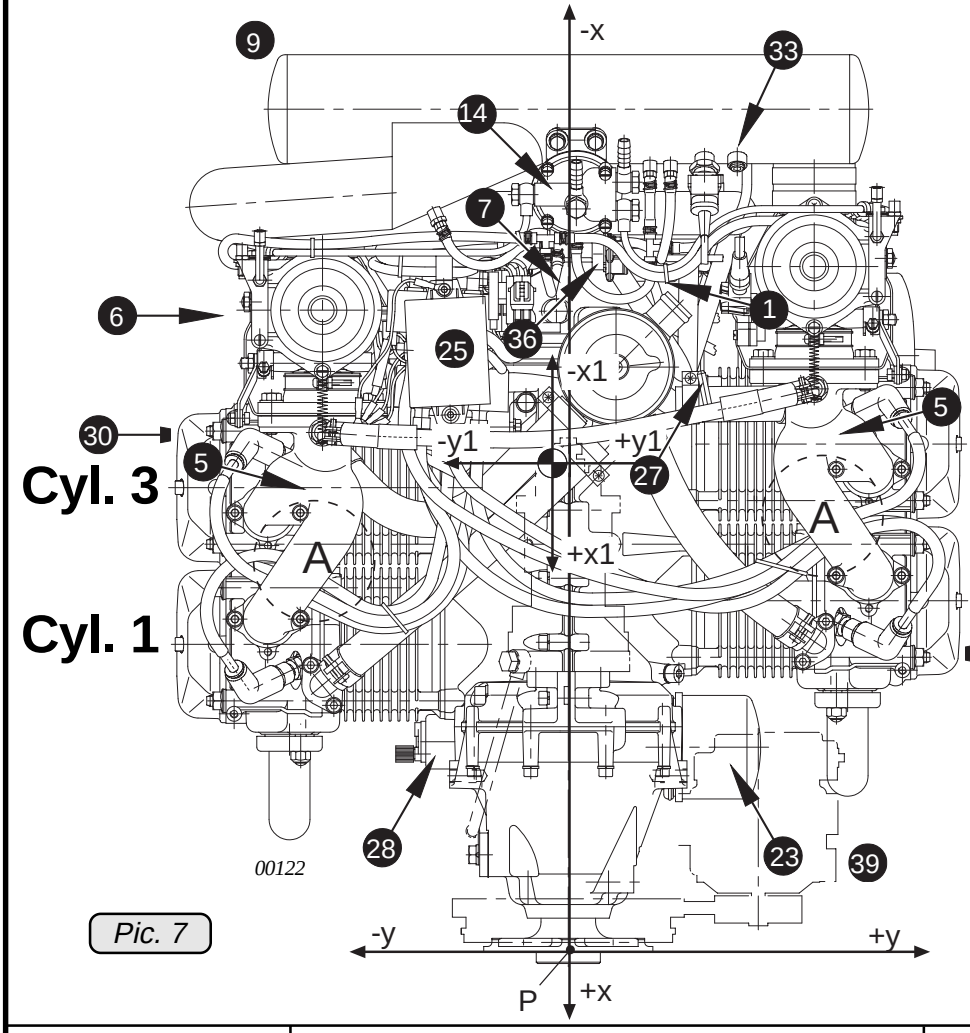
Pic. 5



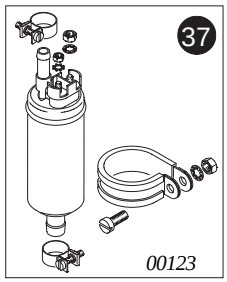
1. engine number
2. propeller flange
3. propeller gear
4. vacuum pump or hydraulic governor for constant speed propeller
5. intake manifold
6. ignition housing
7. ignition cover
8. constant depression carb
9. airbox
10. engine suspension frame
11. stainless steel exhaust system
12. turbocharger
13. turbo control unit (TCU)
14. fuel pressure control
15. servo motor
16. servo cable
17. cable assembly
18. coolant pump
19. expansion tank
20. 2 separate oil pumps
21. connection for oil return line (engine)
22. connection for oil return line (turbo)
23. oil filter
24. electric starter
25. electronic modules for ignition
26. compensation tube
27. connection for manifold pressure
28. sensor for oil pressure
29. sensor for oil temperature
30. sensor for cylinder head temperature
31. 2x pressure sensor
32. connection for mechanical rev-counter
33. connection for additional temperature sensor (airbox)
34. drip tray
35. water trap
36. three way solenoid valve
37. 2x electric fuel pump
38. oil tank
39. external alternator
40. external alternator

Pic. 6

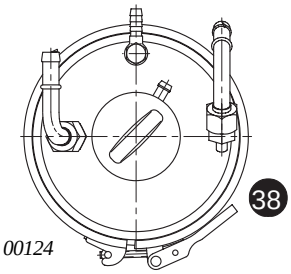




Pic. 7



Pic. 8



Pic. 9

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8) Technical data

■ ATTENTION: Please observe Technical Data relevant for engine operation in the Operator's Manual.

8.1) Limits of operation

Refer to the current Operator's Manual 914, section 8) technical data.

8.2) Operating media / Capacity

Refer to the current Operator's Manual 914, section 8) technical data.

8.3) Fuel consumption

Refer to the current Operator's Manual 914, section 8) technical data.

8.4) Weights

Refer to the current Operator's Manual 914, section 8) technical data.

8.5) Engine / Components

DESIGN:	4-stroke-, 4-cylinder-, horizontally opposed engine
BORE:	79,5 mm (3,13 in.)
STROKE:	61,0 mm (2,4 in.)
DISPLACEMENT:	1211,2 cm^3 (73,9 cu.in.)
CYLINDER:	light alloy, NIKASIL coating
PISTON:	cast light alloy piston, 3 piston rings
CYLINDER HEAD:	4 single cylinder heads
COMPRESSION:	9 : 1
INLET VALVE:	38 mm, valve seat armoured
EXHAUST VALVE:	32 mm NIMONIC, armour welding at seat
VALVE CLEARANCE:	automatic compensation of clearance by hydraulic tappets
VALVE TRAIN:	OHV, hydraulic valve tappets, push rods and rocker arms
CAMSHAFT:	steel, annealed, liquid nitriding
NOMINAL VALVE TIMING (at 1 mm valve lift):	inlet opens 0° at T.D.C. exhaust opens: 48° B.B.D.C. inlet closes 48° A.B.D.C. exhaust closes: 0° at T.D.C.
CRANKSHAFT:	supported in 5 journal bearings, case hardened
COOLING:	liquid-cooled cylinder heads, ram air cooled cylinders
LUBRICATION:	**1) Main lubrication circuit:** Dry sump forced lubrication system, trochoid pump driven by the camshaft, oil return by the blow-by gases **2) Suction pump circuit:** Extra trochoid pump driven by the camshaft serves for oil return from the lower located oil sump of turbo to the oil tank.
OIL DELIVERY RATE:	**1) Main lubrication circuit:** approx. 16 l/min. at 5500 rpm **2) Suction pump circuit:** approx. 4 l/min. at 5500 rpm
IGNITION UNIT:	ROTAX dual ignition, breakerless, capacitor discharge, interference suppression
IGNITION TIMING:	at start: circuit **A and B**: .....4° B.T.D.C. during operation: circuit **A**: .....26° B.T.D.C. circuit **B**: .....22° B.T.D.C.
FIRING ORDER:	1 - 4 - 2 -3
SPARK PLUGS:	12 mm, ND X27EPR-U9
ELECTRODE GAP:	see Pic. 129 dimension ⑥ in Chapter 15)
INTEGRATED GENERATOR:	DUCATI permanently exited single-phase generator (approx. 250W AC)
RECTIFIER-REGULATOR:	12V 20A DC
EXTERNAL ALTERNATOR: (optional extra):	12V 40A DC with full-wave rectifier-regulator

CARBURETOR:	2x BING-constant depression carburetors 32 mm, Type 64
CARB CALIBRATION:	Main jet ..... 162 Idle jet ..... 35 Needle jet ..... 2,72 Jet needle ..... (*part no.* 961 215) Needle position ..... 2 Pilot jet ..... 85 Mixture screw ..... 1,5 turns open
FUEL PUMP:	2 electric fuel pumps
STARTER:	electric starter, engagement via gearbox and sprag clutch, 12V/0,6 kW
PROPELLER GEAR:	integrated, spur gear, with torsional shock absorber
REDUCTION RATIO:	standard 2,4286 (51T. / 21T.)
DIRECTION OF ROTATION:	anti-clockwise, looking at propeller shaft
MOMENT OF INERTIA OF PRO-PELLER:	max. 6000 kgcm^2
OVERLOAD CLUTCH:	multi-disk
VACUUM PUMP (optional extra):	AIRBORNE 211 CCW, drive via gearbox
PROPELLER PITCH GOVERNOR (optional extra):	Hydraulic governor WOODWARD A210786, drive via prop shaft (for F3 only)
REDUCTION RATIO: hydraulic governor and vacuum pump	1 : 0,758 (total 1,842). Transmission ratio from crankshaft to hydraulic governor or vacuum pump is 1,842 e.g. they rev with 0,543 of crankshaft speed.
TURBO CHARGER:	Exhaust gas turbo with waste gate, radial-flow compressor T25
TURBO CONTROL UNIT (TCU):	Electronic, proportional plus integral plus derivative controller with 2 external indicating lamps.
CERTIFICATION:	to FAR 33 and JAR-E,
CERTIFICATION DATA SHEET:	TW 10-ACG

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9) Description of the systems

9.1) Cooling system

See Pic.10.

The cooling system of the ROTAX 914 F is designed for liquid cooling of the cylinder heads and ram-air cooling of the cylinders.

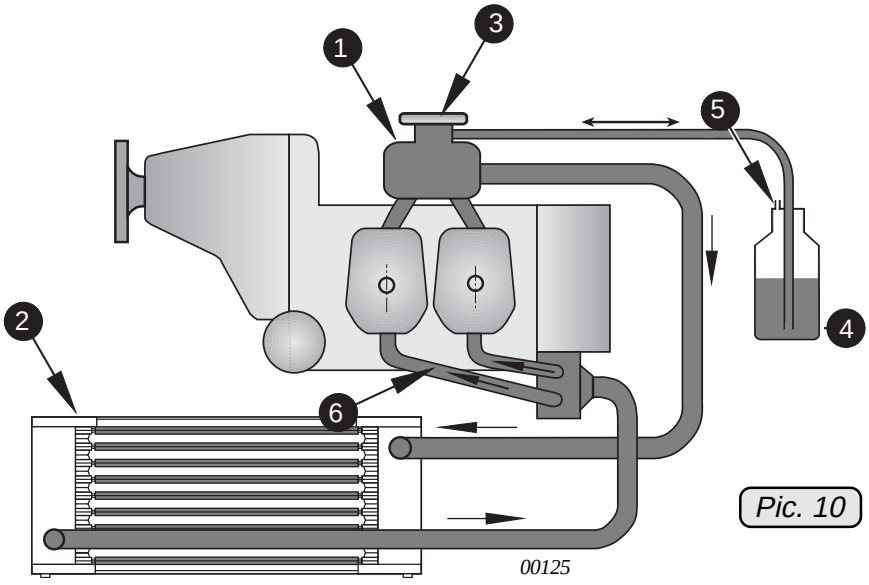
The cooling system of the cylinder heads is a **closed** circuit with an expansion tank.

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the cylinder heads. From the top of the cylinder heads the coolant passes on to the expansion tank ❶. Since the standard location of the radiator ❷ is below engine level, the expansion tank located on top of the engine allows for coolant expansion.

The expansion tank is closed by a pressure cap ❸ (with excess pressure valve and return valve). At temperature rise of the coolant the excess pressure valve opens and the coolant will flow via a hose at atmospheric pressure to the transparent overflow bottle ❹. When cooling down, the coolant will be sucked back into the cooling circuit. The expansion tank ❶ has to be always full with coolant and coolant level in overflow bottle ❹ ought to be between the two marks.

■ ATTENTION: Too high pressure in the cooling system might cause damage. Therefore the hose from expansion tank to overflow bottle and the venting bore ❺ must remain open.

The coolant hoses ❻ for cyl. 1 and 2 are routed very close to the exhaust system therefore they are additionally protected by a heat resistant protection hose.



Pic. 10

◆ NOTE: Filling or replenishing of the cooling system always on the expansion tank ❸.

To drain the coolant open the radiator cap and remove the lowest attachment screw (with sealing ring) of the water pump, as this is the lowest point of the engine assembly.

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9.2) Fuel system

See Pic. 11.

The fuel system comprises the following items:

- ⇨ fuel tank
- ⇨ coarse filter
- ⇨ water trap
- ⇨ fire cock
- ⇨ 2 electric fuel pumps
- ⇨ 2 check valves
- ⇨ and the required fuel piping and connections

The fuel flows from the tank via a combination of filter and watertrap ❶ to the two electric fuel pumps (❷ and ❸), connected in series, passes on to the fuel pressure regulator ❺ and further on to the individual carburetors.

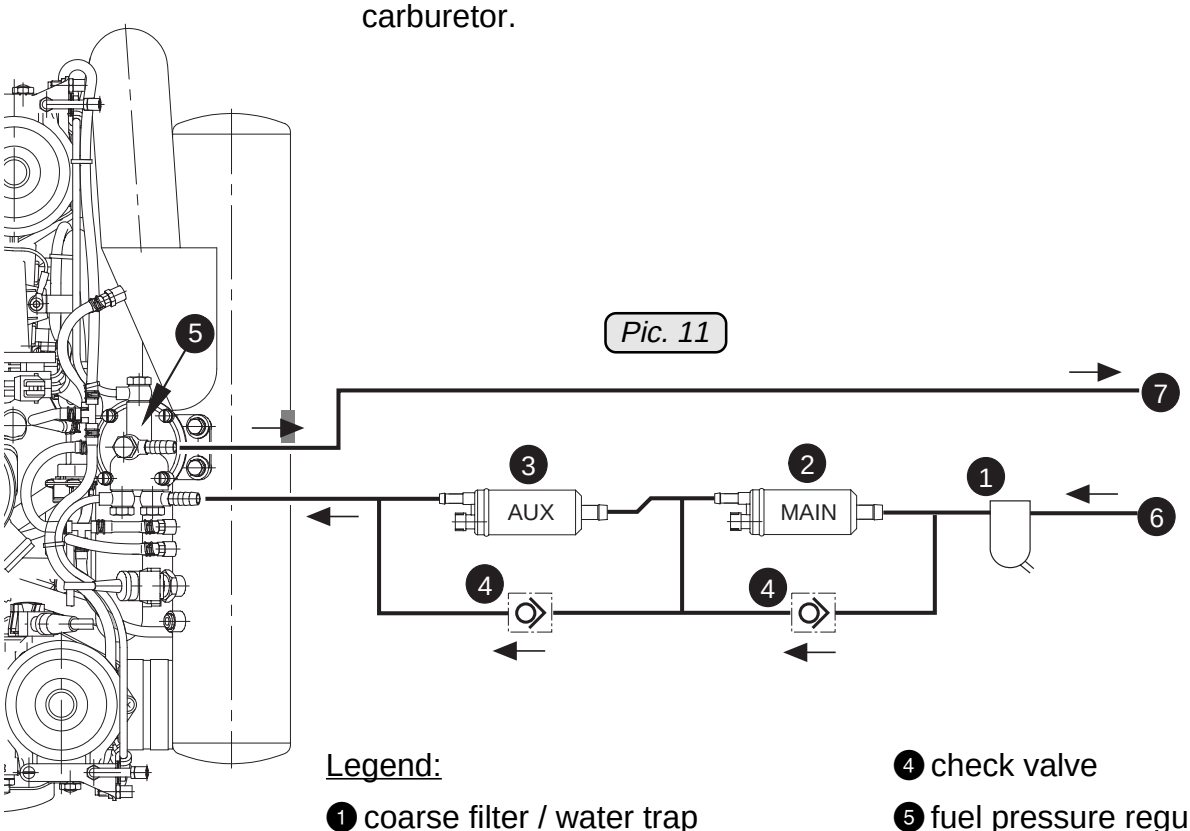
Parallel to each fuel pump a separate check valve ❹ is installed.

◆ NOTE: The arrangement of the two fuel pumps connected in series yields better reserves against vapour formation at high altitudes and temperatures.

The two check valves in the system are necessary to warrant trouble free operation of the fuel system with one pump only.

Via the return line ❼ the surplus fuel passes from the fuel pressure regulator back to the tank or to suction side of fuel system.

◆ NOTE: The fuel pressure regulator serves to maintain the fuel pressure always approx. 0,25 bar (3,6 p.s.i.) above the changing boost pressure in the airbox thus warranting proper operation of the carburetor.



Pic. 11

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Legend:

❶ coarse filter / water trap
❷ main fuel pump
❸ auxiliary fuel pump
❹ check valve
❺ fuel pressure regulator
❻ feeding line from tank
❼ return line to tank

9.2.1) Fuel filter:

- The **coarse filter** installed in or next to the fuel tank has to retain coarse fuel contamination. It must allow opening for cleaning.
- In the feeding line between tank and inlet to the fuel pumps a **fine filter** is located.

  This filter is designed such that it can be inspected for maintenance. In most cases this filter is part of a filter / water trap combination.

  Filter has to be inspected at specified operating intervals. Clean or renew filter as required.
- The built-in filter on suction side of the electric fuel pump is not exchangeable.

9.2.2) Fuel pumps:

To warrant safe and adequate operation of the fuel system two selfpriming vane pumps are used. The voltage supply to the two pumps has to be established completely independent.

◆ NOTE: Voltage supply to main pump directly from internal generator and supply to the auxiliary fuel pump from bus bar or battery.

For engine operation the rate of delivery of one pump only is completely sufficient.

■ ATTENTION: Employ genuine ROTAX fuel pumps only, as the pump must meet certain requirements.

9.2.3) Fuel pressure control

See Pic. 12 and 13.

The fuel pressure regulator ❶ is attached on the airbox.

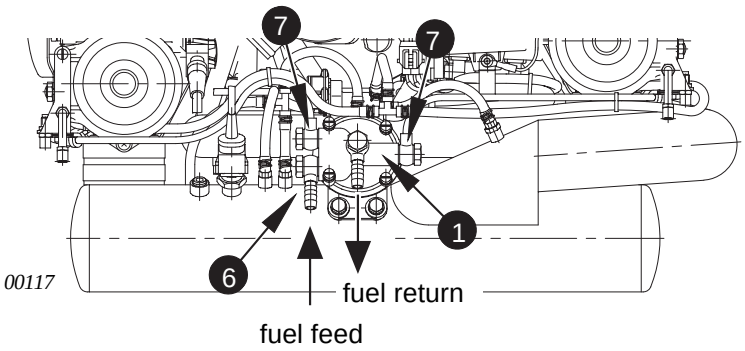
Fuel pressure control is essential for flawless engine operation because it keeps the fuel pressure permanently approx. 0,25 bar (3,6 p.s.i.) above the varying airbox pressure.

Design and function of the fuel pressure regulator:

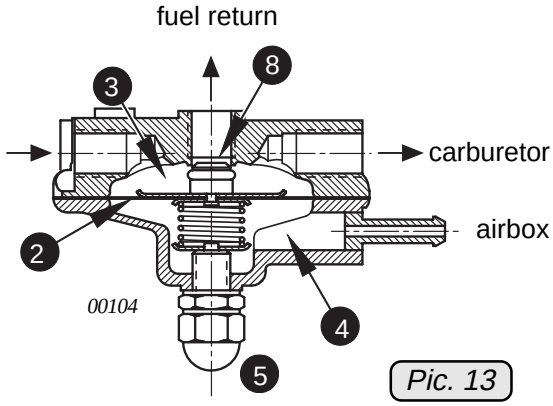
◆ NOTE: The arrows indicate direction of fuel flow.

The diaphragm ❷ devides the regulator into the top fuel chamber ❸ and the air chamber ❹. The compression spring set by the adjustment screw ❺ establishes equilibrium of forces on the diaphragm at the fuel pressure 0,25 bar above the actual air box pressure on the other side.

■ ATTENTION: Each fuel pressure regulator is calibrated already when supplied and does not need any further adjustment or maintenance.



Pic. 12



Pic. 13

◆ NOTE: The cast arrows on top side of pressure regulator are for application of no significance as inlet ❻ and outlet ❼ are directly connected via the chamber.

Part of the fuel flow from the pumps (approx. 100 l/h) is routed back to the fuel tank via the diaphragm controlled cone valve ❽ thus establishing a pressure 0,25 bar higher in the top chamber (fuel side) than in the lower chamber (air side).

Since the lower chamber is connected via the pressure line with the airbox the pressure of the fuel entering the carburetor will be 0,25 bar above airbox/ float chamber pressure.

Fuel pressure = airbox pressure + 250 hPa

In 1000 m altitude with the prevailing atmospheric of approx. 900 hPa the following values will arise at take off performance.

Fuel pressure = 1350 + 250 = <u>1600 hPa</u>

Therefore the required delivery pressure of the fuel pump will be

1600 - 900 = **<u>700 hPa</u>**

Rising airbox pressure will press diaphragm upwards thus decreasing fuel flow back to tank ➪ e.g. fuel pressure rises until equilibrium is reached.

■ ATTENTION: Correct excess fuel pressure is essential for proper function of carburetor.

➪ too **low** fuel pressure (wrong calibration, malfunction of regulator,...) leads to a leaner mixture and can result in engine troubles or engine failure as not enough fuel or no fuel at all reaches the float chamber.

➪ too **high** fuel pressure (wrong calibration, malfunction of regulator, increased flow resistance, blockage of retour line,...) leads to a richer mixture till flooding of carburetors causing engine troubles or engine stop.

9.2.4) Air pressure hoses ❶

See Pic. 14.

The ROTAX 914 F is equipped with constant depression carburetors. For the operation of the carburetors it is necessary that

a) **the pressure in the float chamber corresponds with pressure at carburetor air intake (airbox)**

With varying airbox pressure (carb air intake) this changing pressure must also act upon float chamber.

Therefore the float chamber venting is connected with the airbox.

b) **the fuel pressure is approx. 0,25 bar (3.6 p.s.i.) above the pressure at air intake (airbox).**

Therefore the fuel pressure regulator is connected with the airbox.

Enrichening of the fuel air mixture at take-off performance

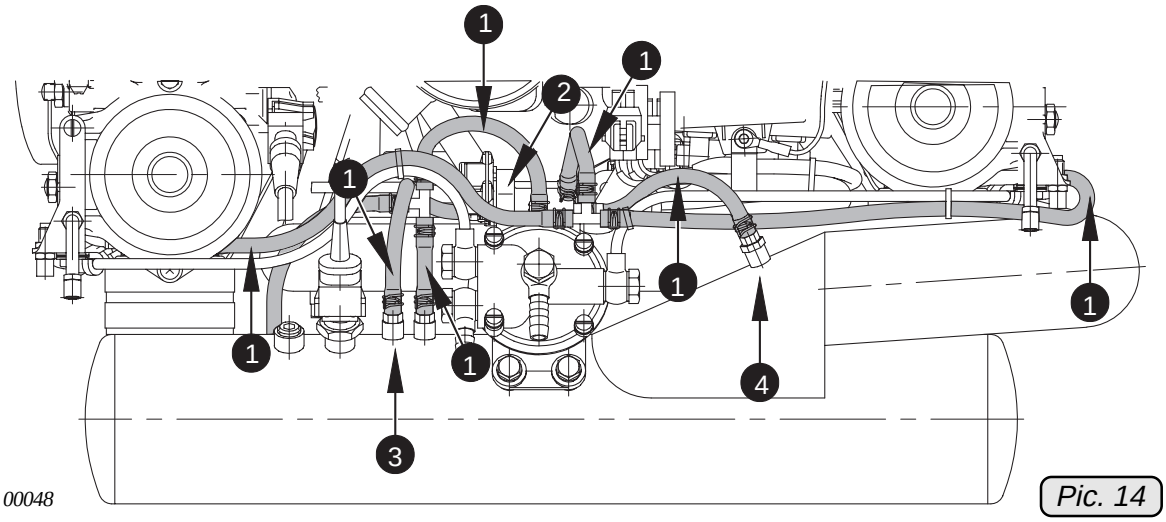
The airbox is furnished with 2 separately located pressure connections interconnected by the 3-way solenoid valve ❷.

Up to the highest continuous power (approx. 1190 hPa airbox pressure) the static airbox pressure prevails via the connection ❸ on the float chamber of the carburetor. At boost pressure (airbox pressure) above 1250 hPa the pressure in the float chamber will be raised by the **velocity pressure** at airbox (connection ❹) initiated by the TCU via the 3-way solenoid valve.

Thereby the effective pressure for the fuel dosing will be increased by the same amount, too.

The aim of this mixture enrichment is to compensate the leaning down process at higher atmospheric pressure by higher specific fuel consumption and thus reducing thermal stress of engine and inducing better precaution against knocking combusting during the short take-off phase.

▲ WARNING: Since a failure of these pressure interconnections would result in engine stop, ensure that these lines are in perfect order, with tight clamps and without kinks.



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Pic. 14

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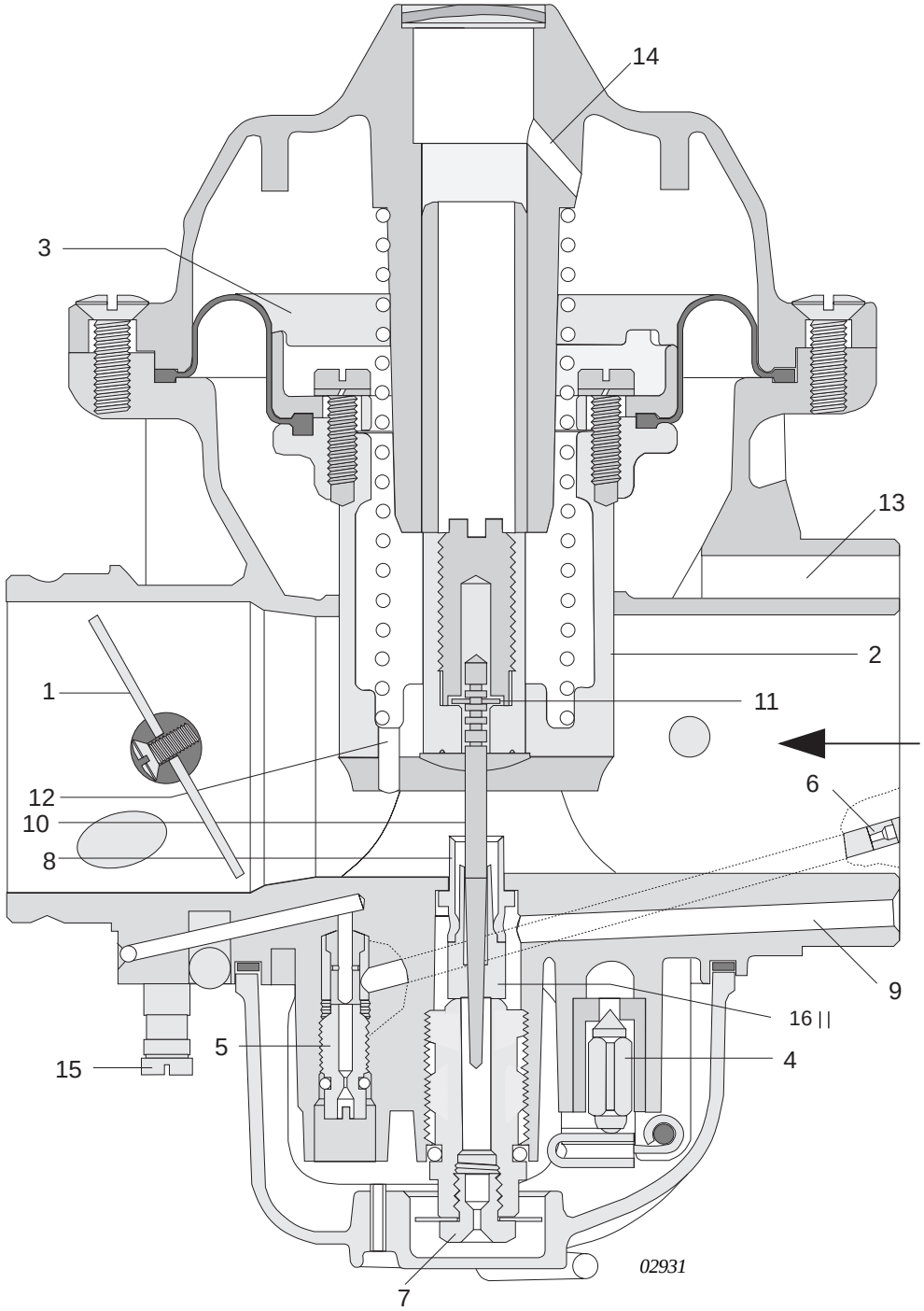
9.2.5) BING constant depression carburetor type 64-3

See Pic. 15/16 and 17.

The BING constant depression carburetor type 64-3 is a cross-draft butterfly valve carburetor with variable venturi, double float system arranged centrally below the venturi, and a rotary valve type starting carburetor. It features a carburetor piston ❷ which is suspended from a roller diaphragm ❸ and projects into the venturi. It changes the smallest cross section (venturi) of the venturi as a function of the vacuum at this point. By actuation of the throttle valve ❶ the depression is influenced and the carburetor piston is moved. The throttle valve diameter is 36 mm (1.42 in.).

When the fuel has reached a specified level in the float chamber, then the floats close the needle valve ❹ via the float bracket thus preventing any further supply of fuel.



Pic. 15

◆ NOTE: The air pressure in the float chamber is decisive for the function of the carburetor and must correspond with the air pressure at entry into the carburetor. Too high pressure enriches the mixture, too low pressure leans down the mixture possibly leading to engine stop.

The float chamber airspace is connected by a duct with the venting nipple ⓲. The duct must be clear. With a hose connected on venting nipple the correct pressure in the float chamber is established.

The amount of mixture drawn in by the engine and thus its performance is determined by the cross-sectional area in the venturi which is opened by the throttle valve ❶. If the throttle valve is opened while the engine is running, the increased airflow in the venturi results in a vacuum building up at the outlet of the needle jet ⓰ which draws fuel from the float chamber through the jet system.

The vacuum in the venturi acts on the top of the diaphragm and the carburetor piston via a bore ⓬ in the carburetor piston and attempts to lift the piston against its own weight and spring. The reference pressure prevailing between airfilter and carburetor (e.g. ambient air pressure) is applied to the underside of the diaphragm via duct ⓭. The space in the cover above the piston guide is vented through bore ⓮. The bore diameter determines the piston damping.

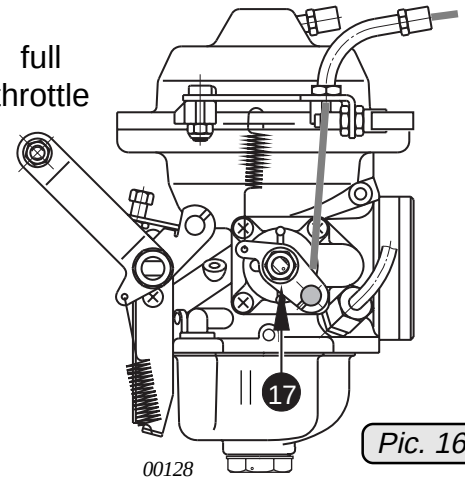
On its way from the float chamber to the venturi the fuel passes through the main jet ❼, the jet carrier and the needle jet, and as it leaves the needle jet it is pre-mixed with air which is brought in from the air filter via an air duct ❾ and the atomizer ❽ in an annular flow around the needle jet. This air flow assists the atomizing process and favours fuel distribution in the intake duct.

The jet needle ❿ responsible for part load is kept in position by the retaining clip ⓫.

During idling and low-load operation the throttle valve is closed to such an extent that the airflow underneath the carburetor piston ❷ no longer forms a sufficient vacuum. The fuel is then supplied via an auxiliary system, the idling system, which consists of the idling jet ❺ and the idling air jet ❻ .

The BING constant depression carburetor is provided with a rotary valve starting carburetor ⓱ as an aid for starting a cold engine, using a Bowden cable.

▲ WARNING: With throttle lever not connected the carb will remain in **full throttle position**. See Pic. 12.
Therefore never start engine without connecting throttle lever first.



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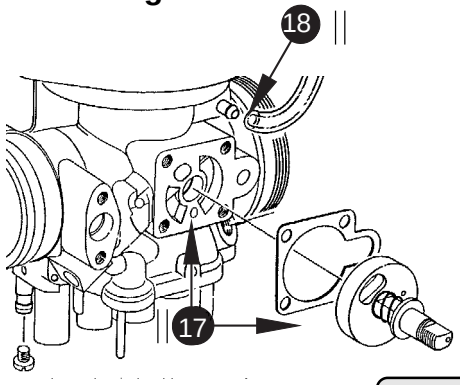
Pic. 16



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Pic. 17

9.2.6) Handling of fuel

Exclusively refuel clean gasoline of a registered brand.

Unleaded fuels contain alcohol which absorbs water up to 50 % of its volume. Water enters the system mainly by condensation. Therefore extreme differences in temperature, long period storage, direct sun and plastic containers should be avoided. When handling fuel, observe directives without fail.

When refuelling respect the relevant regulations of the competent aeronautical authorities.

▲ WARNING: Before refuelling, switch off ignition and remove ignition key!

▲ WARNING: Filter fuel (using filter funnel) when filling tank. Use only clean, non-translucent safety approved fuel containers. Handling of fuel in well ventilated places only.

▲ WARNING: Never refuel in closed rooms. Gasoline is highly inflammable and explosive. Do not smoke, do not allow open flames or sparks in the vicinity. Do not fill the tank brimful. allow for expansion of the fuel. Never refuel while engine is running.

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9.3) Lubrication system

See Pic. 18.

The ROTAX 914 F engine is provided with a dry sump forced lubrication system with a main oil pump with integrated pressure regulator and an additional suction pump.

◆ NOTE: The oil pumps are driven by the camshaft.

The **main oil pump** sucks the motor oil from the oil tank ❶ via the oil cooler ❷ and forces it through the oil filter to the points of lubrication (lubricates also the plain bearings of the turbo charger and the propeller governor).

The surplus oil emerging from the points of lubrication accumulates on the bottom of crankcase and is forced back to the oil tank by the blow-by gases.

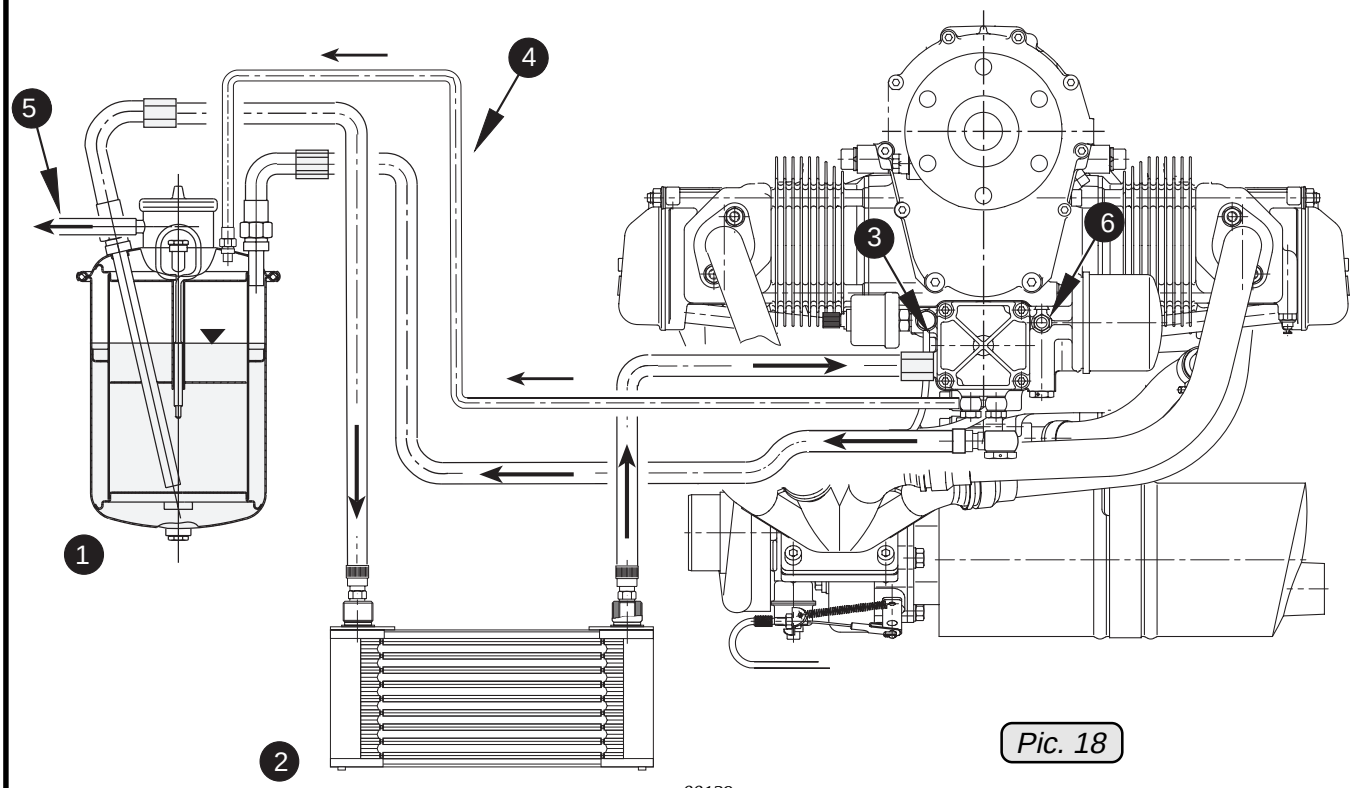
The turbo charger is lubricated via a separate oil line ❸ from the main oil pump.

The oil emerging from the lower placed turbo charger collects in the oil sump and is pumped back by a separate pump to the oil tank via the oil line ❹.

◆ NOTE: The oil circuit is vented via bore ❺ in the oil tank, where the blow-by gases leave the system.

Any hose or pipeline connected there must be of a minimum internal dia. of 6 mm (1/4") and always with free passage as otherwise a too high pressure in the crankcase could result in troubles of engine operation.

◆ NOTE: The oil temperature sensor ❻ is located on oil pump flange and measures the oil feed temperature.



Pic. 18

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9.3.1) Main oil pump (Engine lubrication circuit)

See Pic. 19.

The oil flow, forced by a trochoid type pump starts at the oil tank ❶ and oil cooler ❸ on suction side of pump via oil lines ❷ and ❹ and enters pump rotor ❺ of main oil pump engaging in oil pump shaft ❻ and driven by the cam shaft.

The pump forces oil through filter cartridge from the outside to inside of filter ❼. The oil pressure from 1,5 to 5 bar (22 to 72 p.s.i.) is controlled by the pressure relief valve ❽. The surplus oil returns back to the pump rotor via the duct ❾. If the filter cartridge is completely clogged up, the excess-pressure valve ❿ opens and oil will flow unfiltered to the points of lubrication. Prevent this situation by all means, using oil and filter as specified and punctual change of oil filter.

Consequently the oil is pumped through the oil duct ⓫ located in the left crankcase half with direct supply to the 4 hydraulic tappets ⓬ for the cylinder 2 and 4. Via the hollow pushrod ⓭ and oil duct ⓮ oil flows to the rocker arm bearing. The oil emerging from passage ⓯ lubricates valve mechanism, and flows back to crankcase via oil return tube ⓰ to passage ⓱.

Forced oil supply from oil duct ⓫ also to camshaft bearing ⓲ N3, crankshaft main bearing ⓳ H3, conrod big end bearing ⓴ of cylinder 4 and bronze bush ㉑ of the crankshaft backing bearing S2 in ignition cover.

Through crankcase joint ㉒ oil enters the right crankcase half. From the oil duct ㉓ the camshaft bearing ㉔ N2, the centre bearing of crankshaft ㉕ H2 and the two conrod bearings ㉖ and ㉗ of cylinder 3 and 2 are lubricated. This oil duct serves also the hydraulic tappets and valve mechanism for cylinder 1 and 3.

In further course oil is forced to flow to camshaft bearing ㉘ N1, to crankshaft main bearing ㉙ H1, to conrod bearing ㉚ of cylinder 1 and to the backing bearing ㉛ S1 in gear box cover. Electric terminal for oil pressure gauge on pressure sensor ㉜.

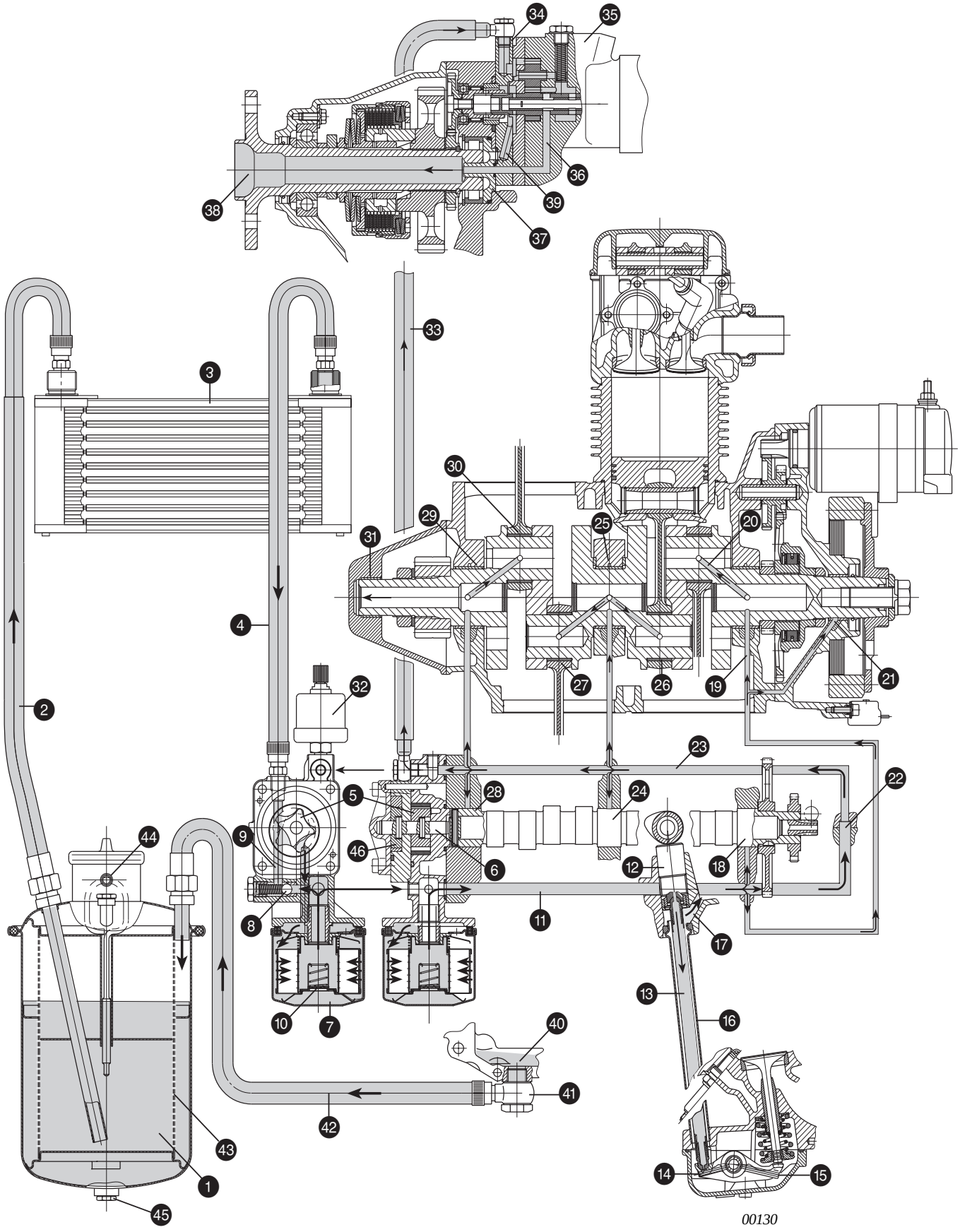
At engine version with hydraulic governor, ROTAX 914 F3, the hydraulic governor ㉟ is supplied with oil at adequate pressure via the oil line ㉝. From the governor flange ㉞ oil flows to gear pump of governor which raises the pressure to approx. 23 bar (333 p.s.i.). According to lever position of governor more or less oil passes via oil duct ㊱ and through oil inlet flange ㊲ and hollow propeller shaft ㊳ to variable pitch propeller, thus changing pitch accordingly.

The surplus oil returns back to the crankcase via the duct ㊴. Oil escaping from every point of lubrication accumulates on the bottom of the crankcase ㊵ and is forced back to the oil tank by the blow by gases via hose nipple ㊶ and oil return hose ㊷.

Owing to the tangential entering of the oil return, separation of air from oil takes place at the baffle insert ㊸, thus establishing an oil supply nearly free of air in the suction line ❷.

Venting of the oil tank via the connection ㊹ to intake filter, to suitable container or into atmosphere.

For oil change, the oil is drained at drain screw ㊺.



◆ NOTE: Rotor ㊻ of **suction oil pump**.

Pic. 19

Modification no.	Reference	Main	Date	Page
- 0 -		914 F	1997 02 01	45

9.3.2) Suction pump (Turbo charger lubrication circuit)

See Pic. 20.

The suction pump ⓫ is of the same design as the main oil pump ⓬ and sits on the extended common pump shaft ⓯.

The lubrication of the turbo charger shaft, supported on plain bearing is via a separate oil line ❷ from the main oil pump.

The pressure valve ❸ at entry into turbo charger housing will prevent flooding of turbo charger ❶ with engine oil by gravity due to ineffective suction pump after engine stop.

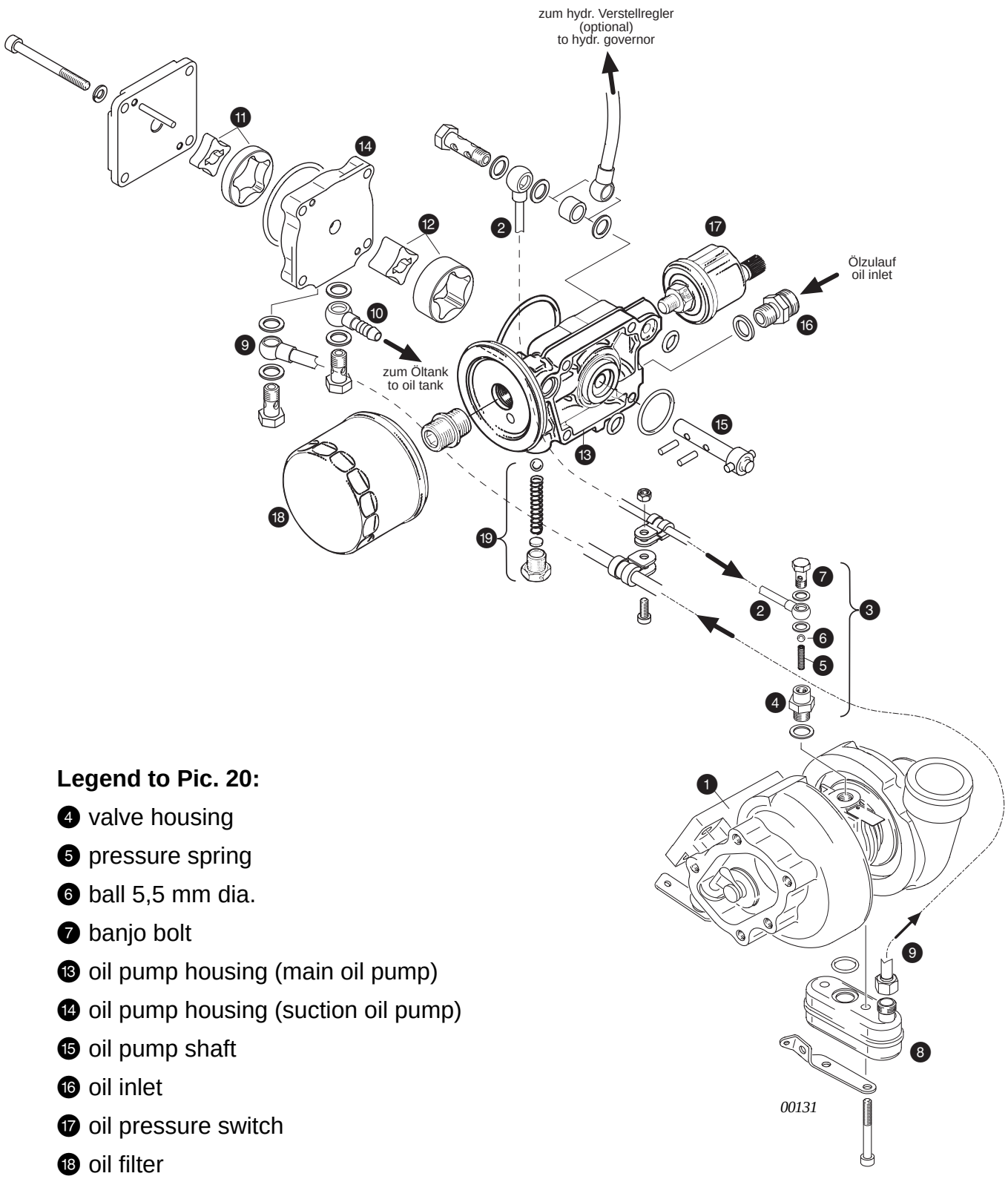
Operation of the pressure valve:

Oil pressure (min. 1 bar (14,5 p.s.i.) will keep open the ball valve against the low spring pressure and the oil will flow nearly unhindered to spot of lubrication. Without oil pressure the valve closes and stops the oil flow.

■ ATTENTION: Oil loss combined with heavy smoke at engine start strongly indicates a defective pressure valve.

Emerging oil from the bearing spot accumulates in the oil sump ❽ and will be pumped back to the oil tank by the suction pump ⓫ via hose nipple ⓾ and separate line ❾.

◆ NOTE: The suction pump is also a trochoid pump and will be driven as well as the main oil pump ⓬ by the common pump shaft engaging in the cam shaft.



Legend to Pic. 20:

❹ valve housing
❺ pressure spring
❻ ball 5,5 mm dia.
❼ banjo bolt
⓭ oil pump housing (main oil pump)
⓮ oil pump housing (suction oil pump)
⓯ oil pump shaft
⓰ oil inlet
⓱ oil pressure switch
⓲ oil filter
⓳ excess pressure valve

Pic. 20

9.4) Electric system (Ignition, generators)

See Pic. 21.

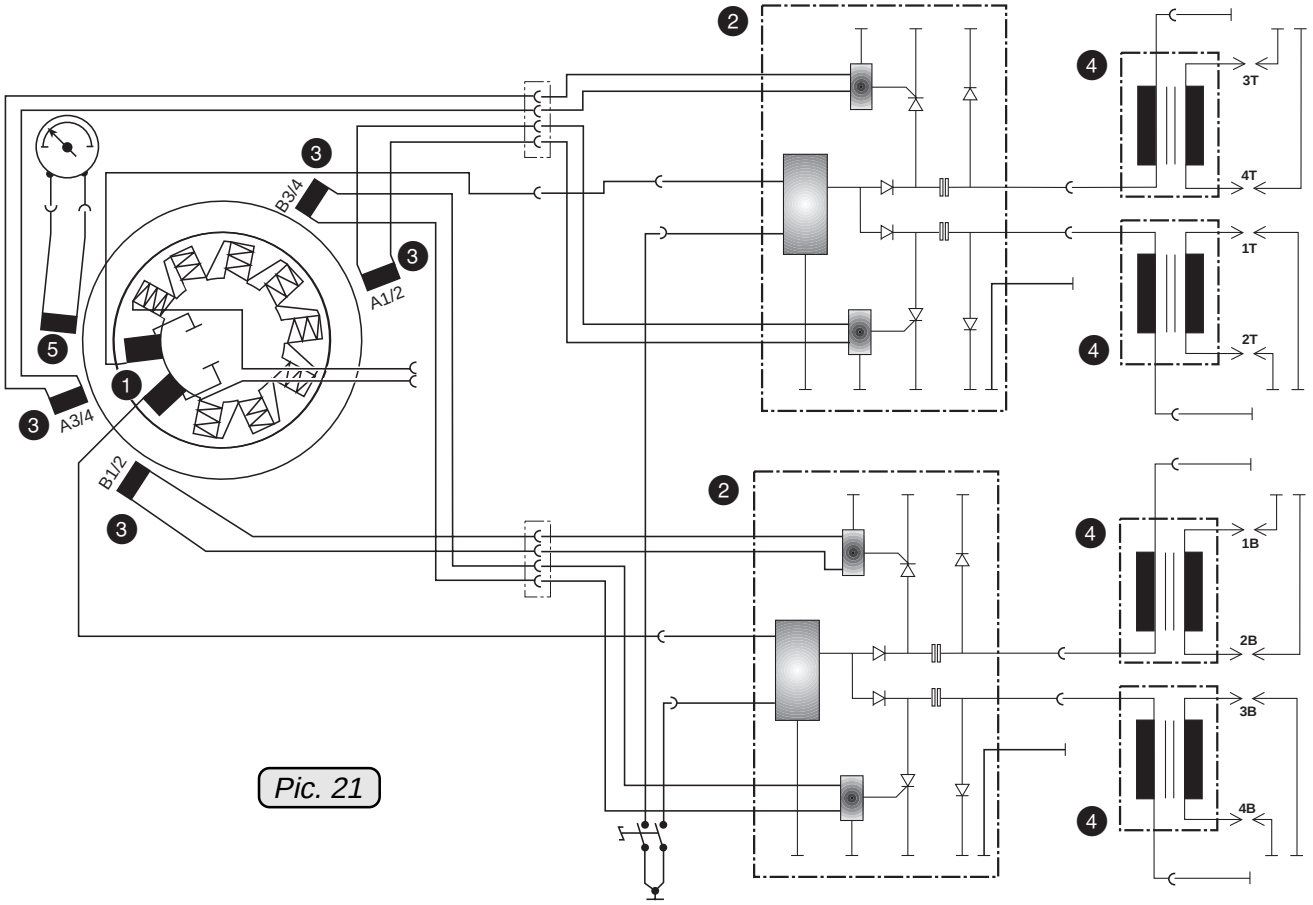
The ROTAX 914 F is equipped with a breakerless Dual Capacitor Discharge Ignition (DCDI).

The ignition unit is completely free of maintenance and needs no external power supply.

Two independent charging coils ❶ located on the generator stator supply one ignition circuit each. The energy is stored in capacitors of the electronic modules ❷. At the moment of ignition 2 each of the 4 external trigger coils ❸ actuate the discharge of the capacitors via the primary circuit of the dual ignition coils ❹.

◆ NOTE: The 5th trigger coil ❺ is provided for the rev-counter signals.

Ignition circuit A (top spark plug)



Pic. 21

Ignition circuit B (bottom spark plug)

The standard equipment includes also an internal generator with external rectifier-regulator (12V 20A DC).

For more power demand installation of an external alternator (12V 40A DC) is feasible.

◆ NOTE: A rectifier-regulator is already integrated in the alternator.

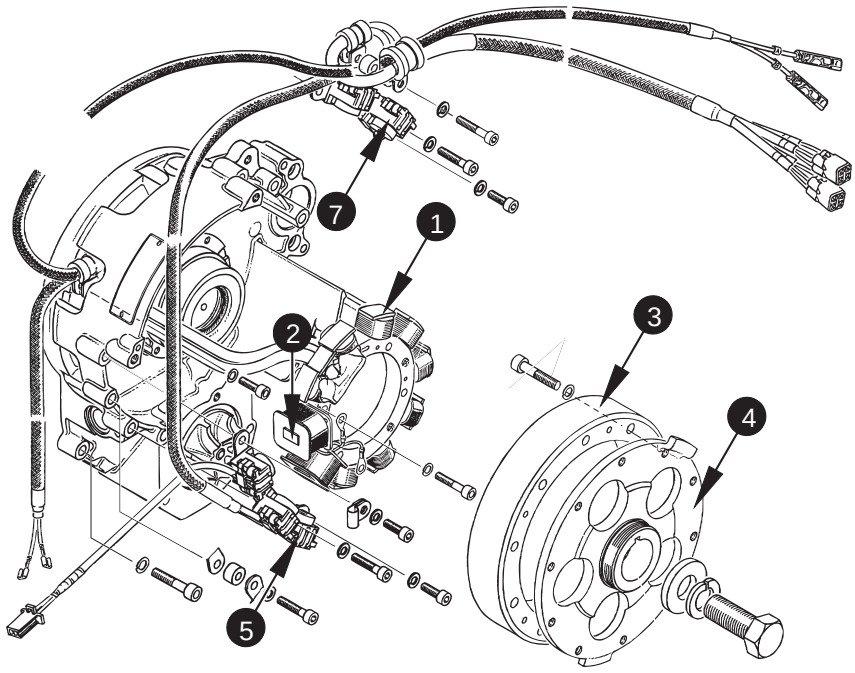
The electric system comprises the **internal generator** with the charging coils for the ignition and the **ignition electrics** with the electronic boxes and the 4 double ignition coils.

➪ **Internal generator:** See Pic. 22.

Consisting of **stator** with 8 lighting coils ❶ and the 2 independent working ignition charging coils ❷ and the ten pole magneto ring ❸.

The magneto ring is attached on flywheel hub ❹ with trigger cams.

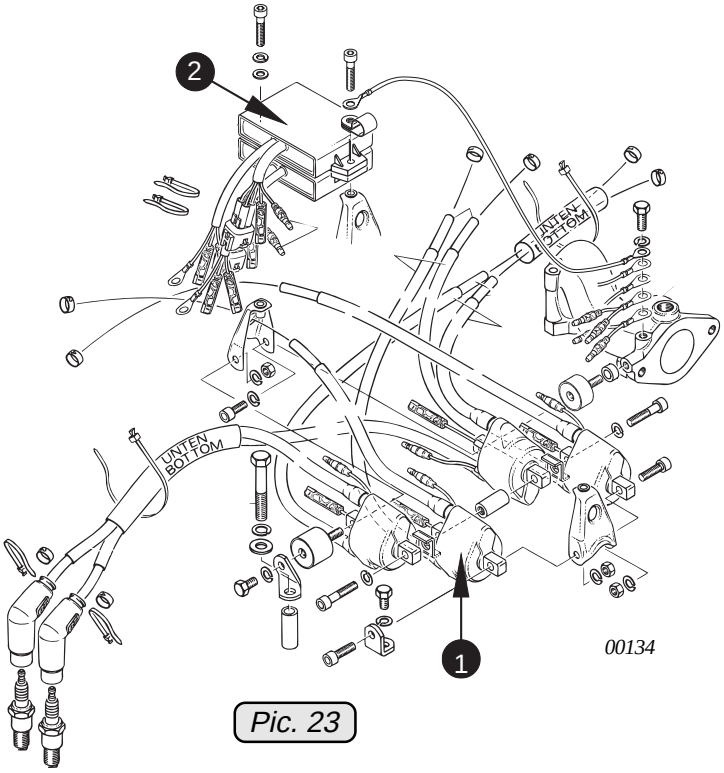
The 4 trigger coils ❺ are fitted externally on generator.



Pic. 22

➪ **Ignition electrics :** See Pic. 23.

The ignition-electrics comprise the 4 double ignition coils ❶ and the two electronic modules placed above ❷, and is supported vibration-damped on 3 silent blocks.



Pic. 23

The 3-point suspension is with one each support on crankcase, ignition housing and intake manifold. For safety reasons, the ignition electrics must not be exposed to ambient temperatures higher than 80°C (176°F).

9.4.1) Ignition

See Pic. 24.

As already stated the engine is equipped with dual ignition of a breakerless capacitor discharge design (DCDI). That means that the ignition unit comprises two independently working ignition circuits (separate trigger coil, electronic module, charging coil etc.).

◆ NOTE: The ignition unit is completely free of maintenance and without any adjustment.

Each ignition circuit consists of two ignition branches. Ignition occurs on cylinder 1 and 2 simultaneously every 360° as well as on cylinder 3 and 4 but 180° offset.

◆ NOTE: Due to engine design ignition occurs also at overlap T.D.C., but this is for engine operation insignificant.

The engine is furnished with an automatic ignition adjustment controlled by the edge of trigger cams on the flywheel and the electronic modules.

◆ NOTE: For easy engine start the ignition timing at start is 4° B.T.D.C. for ignition circuit A and B.

As soon as the engine runs the ignition timing will change over automatically to operation timing of

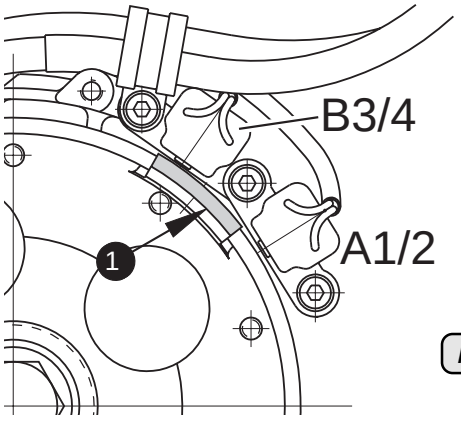
26° BTDC on ignition circuit A and
22° BTDC for ignition circuit B

The transition from start ignition timing to the timing for operation takes place between 650 to 1000 rpm.

◆ NOTE: The different ignition timing for the top spark plugs and the bottom spark plugs take into account the differing ignition lag resulting in better knock behaviour.

The difference in the ignition timing will be achieved by different length of the trigger cam ❶.

Trigger cam for ignition circuit A (raised position) is approx. 4 mm (.16") longer.



Pic. 24

9.4.2) Allocation of trigger coils and ignition circuits

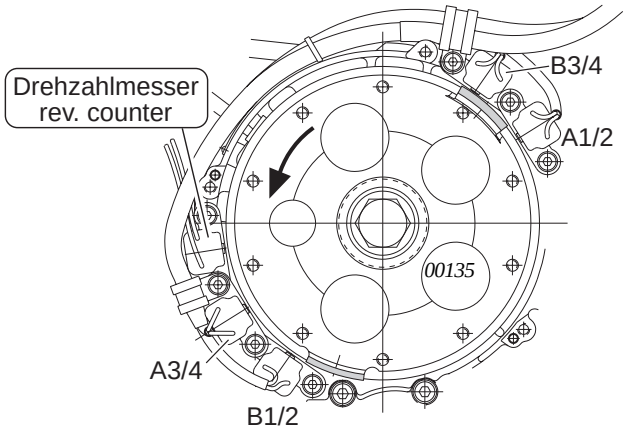
See Pic. 25.

The top placed trigger coils **A1/2** and **A3/4** (in approx. 5 mm higher position) control in conjunction with the top electronic module the top spark plug of the cylinders.

i.e. **Ignition circuit A**: top trigger coils ➪ top electronic module ➪ top spark plugs

Ignition circuit B: lower trigger coils ➪ lower electronic module ➪ lower spark plugs

Legend to Pic. 24 and 25:



Pic. 25

Designation of trigger coils.

e.g. **A3/4** ➪ controls ignition of the top spark plug of cyl. 3 and 4 (ignition circuit **A**)

9.4.3) Firing order

The firing order is **1** - **4** - **2** - **3**.

9.4.4) Ignition cables

The 8 ignition cables are marked with number 1 through 4 for cylinder assignment. 2 cables each are routed together in a protective hose between the cylinder heads.

◆ NOTE: These ignition cables can only be routed into position without spark plug connector.

The connection of ignition cable on ignition coil and spark plug connector is by threaded prong, thus enabling easy exchange.

9.5) Turbo charger and control system

The ROTAX engine 914 F is equipped with an exhaust gas turbo charger, making use of the energy in the exhaust gas for pre-compression of the intake air.

The boost pressure in the airbox is controlled by means of an electronically controlled flap (waste gate) on the exhaust gas turbine.

The actuating off the waste gate is carried out by an electric servo motor.

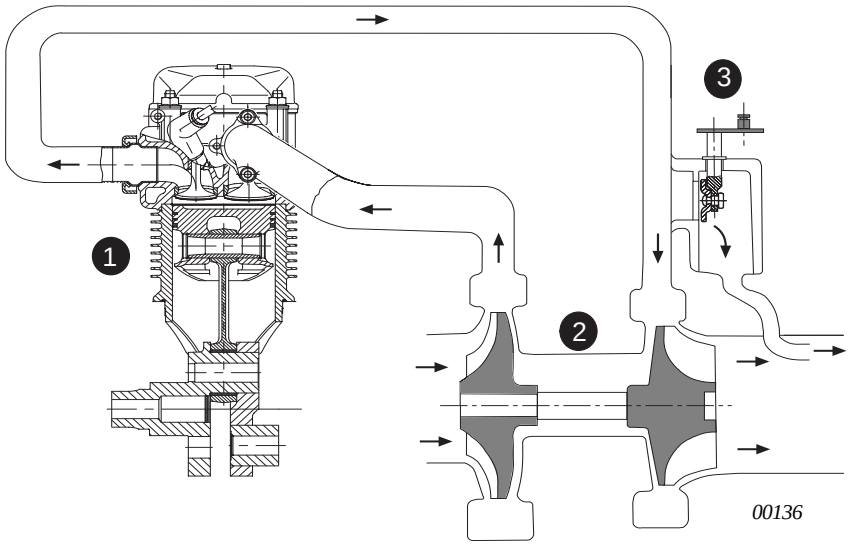
9.5.1) Exhaust gas turbo charger

See Pic. 26.

The exhaust gas turbo charger is basically an arrangement of two turbo machines, a turbine and a blower on a common shaft.

The turbine transforming the energy of the hot exhaust gases drives a blower which aspirates ambient air and transfers it pre-compressed via the carburetors into the cylinders.

The sole operational connection between engine and turbo is the air- and exhaust stream. Speed of the turbo depends mainly on pressure ratio at blower but not directly on engine speed.



Pic. 26

◆ NOTE: Pic. 26 depicts a schematic arrangement of a boost pressure control with the waste gate in exhaust stream

❶ engine
❷ exhaust gas turbo charger
❸ waste gate

Because of the large speed range of the engine and the varying power demand, control of the turbo charger is necessary to achieve the respective target pressure in the airbox.

By action of the waste gate part of the engine exhaust gases bypasses the turbine and flows directly into the muffler.

◆ NOTE: With waste gate completely open, the engine performance can reach up to 70 kW since not all of the exhaust gases bypass the turbine.

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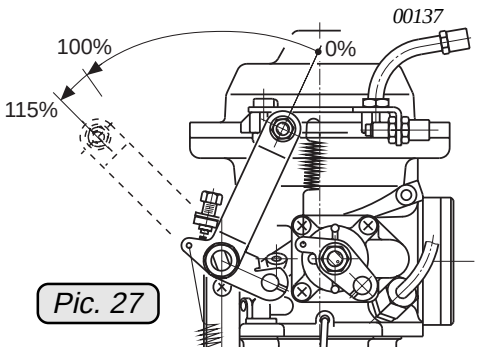
9.5.2) Turbo charge control

9.5.2.1) Control of boost pressure in the airbox



Pic. 27

See Pic. 27/28 and 29.

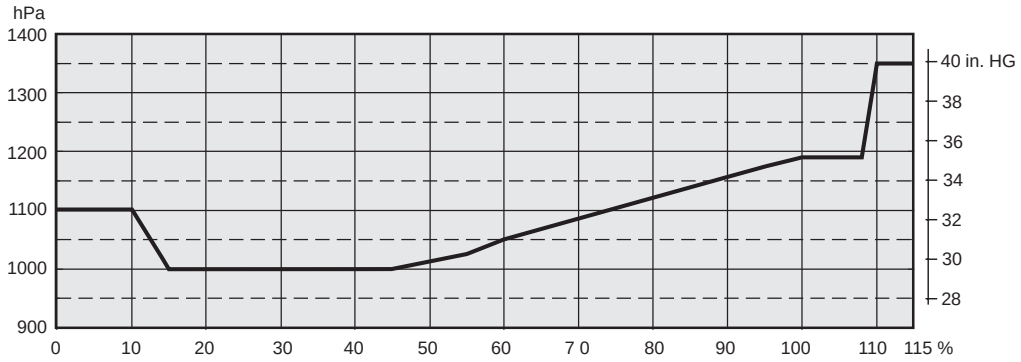
The position of the carb throttle position is signalled by a potentiometer to the TCU where it is transformed in a chosen pattern into target pressure in the airbox.

◆ NOTE: The position of the carb throttle is devided linear from 0 to 115 %.

After comparison of the actual airbox pressure with the target pressure the position of the waste gate will be varied by a servo motor until equalizing of the pressures.

◆ NOTE: With carb throttle closed, although with hardly any exhaust energy at disposal a high boost pressure is specified. The waste gate will then be completely closed and the length of the Bowden cable can be verified or adjusted.

For correlation between throttle position and the target pressure in the airbox refer to the diagram (Pic. 28).



Pic. 28

The most important points for engine operation: 00474

engine performance	throttle position	nominal airbox pressure
idling of engine	~ 0 %	1100 hPa (32,5 in. HG)
max. continuous performance	100 ÷ 108 %	1190 hPa (35,1 in. HG)
take-off performance	110 ÷ 115 %	1350 hPa (39,9 in.HG)

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■ ATTENTION: No steady engine operation is planned between max. continuous power (108 ÷ 110 %) and take-off performance (115 %). Therefore the target pressure rises rapidly between the respective throttle positions and it should not be tried to remain in this phase but to move speedily through this range in both directions to prevent control fluctuations.

◆ NOTE: In the course of model refinement some parameters have been slight changed. Diagram and table show the presently valid state of software.

The electronic TCU (Turbo Control Unit) ❹ is the central processing unit as junction of all engine inputs. For functioning of the TCU following sensors and pick-ups are required.

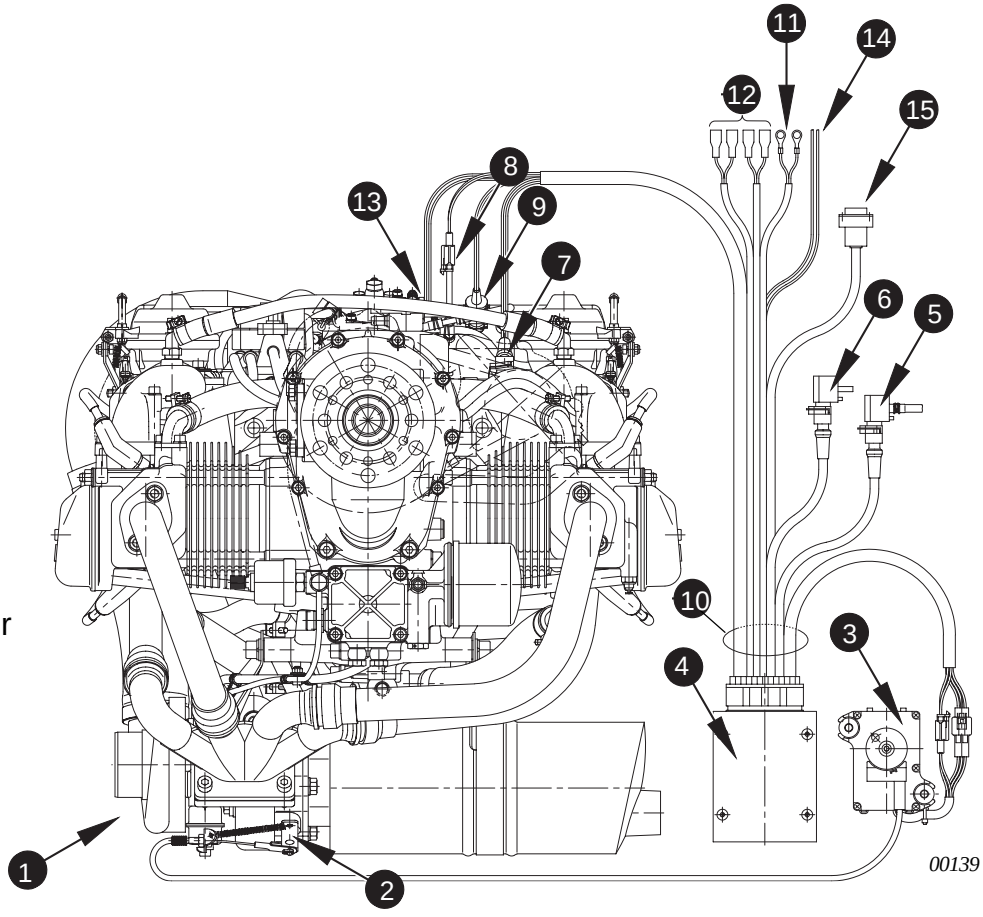
- **airbox pressure sensor ❺**
  provides the actual boost pressure in the airbox
- **static pressure sensor ❻**
  conveys the prevailing atmospheric pressure
- **throttle position potentiometer ❼**
  supplies actual position of carburetor throttle

◆ NOTE: From the inputs of the sensors ❺ - ❼ the target pressure is determined.

- **position of the waste gate**
  supplied directly from position of servo motor
- **rev pick-up ❽**
  transmits the actual engine speed by the 5th trigger coil on ignition housing
- **airbox-temperature sensor ❾**
  conveys the prevailing air temperature in the airbox

All the sensors are connected with the TCU via a common cable harness ❿. Beside the power supply ⓫ for the TCU the following further connections are provided on the cable harness.

- plug connections ⓬ for one each warning and caution lamp
- plug connection ⓭ for the 3-way solenoid valve
- 2 wires for an additional eletronic rev-counter ⓮
- PC interface ⓯ for reading the TCU data by a computer.



❶ turbo charger
❷ waste gate
❸ servo motor

Pic. 29

9.5.3) Reduction of the target pressure

Provision for target pressure reduction depending on various effects as protective measure against overstressing the engine.

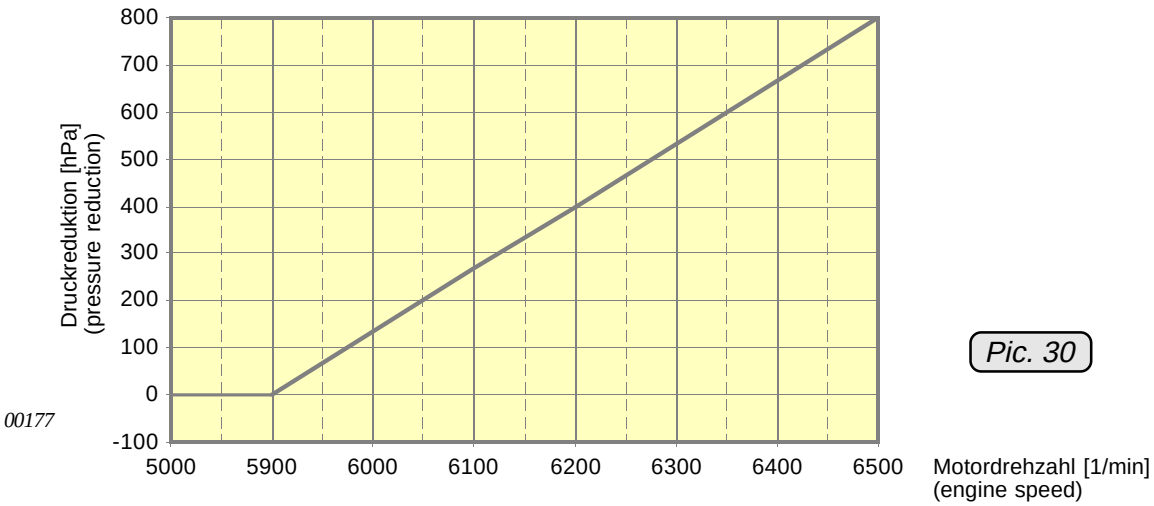
9.5.3.1) Target pressure reduction at overspeeding

See Pic. 30.

The pilot is responsible to prevent engine speed in excess of 5800 rpm and has to reduce early enough engine performance at fast flight and descent when using a fix pitch propeller.

Only in case of omission by the pilot, the TCU will lower the desired pressure when engine speed exceeds 5900 rpm by opening the waste gate and thus reducing boost pressure. See relevant diagram.

■ ATTENTION: The automatic opening of the waste gate by the TCU is an emergency measure only in the event of a pilot error but is not releasing the pilot to reduce the engine performance.



Pic. 30

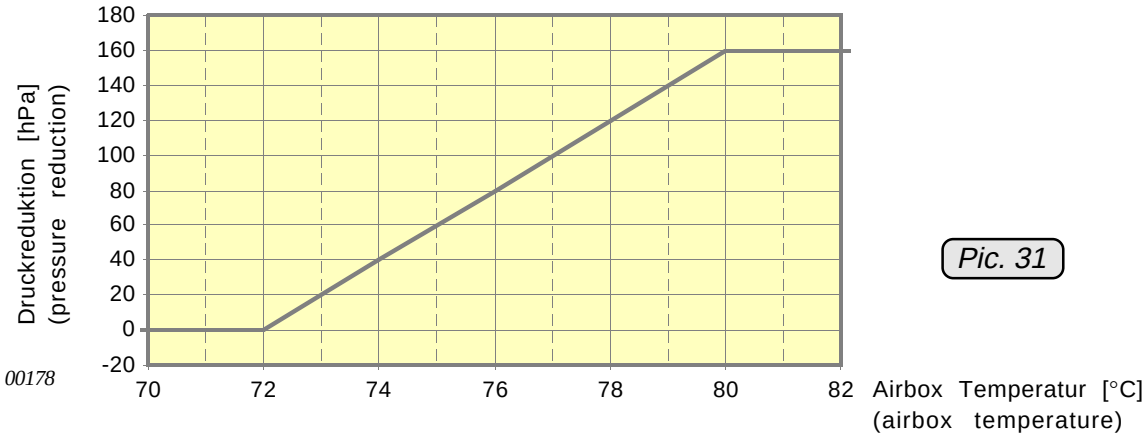
e.g. at take-off performance (throttle position 115 %)

- ➪ **target pressure** 1350 hPa (without limitation)
- ➪ at engine speed of 6100 rpm ➪ **lowering of the target pressure** approx. by 265 hPa (according to diagram).
- ➪ actual boost pressure now 1085 hPa ➪ corresponds to a **performance** of **70 kW** instead of 84,5 kW**.**

9.5.3.2) Target pressure reduction at excessive airbox temperature

See Pic. 31.

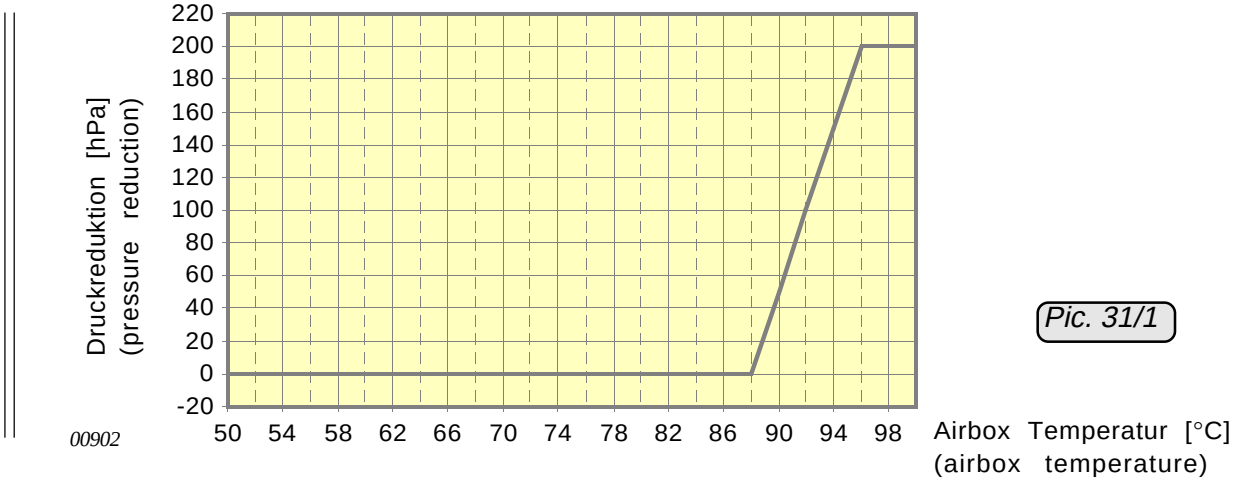
During compression process in the turbo charger the intake air will be heated. To reduce the risk of knocking combustion at high boost pressure with high intake air temperature, lowering of the target pressure will start at 72°C (162°F) airbox temperature. See diagram, Pic. 31.



Pic. 31

Boost pressure reduction will result in a drop of performance e.g. the power drop can reach up to 10 kW at 80°C airbox temperature.

◆ NOTE: On TCU part no. 966.741 the target pressure reduction starts at 88° C. See Pic. 31/1.



Pic. 31/1

9.5.3.3) Target pressure reduction by limiting the compressor pressure ratio

The max. charging speed of approx. 165 000 rpm must not be exceeded to prevent vibration resonances. Since the charger speed can be deduced exactly enough from the pressure ratio, this ratio is limited to max. 2,6.

Example: e.g. at density altitude of 5500 m

atmospheric pressure approx. 500 hPa

max. permitted boost pressure (regarding deactivation) 500 x 2,6 = **1300 hPa**

i.e. no reduction of the target pressure since this boost pressure cannot be reached at all in this altitude.

Explanation:

The critical flight level for max. continuous power is reached at 4500 m. Because of the low density in this altitude, the actual boost pressure is only approx. 1140 hPa, even with the waste gate completely closed.

Deactivation would not start until airbox pressure of 1300 hPa is reached.

◆ NOTE: Deactivation happens very rarely and only under certain climatic conditions and altitudes.

9.5.4) Output connections on the TCU for lamps

The TCU is furnished with output connections for an external **"red"** warning lamp and an **"orange"** caution lamp.

When switching on the TCU the two lamps are automatically subject to a function test. Both lamps light up for 1 to 2 seconds and then extinguish.

Orange caution lamp:

Supervision of all sensor inputs by this lamp of the TCU.

The non-ligthing lamp indicates that the TCU is ready for operation. A lamp keeping blinking indicates a malfunction of the TCU or its periphery.

At trouble, for instance if the wiring is interrupted, the TCU switches over to pre-programmed default values to warrant engine operation.

■ ATTENTION: Whilst the default values are effective, supervision of the respective channel e.g. overspeeding, is not possible. Supervision is set **inactive.**

Red warning lamp:

➪ Exceeding of the admissible boost pressure will activate the red boost lamp and it will keep lighting until boost pressure falls below threshold.

Threshold ..... 1550 hPa (actual boost pressure)

➪ The TCU registers the time of full throttle operation with boost pressure. Full throttle operation for longer than 5 minutes will make the red warning lamp blinking.

■ ATTENTION: The red warning lamp helps the pilot to avoid full power operation with too high boost pressure for longer than 5 minutes as otherwise the engine would be thermally overstressed.

◆ NOTE: The time observation starts at actual boost pressure of 1250 hPa. After 5 minutes the warning by the red warning lamp will follow.

The warning stops again as soon the boost pressure falls below 1250 hPa. If the pressure is exceeding again, warning by red warning lamp starts anew.

9.5.5) 3 way solenoid valve (economy valve)

The TCU controls the 3 way solenoid valve as well, which brings about that the varying pressure acts upon float chamber. For further information refer to chapter 9.2.5.

◆ NOTE: The solenoid valve is inactive below the threshold.

9.5.6) PC interface

The TCU incorporates a sequential interface. By using a specially developed program all input and exit signals of the TCU can by observed, checked and if need be recorded.

This program allows quick and efficient error diagnostic without disassembling the complete control unit.

With this program the operation of the 2 pressure sensors, temperature sensors, rev pick-up, throttle and waste gate position and a lot more can be supervised and recorded.

◆ NOTE: This system works "**online**" i.e. if need be also during engine operation.

If allows the engineering staff to check and record TCU data during flight.

These recordings can then be evaluated on a graph and facilitate problem finding. Further on, these recordings can be used as document for engine repair and overhaul.

◆ NOTE: This communication program is not in the supply volume of the engine but is readily available as spare part from the respective dealer.

9.6) Propeller gearbox

Reduction ratio, crankshaft to prop shaft is **2,4286 to 1**.

The propeller shaft is driven by the crankshaft via a straight spur gear ❶.

The design incorporates a torsional shock absorber. The shock absorbing is based on progressive torsional cushening due to an axial spring load ❸ acting on a dog hub ❷.

The design includes also a friction damped free movement at the dogs to warrant proper engine idling. Due to this backlash at the dogs a distinct torsional impact arises at engine start and stop and at sudden load changes, but due to the integrated overload clutch it will remain harmless.

◆ NOTE: This overload clutch ❹ will also prevent any undue load to the crankshaft in case of ground contact of the propeller.

9.6.1) Gearbox version

See Pic. 32.

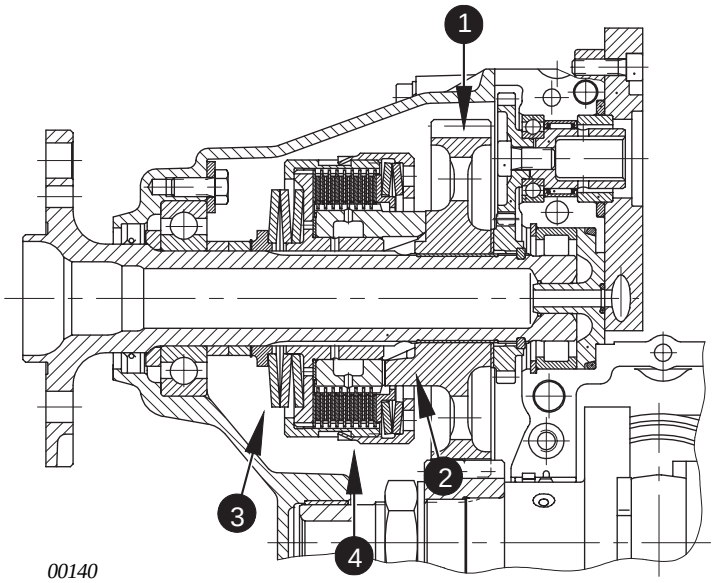
3 gearbox versions are provided for Engine Type 914 F.

➪ **Version F2:**
Hollow prop shaft with flange for fix pitch propeller of for propeller electrically in-flight adjustable.

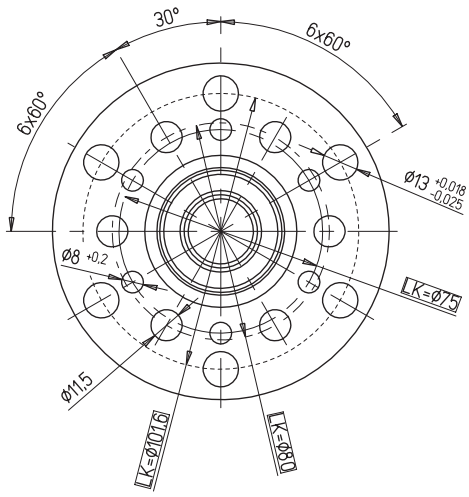
➪ **Version F3:**
Propellershaft with flange for variable pitch prop and drive for hydraulic controlled constant speed propeller.

➪ **Version F4:**
Propellershaft with flange for fix pitch prop but prepaired for retro-fitting of hydraulic controlled constant speed propeller.

◆ NOTE: The propeller flange and hub is equal on all three gear box versions.



Version F3



Version F2, F3 and F4

Pic. 32

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9.7) Connections for instrumentation

■ ATTENTION: Consult also the relevant chapter in the Installation Manual.

9.7.1) Mechanical rev. counter and hour-meter

Drive from camshaft via an angular drive to rev. counter shaft and a flexible rev. counter shaft to a combined instrument, i.e. rev. counter and hour-meter. Subsequent installation of a rev. counter shaft is possible after removal of rev. counter cover on ignition housing.

9.7.2) Electronic rev. counter

On the ignition housing there is an inductive pick-up triggering one each positive or negative impulse at every turn of the crankshaft. The rev. counter is an AC instrument.

9.7.3) Oil pressure indication

Via an electric resistance pick-up attached on oil pump with connection to indicating instrument.

9.7.4) Oil temperature indication

The sensor for the oil temperature is fitted in the oil pump housing. The sensor is a thermo switch with changing resistance according to oil temperature.

9.7.5) Cylinder head temperature monitoring or temperature warn switch

In the cylinder heads of cylinders 2 and 3 temperature sensors are installed. They survey the material temperature of the head, not the coolant temperature. The temperature sensor may be connected alternatively to a monitoring instrument of a temperature warn switch.

9.7.6) Exhaust gas temperature monitoring

The exhaust gas temperature is surveyed by 4 thermocouple sensors (NiCrNi) on the exhaust manifold and indicating instrument on panel.

9.7.7) Airbox temperature indication

For readings of air temperatures in the airbox a connection is provided. This connection is closed on the standard engines by a plug screw.

9.7.8) Boost pressure observation

A Connection is proveded for an absolute pressure gauge in the compensating tube of the two carburetors.

9.7.9) De-icing system and winter operation

The risks of carburetor icing are commonly known. By air preheating the icing of air humidity in the carburetor may be avoided. ROTAX does not supply any carburetor preheating device.

▲ WARNING: Carburetor icing is a common cause for engine trouble.

Because of the heating up of intake air due to boost process preheating of the intake air might not be necessary. But the option of a change over for air intake from engine compartment is recommended as for instance the filter could be blocked by icing.

Preheating of the intake air will result in loss of engine performance because of lowering the air density.

A further measure to reduce the risk of carburetor icing is by proper handling of the fuel. Install also a generously dimensioned water drap in the system to avoid formation of ice in the fuel lines, filters etc.

Always take care at operation in wintertime of correct coolant mixing ratio. To warrant trouble-free engine start also at low temperatures observe the special directives in the Operator's Manual.

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10) Auxiliary units

10.1) Hydraulic governor

The engine version 914 F3 will be supplied with a fitted hydraulic governor for usage with a constant speed propeller. The hydraulic governor is retrofitable on engine version F2 and F4 by adding the drive kit for the governor in prop gear and crankcase and oil supply line to governor and prop shaft (on F2 and F4 engine version).

- ➪ on version 914 F2 the hollow prop shaft has to be exchanged also for the correct one
- ➪ on version 914 F4, the prop shaft can remain as it is of the same design with the exception that the inside bore is plugged. After removeal of the plug the propeller shaft is suitable for use with governor.

◆ NOTE: Installation of both, the hydraulic governor and vacuum pump is not possibel.

Transmission ratio crankshaft: prop shaft .....51: 21, i = 2,4286
Transmission ratio propshaft: governor .....22: 29, i = 0,7586
Direction of rotation..... i = 1,842

◆ NOTE: The reduction ratio between crankshaft and vacuum pump or hydraulic governor is 1,842 i.e. these units run with 0,54 of engine speed

reduction ratio total .....anti-clockwise, looking at governor flange

10.2) Vacuum pump

It is possible to install a vacuum pump for employment of an inertial navigation system. For that the drive kit for the vacuum pump has to be retrofitted on prop gearbox and crankshaft.

◆ NOTE: Installation of both, the vacuum pump and hydraulic governor is not possible.

Transmission ratio: Vacuum pump and hydraulic governor are driven the same way and therefore have the same total reduction ratio. See hydraulic governor.

10.3) Mechanical rev. counter

Drive for the mechanical rev-counter from camshaft. The engine is prepared for later installation of the rev-counter shaft. Just remove rev-counter cover, install retro-fit items and connect flexible shaft to indicating instrument.

The total transmission ratio from crankshaft to flexible shaft i = 4

10.4) External Alternator

The internal generator can supply approx. 20A DC. To meet an increased energy demand, installation of an external 40A alternator is possible, either at serial production or as retrofit kit later on.

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11) Maintenance

In this chapter the maintenance of engine 914 F is described. The description is subdivided into sections and description of function of the various systems. Some overlapping maintenance instructions are treated as generally valid information at the beginning of this chapter.

The information given in the Maintenance Manual is based on data and experience which are considered to be applicable for a skilled mechanic under normal working conditions. The guidelines given in the Maintenance Manual are useful and necessary supplements to training. They, however, cannot substitute competent theoretical and practical personal instruction.

Maintenance of engines and systems requires special knowledge and special tools. See also Chapter 11.3) to 11.7).

We particularly emphasize that parts and accessories not supplied as genuine ROTAX parts are not verified for suitability by ROTAX and thus are not released for use. Installation and/or use of such products may possibly change or negatively influence the constructive characteristics of the engine. For damages resulting from use of non-genuine parts and accessories ROTAX refuses any liability.

Non-authorized modifications as well as the use of components and auxiliary components not corresponding to the installation instructions exclude any liability of the engine manufacturer.

Besides our instructions in the documentation supplied, also respect the generally valid safety and accident preventive directives and legal regulations.

11.1) General proceeding instructions

When carrying out maintenance and service work, respect without fail the safety regulations. At maintenance of cooling-, lubricating and fuel system take care without fail that no contamination, metal chips, foreign material and/or dirt enters the system. Use only mallet (plastic or rubber) for dis- and re-assembly of parts of the engine.

Never loosen or tighten screws and nuts with pliers but only with the specified tools.

Before every re-assembly check assembled components whether parts are missing. Only use the gluing-, lubricating and cleaning agents and solvents indicated in the maintenance instructions. If not respected, damage may be the consequence.

Exactly observe the tightening torques for screws and nuts. Overstretching or too loose tightening may cause severe engine damage.

Before re-using parts disassembled, clean, check and refit them per instructions.

11.2) Trouble shooting

In the Operator's Manual there is a list of possible failures as well as indication of possible remedy.

See Chapter 12) in the Operator's Manual for engine type 914 F.

11.3) Basic information

▲■ To warrant for correct servicing of the engine, the use of genuine spare parts is required. Use of special tools, devices and lubricating media is necessary.

▲ **WARNING: Only qualified personnel (authorized by the local airworthiness authorities) trained especially for this engine are allowed to carry out the maintenance and servicing work.**

▲■ Only use clean screws and nuts. Check the contact faces and threads for damages. In case of doubt, use new screws and nuts.

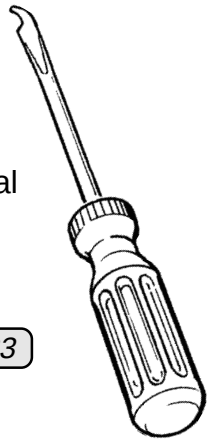
■ Always replace self-locking nuts once unscrewed.

■ Respect without fail the tightening torques indicated in the respective table.

■ Replace all sealing rings, gaskets, lock washer, O-rings and oil seals at engine re-assembly.

11.4) Auxiliary tools

See Pic. 33.



Pic. 33

00141

- Screwdriver ground to shape for piston pin circlip removal (see Pic. 33)
- compression tracer and 2 pressure gauges, adapter for dial gauge in spark plug thread
- valve spring pliers
- step punch for valve guide
- adjustable reamer 6,5 ÷ 7,5 mm
- valve seat rework set, valve lapping paste
- gearbox support plate
- stud extraction tool
- scraper, lapping fleece, grinding tool, cover sheet, adhesive tape
- cleaning agent, approved cleaners, funnel, graphite marker.
- magnetic particle tester DEUTROFLUX, series UHW, or adequate. These testers are suitable for complete combined magnetic particle crack inspection of all ferromagnetic materials. For this purpose an A.C. field circulation can be combined with a shifted phase A.C. circulation . Both magnetizing methods are independent from each other and can be applied separately.

  To achieve the direction changes of the magnetic field vector necessary for indication of cracks in any direction, the alternating current serving as current supply for the different methods of magnetizing are dephased by 120° to each other:

  a) current circulation for longitudinal cracks

  b) field circulation for transverse cracks

  c) auxiliary circulation for axial and radial crack indication on parts with through by using an electric auxiliary conductor (copper bar).

11.5) Measuring tools

Vernier callipers,

dial gauge,

micrometer, internal micrometer,

feeler gauge,

spring scale up to 50 kp (500 N).

Stroboscope: BOSCH 0 684 100 308 or equivalent. Supply voltage 8 - 15 V. Flash triggering by inductive pick-up. Flashing frequency 4500 per minute

Multimeter: FLUKE series 70, series 80 or equivalent.

Electronic, 3 1/2 digits indication.

Current range 10 A.

Direct voltage range 200 V minimum.

Resistance range 200 Ω ÷ 2 MΩ

Accoustic continuity tester.

Oscilloscope: TEKTRONIX 2225 or equivalent

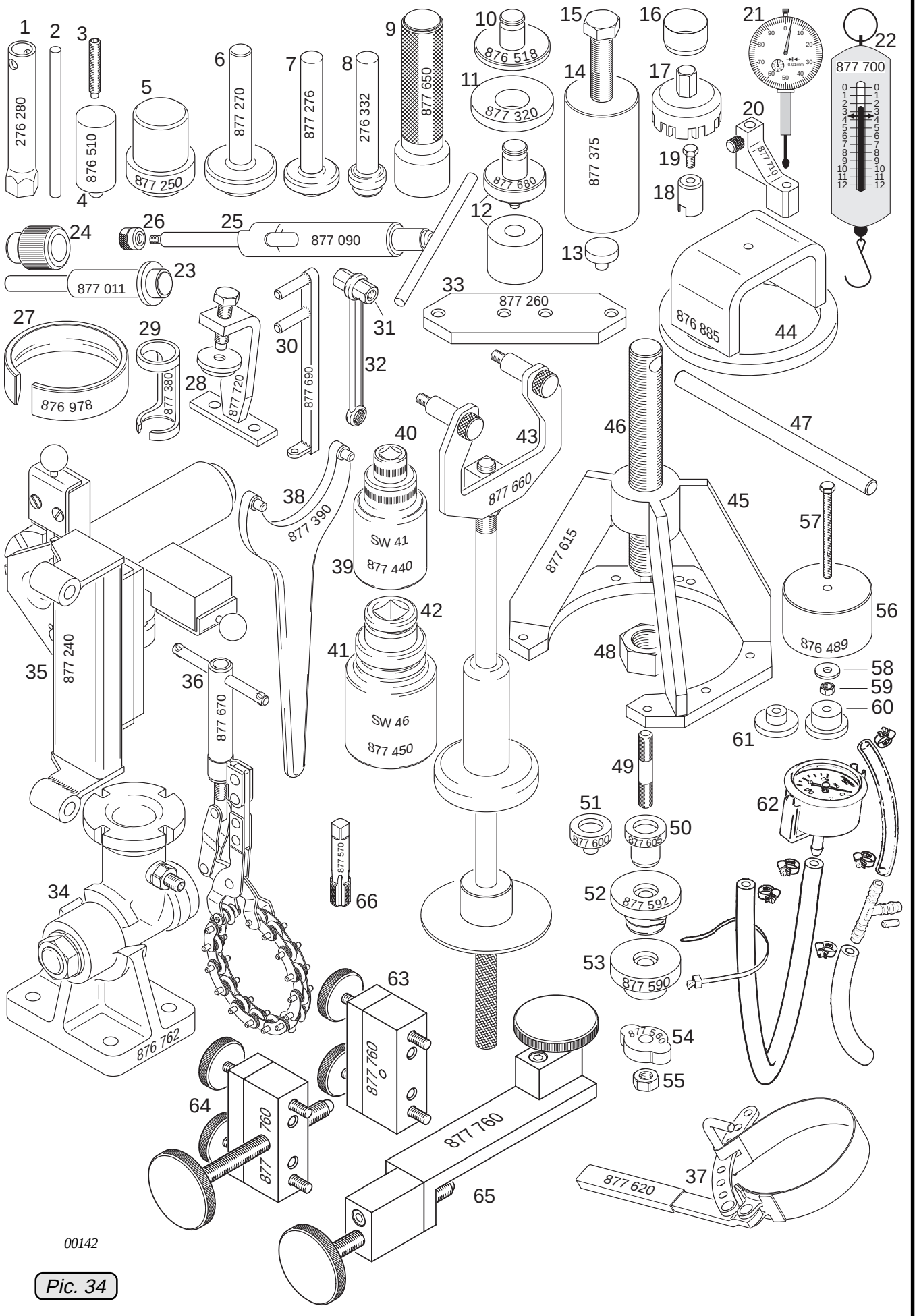
2 channels

Analogous

Sensitivity 5 mV to 5V/div

Frequency limit 50 MHz

▲ WARNING: Using these instruments, observe the manufacturer's specifications.



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Pic. 34

Page	Date	Main	Reference	Modification no.
72	1997 02 01	914 F		- 0 -

11.6) Special tools and devices

See Pic. 34.

The following tools and devices are also indictaed in the spare parts list.

Pic. Nr.	Part-No.	Description, application	quantity
1	276 280	spark plug wrench 16 a/f	1
2	977 420	handle 8x130-10 for spark plug wrench	1
3	240 880	threaded pin DIN 915-M8x50 for crankshaft locking	1
4	876 510	insertion punch for oil seal (12x30x7), water pump shaft	1
5	877 250	insertion punch for rotary seal	1
6	877 270	insertion punch for oil seal 32x52x7, crankshaft, magneto side	1
7	877 276	insertion punch for oil seal 22x32x7, vacuum pump	1
8	276 332	insertion punch for pressing out needle sleeve 22x28x12 and ball bearing 15x32x8, vacuum pump	1
9	877 650	handle for various insertion punches	1
10	876 518	insertion punch for oil seal 40x55x7, gearbox cover	1
11	877 320	insertion ring for ball bearing 35-72-17 propeller shaft, use together with insertion punch 876 518	1
12	877 680	insertion punch with sleeve... for oil seal 6x11x3/4,5 of rev. counter housing	1
13	877 410	protection piece for crnakshaft, magneto side	1
14 - 15	877 375	extractor assy. for magneto flywheel	1
15	841 875	hex. screw M16x120 DIN 931 for extractor	1
16	877 360	insertion sleeve for oil seal 32x52x7, crankshaft, magneto side	1
17	877 295	impeller spanner for water pump impeller	1
18 ÷ 19	877 730	float level gauge assy., for check of float lever	1
19	240 381	hex. screw M6x12 DIN933-8.8 for float level gauge	1
20	877 710	dial gauge adapter assy.,	1
21	876 950	precision dial gauge	1
22	877 700	spring scale for check of valve spring force	1

23 ÷ 24	877 016	circlip installation tool assy., ... 1 for fitting of piston pin circlips
23	877 011	insertion punch ..... 1 for piston pin
24	877 021	locating sleeve ..... 1 for fitting of iston pin circlips
25 ÷ 26	877 090	piston pin extraction tool assy., ... 1 for fitting and removal of piston pin
26	877 155	extracting nut M6 assy., ... 1 for piston pin extraction tool
27	876 978	piston ring spanner ..... 1 for piston 79,5 mm dia.
28 ÷ 29	877 720	valve spring clamp ..... 1 for removal of valve springs
29	877 380	valve spring mounting device ..... 1 for removal and isntallation of valve springs
30	877 690	test lever ..... 1 for check of valve spring force
31	242 660	distance nut spanner M8x33 ..... 1 fixture for vacuum pump drive sleeve
32	876 470	ring spanner 10/13 a/f 1
33	877 260	cylinder aligning tool ..... 1 to align cylinders
34 ÷ 35	877 230	trestle assy., ... 1 for engine fixation
34	876 762	trestle support 1
35	877 240	mounting plate assy., ... 1
36	877 670	cutting tool ..... 1 for oil filter
37	877 620	oil filter wrench 80-110 ..... 1 for oil filter removal
38	877 390	pin-face wrench A90 DIN 3116 ..... 1 for overload clutch
39 ÷ 40	877 445	socket 41x12,5 assy., ... 1 for hex. nut 41 a/f, crankshaft p.t.o. side
39	877 440	socket S 41x20 L DIN 3124 1
40	877 460	reduction socket A 20x12,5 ..... 1 3/4" to 1/2", for socket wrench 41 a/f
41	877 450	socket S 46x20 L DIN 3121 ..... 1 for hex. nut 46 a/f, crankshaft magneto side
42	877 465	reduction socket 3/4x1 ..... 1 1" to 3/4", for socket wrench 46 a/f
43	877 660	puller assy., ... 1 for gearbox
44	876 885	mounting yoke ..... 1 to compress dog gear
45 ÷ 48	877 615	puller assy., ... 1 for prop shaft, roller bearing 25x52x15 and oil seal 30x52x7

46	877 580	pull-in spindle M24x1,5	1
47	276 155	handle 12x250	1
48	842 585	hex. nut M24x1,5 length 19	1
49	941 180	stud M10x45/20 for roller bearing 25x52x15 and oil seal 30x52x7	1
50	877 605	protection piece for propeller shaft F2	1
51	877 600	protection piece for propeller shaft F3 and F4	1
52	877 592	protection piece for roller bearing 25x52x15 and oil seal 30x52x7, for F2	1
53	877 590	protection piece for roller bearing 25x52x15 and oil inlet flange, for F3	1
54	877 560	puller plate for roller bearing 25x52x15, oil seal 30x52x7 and oil inlet cover	1
55	242 091	hex. nut M10 for roller bearing 25x52x15, oil seal 30x52x7 and oil inlet flange	1
56 ÷ 59	876 489	puller cap assy., for ball bearing 15x32x8, needle baring 22x28x12, oil inlet flange and oil inlet cover	1
57	941 730	hex. screw M6x80 DIN 933	1
58	827 305	washer 6,2/18/2	1
59	242 211	hex. nut M6 DIN 934	1
60	877 597	protection piece for needle bearing 22x28x12, vacuum pump and govern.drive	1
61	877 595	protection piece for ball bearing 15x32x8, vacuum pump and governor drive	1
62	874 230	fuel pressure gauge	1
63-65	877 760	crankcase splitting tool assy.,	1
66	877 570	hand tap drill M18x1 to clean the tapping at exchange of coolant bends	1

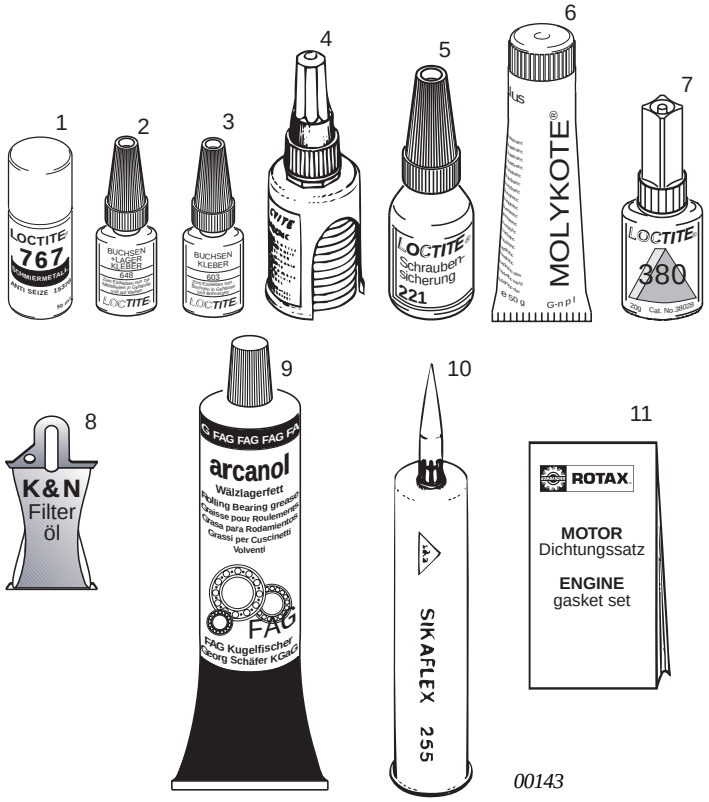
11.7) Consumables

See Pic. 35.

■ ATTENTION: Only use the material specified for the respective maintenance works.

The material specified have been tested for a long time and are suitable for all operating conditions indicated by the manufacturer.

Pic. No.	Part-No.	Description, application	quantity
1	297 431	LOCTITE Anti-Seize, to prevent matal galling	10 g
2	899 788	LOCTITE 648 green, securing agent, high strength bond	5 g
3	899 789	LOCTITE 603, securing agent, high strength bond	10 ml
4	899 784	LOCTITE 574 orange, sealing compound	50 cm^3
5	899 785	LOCTITE 221 violet, securing agent, low strength bond	10 cm^3
6	297 433	MOLYKOTE G-N, lubricant	100 g
7	897 511	LOCTITE 380 black, adhesive, medium strength bond	20 g
8	897 330	Lithium grease, to prevent leakage current	250 g
9	897 870	K&N filter oil 99 - 1131, bag	58 ml
10	297 710	PU-adhesive, for vibration damping	310 ml
11	996 942	gasket set, for the complete engine, incl. carburetor and electr. starter	1



Pic. 35

11.7.1) Motor oil

Consulg chapter 10.2.) "Operating Media" in the Operator's Manual 914 F.

In principle motor oil is used for lubrication of components during re-assembly, except where specified otherwise. Use only oils specified in the "Chart of Lubricants" in order to avoid chemical reaction.

11.7.2) Lithium grease

Is used on all electrical connections, to avoid leaking current. After assembly is complete, apply Lithium grease to the connection as anti-corrosive.

11.7.3) Multi-purpose grease LZ

Generally usable, neutrally coloured multi-purpose grease, water resistant and highly adherent. Usable for temperatures from -35°C to +120°C (-31°F to 248° F). High load capacity.

11.7.4) Corrosion inhibiting oil MOBILARMA 524

Corrosion inhibiting oil, insoluble in water, hydrocarbon basis with additives. The pour point is below -18° C (-3° F).

▲ WARNING: When handling chemicals, respect the generally valid safety directives.

11.7.5) Grease MOLYKOTE G-N

Is used on highly loaded bearing positions as initial lubrication and at press fits for prevention of fretting corrosion. MOLYKOTE is applied to both components mated. It is especially mentioned where to use it.

11.7.6) LOCTITE Anti-Seize 76710

High-temperature lubricating and anti-corrosion agent. LOCTITE Anti-Seize is always applied on both components mated and warrants for maintenance-free bearing seats due to the hermetically sealed sliding surface.

11.7.7) PU adhesive

Serves as damping medium to prevent cable breakage due to vibration. It was used e.g. formerly on pick-up connections on the ignition housing.

11.7.8) SILASTIC

Multipurpose one component sealing compound on silicone base, e.g. SILASTIC 732.

Especially suitable for maintenance and repair. Vulcanizes at room temperatures to a viscous rubber mass and is resistant against chemicals.

To be applied only on clean, dry and grease free-foundation.

11.7.9) LOCTITE "574 orange"

Is a sealing material used as alternative to conventional solid gaskets where a high friction factor and exactly defined distance between parts is required. LOCTITE sealing compound is a solvent-free liquid gasket applied to the sealing surfaces. After assembly it cures under hermetical conditions with metal contact within several hours. This gives a sealing completely adapted to the surface structure of the parts to be sealed.

Its surface sealing properties are guaranteed for temperature range between - 55°C and + 200°C (- 67°F to + 390°F). No corrosion is possible in the sealing gap.

11.7.10) LOCTITE "380 black"

Adhesive suitable for materials of different properties. Suitable for medium duty connections. Its cure time depending on the materials is max. 12 hours and it resists temperatures from -55° C (- 67°F) up to +150° C (300° F).

11.7.11) LOCTITE "648 green"

Heavy duty adhesive or screw securing agent. Its cure time depending on the materials and temperatures is max. 12 hours and it resists temperatures from -55° C (- 67°F) up to +175° C (347° F). To separate parts secured by this agent, it may be necessary to heat the parts to approx. 250° C (480° F).

11.7.12) LOCTITE "221 violet"

Medium duty adhesive or screw securing agent suitable for materials of different properties. In case of strain the stress is distributed evenly over the whole surface of connection. The adhesive connection creates hermetic sealing for gas and liquids. This sealing property protects the parts from corrosion.

LOCTITE 221 is suitable for screws and nuts up to M12 threads and for low duty connections.

11.7.13) MICRONORM shot blasting abrasive

This abrasive is suitable for local and gradual very fine treatment of steel parts with rust film (propeller shaft). The MICRONORM shot blasting abrasive does not contain any noxious matter, is approved by the competent authorities and warrants for optimum cleaning. The granulates used are of sizes 40 to 60 µ. The surface roughness to be achieved is 0,5 - 1 µ representing a microfinish of the parts.

11.7.14) Lapping fleece SR 4600 A - very fine grading

Is sold by the meter and used for manual removal of smaller rust spots or oxidation, especially for optimum ground connections. It is most appropriate to remove LOCTITE from surfaces or threads to make them metallic clean. Before re-applying LOCTITE, clean surfaces with nitro-thinner or degreasing agent (CASTROL ZA 30 or OMV - SOFT SOL). When using solvents, mind the safety regulations for persons and environments.

11.7.15) Cleaning agents

Clean all parts thoroughly before inspection.

■ ATTENTION: Generally all metal components will be rinsed in a suitable cleaning agent, with the exception of hydraulic tappets, pushroids and rocker arms.
On the above mentioned exceptions just let the oil drip off and wipe with a non-frying rag. At the disassembly components were marked to prevent any mix-up. Take care of these marks, daon't ruin them.

▲ WARNING: Use only approved cleaning agents (e.g. fuel, kerosine, varsol, etc.) for cleaning metal parts.

Do not use cold cleaner on lye basis or degreasing agents. Do not clean coolant- and oil hoses with aggressive solutions. Clean off remains of sealing compound with sealant remover.

Soak combustion chamber, piston and cylinder head with cleaning agent and remove combustion residues with a bronze brush. Very good experience was made with CASTROL "Clenvex 2000" as cold cleaning agent on basis of laboratory fuel and kerosine. It is a solvent - cold cleaner, free of halogen, on base of selected fuel fractions, and it is biologically disposable.

Never use caustic or corrosive cleaning agents.

▲ WARNING: Proceed with great caution when using solvents. Inhaling of vapours is hazardous to health.

11.7.16) Valve lapping paste

This paste produced by various manufacturers is a fine granulate lapping paste for valve seats and valves. The paste is usually available in 3 different granulate sizes. Use as per manufacturer's directives.

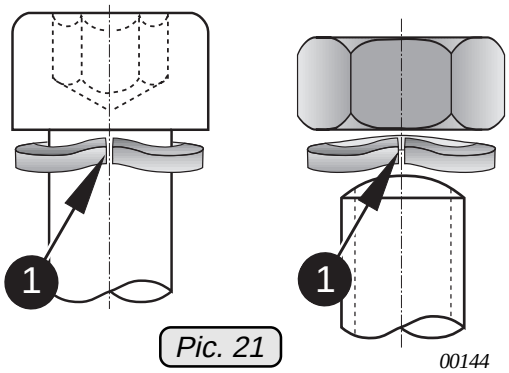
11.8) Securing elements

See. Pic. 36

■ ATTENTION: Self-locking nuts, cotter pins, tab washers and safety wires must be replaced each time they have been removed.

Respect without fail all additional indications regarding securing and sealing means and lubrication of fixation elements. Adhere to specified tightening torques.

■ NOTE: Fit the lock washers with the bent up ends ❶ facing the screw head or nut.



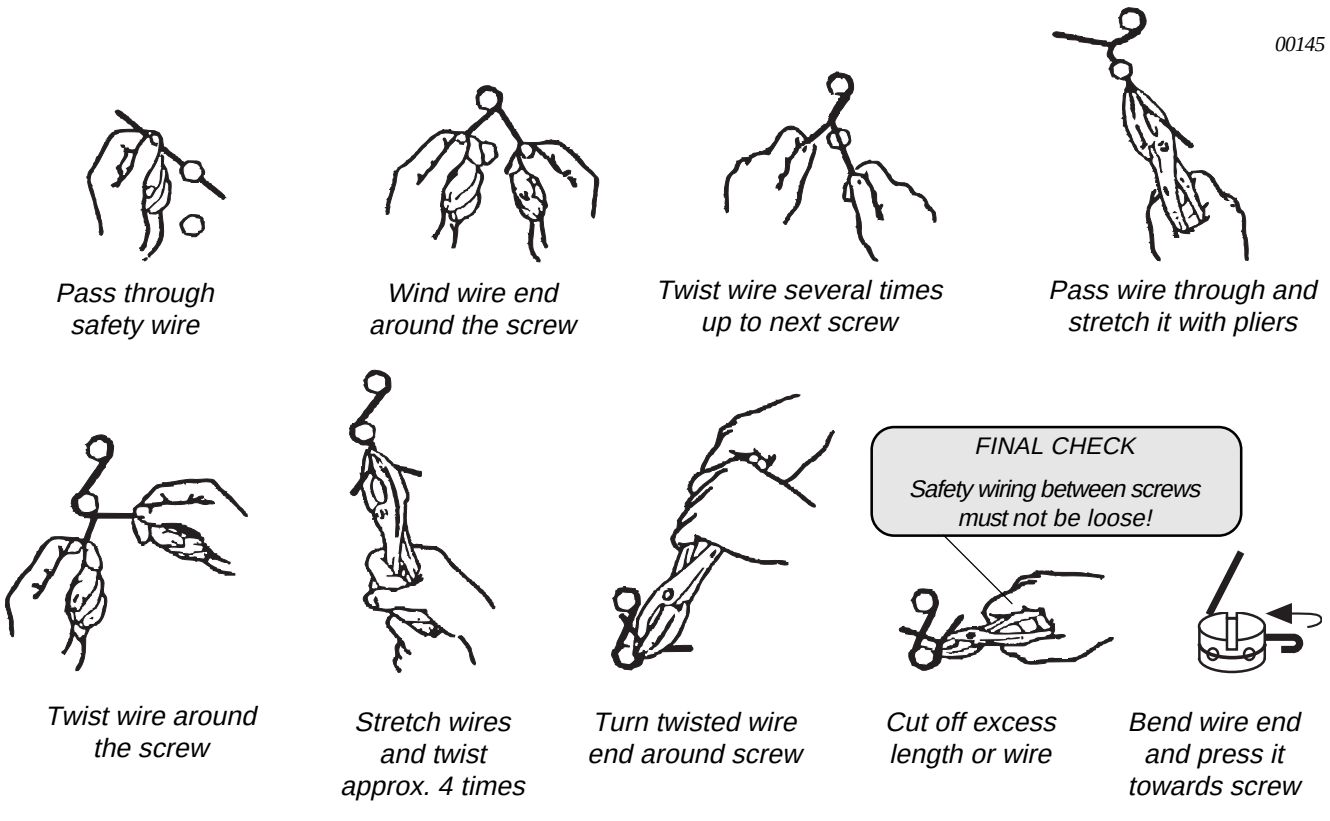
Pic. 21

11.8.1) Wire securing

See Pic. 36 and 37.

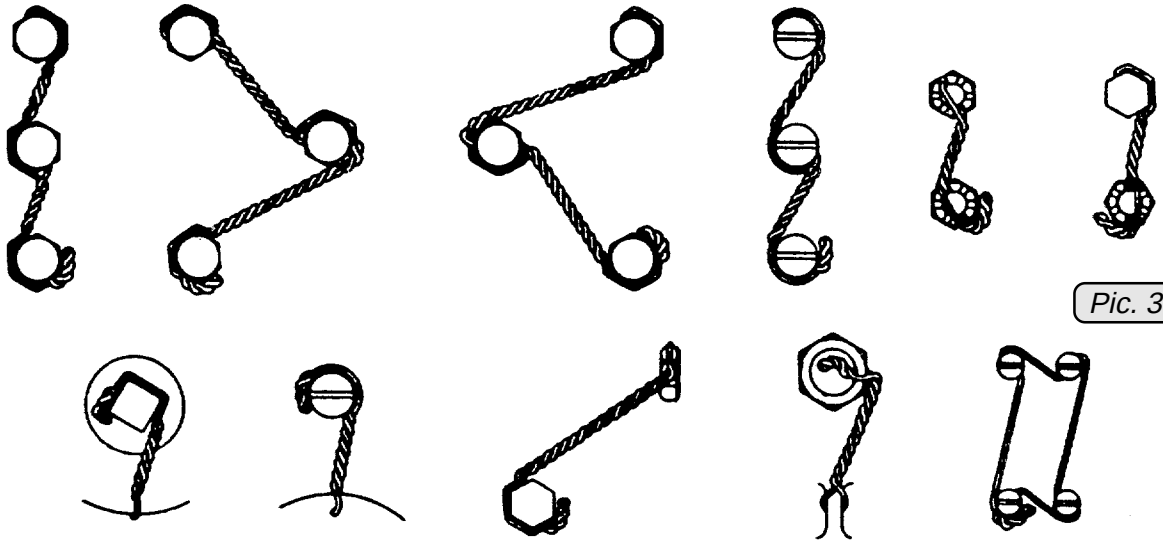
Safety wiring serves to secure screws or nuts to prevent unintended loosening. The screws or nuts are secured by a 0,8 mm (.0315 in.) safety wire twisted 3 to 4 turns per 10 mm (.4 in.). The wire must by no means be overstretched.

▲ WARNING: As a principle, all external engine components and accessories must be wire-secured for safety reasons.



Pic. 37

Various typical applications of safety wiring



Pic. 38

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11.8.2) Nut securing

When using a self-locking nut, take care that the polyamide insert ring on nuts according to DIN 985 as well as the securing element on nuts according to DIN 980 is positioned towards outside.

11.9) Tightening torques

In general all screw connections have to be tightened by the use of a torque wrench.

If not specified otherwise for a component tighten screw-connections to following torque:

M4 ➪ 4 Nm (35 in.lb)

M5 ➪ 6 Nm (53 in.lb)

M6 ➪ 10 Nm (90 in.lb)

M8 ➪ 24 Nm (212 in.lb)

M10 ➪ 35 Nm (310 in.lb)

◆ NOTE: Adhere to the tightening torques specified. See also indications in Spare Parts List.

Hex. nut	free wheel housing	M 34x1,5	120 Nm	(1060 in.lb)
Stud	cylinder and cylinder head	M 8	8 Nm	(70 in.lb)
Hex. collar cap nut	cylinder head	M 8	22 Nm	(195 in.lb)
Hex. nut	cylinder head	M 8	22 Nm	(195 in.lb)
Temperature sensor	cylinder head	M 10	10 Nm	(90 in.lb)
Spark plugs	on cold engine	M 12x1,25	20 Nm	(180 in.lb)
Impeller	water pump	M 8	15 Nm	(130 in.lb)
Allen screw	electronic module	M 5	2,5 Nm	(22 in.lb)
Hex. hd. screw	flywheel	M 16x1,5	120 Nm	(1060 in.lb)
Hex. hd. screw	gearbox bearing fixation	M 7	15 Nm	(130 in.lb)
Hex. nut	drive gear on crankshaft	M 30x1,5 LH	200 Nm	(1770 in.lb)
Box nut	fuel line	M10x1	10 Nm	(90 in.lb)
Plug screw	oil drain in crankcase	M 16x1,5	35 Nm	(310 in.lb)
Banjo bolt	oil drain on crankcase	M 16x1,5	35 Nm	(310 in.lb)
Banjo bolt	oil/fuel line	M 10x1	17 Nm	(150 in.lb)
Banjo bolt	oil line	M 8x1	10 Nm	(90 in.lb)
Socket	oil pump inlet	M 18/14	22 Nm	(195 in.lb)
Plug screw	excess pres. valve, oil pump	M 12x1	25 Nm	(220 in.lb)
Magnetic drain plug	crankcase	M 12x1,5	25 Nm	(220 in.lb)
Hex. hd. screw	oil tank	M 12	25 Nm	(220 in.lb)
Bent socket assy.,	oil line	M 22x1,5	25 Nm	(220 in.lb)
Oil filter nipple	oil pump	M 18x1,5	60 Nm	(530 in.lb)
Oil pressure sensor	oil pump	1/8-27 NPTF	30 Nm	(265 in.lb)
Valve housing	oil line, turbo charger	M 12x1,5	25 Nm	(220 in.lb)

Stud	turbo charger	M 8	6 Nm	(55 in.lb)
Lock nut	exhaust flange	M 8	12 Nm	(105 in.lb)
Clamp 120	muffler		20 Nm	(180 in.lb)
Hex. hd. screw	fuel pressure control	M 6	8 Nm	(70 in.lb)
Hex. hd. screw	external alternator (optional)	M 10	40 Nm	(350 in.lb)
Temperature sensor	oil	M10x1	10 Nm	(90 in.lb)
Temperature sensor	airbox	1/8-27 NPTF	20 Nm	(180 in.lb)
Hose clamp	airbox	M 6	6 Nm	(55 in.lb)
Hex. hd. screw	carb flange	M 8	15 Nm	(135 in.lb)
Clamp 60	carburetor	to 7 mm gap		
oil filter	oil pump	10 Nm(90 in.lb) plus 3/4 turn		

11.10) Treatment of corrosion and surface damages

At longer standstill it may occur that a rust film forms on various metal parts. With considerable corrosion or heavily corroded screws, nuts, shims, bearings, bushes etc., an exchange is inevitable.

Propeller shaft

As preventive measure against formation of rust grease the prop flange slightly but ensure to keep the support face for the propeller clear.

A rusty flange of the prop shaft can be cleaned after removal from the gearboy and covering all bearing seat

s with a plastic tape by shot blasting with MICRONORM with incorporated anticorrosive.

At heavy rust damage, when the material is affected, renewal of the propeller shaft is necessary.

Electric system

Formation of a rust film on the permanent magnets in the magneto flywheel and on the metal cores of the pick-ups is harmless. Replace fixation screws and lock washers at heavy oxidation or rust formation. Before reassembly clean all contact surfaces of the screws removed and apply LITHIUM grease. Take care that no foreign material falls into the magneto flywheel. Clean cable shoes and apply LITHIUM grease to the contact surfaces to assure lasting contact.

Check contact between plugs and/or fasten connections by separation test, if necessary apply contact spray to increase conductivity.

11.11) Engine preservation

Due to the special material of the cylinder wall, the ROTAX aircraft engine needs no extra protection against corrosion. At extreme climatic conditions and for long out of service periods we recommend the following to protect the valve guides against corrosion :

— Let engine run until warm, then change the oil.

— Drain carburetor float chambers.

— Apply motor oil to all joints on carburetors.

— Close all openings on the cold engine, like exhaust end pipe, venting tube and air intake against entry of dirt and humidity.

— Spray all external engine steel parts with corrosion inhibiting oil.

11.11.1) Preservation of a new engine

Storage and preservation directives of BOMBARDIER-ROTAX for the aircraft engine type 914 F:

BOMBARDIER-ROTAX as the manufacturer of the engine warrants for perfect corrosion protection of aircraft engine 914 F for min. 12 months from date of delivery by BOMBARDIER-ROTAX.

This warranty consent is subject to the following conditions:

- ➪ The engine must be stored in the original packing as supplied by ROTAX.
- ➪ The protection covers must not be removed.
- ➪ The engine must be stored in a suitable place (closed area, clean and dry).

If the engine is stored longer than 12 months, the following inspections have to be carried out every 3 months:

- ➪ Remove 1 spark plug on each cylinder and turn crankshaft by hand 2 full turns
- ➪ Visually check for corrosion (e.g. on propeller shaft). If corrosion is detected, the engine has to be sent immediately to an authorized overhaul facility for inspection.

▲ WARNING: The engine is not allowed to be taken into operation.

◆ NOTE: The maximum possible storage period is limited to 24 months.

If exceeding this period, the engine has to be sent to an authorized overhaul facility for inspection.

11.11.2) Engine back to operation

- — Remove all plugs and fasteners.
- — Clean spark plugs with solvent and a plastic brush.
- — If preservation including oil change took place not longer than a year ago, oil renewal won't be necessary. At longer shut down periods repeat preservation annually.

▲ WARNING: Work on the engine is only allowed to be carried out and approved by authorized persons. See Chapter 11.3).

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12) Maintenance Checks

▲ WARNING: Work on the engine is only allowed to be carried out and eligible for approval by authorized persons. See Chapter 11.3).

The scheduled maintenance checks consist of the following groups:

12.1) Periodical maintenance

12.1.1) Operating-hours-related checks

These are checks prescribed after reaching defined hours of operation, to avoid engine troubles by preventive maintenance. What has to be done after which period is defined in the “MAINTENANCE SCHEDULE“.

12.1.2) Seasonal checks

Besides the checks already indicated periodical checks have to be made. These tasks are also shown in the “MAINTENANCE SCHEDULE“.

12.2) Maintenance Schedule

The following maintenance is planned and necessary for ROTAX 914 F:

Description	25 hrs [1]	every 100 hrs [2]	every 200 hrs	every 300 hrs	every 600 hrs	every 1000 hrs [3]	every 2 years	every 5 years	10 years [3]	see Chapter
Engine cleaning	X	X	X	X	X					12.3.1)
Visual engine check	X	X	X	X	X					12.3.2)
Leakage check	X	X	X	X	X					12.3.3)
Inspection of engine suspenion	X	X	X	X	X					12.3.4)
Check of external engine parts	X	X	X	X	X					12.3.5)
Check of waste-gate position	X	X	X	X	X					12.3.6)
Check of waste gate cable bowden		X	X	X	X					13.5.4.2)
Check of gearbox	X	X	X	X	X					12.3.7)
Oil level check	X	X	X	X	X					12.3.8)
Oil change	X	X	X	X	X					12.3.9)
Oil filter renewal	X	X	X	X	X					12.3.10)
Inspection of magnetic screw	X		X	X	X					12.3.11)
Inspectino of gear set					X					12.3.12)
Check of cooling system	X	X	X	X	X					12.3.13)
Rinsing of cooling system			X		X					12.3.13.1)
Renewal of coolant							X			12.3.13.2)
Inspection of air filter	X	X	X	X	X					12.3.14)
Check of carburetors	X		X		X					12.3.15)
Check of cables	X	X	X	X	X					12.3.16)
Check of V-belt	X	X	X	X	X					12.3.17)
Renewal of spark plugs		X	X	X	X					12.3.18)
Security check of spark plug connectors			X		X					12.3.19)
Check of compression			X		X					12.3.20)
Inspection of fuel filter, fuselage side	X	X	X	X	X					12.3.21)
Conduct engine test run	X	X	X	X	X					12.3.22)
Renew rubber parts								X		12.3.23)
Overhaul						X			X	12.3.24)
Description	**25 hrs [1]**	**every 100 hrs [2]**	**every 200 hrs**	**every 300 hrs**	**every 600 hrs**	**every 1000 hrs [3]**	**every 2 years**	**every 5 years**	**10 years [3]**	**see chapter**

Pic. 38

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Comment to [1]: To be carried out after the first 25 operating hours.

Comment to [2]: 100 operating hours or after 1 year, whichever comes first.

Comment to [3]: 1000 operating hours or after 10 years, whichever comes first.

12.3) Maintenance Instructions

12.3.1) Engine cleaning

If necessary, clean the engine carefully. If leaks are noticed, they have to be traced before cleaning. As a principle, clean engine only when cold. Use of commercially available cold cleaning agent is recommended.

■ ATTENTION: For cleaning of engine do not use highly inflammable liquids or caustic cleaning agents.

Never clean an engine with a high pressure cleaner. This is detrimental for the electrical installations and the oil seals. Oxidation of the various components and failures are the consequence!

After each cleaning procedure blast all electrical components, like battery, ignition unit, spark plug connector, clamp connections etc. with compressed air, to prevent leaking current.

■ ATTENTION: When cleaning the engine, the dissolved residues of fuel, oil and other environment-contaminating agents are rinsed off. Collect the cleaning water and dispose of it in an environment-friendly way.

12.3.2) Visual check of engine

See Pic. 38/1.

General visual inspection of the engine for damages and anomaly.

■ ATTENTION: Take note of temperature related variations not conform with standard operation.

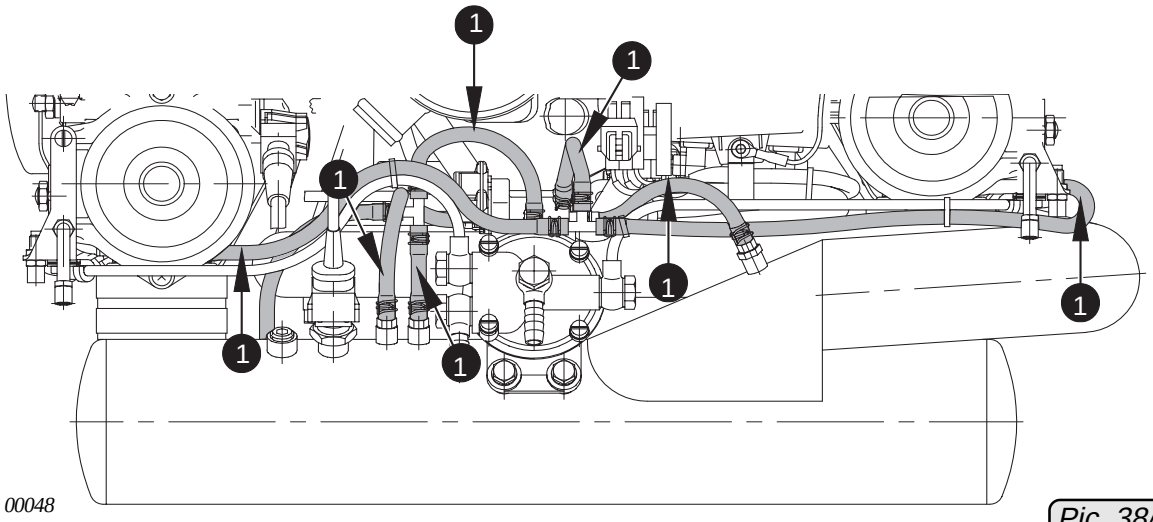
Pay special attention to the following items:

- ⇨ Exhaust system and turbocharger inclusive attachment

  Notes to turbo charger:
  The turbo charger is free of maintenance, requires only visual inspection
  Inspect turbo wheel for damage and verify easy rotation.
  Visually inspect compressor and turbine housing for cracks.
- ⇨ **Engine suspension** - refer to chapter 13.5)
- ⇨ **Airbox** - refer to chapter 13.1)
- ⇨ **Fuel and oil lines** - refer to chapter 13.1) and 13.2)
- ⇨ Check the two **heat protection tubes**
  (water pump - cyl. head 1 and 2) for physical damage
- ⇨ **Turbo control unit (TCU)** - consult chapter 13.6)
- ⇨ **Servo motor** - refer to chapter 13.6)
- ⇨ **Pressure sensors**
- ⇨ **Fuel pumps**

➪ **Air pressure hoses** airbox - fuel pressure control
airbox airbox pressure sensor
airbox - solenoid valve
solenoid valve - 2 x float chamber venting

▲ WARNING: Since a failure of pressure interconnections ❶ of airbox, float chambers, fuel control and pressure sensor would possibly result in an **engine stop** all these interconnections have to be made very carefully.



Pic. 38/1

➪ **Cooling air guide** and **cooling fins** on cylinder

➪ **Condensate water trap**
Between airbox and pressure sensor a condensate water trap is located. Renew water trap in case of water accumulation.

12.3.3) Leakage check

Prior to further tasks, inspect the complete engine for leaks. On the underside of the water pump a leakage bore is located.

An oily leakage bore indicates a defective oil seal, which has to be renewed. In case of emergence of water the rotary seal has to be removed. See chapter 13.3.

Inspect fuel lines, joints and connections. Look for scuffing marks.

Check oil feed line from oil tank to oil cooler and to the engine, as well as return line from crankcase to oil tank. Additionally, check all oil transfer lines i.e. from the main oil pump to oil inlet flange of hydraulic governor, from main oil pump to the turbocharger and from turbo charger to suction pump.

Inspect coolant hoses, their connections and screw plugs for tightness. Check surroundings for leaks!

At signs of operating media leaks find the reason and provide for remedy.

■ ATTENTION: Avoid overstressing of fastening elements.

Inspect all hoses, especially in the area of hose clamps and hose connections for porosity, damages or kinks. If damage is noticed, renew hose immediately.

12.3.4) Inspection of engine suspension

Inspect each attachment point of engine suspension frame.

Inspect the immediate surrounding of the attachment points on engine and gearbox. Discoloration (black ring) around the attachment point indicates abrasion caused by loose connection.

12.3.5) Inspection of external engine components

Check nuts and screws attaching external components for tight fit. For tightening torques refer to the relevant chapter. Verify wire securing, renew as required.

12.3.6) Check of the waste gate

See Pic.

Inspect servo cable of waste gate actuation ❶ for physical damage and wear.

■ ATTENTION: Use of a damaged servo cable is not permitted. Even with only one of the strands worn through, the cable has to be renewed. See chapter 13.5)

Check also cable engagement and spring.

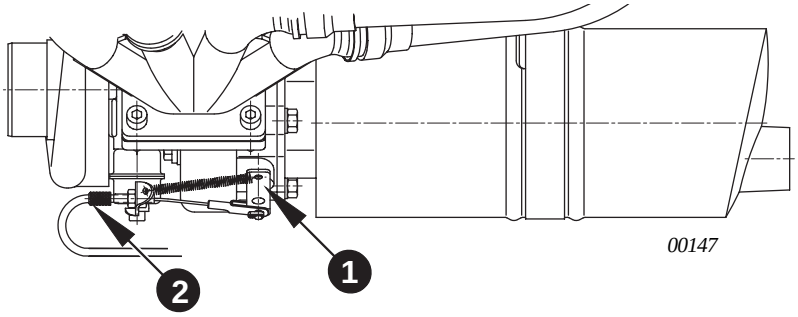
Verify adjustment of waste gate.

◆ NOTE: After engine stop, the servo motor will move into closed position.

The same happens after switching on the TCU. The servo motor rotates approx. half a turn and will then remain in the closed position.

In this position the waste gate has to be completely closed. If necessary reset by adjustment screw ❷. See chapter 13.5)

Pic. 39



12.3.7) Checking of propeller gearbox

Checking of backlash

With engine at standstill, the propeller can be turned by hand by approx. 15° taking into consideration a slight friction torque. Thereby no odd noises or irregular resistance must be noticeable. Otherwise repair is necessary.

Checking of the friction torque

Within the backlash the torque by friction is 15 to 45 Nm (130 to 400 in.lb). This value is calculated by the indication of the spring scale multiplied by length of lever arm (N x m = Nm). If the above mentioned friction torque is not achieved, remove gearbox and inspect it. See Chapter 14.4).

12.3.8) Oil level check

It is an advantage to check the oil level before oil change to be informed about oil consumption. Before oil level check let the engine idle for approx. 1 minute or turn the propeller manually several times to pump engine oil completely out from crankcase. Stop engine and check oil content on oil gauge of oil tank. The oil level in the oil container should be between the 2 marks (max. / min.) and must never be below the minimum mark.

Difference between max. and min. mark = 0,75 litre (1.6 liq pt).

12.3.9) Oil change

See Pic. 39/1.

Change the oil only when engine is warm.

Remove oil drain screw from oil tank, drain old oil and dispose of it as per environmental regulations. See Chapter 10.2) and Pic. 013.

▲ WARNING: Careless draining of hot engine oil may cause scalds! Dispose of used oil and filters respecting the environmental regulations!

◆ NOTE: At every oil change also exchange the oil filter.

Only in case of extraordinary oil contamination the oil tank must be opened and the interior be cleaned. Then refit drain screw and torque to 25 Nm (220 in.lb) and wire secure. Install new genuine oil filter.

Refill with 2 litres (.53 US gal) oil.

■ ATTENTION: Only use oil of a registered brand according to the current Operator's Manual.

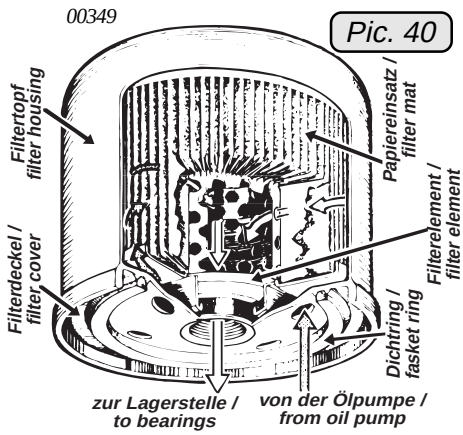
▲ WARNING: Pay attention to specifications in the Operator's Manual.

■ ATTENTION: Venting the lubrication system, see section 13.2.10).

12.3.10) Oil filter — replacement and inspection

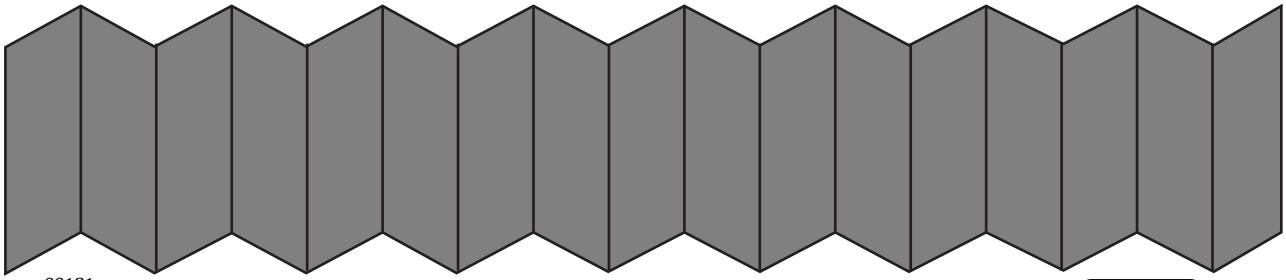
See Pic. 024 and 025.

Unscrew oil filter with filter wrench, part no. *877 620*. At every oil change replace the oil filter and open the old one with special tool, part no. *877 670* not producing chips. Remove filter insert, cut top and bottom cover off the mat. Remove filter mat, unroll and check it for metal chips, foreign matter, contamination and abrasion. This check is important as it allows conclusions regarding the condition of the engine and gives information about a possible cause of failure.



Pic. 40

■ ATTENTION: It is absolutely necessary to scrutinize the filter insert.



Pic. 41

Possible foreign matter: Steel chips, bronze chips, aluminium chips, sliver of plain bearing material, remains of sealing compound.

■ ATTENTION: If an increased amount of metal particles is found, like brass- or bronze chips or sliver from bearings, search for the cause and correct!

For correct judgement long-term experience in repair of piston engines is required.

If the filter mat is clogged by foreign matter, the lubricating oil flows unfiltered back to the oil pump via the bypass valve in the oil filter. The unfiltered oil arrives at the parts to be lubricated.

■ ATTENTION: To warrant the function of the oil circuit and the forced flow lubrication, use genuine oil filter only. Only these filters assure correct pressure in the bypass valve.

Slightly lubricate the rubber seal of the new oil filter. Screw oil filter on by hand. Then tighten an extra 3/4 turn.

12.3.11) Inspection of the magnetic plug

Remove magnetic plug and inspect for chips possibly collected.

▲ NOTE: The magnetic plug (torx screw) is located on crankcase between cylinder 2 and gearbox.

This inspection is important as it reveals about condition of gearbox and engine and conveys information on causes of possible damages.

■ ATTENTION: If a larger amount of chips (bigger than 0.2 mm) has accumulated an inspection as per chapter 12.3.12 will be necessary.

Trace the cause and remedy.

Proper judgement needs a man with years of experience in repair of internal combustion engines.

Clean magnetic plug and refit. Tightening torque 25 Nm (220 in.lb). Wire secure plug.

12.3.12) Examination of the drive gear set

The inspection of the gear set helps to detect possible damage on the gearing.

Remove propeller in accordance with installation instructions of the prop manufacturer.

Remove prop gear box. Refer to chapter 14.4.

■ ATTENTION: It is also feasible to scrutinise the gear set by Endoscope but ensure the exact inspection of all tooth flanks.

Clean drive gear and dog gear for inspection.

■ ATTENTION: Inspect all tooth flanks for damage and pitting.

At formation of pitting distinguish between **tolerated seasoning pitting** and **spallation**. To assist your judgement please read the following.

General note on pitting:

The term pitting can be interpreted as spalling of more or less material particles from the active tooth flank. Whereas fracture of a tooth results in the complete gearbox failure, formation of pitting normally will not stop operation of gearbox.

Distinguish between various grades of damage.

◆ NOTE: Tiny pitting or zones of pitting will hardly influence operational behaviour of the gearing.

But normally pitting will increase with period of operation. The pitting progress depends on lubricant and load. The zone of pitting might increase to such an extend, that the remaining unharmed tooth flank can not transmit the load any more. Further operation will result in the complete ruin of the gearing.

◆ NOTE: The preferred zone of pitting formation is the root flank of the driving gear. Therefore check first the driving gear.

Pitting is damage caused by fatigue of the material. According to the present knowledge, decisive for formation of pitting is the exceeding of pressure, tangential stress on the surface and temperature strain. Besides material properties and heat treatment, surface texture and finish and of course viscosity of the lubricant at temperature of operation are of importance.

Depending on size, grade and number of pitting distinguish between the following:

⇨ tiny pitting (seasoning pitting)

⇨ progressing pitting

⇨ spallation over a wide zone

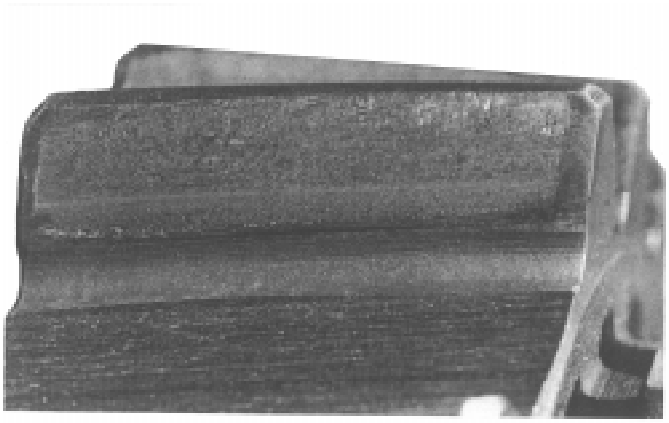
Tiny pitting: See Pic. 42, 43 and 44.

Features:
Isolated tiny pitting (up to approx. 0,5 % of flank surface) or pore like zones of pitting, normally only at root range of the flank. This process of pitting formation may stop with gear box operation.

Causes:
High local pressure on not yet run-in gears could lead to isolated pitting. The seasoning wear leads to stress relieve, resulting in possible stop of pitting formation. Changed conditions of operation may stop progress of pitting formation too.

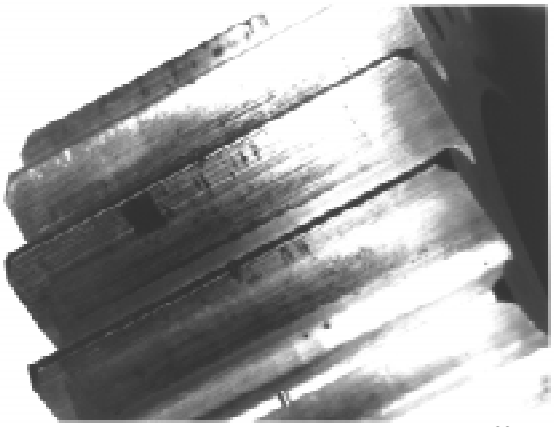
Conclusion
These pitting are of no hindrance for the safe operation. The gear set can be used further on.

◆ NOTE: Pic. 42 to 44 show tooth flanks with tiny pitting.



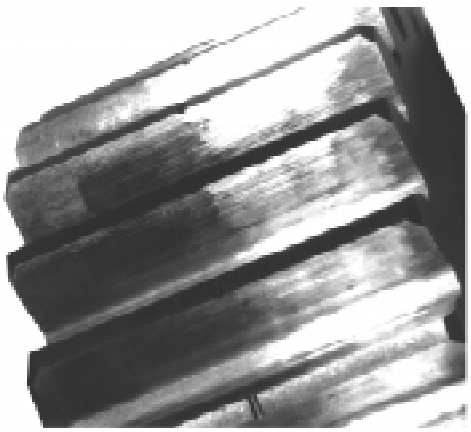
00148

Pic. 42
magnification: approx. 2 times



00149

Pic. 43
magnification: approx. 1,5 times



00150

Pic. 44
magnification: approx. 1,5 times

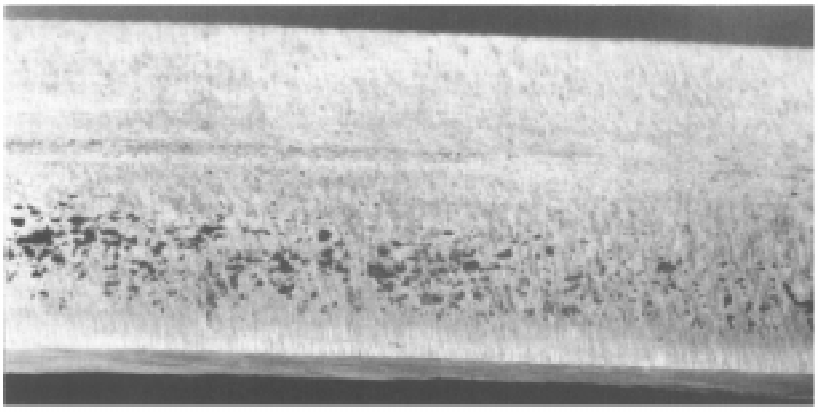
◆ NOTE: Because of the tiny pitting depicted and the copying process these illustrations might not proof very revealing. In case of doubt seek assistance by studying technical publications.

Progressive pitting: See Pic. 45 and 46

Features:
Limited spalling, normally appearing as pitting zones, spalling base normally of shell like structure. The total pitting zone might reach a size impairing smooth engine run or favouring fast ruin of the remaining active tooth flank by wear.

Cause:
Pitting derive from material fatigue formed by a combination of pressure and friction started by local exceeding of material strength. Decisive for formation of pitting: Viscosity and temperature of oil.

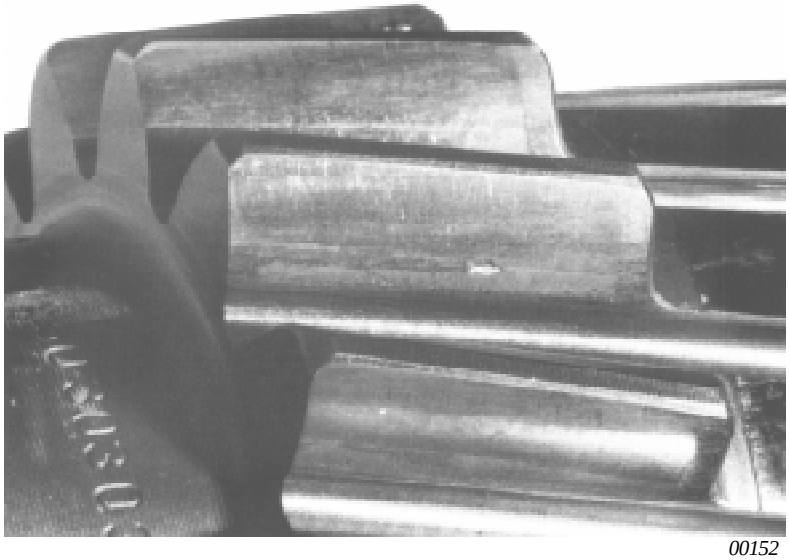
Conclusion:
Pitting up to approx. 5% of flank area can be tolerated if the largest dimension of the spalling does not exceed 0,5 mm.



00151

pitting zone on root of flank on a spur gear

Pic. 45
magnification: approx. 1,5 times



00152

formation of pitting at root range on spur gearing

Pic. 46
magnification: approx. 1,5 times

▲ WARNING: Always exchange gears set wise. Renewal of a single gear is not permitted

Spalling over a large zone: See Pic. 47 and 48.

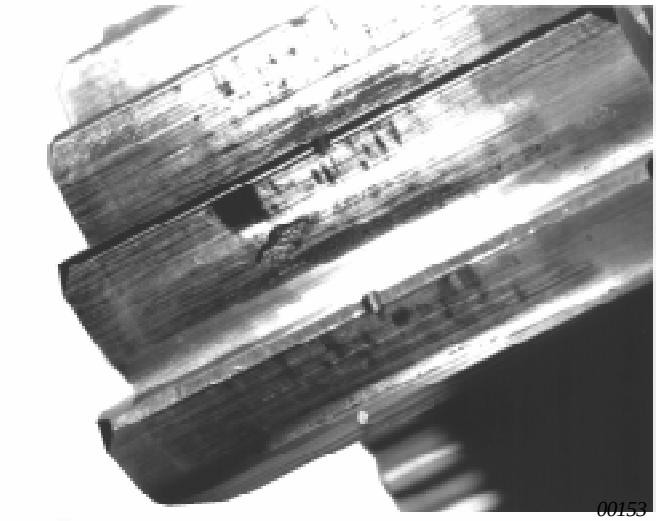
Features:
Large size triangular spalling starting at a grey zone or tiny pitting range on root of tooth. Spalling area of relatively constant depth. Possible additional incipient cracks across flank. Partial, damage reaches tip range of tooth resulting in tooth tip fracture.

Cause:
Occurrence normally on operation with oil of low viscosity and high oil temperature, and the same cause as for formation of pitting.

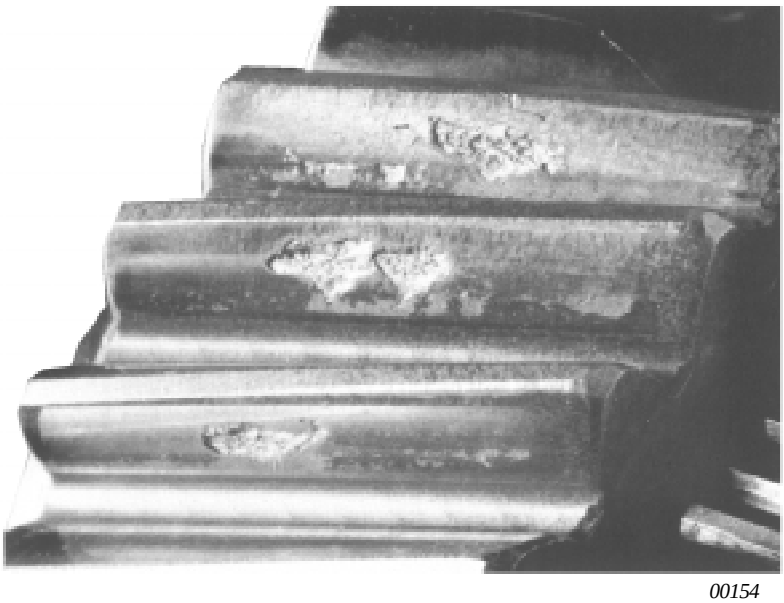
Conclusion:
■ ATTENTION: At detection of spalling, renew the gear set.

For tolerated pitting and spalling, see chapter progressive pitting.

◆ NOTE: Pic. 47 and 48 depict triangular spalling.



Pic. 47
magnification: approx. 2 times



Pic. 48
magnification: approx. 2 times

▲ WARNING: Always exchange gears set wise. Renewal of a single gear is not permitted.

12.3.13) Check of the cooling system

Inspect all coolant hoses. Check all connections on cylinder head top- and bottom side and on the water pump. Check expansion tank for damages. Check protection rubber at bottom of the tank for tight fit.

Check gasket of radiator cap as well as the pressure control valve and return valve. The pressure control valve opens at 0,9 bar (13 psi).

Check coolant with tensiometer or glycol tester. If necessary, replenish with coolant of same composition. Remarkably discoloured or thickened anti-freeze has to be renewed.

◆ NOTE: 80 % antifreeze concentrate with anti-corrosion additives and 20 % water is recommended. Sufficiently satisfactory results were achieved with "BASF Glysantin Anticorrosion". This or equivalent coolant has to be used.

▲ WARNING: Pay attention to specifications of operating media in Operator's Manual.

As long as there is no boiling problem after engine stop, water may be added up to approx. 50 %.

▲ WARNING: Never open radiator cap when cooling system is hot. For safety's sake, cover cap with a cloth and open cap slowly. Sudden opening of the cap would provoke exit of boiling water and in consequence scalds.

12.3.13.1) Rinsing of cooling system

At the 200 hours check rinse the cooling system. This can be done with a water hose at maximum pressure of 2 bar (30 psi). For this procedure open the coolant hose at the lowest position. See Pic. 10.

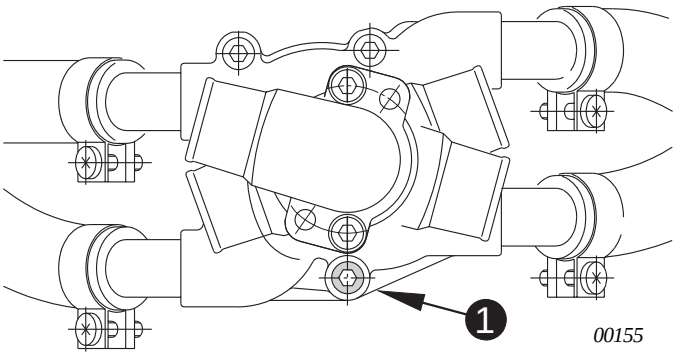
12.3.13.2) Coolant renewal

See Pic. 49.

The cooling liquid (mixed with 20 % water) has to be changed every 2 years. For this purpose open the radiator cap, remove the bottom fixation screw ❶ (with sealing ring) for water pump, and drain the cooling liquid. If the radiator is fitted lower than the engine, detach the coolant hose.

Refill newly mixed coolant into expansion tank (highest position in cooling system).

◆ NOTE: Let engine run for a short time and then, if necessary, replenish with pure coolant.



Pic. 49

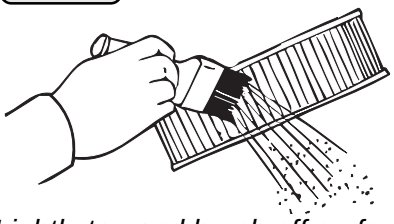
12.3.14) Check of the air filter

See Pic. 50 and 51.

Inspect dry type air filter according to maintenance plan. Clean dirty filter to maintenance directives of aircraft builder. When used in heavy dust condition clean air filter at shorter intervals accordingly. If filter mat is damaged, renew air filter.

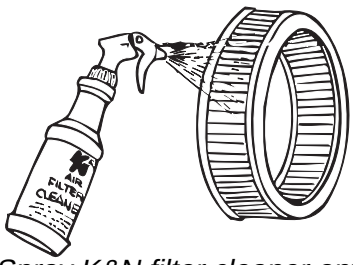
■ ATTENTION: A dirty filter will not only reduce the engine performance but might also promote premature wear of the engine.

Pic. 50

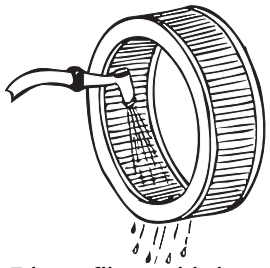


Lightly tap and brush off surface dirt.

00182



Spray K&N filter cleaner onto entire element and let soak for approx. 10 min.



Rinse filter with low pressure water from inside to outside and let element dry naturally.

Cleaning of dry air filter

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

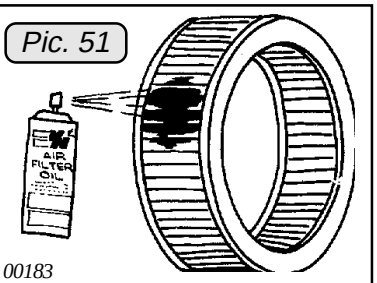
After soaking period, rinse with cold water from inside to outside, shake off and let it dry naturally.

▲ WARNING: Do not dry over naked flame or with hot air gun. Excessive heat will shrink the pores of the filter mat.

After cleaning, lubricate filter element evenly with K&N filter oil spray or K&N filter oil, part no. *897 870*, to achieve optimum filtering effect.

◆ NOTE: Each pleat of filter element to be sprayed with oil.

Pic. 51



00183

After 5 to 10 min. the filter mat will be soaked with oil, noticeable on the uniform red colouring.

■ ATTENTION: Never use gear oil, diesel or motor oil as they attract water.

▲ WARNING: Besides clamp attachment of the filters, wire-secure filter against loss additionally. Filter connection must be free of oil.

Renewal of dry type air filter

Only use dry type air filters which are specified by the aircraft manufacturer!

Attach new filter, free of grease at connection faces, and wire-secure against loss.

12.3.15) Checking of the carburetor

See also Chapter 13.1.2)

12.3.15.1) Float chamber

Remove float chamber, clean inside and check gasket. Insert both floats on the guides in float chamber. When the floats rest on the distance sleeve, the single floats must still be freely moving. They must not block on the float chamber wall. Check guide sleeve pressed into the float. If necessary, clean the complete inside of the carburetor. If contamination is suspected, check the float needle valve too.

12.3.15.2) Inspection of the float needle valve

Only necessary in case of irregularities.

12.3.15.3) Venting of the float chamber

Every disturbance of the float chamber venting influences the carburetor- and engine function and must be avoided therefore. Ensure free passage of vent line. Prevent kinks. See Chapter 13.3.2) and 13.1.11).

12.3.15.4) Calibration

Normally, carburetor calibration must not be changed. Size of main jet is determined on the dyno at an altitude of 300 m (1000 ft.) above M.S.L.

▲ WARNING: Correction of the main jetting only at Aeronautical Service Centres or by authorized test staff to specifications from ROTAX. See Chapter 11.3).

12.3.15.5) Carburetor synchronization

The throttle valves have to open synchronously to achieve a steady run on all four cylinders.

12.3.15.6) Adjusting of the idle speed

Adjusting of the idle speed should always be done at operating temperature of engine. Under normal circumstances no modification of the idle adjustment is necessary. If need be, the idle air screw can be turned until reaching an acceptably smooth running of engine.

◆ NOTE: Turning idle mixture control screw in clockwise direction results in a leaner mixture, and turning anti-clockwise in a richer mixture.

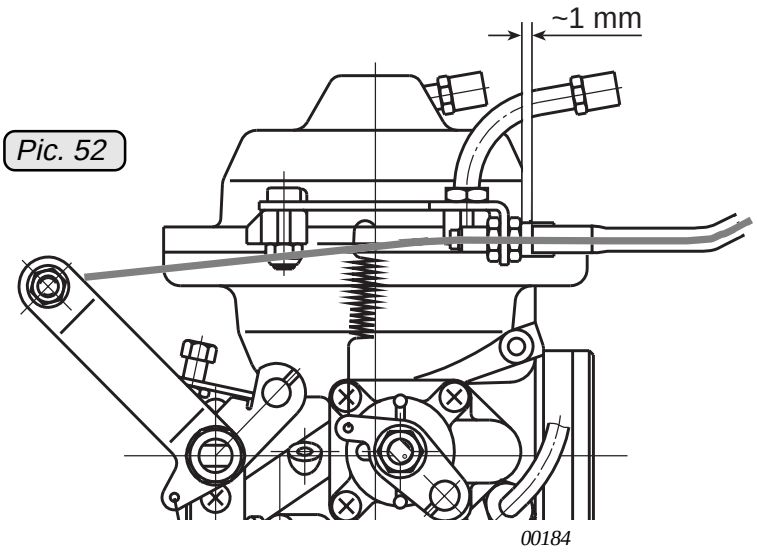
12.3.15.7) Throttle cable and linkage

See Pic. 52.

Adjust Bowden cable to a clearance of 1 mm (.04 in). Inspect and lubricate actuation linkage and joints with motor oil.

▲ WARNING: With carburetor levers not connected, the carburetor is fully open. Never start the engine without carburetor Bowden cable connected, as the home position of the CD-carburetor is with throttle fully open.

Pic. 52



12.3.15.8) Checking of starting carburetor (choke)

Check Bowden cable and lever for easy movement. Bowden cable must allow complete travel of lever from stop to stop.

12.3.16) Check of wiring

— Check all cable plugs and connections for tight fit and good contact.

— Check all shorting connections for corrosion.

— Check plug connections between pick-up cable and electronic module and of charging and shorting cables.

— Check plug connections between electronic module and ignition coils.

— Check plug connections of generator cables with rectifier-regulator and connections of all cables on rectifier-regulator for good contact and tight fit.

— Check shorting cables for tight fit.

— Check shielding of cable assemblies for damage, perfect ground contact and attachment of shielding.

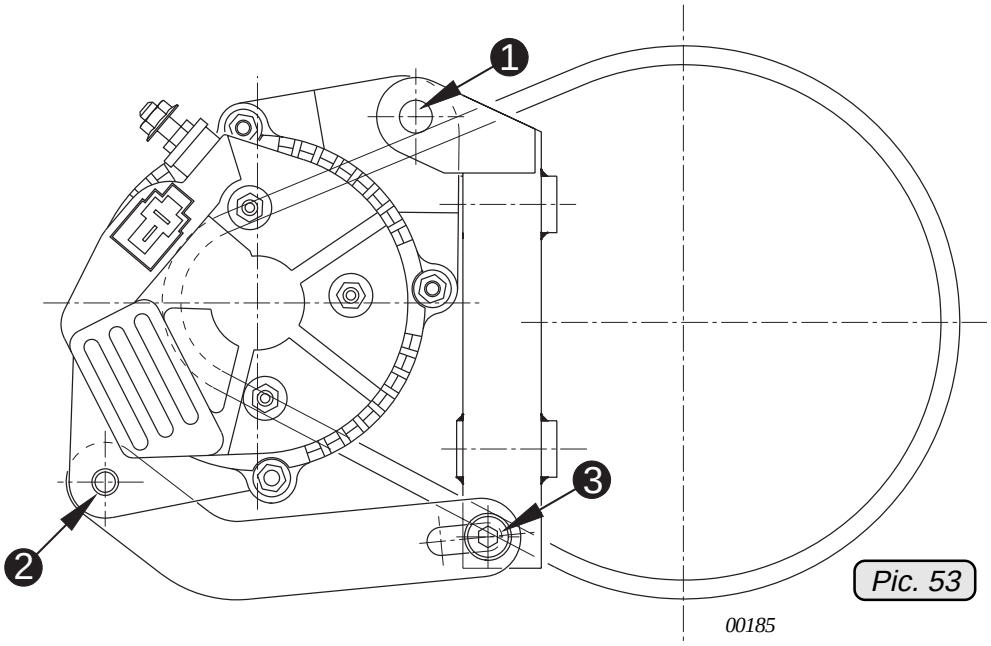
— Inspect all 8 ignition cables to spark plug connector for damage and tight fit. Check resistor plug connector for tight fit on spark plug.

— Verify tight plug connections of cable assy, on Turbo Control Unit (TCU) on 2 pressure sensors, rev-counter pick-up, throttle potentiometer, air box temperature sensor, servo motor, isolating switch, control valve and on the two lamps.

12.3.17) Check of V-belt tension

See Pic. 53 and 54.

At configuration with additional external alternator, check attachment and V-belt tension.

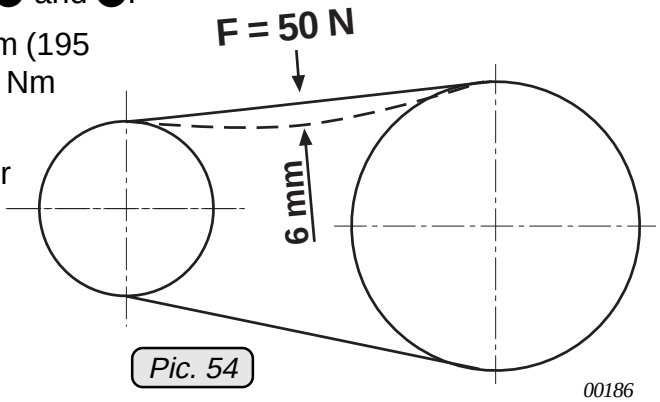


Pic. 53

For adjustment of the V-belt tension, loosen the hex. screw ❶ M10 and the two Allen screws ❷ and ❸. Push alternator upward and tighten Allen screw ❸. Then tighten the screws ❶ and ❷.

Thighten screws M8 to 22 Nm (195 in.lb), and screw M10 to 35 Nm (310 in.lb).

Check V-belt tension as per drawing beside.



Pic. 54

12.3.18) Renewal of spark plugs

Renew spark plugs according to Maintenance check list. Use only original spark plugs of 12 mm **ND X27EPR-U9**.

■ ATTENTION: Tighten spark plugs to 20 Nm (180 in.lb) on the cold engine only.

Renew always both plugs of a cylinder and do not interchange between cylinders.

Remove spark plugs and put them aside coordinated to cylinder and position. Plug face appearance reveals the following about operating condition of engine:

☞ **light coloured to brown**

plug and calibration are correct

☞ **velvet black**

Indicates the following:

— mixture too rich

— insufficient air intake (clogged air filter)

— engine operating temperature too low

☞ **oily, glossy coating**

indicates the following:

— misfiring

— too much oil in combustion chamber

— worn cylinder and piston rings

☞ **whitish with melt droplets**

Indicates the following:

— mixture too lean

— leaking valves

— air box temperature too high

— fuel control incorrect adjusted or defective

— faulty control valve

— poor fuel quality

12.3.19) Checking of spark plug connector for tight fit

Check spark plug connector for tight fit on spark plug every 200 hours of operation. Min. pull-off force to be **30 N** (7 lbf.). Renew loosely fitting spark plug connectors.

12.3.20) Check of compression

See Pic. 55.

Ignition switch for both ignition circuit in "OFF" position.

Two methods to check compression are feasible:

1. Compression test

It needs a compression tracer to check compression. The compression should be between 9 and 12 bar (130 and 174 psi).

PROCEDURE:
Bring engine to operation temperature (engine oil temperature between 30 to 70° C (90 - 160° F). Remove top spark plug and press compression tracer against plug tap hole and set engine with open throttle into rotation by activating starter until maximum pressure is reached.

Successively take readings on all four cylinders and compare results. Individual readings of the cylinders must not differ by more than 2 bar (29 psi).

If readings are below 9 bar (130 psi), check compression by the more exact pressure difference method.

If readings are below 6 bar (90 psi) inspect pistons, cylinders, valves and cylinder heads (consult Repair Manual)

- or with

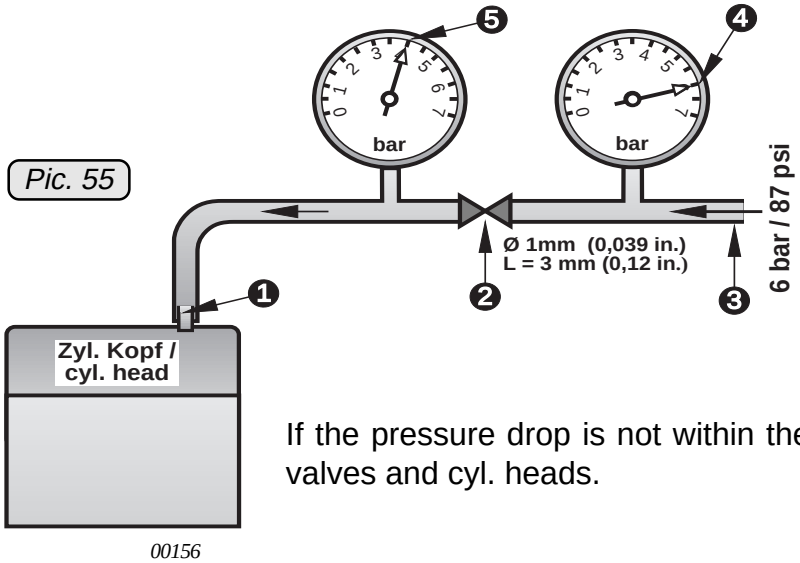
2. Pressure difference method

For this method you need the following: Compressed air supply of 5 to 7 bar (70 ÷ 100 psi), two pressure gauges, an orifice of 1 mm (.04 in) ∅ and 3 mm (.12 in) length and an adaptor to connect line to plug tap as well as connection hoses.

PROCEDURE:
Bring engine to operating temperature. Lock crankshaft in ignition T.D.C.

Remove respective spark plug and fit adaptor ❶ instead, and connect line with the two pressure gauges and intermediate orifice ❷. Now put constant pressure on the line ❸ and take readings on pressure gauges ❹ and ❺.

The maximum allowable pressure drop is 25 %, e.g. from 6 to 4,5 bar (87 psi to 65 psi).



Pic. 55

Successively take readings on all four cylinders and compare results. Individual readings of the cylinders must not differ by more than 1 bar (15 psi).

◆ NOTE:
Standard pressure readings on a new engine - 5,8 ÷ 6,0 bar (84 psi ÷ 87 psi); on an engine after 600 hrs of operation - approx. 5,2 ÷ 5,8 bar (75 ÷ 84 psi).

If the pressure drop is not within the allowance, check pistons, cylinders, valves and cyl. heads.

12.3.21) Inspection of the fuel filter in fuselage

See Ill 56 and 57.

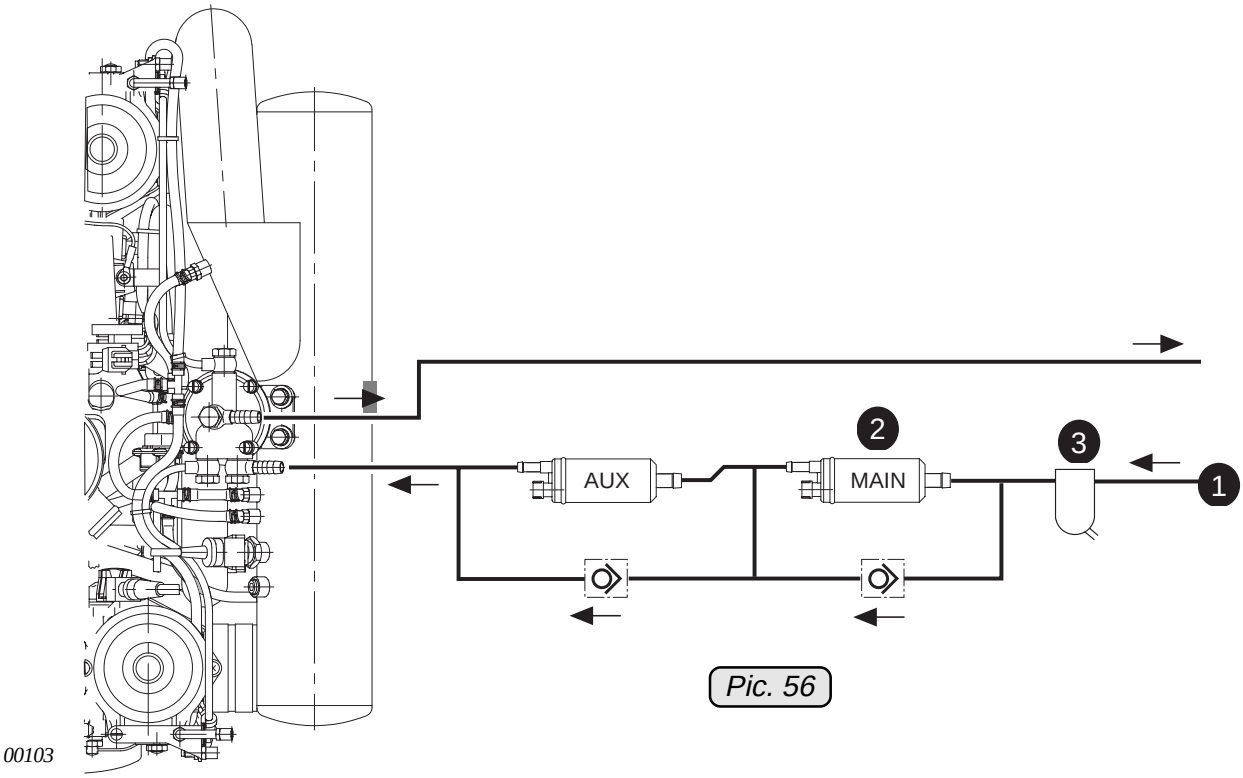
In the feed line between fuel tank ❶ and supply to the two fuel pumps ❷ a fine filter ❸ with meshsize 0,1 mm is installed.

◆ NOTE: The fine filter may be fashioned also as a combination of filter and water trap.

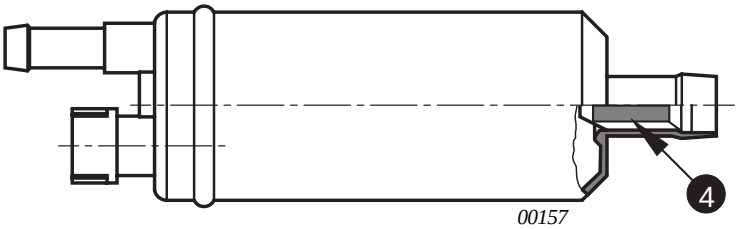
Inspect filter ❸ according to maintenance check list.

At bad contamination of the filter in the fuselage inspect also the two fine filters ❹ integrated in the fuel pumps.

■ ATTENTION: The fine filters ❹ in the fuel pumps can't be exchanged. Renew complete pump as required.



Pic. 56



Pic. 57

12.3.22) Test run of engine

Ensure that all the operating fluids are replenished to the specified level. Make sure that no tools are scattered in engine compartment. Check tight fit of propeller. Anchor aircraft suitably to ground and place chocks under the wheels. Secure area and make absolutely sure not to endanger any person involved or onlookers.

▲ WARNING: Always observe the engine while running from a secure place. The cockpit must be occupied.

In succession:

— open fuel cock

— activate choke

— throttle to idle position

— main switch "ON"

— ignition for both ignition circuits "ON".

— press starter button for max. 10 sec. followed by a cooling period of 2 min.

— after engine start observe oil pressure. Pressure has to be built up within 10 sec.

— start warming up period with running at 2000 rpm., continue with 2500 rpm. until oil temperature reaches 50° C (120° F).

— observe temperatures and oil pressure. At a steady oil pressure above 2 bar (29 psi) engine speed may be increased.

— Ignition check:

check the two ignition circuits at 4150 rpm. Speed drop with only one ignition circuit must not exceed 300 rpm.; 120 rpm. max. difference of speed by use of either circuit, A or B.

— Short full throttle run and check if engine reaches max. full throttle speed. Consult aircraft manual for nominal engine speed as it depends on the propeller used.

— after full-load run allow a short cooling period to prevent formation of vapour lock in cylinder heads

— stop engine.

▲ WARNING: When stopping the engine, switch off ignition and remove ignition key!

— replenish engine oil and coolant as required

— carry out leakage test

— register operations in log book

12.3.23) Renewal of rubber parts

Renew rubber parts acording to Maintenance check list.

All rubber hoses are subject to renewal. Affected are the venting ho ses of the carbs, air pressure hoses to fuel pressure control and pressure sensor, hoses on compensating tube as well as all rubber hoses of the cooling system.

Renewal of the diaphragm on both carburetors, see chapter 13.1).

12.3.24) Overhaul

Overhaul the engine every 1000 hours of operation or after 10 years (whichever comes first) in accordance with the Overhaul Manual. Remove engine from aircraft and send it in clean condition to an authorized overhaul facility.

If the engine is shipped to an overhaul facility, include the following in the shipment:

— engine log book

— service record (life act) of the engine

— any part of equipment like carburetors, filter, intake silencer, ignition unit, vacuum pump, hydraulic governor, engine frame, fuel pumps, oil tank, external alternator

— indication of total time of operation

— statements to the aircraft used

— useful notes and observations regarding the engine.

At receipt of an engine for overhaul a test run is conducted, followed by tear-down inspection with recording of findings, and necessary repair work carried out afterwards. The overhauled engine is subject to a running-in period and a final performance check. The overhaul is indicated on the name plate. Each overhauled engine is accompanied by the report of engine repair with filled-in data sheets.

The overhaul of an engine is registered in the Overhaul Manual.

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12.4) Special checks

▲ WARNING: After every repair work the engine is subject to a test run. Work on the engine is only allowed to be carried out and eligible for approval by authorized persons. See chapter 11.3).

In this chapter all work exceeding the prescribed maintenance is listed.

Respect indications in the Operator's Manual, chapter 10.4).

12.4.1) Check of engine after propeller ground contact or accidental propeller damage

See Pic. 58.

▲ WARNING: Respect without fail the relevant directives! Not respecting them could lead to personal injury!

— Remove gearbox and send it to an authorized overhaul facility for inspection and repair in accordance with chapter 14.4).

— Check drive for hydraulic propeller governor (if fitted).

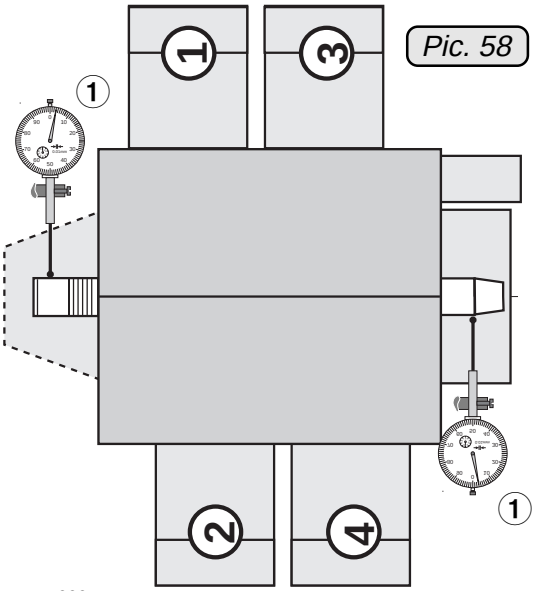
— Check crankshaft for out-of-round ①, both on magneto side and p.t.o. side.

— Visually check engine for damage. If any damage is found, send the engine to an authorized overhaul facility. See Chapter 14.4).

— Check engine equipment for damage (hydraulic governor, ignition unit, water and oil hoses).

— Observe directives of aircraft manufacturer.

— After taking the engine again into operation, visually check for leakage.



Pic. 58

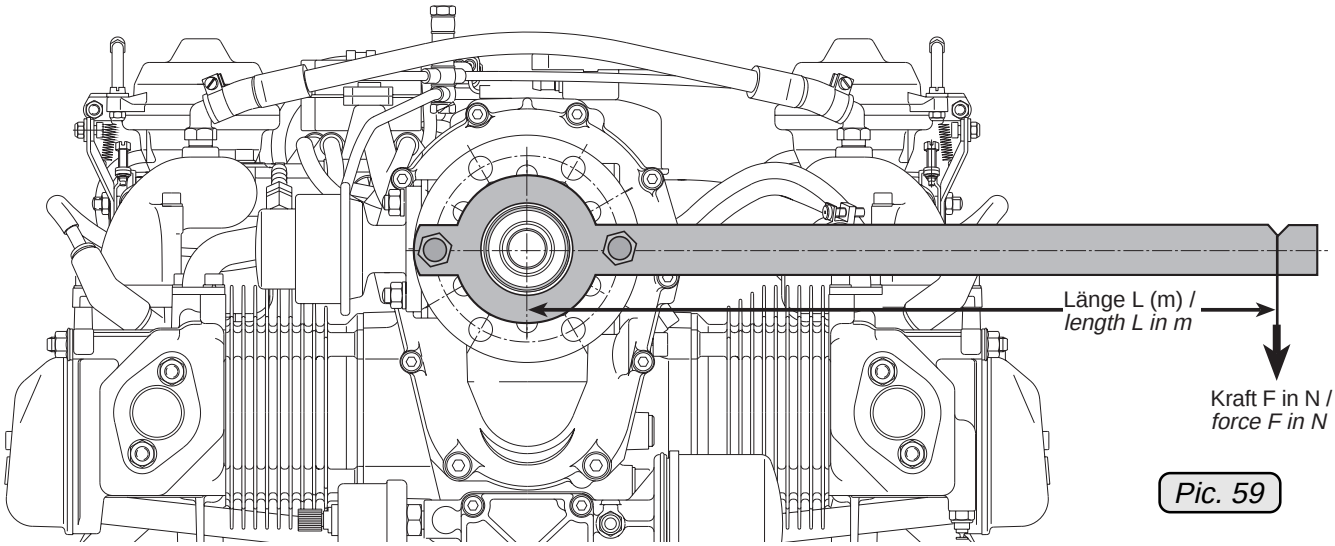
Dimensions **new** **wear limit**

Consult chapter 15.

12.4.2) Checking of the overload clutch

See Pic. 59.

To be carried out at overhaul or at suspicion of slipping. Inspection is done with crankshaft locked. Remove plug screw from crankcase, p.t.o. side, and insert crankshaft locking screw, part no. *240 880*. Turn in until the screw engages noticeably in the crankweb recess. (see chapter 13.3.1).



Pic. 59

Fit a specially prepared lever to the propeller flange (e.g. length 1,5 m / 5 ft.) and determine slipping torque with a spring scale. Applicable is the value determined during slow turning motion. Repeat the measurement several times to get a stable value.

▲ WARNING: Always observe the requisite safety instructions. Non-compliance could result in personal injury.

The slip moment is calculated from the spring force (F) measured in N and the length of the lever arm (L) applied in m (N x m = Nm).

The determined value must be at least 600 Nm (440 ft.lb). If this value is not reached disassemble and examine the overload clutch. See chapter 14.4).

12.4.3) Check after engine failure

After a failure it is important to communicate all details available to the authorized workshop. Also observations on the aircraft and the engine suspension can be of help. To ease diagnosis of the failure, pay special attention of the engine behaviour described below:

12.4.3.1) Engine runs erratic and misfires

May be caused by a failure in the fuel system (fuel supply, contamination, float chamber venting, false air intake due to defective carburetor flange, carburetor icing), or in the ignition system (shorting cable, electronic module, spark plugs, wrong spark plug connection, grounding defect etc.). See details regarding fuel- and ignition system.

12.4.3.2) Unintended engine stoppage by seizing

A failure in the lubricating system may be the cause. Oil pressure too low or no oil pressure due to oil shortage, contamination or bad venting of the oil system, defect in the oil pump. As a consequent damage, often the camshaft and/or the conrod bearings are seized. Carry out complete tear-down inspection and repair. See details regarding lubrication system.

▲ WARNING: If one of the above failures should arise even only for a short time, an exact engine check is necessary. Localize trouble and rectify.

12.4.3.3) Engine back to operation after submerging in water

An engine having submerged in water has to be sent immediately for overhaul to an authorized overhaul facility. See Chapter 14.4).

■ ATTENTION: The engine must be marked clearly with the note: "Engine submerged in water during operation".

12.4.4) Rough engine run

Either a failure of the ignition system or in the carburetor may be the reason (fuel supply, contamination in float chamber or float needle valve, float chamber venting, false air intake due to defective carburetor flange, engine temperature too low, too lean carburetor jetting due to conditions prevailing in intake silencer). See details regarding fuel- and cooling system.

12.4.5) Checks for extreme climatic conditions

Flying in deserts or areas with heavily contaminated or dusty air causes increased wear of all components. Therefore shorter maintenance intervals are recommended.

▲ WARNING: More frequent checks of air filter, coolant radiator and oil cooler are necessary.

Flying in areas of extreme climatic conditions or in extreme altitudes requires correction of carburetor jetting and of the cooling system. This requires consultation with the engine manufacturer.

12.4.6) Exceeding of maximum admissible engine speed

Any exceeding of the max. admissible engine speed has to be entered by the pilot into the logbook, stating duration and extent of overspeeding.

— Exceeding up to max. 1 minute up to 6200 rpm.: Check push rods for straightness. See Chapter 14.8).

— Exceeding more than 1 minute:

Complete check and/or repair of engine is necessary. See Overhaul Manual.

— Exceeding 6200 rpm.:

Complete check and/or repair of engine is necessary. See Overhaul Manual.

12.4.7) Exceeding of cylinder head temperature

See Pic. 60.

Any exceeding of the max. cylinder head temperature has to be entered by the pilot into the logbook, stating duration and extent of excess-temperature condition.

Find reason for overheating.

At short term exceeding of the cylinder head temperature of up to 150 °C (300°F) localize the cause and inspect the complete cooling system for damage. Verify that pistons are not damaged by knocking combustion.

If a cylinder head temperature above 150° C (300° F) is noticed longer than 30 minutes, a leakage test by the difference pressure method (see Chapter 12.3.17) is necessary. Also a hardness test of the cylinder head material in the area ❶ of the bearing support is required. Minimum hardness 85 HB (Brinell hardness).

■ ATTENTION: Do not damage the sealing face ❷ for O-ring!

Inspect complete installation of cooling system for damage, renew all coolant hoses and conduct operational check of the cooling system. See Chapter 13.3).

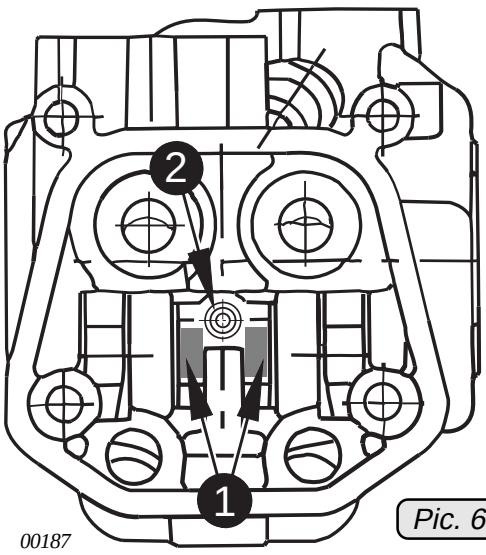
◆ NOTE: A rise in cylinder head temperature above 135° C (275° F) is a clear signal for a shortcoming in the cooling system:

— insufficient coolant, badly vented system

— radiator contaminated

— malfunction of water pump.

See details in chapter 12.3.13) and 13.3) cooling system.



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Pic. 60

12.4.8) Exceeding of oil temperature

Any exceeding of the max. admissible oil temperature has to be entered by the pilot into the logbook, stating duration and extent of excess temperature condition.

With oil temperature in excess of 130 °C (266 °F) for max. 5 minutes localize the cause. Check oil level in tank. Check oil cooler for soiling and the complete oil circuit for proper operation. Cut oil filter apart and check oil filter mat for foreign matter. Carry out oil change. See Chapter 12.3.8) and 12.3.9) oil filter replacement.

If the oil temperature exceeds 160° C (320° F), consequential damage is likely. A complete examination and engine repair is required.

12.4.9) Oil pressure below minimum value

If noticed on ground, immediately stop the engine and check for reason. Check complete lubrication system, trace cause and rectify.

With oil pressure below 0,5 bar (1 p.s.i.) at flight reduce engine speed to value as low as justifiable and carry out precautionary landing. Check complete lubrication system, trace trouble and rectify.

— Check free passage of oil feed line. See chapter 9.3).

— Check oil quantity. See chapter 12.3.8).

— Check oil pressure gauge. See chapter 13.7).

— Check indication instrument as per manufacturer's specifications, replace if necessary.

— Check correct function of pressure release valve. Renew valve and spring as requried. See chapter 13.2).

— If no cause of low oil pressure is found after doing the above checks, change the oil using a product meeting the requirements of Chapter 8.2) and 13.2).

— If after the previous checks the oil pressure remains too low, the engine must be completely checked and overhauled.

12.4.10) Oil specification not respected

If by error aircraft engine oil, with or without additives, has been refilled and the engine has been operated for less than 5 hours, the following measures have to be taken:

— Change oil. See chapter 12.3.9).

— Open plug screw and drain remaining oil from crankcase.

— Renew oil filter. See chapter 12.3.10).

— Drain oil completely from oil cooler.

— Refill oil tank with new automotive type engine oil as specified.

— Let engine run for approx. 1 hour and renew oil once more using specified automotive engine oil, renewing also the oil filter again, as described before.

If the engine has been operated longer than 5 hours with aircraft engine oil, with or without additives, remove propeller gearbox and the mating drive gear from engine.

Send propeller gearbox with the required documentation and the engine log book to an authorized overhaul workshop for check and overhaul. See chapter 14.4).

12.4.11) Sudden drop of boost pressure and engine speed

Inspect engine and especially turbo charger and air intake system.

➩ check oil consumption - oil level check. See chapter 12.3.8).

➩ check wiring. See chapter 12.3.16)

▲ WARNING: If the turbo charger is damaged send the engine to our authorized overhaul centre for repair.

If no physical damage can be detected, check the TCU. Consult chapter 13.6).

12.4.12) Sudden rise of boost pressure and engine speed

Inspect engine and especially turbo charger and air intake system.

➩ check wiring. See chapter 12.3.16)

If no physical damage can be detected, check the TCU. Consult chapter 13.6).

■ ATTENTION: If the limits of operation are exceeded or fall short of conduct the additional relevant checks.

▲ WARNING: Don't start engine before trouble is found and rectified.

12.4.13) Periodical rising and dropping of boost pressure and engine speed (surging of the TCU)

Inspect engine and especially turbo charger and air intake system.

⇨ check wiring. See chapter 12.3.16)

If no physical damage can be detected, check the TCU. Consult chapter 13.6).

■ ATTENTION: If the limits of operation are exceeded or fall short of conduct the relevant checks additionally.

▲ WARNING: Do not start engine before trouble is found and rectified.

12.4.14) Constant lighting of the red boost lamp of the TCU

Lighting up of the red boost lamp signals an exceeding of the target pressure in the airbox.

Depending on duration of time limit exceeding, increased wear by thermal overstressing of cylinder, valves and spark plugs has to be considered.

The following checks are necessary:

Exceeding the limit up to 1 min:

Inspect engine and especially turbo charger and air intake system.

⇨ check wiring. See chapter 12.3.16).

If not physical damage can be detected, check the TCU. Consult chapter 13.6).

No direct checks are necessary as long as no further operating limits are exceeded.

■ ATTENTION: If further limits of operation were exceeded or fell short of conduct the additional relevant checks.

▲ WARNING: Do not start engine before trouble is found and rectified.

Exceeding the limit longer than 1 minute:

Examination of pistons, cylinders, valves and cylinder heads is necessary.

■ ATTENTION: If further limits of operation were exceeded or fell short of conduct the additional relevant checks.

12.4.15) Flashing of the red boost lamp of Turbo Control Unit (TCU)

Flashing of the red boost lamp signals exceeding of the 5 minute time limit for take-off performance. Depending on the time the 5 minute limit is exceeded, increased wear by thermal overstressing of cylinder, valves and spark plugs has to be considered.

The following checks are necessary:

➪ check wiring. See chapter 12.3.16)

If no physical damage can be detected, check the TCU. Consult chapter 13.6).

Exceeding time limit up to 1 minute:

No direct checks are necessary as long as no further operating limits are exceeded.

■ ATTENTION: If further operating limits were exceeded or fell short of conduct the additional relevant checks.

Exceeding time limit between 1 to 3 minutes:

➪ Inspection of engine. See chapter 12.3.2).

➪ Check of the spark plugs. See chapter 12.3.18).

➪ Check compression. See chapter 12.3.20).

■ ATTENTION: If further operating limits were exceeded or fell short of conduct the additional relevant checks.

Exceeding time limit by more than 3 minutes:

Examination of the pistons, cylinders, valves and cylinder heads is necessary.

■ ATTENTION: If further operating limits were exceeded or fell short of conduct the additional relevant checks.

12.4.16) Flashing of the orange caution lamp

◆ NOTE: The non-lighting orange caution lamp indicates that the TCU is ready for operation.

If this lamp is flashing it signals a malfunction of the TCU or its periphery.

At trouble, for instance if the wiring is the TCU switches over to the pre-programmed default values to warrant engine operation.

■ ATTENTION: Whilst the default values are effective, supervision of the respective channel, e.g. overspeeding is not possible. Supervision is set **inactive**.

Inspect engine especially turbo charger and air intake system.

⇨ check wiring. See chapter 12.3.16)

If no physical damage can be detected check the TCU. Consult chapter 13.6).

■ ATTENTION: If the limits of operation are exceeded or fall short of, conduct additional relevant checks.

▲ WARNING: Do not start the engine before trouble is found and rectified.

12.4.17) Failure of power supply to the TCU

Inspect engine.

⇨ check electric system (power supply). Consult chapter 13.4)

⇨ check wiring. See chapter 12.3.16)

If no physical damage can be detected check the TCU. Consult chapter 13.6).

■ ATTENTION: If the limits of operation are exceeded or fall short of, conduct additional relevant checks.

▲ WARNING: Do not start the engine before trouble is found and rectified.

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13) Maintenance of the various systems

13.1) Fuel system

Besides the maintenance work prescribed, see Chapter 12), and description of the fuel system, Chapter 9.2), further maintenance procedures are described as follows:

13.1.1) Removal of carburetors, carburetor flanges, fuel tubes and drip trays

See Pic. 61.

For check or maintenance the carburetors have to be removed.

◆ NOTE: Due to the drip tray ❶ the float chamber ❷ cannot be removed from carburetors installed.

To remove the carburetors, loosen the tube clamps ❸.

Remove fuel tubes ❹ by removal of banjo screws M10 ❺ with sealing rings ❻. Loosen clamps ❼ of pressure tubes ❽ on carburetor (float chamber venting) and fuel pressure regulator ⓱ and remove tubes.

Remove spring ❾ for carburetor suspension with suitable tool.

Now the airbox ❿ can be withdrawn towards back from the carburetors.

◆ NOTE: If required, remove 2-pole plug connector of temperature sensor ⓫ and/or loosen air intake hose ⓬.

Remove 3-pole connector of throttle valve potentiometer.

Remove clamp ⓭ from carburetor flange ⓮ and remove carburetor by gentle turning and swivel motion along with fuel tubes.

Withdraw aluminum spacer ⓯ 36/43/4,2 from carburetor flange and close intake openings. Remove hose clamp ⓰, union nut ⓱ and fuel tubes.

For disassembly of carburetor flanges ⓮ only the 2 hex. screws M8x25 with shims have to be removed. Then the carburetor flanges ❶ and the drip tray ❺ can be removed.

13.1.2) BING constant depression carburetor: Check and maintenance

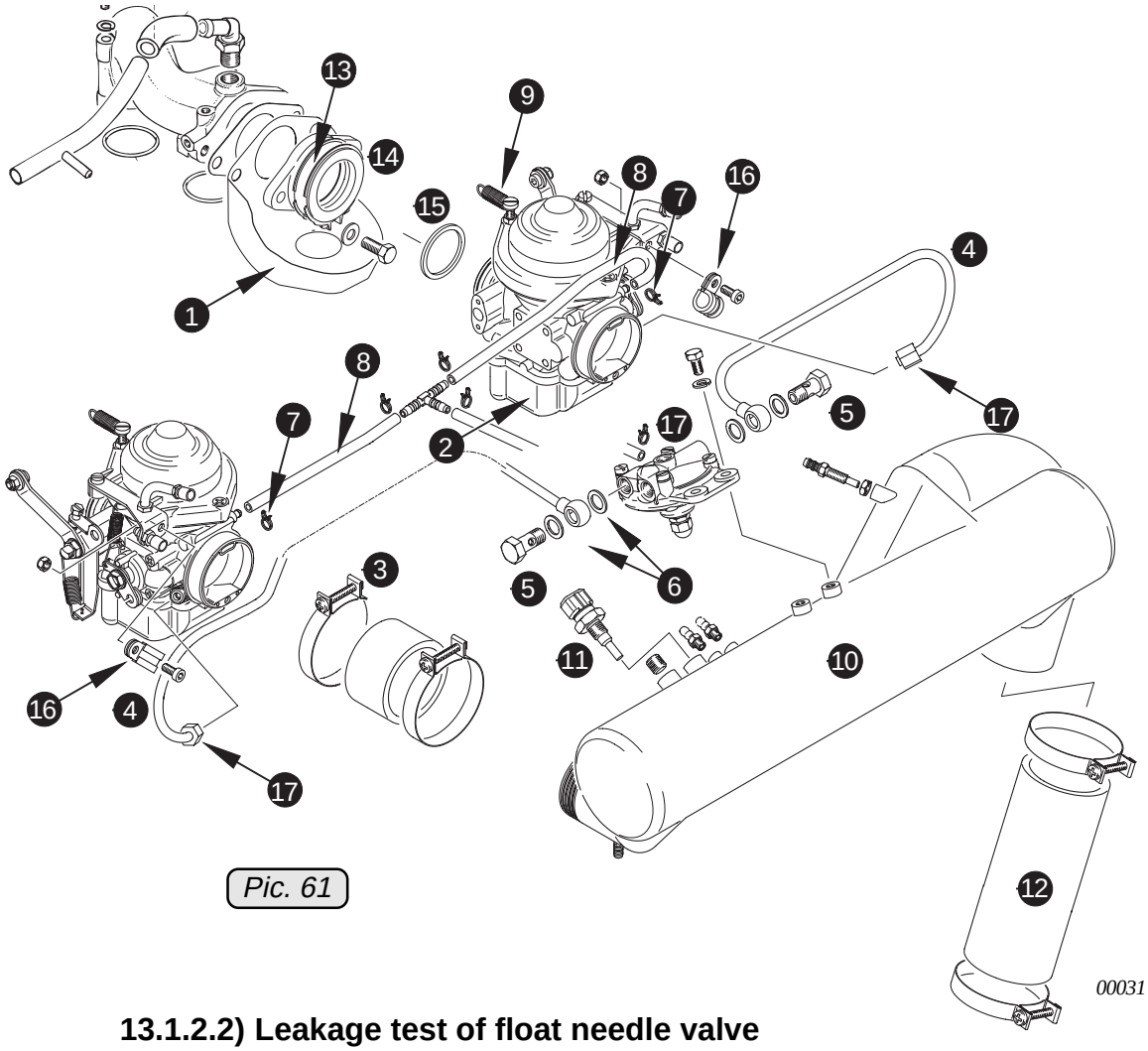
13.1.2.1) General

■ ATTENTION: In principle no modification must be made on the carburetor calibration. The determination of the main jet is carried out on a dyno at 300 m (1000 ft) above Mean Sea Level.

Modification is allowed to be carried out to our specifications only by aeronautical personnel or authorized test staff.

Before removal of the carburetors for a precise inspection, close the fuel cock and remove the fuel feed lines, collect possibly emerging fuel and ensure proper disposal.

■ ATTENTION: To avoid contamination in the fuel system proceed with great care and cleanliness. Put carburetor and parts removed on a clean surface.



Pic. 61

13.1.2.2) Leakage test of float needle valve

See Pic. 62.

◆ NOTE: This check can be carried out right on the engine, only the fuel tubes have to be removed.

With this check the float needle seat is checked for tightness. If the depression is not maintained, pay particular attention during disassembly to the float needle with Viton tip and the carburetor housing.

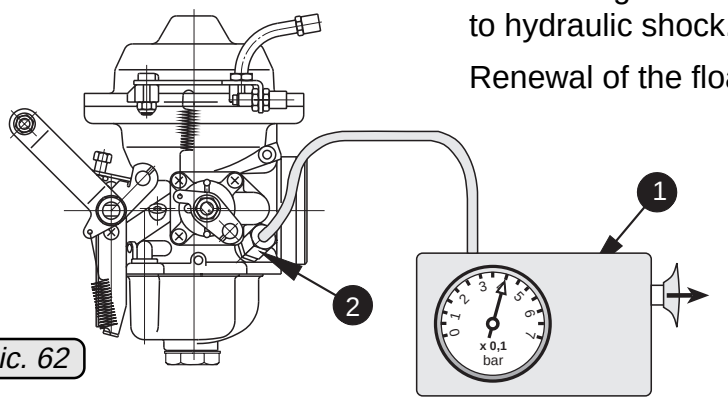
Connect vacuum pump ❶ to the fuel supply line ❷ and generate a depression of approx. 0,4 bar (5,8 p.s.i.).

The depression must not change within approx. 5 seconds.

Check float needle valve.

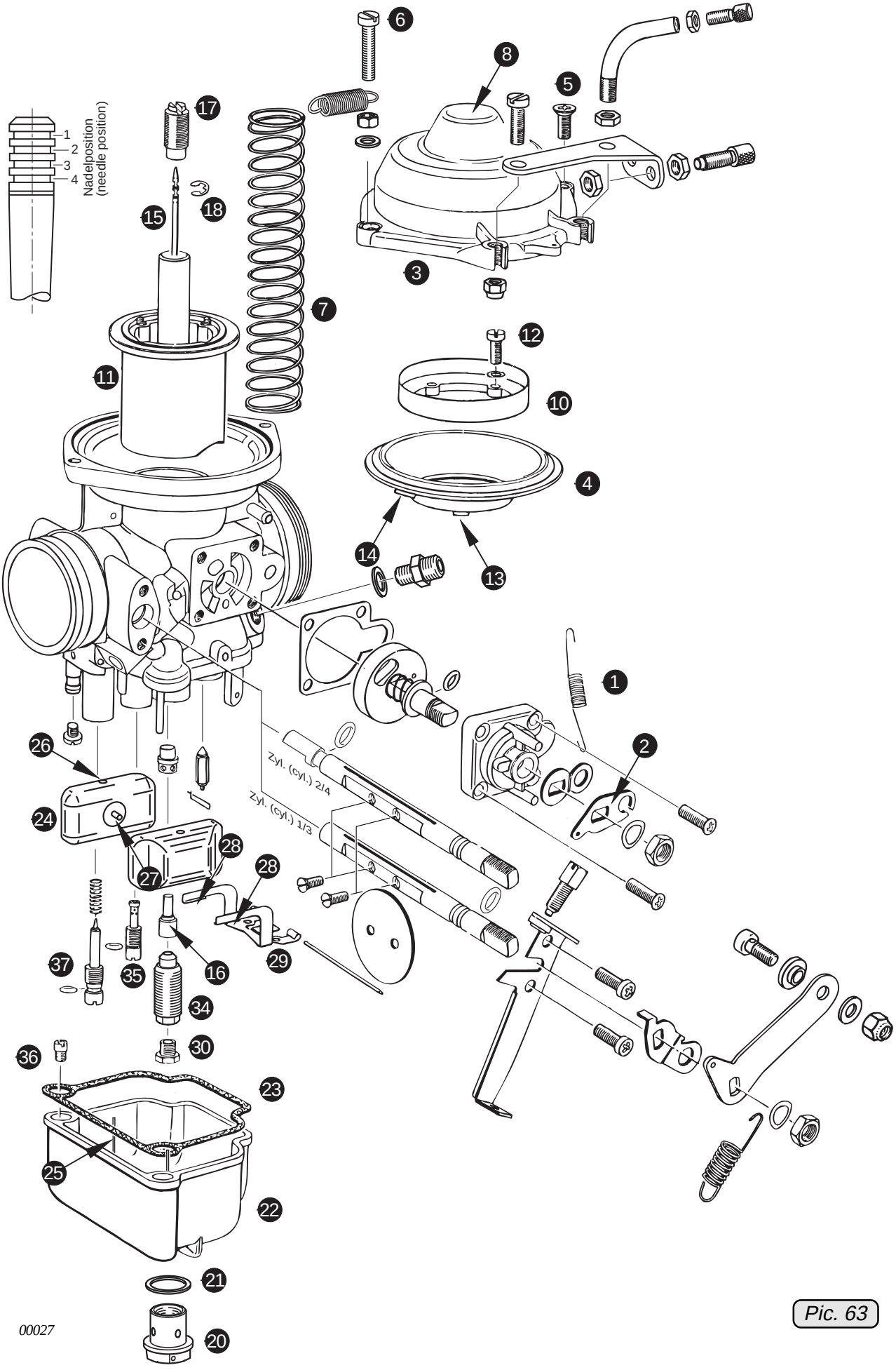
■ ATTENTION: If depression drops, this indicates leakage which may cause overflowing of fuel and in consequence engine damage due to hydraulic shock.

Renewal of the float needle seat is not allowed.



Pic. 62

13.1.2.3) Carburetor components



Pic. 63

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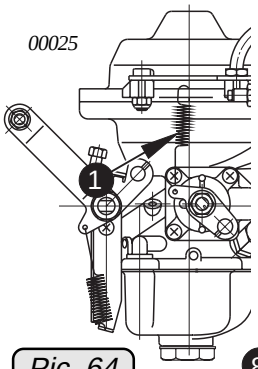


Pic. 64

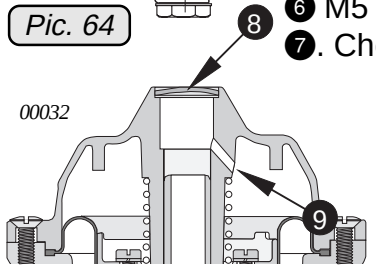
13.1.2.4) Diaphragm

See Pic. 63/64 and 65.

Unhook spring ❶ of choke from start lever ❷ and chamber top ❸.

◆ NOTE: The diaphragm ❹ is linked to the plunger (carburetor piston). Depending on the pressure prevailing, the plunger is moved up or down.

For checking, remove the 2 countersunk screws ❺ M5x12 and Allen screw ❻ M5 along with nut and shim, remove the chamber top ❸ and the spring ❼. Check tight fit of the cover ❽ on chamber top.



Pic. 65

Wash chamber top with cleaning agent and blow the inside venting bore ❾ with compressed air, then check visually. See Pic. 65.

◆ NOTE: The diaphragm ❹ is fixed by the retaining ring ❿ to the carburetor piston ⓫.

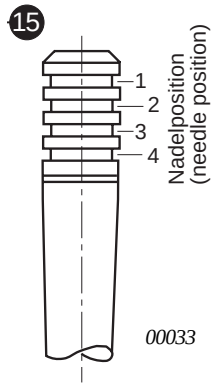
Remove plunger from the carburetor housing and remove 4 Allen screws ⓬ M4x12.

■ ATTENTION: The position of the carburetor piston is controlled via the diaphragm. On the diaphragm there are 2 positioning noses**.** The nose ⓭ fits exactly in the recess in the plunger, nose ⓮ must engage in the recess in the carburetor housing.

Check diaphragm for cracks or brittleness, replace if necessary.

13.1.2.5) Jet needle, carburetor piston

See Pic. 63/66 and 67.



Pic. 66

The jet needle ⓯ controls the fuel consumption at part load. It may be regulated by choosing position of jet needle between 1 and 4.

Modifications are allowed only after consultation with the engine manufacturer.

◆ NOTE: A **higher** position causes "deeper plunging" of the jet needle into the needle jet ⓰ ➪ smaller flow diameter ➪ leaner mixture.

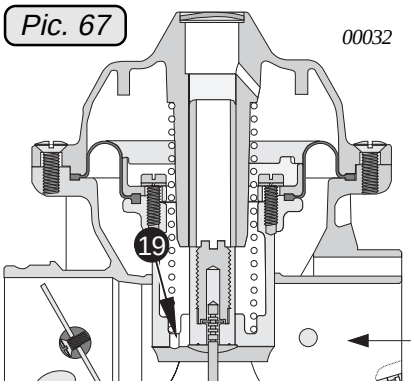
Lower position ➪ richer mixture.

Remove fixation screw ⓱ and check jet needle ⓯ with circlip ⓲ for wear. Pay special attention to the grooves and the taper of the needle. At visible wear the jet needle must be exchanged and refitted in the same position.

■ ATTENTION: The jet needle fitted must move freely.

Visually check outside of plunger ⓫ and the two inside compensation bores ⓳.

Pic. 67



13.1.2.6) Float chamber, floats

See Pic. 63 and 69.

Remove safety wiring and plug screw ⓴ with sealing ring ㉑ 16/22/1.

Remove float chamber ㉒ with gasket ㉓ and clean float chamber.

Check both floats ㉔ for free movement on the guide pin ㉕. When the float is at its lowest position it still must have clearance and must not stick on the float chamber wall.

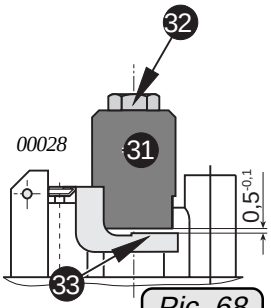
Check if both distance pieces ❹ are in position.

■ ATTENTION: A float stuck causes the carburetor to flood.

Check wear of guide sleeves ㉖ inserted in the float. Check the pins ㉗ for float support ㉘ for wear due to excessive vibration. At noticeable wear replace both floats and if necessary also the float suspension brackets ㉙.

13.1.2.7) Float suspension

See Pic. 63/68 and 69.

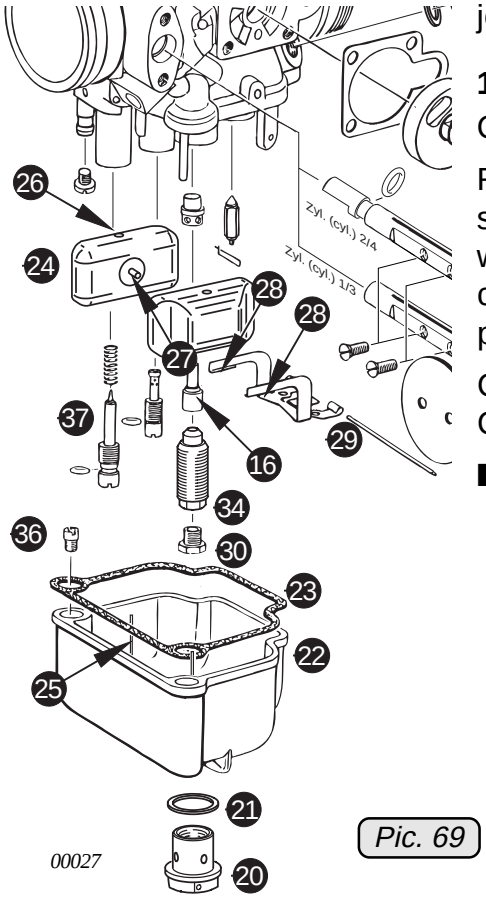


Pic. 68

Check if float suspension brackets ㉙ are parallel. To do so, remove main jet ㉚ and attach gauge ㉛, *part no. 877 730*, with a hex. screw ㉜ to the mixing tube. When the needle valve is closed, both brackets ㉝ of the float suspension must be of equal distance of 0,4 ÷ 0,5 mm (.016 ÷ .02 in.).

Renew float suspension always together with float needle valve.

At noticeable imperfection the float suspension can be bent for correction or be renewed. After the check remove the gauge and refit main jet.



Pic. 69

13.1.2.8) Jets

Carburetor jets, see Chapter 8, or latest spare parts list.

Remove main jet ㉚, mixing tube ㉞, needle jet ⑯, idle jet ㉟, start jet ㊱, and mixture screw ㊲. Clean carburetor and jets with fuel. Carefully blow through all jets and bores in the carburetor housing with compressed air and check for free passage.

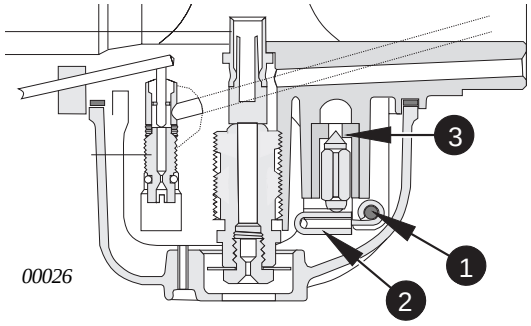
Check inner diameter of needle jet if oval, replace if necessary. Check the size.

■ ATTENTION: At all work on the carburetor proceed with optimum cleanliness.

13.1.2.9) Check of float needle valve

See Pic. 70 and 71.

Pic. 70

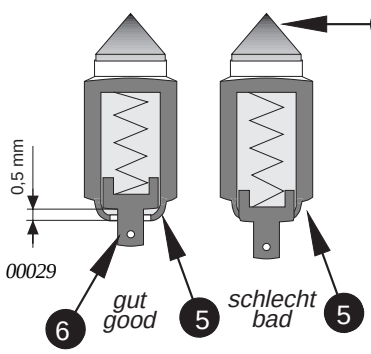


Drive out peg ❶ with a pin punch and remove float suspension ❷ and float needle.

Check float needle ❸ and its seat for wear and the inlet for contamination.

Check fuel inlet for free passage.

Inspect Viton tip ❹. At visible wear of the beaded edge ❺ at the sprung pin ❻ the valve has to be renewed. If the distance becomes less than 0,5 mm (.02 in.) the float level will be affected, leading even to interruption of the fuel flow.



Pic. 71

Insert float needle valve into the needle seat. Engage float needle clip into float bracket, place it in position and fix float bracket with pin.

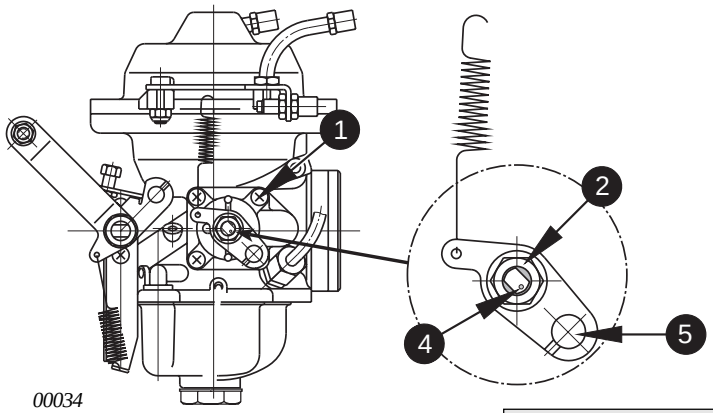
Fit float chamber and fix it with plug screw ❶ and sealing ring 16/22/1. Apply safety wiring.

13.1.2.10) Starting carburetor (choke)

See Pic. 72 and 73.

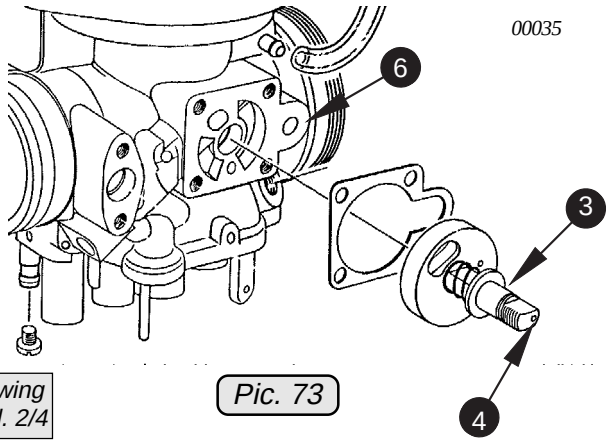
Remove 4 countersunk screws ❶ M4x14 and remove the complete choke housing. Remove hex. nut ❷ and complete fuel choke valve from the housing. Clean all parts and check.

◆ NOTE: The choke shaft ❸ has a mark ❹. This mark has to point towards cable engagement ❺ or to bore ❻.



Pic. 72

the pictures are showing the carburetor for cyl. 2/4



Pic. 73

Clean all parts and blow all bores and ducts with compressed air. Check all parts and replace imperfect ones.

13.1.2.11) Carburetor reassembly

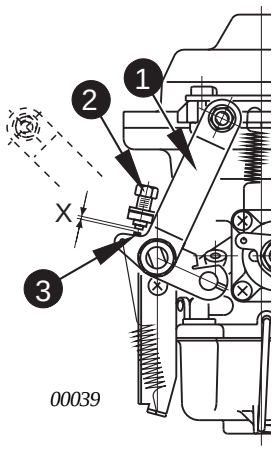
Reassembly of the carburetor with new O-rings and gaskets in reversed sequence.

13.1.3) Carburetor synchronization

For smooth idling, synchronization of the throttle valves is necessary. When synchronizing, slacken both throttle cables.

13.1.2.1) Mechanical synchronization

See Pic. 74.



Pic. 74

For synchronous basic throttle adjustment (mechanical synchronization) proceed as follows:

For new adjustment turn back both stop screws ❷ (throttle valve stop screws) so that throttle valves close fully.

Close throttle valve fully with throttle lever ❶. Adjust stop screw ❷ so that a gap **(X)** of 0,1 mm (.004 in.) remains between stop screw ❷ and stop ❸ on the lever. Now turn stop screw in by 1,5 turn.

Same procedure on the second carburetor.

Under normal circumstances the mechanical carburetor synchronization is sufficiently precise.

◆ NOTE: Subsequently adjust cables for simultaneous opening of the throttles.

13.1.3.2) Pneumatic synchronization

See Pic. 75.

◆ NOTE: Is not possible with drip tray fitted. If a pneumatic synchronization should be absolutely necessary, remove the drip tray and refit it after synchronization.

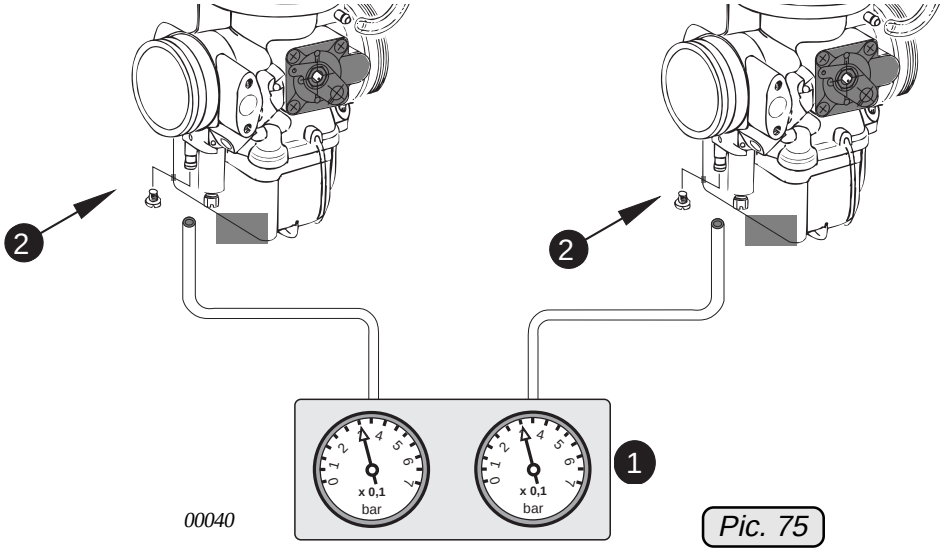
With suitable flow meters (synchro tester) or depression gauges both carburetors are adjusted to equal flow rate at idling. Remove the compensating tube (connection between intake manifolds) and plug the connections.

Remove plug screws ❷ M3,5x5 and connect the depression gauge(s).

At idling adjust the stop screws (see Pic. 74) so that both depression gauges indicate the same pressure and the idle speed is correct. With alternating acceleration on each carburetor respectively, the idle mixture screws can be fine-adjusted to achieve equal response to throttle movement on both carburetors.

■ ATTENTION: Respect the indication of the instrument manufacturer.

Refit plug screws M3,5x5.



Pic. 75

13.1.4) Idle speed adjustment

See Pic. 76.

Basic adjustment:

Close mixture control screw ❶ completely by turning clockwise and then open up again by 1 1/2 turn.

Basic adjustment is 1 1/2 turn.

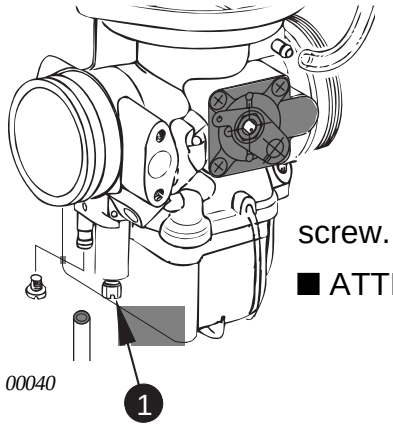
Fine adjustment on engine:

◆ NOTE: Idle adjustment is not possible with drip tray fitted. If an idle adjustment is absolutely necessary, remove the drip trays and refit them after adjustment.

Adjusting of the idle speed should always be done at operating temperature of engine.

First, close mixture control screw ❶ completely by turning clockwise and then open up again by 1 1/2 turn (like for basic adjustment).

◆ NOTE: Turning idle mixture control screw in clockwise direction results in a leaner mixture and turning anti-clockwise in a richer mixture.



Starting from the basic setting turn the mixture control screw until reaching the maximum engine rpm. The optimum setting is the middle between the two positions at which an rpm. drop is noticed. Finalize the setting of the idle speed by fine adjusting with idle screw (see Pic. 74) and, if necessary, by adjusting again mixture control screw.

■ ATTENTION: If satisfactory idle ajdustment is not possible, an additional pneumatic synchronization is necessary.

Pic. 76

13.1.5) Check of the fuel system

The most common reason for engine failure is a shortcoming in the fuel system. Many problems can be prevented by regular checks. Contamination and water by condensation can lead to erratic engine run or misfiring.

- ➪ Check float chamber for dirt and water.
- ➪ With bad contamination or formation of water, drain the complete system inclusive tank, filter and fuel lines, clean and rinse it well.

13.1.5.1) General notes on fuels

■ ATTENTION:

- ☛ Water and dirt in the fuel may cause engine failure and performance drop.
- ☛ Leaks in the fuel system may cause performance drop and bad idling of the engine.
- ☛ Unsuitable routing of fuel tubes may cause engine failure.
- ☛ After maintenance work the fuel system has to be checked for leaks.
- ☛ Always use clean and non-translucent, safety approved fuel containers. At refuelling use filter funnel. Do not smoke, do not allow open flames or sparks in the vicinity.
- ☛ Never refuel with engine running.
- ☛ Do not refill tank brimfull, allow for expansion of the fuel.
- ☛ Remove spilt fuel immediately, dispose of it respecting environmental regulations.
- ☛ Gasoline is highly inflammable and under certain conditions explosive. Handling of fuel in well ventilated places only.
- ☛ The float needle valve cannot retain the fuel pressure over a longer period or during transport of the aircraft.
- ☛ If problems with fuel supply are encountered and cannot be resolved, contact a ROTAX Distribution Partner or Service Centre.

13.1.6) Fuel pressure

See Pic. 77.

There is no specific connection on the engine for reading of fuel pressure. For survey or if function is disturbed, it is an advantage to take readings of fuel pressure.

For connection it is recommended to fit an additional hose nipple 4/6 ❶ which is screwed with the connection for fuel tube ❷.

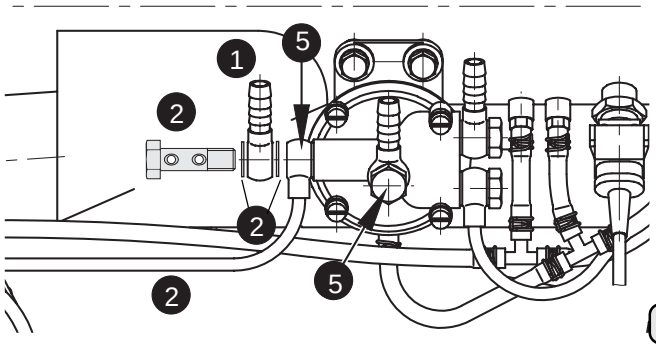
➪ Remove banjo screw M10x1x19. Fit additonal hose nipple (with integrated orifice) ❶ and 2 sealing rings ❸ with banjo screw ❹ M10x1x30.

Tightening torque of banjo screw: 17 Nm (150 in.lb).

■ ATTENTION: At tightening of the fuel lines ❷ support the specific line, to prevent any internal stress.

◆ NOTE: The illustration shows an additional hose nipple connected to fuel line of carburetor 1/3. The additional nipple can be fitted of course to any other connection, with the exception of **outlet** ❺.

All the necessary items are available as spare parts.



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Pic. 77

■ ATTENTION: **The fuel pressure must be approx. 250 hPa above the constantly varying boost pressure in the "airbox".** Otherwise the perfect function of the carburetors is not assured. For further information see Chapter 9.2).

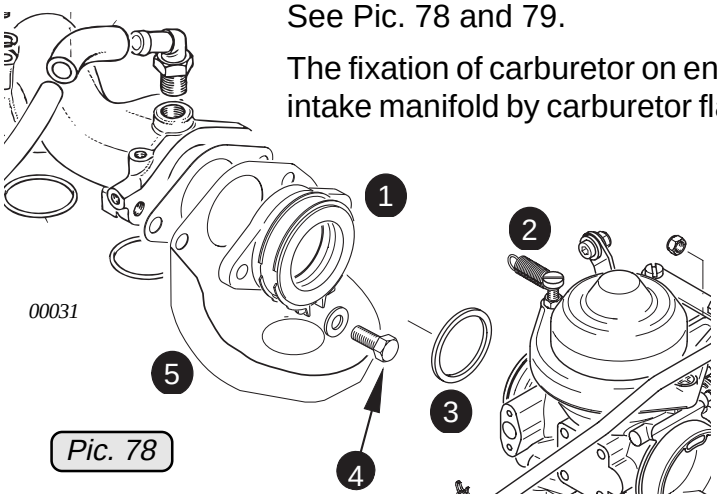
Fit the pressure gauge where it can be easily observed by the operator of the ground test run.

■ ATTENTION: Make sure there is no danger that the gauge and hose get drawn into the propeller airstream. If necessary, secure with cable ties.

If during the test run the nominal fuel pressure values are not met, stop engine and start with the trouble shooting procedure.

▲ WARNING: No aircraft take-off before an obvious fault has been found and eliminated!

13.1.7) Carburetor flange, drip tray



Pic. 78

See Pic. 78 and 79.

The fixation of carburetor on engine is designed to allow secure fastening on intake manifold by carburetor flange ass'y ❶ 267 785. There is an additional carburetor attachment by spring ❷ and spacer ❸.

This kind of fixation warrants for safety in case of hard landing, air turbulences, excessive vibration etc., protecting the carburetor at a large extent from vibration.

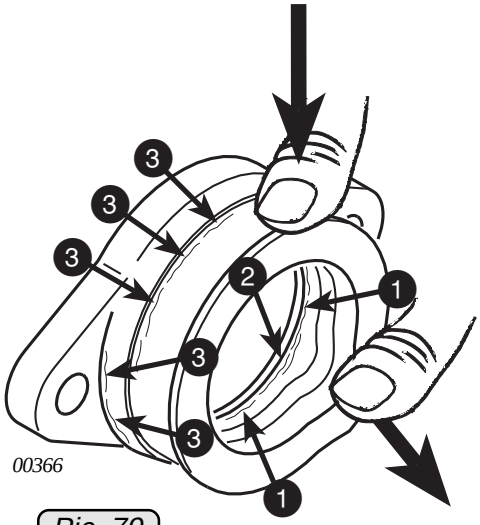
For disassembly only remove the 2 hex. screws ❹ M8x25 and washers. Then the carburetor flange ❶ and drip tray ❺ can be removed.

Carburetor flange: See Pic. 51

The carburetor flange is subject, apart from chemical strain due to fuel and UV radiation also to stress by vibration. Excessive tightening of the clamp may also damage it.

Compress carburetor flange in the area of the carburetor connection to allow easier detection of existing cracks ❶ and ❸. Also check the area of the inner diameter ❷.

▲ WARNING: If cracks are suspected, fit a new carburetor flange.



Pic. 79

■ ATTENTION: To assure safety of the fixation, it is recommended to apply a safety wiring of suitable dimension, as per usual standard in aviation.

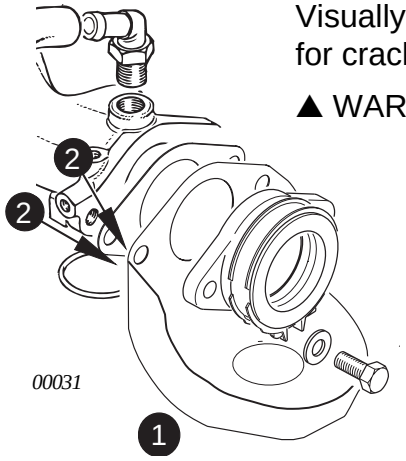
Every modification on the intake unit (e.g. air box etc.) should be fitted only after careful judgement of consequences. No additional weight must be charged on the carburetor flange.

▲ WARNING: Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

Drip tray: See Pic. 80.

Visually check drip tray ❶. Especially in the area of the fixation bores check for cracks.

▲ WARNING: If cracks are suspected or evident, renew the drip tray.

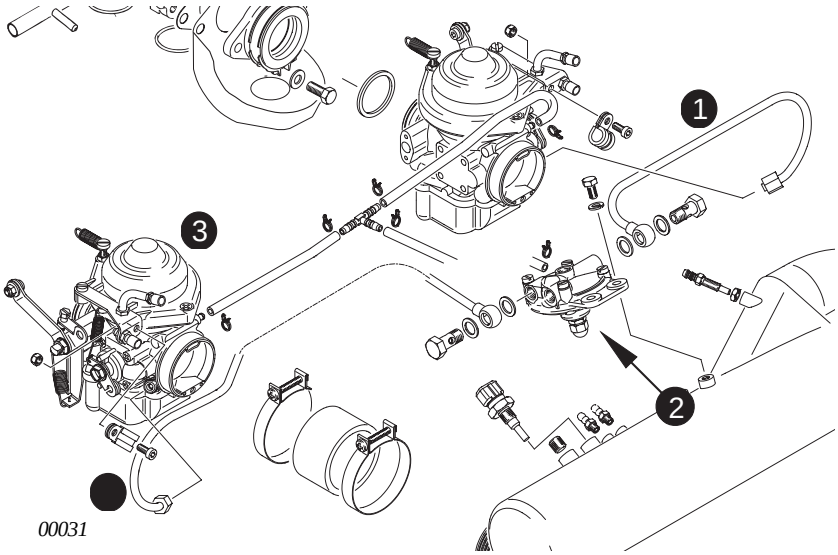


Pic. 80

13.1.8) Fuel tubes

See Pic. 81 and 82.

Check the 2 fuel tubes ❶ between fuel pressure regulator ❷ and carburetor ❸ for leaks. Check connections on the carburetors.



▲ WARNING:
Renew damaged fuel tubes!

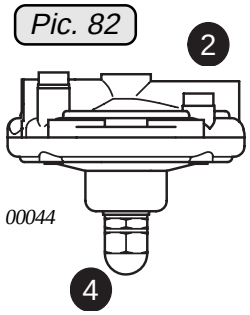
Pic. 81

13.1.9) Fuel pressure regulator

See Pic. 81 and 82.

Visually check fuel pressure regulator ❷.

Pic. 82



All fuel pressure regulators are calibrated by the engine manufacturer and need no further adjustment or maintenance.

If this nevertheless should be necessary, there is an adjustment screw ❹ at the bottom of the regulator.

Set ignition switch for both ignition circuits to "OFF" position. Switch ON electric fuel pump, and with the adjustment screw ❹ adjust to the correct fuel pressure (approx. 250 hPa above airbox pressure).

■ ATTENTION: The fuel pressure regulator must not be disassembled as there are no spare parts available. If necessary, renew the complete regulator.

Fitting of fuel pressure regulator by hex. screws M6x16 and lock washers on the airbox. Tightening torque 8 Nm (70 in.lb).

13.1.10) Fuel pump

See Pic. 83/84 and 85.

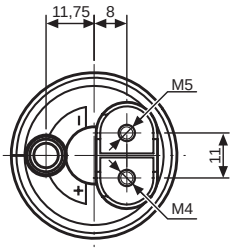
The fuel pumps are **maintenance-free** and need no adjustment or servicing.

Visually check the fuel pump.

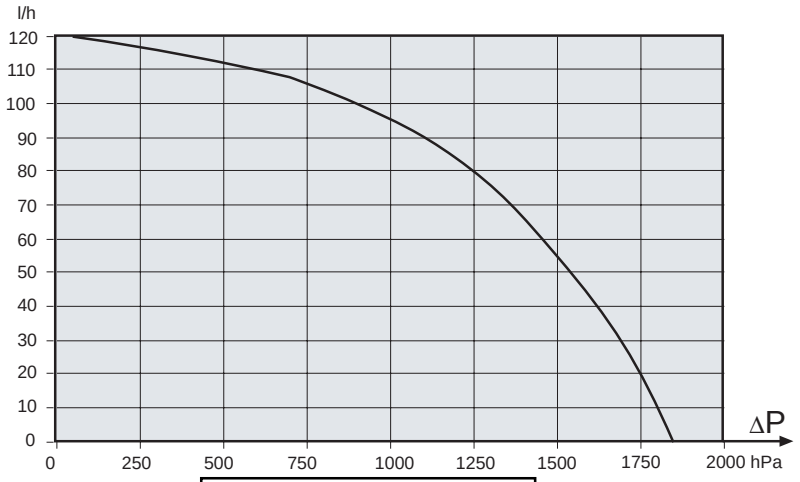
■ ATTENTION: The fuel pump must not be disassembled, there are no spare parts available. If necessary, renew the complete fuel pump.

In case of troubles, check function via the fuel supply and/or current input.

Flow rate / pressure: See diagram Pic. 84.

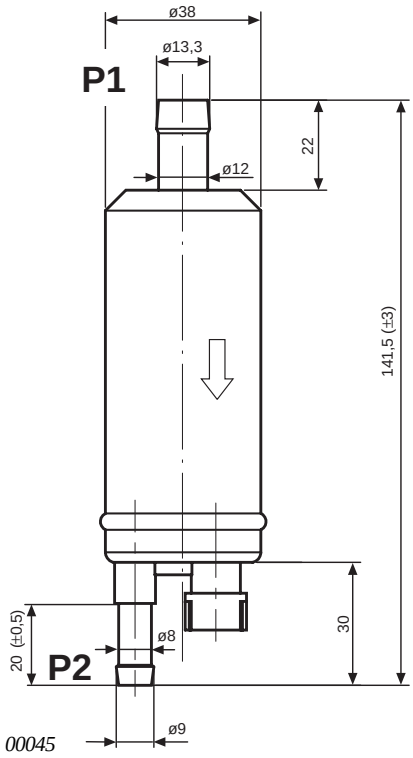


Pic. 83



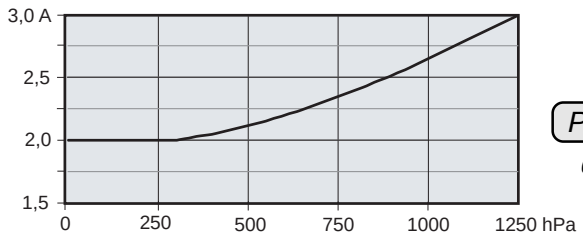
$\Delta P = P2 - P1$

Pic. 84



The diagram shows the flow rate of the electric fuel pump in relation to pressure.

Current input / pressure: See diagram Pic. 85.



Pic. 85

Take care of the following:

➪ The diagrams show the minimum limit curve at nominal voltage (12V DC) of the pump.

➪ Pressure indications in Pic. 84 and 85 refer to boost pressure.

➪ Pressure and suction height are "ZERO".

➪ The graph applies only to a seasoned pump: Run-in period approx. 30 minutes.

◆ NOTE: The pump may increase its performance by approx. 20 % after running-in.

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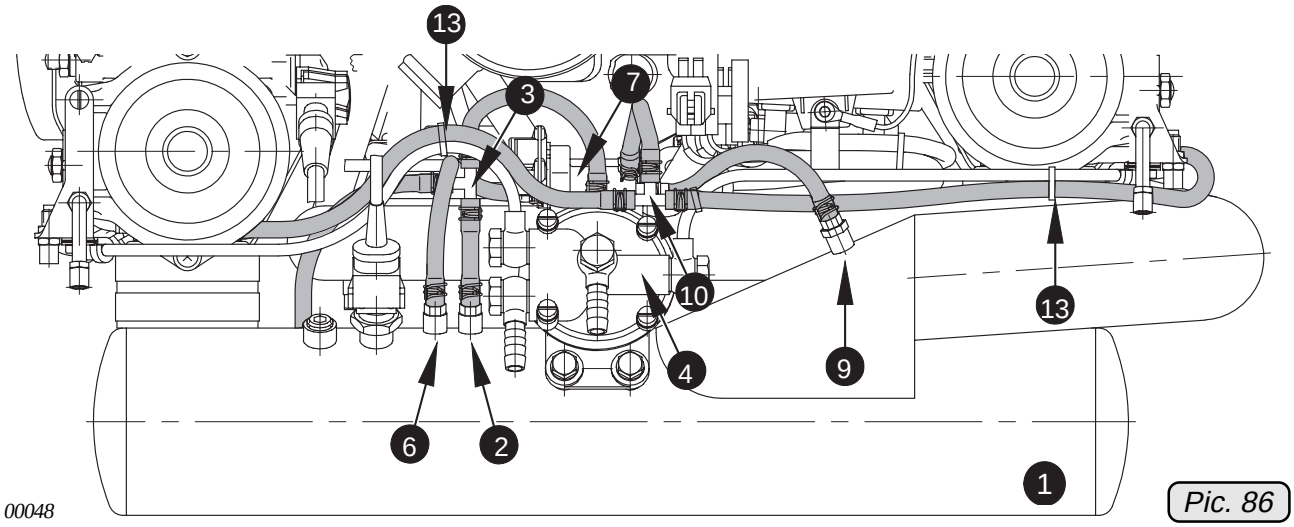
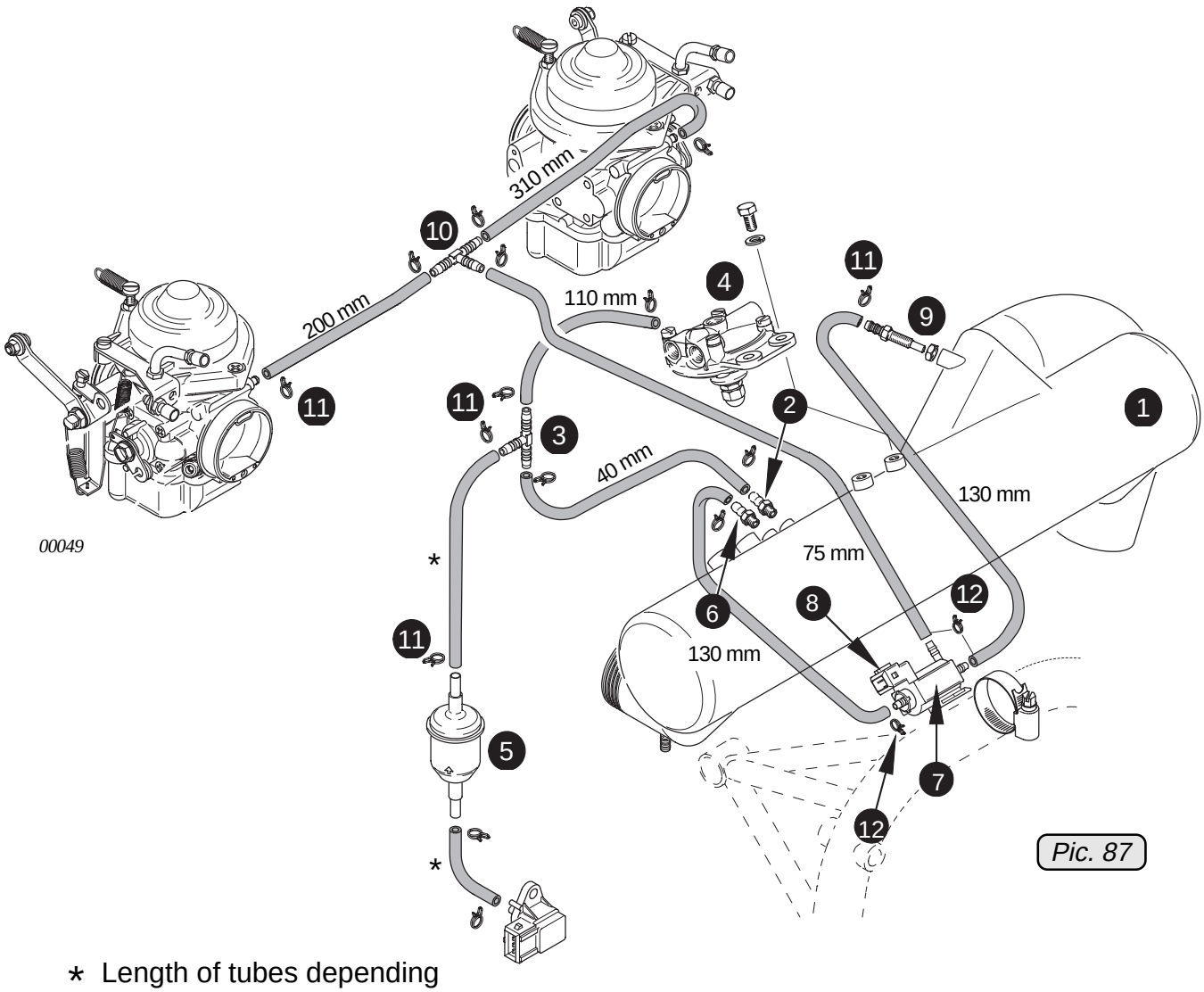
13.1.11) Pressure connection tubes

See Pic. 86 and 87.



Pic. 86



Pic. 87

* Length of tubes depending on installation conditions

The pressure connection tubes are of essential importance for safe operation of the engine. See Chapter 9.2) and 12.3.2).

Check all tubes for damage (mechanical, thermical, etc.) and leakage.

■ ATTENTION: All tubes are secured with clamps. Check them for security.

If the tubes have been detached or renewed, connect them correctly:

- ➪ hose nipple ❷ to T-piece ❸
- ➪ T-piece ❸ to fuel pressure regulator ❹
- ➪ T-piece ❸ to condensation water trap ❺
- ➪ condensation water trap ❺ to airbox pressure sensor
- ➪ hose nipple ❻ to 3-way solenoid valve ❼ (towards 2-pole electric connector ❽)
- ➪ hose nipple ❾ to 3-way solenoid valve ❼ (towards opposite side of electrical connector ❽)
- ➪ 3-way solenoid valve ❼ (top connection) to T-piece ❿
- ➪ T-piece ❿ to float chamber venting of carburetor 1/3
- ➪ T-piece ❿ to float chamber venting of carburetor 2/4

Secure all tubes with clamps 8 ⓫.

An exception are the 3 tubes on 3-way solenoid valve which, due to the dimensions of the valve, have to be secured with clamps 6,8 ⓬.

The tubes for float chamber venting are to be fitted with cable strap ⓭ to the fuel tubes. Do not constrict!

■ ATTENTION: For all pressure connection tube, utilize the total slip-on length for tube connection, and secure tubes with suitable clamps.

Route the tubes so that scouring or kinks are avoided.

13.1.12) Reassembly of carburetors, carburetor flanges, fuel tubes and drip trays

See Pic. 88/89 and 90.

The drip tray ❶ is fitted together with the carburetor flange ❷.

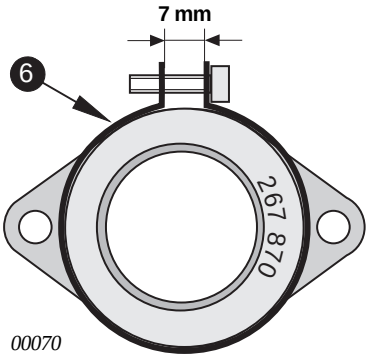
Fit carburetor flange, drip tray and new gasket ❸ with 2 hex. screws ❹ M8x25 and washers.

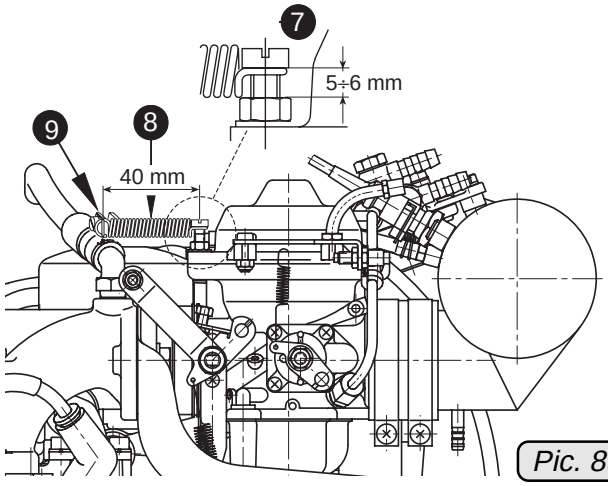
Secure screws with LOCTITE 221. Tightening torque 15 Nm (135 in.lb).

◆ NOTE: If leakage is noticed in the area of the drip tray, seal with SILASTIC.

Insert aluminum spacer ❺ 36/43/2,5 into carburetor flange. Fit carburetor in carburetor flange **free of grease and oil**, align and fix with tube clamp ❻.

■ ATTENTION: Tighten the new carburetor flange only up to the prescribed gap of 7 mm (.275 in.). See Pic. 88.





Pic. 89

From field experience cases are known where the hose clamp was tightened excessively. This may cause the flange to be scoured at the inside by the carburetor rim possibly damaging it.

Check distance of 5 ÷ 6 mm (.20 ÷ .24 in.) on Allen screw ❼ as this is important to allow free movement of the spring ❽.

Engage spring with suitable tool on the bracket ❾.

■ ATTENTION: To ensure efficient carburetor suspension, a distance of 40 mm (1.57 in.) between Allen screw and bracket must be respected.

◆ NOTE: Now fit the 2 fuel tubes as this will no more be possible with airbox mounted.

Fit fuel tube ❿ with union nut ⓫ on carburetor (fuel inlet). Support the tube with hose clamp ⓬ on carburetor bracket. Attach hose clamp with Allen screws ⓭ M5x12 and nuts ⓮. The tighten union nut to 10 Nm (90 in.lb).

Now the airbox ⓯ can be fitted on the connections of the carburetors. Do not damage the previously fitted fuel tubes and pressure connection tubes.

Pay attention that all faces of attachment are **free of grease**.

■ ATTENTION: Utilize the complete push-on length on the connection pieces.

Take care that the airbox ⓯ is fitted horizontally and torsion-free. There must be no additional load on the carburetor fixations.

Now the tube clamps ⓰ can be tightened on the connection tube ⓱ and, if necessary, on air intake tube ⓲.

Fit the pressure connection tubes ⓳ (float chamber venting) on both carburetors and fuel pressure regulator ㉑ with clamps ⓴ 8. See also "pressure connection tubes", Chapter 12.1.11).

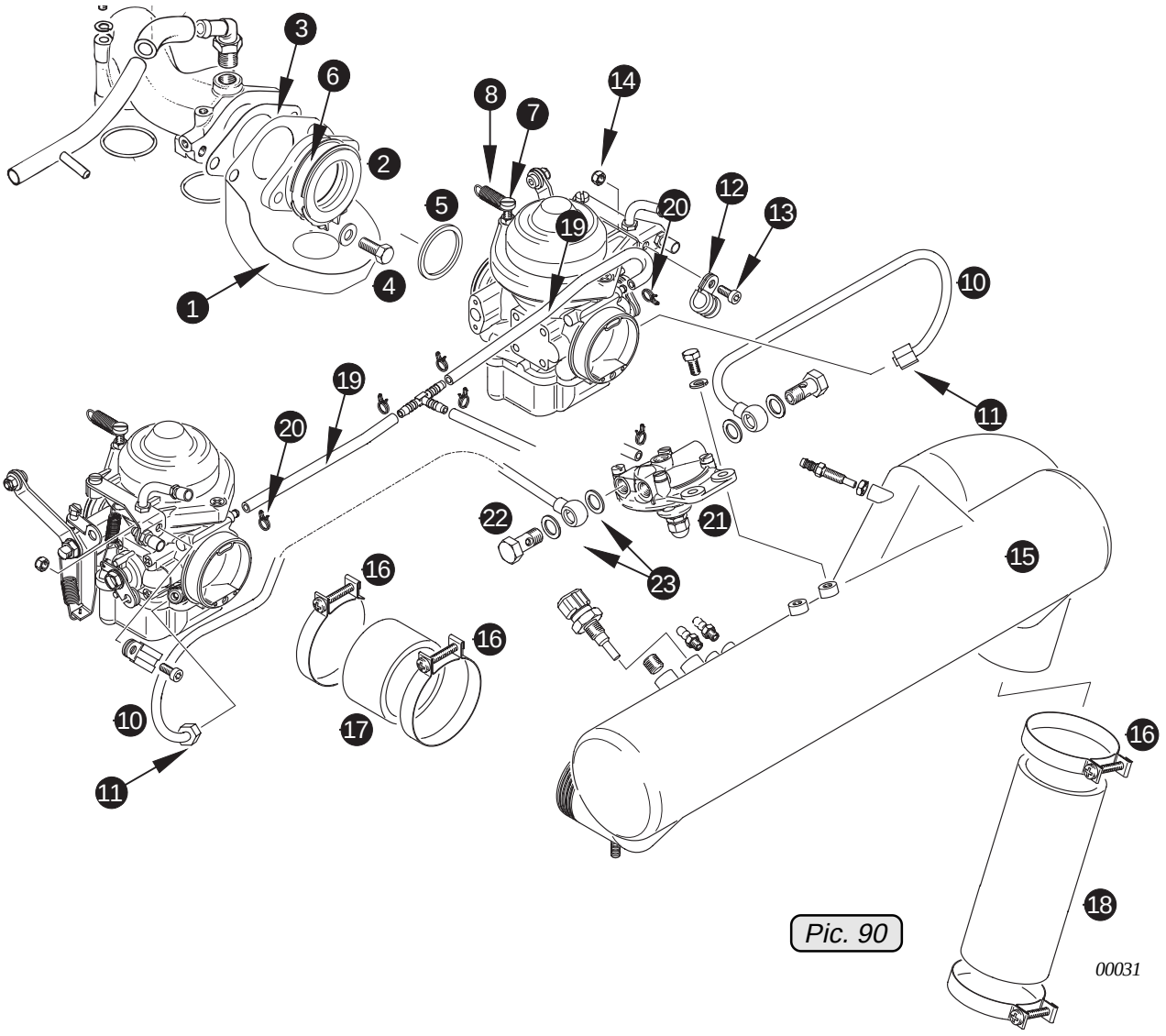
Fit the 2 fuel tubes ⓾ on fuel pressure regulator ㉑ with banjo screws ㉒ M10 and sealing rings ㉓ 10x14 on both sides.

Tightening torque: 17 Nm (150 in.lb)

■ ATTENTION: At fitting of fuel tubes support them adequately to avoid strain or additional load.

Reconnect plug connectors to temperature sensors and throttle valve potentiometer.

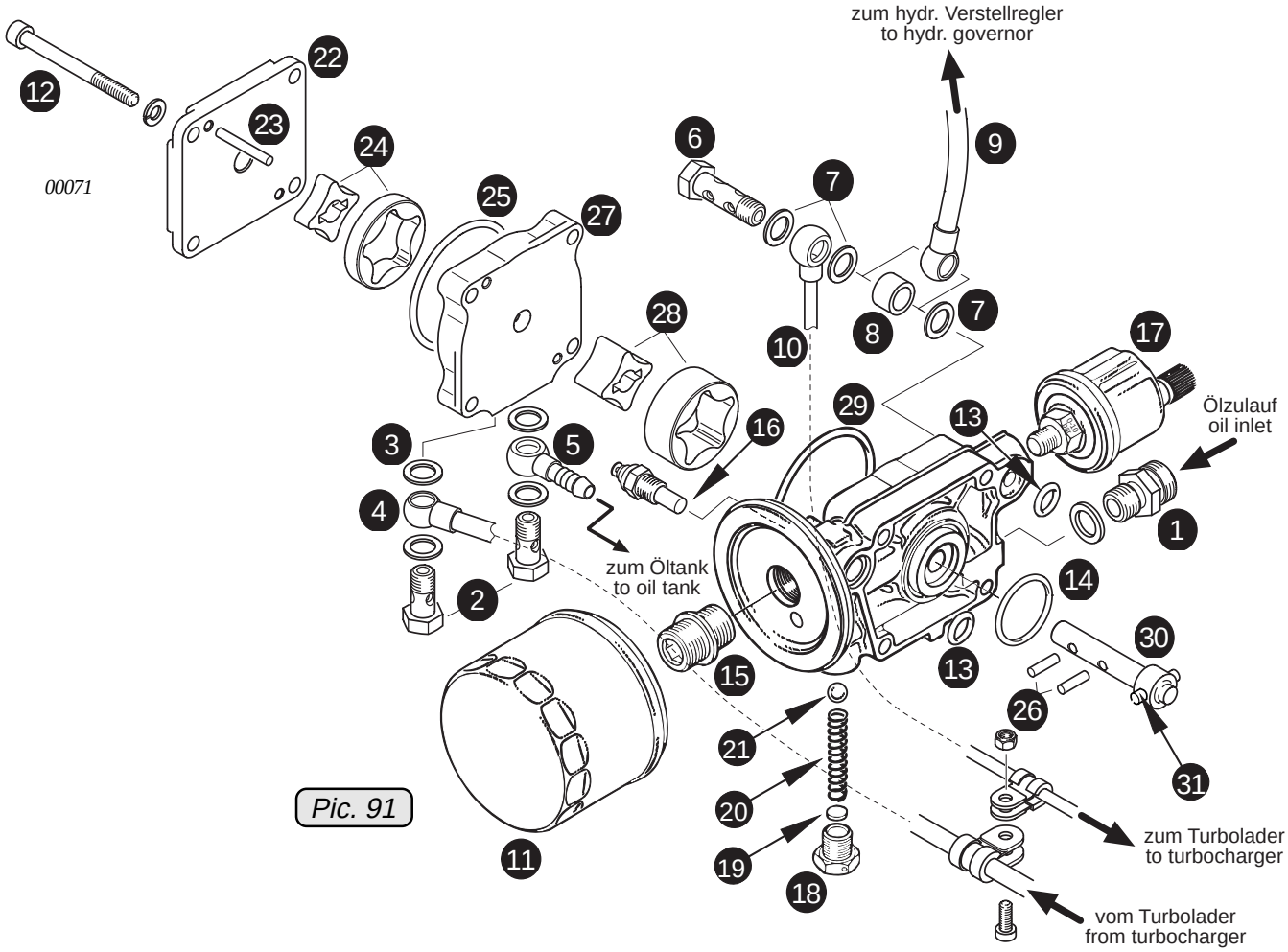
Check plug connections for security.



Pic. 90

13.2) Lubricating system

Besides the maintenance work prescribed in Chapter 12) and description of the oil circuit in the engine in Chapter 9.3) further work for maintenance is described as follows:



Pic. 91

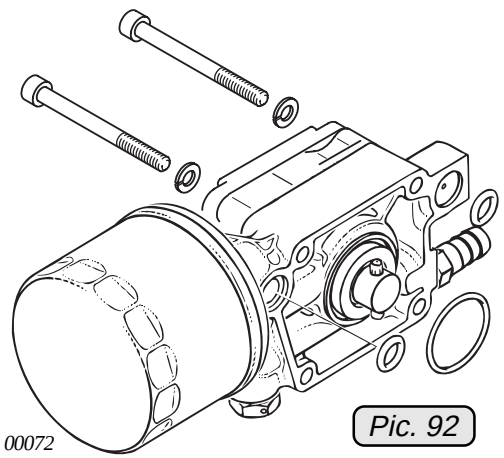
13.2.1) Oil pump

13.2.1.1) Oil pump removal (main- and suction oil pump)

See Pic. 91 and 92.

Drain oil.

Remove oil tube from screw socket ❶ (inlet). Remove both banjo screws ❷ from suction pump and sealing rings ❸.



Pic. 92

◆ NOTE: The suction oil tube ❹ and the hose nipple ❺ need not be removed.

Remove banjo screw ❻ and 3 sealing rings ❼. Also remove the spacer ❽ (versions F2 / F4). On version F3 the pressure oil tube ❾ towards propeller governor should be removed for easier disassembly. Same procedure on pressure oil tube ❿ towards turbo charger.

Remove oil filter ⓫ with strap spanner, part no. *877 620*.

Remove 4 Allen screws ⓬ M6x65 with lock washers and the oil pump ass'y with 2 O-rings 11x2,7 ⓭ and 1 O-ring 30x2,5 ⓮.

13.2.1.2) Oil pump disassembly

See Pic. 91.

◆ NOTE: The oil filter nipple ⓯, nipple M18x1,5/M14x1,5 ❶, oil temperature sensor ⓰ and oil pressure sensor ⓱ are only removed if required, e.g. at damage or for cleaning.

Remove plug screw ⓲, adjustment shim ⓳, pressure spring ⓴ and ball 8,5 mm ㉑ of oil pressure release valve.

◆ NOTE: The adjustment shim is only fitted if required to reach the specified oil pressure.

Remove oil pump cover ㉒, locating pins ㉓, revolving piston with rotor ㉔ and O-ring 46x3 ㉕. Withdraw one of the two pegs ㉖ (drive pin).

Remove oil pump housing ㉗ of suction pump, revolving piston with rotor ㉘ and O-ring 57x3 ㉙ of main oil pump.

Remove last peg ㉖ (drive pin) and oil pump shaft ㉚ with driving pin ㉛ pressed-in.

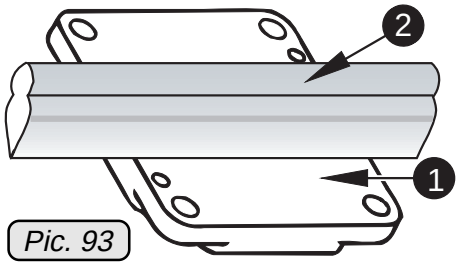
13.2.1.3) Oil pump checking

See Pic. 93/94/95/96 and 97.

Visually check all components of oil pump.

Check inside ❶ of oil pump cover with a straightedge ❷ for wear.

Check all revolving pistons and rotors of pump. At noticeable furrows on mating faces of rotor inside ❸ and revolving piston outside ❹ renew both components.



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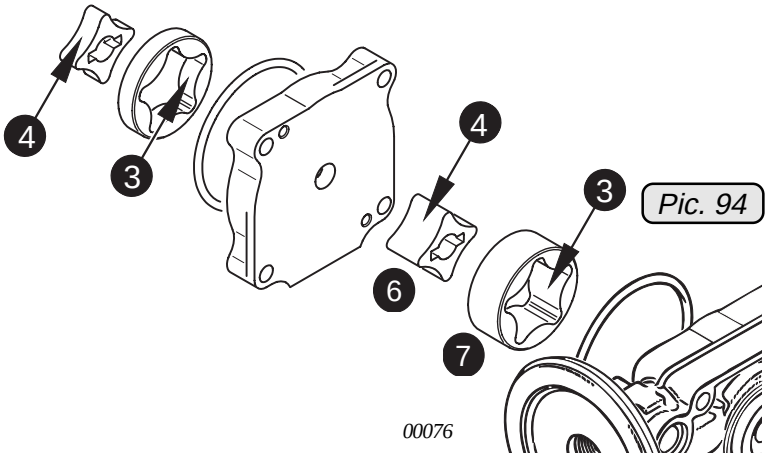
Pic. 93



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Pic. 94

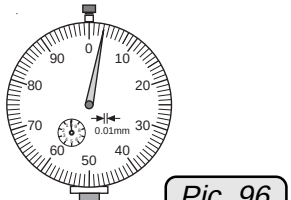
Insert revolving pistons and rotors into their respective housings.

Check gap ② **(suction oil pump)** between

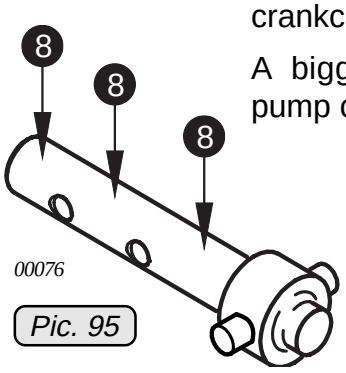
crankcase flange surface — revolving piston
crankcase flange surface — pump rotor

Check gap ② **(main oil pump)** between
crankcase flange surface ❺ — revolving piston ❻
crankcase flange surface ❺ — pump rotor ❼

A bigger gap greatly reduces pump capacity.



Pic. 96



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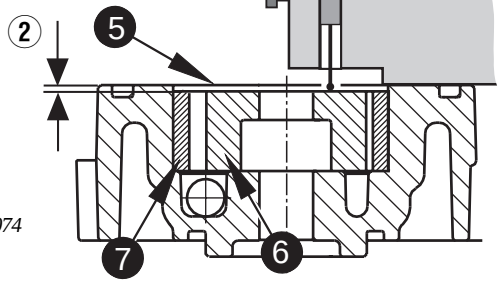
Pic. 95



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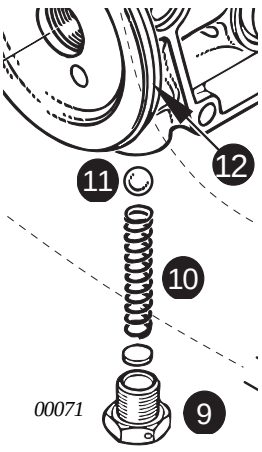

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Pic. 97

Check sealing faces of both oil pump housings and pump cover, plane on an even plate if necessary.

Check pump shaft on the bearing seats ❽.

Remove plug screw ❾, spring ❿ and ball ⓫, clean and check ball seat ⓬ in pump housing. The shim ⓭ is only fitted if required to reach specified oil pressure.

Clean all parts and clear oil bores with compressed air.

Dimensions **New** **Wear limit**
See Chapter 15.

13.2.1.4) Oil pump re-assembly

See Pic. 91.

Lubricate bearing bore for pump shaft in oil pump housing with motor oil and install pump shaft ㉚.

Insert pin ㉖ 4x15,8 in the pump shaft, install revolving piston with rotor ㉘ in main oil pump and turn pump shaft for check.

Insert O-ring ㉙ 57-3, oil pump housing ㉗, second peg ㉖ 4x15,8 into pump shaft, fit revolving piston and rotor ㉔ of suction pump and turn pump shaft for check.

Push the 2 locating pins ㉓ 4x15,8 through both pump housings and fit O-ring ㉕ 46-3. Fit the 2 outer O-rings ⑬ 11-2,7 and O-ring ⑭ 30-2,5 in the oil pump housing and fit it to the crankcase.

◆ NOTE: Turn oil pump shaft until the driving pin ㉛ engages in the camshaft.

Equally tighten oil pump cover ㉒ with Allen screws ⑫ M6x65 and lock washers. Tightening torque 10 Nm (90.in.lb).

Fit ball 8,5 mm ㉑, spring ⑳ 39,5 mm (1,55 in.) long and plug screw ⑱ M12x1. Torque to 25 Nm (220 in.lb).

■ ATTENTION: The adjustment shim ⑲ is not fitted for the time being and is only fitted if during test run the prescribed oil pressure is not reached.

If the oil filter nipple ⑮ has been removed, re-tighten it to 60 Nm (530 in.lb). Slightly lubricate the rubber seal for oil filter ⑪ with motor oil. Screw oil filter on by hand until it stops at the oil filter housing.Then tighten by an extra 3/4 turn.

Fit hose nipple ❶ with sealing ring, tighten to 22 Nm (195 in.lb) and oil temperature sensor ⑯ secured with LOCTITE 221. Tightening torque 8 Nm (70 in.lb).

Fit oil pressure sensor ⑰ secured with LOCTITE 221. Tightening torque 15 Nm (130 in.lb).

13.2.2) Check valve (Turbo)

See Pic. 98.

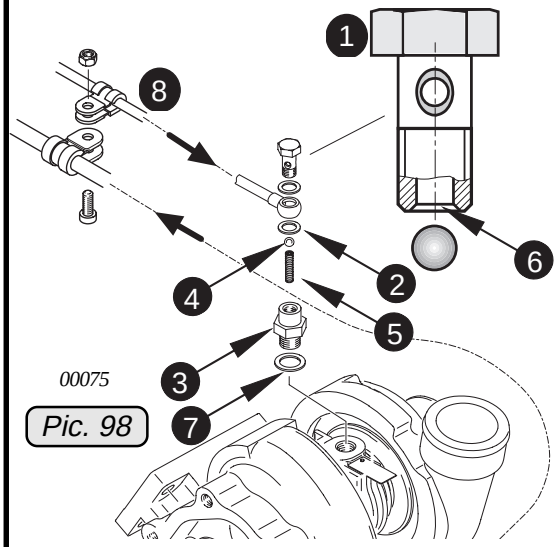
Remove banjo screw ❶ M8 with sealing rings ❷ 8x13.

◆ NOTE: The valve housing ❸ is only removed in case of damage or for cleaning.

Remove ball ❹ 5,5 and spring ❺, 22 mm long, from valve housing.

◆ NOTE: The banjo screw together with ball and spring serves as pressure check valve. For further information, see Chapter 9.3.2.

Check all components and check them visually.



Pic. 98

Also check thread and flange surface of turbo charger housing.

In case of leakage at valve seat ❻ it can be reworked with valve lapping paste or other suitable method. If necessary, renew banjo screw.

Reassembly in reversed sequence.

Insert valve housing ❸ with sealing ring ❼ 12x18 into turbo charger housing and tighten to 25 Nm (220 in.lb).

Insert spring ❺ and ball ❹.

Tighten pressure oil tube ❽ with banjo screw ❶ and sealing rings ❷ on both sides. Tightening torque 10 Nm (90 in.lb).

13.2.3) Oil sump container (Turbo)

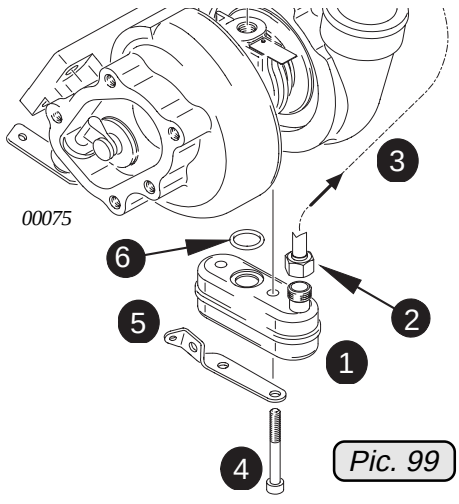
See Pic. 99.

◆ NOTE: The oil sump container ❶ is only removed in case of damage or for cleaning.

Remove spring from waste gate flap with a suitable tool.

Unscrew union nut ❷ of turbo suction oil tube ❸. Remove the 2 Allen screws ❹ M6x55 and cable support ❺, from oil sump container ❶ and O-ring ❻ 9x2,3.

Clean all components and check them visually. Also check thread and flange surface of tubo charger housing. In case of damage renew oil sump container.



Pic. 99

Reassembly in reversed sequence.

Fit oil sump container ❶ with O-ring ❻, cable support ❺ and 2 Allen screws ❼ M6x55. Tightening torque 10 Nm (90 in.lb).

Tighten union nut ❷ of turbo suction oil tube to 20 Nm (180 in.lb).

13.2.4) Magnetic screw

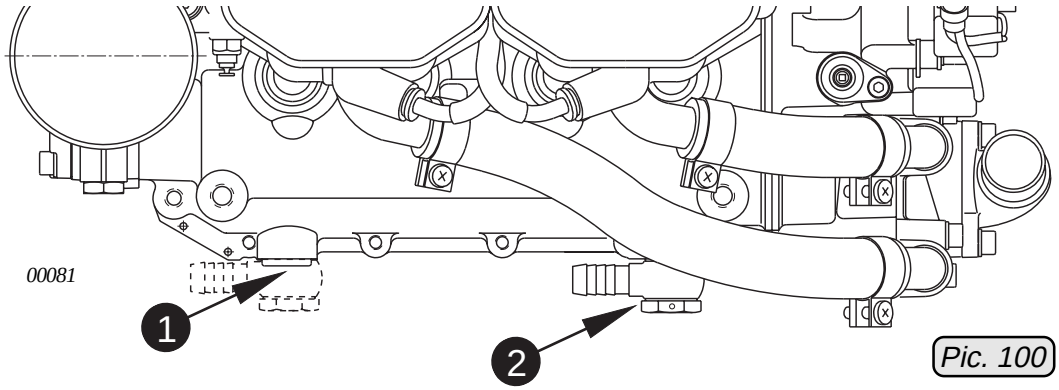
See Chapter 12.3.11).

13.2.5) Drain screw

See Pic. 100.

On crankcase bottom side there is a plug screw ❶ and a banjo screw ❷ for oil return line.

Remove both screws, drain remaining oil and check. Refit the cleaned screws, tighten to 35 Nm (310 in.lb) and secure with safety wiring.



Pic. 100

13.2.6) Oil tank

See Pic. 101.

Detach oil tubes. Remove banjo screw ❶ M10 and hose nipple ❷ with sealing rings 10x14.

Loosen profile clamp ❸ and remove oil tank cover ❹ with O-ring ❺.

Disassemble internal parts of oil tank like baffle insert ❻ and partition ❼.

Remove oil drain screw ❽ and sealing ring 10x18 ⓮.

Clean all parts.

Check oil inlet ❾, oil outlet ❿ (towards oil cooler/oil pump), venting nipple ⓫, oil return ⓬ (turbo) and suction tube ⓭ for free passage and for damage.

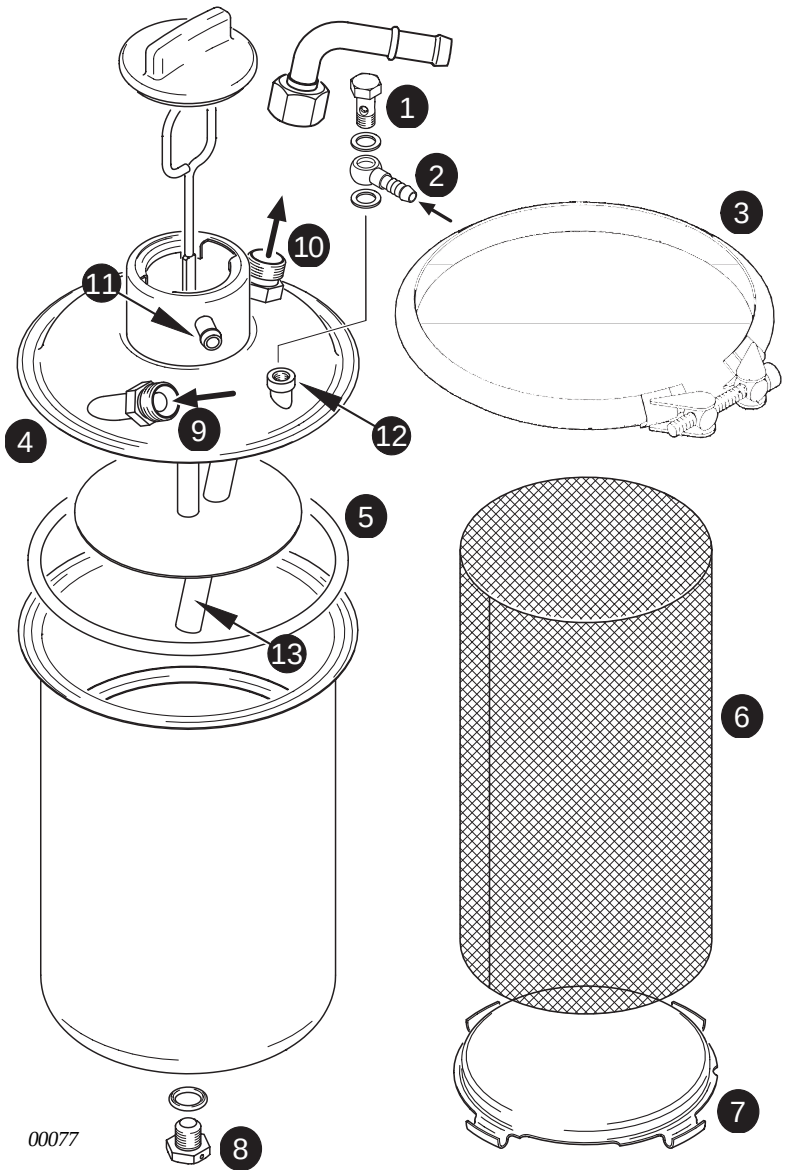
Visually check all parts of oil tank.

Re-assembly of oil tank in reversed sequence of disassembly.

Fit oil drain screw M12x12 with new sealing ring, tighten to 25 Nm (225 in.lb). Secure with safety wiring.

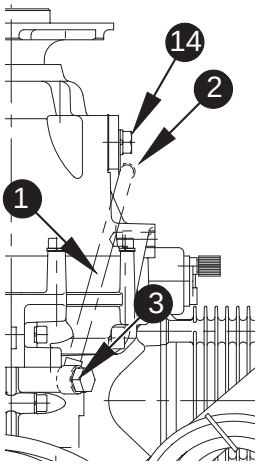
Tightening torque of banjo screw ❶ 17 Nm (150 in.lb).

▲ WARNING:
After re-installation of the engine ensure no air is trapped in the lubrication system. For correct procedure, see Chapter 13.2.10).



Pic. 101

13.2.7) Oil tubes (steel tubes)



00083 Pic. 102

See Pic. 102 and 103.

The steel oil tubes (not part of engine supply scope) are only removed in case of damage or for cleaning.

➪ **Governor pressure oil tube ❶ to hydraulic governo**r (only version F3).

Remove tube clamp ❷ for tube support from gearbox.

Remove banjo screw ❸ M10 and sealing rings from governor flange. Remove banjo screw ❹ from oil pump housing and the 3 sealing rings.

➪ **Turbo pressure oil tube ❺**

◆ NOTE: The turbo pressure and suction oil tubes are attached together by 2 tube clamps ❻ ø8/M5 and ❼ ø5/M5. Before dismounting of the tubes detach this attachment from the bottom of the crankcase.

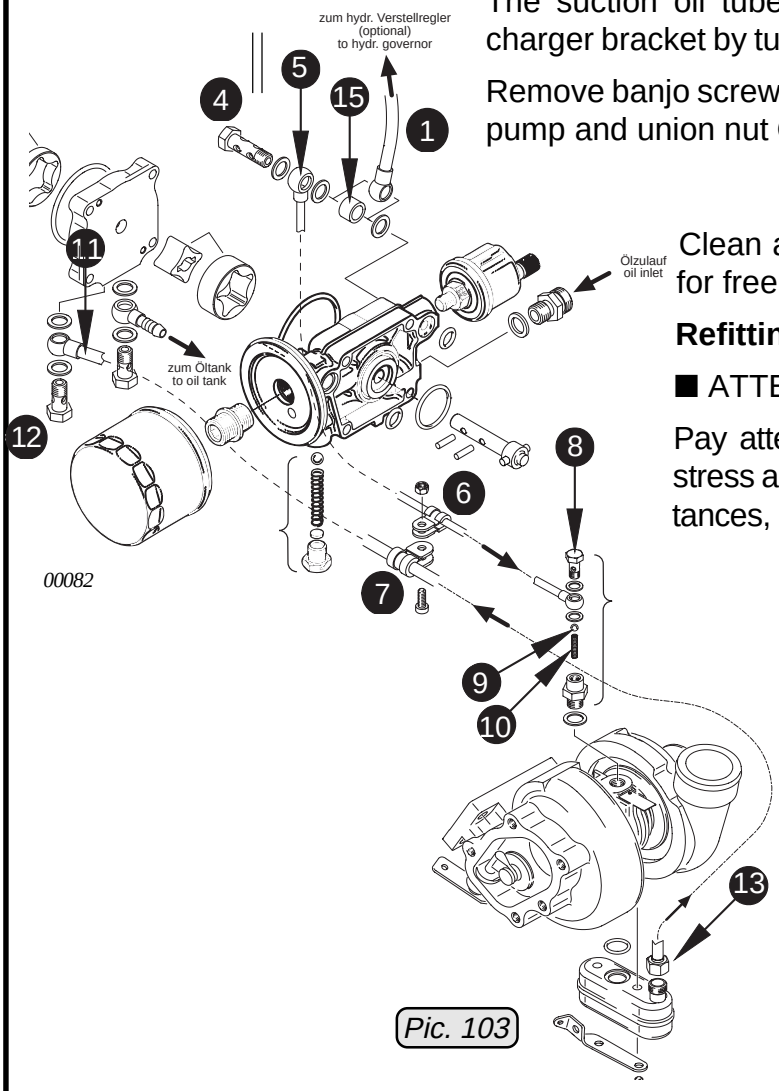
Remove banjo screw ❽ with sealing rings.

■ ATTENTION: Pay attention not to damage or lose or damage the ball ❾ and spring ❿ of check valve.

➪ **Turbo suction oil tube ⓫**

The suction oil tube is additionally supported on the turbo charger bracket by tube clamp. Remove it before disassembly.

Remove banjo screw ⓬ M10 with sealing rings from suction oil pump and union nut ⓭ from oil sump container.



Pic. 103

Clean all tubes and check them visually. Check for free passage.

Refitting of the tubes in reversed sequence.

■ ATTENTION:

Pay attention that the tubes are mounted free of stress and without scouring. Respect minimum distances, e.g. 2 mm from crankcase.

Tightening torques:

Banjo screws M10:	17 Nm (150 in.lb)
Banjo screws M8:	10 Nm (90 in.lb)
Union nut ⓭:	20 Nm (180 in.lb)
Hex. screw M8x20 ⓮:	15 Nm (135 in.lb)

(secure with LOCTITE 221).

◆ NOTE:
On versions F2/F4 instead of the governor oil tube ❶ a spacer ⓯ 10,5/15/10 is used.

13.2.8) Oil tubes

■ ATTENTION: The oil tubes (not part of engine supply scope) have to be serviced as per aircraft manufacturer's specifications.

In addition the following maintenance work should be done:

Clean oil feed tube from oil tank to oil cooler and to oil pump and check visually. The same applies to the oil return tubes. Pay special attention to the tube ends. For replacement, only use genuine, approved tubes. For fixation of the tubes use suitable tube clamps or crimp connections.

■ ATTENTION: Use oil tubes and tube clamps as specified in the aircraft manufacturer's Manual.

13.2.9) Oil cooler

■ ATTENTION: The oil cooler (not part of engine supply scope) has to be serviced as per aircraft manufacturer's specifications.

In addition the following maintenance work should be done:

Clean oil cooler fins and straighten them, if necessary. Rinse the oil cooler inside. This is absolutely necessary after an engine failure. Visually check the oil cooler body and the connections. Test the oil cooler for leakage.

13.2.10) Venting of lubrication system

Fill oil tank with approx. 2 litres (0,53 gal.US) motor oil. See Chapter 8). Start engine and observe oil pressure indication. Within 10 seconds the oil pressure must rise to min. 2 bar (30 psi). Otherwise stop the engine instantly and vent suction line between oil tank and oil pump.

Remove suction line from oil tank and refill with oil using a funnel. By a few manual turns of the propeller the pump sucks oil.

▲ WARNING: For safety, switch off ignition and remove ignition key!

Refit oil line and start engine again. After short idling, stop the engine and refill oil level in the tank to max. mark. Do not overfill, otherwise oil would exit through vent bore during operation. At oil level check the max. mark must not be exceeded.

▲ WARNING: Always observe the engine while running from a secure place.

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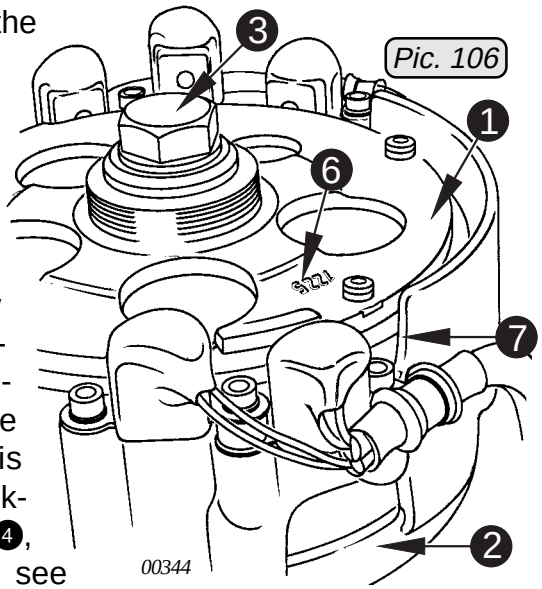
13.3) Cooling system

Besides the maintenance work prescribed in Chapter 12) and description of the cooling system, Chapter 9.1) further maintenance work is described as follows:

13.3.1) Water pump removal

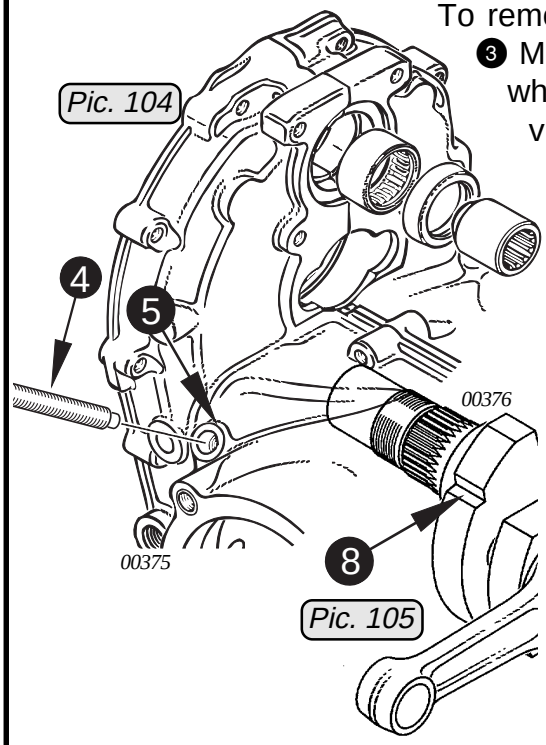
See Pic. 105 and 106.

The water pump is integrated in the ignition housing. For maintenance work the magneto hub ❶ and the magneto housing ❷ have to be removed. On some engine installations this requires removal or partial lifting of engine.



Pic. 106

To remove the hex. screw ❸ M16x1,5 from the flywheel hub, it is an advantage to lock the crankshaft. This is possible with crankshaft locking screw ❹, *part no. 240 880*, see „Special Tools“!



Pic. 104

Remove the plug screw on the left crankcase half ❺. Turn crankshaft for cylinders no. 1 and 2 to Top Dead Centre position. Lock with crankshaft locking screw ❹. To facilitate finding of this position, turn crankshaft to have the 4-digit number ❻ cast in the flywheel hub ❶ align with the edge ❼ of the ignition cover. Insert crankshaft locking screw into crankcase. Turn crankshaft with a ring wrench slightly to and fro until the locking screw engages in the recess ❽ of the crankshaft, and tighten to 10 Nm (90 in. lb).

Pic. 105

13.3.2) Water pump housing - disassembly and check

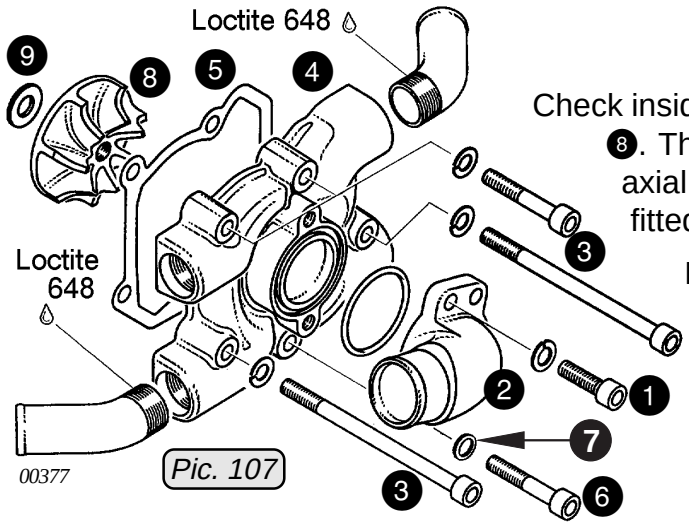
See Pic. 107 and 108.

Remove the 2 Allen screws M6x20 ❶ of the water inlet elbow ❷ and remove elbow with O-ring.

◆ NOTE: Register the position of the inlet elbow!

Remove the 4 hose clamps from water drain hoses and from water pump housing. By removing 5 Allen screws M6 ❸ the water pump housing ❹ with gasket ❺ can be taken off.

■ ATTENTION: The Allen screw ❻ goes through to the water chamber and therefore is sealed with sealing ring ❼.

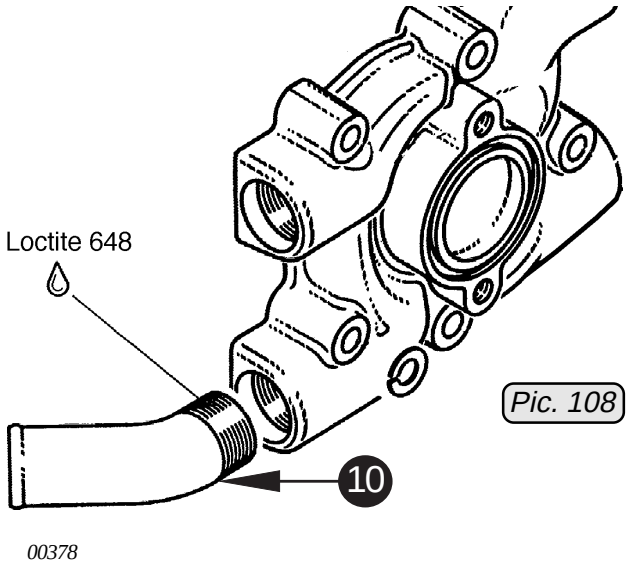


Pic. 107

Check inside for traces of possible contact with impeller ❽. The necessary clearance can be achieved by axial spacing of the water pump shaft. The shim ❾ fitted behind the impeller is of stainless steel.

Remove the impeller ❽ with special tool, *part no 877 295*, with crankshaft locked, turning counter-clockwise.

Check the bent water socket ❿ screwed into the water pump housing for leakage, cracks and tight fit, replace if necessary. Mark the position of the bent socket. Warm up water pump housing to approx. 80° C (180° F) and remove the socket. Clean threads carefully from LOCTITE remains, apply LOCTITE 648 to the new bent water socket and fit it into position after 5 turns.



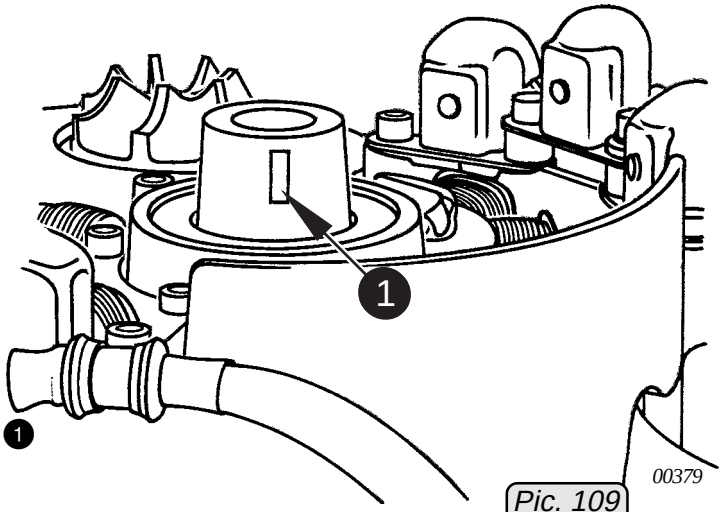
Pic. 108

13.3.3) Magneto hub

See Pic. 109.

Remove hex. screw M16x1,5. Place protection piece *877 410* onto the crankshaft, screw puller *877 375* fully down and pull off magneto hub with washer.

Remove Woodruff key ❶ from crankshaft.



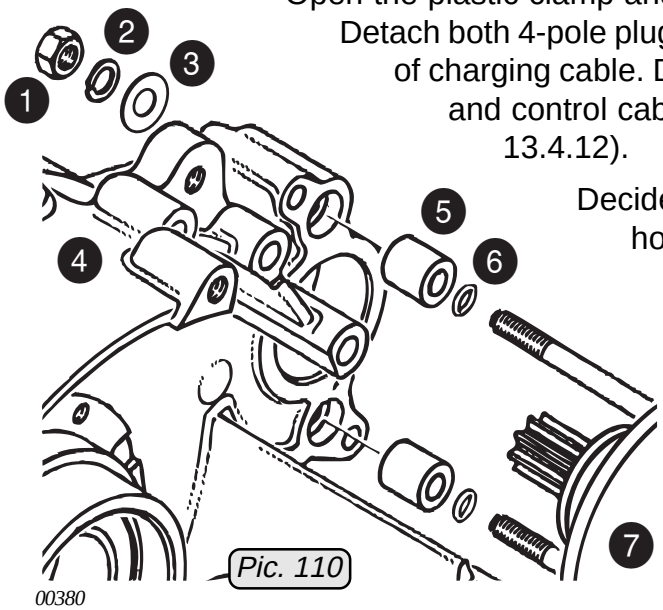
Pic. 109

■ ATTENTION: If Woodruff key is not removed, the oil seal and bearing bush will be damaged when removing the ignition housing!

13.3.4) Ignition housing - removal and check

See Pic. 110/111/112/113 and 114.

Open the plastic clamp and remove cable clamp from electronic module. Detach both 4-pole plugs of the 2 pick-up cables and both connections of charging cable. Detach both plug connectors of generator cable and control cable for the electronic rev. counter. See Chapter 13.4.12).

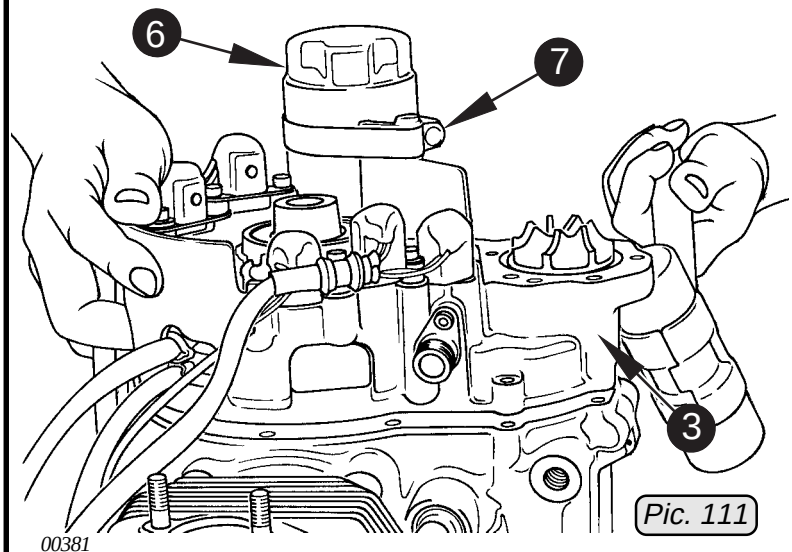


Pic. 110

Decide whether the stator may remain in the ignition housing. Otherwise remove the cable clamps and remove the stator.

Cover the groove for Woodruff key with a protective tape to avoid damage to the oil seal. See Pic. 109.

Remove 7 Allen screws M6 from ignition cover and 2 hex. nuts M5 ❶ with lock washers ❷ from the bottom side of the ignition cover. By a smart blow with a mallet the ignition cover ❸ separates from the crankcase and can be taken off.



Pic. 111

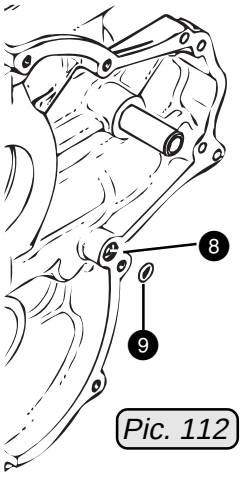
Remove the electric starter ❻, if necessary, by removing the strap clamp ❼. The electric starter is kept in position by 2 distance sleeves ❹ and O-rings ❺. When withdrawing the electric starter from the ignition housing, keep the bearing flange with starter housing and rotor support assembled. Otherwise the carbon brushes will jump off the rotor.

Remove O-ring ❷.

◆ NOTE: The crankshaft bearings in the ignition housing are lubricated via the oil duct ❽. Sealing of the oil duct at the joining face between crankcase and ignition housing is by an O-ring ❾ 5x2.

◆ NOTE: At the backside of the ignition housing a thrust washer of the intermediate starter gear may stick.

Visually check the sealing surfaces. Clean oil duct ❿ with compressed air and check for free passage. Check dimension of bore ⓫ (dimension ③) of bearing bush for crankshaft support ⓬,(dimension ④) , see Chapter 15).

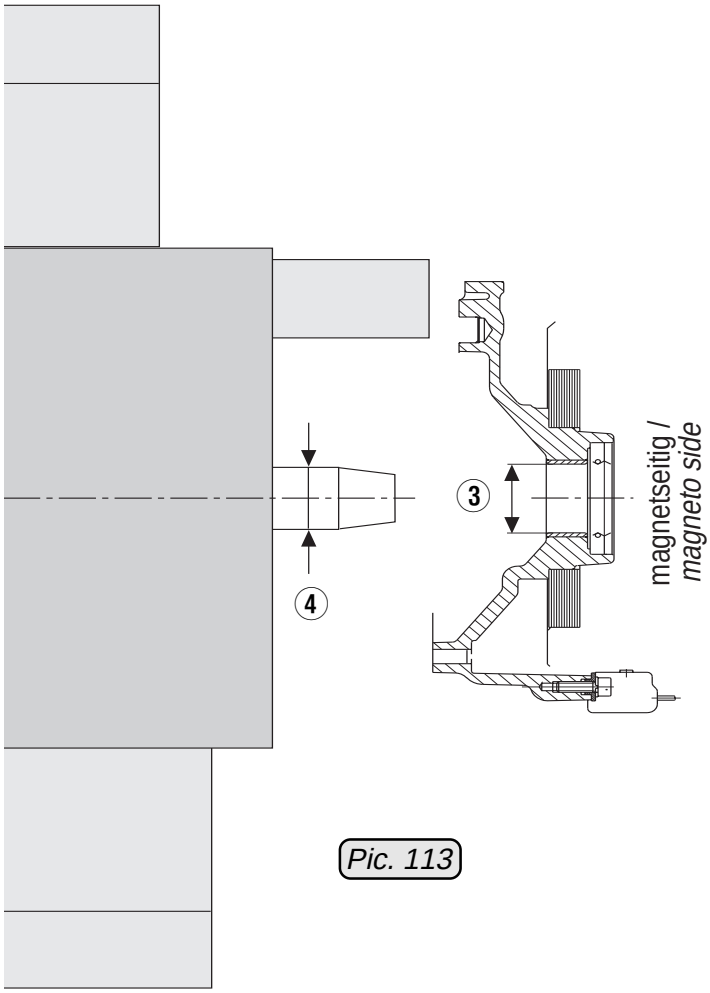


Pic. 112

00382

dimensions **new** **wear limit**

See Wear Limits, Chapter 15).

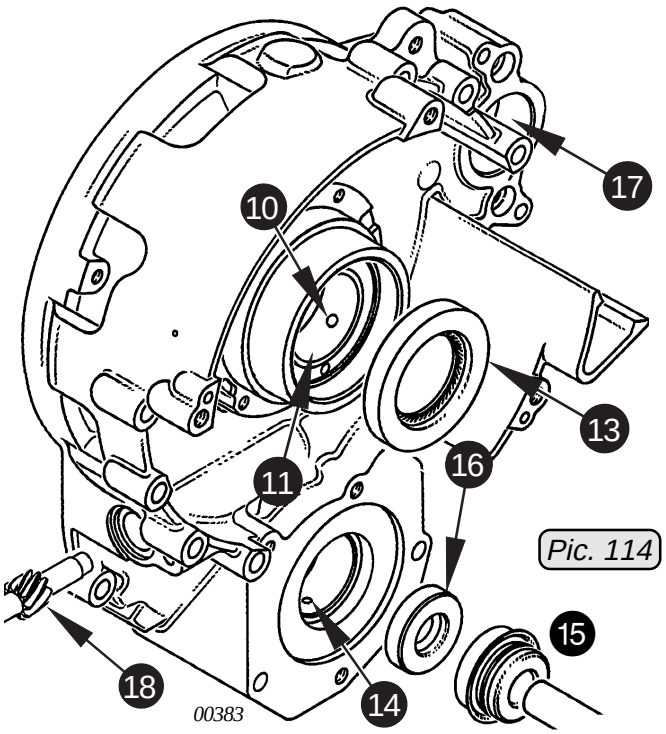


Pic. 113

00084

Renewal of the bearing bush ⓫ is not planned as after pressing in the bush, the internal bore and the lubricating bore ⓾ are machined. At wear of the bearing bush ⓫ the complete ignition cover with pressed-in and machined bush has to be replaced or to be sent for repair to an authorized overhaul facility.

Check oil seal ⓭ 32x52x7 for crankshaft, replace if necessary. Press in new oil seal with insertion jig, *part no. 877 270*. Check whether at the leakage bore ⓮ emergency of oil or water is visible.



Pic. 114

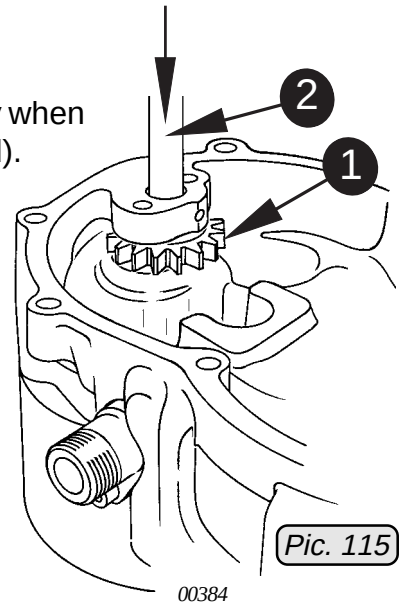
Check rotary seal ⓯ for water pump sealing. At emergency of liquid, renew rotary seal and oil seal ⓰. Visually check support ⓱ for electric starter.

⓲ = Drive shaft for mechanical rev. counter.

13.3.5) Water pump shaft - removal

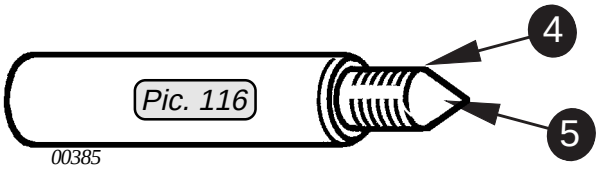
See Pic. 115 and 116.

It is an advantage to loosen the impeller already when dismantling the engine (with crankshaft locked). Otherwise block water pump drive gear ❶ with suitable tool. Unscrew impeller using impeller wrench *877295* to avoid damage to the impeller blades. Place ignition cover on a suitable plain surface and press water pump shaft out with a suitable punch ❷. Remove drive gear ❶.



Pic. 115
00384

Inspect water pump shaft ❸ for wear. Pay attention to possible corrosion at the thread end ❹. If engine is run without antifreeze, formation of corrosion is possible in this position.



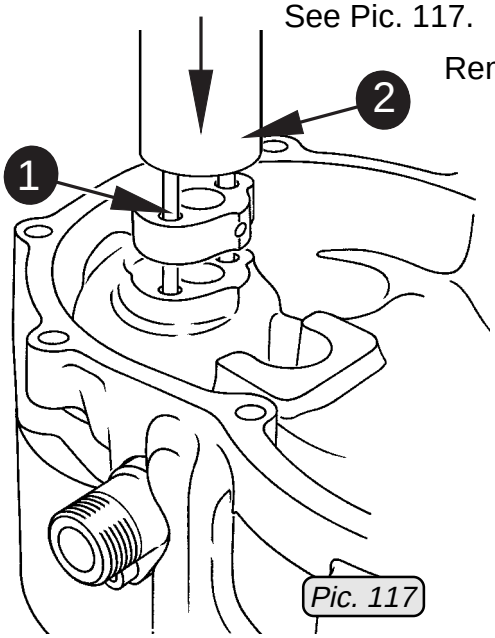
Pic. 116
00385

If corroded, replace the water pump shaft.

◆ NOTE: The shaft has a conical end ❺.

13.3.6) Rotary seal - removal

See Pic. 117.



Pic. 117

00386

Remove old oil seal and rotary seal utilizing 2 pins ❶ 5 mm dia. (0,2 in.) and suitable punch ❷. Oil seal and rotary seal will be destroyed at removal and must be replaced.

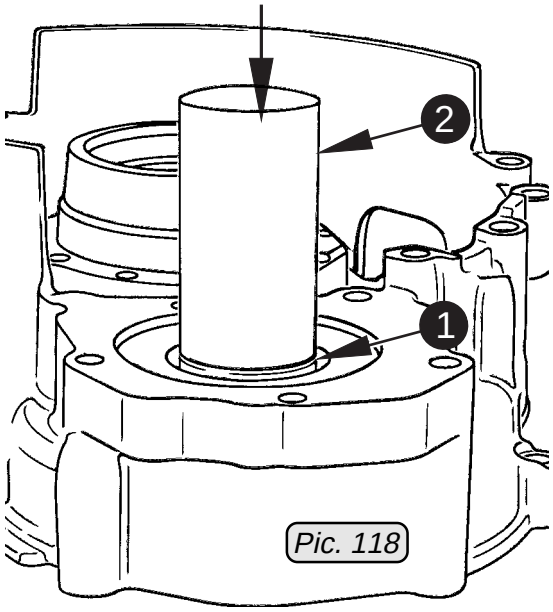
13.3.6) Rotary seal - refitting

See Pic. 118/119 and 120

Press new oil seal ❶ 12x30x7, pre-oiled sealing lip showing inwards, into ignition cover using punch ❷, *part no. 876 510*.

Carefully press rotary seal ❸ on punch ❹, part no.*877 250*, and press the water pump shaft ❺ carefully into the positive stop of the insertion jig.

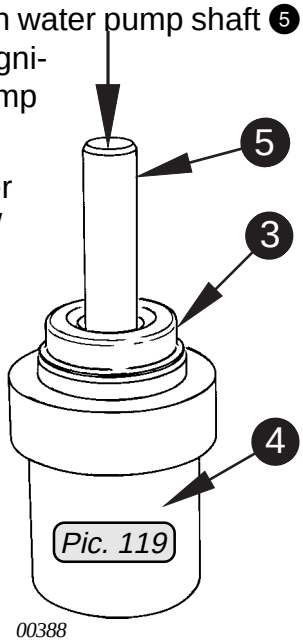
Place pump gear with larger collar towards inside into ignition cover. Turn punch ❹ around and push water pump shaft ❺ with rotary seal ❸ already fitted into ignition cover. Align drive gear with pump shaft.



Pic. 118

00387

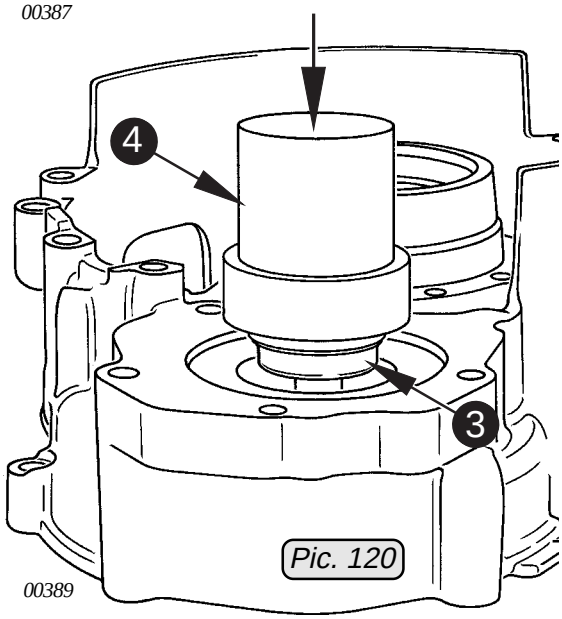
Now place the ignition cover under a hand press (20 kN / 4400 lb. capacity) on a plane face and press pump shaft into position until stop. Then turn ignition housing and press water pump shaft back using 10 mm (.4 in.) punch ❹ until level with sealing face. Turn water pump shaft for check.



Pic. 119

00388

◆ NOTE: The spring of the rotary seal presses the water pump shaft outwards towards the sealing face ❻, depending on axial clearance ❾. See Pic. 121.



Pic. 120

00389

13.3.8) Section through water pump

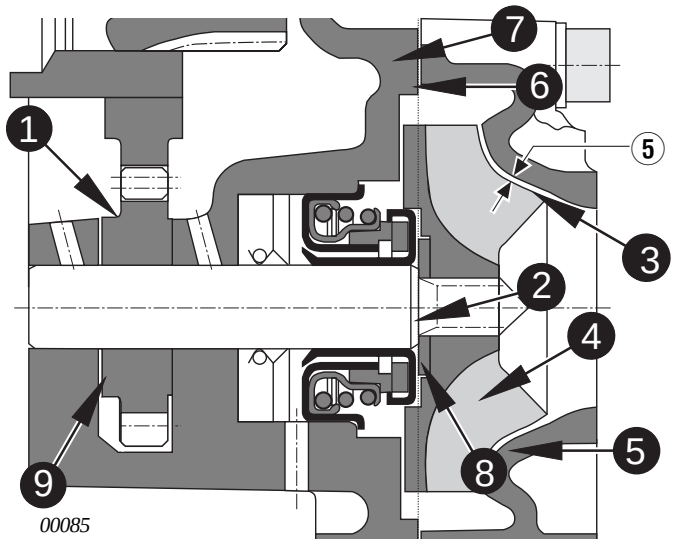
See Pic. 121.

Check axial position of water pump shaft and pump gear. Large collar ❶ of the gear shows inward to the sealing face.

◆ NOTE: To warrant the correct gap ❸ (dimension ⑤ in Chapter 15) between impeller ❹ and water pump housing ❺, ensure alignment of shoulder ❷ on water pump shaft with sealing face ❻ of ignition cover ❼.

If need be, place ignition cover on a hardened and ground face plate with an 8 mm (0.3 in.) dia. clearance hole, and press shaft backwards accordingly, using a 10 mm (0.4 in.) dia. pin. Trial spin the pump shaft installed.

Place washer ❽ out of stainless steel on the shaft and fit impeller ❹ turning clockwise, tighten with special wrench, part no. *877 295*. Torque to 15 Nm (133 in.lb).



Pic. 121

◆ NOTE:
Check impeller ❹ for out-of-round. At noticeable out-of-round replace impeller or if necessary also the pump shaft.

dimensions	new	wear limit

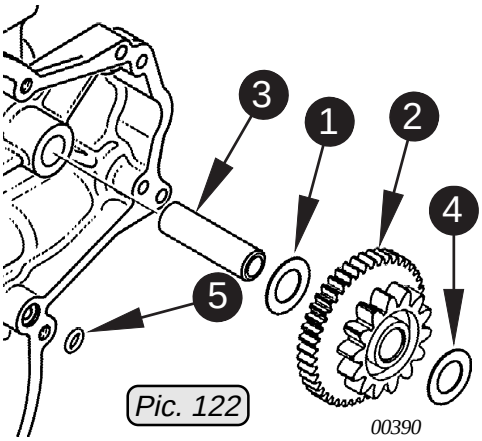
See Wear Limits, Chapter 15).

13.3.9) Fitting of ignition housing

See Pic. 122 and 123.

If the idle gear ❷ for electric starter has previously been removed, place thrust washer ❶ 12,5/21,5/1 onto the crankcase. Place idle gear into position and lubricate idle gear shaft ❸ with motor oil (see Chapter 13.2.10) and insert it. Place thrust washer ❹ 12,5/21,5/1 on top.

Place O-ring 5x2 ❺ into crankcase and fit guide sleeve, *part no. 877 360*, for oil seal onto the crankshaft.

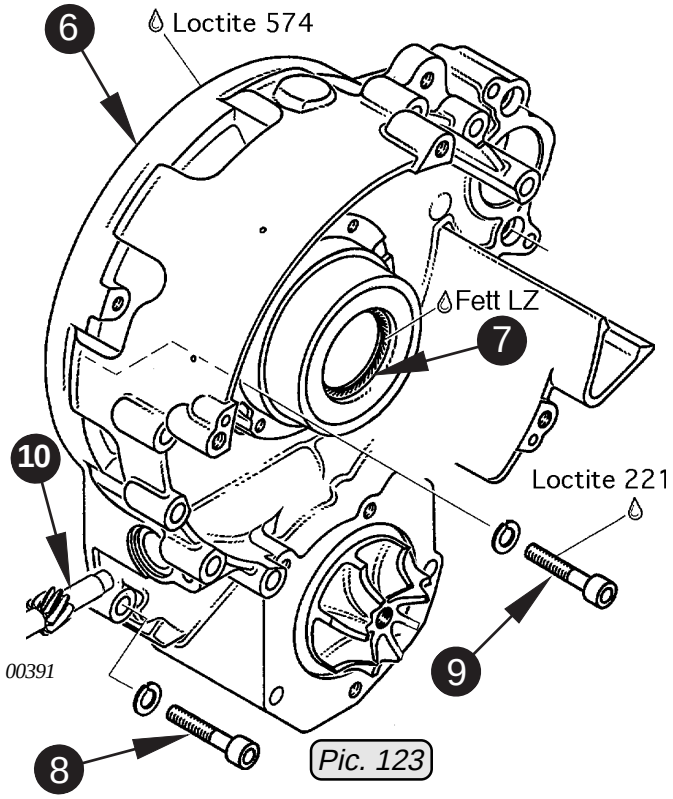


Pic. 122

■ ATTENTION: Without using the guide sleeve, *part no. 877 360,* the oil seal will be damaged by the keyway in crankshaft.

Apply LOCTITE 574 sealing compound on the sealing face ❻ of pre-assembled ignition cover, apply multi-purpose grease LZ or equivalent grease onto oil seal ❼ (see Chapter 11.7.3), fit it and turn water pump to engage in the teeth. Tighten ignition cover with 7 Allen screws M6x30 ❽ and lock washers evenly to 10 Nm (90 in.lb.).

◆ NOTE: The Allen screw ❾ M6x30 reaches into the oil compartment and must be sealed with LOCTITE 221.
❿ = drive shaft for mechanical rev. counter.



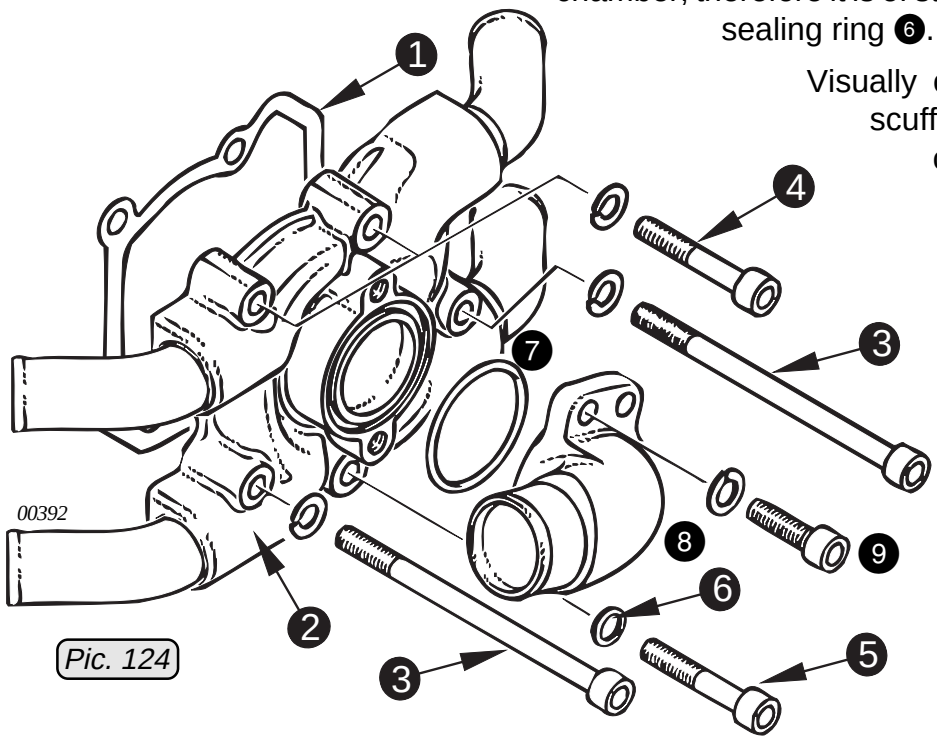
Pic. 123

13.3.10) Water pump housing — reassembly

See Pic. 124.

Place gasket ❶ and attach water pump housing ❷ with 2 Allen screws M6x90 ❸ and 3 Allen screws ❹ M6x35 with lock washers to the ignition housing, torque to 10 Nm (90 in.lb).

■ ATTENTION: The bottom Allen screw M6x35 ❺ reaches into the water chamber, therefore it is of stainless steel and fitted with a sealing ring ❻.



Pic. 124

Visually check whether the impeller scuffs in the pump housing. This can be recognized by scuffing traces in the pump housing or on the impeller. If necessary, the axial position of the impeller can be corrected to achieve an optimum gap (see Chapter 13.3.8).

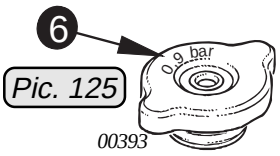
Insert O-ring ❼ into water pump housing and fit the water inlet elbow ❽ in the position marked before disassembly with 2 Allen screws ❾ M6x20 and tighten to 10 Nm (90 in.lb).

◆ NOTE: The water inlet elbow is symmetrical and can be fitted turned by 180° if required.

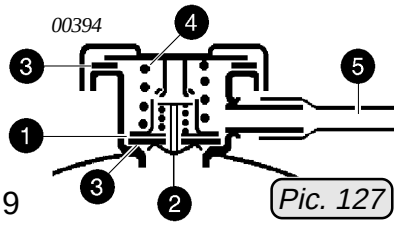
Fit coolant hoses and fix them with genuine hose clamps.

■ ATTENTION: Do not tighten hose clamps excessively in order not to damage the hose!

13.3.11) Expansion tank



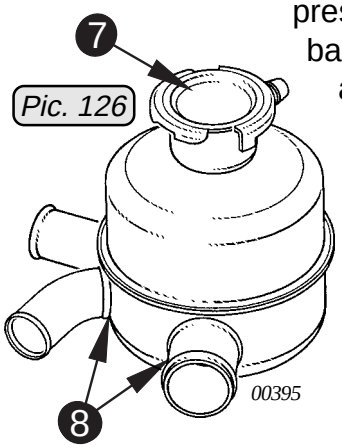
Pic. 125



Pic. 127

See Pic. 125/126 and 127.

To allow pressure compensation in the cooling system, an expansion tank is required. When due to heating of the coolant the pressure in the cooling system rises above 0,9 bar (13 p.s.i.), the excess pressure valve ❶ opens and the coolant can escape to the overflow bottle. When the liquid cools down, the return valve ❷ opens and the coolant is sucked back into the expansion tank.



Pic. 126

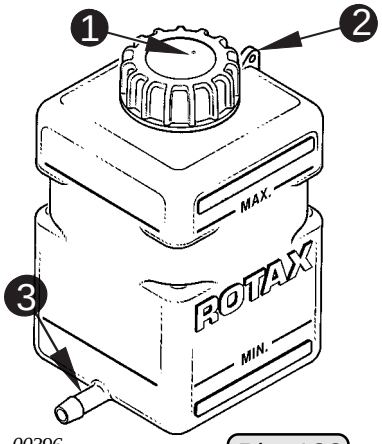
Check seal ❸, spring ❹ and both valves of the radiator cap. If necessary, replace radiator cap to assure 0,9 bar (13 p.s.i.) ❻ opening pressure. ❺ = connection to overflow bottle.

Check sealing surface ❼ and hose connections ❽ of the expansion tank. Check for possible damages or chafing marks. A rubber plate is glued to the bottom side of the expansion tank. Attach expansion tank so that no scouring with neighbouring parts is possible.

13.3.12) Overflow bottle

See Pic. 128

Check for damages. Check venting bore ❶ in the cover. Check bracket ❷ for the safety wiring. Check tube connection ❸.



Pic. 128

13.3.13) Radiator

Clean radiator elements and check for damages, straighten if necessary. Especially check the hose connections and the fixations. Check for tightness if leaks are suspected.

13.3.14) Radiator hoses

Visually check for damages, especially in the area of the hose clamps. If chafing spots are detected, replace coolant hose.

■ ATTENTION: Only use temperature- and pressure resistant hoses meeting the aeronautical standards.

13.3.15) Hose clamps

Visually check. Do not tighten hose clamps excessively to avoid damage to the coolant hose. Position the lugs as to avoid collision and friction with neighbouring parts.

13.3.16) Cooling air baffle

The cylinders are ram-air cooled. The cooling air is pushed at flight and by the propeller into the engine compartment and is distributed by the air baffle equally to the single cylinders. Visually check for damages, cracks, chafing marks, burnt spots etc. At noticeable damages replace the air baffle.

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13.4) Ignition system

Besides the maintenance work prescribed in Chapter 12) and description of the ignition system in Chapter 9.4), further maintenance work is described below.

In principle the ignition unit requires no maintenance. Before, however, dismantling the ignition unit it is useful to trace defects by trial and error method.

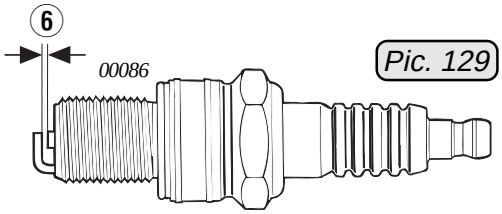
13.4.1) Checking of ignition unit, trouble shooting

Components can only be exchanged but not repaired. If there is no spark, systematically trace for possible cause.

▲ WARNING: For safety's sake, switch off ignition, if possible, and withdraw ignition key!

13.4.2) Spark plugs, ignition cables, spark plug connectors, cables

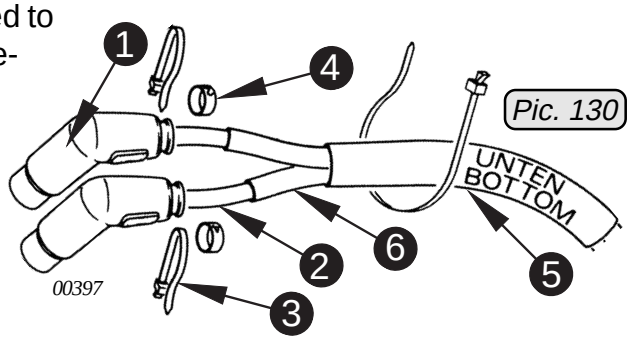
See Pic. 129 and 130.



Pic. 129

— Check of the resistance spark plugs. Check electrode gap , see dimension ⑥) and caloric value. See Chapter 8).

— Visually check resistance spark plug connector ❶. Assure security of the spark plug connector. Minimum withdrawal force is 30 N. The spark plug connector is screw-fastened to the ignition cable ❷ and secured with a cable clamp ❸. At visible wear renew spark plug connector.



Pic. 130

— Check for correct connection of the ignition cables ❷, as per Wiring Diagram (see Pic. 138).

The cable ends are furnished with coding sleeves ❹. The ignition cables for the bottom spark plugs are protected by glass fibre/silicone protection hose ❺. All ignition cables are covered by a protection hose ❻ — renew at visible wear.

Resistance spark plug connector .... 4,4 ÷ 6,0 kΩ

— Check all cables and their plug connections for damage and correct connection as per Wiring Diagram (see Pic. 138).

— Check all plug- and screwed connections for oxidation and tight fit.

— Check short-circuit cables and ignition switch. If an ignition switch failure is suspected, the short-circuit cable can be withdrawn from the ignition switch.

▲ WARNING: Proceed with particular care because the ignition is not switched off.

— Assure sufficient ground connection between engine, battery and fuselage. Respect the wiring diagram of the aircraft manufacturer.

13.4.3) Electronic module, trigger set

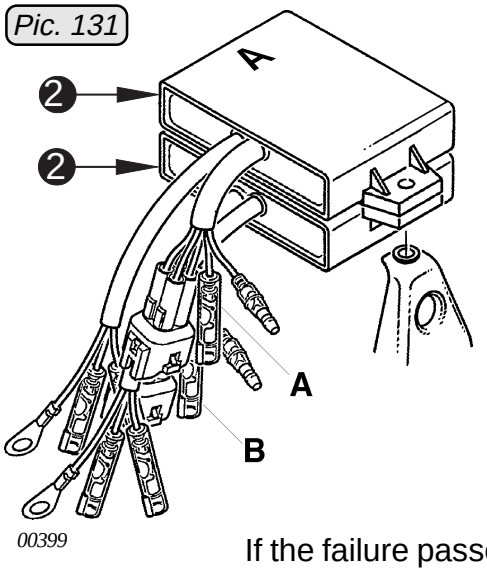
See Pic. 131 and 132.

■ ATTENTION: If one ignition circuit fails, **do not interchange** the 2 4-pole plug connectors ❶ of trigger cables for failure tracing. Contrary to ROTAX engine 912 the ignition timing for circuit A and B are different!

It, however, is possible to interchange the modules ❷ as they are identical.

If the failure remains with the ignition circuit, either the electronic module or the charging coil on the stator is the cause. If renewal of the respective electronic module does not help, the charging coil is defective. Remove and renew the stator, see Chapter 13.4.16).

Pic. 131



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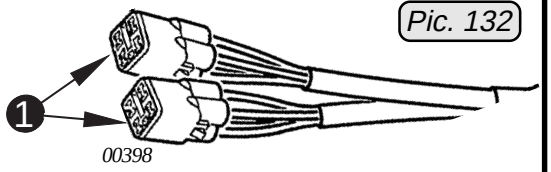
Pic. 132



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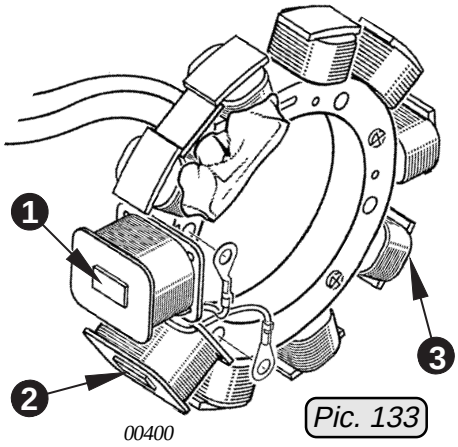
If the failure passes on with the ignition circuit, the triggers of the respective ignition circuit are the cause. In both cases the disassembly work described below is necessary, see Chapters 13.4.12 through 13.4.15).

13.4.4) Charging coil

See Pic. 133.



Pic. 133

In case of failure of one ignition circuit, the 2 single-pole plugs of the red charging cables may be interchanged for failure tracing.

If the failure remains on the same circuit, the electronic module is the cause and the respective module has to be renewed (see Chapter 13.4.15).

If the failure passes on with the ignition circuit, the charging coil ❶ for ignition circuit "**A**" or ❷ for circuit "**B**" is the cause. In this case the stator must be removed (see Chapter 13.4.16).

Check charging cable for damage. Check resistance value with ohmmeter. If required, renew the complete stator.

dimensions	**new**	**wear limit**

See Wear Limits, Chapter 15).

13.4.5) Generator coil

See Pic. 133.

If the generator does not work, the reason may be a defective or squeezed yellow generator cable or a defective winding on the 8 generator coils ❸. Disconnect generator cables (yellow) and check resistance values.

◆ NOTE: If the value measured corresponds with the values specified, the cause may be a defective rectifier-regulator.

Check of the complete ignition unit is only possible on an ignition test bench with an oscilloscope. Especially if the failure occurs only occasionally this is necessary. In this case send the complete ignition unit to an authorized overhaul facility.

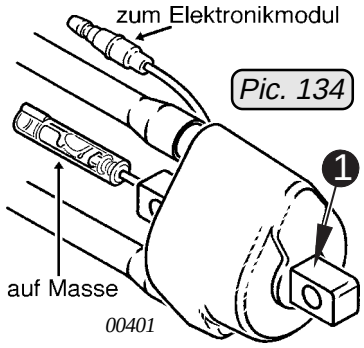
■ ATTENTION: On all these works pay special attention that no foreign matter will enter the ignition.

dimensions	**new**	**wear limit**

See Wear Limits, Chapter 15).

13.4.6) Double ignition coil

See Pic. 134.



Pic. 134

If the failure of a single spark plug or 2 spark plugs is noticed, check the connections and the resistance values of the respective double ignition coil (see Chapter 13.4.11) and 13.4.14).

Assure the iron core ❶ is not loose. If required, renew the double ignition coil. In this case the disassembly work as described below is necessary (see Chapter 13.4.12 and 13.4.13).

ignition coil, primary ... connection contact — ground ..... 0,1 ÷ 0,4 Ω

ignition coil, secondary ..... high voltage — high voltage. 6,1 ÷ 6,7 kΩ

dimensions	**new**	**wear limit**

See Wear Limits, Chapter 15.

13.4.7) Cut-in speed of ignition

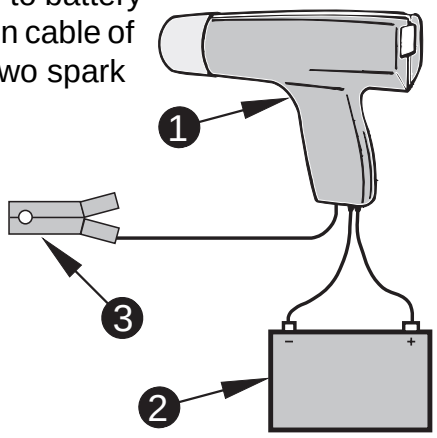
See Pic. 135.

Ignition must cut-in between 150 rpm. and max. 220 rpm. of crankshaft. To be checked with stroboscope and inductive pliers (see Chapter 11.5).

For this procedure, connect stroboscope ❶ to battery ❷ and clamp inductive pliers ❸ to the ignition cable of cylinder **1 (top)** or cylinder **2 (top)**. These two spark plugs are actuated by the trigger coil A1/2.

Start engine, aim stroboscope towards trigger coil A1/2 and observe flashing light.

This procedure should be conducted with all ignition cables.



Pic. 135

13.4.8) Ignition timing control

See Pic. 136 and 137.

The automatic ignition timing control is actuated by the trigger cam ❶ on the flywheel hub of ignition circuit **A** or trigger cam ❷ of ignition circuit **B**. Transition from start ignition timing to operating ignition timing takes place between 650 and 1000 rpm.

Check with stroboscope and inductive pliers (see Chapter 13.4.8).

For this procedure, connect stroboscope to battery and clamp inductive pliers to the ignition cable of cylinder **"1 top"**. This spark plug is actuated by the trigger coil **A1/2**.

At an engine speed of 150 to approx. 650 r.p.m. the trailing edge ❸ of the trigger cam aligns with the core ❹ of the trigger coil.

Trigger coil A1/2 serves the top spark plug of cylinder 1 and 2

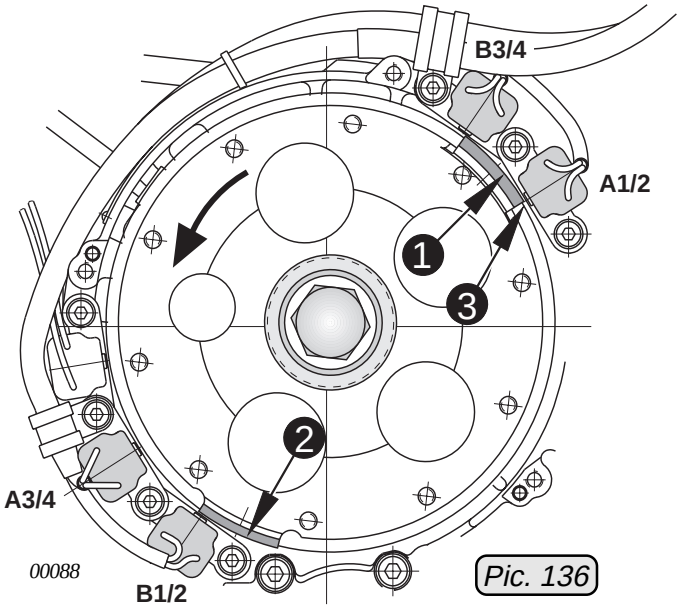
Trigger coil A3/4 serves the bottom spark plug of cylinder 3 and 4

Trigger coil B1/2 serves the bottom spark plug of cylinder 1 and 2

Trigger coil B3/4 serves the top spark plug of cylinder 3 and 4.

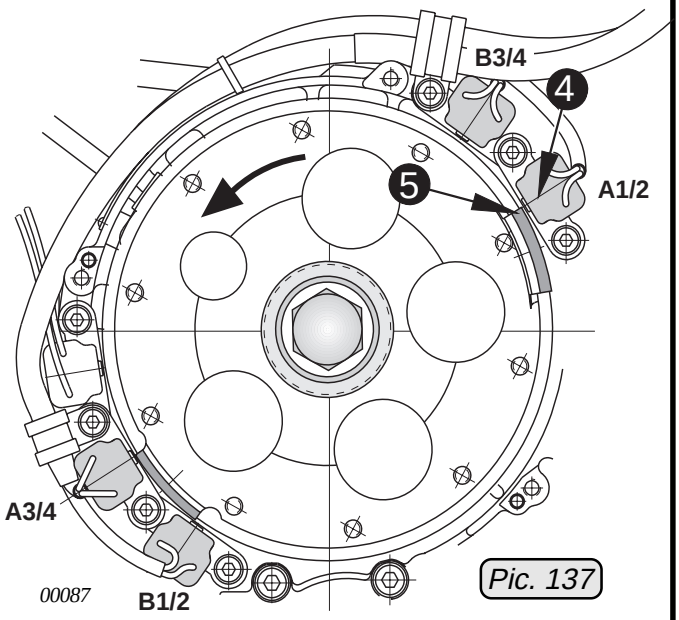
After transition from start ignition timing to operating ignition timing the leading edge ❺ of the trigger cam aligns with the core ❹ of the trigger coil.

This procedure can be performed on all 4 trigger coils, taking into consideration the corresponding ignition cable, see Pic. 138.



Pic. 136

Start ignition timing



Pic. 137

Operating ignition timing

13.4.9) Check of ignition circuits (magneto check)

Let engine run warm. Make magneto check at engine speed of 4150 r.p.m. (1700 r.p.m. propeller speed).

Switch off ignition circuit "A" with ignition switch. This causes only 1 spark plug per cylinder to ignite. The speed drop with only one ignition circuit must not exceed 300 r.p.m. Then make the same check with ignition circuit "B" switched off. Also here the speed drop must not exceed 300 r.p.m. Difference of speed by use of either circuit, A or B, must not exceed 115 r.p.m.

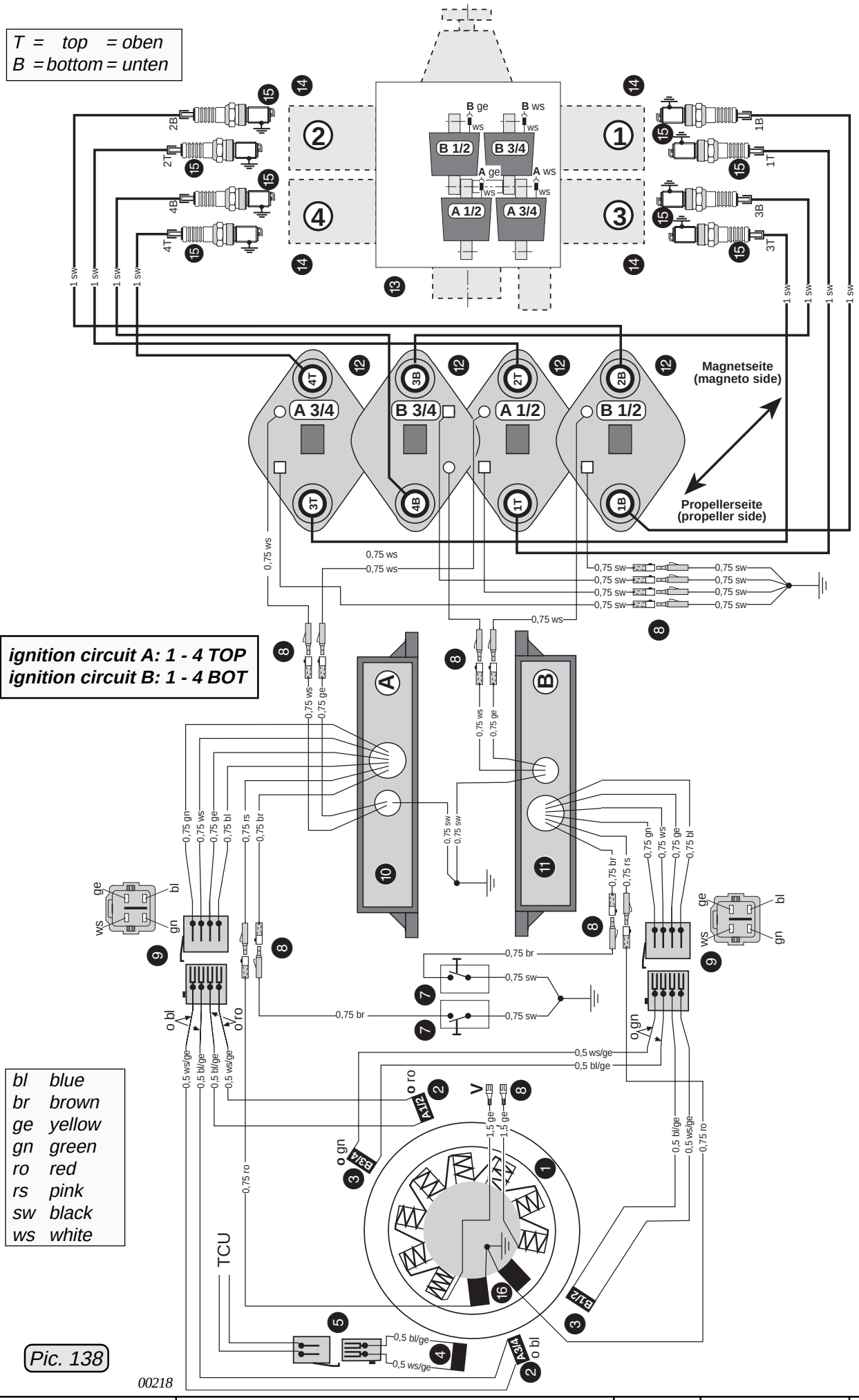
13.4.10) Wiring diagrams

13.4.10.1) Engine, internal

See Pic. 138.

Legend to wiring diagram (Pic. 138)

1	ignition magneto generator
2	trigger coil for ignition circuit ”A”
3	trigger coil for ignition circuit ”B”
4	trigger coil for rev. counter
5	plug receptacle 2-pole
6	electronic tachometer
7	shorting switch for ignition circuit ”A” and ”B”
8	plug receptacle 1-pole
9	plug receptacle 4-pole
10	electronic module for circuit ”A”
11	electronic module for circuit ”B”
12	double ignition coil
13	engine
14	cylinder 1 - 4
15	spark plugs
16	charging coils
V	consumer connection
o	colour code



Pic. 138

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13.4.10.2) Engine, external

See Pic. 139.

Legend to wiring diagram (Pic. 139)

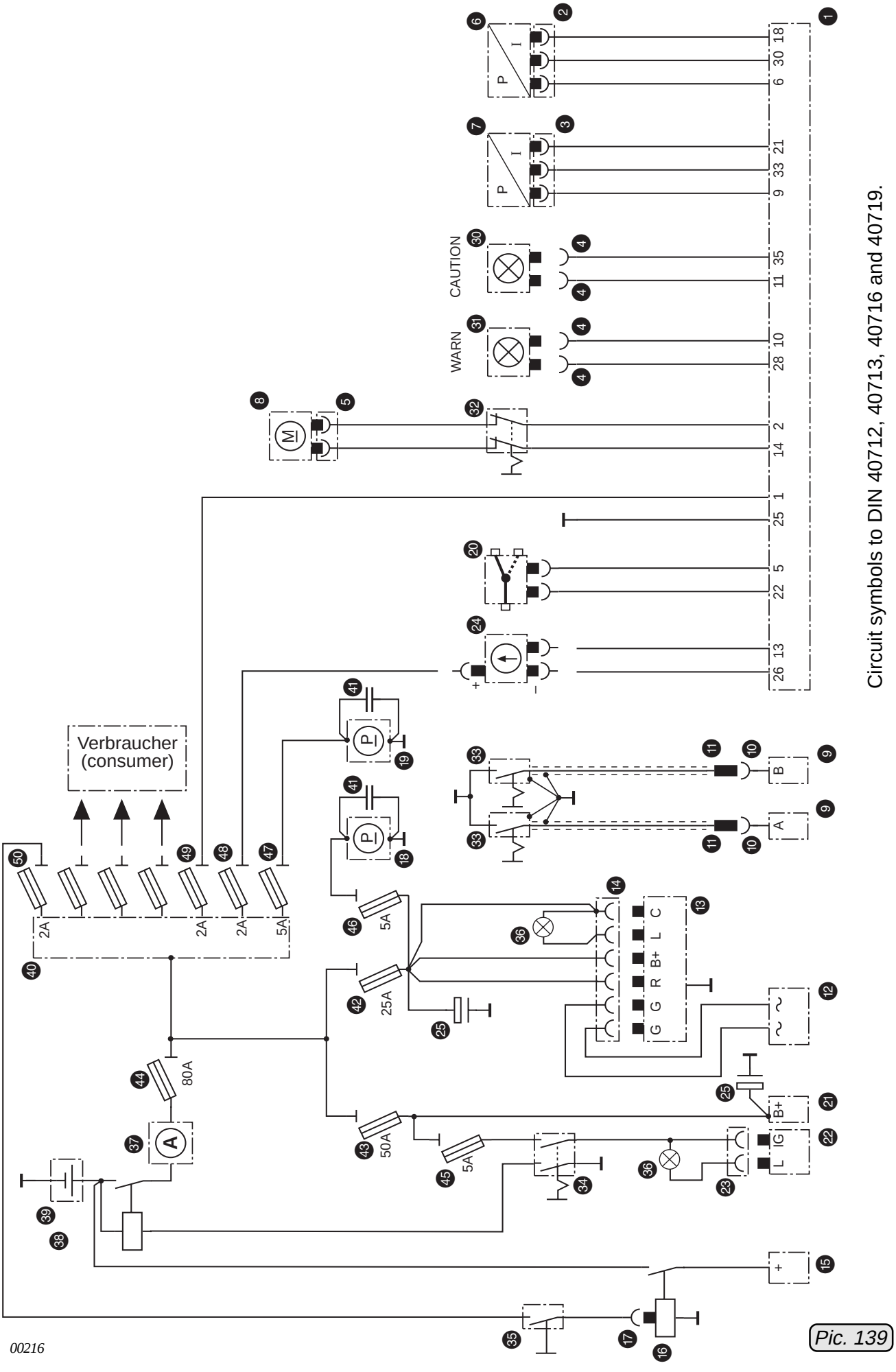
Position 1-20 contained in serial supply scope of engine

Position 21-25 available as accessories.

Position 30-51 not supplied by ROTAX

▲ WARNING: Check of parts/components which are **not** in the serial supply scope of ROTAX have to be checked as per aircraft or fuselage manufacturer's specifications.

1	36-pole plug receptacle for TCU
2-3	plug receptacles for pressure sensor
4	plug receptacles for lamps
5	plug receptacles for servo motor
6	pressure sensor (ambient pressure)
7	pressure sensor (Airbox pressure)
8	servo motor
9	2 elektronic modules
10-11	plug receptacles for stop switch
12	internal generator
13-14	external rectifier-regulator with plug receptacles
15	electric starter
16-17	starter relais with plug receptacle
18-19	electrical fuel pumps
20	3-way solenoid valve (float chamber pressure)
21-23	external alternator with plug receptacles
24	electronic rev. counter
25	capacitor
30-31	lamps
32	switch for servo motors
33	2 short-circuit switches
34	main switch (Master Switch)
35	start switch
36	signal lamps
37	instrument (Amperemeter)
38	battery relay
39	battery
40	Bus Bar
41	capacitor
42-51	circuit breaker



Pic. 139

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13.4.11) Removal of ignition electric set

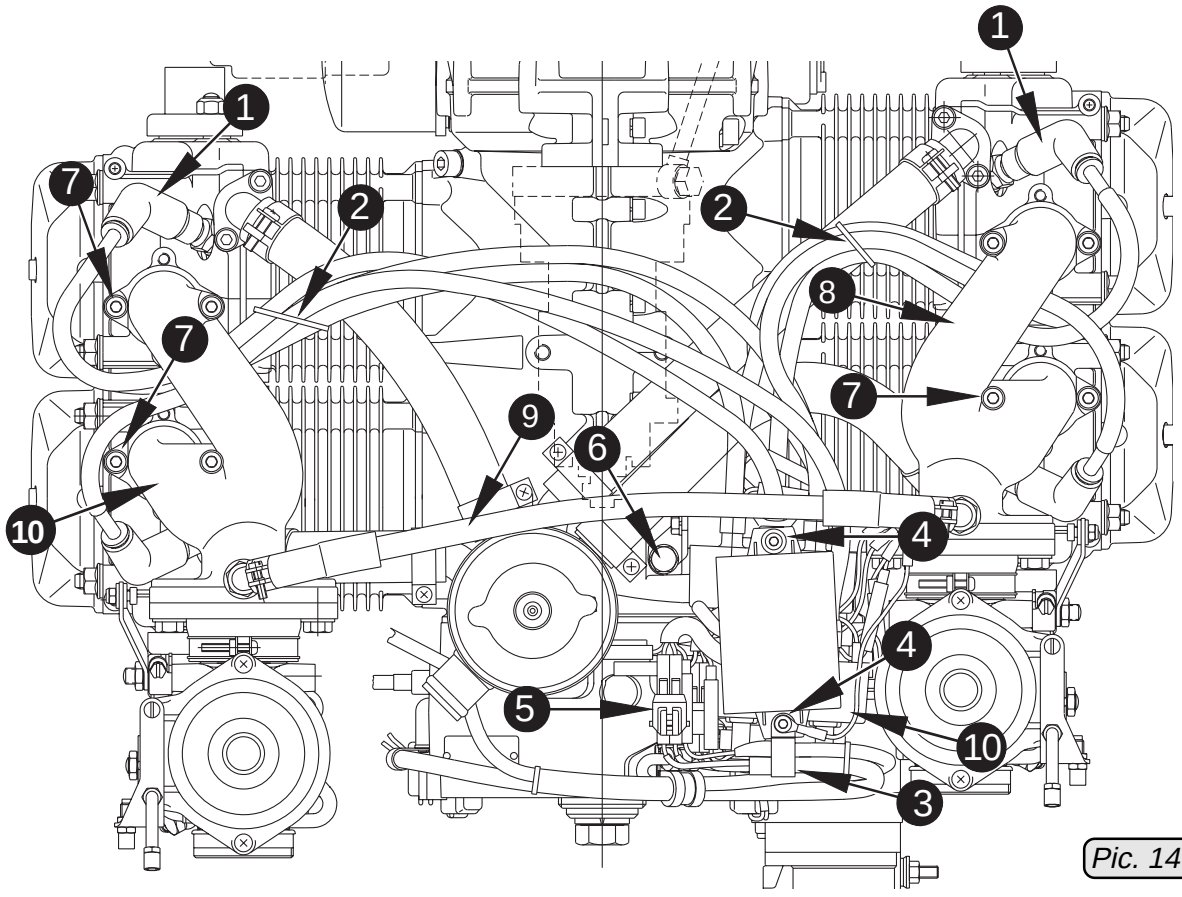
See Pic. 140.

The ignition electric set, consisting of 2 electronic modules and 4 double ignition coils, is fitted to the engine on 3 rubber elements. For removal, detach all 8 spark plug connectors ❶ from the spark plugs. Cut the cable straps for the 4 lower spark plug connectors and draw the ignition cables with protection hose through the cylinder heads. Take care not to lose the ignition cable marking sleeves.

◆ NOTE: On engines with hydraulic propeller governor it is necessary to remove also the spark plug connectors of the 2 upper spark plugs of cylinders 2 and 4 to allow easy removal of the ignition cables.

Cut off cable straps ❷ for ignition cable fixation and the plug connectors. Remove hose clamp ❸ and grounding cable ❿ after removal of Allen screw M5x25 ❹ at the electronic module. Mark the two 4-pole plugs ❺ of the trigger cables and the plug connection of the red charging cable and remove them (see Chapter 13.4.11 Wiring Diagram for ignition unit). Detach both fasteners ❻ of the ignition electric set (1 x M6 on ignition housing, and 1 x M8 on crankcase).

Remove each 4 Allen screws M6 ❼ from both intake manifolds ❽. Now the 2 intake manifolds with O-rings, compensating tube ❾, and ignition electric set can be removed, proceeding with great care. Plug all 4 intake apertures to avoid entry of foreign matter.



Pic. 140

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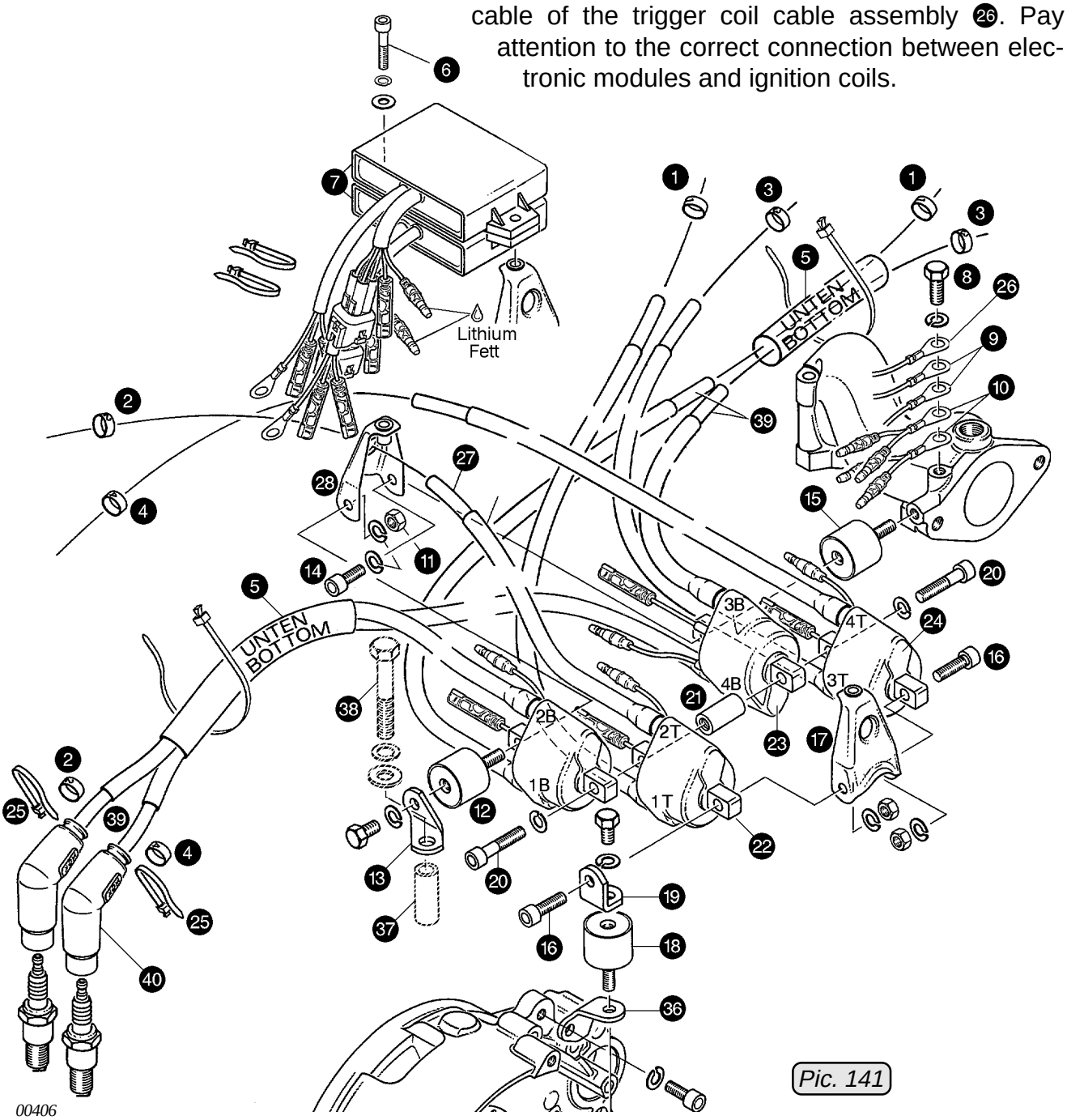
13.4.12) Dismantling of ignition electric set

See Pic. 141,142.

◆ NOTE: Before removal, mark all 8 ignition cables resp. check the correct application of the marking sleeves ❶-❷-❸-❹ of cylinders no. 1 through 4, to avoid mix-up at reassembly.

Cut the cable straps ❷❺ of the lower spark plug connectors and pull ignition cables through the cylinder heads. If necessary, push off the 2 protection hoses ❺ for the lower ignition cables.

Remove Allen screw M5x25 ❻ for the electronic modules ❼ and tilt modules sideways from the engine. Remove hex. screw M6x16 ❽ and lock washer from intake manifold and the ground cables ❾ from both electronic modules and ❿ from the 4 ignition coils as well as the ground cable of the trigger coil cable assembly ❷❻. Pay attention to the correct connection between electronic modules and ignition coils.



Pic. 141

Renewal of double ignition coils

At renewal of a double ignition coil, the following dismantling procedure is required:

Remove hex. nut M6 ⓫ and rubber buffer ⓬ with bracket ⓭. Remove the Allen screw M6x16 ⓮ from rubber buffer ⓯ with an Allen key. Remove both Allen screws ⓰ and ignition coil bracket ⓱ as well as the 3rd rubber buffer ⓲ with bracket ⓳.

Remove both Allen screws M6x30 ⓴ from the distance nut M6 ㉑. After detaching the double grounding cables ⓾, the double ignition coils ㉒ can be replaced individually. The ignition cables are screwed in and therefore are renewable.

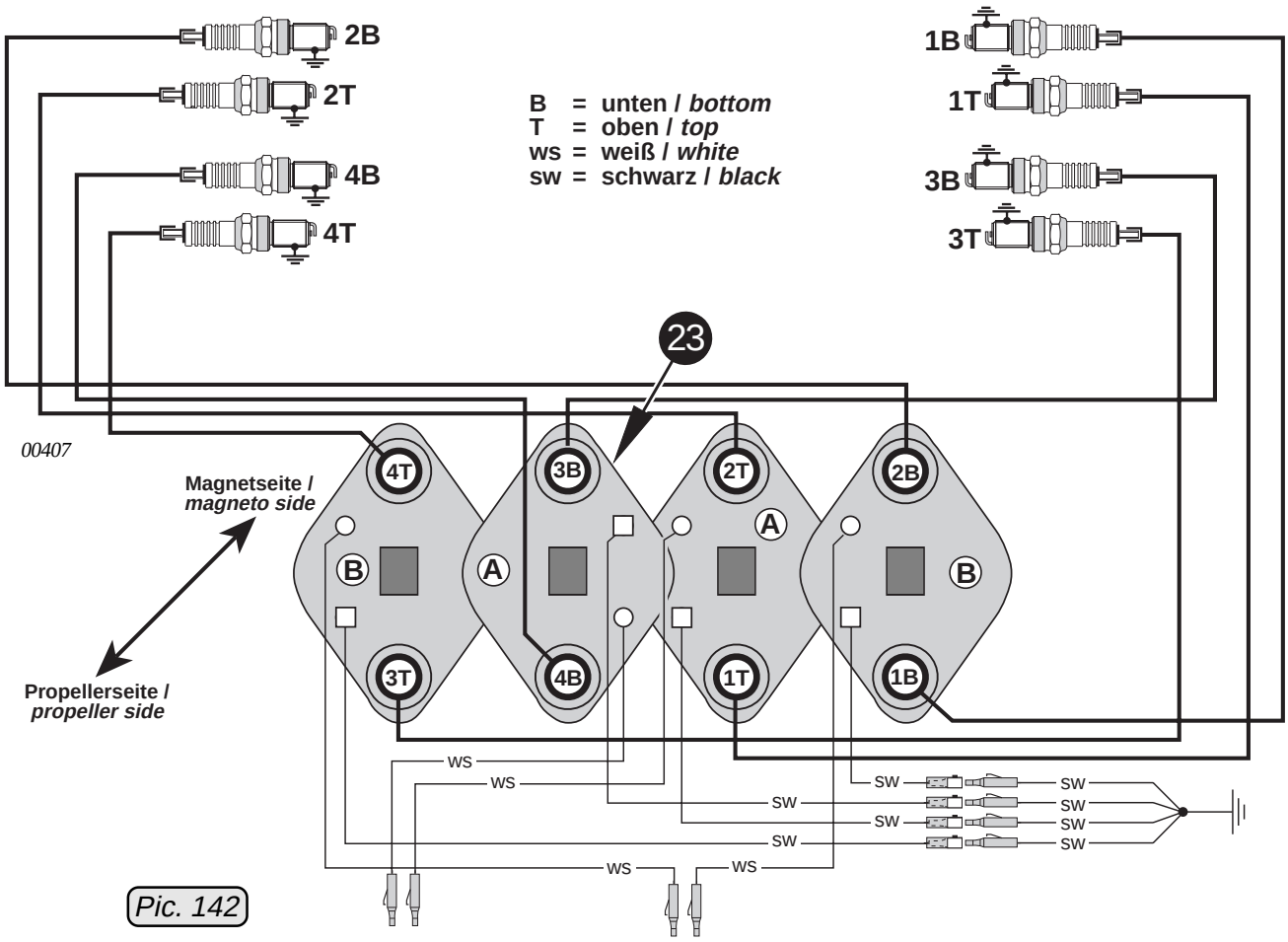
◆ NOTE: Except the double ignition coil ㉓ for spark plug 3 and 4 bottom, all are fitted in the same position, with boss ㉔ upwards.

13.4.13) Re-assembly of ignition electric set

See Pic. 141, 142

Re-assembly of double ignition coils in reversed sequence.

Attach the double ignition coils offset and in the correct position as per illustration, with the two Allen screws M6x30 ⓴ and lock washers A6 with distance nut M6 ㉑. Pay attention to the double ignition coil ㉓ for spark plugs 3B and 4B. It must be fitted turned by 180°, compared with the 3 other double ignition coils (see Pic. 105).



Pic. 142

With the two Allen screws M6x20 ⑯, lock washer A6 and hex. nut M6 re-assemble, first only slightly tightening, the ignition coil bracket ⑰, the ignition coil bracket ⑲, and the double ignition coils.

Insert ignition cable ㉗ into the ignition coil bracket ㉘, and fit the double ignition coils on rubber buffer ⑮ with the Allen screw ⑭ M6x16 and lock washer.

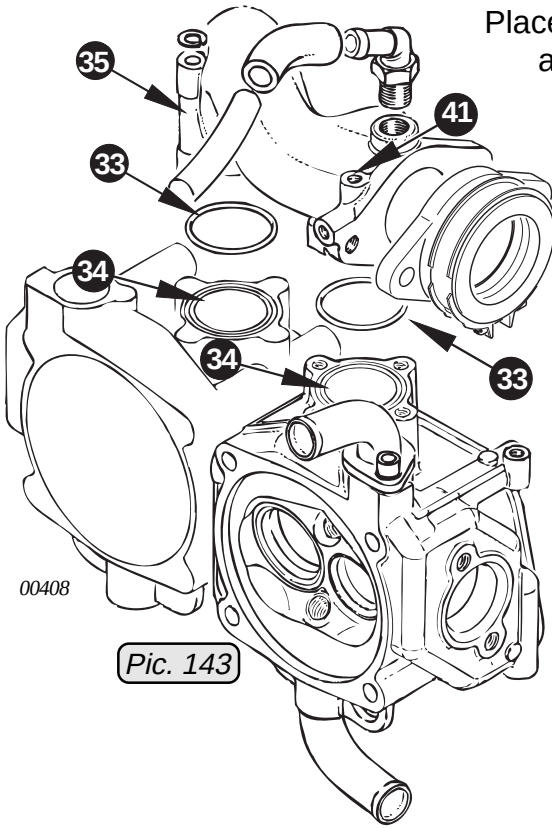
◆ NOTE: When replacing the rubber buffer ⑮, secure it with LOCTITE 221 on intake manifold.

Connect the white cables and the black grounding cables of the double ignition coils without fail as per wiring diagram. Route the grounding cables ❾ and ❿ towards outside. To achieve correct distance, fit the electronic modules ❼ on the ignition coil brackets with Allen screws ❻ M5x25.

Now all ignition coil fasteners can be tightened. Tighten ignition coil bracket ⑬ and rubber buffer ⑫ with hex. nut M6 and lock washer.

13.4.14) Re-fitting of ignition electric set

See Pic. 141 and 143.



Pic. 143

Place O-rings ㉝ 34x2 into the groove ㉞ of cylinder heads and remove the protections from the intake apertures. Fit both intake manifolds ㉟ with pre-assembled ignition electric set and tighten crosswise with 4 Allen screws to 10 Nm (90 in.lb). Insert rubber buffer ⑱ into bracket ㊱ of ignition housing and tighten with hex. nut and lock washer.

Place distance sleeve ㊲ into position and fix ignition electric set with hex. screw ㊳ M8, washer and lock washer on crankcase. Now tighten all screws and nuts of the ignition electric set.

Fit grounding cables ❾, ❿ and ㉖ on boss ㊶ of intake manifold with hex. screw ❽ M6x16 and lock washer. Attach both 4-pole plug connectors (electronic module to trigger set) and secure with cable strap.

◆ NOTE: The trigger cable of ignition circuit **A** (top module) is marked at the end of the isolating hose with the colours blue and red. Those of ignition circuit **B** (bottom module) are marked with colours green and colourless (neutral).

Connect the two red cables coming from the charging coils with the two pink cables of the SMD electronic modules. Route the whole cable assembly into the cable clamp and fit electronic module with Allen screw ❻ M5x25 on the ignition coil bracket ⑰.

■ ATTENTION: The cable shielding must be fully inserted into the cable clamp to assure optimum mass connection.

Fit two each ignition cables ❸❾ for the lower spark plugs into the glassfibre/ silicone protection hose ❺ and route them between cylinder heads. Screw spark plug connector ❹❿ onto the ignition cables, secure with cable straps ❷❺ and plug them to the spark plugs according to the wiring diagram, see Pic. 139.

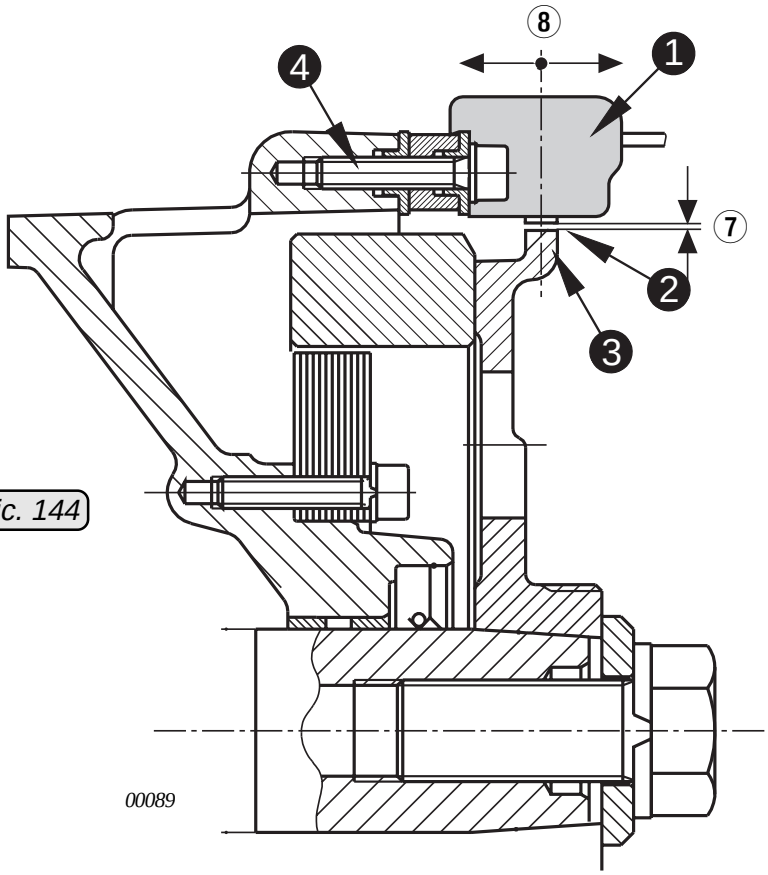
Fasten ignition cables for cylinder 1 - 3 and 2 - 4 with new cable strap on coolant hose, see Pic. 139.

13.4.16) Exchange of external trigger coils

See Pic. 144 and 145.

Because of the shielding ❻ the trigger coil set ❺ can be exchanged only in pairs. Remove the fixation screws ❼ with the distance sleeves ❽ and clamps and re-fit new trigger coil set. The stator ❾ need not be removed in this case.

The trigger coil ❶ is adjustable only to a limited extent. The gap ❷ between pick-up and trigger cam ❸ is dimension ⑦. The axial position of the triggers should be in the middle over the trigger cam and may be offset by max. dimension ⑧.



Pic. 144

■ ATTENTION: Fit the clamps as to ensure perfect ground connection between shielding and ignition housing.

dimensions	**new**	**wear limit**

See Chapter 15.

13.4.16) Stator removal and re-fitting

See Pic. 145.

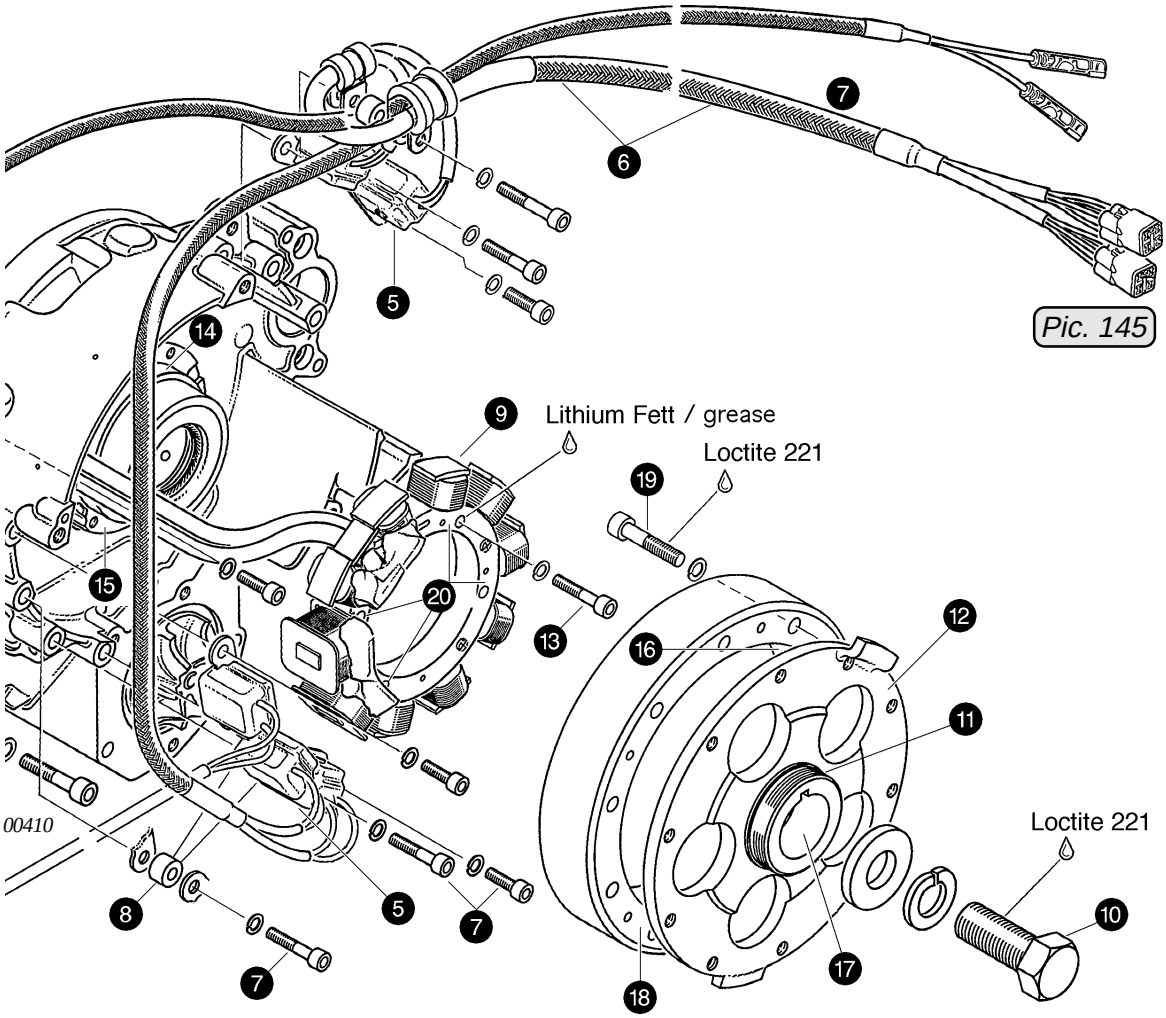
Block crankshaft with crankshaft locking screw, part no. *240 880* (see Chapter 13.3).

Remove hex. screw ⑩ M16x1,5 together with lock washer and washers. Place protection piece, part no. *877 410,* on crankshaft, screw puller, part no. *877 375,* fully onto thread ⑪ and press off magneto hub ⑫ together with magneto flywheel with hex. screw. Lay magneto hub ass' y aside so that no particles can be attracted.

◆ NOTE: For removal of stator the ignition housing need not be removed.

Remove four Allen screws ⑬ M5x25 and hose clamp. Remove stator ass'y ⑨ from the centering ⑭ and make visual check. Check cable assembly for damage. The contact faces ⑮ between stator and ignition housing must be clean to assure good ground connection. Check of resistance values, see Chapter 15).

Repair of the stator is not planned. At exchange of the stator take care for correct routing of cable assembly. One each charging coil grounding cable is screwed with the stator fixation. At assembly apply Lithium grease to the contact faces ⑳ of the stator and the screw heads.



Pic. 145

13.4.17)Flywheel ass'y

See Pic. 144 and 145.

Visually check magneto inner side ⓰ and the taper surface ⓱. Under normal circumstances dismantling of flywheel hub is not necessary.

If it had been dismantled, clean the contact surfaces ⓲. Apply LOCTITE 221 to all 10 Allen screws ⓳ (alternating 5 screws M6x30 and 5 screws M6x25) and torque to 10 Nm (90 in.lb.).

◆ NOTE: The hole pattern in the magneto ring is symmetrical and therefore it can be assembled in any position.

Check Woodruff key in crankshaft for tight fit and degrease tapers of crankshaft and flywheel hub. Apply LOCTITE 221 sparingly, however well spread into the taper of magneto hub.

Fit flywheel hub ass'y, washer 17/36/5, lock washer 16 and hex. screw M16x1,5 and tighten it to 120 Nm (1060 in.lb).

■ ATTENTION: The Woodroff key must remain in the keyway.

Adjust the air gap of the external triggers with feeler gauge to dimension ⑦. Check external trigger coils for correct axial position with reference to the trigger cam of the magneto hub. Max. off-set by dim. ⑧ is allowed.

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13.5) Turbo charger and exhaust system

Besides the specified maintenance checks, see chapter 12) and description of the turbo charger and control system, chapter 9.5). Instructions for further maintenance tasks are stated here.

13.5.1) Dismantling of the complete exhaust system inclusive turbo charger and engine suspension frame

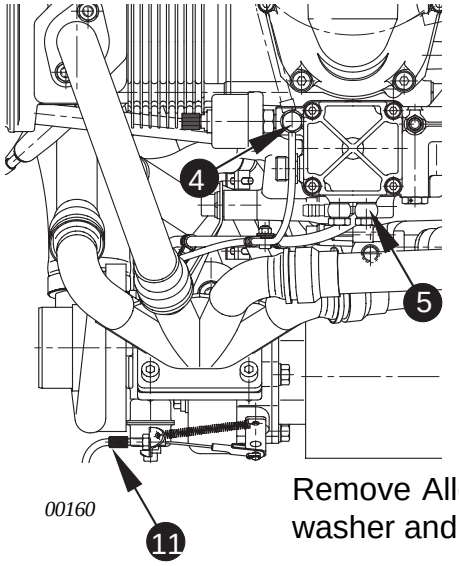
See Pic. 146 and 147.

■ ATTENTION: Perform tasks only on the cold engine ➪ **danger of burning!**

Exhaust manifold / muffler assembly:

Remove lock nuts M8 ❶ on exhaust bend flanges.

◆ NOTE: If one of the studs M8x23/20 ❷ should become loose refit stud again to 8 Nm (71 in.lb).
Longer threaded end (23 mm) to stay in cylinder head.



Pic. 146

Withdraw exhaust bends ❸ by slight pulling and swivel action.

Detach oil lines for turbo lubrication from pressure side ❹ and suction side ❺ of oil pump. See Pic. 146. For further details of "Turbocharger oil circuit" refer to chapter 13.2.

Slacken clamp 120 ❻ but do not remove it, not even from the exhaust bracket ❼.

Remove Allen screw M10x50 ❽ (attaching turbo bracket) along with lock washer and washer.

Further detach connection ❾ turbo bracket - engine frame (not in the supply volume of engine).

Support the complete unit of muffler - turbo charger - manifold, remove the clamp 120 and take off the complete unit. Pull out spacer ❿ 10,5/17/15 from arm of engine frame.

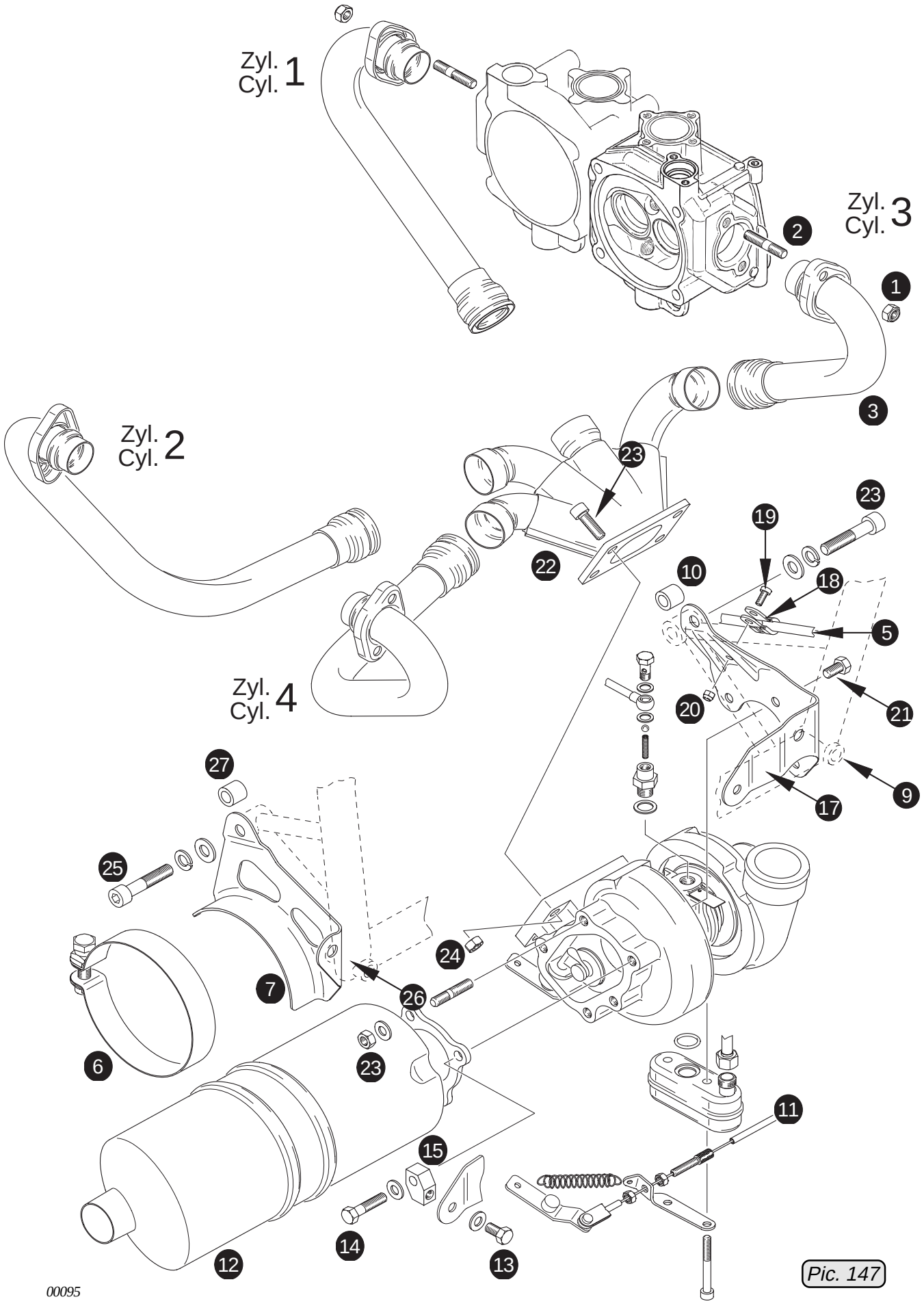
◆ NOTE: If found necessary remove the servo cable ⓫ for waste gate control, but normally this is not required. See chapter 13.5).

Muffler:

◆ NOTE: To take off the muffler does not need the removal of the unit exhaust bends - manifold - turbo charger.

For removal of the muffler ⓬ remove hex. hd. screw ⓭ M8x16 and washer followed by hex. hd. screw ⓮ M8x35 along with washer and support plate ⓯.

After removal of the 4 nuts ⓰ and washers, the muffler can be taken off.



Pic. 147

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Turbo charger bracket:

The oil suction line ❺ is additionally attached on the turbo bracket ⓱ by means of a cable clamp ⓲, Allen screw ⓳ M5x12 and lock nut ⓴. Remove these items to start with.

The turbo bracket is attached on turbine housing by 3 hex. hd. screws ㉑ M8x16.

Turn out these 3 screws as far as possible.

◆ NOTE: These screws cannot be removed at once completely as they touch the bearing housing. For the complete removal it is necessary to slacken the fourth attachment screw slightly.

■ ATTENTION: To prevent any damage of the turbine impeller fit the screws ㉑ again. This will warrant that the turbine housing will not come apart.

Ensure that the two retaining ring halves are in position.

Exhaust manifold:

◆ NOTE: No need to disassemble the complete unit of muffler and turbo charger for removal of the exhaust manifold.

The exhaust manifold ㉒ is directly attached on turbine housing by Allen screws ㉓ M8x25 and nuts ㉔.

Muffler bracket:

◆ NOTE: No need to disassemble the complete unit of muffler - turbo charger - exhaust manifold for the removal of the muffler bracket.

Remove Allen screw ㉕ M10x50 along with lock washer and washer.

Further detach connection ㉖ of exhaust bracket with engine frame (not in supply volume of engine).

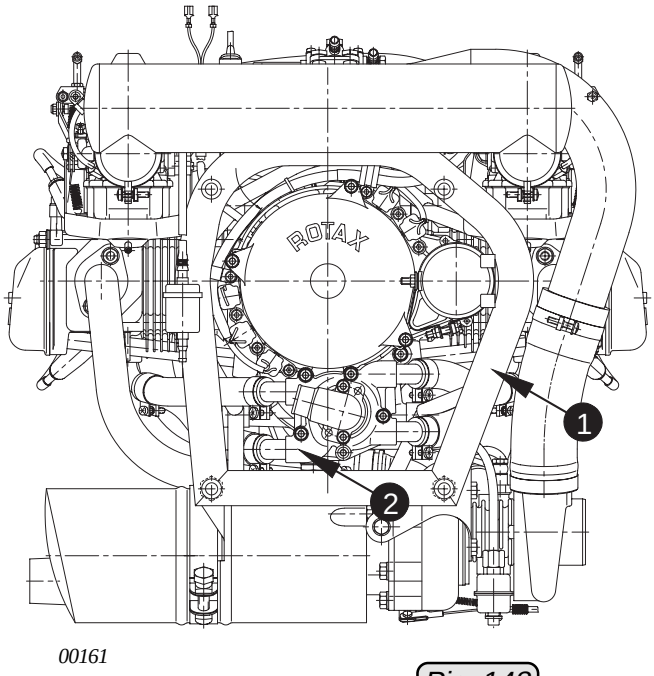
Take out spacer ㉗ 10,5/17/15 from arm of engine frame.

Engine suspension frame:

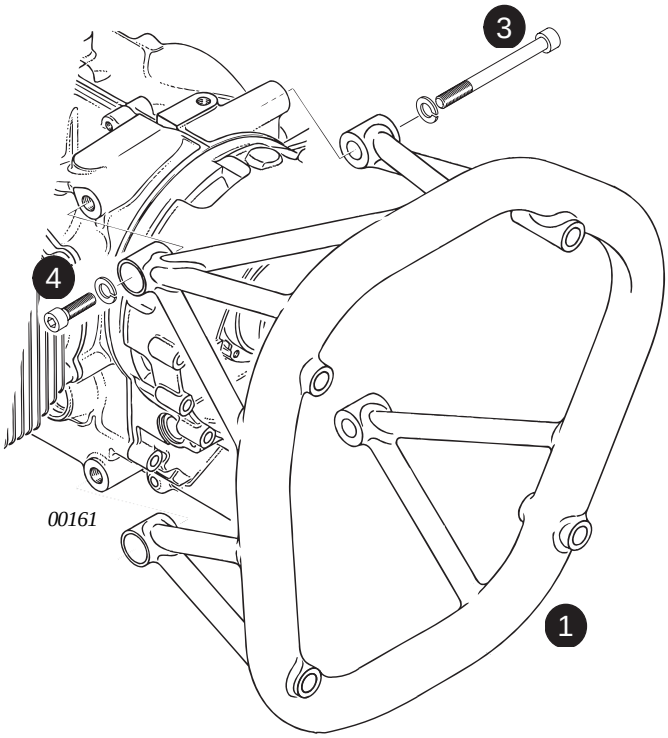
See Pic. 147 and 148.

◆ NOTE: Prior to detachment of the engine suspension frame ❶ remove the water pump housing ❷ as the outwards extending coolant sockets would hinder removal of the engine suspension frame. See chapter 13.3).

After removal of the two Allen screws M10x110 ❸ and M10x35 ❹ along with lock washers the engine suspension frame can be taken off.



Pic. 148



Pic. 149

13.5.2) Checking of the engine suspension frame, exhaust system and turbo charger components

Visual inspection of all components.

■ ATTENTION: Because of the high thermal stress inspect the complete exhaust system especially for crack formation.

Turbo charger:

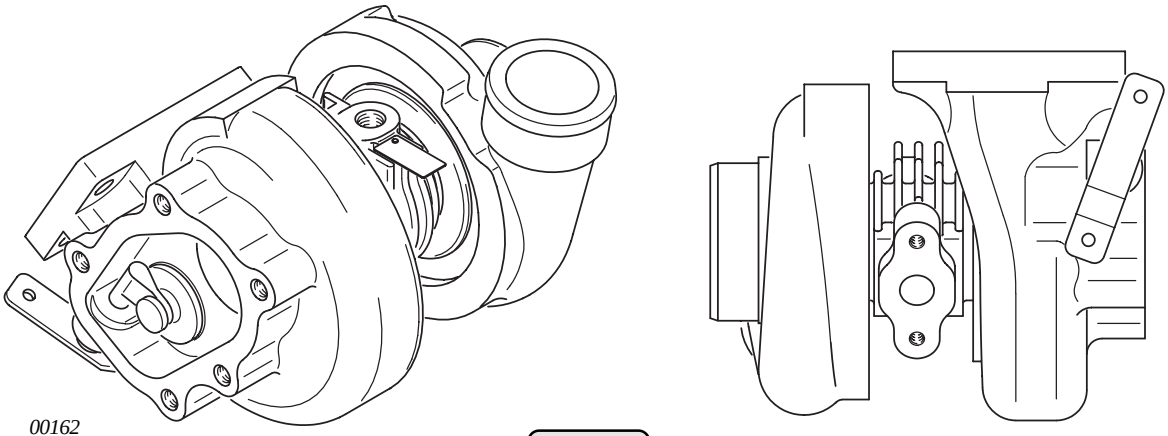
See Pic. 150.

Visual inspection of the turbo charger.

◆ NOTE: The turbo charger is handled as a complete unit e.g. no spare parts are available at BOMBARDIER-ROTAX. In case of damage the complete unit has to be renewed.

Check waste gate lever for easy movement and verify the bearing clearance.

Inspect face of turbine inlet.



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Pic. 150

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13.5.3) Assembly of the complete exhaust system inclusive turbo charger

See Pic. 151,151/1 and 152.

Turbo charger / turbo charger bracket / exhaust manifold

Remove the 3 upper hex. hd. screws ❶ M8x16 on turbine housing but slacken the lower screw only.

Place the turbo charger bracket ❷ on outer side of retaining ring in position and loosely attach with the 3 screws. Fit 4 studs ❸ M8x19,5/13 with the longer threaded end (19,5 mm) into turbine housing and tighten to 6 Nm (33 in.lb).

◆ HINWEIS: No stud will be fitted in the top tapped hole ❹.

Attach muffler ❺ with washers and M8 nuts ❻ on turbine housing ❼ with washer and hex. hd. screw ❽ M8x35 on turbine housing. Attach turbo charger bracket ❷ with washer and hex. hd. screw ❾ M8x16 on support plate and tighten screw slightly.

Tighten muffler attachment nuts M8 to 25 Nm (220 in.lb).

Fit the exhaust manifold ❿ onto turbine housing using Allen screws ⓫ M8x25 and M8 nuts ⓬. Tighten nuts only slightly.

■ ATTENTION: Fasteners for exhaust manifold and turbo charger bracket will be tightened not before installation on engine is complete, to prevent locking up of stresses.

Installation of the check valve. Refer to chapter 13.2.

Engine suspension / muffler assembly / exhaust bends

Attach engine suspension frame ❶ with lock washers, Allen screws M10x110 ❸ and M10x35 ❹ on crankcase. See Pic. 148 and 149.

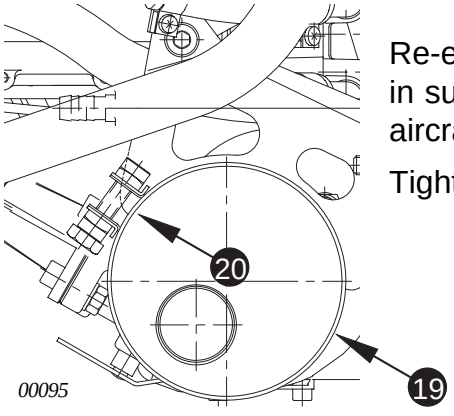
Place spacer ⓭ 10,5/17/15 into left arm of engine suspension frame and attach muffler bracket ⓮ with washer and Allen screw ⓯ M10x50 on crankcase.

Re-establish attachment ⓰ muffler bracket / engine suspension frame (not in supply volume of engine). Tightening torque as specified by the aircraft builder.

Place spacer ⓱ 10,5/17/15 into right arm of engine frame.

Attach turbo charger / muffler and turbo charger bracket assembly with Allen screw ⓲ M10x50 and washer plus lock washer on crankcase of engine. The muffler will be attached by clamp ⓳.

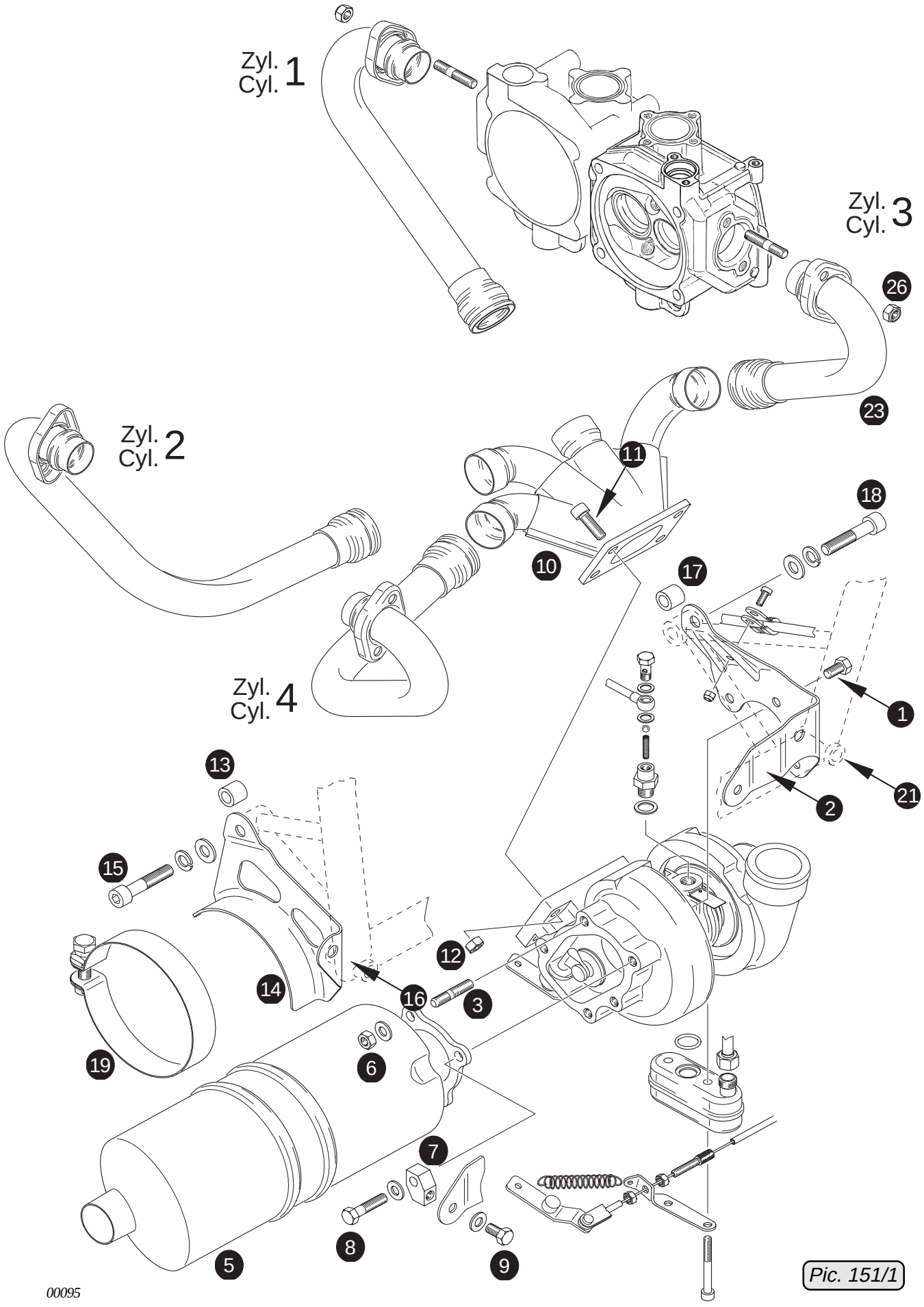
■ ATTENTION: Place clamp in position such that the tension free zone ⓴ comes to rest on edge of muffler bracket. See Pic. 151.



Pic. 151

Re-establish attachment ㉑ turbo charger bracket - engine frame (not in supply volume of engine). Tightening torque as specified by the aircraft builder.

Tightening torque of the M10 screws = 35 Nm (310 in.lb).



Pic. 151/1

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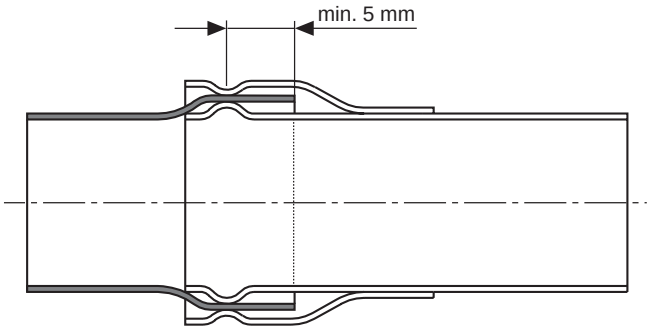
Reconnect the two oil lines for turbo charger on the oil pump. See chapter 13.2.

◆ NOTE: If location of oil line connections on turbo does not correspond with oil pump housing, correction can be achieved by slight turning of the turbo centre section ㉒.

Fitting of the 4 exhaust bends ㉓.

◆ NOTE: To make fitting easier Loctite Anti Seize can be applied on the labyrinth end ㉔.

The connecting ends ㉕ of the exhaust bends must overlap the pleat of the labyrinth by at least 5 mm (0.2 "). See Pic. 152.



Pic. 152

■ ATTENTION: All 4 exhaust bends must be fitted free of stress and must not be damaged at installation.

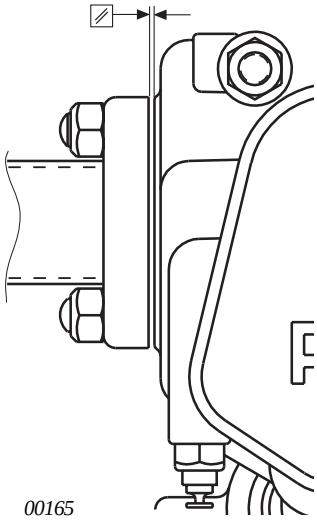
After completion of installation all the screw connections at turbo charger bracket, exhaust manifold, exhaust bends and clamp have to be tightened to the specified torque.

Tightening torque:

hex. hd. screw	❶	M8x16	Turbo charger bracket	25 Nm / 220 in.lb
Allen screws	⓫	M8x25	Exhaust manifold	25 Nm / 220 in.lb
hex. hd. screw	⓴	M10	Clamp	20 Nm / 177 in.lb
hex. nuts	㉖	M8	Exhaust socket flange	12 Nm / 106 in.lb

At tightening of the exhaust bend flanges ensure equal distance between flange and cylinder head from top to bottom. See Pic. 153.

■ ATTENTION: In the high temperature zone of turbo charger and exhaust system use exclusively high grade, stainless steel screws.



Pic. 153

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13.5.4) Servo cable, rope sheave and spring for waste gate control

See fig. 154

13.5.4.1) Disassembly

Remove tension spring ❶ by using a suitable tool and sever securing wire ❷.

Loosen set screw of nipple ❸ and pull out servo cable from the cable retainer ❹.

Take note of the **loose compression spring** ❺ 5,5/1,2/16,9. Remove this spring and store it in a safe place.

Remove cotter pin ❻ and pin ❼ from waste gate lever ❽.

Now the wire rope can be pulled out from the conduit.

If required take off rope sheave ❾ after removal of the Allen screw ❿ M5 x 20 along with spring washer and washer.

13.5.4.2) Checking of the components

Visual inspection of all components. Check servo cable for easy movement.

■ ATTENTION: Renew servo cable if damaged. Refer to section 12.3.6).

Check spring engagement holes ⓫ for wear.

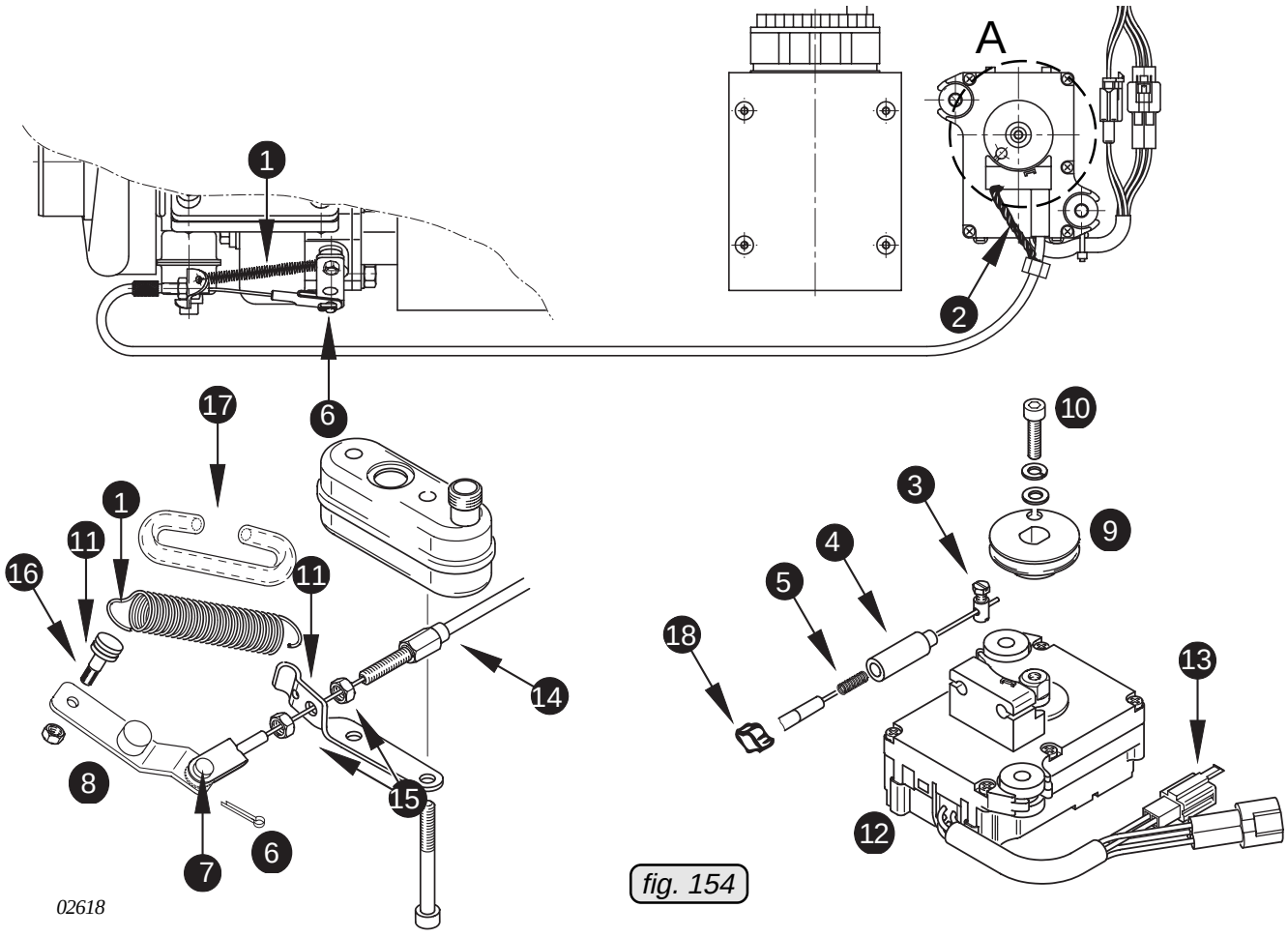


fig. 154

13.5.4.3) Assembly and adjustment

Position ascertaining of the servo motor:

See fig. 154 and 154/1.

For position ascertaining of the servo motor power-up the TCU.

◆ NOTE: After the automatic check of the servo motor ⑫ put the throttle lever into idle position to make sure that the servo motor will remain always in positon with waste gate **"closed"**. The servo motor is self locking.

Position ascertaining is absolutely necessary for correct adjusting of the servo cable.

Whilst fitting the rope sheave **interrupt** the voltage supply to the **TCU**, or unplug the 2-pole connection ⑬. **Risk of ruining** the servo motor if it would be activated by the TCU during assembly.

Fit rope sheave as per detail **A**, fig. 154 and secure with washer, lock washer and Allen screw M5x20 ⑨. The rope sheave has to be fixed to prevent rotating of the output shaft when the rope sheave is tightened. Tighten to 6 Nm (53 in.lb).

If the cable retainer has been removed at disassembly, apply LOCTITE 648 on cable retainer ④ and press it into servo motor housing.

Fit servo cable with pin ⑦ on waste gate lever and secure by cotter pin ⑥.

Feed wire rope through adjusting screw ⑭ and flexible conduit. Fit suitable clamp ⑱ (e.g. crimp band clamp) for traction relief on servo cable as per fig. 154/1, using suitable tool. Insert pressure spring ⑤ into cable retainer ④, feed rope through spring and retainer around rope sheave and secure with screw nipple ③.

Adjust servo cable by M6 hex. nuts ⑮ such that no clearance is perceptible on waste gate lever.

With this adjustment set, pre-tension the compression spring by 1 to 2 mm (0,04 - 0,08 in.) at straightened cable with the adjustment screw at support.

Fit the Silicone tube 5x8 ⑰ into restoring spring.

Engage restoring spring on support and spring pin ⑯.

■ ATTENTION: To minimize wear on spring engagement holes, engage spring on spring pin, twist it by approx. one turn and engage other end of spring on support.

Wire secure ② between servo motor and traction relief such, that the servo cable cannot escape from cable retainer and consequently changing the setting.

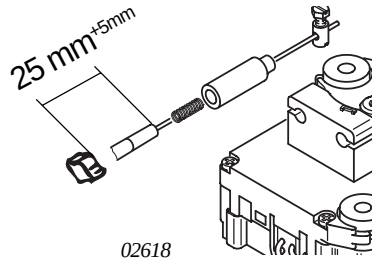


fig. 154/1

13.6) Control system of the turbo charger

Besides the specified maintenance checks, see chapter 12) and description of the turbo charger and of control system chapter 9.5) further maintenance procedures are described as follows.

13.6.1) Checking of the turbo control unit (TCU) by means of a communication program

13.5.1.1) Scope of the communication program

For trouble-free engine operation it is necessary that the pilot can locate the exact throttle position for the max. continuous performance.

- ⇨ Verification of function of all sensors and pick-ups
- ⇨ check of throttle potentiometer (throttle position)
- ⇨ on-line data recording of the turbo control
- ⇨ quick analysis of errors

With this program a prompt analysis of defects and irregularities can be conducted.

13.6.1.2) Required items

See Pic. 155.

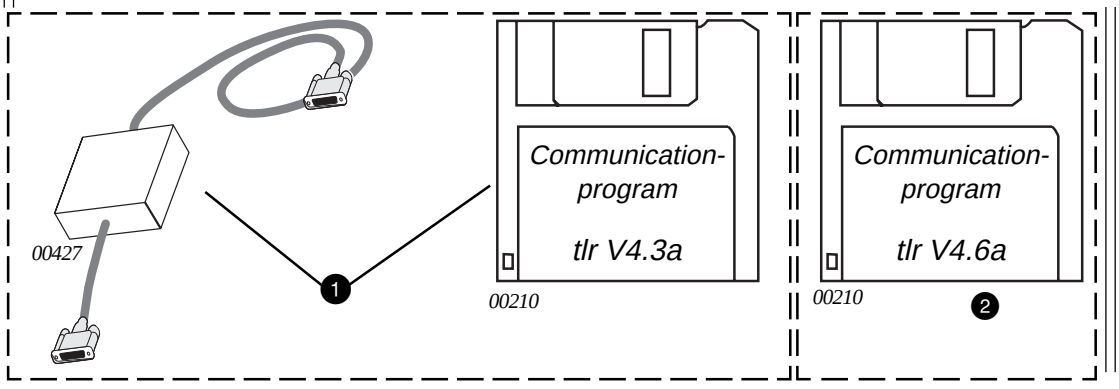
- ⇨ PC with processor 80 286 or higher level with Random Access Memory of at least 640 KB RAM
  graphic card EGA, CGA or VGA
  serial interface COM 1 or COM 2
  operating system MS-DOS 5.0 or higher level
  diskette drive 3,5 inch

◆ NOTE: We recommend a Laptop- or Notebook-computer since these units can be utilized also directly on engine or aircraft.

- ⇨ Communication program: software linking TCU with computer
  tlr V4.3a for TCU 966.470
  tlr V4.6a for TCU 966.741
- ⇨ Decoding unit (Dongle) with data cable to link with computer

◆ NOTE: The Dongle is only required for the TCU 966.470. On the TCU 966.741 the computer has to be connected directly on RS 232, the 9-pin port of the cable harness.

◆ NOTE: All the required items, except the computer are available in form of a monitoring kit ❶ or as diskette ❷.



Pic. 155

13.6.1.3) Introduction to employment of the communication program

a) Software

⇨ The software is the property of BOMBARDIER-ROTAX. Duplication is only permitted for transmission on a fixed disk or for back up and filing.

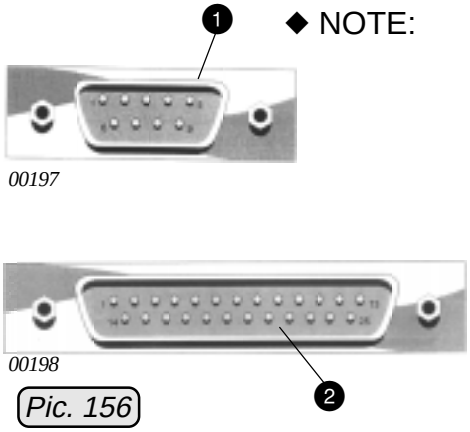
b) Necessary connections

See Pic. 156 and 157.

⇨ On the TCU 966.470 connect the decoding unit (Dongle) on the RS 232, the 9-pin port of the cable harness.

On the TCU 966.741 connect the computer direct on the RS 232 the 9-pin port of the cable harness.

⇨ Connect data cable of decoding unit (Dongle) with the **COM1** interface of computer.

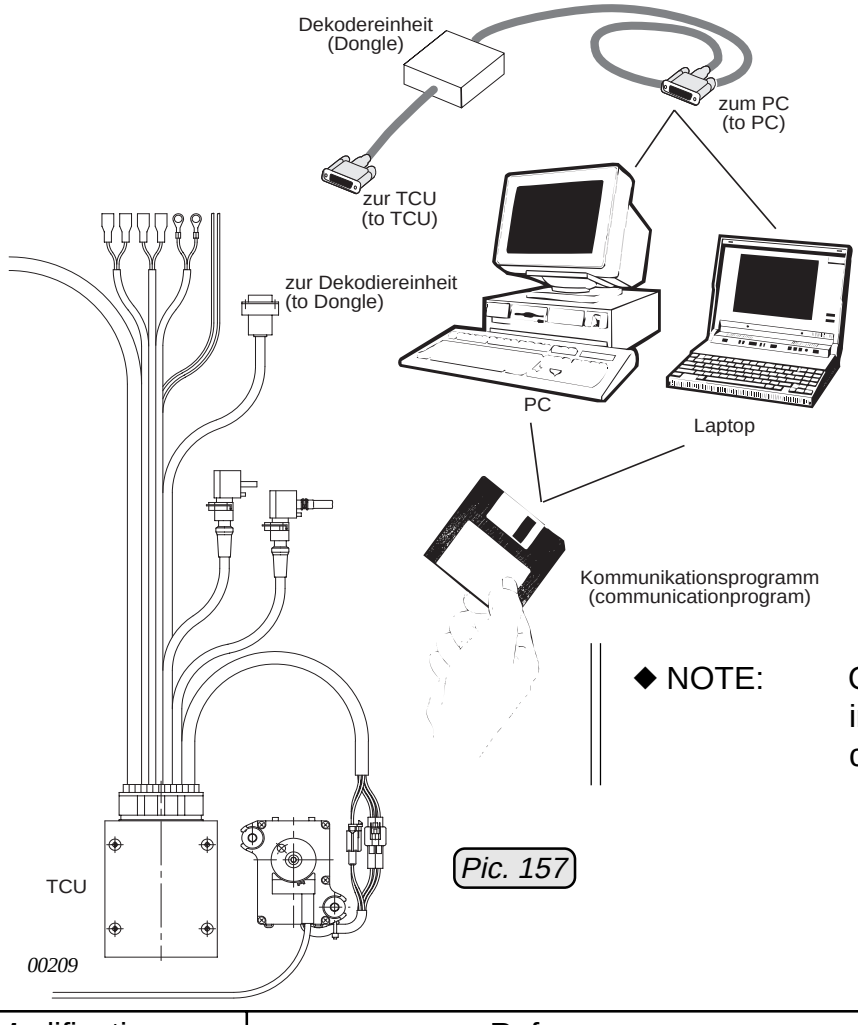


Pic. 156

◆ NOTE: The computer is normally provided with two serial interfaces ❶ and ❷.

Normally a serial interface (usually a 9-pin port) is used for connection of a mouse.

Since there is no need for a mouse to control the communication program the Dongle can be connected with the interface for the mouse, best known as COM 1.



Pic. 157

◆ NOTE: On the TCU 966.741 the decoding unit is inapplicable and the connection is direct.

c) Procedure for installation of the communication program on the PC

➩ Make sure of, which TCU and thus which program is the applicable one. For TCU 966.470 use prog43 and for TCU 966.741 use prog46.

➩ Switch on the PC and wait for message **C:\>**.

◆ NOTE: If this message should not appear (e.g. immediate start of a Windows-version) change over to MS-DOS level.

➩ To establish the directory designated as **914/progxx** enter the command

MD 914\progxx [Enter]

➩ Insert program diskette into the drive "A" and enter the command

C:\>**XCOPY␣A:*.*␣C:\914\progxx\␣/s [Enter]**

(enter only bold face printed command).

◆ NOTE: With this command the directory "914" with all its sub directories will be established.

➩ Remove diskette from drive and store safety.

■ ATTENTION: Perform installation of the program every time with the original diskette.

13.6.1.4) Application of the communication program

a) Start of the program:

➩ **establish connections PC→Dongle→TCU**

➩ **switch on TCU**

▲ WARNING: Ensure engine ignition "OFF" and secured against unintentional "ON".

➩ **switch on PC (if not active already)**

➩ start of the program direct from MS-DOS by call.

To start the program enter with command line

C:\914\prog43\>**tlr43a [Enter]**

or C:\914\prog46\>**tlr46a [Enter]**

◆ NOTE: If only the message **C:\>** appears start the program with the same command line but in bold face print

C:\>**914\prog43\tlr43a [Enter]**

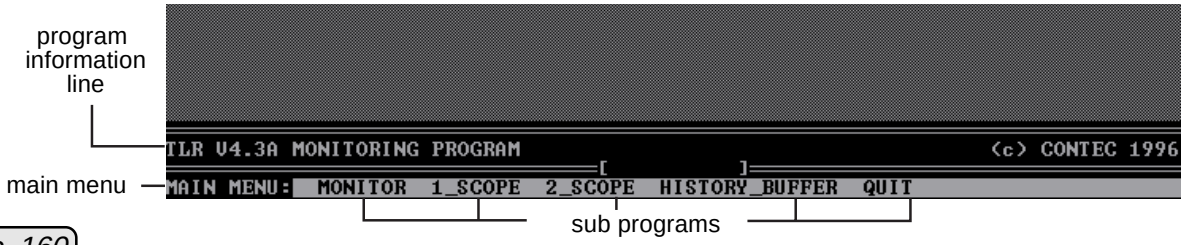
C:\>**914\prog46\tlr46a [Enter]**

b) Starting of the sub programs:

See Pic. 160.

The sub programs are always listed on the bottom line and will be activated by input of the first letter of the program e.g. **"M"** for MONITOR (monitoring program)

◆ NOTE: The key "ESC" will transfer you always back to the main menu.



Pic. 160

◆ NOTE: The Pic. 160 shows the program TLR V4.3A.

c) Description of the sub programs

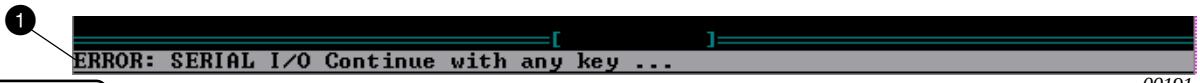
➪ **On-line-display:** See Pic. 161/162/163/164 and 165.

◆ NOTE: If at start of the on-line sub programs (MONITOR, 1_SCOPE und 2_SCOPE) the error message

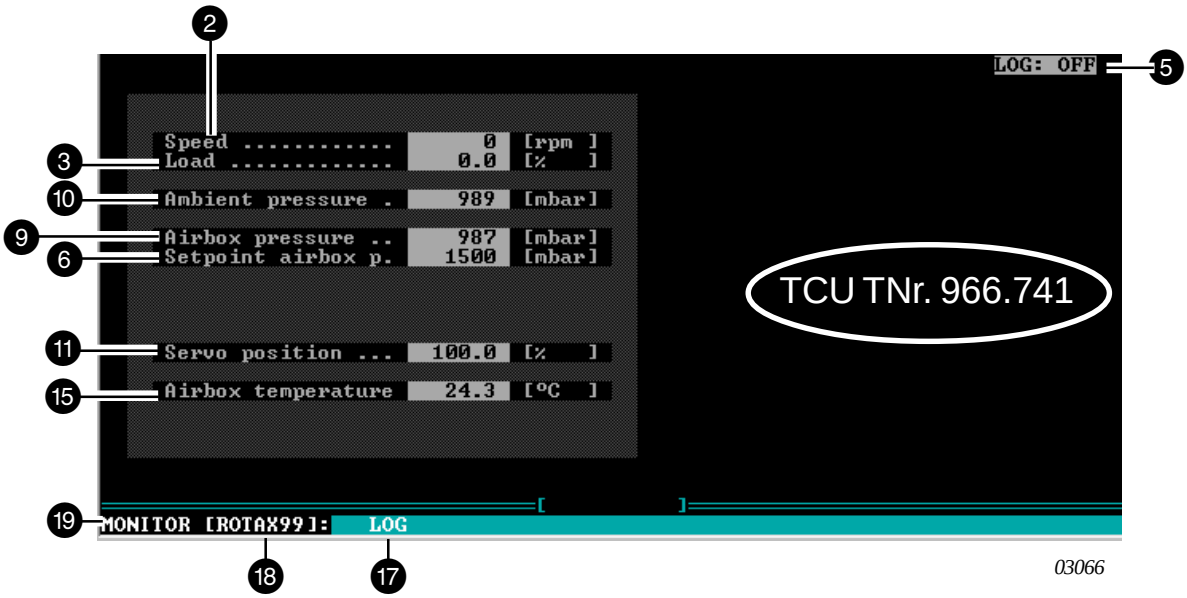
"/ERROR: Serial I/O Continue with any key..."

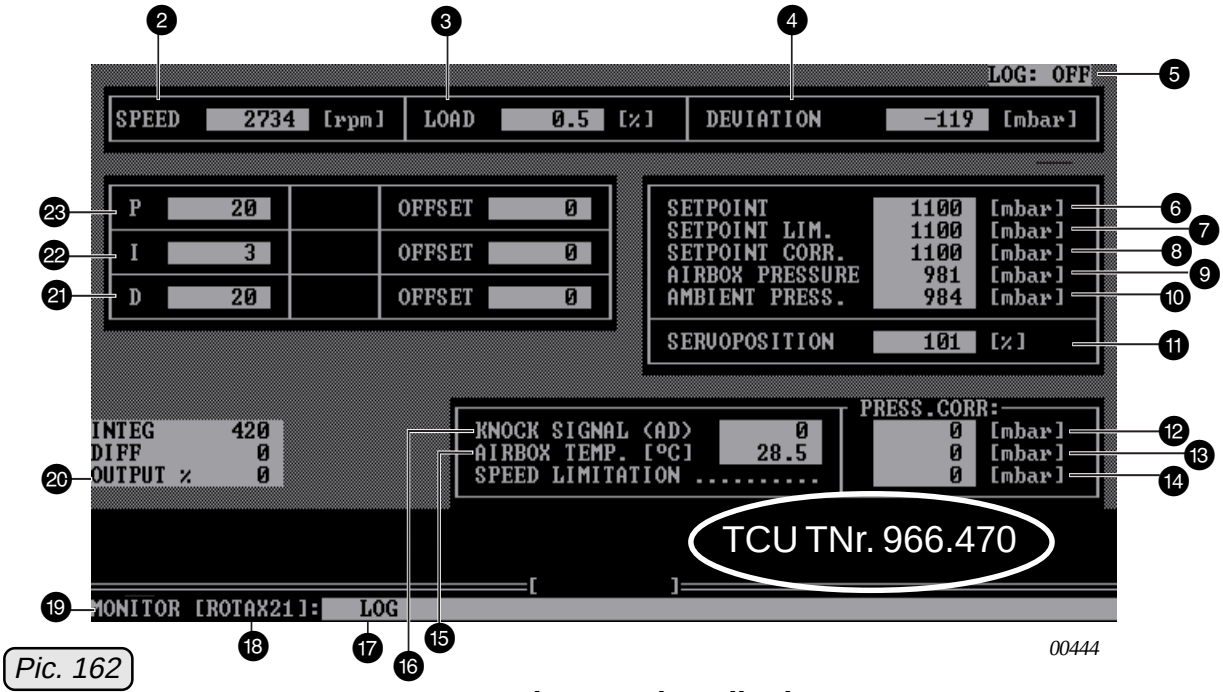
should appear in the last line ❶ a connection between TCU and computer is interrupted. Checking of all plug connections between TCU and computer is necessary. In addition verify voltage supply to TCU.

Rectify any detected interruption between TCU and computer and switch "OFF" and "ON" TCU power supply.



Pic. 161





Pic. 162

Legend to monitor display

❷ **engine speed**

❸ **throttle position**

❹ pressure deviation of ❽ and ❾

❺ LOG-state ON/OFF

❻ target pressure input on basis of throttle position

❼ target pressure input on basis of pressure ratio between ❾ and ❿

❽ effective target pressure input (possibly reduced for instance by excessive speed, airbox temperature or too high pressure ratio)

❾ **airbox pressure**

❿ **atmospheric pressure**

⓫ servo position

⓬ not active

⓭ target pressure reduction by exceeding of the max. airbox temperature

⓮ target pressure reduction by excessive engine speed

⓯ **airbox temperature**

⓰ knocking signal: not active

⓱ logging ON/OFF

⓲ software-version

⓳ program designation

⓴ servo-output %

㉑ D-factor

㉒ I-factor

㉓ P-factor

◆ NOTE: Because of the multitude of indications, parameters important for the user are printed in bold type and underlined.

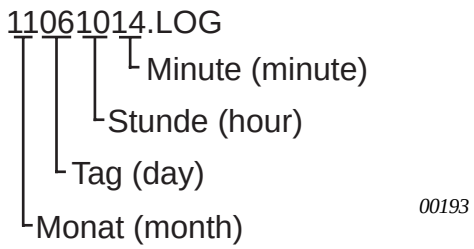
MONITOR: Serves for the on-line display of operational engine data such as airbox pressure, atmospheric pressure, servo position, airbox temperature etc.

LOG: Is a submenu ⓲ of the monitoring program and facilitates recording of the relevant operational data on the hard disk of the connected PC.

The logging will be actuated and stopped by pressing the key **L**. The logging state will be indicated by "ON" for on-line recording and "OFF" respectively for non-recording (see Pic. 162, item ❺).

As so-callded Log-file will be loaded on a **hard disk** stating date and starting time of the recording.

Example:



◆ NOTE: Verify this date and starting time at start of the PC.

Use at MS-DOS level the commands

C:\> **DATE [Enter]** and

C:\> **TIME [Enter]**

and up-date as per input command date and time.

If more than 4000 data lines are recorded the current LOG file will be closed automatically and a new one opened.

Subsequent to recording the data can be stored on a diskette or printed for evaluation.

⇨ data transfer to diskette:

with the command

C:\914\progxx> **DIR*.log [Enter]**

read list of sub directory on MS-DOS Monitor.

After finding the requested LOG file, data can be transferred to diskette by command line

C:\914\progxx\>**COPY␣C:\FILE-Name␣A:**

e.g.11061014.log

The thereby established LOG-files are text files which can be used for further data editing in text- and table-calculation programs.

The Pic. 163 shows for instance usage of data on an EXCEL-table.

time PC (hh:mm:ss)	speed (1/min)	load throttle (0-115%)	pressure difference (mbar)	nominal pressure (mbar)	actual pressure (mbar)	ambient pressure (mbar)	servo position (0 - 100 zu)	knocking	airbox (°C)	P-factor	I-factor	D-factor	output servo (+/-100)
16:53:01	2388	3,3	-123	1100	977	978	100	500	27,6	20	3	80	0
16:53:01	2384	3,3	-123	1100	977	978	100	495	27,6	20	3	80	0
16:53:02	2386	3,3	-123	1100	977	978	100	495	27,6	20	3	80	0
16:53:02	2369	3,3	-122	1100	978	978	100	528	27,6	20	3	80	0
16:53:02	2387	3,3	-122	1100	978	978	100	526	27,6	20	3	80	0
16:53:02	2388	3,3	-122	1100	977	978	100	526	27,6	20	3	100	0
16:53:02	2387	3,3	-123	1100	977	978	100	521	27,6	20	3	80	0
16:53:03	2377	3,3	-123	1100	977	978	100	522	27,6	20	3	80	0
16:53:03	2375	3,3	-122	1100	978	978	100	516	27,6	20	3	80	0
16:53:03	2376	3,3	-122	1100	978	978	100	518	27,6	20	3	80	0
16:53:03	2385	3,3	-122	1100	978	978	100	521	27,6	20	3	80	0
16:53:03	2375	3,3	-123	1100	977	978	100	517	27,6	20	3	80	0
16:53:03	2369	3,3	-123	1100	977	978	100	516	27,6	20	3	80	0
16:53:04	2386	3,3	-123	1100	977	978	100	497	27,6	20	3	80	0
16:53:04	2391	3,3	-123	1100	978	978	100	497	27,6	20	3	80	0
16:53:04	2386	3,3	-122	1100	978	978	100	530	27,6	20	3	80	0
16:53:04	2394	3,3	-123	1100	977	978	100	524	27,6	20	3	80	0
16:53:04	2371	3,3	-123	1100	977	978	100	523	27,6	20	3	80	0
16:53:05	2373	3,3	-123	1100	977	978	100	521	27,6	20	3	80	0
16:53:05	2368	3,3	-122	1100	978	978	100	520	27,6	20	3	80	0
16:53:05	2396	3,3	-122	1100	978	978	100	517	27,6	20	3	80	0
16:53:05	2384	3,3	-122	1100	978	978	100	516	27,6	20	3	80	0
16:53:05	2384	3,3	-123	1100	977	978	100	510	27,6	20	3	80	0
16:53:05	2386	3,3	-123	1100	977	978	100	511	27,6	20	3	80	0
16:53:06	2387	3,3	-122	1100	978	978	100	527	27,6	20	3	80	0
16:53:06	2384	3,3	-122	1100	978	978	100	504	27,6	20	3	80	0
16:53:06	2391	3,3	-123	1100	977	978	100	523	27,6	20	3	80	0
16:53:06	2380	3,3	-123	1100	977	978	100	518	27,6	20	3	80	0
16:53:06	2391	3,3	-123	1100	977	978	100	517	27,6	20	3	80	0
16:53:06	2373	3,3	-122	1100	978	978	100	513	27,6	20	3	80	0
16:53:07	2376	3,3	-123	1100	977	978	100	512	27,6	20	3	80	0
16:53:07	2392	3,3	-123	1100	977	978	100	533	27,6	20	3	80	0
16:53:07	2372	3,3	-122	1100	978	978	100	524	27,6	20	3	80	0
16:53:07	2371	3,3	-122	1100	978	978	100	502	27,6	20	3	80	0
16:53:08	2365	3,3	-122	1100	978	978	100	501	27,6	20	3	80	0
16:53:08	2368	3,3	-123	1100	977	978	100	520	27,6	20	3	80	0
16:53:08	2369	3,3	-123	1100	977	978	100	520	27,6	20	3	80	0
16:53:08	2362	3,3	-123	1100	978	978	100	503	27,6	20	3	80	0
16:53:08	2382	3,3	-122	1100	978	978	100	502	27,6	20	3	80	0

00475

❷ ❸ ❹ ❻ ❾ ❿ ⓫ ⓰ ⓯ ㉓ ㉒ ㉑ ⑳

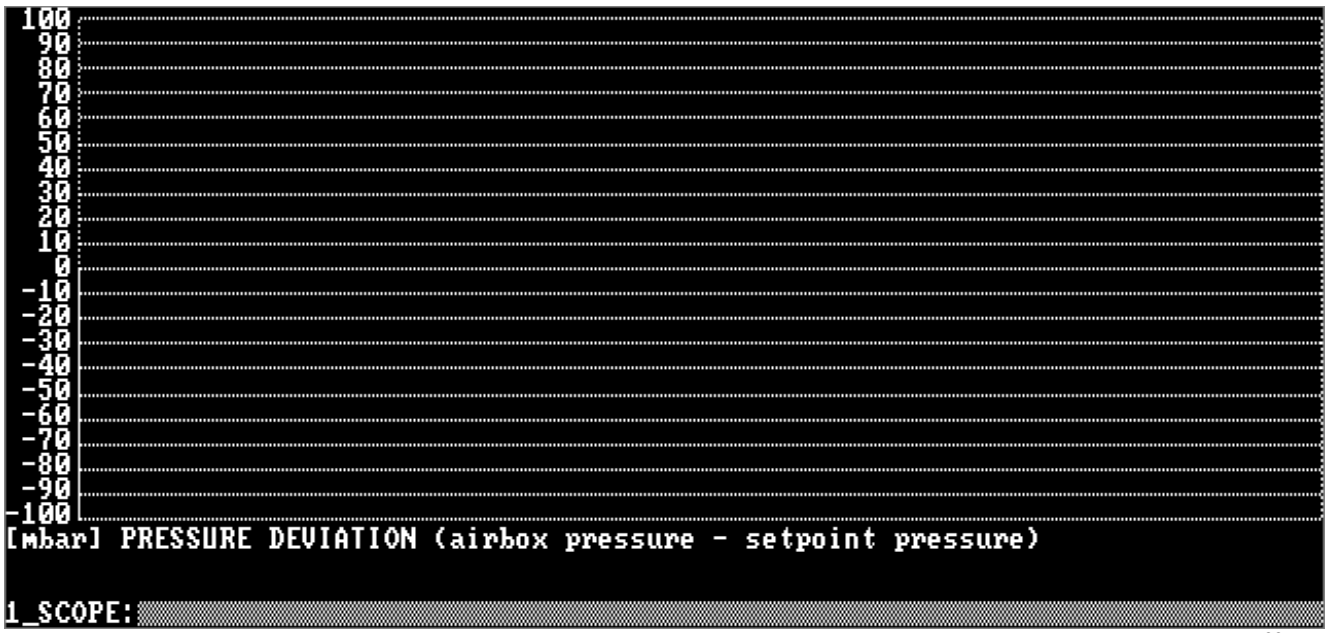
For above numbering see also monitor display.

Pic. 163

◆ NOTE: The Pic. 163 shows an EXCEL-table of the program version TLR V4.3A.

1_SCOPE: For on-line display of the control action with regard to pressure deviation (airbox pressure to target pressure) in the range of ±100 hPa (mPa).

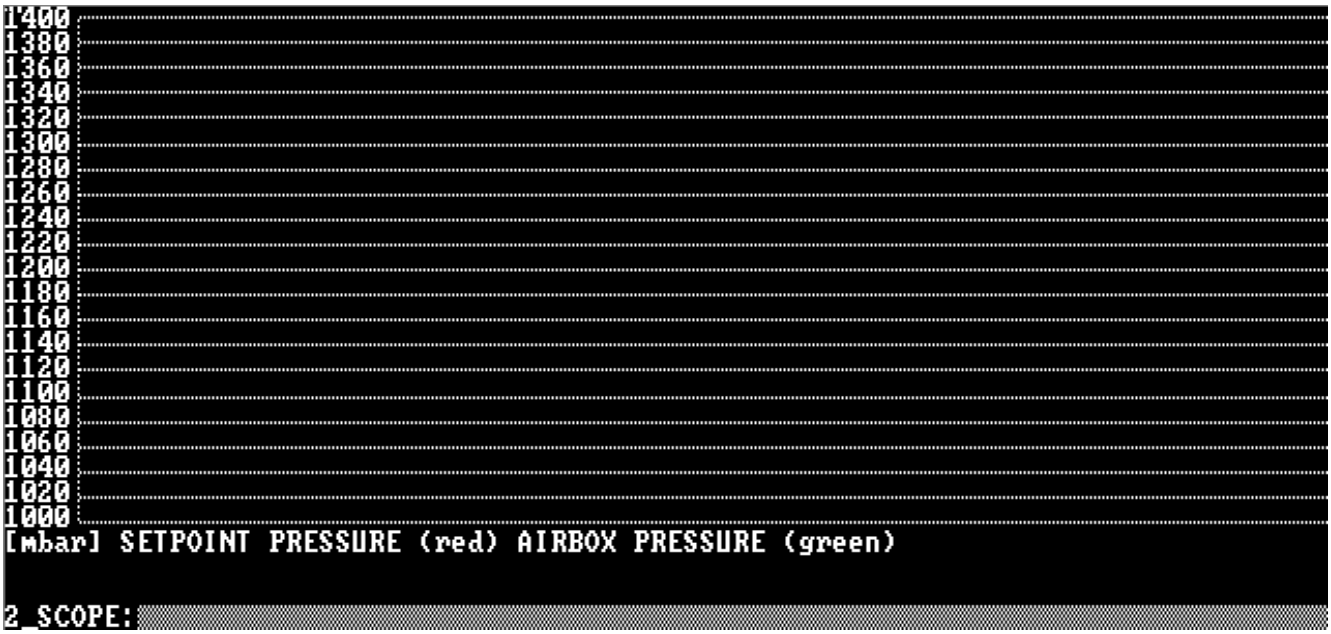
The program is for graphic evaluation of the parameters ❽ and ❾ in the monitor program.



Pic. 164 *00194*

2_SCOPE: For on-line display of the control action between target pressure and effective airbox pressure in the range of 1000 to 1400 hPa (mPa).

The program is for graphic evaluation of the parameters ❽ and ❾ in the monitor program.



Pic. 165 *00195*

➪ **Data display**

See Pic. 166/167/168/169 and 170.

HISTORY_PUFFER: Is a sub program for reading, display and printing of data stored in the TCU. Pic. 168 shows that 8 control parameters are displayed.

00199

Pic. 166

The display takes place in 6 minute intervals whereby the highest value of each period will be stored.

READ_DATA: Reads data such as serial number, time of operation and the latest transmitted engine data from the storage in the TCU. At reaching 100 % the reading is complete.

00200

Pic. 167

◆ NOTE: If this command should be carried out during establishing of a LOG file the error message "SERIAL ACCESS DENIED" will appear. In this case repeat the reading procedure.

VIEW_DATA: Shows the file data deduced from READ_DATA on the screen. The keys "page up" ↑ and "page down" ↓ enable paging on the screen.

```
TLR                                                BOMBARDIER-ROTAX/conTec
Serial Number        :     500
Hours of Operation   :     564.1

----------------------- Intervall Memory -----------------------

  Channel   Input                      Unit/Range

    1       SPEED                      [Rpm]
    2       LOAD (Throttle-Pos.)       [%]
    3       AIR_PRESSURE               [mbar]
    4       AIRBOX_PRESSURE            [mbar]
    5       AIRBOX_TEMPERATURE         [°C]
    6       SERVO_POSITION             [%]
    7       KNOCK_A/D_VALUE            [0..1023]
    8       BOOST_TIME                 [s]

 Mode/Time[h]/Ch.    1     2     3     4     5     6     7     8

 0    564.0          0     0   985  1249    28    -1     0     0

VIEW:                                          <cursor/page-up/down>
```

00201

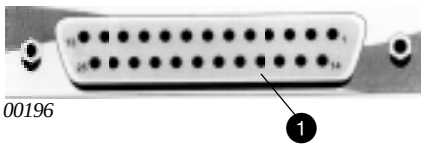
Pic. 168

PRINT_DATA: Option to print data deduced from READ_DATA.

```
TLR                                                BOMBARDIER-ROTAX/conTec
Serial Number        :     500
Hours of Operation   :     564.1

----------------------- Intervall Memory -----------------------

  Channel   Input                      Unit/Range

    1       SPEED                      [Rpm]
    2       LOAD (Throttle-Pos.)       [%]
    3       AIR_PRESSURE               [mbar]
    4       AIRBOX_PRESSURE            [mbar]
    5       AIRBOX_TEMPERATURE         [°C]
    6       SERVO_POSITION             [%]
    7       KNOCK_A/D_VALUE            [0..1023]
    8       BOOST_TIME                 [s]

 Mode/Time[h]/Ch.    1     2     3     4     5     6     7     8

 0    564.0          0     0   985  1249    28    -1     0     0
```

00205

Pic. 169



00196

Pic. 170

◆ NOTE: The Pic. 168 and 169 show the program version TLR V4.3A.

◆ NOTE: The printer has to be connected with the PC via a parallel interface ❶.

d) End of program

⇨ With "**Q**" for QUIT stop communication program

⇨ **Turn off the TCU**

⇨ **Disconnect wiring. Store Dongle properly**

⇨ **Switch off PC**

13.6.1.5) Checking the items of turbo charger control

By use of the communication program shortcomings of the components can be quickly detected on the sub program "MONITOR".

◆ NOTE: The respective error detection chart is available at request from the authorized distributor. See chapter 17.

Blank page

13.6.1.6) Checking of the throttle position

See Pic. 172 and 173.

➪ Start-up of the sub program MONITOR.

Program version TLR V4.3A *00445*

Program version TLR V4.6A *03066*

Pic. 172

Throttle position is displayed in the middle of the top line ❶ (carb 2/4)

0 % ➪ **throttle completely closed**

115 % ➪ **throttle fully open**

➪ visually check whether the throttle on both carburetors can be fully opened and closed. If necessary correct the installation setting.

00214

00215

Pic. 173

➪ check of the display with throttle completely closed:
nominal: 0° tolerance +3%

➪ check of the display with throttle fully open:
nominal: 115 % tolerance -2%

■ ATTENTION: Check whether indication is **linear over the complete range** from 0% to 115% i.e. the 115% position is not indicated before throttle is fully open.

➪ Check of the display at max. continuous power.

■ ATTENTION: Throttle lever must be in positive stop position.

nominal: 100 % tolerance +3%.

▲ WARNING: This check of position is only meaningful and allowed, if idle- and full throttle-position are within the allowance variation.

If the throttle position for idle and full throttle are not within the allowance or if not proceeding linear, then a new calibration of the throttle position is absolutely necessary. Recalibration exclusively by an authorized ROTAX-Dealer or his Service Center if the TCU is of part no. 966.470.

If TCU 966.741 is used than proceed with calibration as per the following section.

13.6.1.7) Calibration of the throttle position

See Pic. 173/1, 173/2 and 173/3.

- ⇨ Start up of the sub program THROTTLE.
- ⇨ Check whether the throttle (carb 2/4) can be fully opened and closed. Verify that the Bowden cables allow the complete travel from stop to stop.
- ⇨ Follow the directives on the display, i.e.:
- ⇨ Close the throttle completely (carb 2/4) and confirm with ENTER.

Pic. 173/1

03071

- ⇨ Fully open the throttle (carb 2/4) and confirm with ENTER.

Pic. 173/2

03072

- ⇨ Calibration data will be transferred automatically and the calibration takes place.

Pic. 173/3

03073

- ⇨ Verification of the throttle position as per section 13.6.1.6).

13.6.2) Static check of the turbo charger control

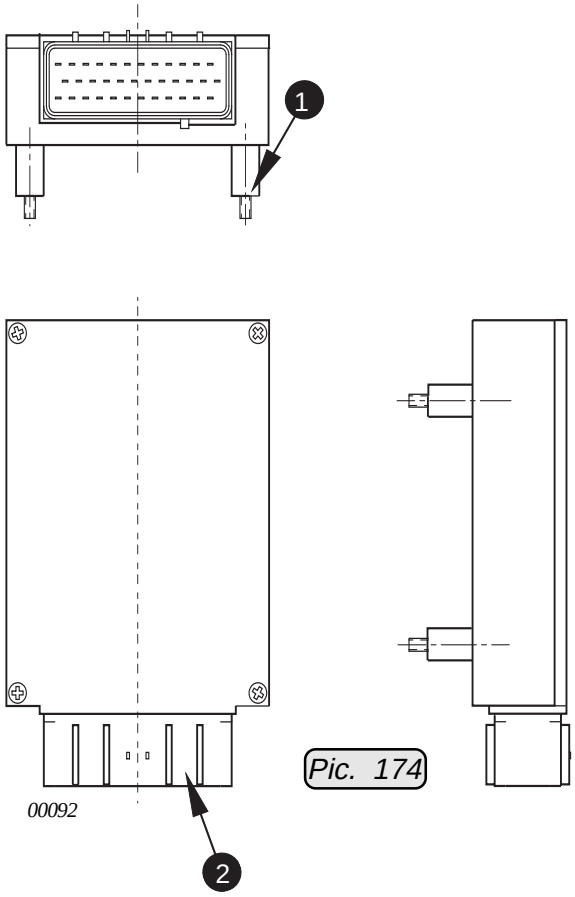
The easiest way to check function of turbo control items is by the communication program. If this program is not at your disposal, the following static checks of the sensors can be performed.

◆ NOTE: Visual inspection of all components.

13.6.2.1) Turbo control unit (TCU)

See Pic. 174.

Location of installation may vary depending on type of aircraft and is limited by the length of the wiring harness.



Pic. 174

⇨ Inspection for physical damage.

⇨ Inspection of the 4 rubber mounts ❶ with regard to damage, detrimental for vibration damping.

⇨ Check of the 36-pole plug receptacle ❷.

▲ WARNING:

The TCU must never be opened.

■ ATTENTION:

Exchange TCU without delay at physical damage or incorrect operation.

Further shortcomings can only be detected in correlation with the respective component of the turbo control unit.

■ ATTENTION: In case of renewal of the TCU, checking of the throttle position by the communication program will be necessary. See chapter 13.6.

If this aid is not at disposal, a trial run of the engine is required. See chapter 12.3.22. **Engine operation is only allowed for transfer to the nearest service place**, where this check has to be conducted afterwards.

13.6.2.2) Warning lights

See Pic. 175.

The TCU is furnished with output terminals for an external **red** warning lamp and an **orange** caution lamp.

Location of the lamps depends on type of aircraft and is limited by the length of the wiring harness. Standard location is on the instrument panel.

When switching on the voltage supply of the TCU the function of the two lamps is automatically checked. For approx. 1 to 2 seconds both lamps light up and then extinguish. If this should not happen check the following:

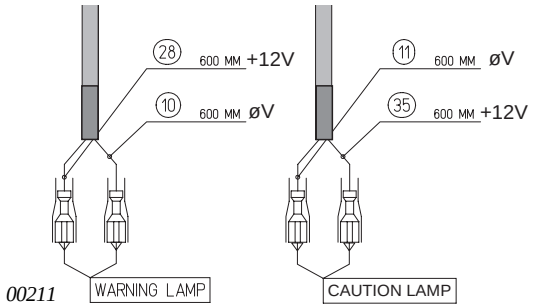
⇨ Inspection for physical damage

⇨ Verify connection of cable harness

⇨ Check warning lamps for function

◆ NOTE: The two warning lamps are not in the supply volume of engine.

Pic. 175



■ ATTENTION: Exchange any part with physical damage or if not operating correctly, without delay.

13.6.2.3) Wiring harness

See Pic. 176.

The sensors are connected with the TCU via the wiring harness.

The easiest way to check function of turbo control components is by the communication program. If this program is not at your disposal, the following static checks of the sensors can be performed.

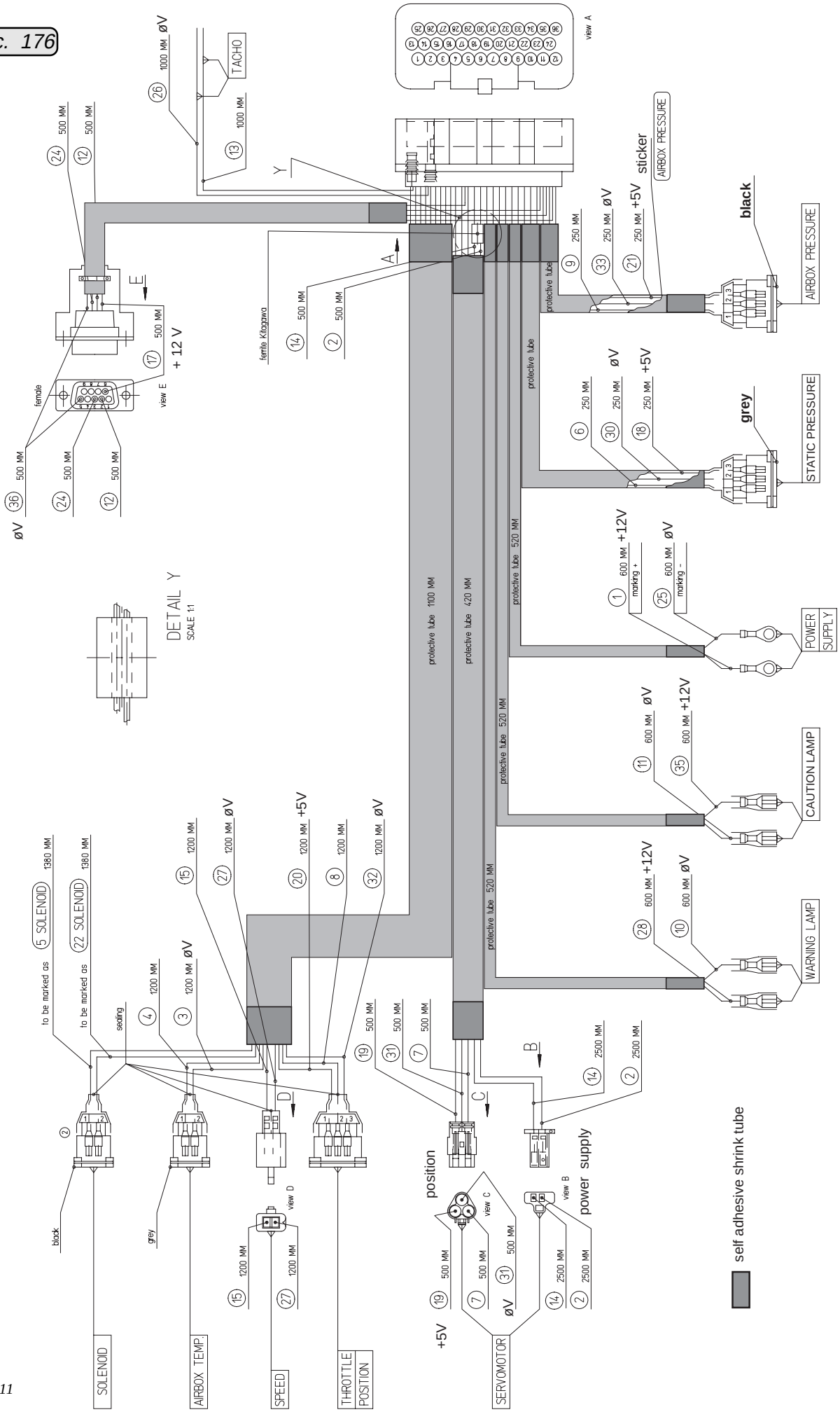
⇨ For verification and error detection check all interconnections for continuity and physical damage. See Pic. 176.

⇨ Verify tight fit of all plug connections.

■ ATTENTION: Parts physically damaged or of not correct function have to be exchanged without delay. Repair on one's own authority is not allowed.

◆ NOTE: Pic. 176 contains a lot of information. Besides the wiring designations, plugs allocation, cable length, the polarity of the voltage supply to the single components is stated, too.

Pic. 176



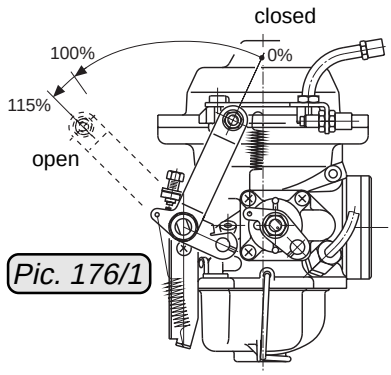
Modification no.	Reference	Main	Date	Page
- 0 -		914 F	1997 02 01	213

13.6.2.3.1) Throttle position potentiometer

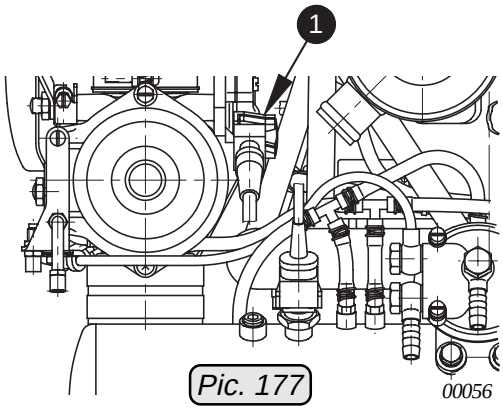
See Pic. 176/1,177,178,178/1,179 and 180.

The throttle position potentiometer ❶ is installed on CD carburetor 2/4.

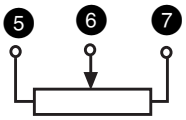
The turning range when installed is from 0% - 115%. See Pic. 176/1 and consult description of system chapter 9.5.



Pic. 176/1

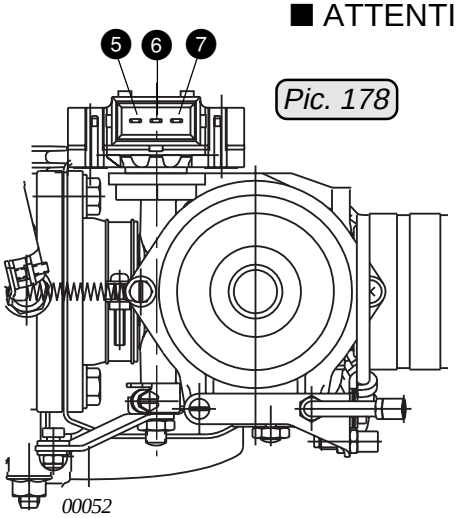


Pic. 177



For resistance measuring unplug connection with wiring harness but reconnect straight after completion of check and verify tight fit and engagement of catch.

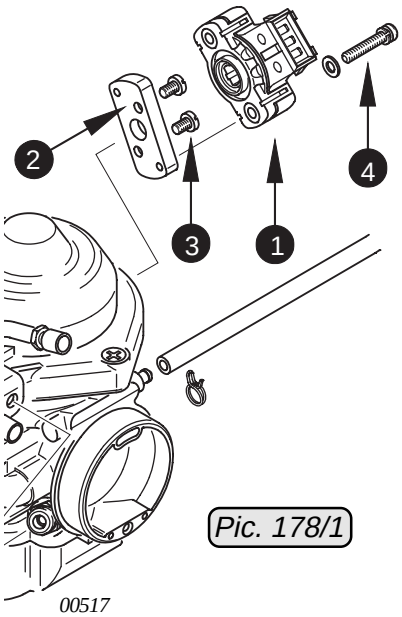
■ ATTENTION: If the throttle position potentiometer was removed from carburetor for checking, then verification of the throttle position by the communication program will be necessary. See chapter 13.6.



Pic. 178

If this aid is not available, a trial run has to be conducted. See chapter 12.3.22. **Engine operation is only allowed for transfer to the nearest service place**, where this check has to be performed afterwards.

◆ NOTE:
Removal of the intermediate flange ❷ is not necessary, it would only increase fitting tolerances.



Pic. 178/1

At installation of the throttle position potentiometer ensure that it engages easily on flat of throttle shaft. Secure cheese hd. screws M4x7 ❸ and combi screws M4x22 ❹ with LOCTITE 221 and mark combi screw with paint.

◆ NOTE: Small installation tolerances can be compensated by turning of the throttle position potentiometer. Refer to chapter 13.6.16). Otherwise new calibration will be necessary.

➪ check for physical damage

➪ checking for nominal resistance

Measure resistance between terminals ❺ and ❼.

Nominal resistance: 3,2 ÷ 4,8 kΩ

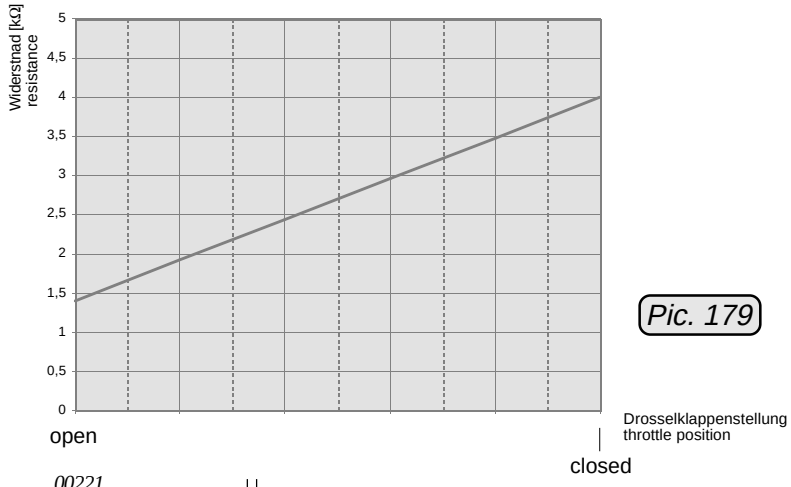
➪ Measuring of resistance across turning range of fitted throttle.

To check the function of the throttle position potentiometer over operating range take the following readings:

Resistance between the terminals ❻ and ❼:

Throttle **closed** (throttle lever pos. 0%):3,4 ÷ 4,6 kΩ

Throttle **open** (throttle lever pos. 115%): 0,8 ÷ 2,0 kΩ



Pic. 179

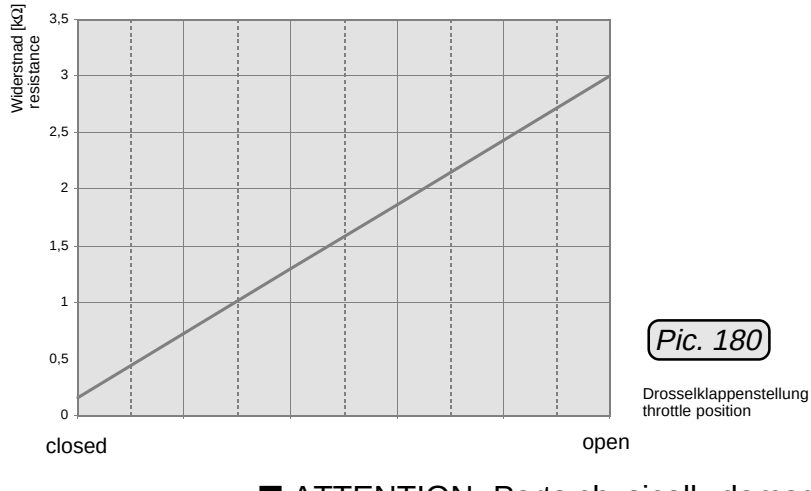
◆ NOTE:

Check complete operating range as per diagram (Pic. 179) for linear resistance progress.

Resistance between the terminals ❺ and ❻:

Throttle **open** (throttle lever pos. 115%): 2,4 ÷ 3,2 kΩ

Throttle **closed** (throttle lever pos. 0%): 100 ÷ 300 Ω



Pic. 180

◆ NOTE:

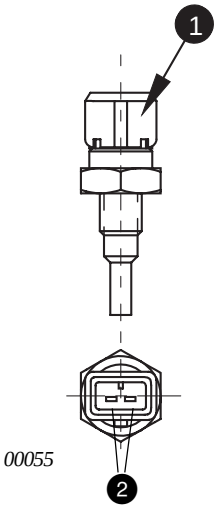
Check complete operating range as per diagram (Pic. 180) for linear resistance progress.

■ ATTENTION: Parts physically damaged or of not correct function have to be exchanged without delay.

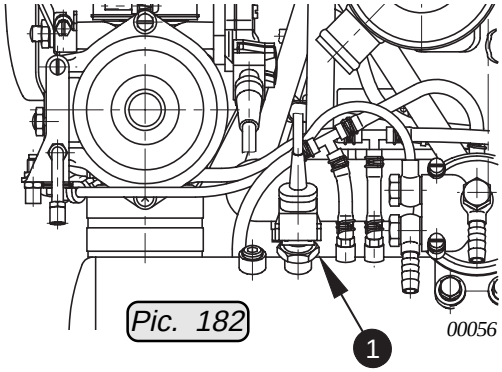
13.6.2.4) Resistance thermometer (Intake air temperature sensor)

See Pic. 181,182 and 183.

The sensor ❶ for measuring intake air temperature is screwed into airbox.



Pic. 181

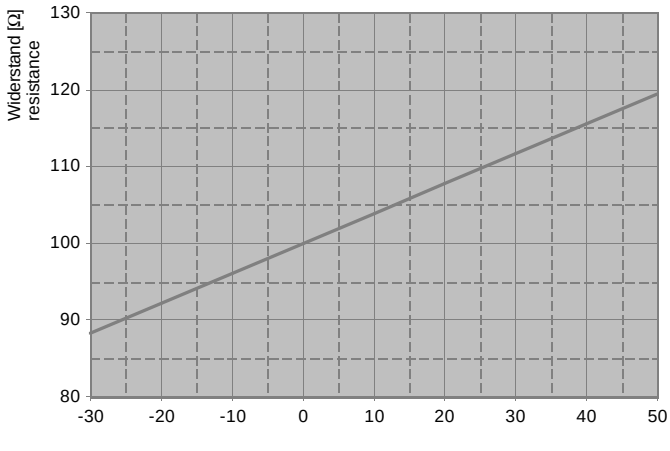


Pic. 182

➩ Inspect for physical damage

➩ Measuring of the resistance:

- sever plug connection to wiring harness and re-establish connection straight after readings were taken and verify tight fit of plug and engagement of catch
- measure resistance between the two terminals ❷ and compare with relevant resistance/temperature chart below.



Pic. 183

00223

Allowance for resistance: max ±1%

■ ATTENTION: At physical damage or readings outside allowance exchange sensor without delay.

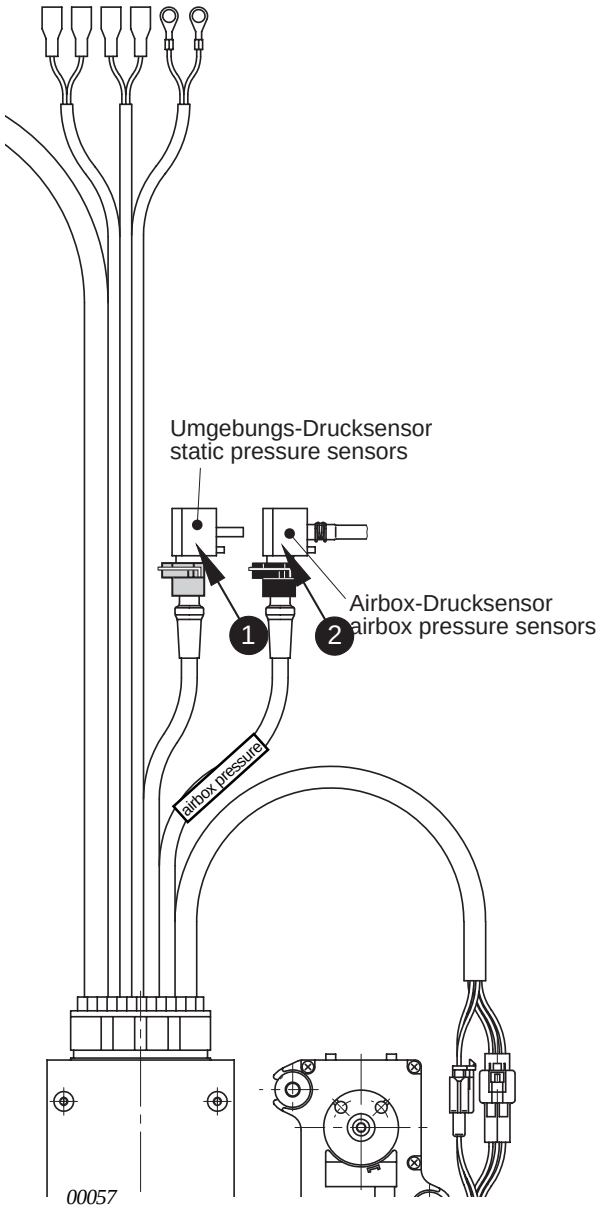
At fitting of the resistance thermometer secure with LOCTITE 221 and tighten to 20 Nm (180 in.lb).

13.6.2.5) Pressure sensors

See Pic. 184.

◆NOTE: To prevent any mix-up of the two pressure sensor inputs the plug connections are fashioned in different colours and the air box temperature sensor cable is labelled additionally.

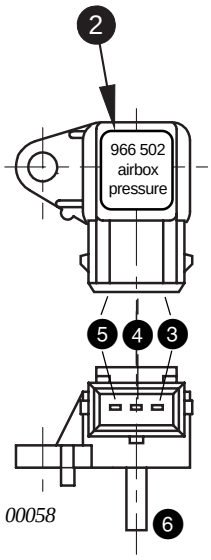
grey plug connection ❶	➪	**static pressure sensor**
black plug connection ❷	➪	**airbox pressure sensor**



Pic. 184

a) Airbox pressure sensor:

See Pic. 185 and 185/1.



Pic. 185

The location of the airbox pressure sensor ❷ depends on type of aircraft but is limited by the length of the wiring harness.

■ ATTENTION: The sensor is designed for a pressure range of 500 hPa to 2500 hPa and max. pressure must not exceed 3500 hPa.

If during the course of measuring the max. pressure is exceeded, the sensor has to be exchanged.

When taking the following readings the plug connection to the wiring harness has to be severed and straight after completion of checks re-established. The same applies for the air pressure hose.

The easiest way to check function of the two pressure sensors is by use of the communication program. If this program is not at your disposal, the following static checks can be carried out.

➪ Inspect for physical damage

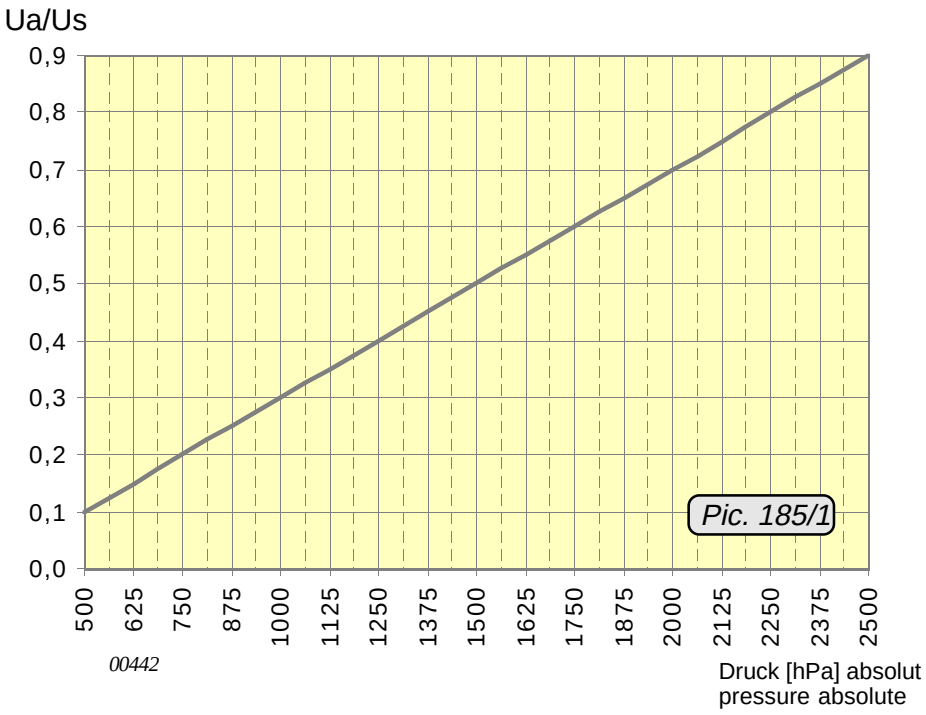
➪ Static check for function of airbox pressure sensor:

Allowcation of connections for test set-up / legend to Pic. 185

❸ Voltage output **Ua**
❹ Grounding **(øV)**
❺ Voltage supply **Us** min. + 3 V
max. + 15 V
❻ Pressure input

Test set-up

Connect pin ❹ to ground and connect pin ❺ with plus side of voltage supply **Us**. Let test pressure act upon sensor ❻. Take reading of voltage out put between pin ❹ und pin ❸.



Pic. 185/1

Divide the measured output voltage (Ua) by the supply voltage (**Us**).

◆ NOTE:
To calculate this pressure ratio is required since the diagram is effective over a voltage range and not just for a single voltage.

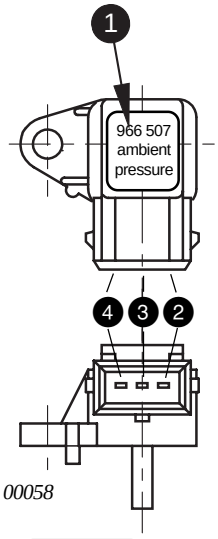
Enter this ratio on Ua/Us axis, go across. From intersection with the straight line follow down and read corresponding pressure.

Max. allowance ± 40 hPa

■ ATTENTION: At physical damage or readings outside allowance exchange sensor without delay.

b) Static pressure sensor:

See Pic. 186.



Pic. 186

The location of the static pressure sensor ❶ depends on type of aircraft, but is limited by the length of the wiring harness.

■ ATTENTION: The sensor is designed for a pressure range of 100 hPa to 1200 hPa and the max. pressure must not exceed 3500 hPa.

If during the course of measuring the max. pressure is exceeded, the sensor has to be exchanged.

When taking the following readings the plug connection to the wiring harness has to be severed and straight after completion of checks re-established. The same applies for the air pressure hose.

The easiest way to check function of the two pressure sensors is by use of the communication program. If this program is not at your disposal, the following static checks can be carried out.

⇨ Inspect for physical damage

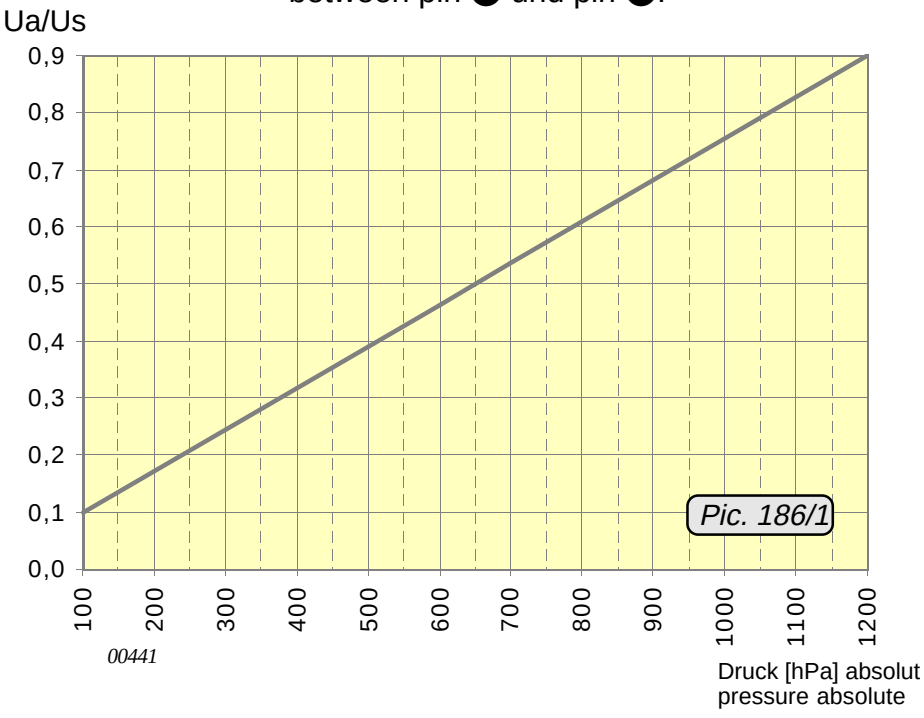
⇨ Static check for function of airbox pressure sensor:

Allowcation of connections for test set-up / legend to Pic. 185

❸ Voltage output **Ua**
❹ Grounding **(øV)**
❺ Voltage supply **Us** min. + 3 V, max. + 15 V
❻ Pressure input

Test set-up

Connect pin ❹ to ground and connect pin ❺ with plus side of voltage supply **Us**. Let test pressure act upon sensor ❻. Take reading of voltage out put between pin ❹ und pin ❸.



Pic. 186/1

Divide the measured out put voltage (Ua) by the supply voltage (**Us**).

◆ NOTE:
To calculate this pressure ratio is required since the diagram is effective over a voltage range and not jsut for a singel voltage.

Enter this ratio on Ua/Us axis, go across. From intersection with the straight line follow down and read corresponding pressure.

Max. allowance ± 60 hPa

■ ATTENTION: At physical damage or readings outside allowance exchange sensor without dealy.

13.6.2.6) Servo motor

See Pic. 187.

Place of installation of the servo motor ❶ depends on type of aircraft but is limited by the length of the wiring harness and servo cable length to waste gate.

➪ After switching on the TCU ensure that the automatic check of the servo motor is performed. During this auto test the complete operating range is traversed and afterwards the servo motor remains in position corresponding to throttle lever position.

➪ Check for physical damage

When taking the following readings the plug connection with the wiring harness has to be severed and straight after completion of check re-established.

➪ Verification of the **nominal resistance**:

Take the reading between terminal ❷ and ❹.

Nominal resistance: 4,4 ÷ 5,5 kΩ

➪ Measuring of the resistance with waste gate closed:

Check the following values with the throttle in 0% position:

Resistance between terminal ❷ and ❸:

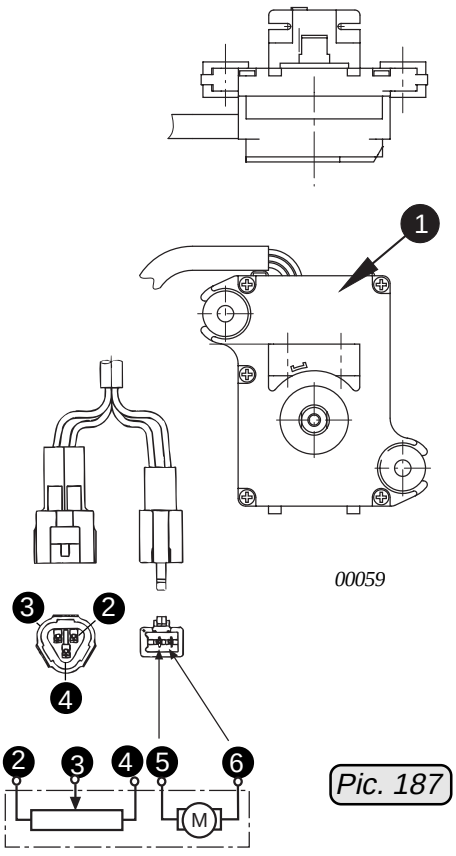
Resistance value: 0 ÷ 70 Ω

Resistance between terminal ❹ and ❸:

Resistance value: 4,6 ÷ 5,4 kΩ

➪ Checking between terminals for power supply ❺ and ❻:

Resistance: 5,0 ÷ 20,0 Ω



Pic. 187

■ ATTENTION: At physical damage or resistance readings outside allowance exchange servo motor without delay.

■ ATTENTION: At a renewal of the servo motor verification of the relevant values by use of the communication program (monitoring) is required. See chapter 13.6.

If this aid is not at your disposal, an engine trail run has to be performed. See chapter 12.3.22.

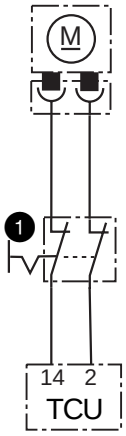
▲ WARNING: If at checking shortcomings arise, then the engine must not be taken in operation until trouble is found and rectified.

13.6.2.7) Circuit breaker for servo motor

See Pic. 188.

Place of installation of the circuit breaker ❶ depends on type of aircraft but is limited by the length of the wiring harness.

■ ATTENTION: The circuit breaker is not in the supply volume of the engine. Check circuit breaker according to directives of the aircraft builder.



00217

Pic. 188

⇨ Operational test of circuit breaker:

1) - circuit breaker closed

   - switch on TCU

   Automatic check of servo motor is performed.

2) - circuit breaker open

   - switch on TCU

   No automatic check of servo motor is conducted.

With the circuit breaker open the servo motor must not start turning. The orange caution lamp starts blinking.

■ ATTENTION: If the required boost pressure cannot be reached or if circuit breaking does not act correctly, find the reason. Until finding of trouble and rectifying, engine operation is only permitted for ground testing.

■ ATTENTION: At physical damage or incorrect operation exchange circuit breaker without delay.

13.6.2.8) Three-way solenoid valve

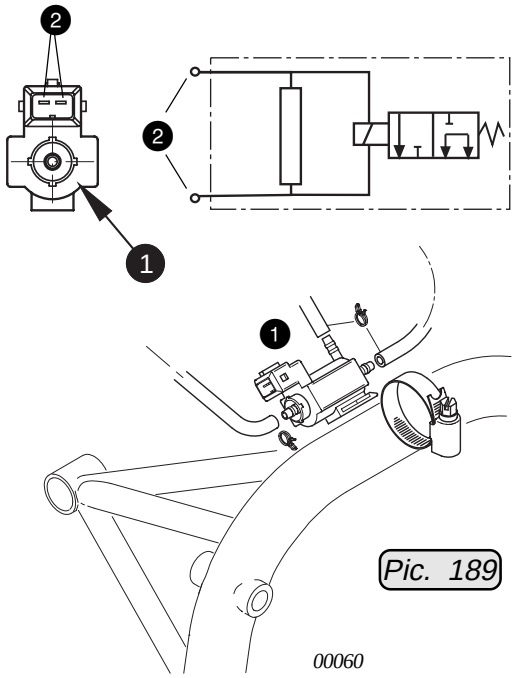
See Pic. 189.

The threeway solenoid valve ❶ is installed on engine frame.

➩ Check for physical damage

➩ check for air passage

For removal of the air pressure hoses refer to chapter 13.1.11.



Pic. 189

00060

➩ checking the mixture enrichment (dynamical)

For that fit a T-branch into line between solenoid valve and float chamber to facilitate the measuring by pressure gauge of the pressure rise at exceeding the airbox pressure of 1250 hPa. The T-branch may remain but for normal operation it has to be securely closed.

➩ Reading of resistance between the two terminals ❷ :

- Sever plug connection with wiring harness but re-establish straight after completion of check and verify tight fit and engagement of catch.
- resistance at 20°C: 28,3 ÷ 31,1 Ω

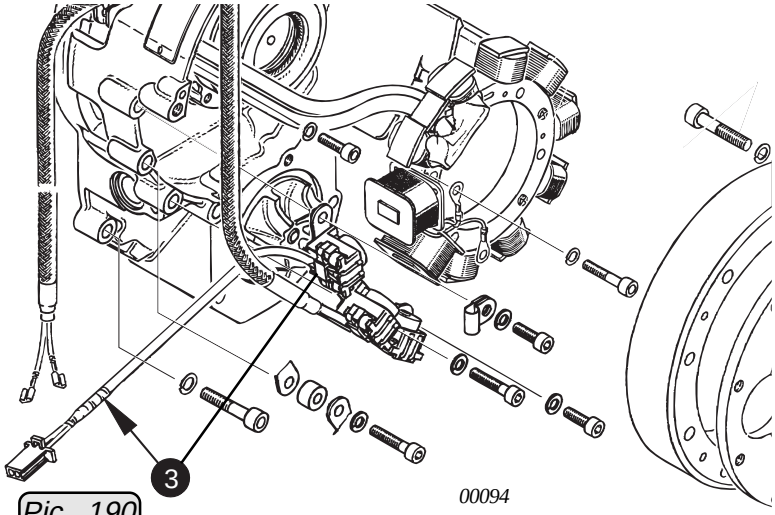
■ ATTENTION: At physical damage, mechanical defects or readings outside tolerance exchange the threeway solenoid valve without delay.

13.6.2.9) Trigger coils for electric rev-counter and ignition:

See Pic. 190 and 191.

◆NOTE: All 5 trigger coils are of equal design. Therefore this checking procedure is valid for the ignition trigger coils too.

The rev-counter trigger coil ❸ is fitted on ignition housing.



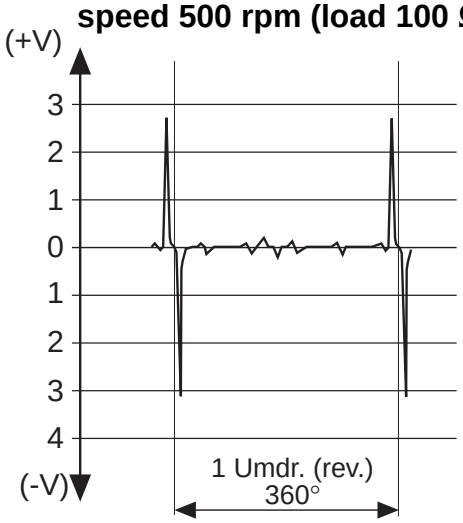
Pic. 190

➪ Inspect for physical damage

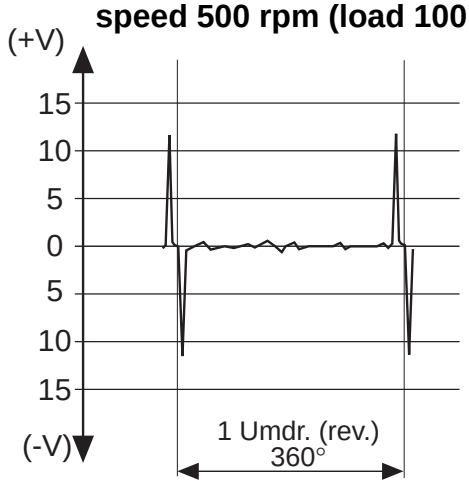
➪ Inspect all connections

■ ATTENTION: At physical damage or incorrect operation renew trigger coil without delay.

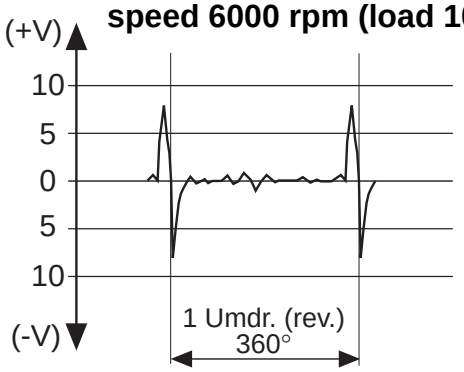
speed 500 rpm (load 100 Ω)



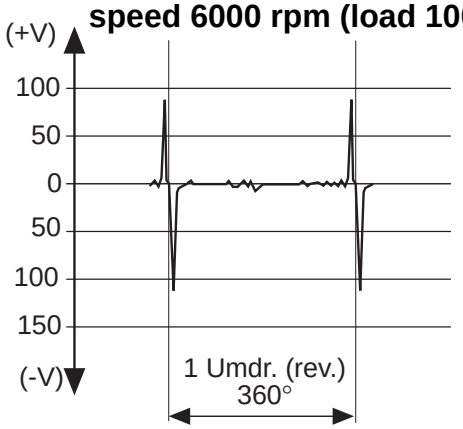
speed 500 rpm (load 100 Ω)



speed 6000 rpm (load 100 Ω)



speed 6000 rpm (load 100 Ω)



Pic. 191

00219

13.7) Temperature- and pressure observation

Besides the special checks, see chapter 12.4 and description of the systems find further maintenance precedures as follows.

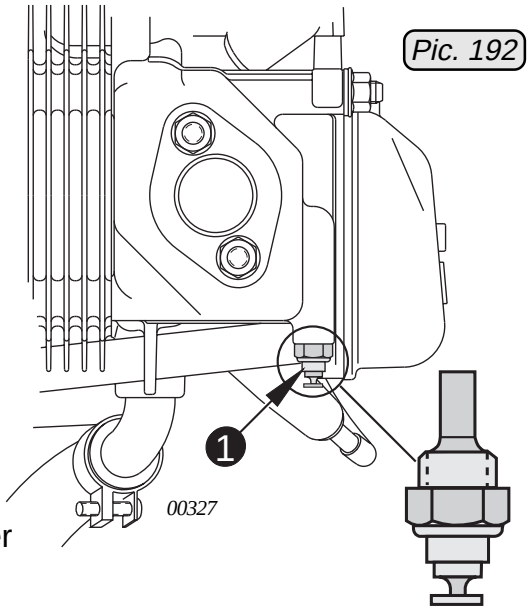
◆ NOTE: Several temperature control points are located on the Rotax engine 914 F. Refer to wiring diagram in Maintenance Manual.

13.7.1) Cylinder head temperature sensor

See Pic. 192 and 193.

The two temperature sensors ❶ are screwed into position on underside of cylinder head 2 and 3. At cylinder head temperature observation only temperature of cylinder head material but not of coolant is taken. The max. operating temperature must not be exceeded. At a rise above the limit check the following.

— cooling system
— temperature sensor
— indicating instrument
— wiring connections
— sensor cable



Pic. 192

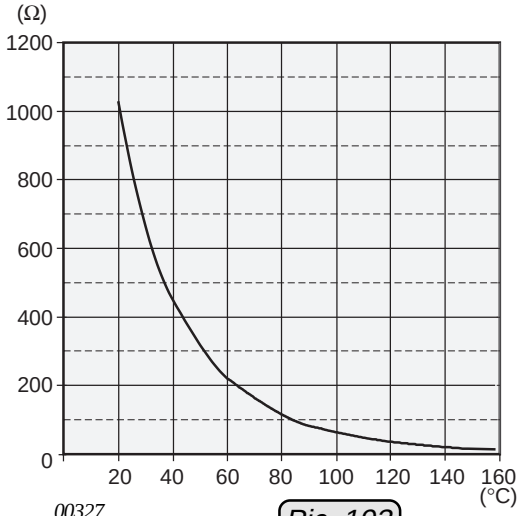
At engine operation with 100% anti-freeze concentrate (without adding water) possible formation of residues near sensor might result in too high temperature indication. Adding of approx. 20% water will rectify this fault.

◆ NOTE: Grounding connection of the sensor direct via the cylinder head.

For sensor resistance see graph below of sensor resistance over temperature.

deviation: max ± 10%

At installation secure temperature sensor with LOCTITE 221 and tighten to 10 Nm (90 in.lb).

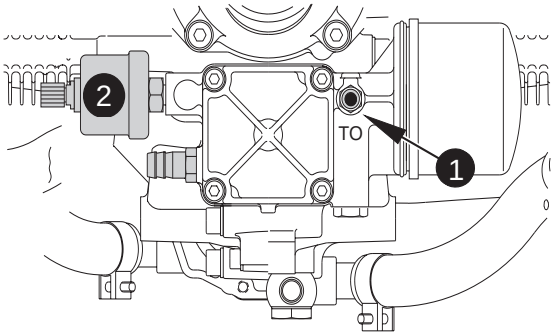


Pic. 193

13.7.2) Oil temperature sensor

See Pic. 194.

The sensor ❶ for oil temperature observation is screwed into oil pump housing. The sensor is a NTC resistor and identical with the two sensors for the cylinder head temperature.



00226

Pic. 194

The max. operating temperatures must not be exceeded. At temperature rise above the limit check the following:

— lubrication system

— temperature sensor

— indicating instrument

— wiring connections

— sensor cable

◆ NOTE: Grounding connection of the sensor direct via the oil pump housing.

At installation secure temperature sensor with LOCTITE 221 and tighten to 10 Nm (90 in.lb).

■ ATTENTION: Before exchanging a temperature sensor let the engine cool down first. Hazard of burning or scalds.

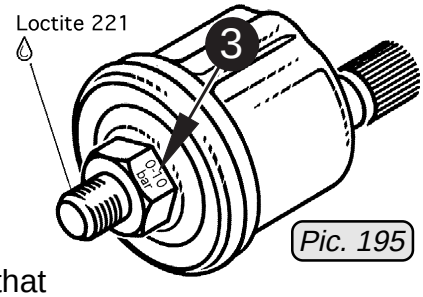
13.5.3) Oil pressure sensor

00228

See Pic. 194, 195 and 196.

The sensor ❷ for oil pressure observation is screwed into oil pump housing.

The range of the sensor is from 0 ÷ 10 bar. This range is clearly indicated on the hexagon ❸ of sensor.



Pic. 195

■ ATTENTION: It is absolutely necessary that the pressure range of the pressure gauge corresponds with the pressure range of the pressure sensor.

Non-correspondence would result in false oil pressure indication-check.

— lubrication system

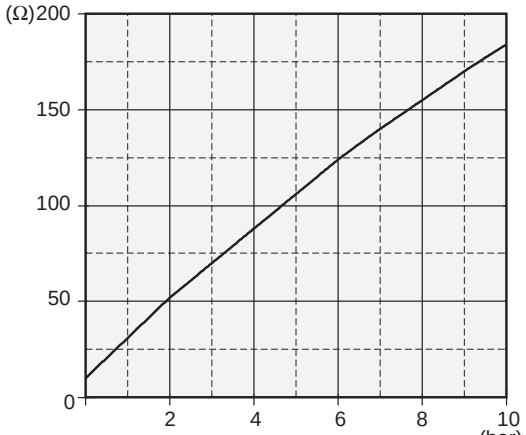
— oil pressure sensor

— pressure gauge

— wiring connections

— sensor cable

◆ NOTE: Grounding connection of the sensor direct via the oil pump housing.



00229

Pic. 196

For sensor resistance see graph above of sensor resistance over pressure. Compare pressure gauge with a calibrated instrument.

■ ATTENTION: The graph resistance over pressure has been determined, and is effective at the following conditions only.

ambient temperature: 20 °C
voltage: 12 V
deviation: max ± 5%

After removal of oil pressure sensor clean the thread. Secure new sensor with LOCTITE 221 and tighten to 15 Nm (133 in.lb).

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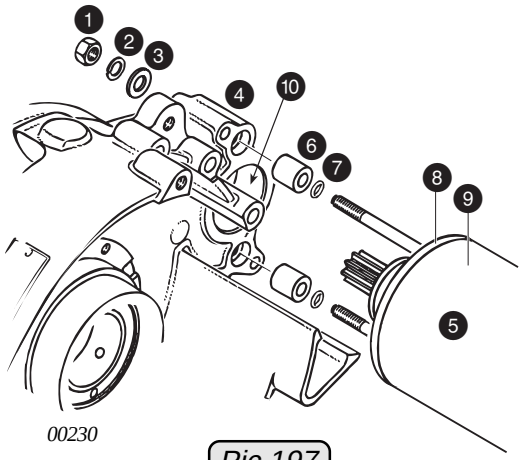
14) Maintenance of components

14.1) Electric starter

See Pic. 197.

Remove 2 hex. nuts M5 ❶ and lock washers ❷ from crankcase side of ignition housing. By loosening the strap clamp the electric starter ❸ can be removed. The electric starter is kept in position by 2 distance sleeves ❹ and O-rings ❺.



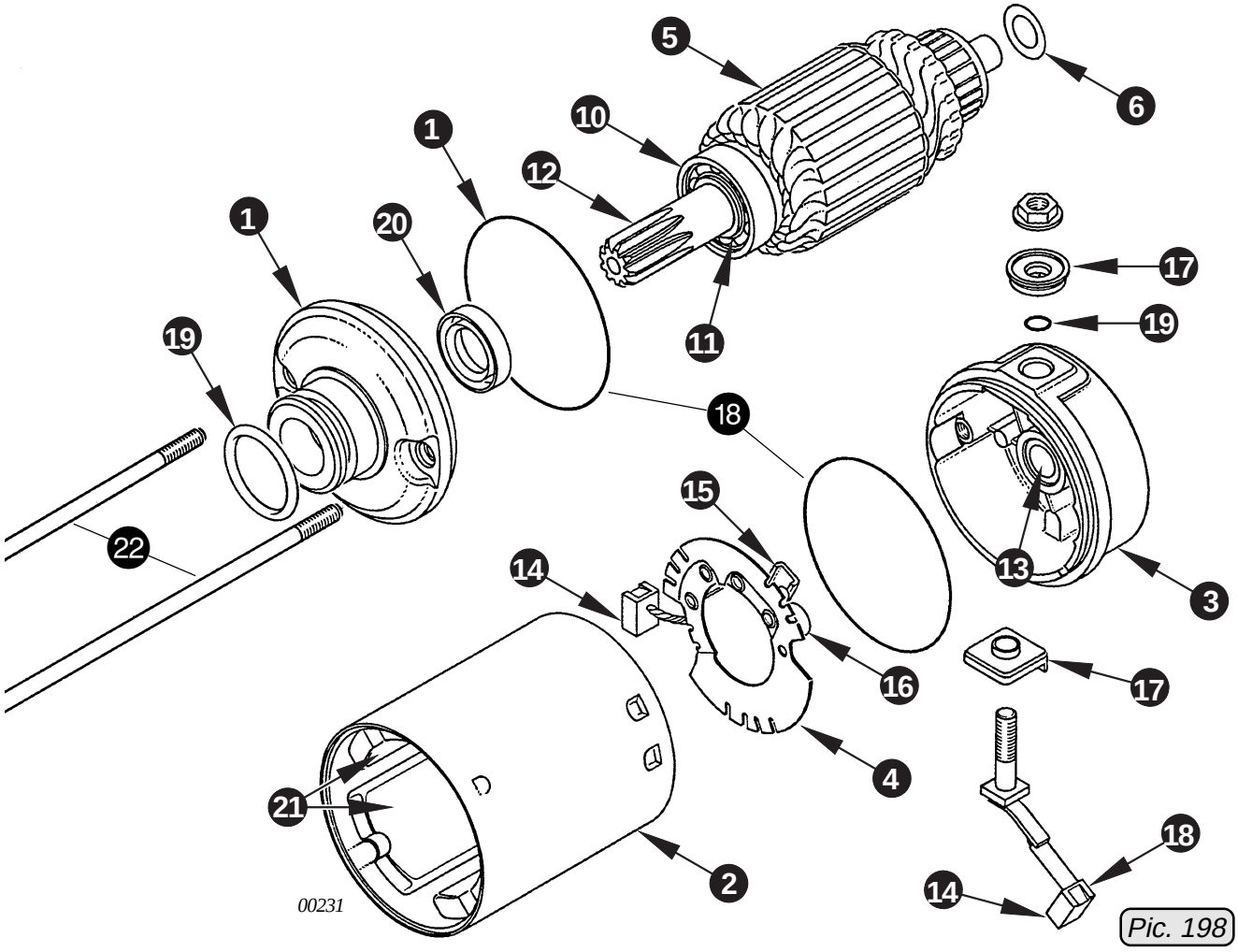
Pic.197

◆ NOTE: When withdrawing the electric starter from the ignition housing, hold supporting flange together with the starter housing and commutator bearing, to prevent the carbon brushes from jumping off the commutator.

14.1.1) Electric starter — disassembly

See Pic. 198.

Remove supporting flange ❶ from starter housing ❷. Withdraw commutator bearing ❸ from starter housing and remove carbon brush holder ❹ together with springs from armature ❺. Withdraw armature and thrust washer ❻ from starter housing. Clean parts carefully (see Chapter 11.7).



Pic. 198

14.1.2) Electric starter single parts — check

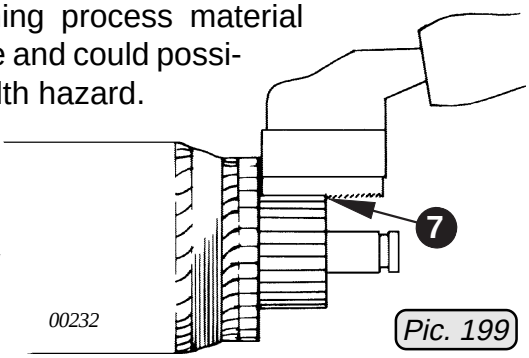
See Pic. 198, 199 and 200.

After dis-assembly of starter, check the following parts:

Armature

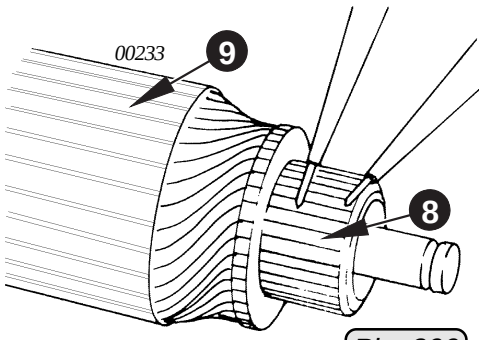
Clean commutator, check for straightness, check visually, and if need be, slightly machine and undercut segments ❼ (see Pic. below). The insulation should start 0,5 mm (0,02 in.) below face of segments.

▲ WARNING: During this machining process material particles are set free and could possibly be inhaled. Health hazard.



Pic. 199

Check armature at 12 or 24 Volt with test lamp between commutator ❽ and iron core ❾ for connection to ground. If the lamp lights up, renew armature. Check windings for interruption, utilizing 2 or 4 Volt supply and interconnected amperemeter (measuring range 60 A) (see Pic. 200). The armature has to be renewed if the ampere readings differ essentially between single segments. If the armature shows heavy signs of overheating, renew it.



Pic. 200

Check ball bearing ❿ 6002 Z. At renewal, fit it with closed side facing towards middle of armature (open side ⓫ facing outward). Inspect teeth ⓬ and radial clearance of armature shaft bearing ❸.

Bearings

Check bearing sleeve ⓭ in commutator housing, renew as necessary.

Carbon brushes

Carbon brushes ⓮ must be freely moving in their guides ⓯. Renew too short brushes (min. length 8 mm = 0,32 "). Check spring pressure, renew hot-run brush springs ⓰. Check connector sheath ⓱ of the plus-pole carbon brush ⓲, renew as required.

O-rings

Renew all O-rings ⓳ and oil seal ⓴ at repair of electric starter.

Starter housing

Visually check inner magnets ㉑ for cracks.

Studs

Visually check both studs ㉒ . To be removed only if required.

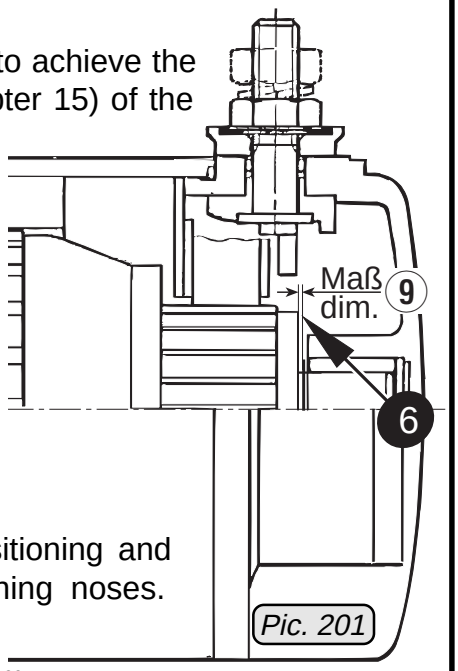
14.1.3) Electric starter — Re-assembly

See Pic. 197, 198 and 201.

Define the necessary number of shims ❻ to achieve the axial clearance (see dimension ⑨ in Chapter 15) of the armature ❺. Grease oil seal ⓴, the ball bearing ❿ and bearing bush ⓭. Insert armature into the bearing support ❺, fit new O-ring 62x1,5 and put starter housing ❷ over armature.

Install carbon brush holder ❹ with springs. Place the necessary number of shims ❻ onto armature shaft and fit the complete commutator support ❸ with new O-ring 62x1,5 on starter housing.

◆ NOTE: Take care for correct positioning and engagement of the positioning noses.



Pic. 201

00234

14.1.4) Electric starter — installation

See Pic. 204.

Grease bearing ❼ slightly. Insert complete electric starter ❸ with new O-rings ❺ 4,7x1,4 and distance sleeves ❹ into the ignition housing ❻.

◆ NOTE: Take care that the electric starter is not coming apart.

Tighten electric starter with lock washer A5 ❷ and hex. nut M5 ❶ and fix it with strap clamp 76 on ignition housing.

14.2) Sprag clutch

See Pic. 119 and 121.

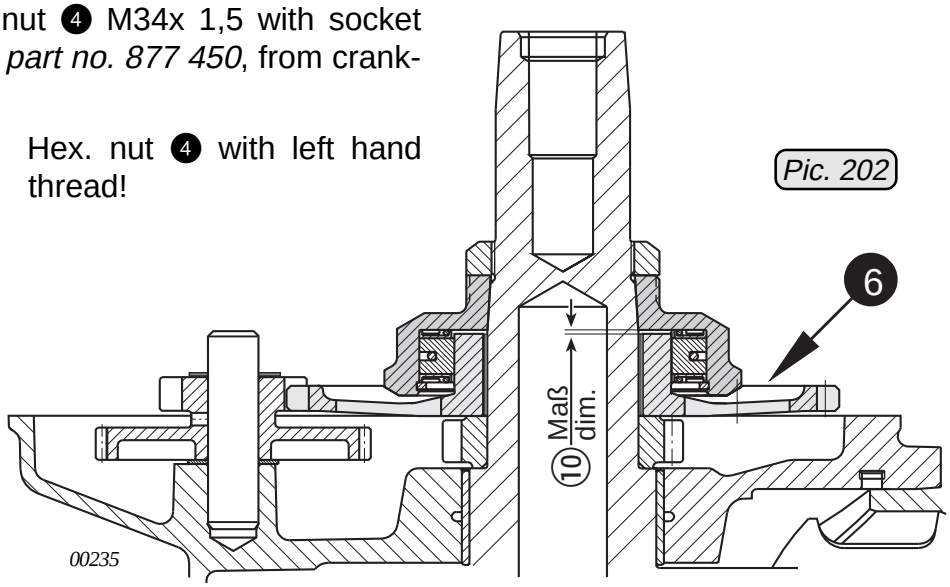
After removal of flywheel hub and ignition housing, see chapter 13.3.3) and 13.3.4), the sprag clutch can be removed. Withdraw idle gear shaft ❶ and idle gear ❷ and both thrust washers 12,5/21,5/1 ❸ from both sides of the idle gear.

Check the axial clearance of the sprag clutch housing. It should be dimension ❿ in Chapter 15). At no or too little axial clearance the sprag clutch may not disengage and the electric starter will be damaged.

Remove hex. nut ❹ M34x 1,5 with socket wrench 46 a/f, *part no. 877 450*, from crankshaft.

◆ NOTE: Hex. nut ❹ with left hand thread!

Pic. 202



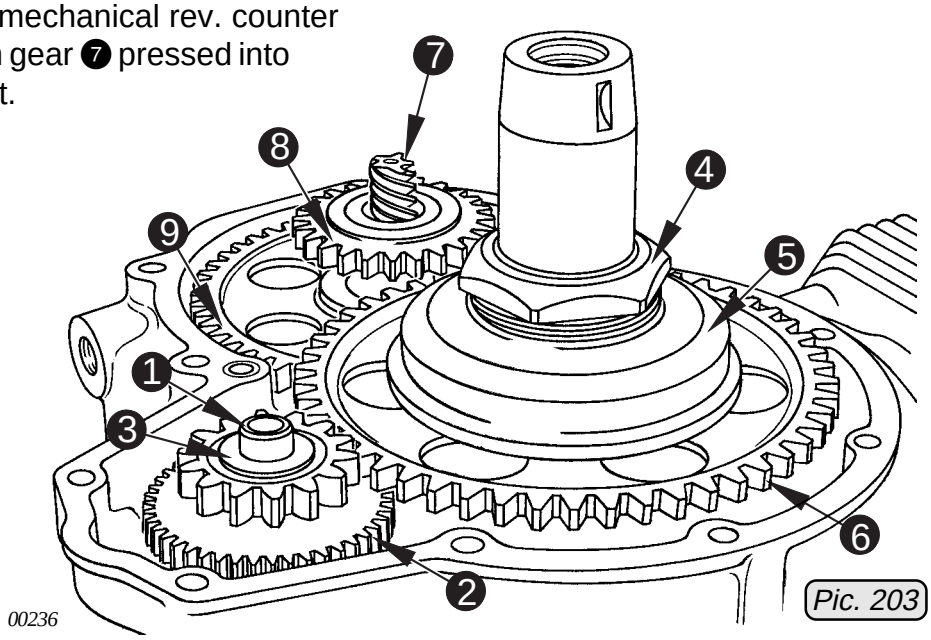
00235

14.2.1) Sprag clutch — removal

See Pic. 203.

Insert protection piece, *part no. 877 410*, into crankshaft and remove sprag clutch housing ❺ with puller *877 375* from crankshaft. The freewheel gear ❻, the timing gear placed behind, the pump gear ❽ pressed onto the camshaft and the timing gear ❾ underneath can be removed only after splitting of the crankcase.

Drive of mechanical rev. counter via worm gear ❼ pressed into camshaft.

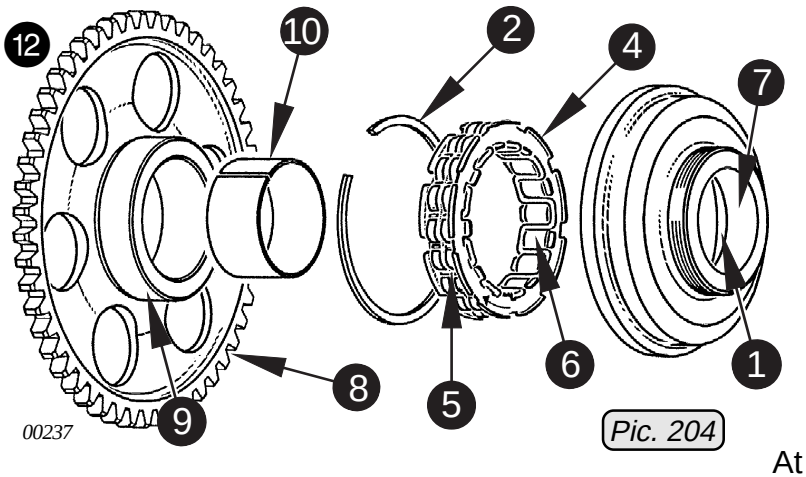


Pic. 203

14.2.2) Sprag clutch — dismantling

See Pic. 204 and 205.

Visually check for accumulation of oil sludge in sprag clutch housing ❶. For cleaning, remove retaining ring ❷. Compress circlip ❸ in sprag clutch ❹ with circlip pliers and twist sprag unit out of the sprag clutch housing. Clean all parts. The circumferential helical spring ❺ must not be loose or wavy distorted. Replace sprag unit as required.



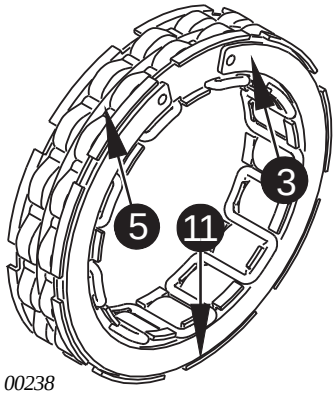
Pic. 204

The sprags ❻ must be freely moving and the surface free of damage. Check engagement face in sprag clutch housing ❶.

At detectable wear of gripping faces exchange corresponding parts. Inspect taper bore ❼ in housing. Check teeth ❽ and sprag engagement face ❾ on free wheel gear and inspect bearing bush ❿.

14.2.3) Sprag clutch — installation

See Pic. 202, 204, 205 and 206.



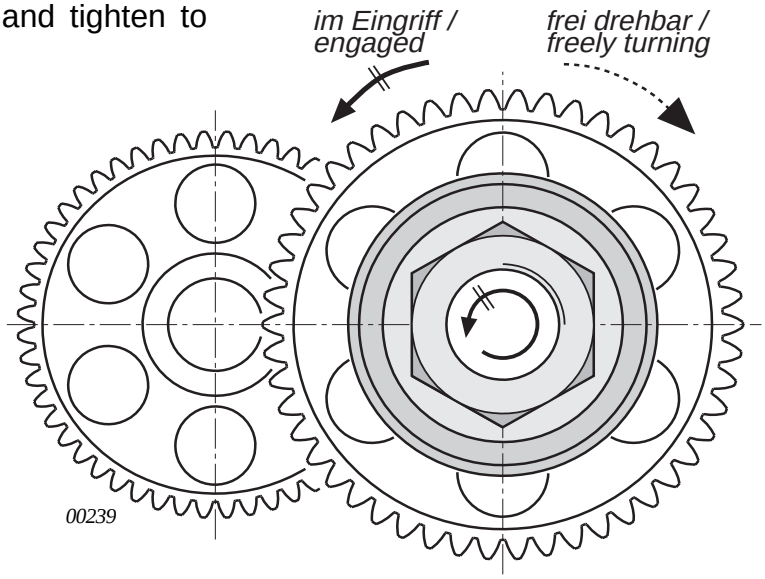
Pic. 205

Place sprag clutch into clutch housing with brake clip ❸ visible. At fitting of brake clip, compress slightly using circlip pliers and ensure that clip remains in position and engages fully on the catches in sprag unit ⓫. Fit retaining ring ❷.

Lock crankshaft using fixing screw *241 965*. Degrease taper and threads of crankshaft and taper of clutch housing. Coat taper of clutch housing thinly with LOCTITE 221 and fit on crankshaft. Turn free-wheel gear to facilitate aligning of the sprags ❸.

◆ NOTE: The free-wheel gear ⓬ gear must engage on crankshaft when turning anti-clockwise, looking towards magneto side of engine, and turn freely when turning clockwise.

Secure degreased hex. nut M34x1,5 with LOCTITE 221 and tighten to 120 Nm (1060 in.lb).



Pic. 206

◆ NOTE: Hex. nut with left hand thread.

■ ATTENTION: Check axial clearance of free-wheel gear, see Pic. 202 and dimension ⑩ in Chapter 15).

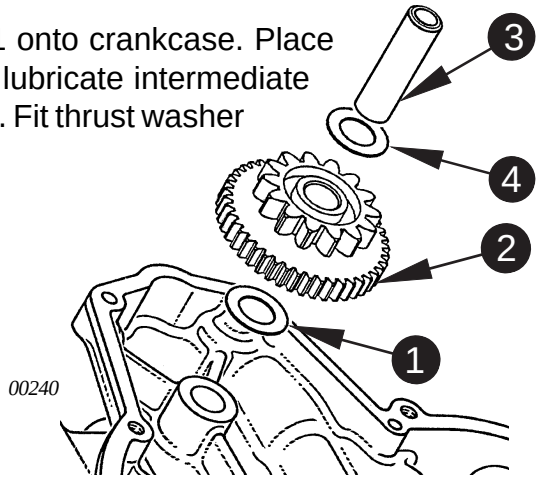
14.2.4) Reduction gear for electric starter

See Pic. 207.

Place thrust washer ❶ 12,5/21,5/1 onto crankcase. Place intermediate gear ❷ into position, lubricate intermediate gear shaft ❸ and push into position. Fit thrust washer ❹ 12,5/21,5/1 on top of it.

14.2.5) Fitting of ignition housing

See Chapter 13.3.9).



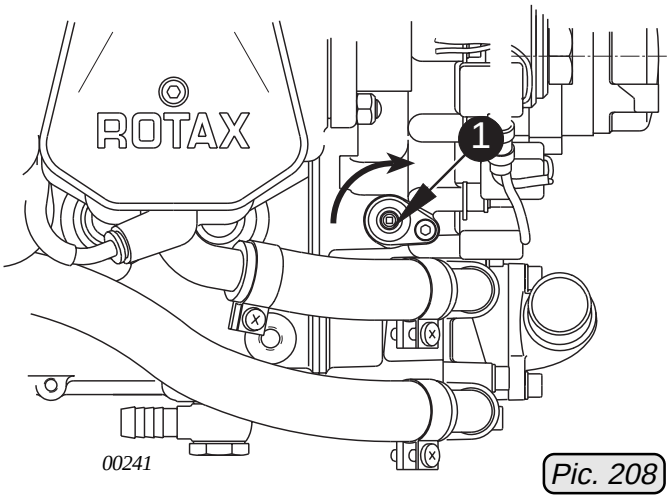
Pic. 207

14.3) Rev. counter drive

See Pic. 208 and 209.

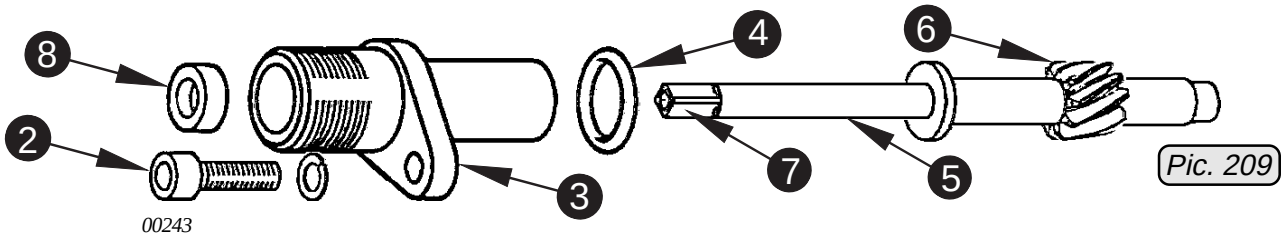
Drive of the mechanical rev. counter ❶ offered as optional extra via the worm gear pressed into the camshaft.

Remove Allen screw M5x16 ❷ and lock washer and withdraw rev. counter housing ❸ along with O-ring ❹ and rev. counter shaft ❺ from ignition housing (see Chapter 13.3.9).



Pic. 208

Inspect teeth ❻ and square end ❼ of rev. counter shaft. At oil leakage renew oil seal ❽ 6x11x3 resp. O-ring ❹. Press in new oil seal fully home to stop in housing using punch, part no. *877 680*.



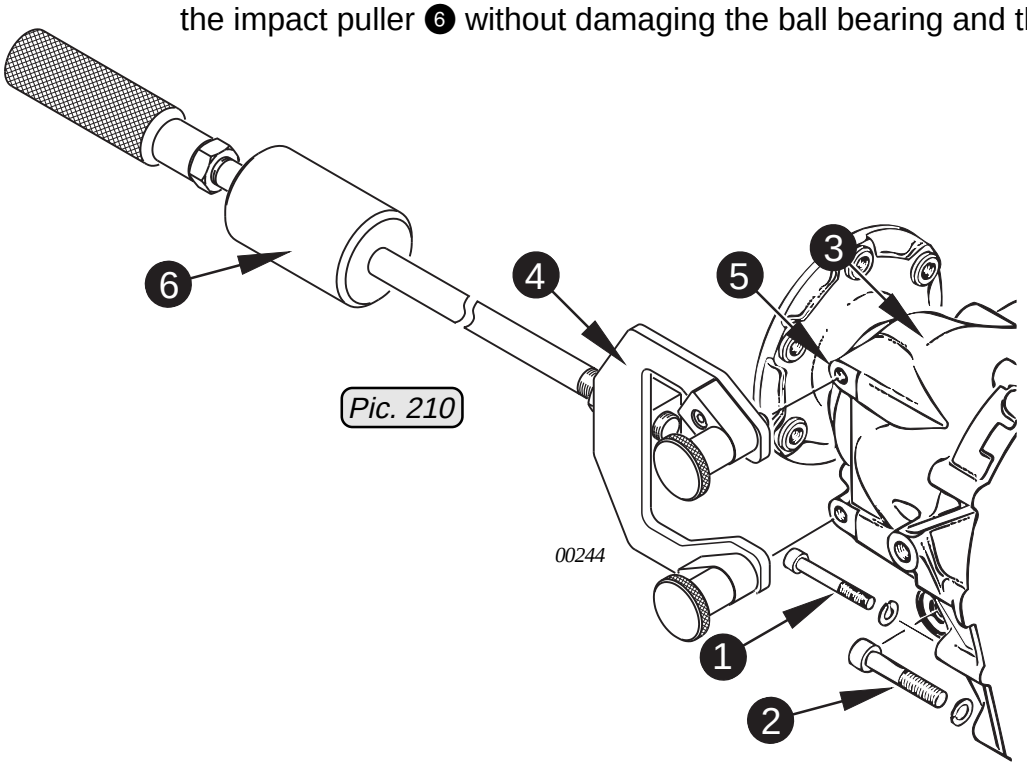
Pic. 209

14.4) Propeller gearbox

See Pic. 210, 211, 213 and 214.

Before removing the gearbox it is useful to check the slipping torque (see Chapter 12.4.2).

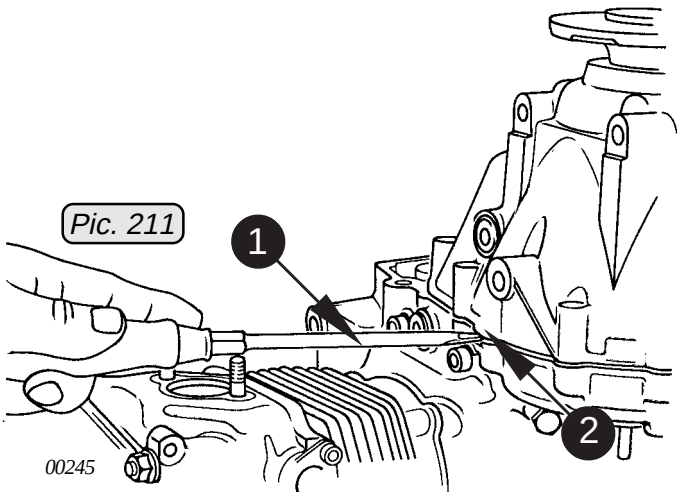
Remove 8 Allen screws ❶ M6 and 2 Allen screws ❷ M8 crosswise from gear cover ❸. The gear cover is kept in position by 2 dowels. Screw puller ❹, part no. *877 660,* onto M8 taps ❺ of gear cover ❸. Now the complete gearbox can be pulled off with the impact puller ❻ without damaging the ball bearing and the propeller shaft.



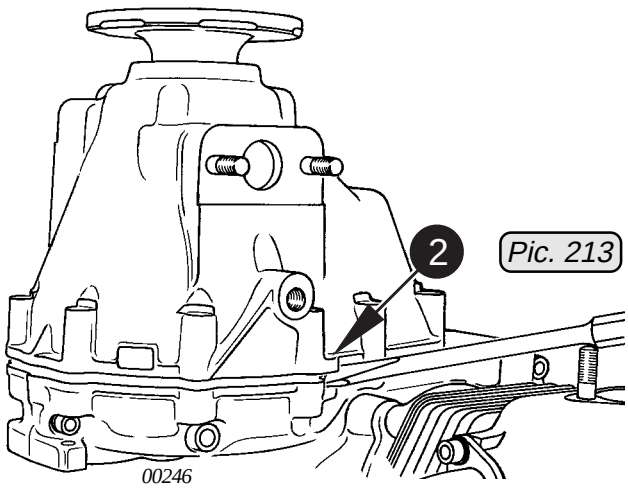
Pic. 210

When the gearbox is loosened, it can be removed with 2 screwdrivers ❶ levering on the lugs ❷ provided on the gear cover.

Pic. 211



Pic. 213



■ ATTENTION: When removing the gearbox, take care not to damage the bearing seat and the oil ring contact surface of propeller shaft.

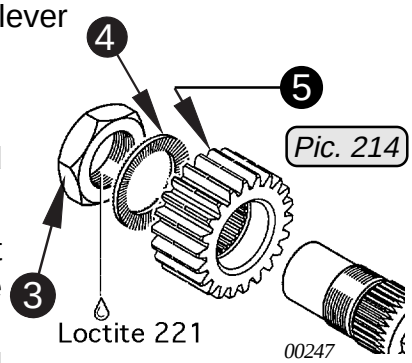
Remove hex. nut M30x1,5 ❸ with wrench 41 a/f, part no. *877 445*, and the drive gear with friction washer ❹ from crankshaft. If required, lever drive gear gently off with 2 screwdrivers.

◆ NOTE: The hex. nut with left hand thread!

Make sure that both dowels remain with crankcase and not with gear cover.

■ ATTENTION: The gear set has a continuous 6-digit serial number which is shown on drive gear front side ❺ and on dog gear. The gears are paired as a set and must not be exchanged individually.

Pic. 214



14.4.1) Removal of roller bearing for F2 only

See Pic. 215.

After the propeller gearbox is removed, the crankcase side propeller shaft bearing and oil seal can be renewed if necessary.

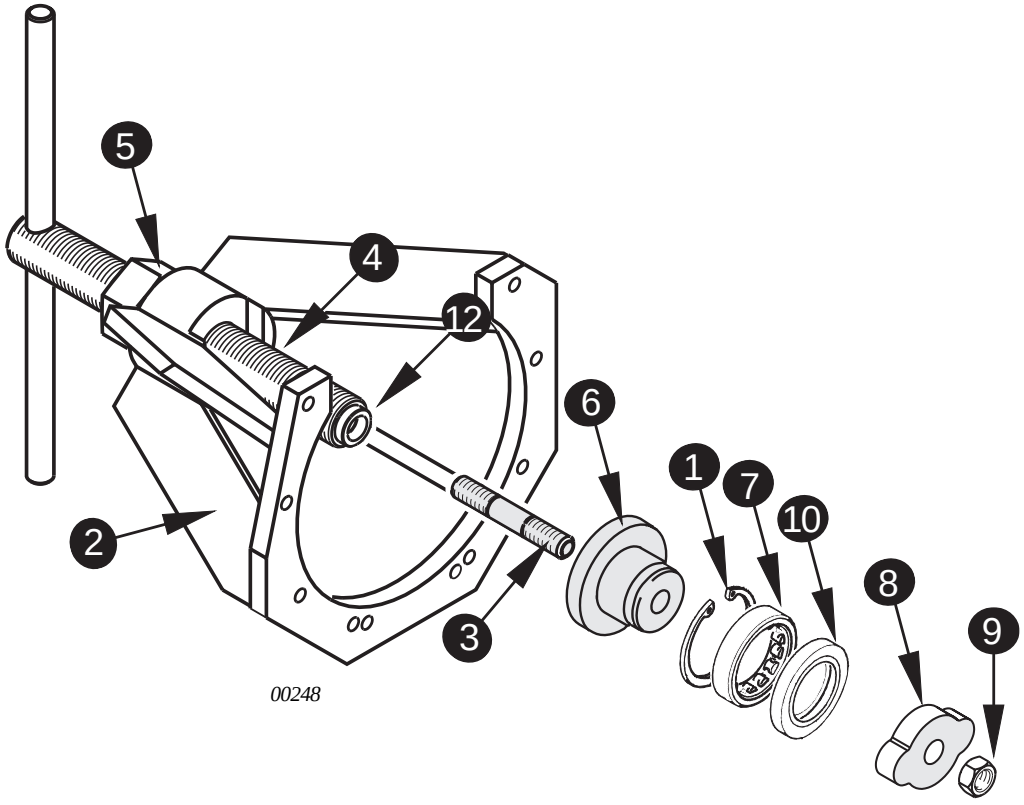
Remove circlip ❶ with circlip pliers. Fit extractor assy ❷, part no. *877 615,* with 8 Allen screws M6x25 to the crankcase. Screw stud ❸ M10x45/20, part no. *941 180*, into the pull-in spindle ❹, part no. *877 580*, and fit hex. nut ❺ M24x,15 onto the spindle.

For better guidance push the adaptor ❻, part no. *877 592*, into the roller bearing ❼ and insert spindle into the extractor ass'y.

Place the puller plate ❽, part no. *877 560*, onto the stud at the backside of the crankcase and fix with hex. nut M10 ❾, part no.*242 091*.

Keep pull-in spindle with handle in position and turn hex. nut clockwise until the roller bearing ❼ with oil seal ❿ is pulled out of the crankcase. Unscrew hex. nut, remove adaptor plate with roller bearing and oil seal and withdraw spindle. Remove extractor ass'y from crankcase.

■ ATTENTION: During this procedure the oil seal ❿ is destroyed and must be renewed.



Pic. 215

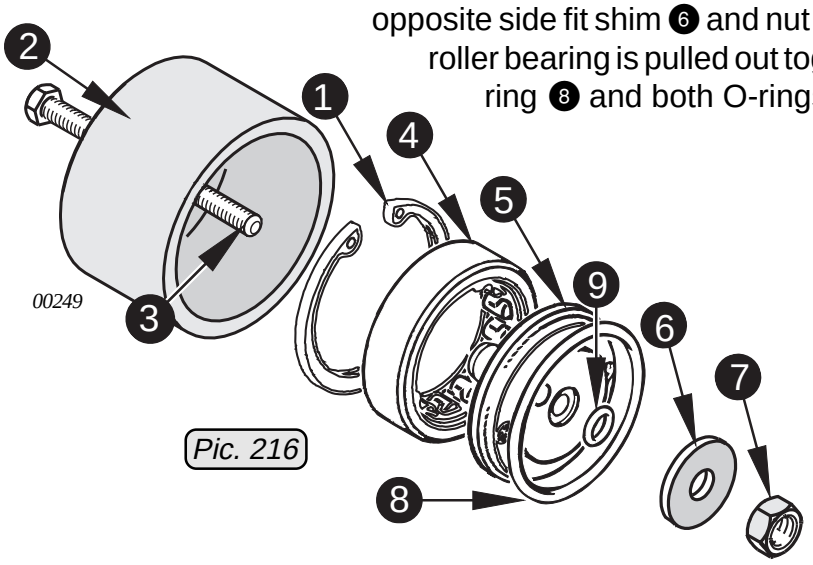
14.4.2) Removal of roller bearing for F3 only

See Pic. 216.

After the propeller gearbox is removed, the crankcase side propeller shaft bearing and oil inlet flange can be renewed, if necessary.

Before disassembly, the governor flange must be removed. At configuration 912 F3 with hydraulic governor the pull out procedure is different from type F2 and F4. The roller bearing is pulled out together with the oil inlet flange.

Remove circlip ❶ with circlip pliers, position puller cap ❷ *876 489* and push hex. screw ❸ through cap, roller bearing ❹ and oil inlet flange ❺. On the opposite side fit shim ❻ and nut ❼. Turning hex. screw clockwise, the roller bearing is pulled out together with oil inlet flange. Remove O-ring ❽ and both O-rings ❾.



Pic. 216

14.4.3) Removal of roller bearing for F4 only

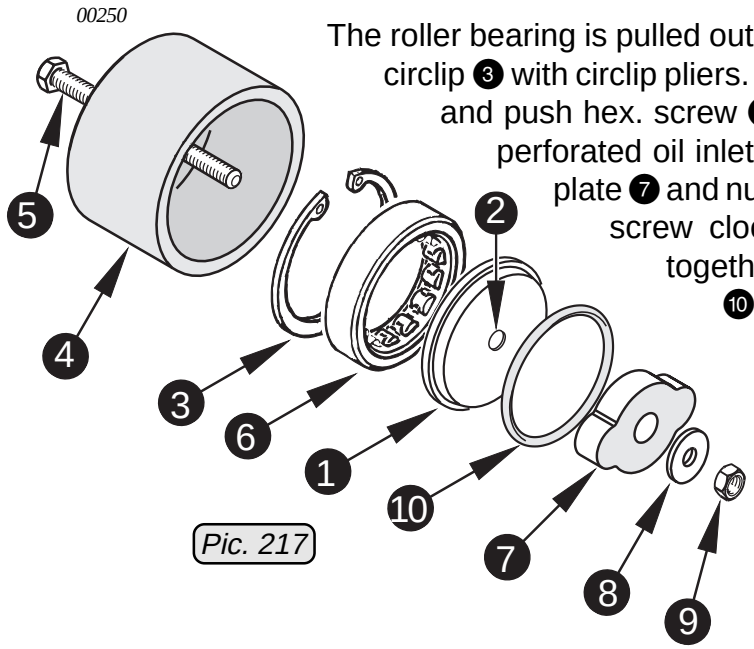
See Pic. 217.

After the propeller gearbox is removed, the crankcase side propeller shaft bearing can be renewed, if necessary.

For the extracting procedure it is necessary to drill a bore of at least 6,2 mm dia., (1/4") ❷ into the middle of the oil inlet cover ❶.

■ ATTENTION: Remove metal chips carefully after drilling.

The roller bearing is pulled out together with the oil inlet cover. Remove circlip ❸ with circlip pliers. Fit puller cap ❹ *876 489* on gearbox side and push hex. screw ❺ through cap, roller bearing ❻ and the perforated oil inlet cover ❶. On the opposite side fit puller plate ❼ and nut ❾ together with shim ❽. By turning hex. screw clockwise, the roller bearing is pulled out together with the oil inlet cover. Remove O-ring ❿.

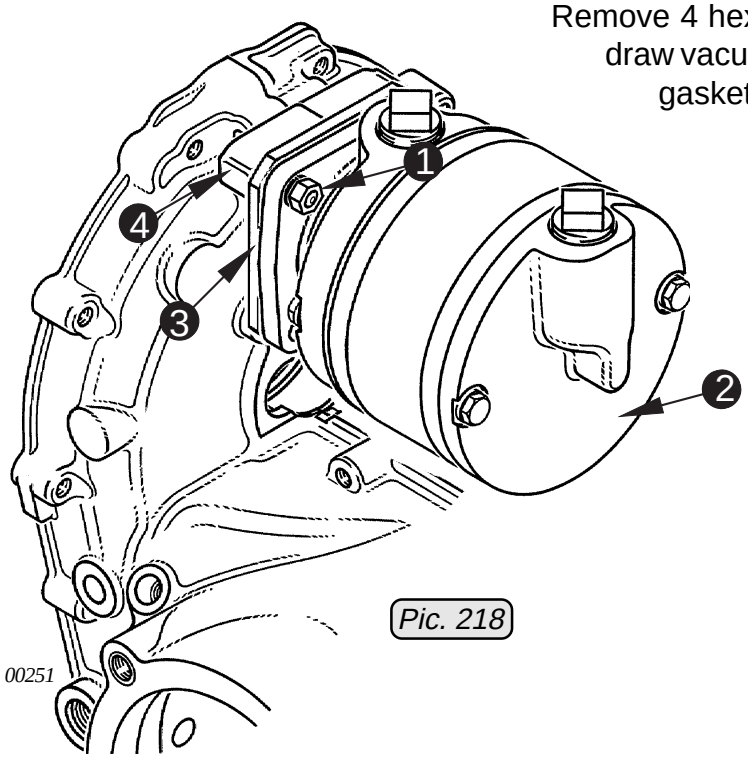


Pic. 217

14.4.4) Vacuum pump - removal

See Pic. 218.

Remove 4 hex. nuts ❶ M6 and lockwashers and withdraw vacuum pump ❷ from crankcase ❹ along with gasket and attachment flange ❸.



Pic. 218

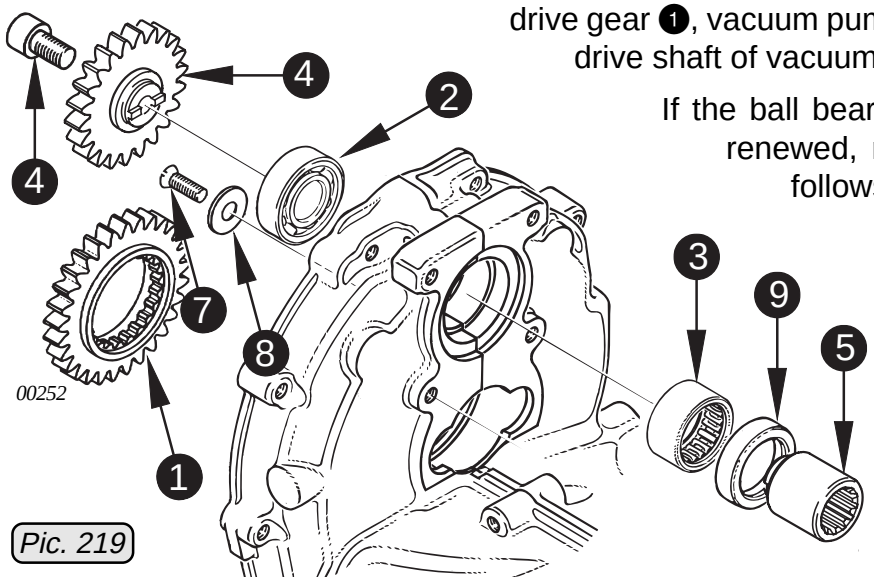
14.4.5) Drive of vacuum pump - removal

See Pic. 219.

Drive of vacuum pump via drivegear ❶ fitted on propeller shaft. Reduction ratio 22 : 29.

Check ball bearing ❷ and needle sleeve ❸. Check toothing of drive gear ❶, vacuum pump gear ❹, drive sleeve ❺ and drive shaft of vacuum pump.

If the ball bearing or needle sleeve must be renewed, remove the vacuum pump as follows:



Pic. 219

Lock drive sleeve ❺ with holder, part no. *242 660*, remove Allen screw ❻ M8x14 and withdraw vacuum pump gear ❹ with drive sleeve ❺.

Remove countersunk screw ❼ M5x12 with washer ❽ for ball bearing fixation.

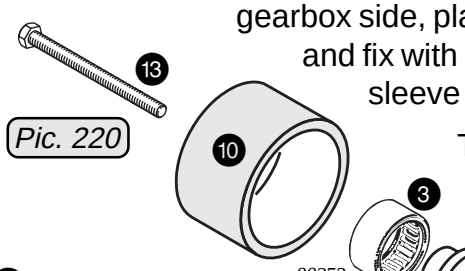
Remove oil seal ❾ and press out needle sleeve and ball bearing with suitable step punch towards propeller flange. Clean and inspect bearing seat.

◆ NOTE: At this procedure the needle sleeve ❶, oil seal ❾ and ball bearing ❸ are damaged and must be renewed.

14.4.6) Drive for vacuum pump and propeller governor - re-fitting

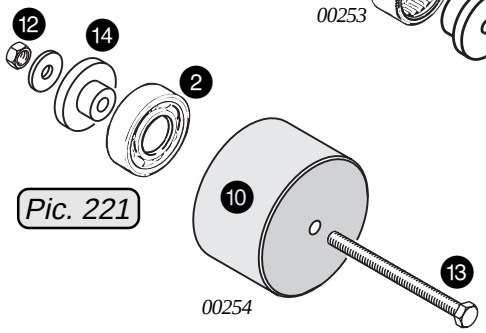
See Pic. 219, 220 and 221

Lubricate new needle sleeve ❸. Position puller cap ❿, part no. *876 489* on gearbox side, place press-in tool, part no. *877 579* ⓫ onto the needle sleeve and fix with hex. nut ⓬. Turning the hex. screw ⓭ clockwise, the needle sleeve is pressed in completely.



Pic. 220

The ball bearing ❷ is pressed in with same procedure, however, the puller cap ❿ part no. *876 489* is fitted on pump flange side, and the press-in tool ⓮, part no. *877 595,* is used.



Pic. 221

Then press in new oil seal ❾ with assembly punch, part no. *877 276* and grease it. Apply LOCTITE 221 to countersunk screw ❼ M5x12 and washer ❽ for ball bearing fixation and tighten.

Fit vacuum pump gear ❹ and fix drive sleeve ❺ with holder, part no. *242 660*. Apply LOCTITE 221 on Allen screw ❻ M8x14 and turn in.

■ ATTENTION: The length of Allen screw ❻ M8x14 must be absolutely respected as otherwise the screw will collide with the drive shaft of vacuum pump.

14.4.7) Vacuum pump

See Pic. 222.

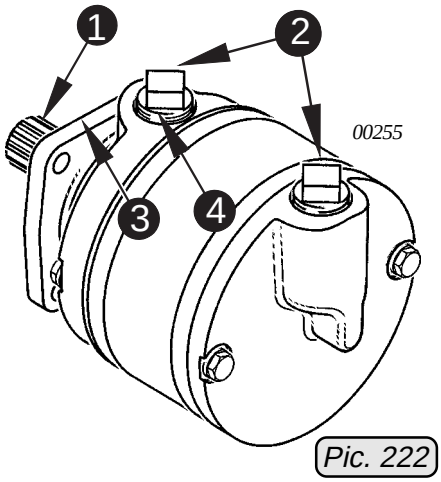
The vacuum pump serves as drive of pneumatic inertial navigation instruments.

◆ NOTE: The vacuum pump must not be taken apart and must be renewed as complete unit, if necessary. Renewal during overhaul at the latest.

Check teeth ❶. Remove connections or plugs ❷ from used vacuum pump. If still in good condition they can be re-used. Renew damaged connections. For fitting of hose connections, the pump can be clamped in a vice with drive downward, using protective jaws.

■ ATTENTION: Only clamp on flange ❸. Never clamp the pump directly on pump housing as this would damage the pump rotor. Never install a pump that has been dropped!

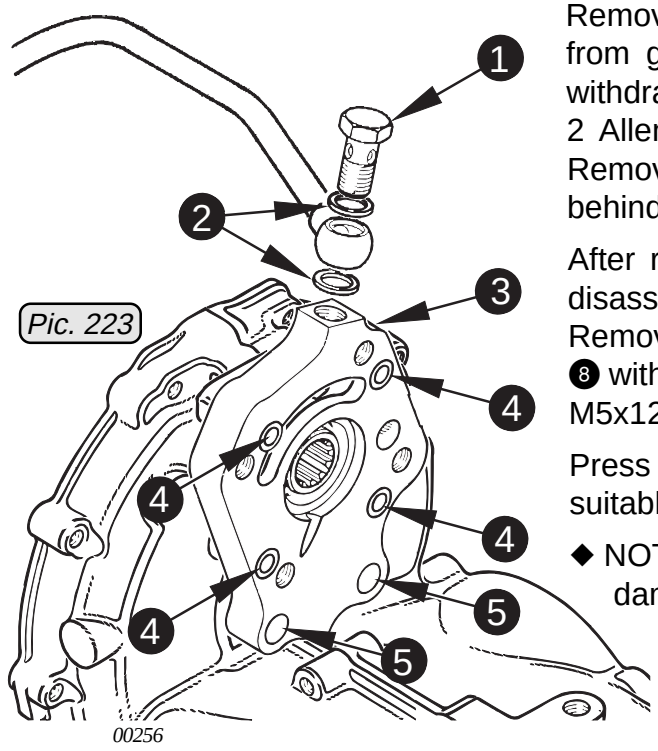
Spray connection threads ❹ 3/8" NPT with silicon and let dry. Do not use Teflon tape, hose sealing lacquer or thread grease on the connections. Only tighten connections with ring- or socket wrench and bring them to correct position. Retighten by max. 1,5 turn.



Pic. 222

14.4.8) Drive for propeller governor - removal

See Pic. 223 and 224.



Pic. 223

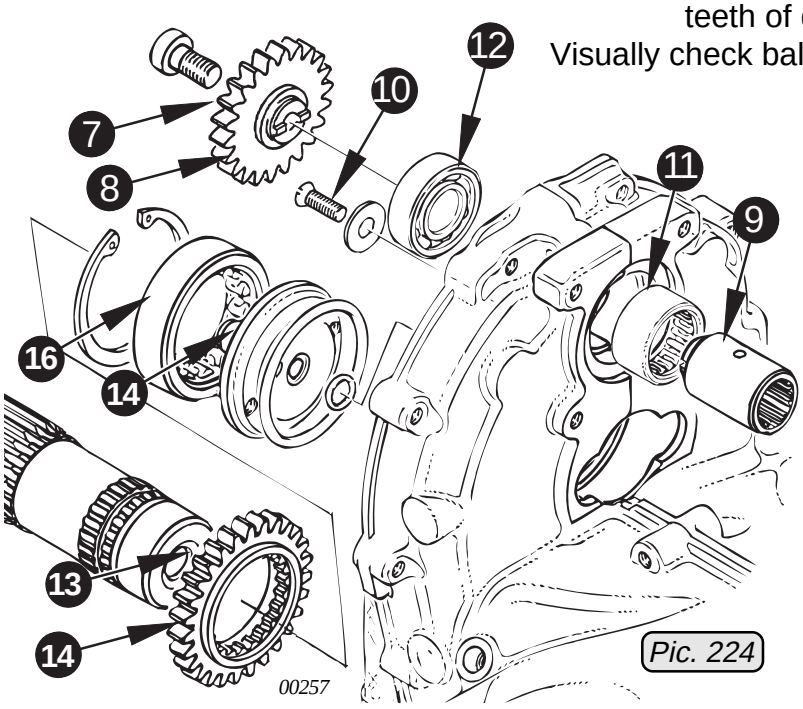
Remove banjo bolt ❶ M10x1 and both sealing rings ❷ from governor flange ❸ and oil pump housing and withdraw oil hose. Remove 4 Allen screws M6x20 ❹ and 2 Allen screws ❺ M6x16 for oil inlet flange fixation. Remove governor flange with O-ring and distance sleeve behind.

After removal of propeller gearbox the drive can be disassembled. Fix drive sleeve ❻ with holder 242 660. Remove Allen screw M8x16 ❼ and vacuum pump gear ❽ with drive sleeve ❾. Remove countersunk screw ❿ M5x12 with washer for ball bearing fixation.

Press out needle bearing ⓫ and ball bearing ⓬ with suitable step punch towards gearbox.

◆ NOTE: Needle bearing and ball bearing will be damaged by this procedure and must be replaced.

Check inner diameter ⓭ of propeller shaft and journal ⓮ of oil inlet flange. The wear will probably appear as a flat area on the journal. Check teeth of drive gear and vacuum pump gear ❽. Visually check ball bearing ⓬ and roller bearing ⓰.



Pic. 224

■ ATTENTION: The attachment screw ❼ M8 of vacuum pump gear for hydraulic governor drive is ⓰ **mm long** (.63 in.) and with a low screw head. For vacuum pump drive, however, it is only **14 mm long** (.55 in.) with standard screw head.

Clean parts carefully and remove sealant residues. Check sealing surface and all oil bores in governor flange ❸ for free passage. Visually check needle bearing ⓫ as well as teeth and bearing surface of drive sleeve ❾. Ensure clean connecting face for oil pressure hose.

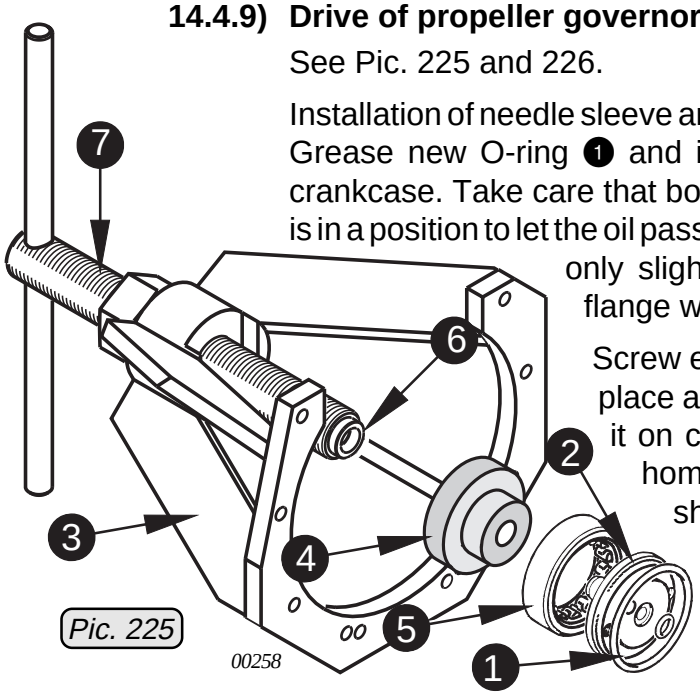
If service work is necessary on the propeller governor, it must be sent to the engine manufacturer.

dimension	**new**	**wear limit**

See Chapter 15).

14.4.9) Drive of propeller governor - installation

See Pic. 225 and 226.



Pic. 225

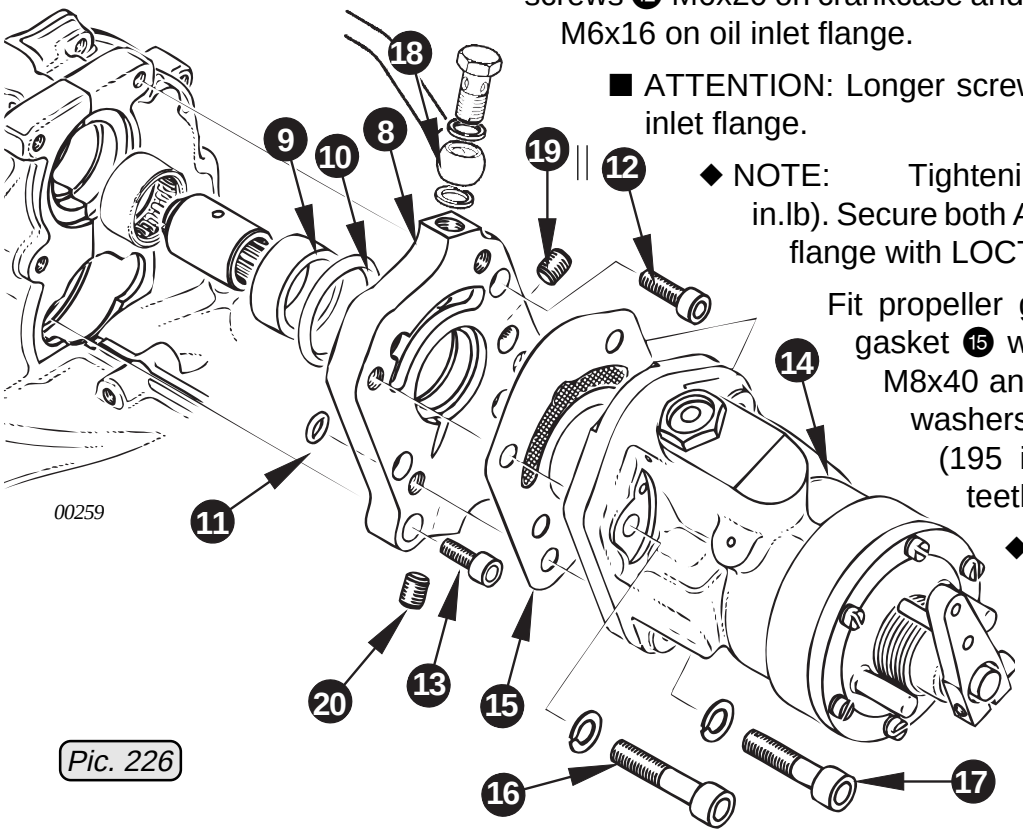
Installation of needle sleeve and ball bearing as described in chapter 14.4.6). Grease new O-ring ❶ and insert it together with oil inlet flange ❷ into crankcase. Take care that both M6 threads are horizontal and the opening is in a position to let the oil pass. For better positioning tighten governor flange only slightly with 2 Allen screws M6x20 and oil inlet flange with 2 Allen screws M6x16.

Screw extractor ❸, part no. *877 615* onto crankcase, place adaptor ❹ 877 590 into roller bearing ❺, place it on centering ❻ and press it with spindle ❼ fully home into crankcase. Fit circlip in groove with its sharp edge towards outside.

■ ATTENTION: The oil inlet flange must be fitted well aligned and the O-ring must not be squeezed.

Remove governor flange ❽ again. Fit distance sleeve ❾ and new O-ring ❿ 32x4 into the crankcase. Place one each O-ring ⓫ 7x2 into the oil inlet flange and into governor flange and keep them in position with some grease. Place governor flange and fix it with 4 Allen screws ⓬ M6x20 on crankcase and with 2 Allen screws ⓭ M6x16 on oil inlet flange.

■ ATTENTION: Longer screws will damage the oil inlet flange.



Pic. 226

◆ NOTE: Tightening torque 10 Nm (90 in.lb). Secure both Allen screws for oil inlet flange with LOCTITE 221.

Fit propeller governor ⓮ and new gasket ⓯ with 3 Allen screws ⓰ M8x40 and 1 x M8x35 with lock washers and tighten to 22 Nm (195 in.lb). Take care that teeth engage.

◆ NOTE: The 35 mm (1,38 in.) long screw ⓱ to be mounted on bottom left side.

Fit pressure oil hose ⓲ on governor flange and on oil pump housing and secure with hose clamp. The plug screws ⓳ and ⓴ remain normally closed. On position ⓳ a pressure gauge for governor pressure observation can be connected. The maximum control pressure is between 22 and 25 bar (320 ÷ 360 p.s.i.). The governor starts regulating at 3600 ÷ 3700 r.p.m.

At malfunction of propeller governing suspect the following as possible cause:

— adjustment of governor actuation

— malfunction of propeller governor

— insufficient oil pressure, oil pressure fluctuations

— propeller pitch control.

14.4.10) Gearbox - disassembly

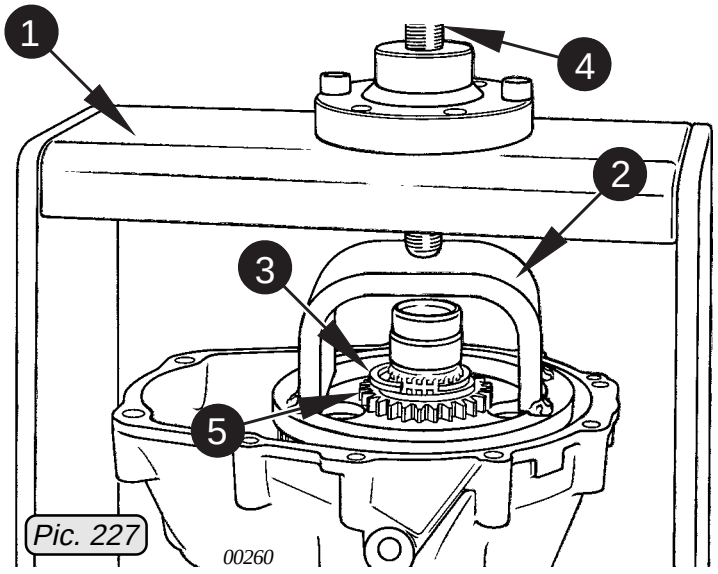
See Pic. 227, 228 and 229.

Place gearbox ass'y under a suitable fixture ❶ and put pressure via yoke ❷ on dog gear until ring halves ❸ come free and can be removed.

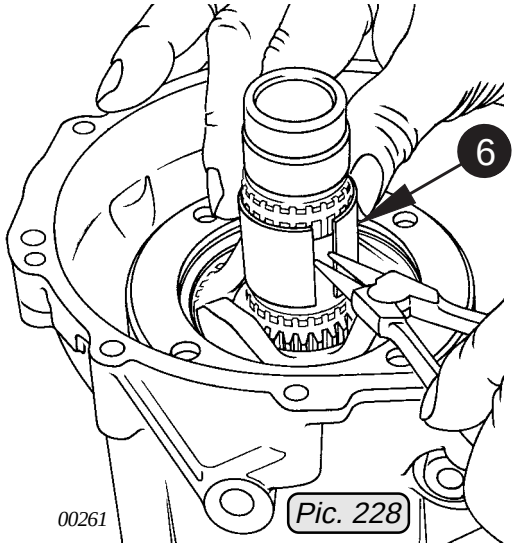
■ ATTENTION: Do not depress dog gear excessively as this might destroy gear cover.

Now release pressure from gear by turning spindle ❹ back and remove gearbox from fixture. Remove drive gear ❺, thrust washer and dog gear. Force apart bush ❻ with circlip pliers and withdraw from propeller shaft.

■ ATTENTION: Do not overstress bearing bush ❻, otherwise it will become unusable.

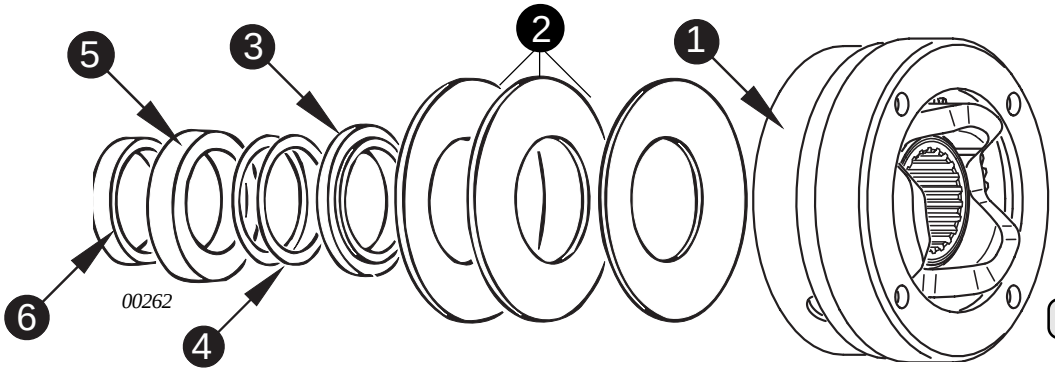


Pic. 227



Pic. 228

Remove overload clutch ass'y ❶, 3 disk springs ❷ 80x35x3, step collar ❸, shims ❹, eccentric collar ❺ for fuel pump and 8 mm (.315 in.) distance sleeve



Pic. 229

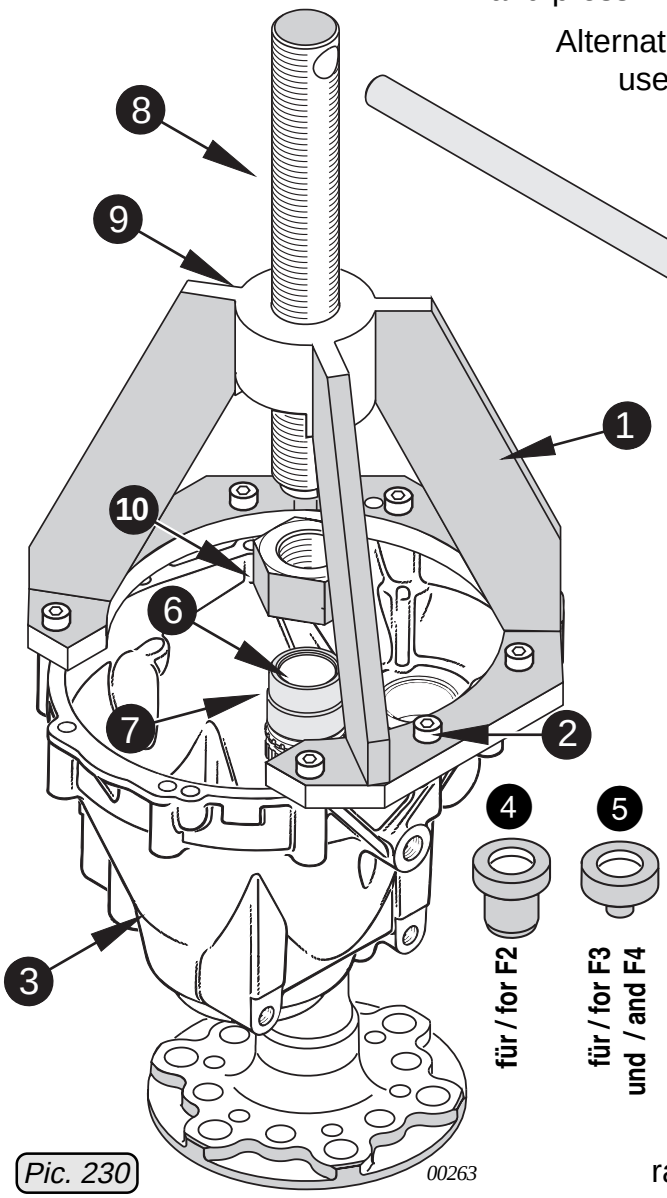
14.4.11) Propeller shaft - removal

See Pic. 230 and 231.

Place gear cover on a suitable fixture and press out propeller shaft with a hand press.

Alternatively the extractor ❶, part no. *877 615* can be used to press out the propeller shaft. Fit extractor with 6 x M6 screws ❷ onto gear cover ❸ and place protection piece ❹, part no. *877 605 (* for engine version F2) or ❺, part no. *877 600* (for versions F3 and F4) onto the end ❻ of propeller shaft ❼.

Insert spindle ❽ into the support ❾ of the extractor ❶ and turn hex. nut ❿ M24x1,5 from inside onto the spindle ❽. Keep nut in position with fork wrench. By turning the spindle clockwise, the propeller shaft is pressed out of the gear cover.



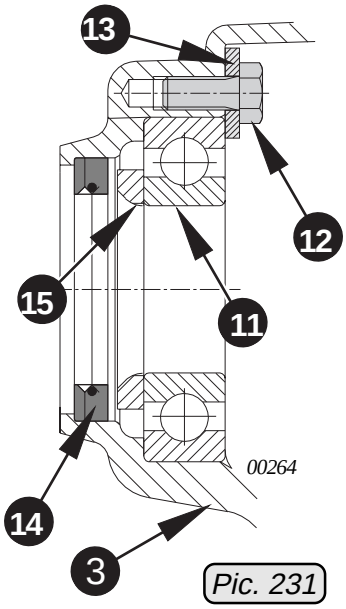
Pic. 230

■ ATTENTION: The protection piece must be used without fail as otherwise the machined internal diameter of propeller shaft would be damaged. If the propeller shaft is removed, the ball bearing should be renewed!

For removal of ball bearing ⓫ remove the 4 hex. screws ⓬ M7x16 and washers ⓭ from gear cover ❸.

Heat gear cover to 80 ÷ 100° C (180 ÷ 210° F) and knock out ball bearing ⓫ with suitable punch together with oil seal ⓮ and radius shim ⓯ from outside towards inside.

■ ATTENTION: At this procedure the oil seal ⓮ will bedamaged and must be renewed.

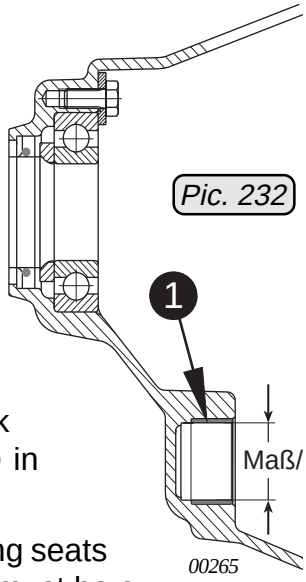


Pic. 231

14.4.12) Gearbox components — checking

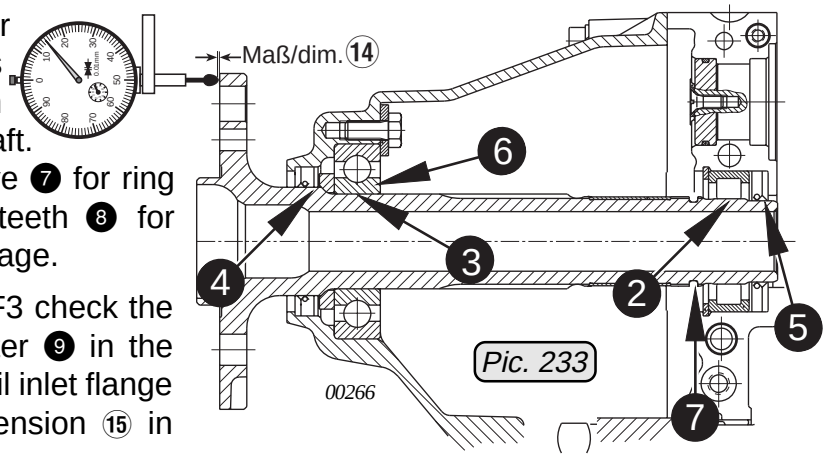
See Pic. 232, 233, 234, 235, 236 and 237.

Clean disassembled gearbox with kerosine or gasoline and check the following components:



Pic. 232

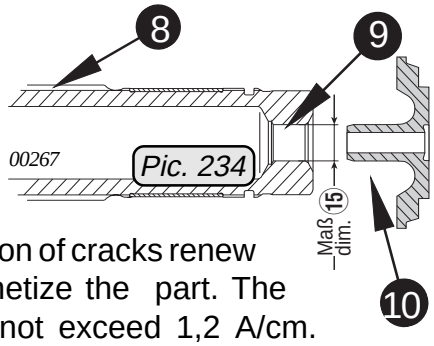
- ☞ Check crankshaft bearing bush ❶ fitted in gear cover for tight fit, check dimension ⑪, see Chapter 15).
- ☞ Check both bearing seats ❷ and ❸ on propeller shaft. See dimensions ⑫ and ⑬ in Chapter 15). Check oil seal contact surfaces ❹ and ❺. Check propeller flange for out of true, see dimension ⑭ in Chapter 15).
- ☞ Propeller shaft must be without corrosion on bearing seats ❷ and ❸. The ball bearing ❻ 6207 E (35-72-17) must be a press fit on its outer race in gear cover and its inner race on propeller shaft. Check groove ❼ for ring halves and teeth ❽ for wear or damage.



Pic. 233

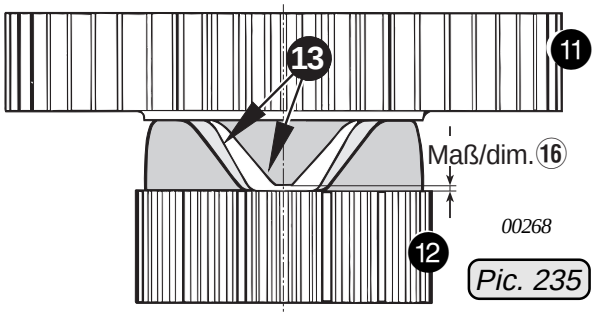
On version F3 check the inner diameter ❾ in the area of the oil inlet flange ❿, see dimension ⑮ in Chapter 15).

Inspect propeller shaft for cracks by magnetic particles inspection method (Magnaflux), see Chapter 11.4). Check tangential intensity of magnetic field with test instrument DEUTROMETER 3870. Nominal value is 10 ÷ 50 A/cm. At indication of cracks renew the respective part. Clean and demagnetize the part. The maximum remaining magnetism must not exceed 1,2 A/cm. Register the results of the magnetic particle inspection in the respective Form Sheet, see Chapter 16.4).



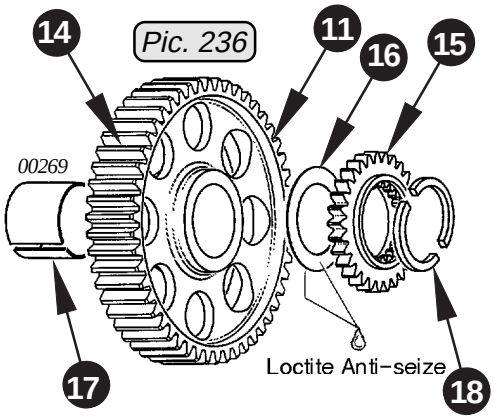
Pic. 234

- ☞ Visually check dog gear ⓫ and dog hub ⓬ for pitting on gear teeth and sliding ramps ⓭ of dogs. Ensure that ramp tops of the dog gear are clearing ramp valleys of dog hub. Check clearance, dimension ⑯ in Chapter 15). Slight wear and pitting on the dogs is permissible.



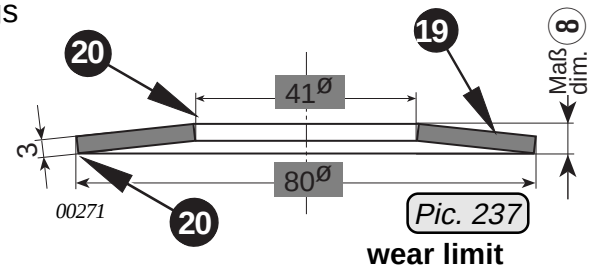
Pic. 235

- ☞ Check teeth ⓮ of gear set.
- ☞ Inspect eccenter for fuel pump and fuel pump plunger for wear, see Chapter 13.1.7).
- ☞ Check step collar for wear in the area of disk spring contact surface.
- ☞ Measure plastic thrust washer ⓰ between dog gear ⓫ and drive gear ⓯, see dimension ⑰ in Chapter 15).
- ☞ Check dog gear bush ⓱ of hardened steel for wear.



Pic. 236

- ☞ Visually check ring halves ⓲, renew as required.
- ☞ At visible wear of disk springs ⓳ in the contact area ⓴ they have to be renewed. Check dimension ⑱ of the released disk spring, see Chapter 15).



Pic. 237

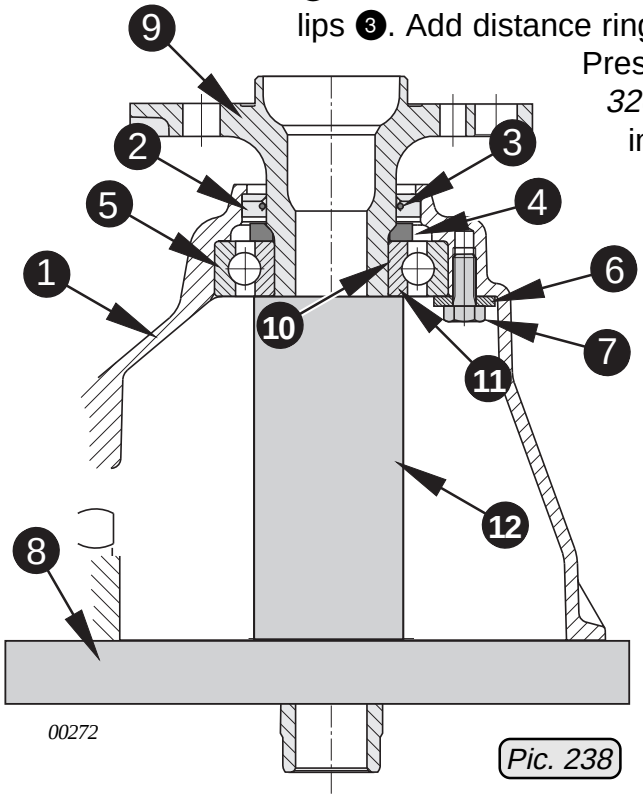
Dimensions of new wear limit

See Wear Limits, Chapter 15).

14.4.13) Gearbox — Re-assembly

See Pic. 238, 239 and 240.

Heat gear cover ❶ with hot air gun to approx. 100° C (215° F). Insert oil seal ❷ 40-55-7 from the inside, using punch, part no. *876 518*, and grease sealing lips ❸. Add distance ring ❹ 36/50/5,5 with rounded side towards oil seal. Press in ball bearing ❺, utilizing press-ring, part no. *877 320* and insertion punch, part no. *877 275*. Fix bearing in position, using 4 hardened washers ❻ 7,2/18,8/3 and hex. screws ❼ M7x16.



Pic. 238

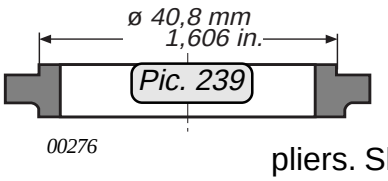
◆ NOTE: Secure screws with LOCTITE 221 and tighten to 10 Nm (90 in.lb).

Place gear cover on a suitable plate ❽ with a bore for propeller shaft. Apply LOCTITE Anti-Seize to bearing seat ❿ 35 mm (1,4 in.) dia. and press propeller shaft ❾ carefully from outside into gear cover.

■ ATTENTION: Do not tap!

Make absolutely sure to support the inner ring ⓫ of the bearing with suitable tube ⓬. It is an advantage if gear cover is still warm at this stage.

Turn gear cover. Next to fit are distance sleeve ⓭ 35,2/42/8 and eccenter ⓮ for fuel pump. Then fit step collar ⓯ with dia. 40,8 mm towards disk spring, 2 disk springs ⓰ placed against each other and the 3rd disk spring ⓱ with it's back to the previous disk spring. Take care that the disk springs rest on the centering collar ⓲ of the hub. Apply LOCTITE Anti-Seize to teeth of pre-assembled overload clutch ⓳ and slide into position on propeller shaft. Carefully fit pre-oiled bearing bush ⓴ using circlip pliers. Slide on dog gear ㉑, plastic thrust washer ㉒ 33,2/51/1,2 coated on both sides with LOCTITE Anti-Seize, and drive gear ㉓.



Pic. 239
00276

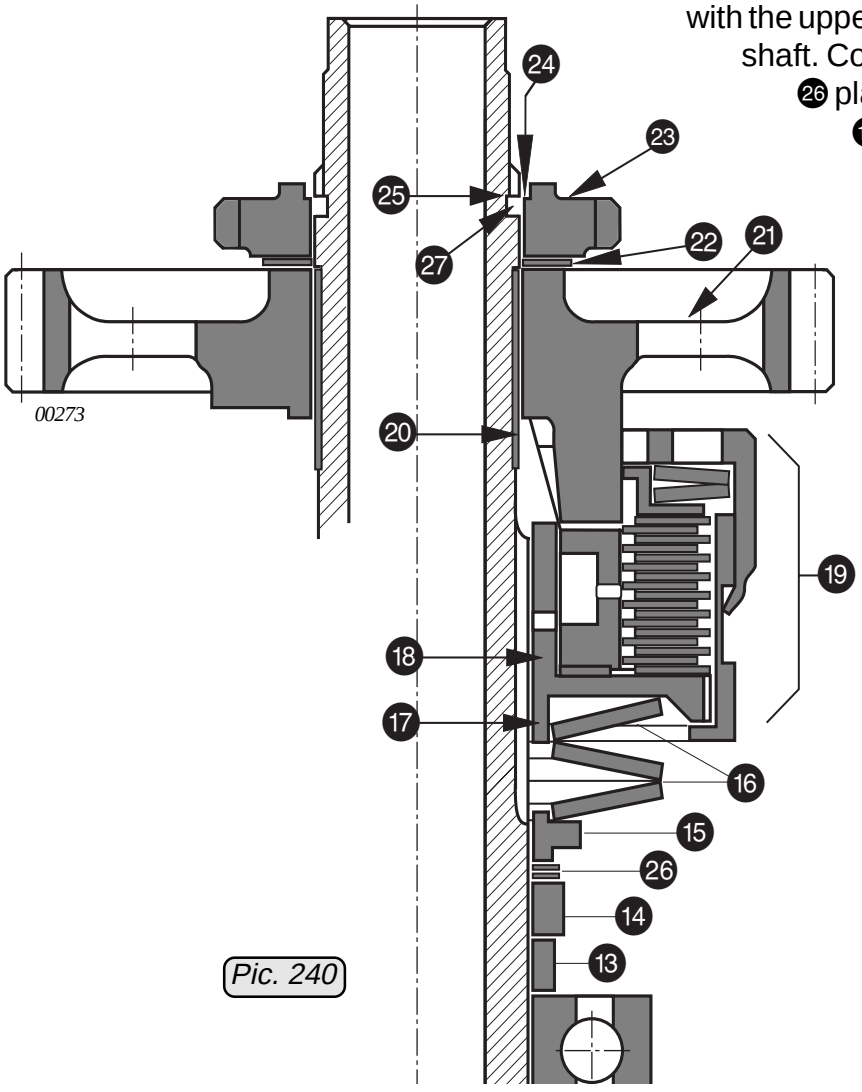
■ ATTENTION: If the disk springs are not placed well centered, the dog gear cannot be depressed sufficiently to allow inserting of ring halves. Do not increase the pressure, but disassemble the clutch again and center the disk springs more accurately.

◆ NOTE: Coat contact surfaces of disk springs and dogs as well as the tooth profile of propeller shaft with LOCTITE Anti-Seize.

14.4.14) Adjustment of disk spring pre-tension

See Pic. 240 and 227.

With springs in the released state, the face ㉔ for the ring half must be in line with the upper edge ㉕ of the groove in propeller shaft. Compensate the difference by shims ㉖ placed without fail between eccenter ⓮ and step collar ⓯.



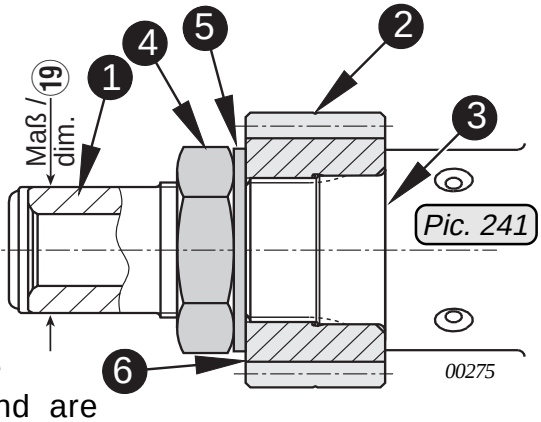
Pic. 240

After pre-tensioning of disk springs, depress gear ㉑ with assembly ring, *part no. 876 885*, until the ring halves can be inserted. Insert ring halves. Release disk springs (see also Chapter 14.4.10).

■ ATTENTION: Never depress springs flat, otherwise clutch drum of overload clutch will damage the gear cover. The ring halves must be completely inserted in the groove on propeller shaft!

14.4.15) Propeller gearbox — re-fitting

See Pic. 241 and 242.



Pic. 241

Visually check p.t.o. side crankshaft ❶, see dimension ⑲ in Chapter 15). Slide drive gear ❷ onto crankshaft ❸. Fit hex. nut ❹ M30x1,5 secured with LOCTITE 221 and friction washer ❺ VS 30 on crankshaft. Torque to 200 Nm (1770 in.lb).

■ ATTENTION: Dog gear and drive gear are paired and are marked with a consecutive serial number ❻. Use only parts of the same serial number!

Clean sealing surface of gear cover and crankcase. Insert both dowels 6x20 into crankcase. Grease oil seal 30x52x7 for propeller shaft in crankcase. Lubricate bearing bore for propeller shaft.

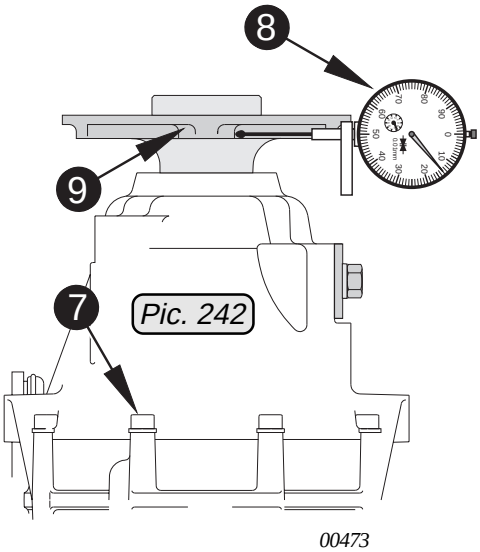
◆ NOTE: On engines type 914 F3 / F4 this oil seal is not fitted.

Keep the rollers of the roller bearing in position with grease to facilitate assembly of propeller shaft.

Position gear cover with completely pre-assembled gear unit, previously coated with sealing compound LOCTITE 574. Turn propeller shaft slightly to allow the dog gear to engage. By gently tapping on the gear cover with a plastic mallet (not on propeller shaft) the gearbox is fitted on crankcase.

◆ NOTE: If there is resistance, at a gap of approx. 10 mm (.4 in.) the rollers must be better aligned and/or the vacuum pump gear be turned to allow engagement.

■ ATTENTION: If excessive force is applied at assembly, the roller bearing or the vacuum pump drive can be damaged. If sealing face becomes oily during assembly process, clean it and apply again sealing compound LOCTITE 574.



Pic. 242

Tighten gearbox evenly with 2 Allen screws M8x45 and 8 Allen screws ❼ M6x45 and lockwashers crosswise. Torque for M8 = 25 Nm (220 in.lb), for M6 = 10 Nm (90 in.lb).

Check gear backlash (see dimension ⑳ in Chapter 15) with dial gauge ❽ on propeller flange ❾.

Remove crankshaft locking screw and fit crankshaft plug screw with Cu sealing ring and tighten to 22 Nm (195 in.lb). For verification turn crankshaft with wrench 24 a/f on hex. screw on magneto side.

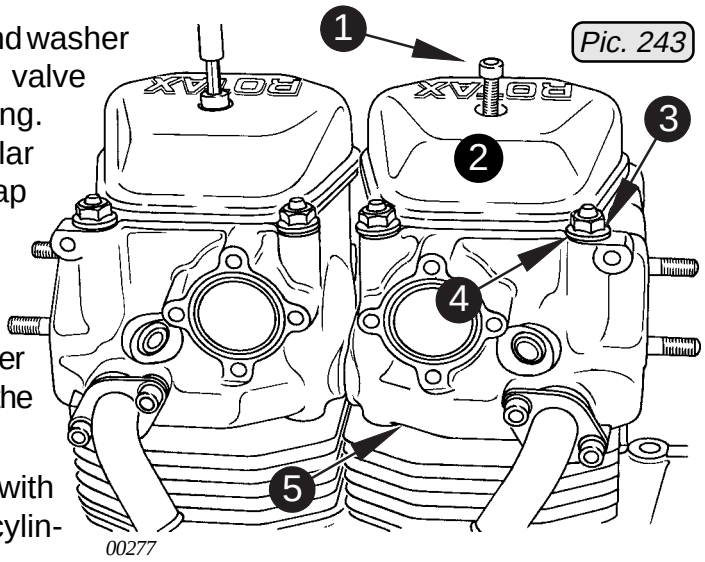
14.5) Cylinder head — removal

See Pic. 243 and 244.

If components of several cylinders are dis-assembled, they must be marked to ensure correct coordination at re-fitting.

Remove Allen screw M6x25 ❶ and washer from valve cover ❷ and lift off valve cover and large and small O-ring. Remove crosswise 2 each collar nuts ❸ with washers ❹ and 2 cap nuts M8. The cap nut is inside the valve cover and has a sealing edge.

◆ NOTE: There is no washer required under the cap nut.



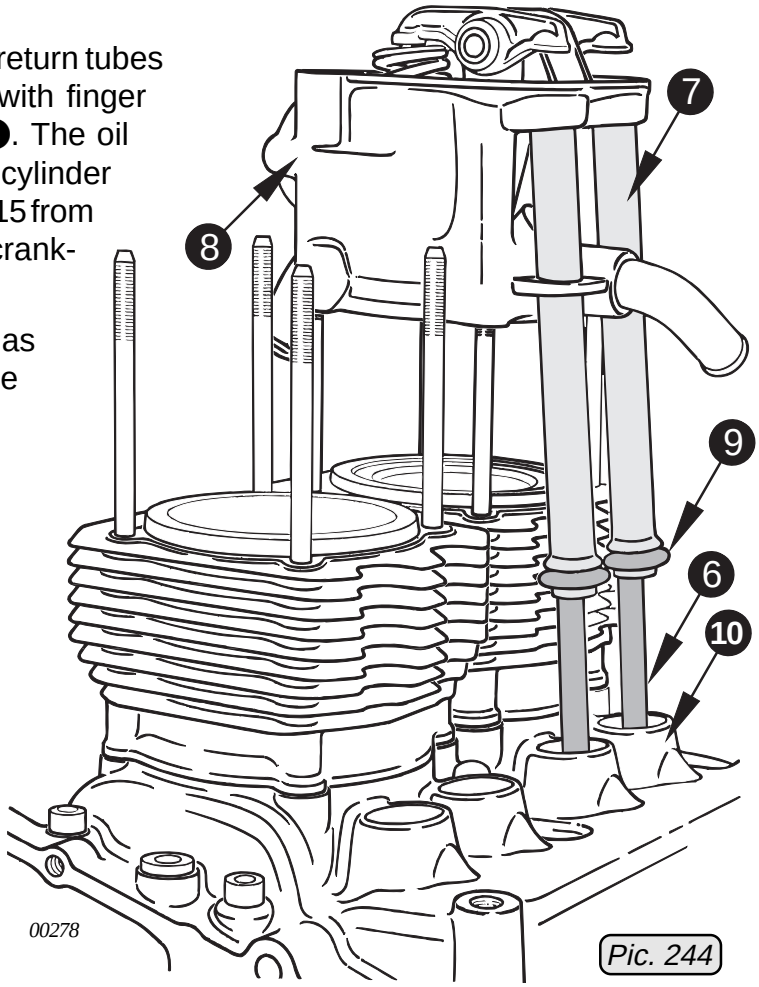
Pic. 243

Lever complete cylinder head off with screwdriver, levering between cylinder ❺ and cylinder head.

■ ATTENTION: Do not damage the sealing surface!

Keep both push rods ❻ in oil return tubes ❼ in position, seal oil bore with finger and remove cylinder head ❽. The oil return tubes remain with the cylinder head. Remove O-rings ❾ 16x15 from the oil return tubes or from crankcase ❿.

Lay aside cylinder head so as not to damage sealing surface and oil return tubes. Lift out oil filled push rods, stop oil from dripping by sealing with finger. Coordinate push rods with cylinder heads to prevent any mix-up.



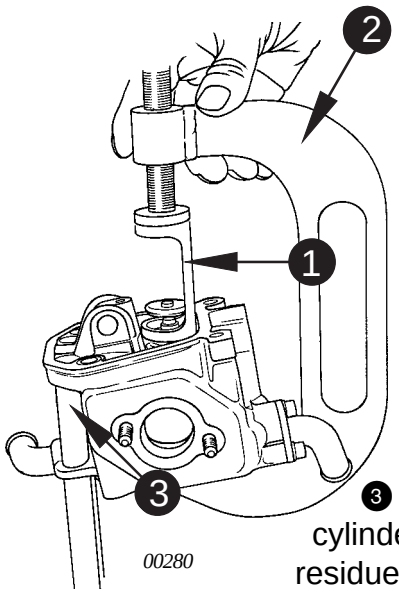
Pic. 244

14.5.1) Cylinder head - disassembly

See Pic. 245.

If the cylinder head is not removed but the rocker arms should be dismantled, turn crankshaft to set the piston of the respective cylinder to ignition T.D.C. and thus only little pressure remains on the rocker arm. Depress rocker arm with test lever *877 690* towards hydraulic valve tappet. Now the rocker arm is completely released and the rocker arm shaft can be removed.

◆ NOTE: The hexagon of the cap nut may be in an unfavourable position as to prevent removal of the rocker arm shaft. In this case loosen the nut.



Pic. 245

Withdraw rocker arm shaft and remove both rocker arms.

Compress valve springs utilizing valve spring mounting device ❶, part no. *877 380* and clamp ❷ or similar tool and lift out valve cotters. Release valve spring. Remove valve spring retainer and both springs, and withdraw valve.

◆ NOTE: Prior to removal of valves, clear burrs which may be present on valve stems to prevent damage to valve stem seal and valve guide. Mark valves coordinately.

Repeat procedure for the second valve. Clean cylinder head.

Check oil return tubes for leaks (visual check). If leaking in the area ❸ the respective tubes must be renewed. For this procedure heat the cylinder head to approx. 180° C (360° F). Extract tubes and remove any glue residues from bore. Apply LOCTITE 648 on oil tubes in the area of the two grooves and twist and push tube into position in the preheated cylinder head.

◆ NOTE: Apply LOCTITE only on the cold part!

At renewal of bent socket for coolant, mark its position, heat cylinder head to approx. 80° C (176 °F) and turn out socket. Remove residues of securing agent and check threads. Apply LOCTITE 648 on cylinder head and on bent socket and turn socket into the cold cylinder head. Let cylinder cure for approx. 10 minutes at 80° C (176° F).

If there are oil carbon residues on the sealing face with cylinder, remove them carefully. Check sealing face for planeness.

◆ NOTE: At re-assembly coat cylinder sealing face thinly with LOCTITE 221.

At slight wear, valve and valve seat may be seal-lapped, using emery paste. Because of seat armour, restrict lapping to 0,2 mm (.008 in.) max.

Clean cylinder head and single components in gasoline or kerosine. Check sealing face of cylinder head, and if need be, true up along with cylinder, but only slight rework is allowed.

Renew valve stem seals. If the engine has been "run hot", check in any case hardness of cylinder head material, see Chapter 12.4.6).

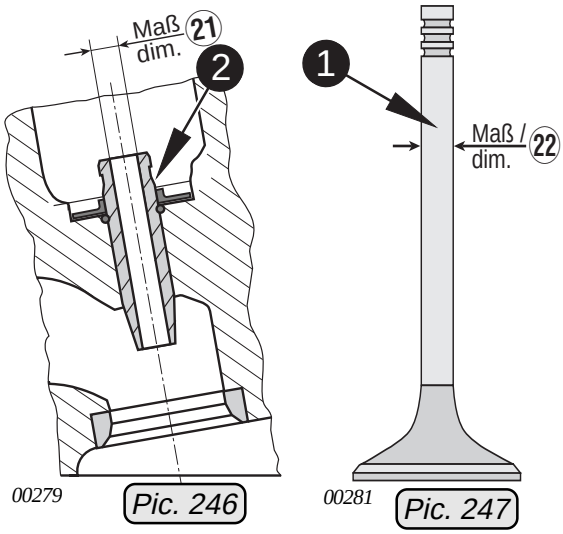
14.5.2) Valve guides

See Pic. 246 and 241.

Check diameter of valve stem ❶ and int. dia. of valve guide ❷ (dimension ㉒ and dim. ㉑):

If wear limit is reached, renew valve guide.

For this procedure sent the cylinder head to an authorized overhaul facility.



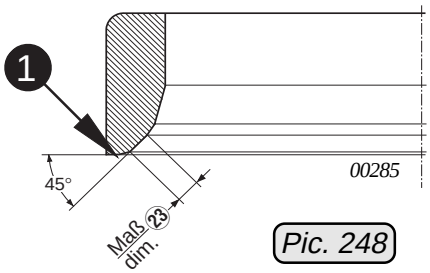
Dimension	new	wear limit

See Wear Limits, Chapter 15).

14.5.3) Valve seats

See Pic. 248.

Ensure that the sealing faces ❶ of valve seats are clean. If need be, relap using emery paste, see Chapter 11.7.16). Check sealing face width, dimension ㉓, see Chapter 15). At presence of burned spots or deformation, send cylinder head for overhaul to an authorized overhaul facility.



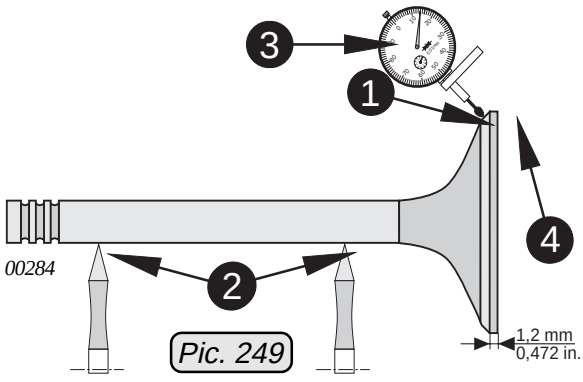
Dimension	new	wear limit

See Wear Limits, Chapter 15).

14.5.4) Valves

See Pic. 249.

Clean valves and check valve head ❶ for wear. Place valve on V-blocks ❷ and check valve head out-of-true with dial gauge (max. admissible out-of-true, measured on valve head, see dimension ㉔ in Chapter 15).



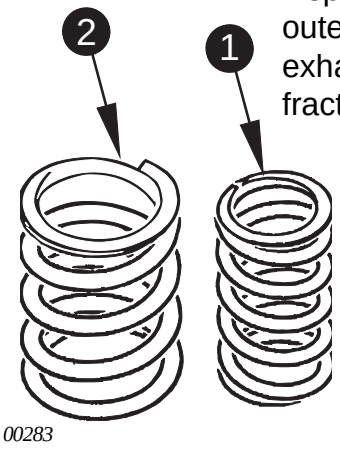
Sealing face of valve head is armoured. Therefore **do not** rework valve head. However, seal-lapping with emery paste is allowed, see Chapter 11.7.16). Renew valve as required. Minimum rim thickness ❹ 1,2 mm (0,047 in.). Check retaining grooves ❺ on valve stem. Check valve cotters, replace if necessary.

The exhaust valves (dia. 32 mm = 1,3 in.) are thermally higher stressed and therefore should be particularly checked. Seal-lap both valves and check for leakage.

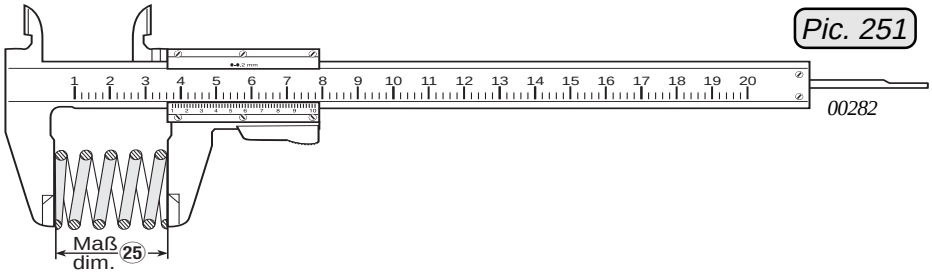
14.5.5) Valve springs

See Pic. 250 and 251.

2 springs per valve are fitted. The inner spring ❶ is of 2,3 mm thick wire, the outer spring ❷ is of 3,5 mm thick wire. The same springs are on inlet and exhaust valves. Spring rate non-progressive. Visually check springs for fracture and deformation.



00283



00282

Pic. 251

Check free length of both springs, see dimension ㉕ in Chapter 15). Renew valves shorter than the minimum length.

Pic. 250

◆ NOTE: Actual spring length ought to be as equal as possible on inlet- and outlet side. If need be, renew.

Dimensions	new	wear limit

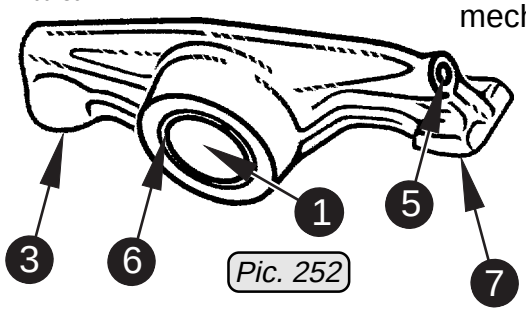
See Wear Limits, Chapter 15).

14.5.6) Rocker arms

See Pic. 252 and 253.

The rocker arm bearing surface ❶ is lubricated via the hollow push rod ❷ to the ball cup ❸. The oil flows through the bores ❹ in the rocker arm. The oil exit and in consequence the splash oil lubrication of the complete valve mechanism is via bore ❺. The rocker arms for inlet and outlet are different.

00286

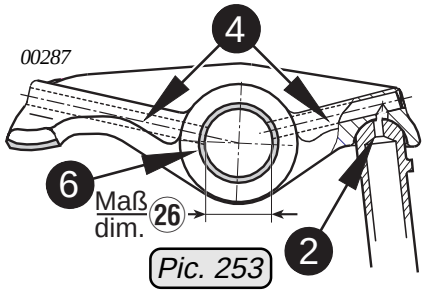


Pic. 252

Check surface of rocker arm shaft and bearing bush ❻ for wear. Visually check valve stem contact area ❼ and ball cup ❸ of rocker arm. Excessive signs of wear indicate lack of oil. Slight rework of contact area ❼ on rocker arm is allowed. Check oil bore ❹ for free passage.

The bearing bush ❻ can be renewed. Knock out old bearing bush with a suitable punch, clean both oil ducts ❹ and check for free passage with compressed air. Press in new bush so that the oil ducts in rocker arm and bearing bush align. After fitting of bearing bush, ream to dimension ㉖, see Chapter 15). Deburr bores and clean oil ducts with compressed air.

00287



Pic. 253

Dimension	new	wear limit

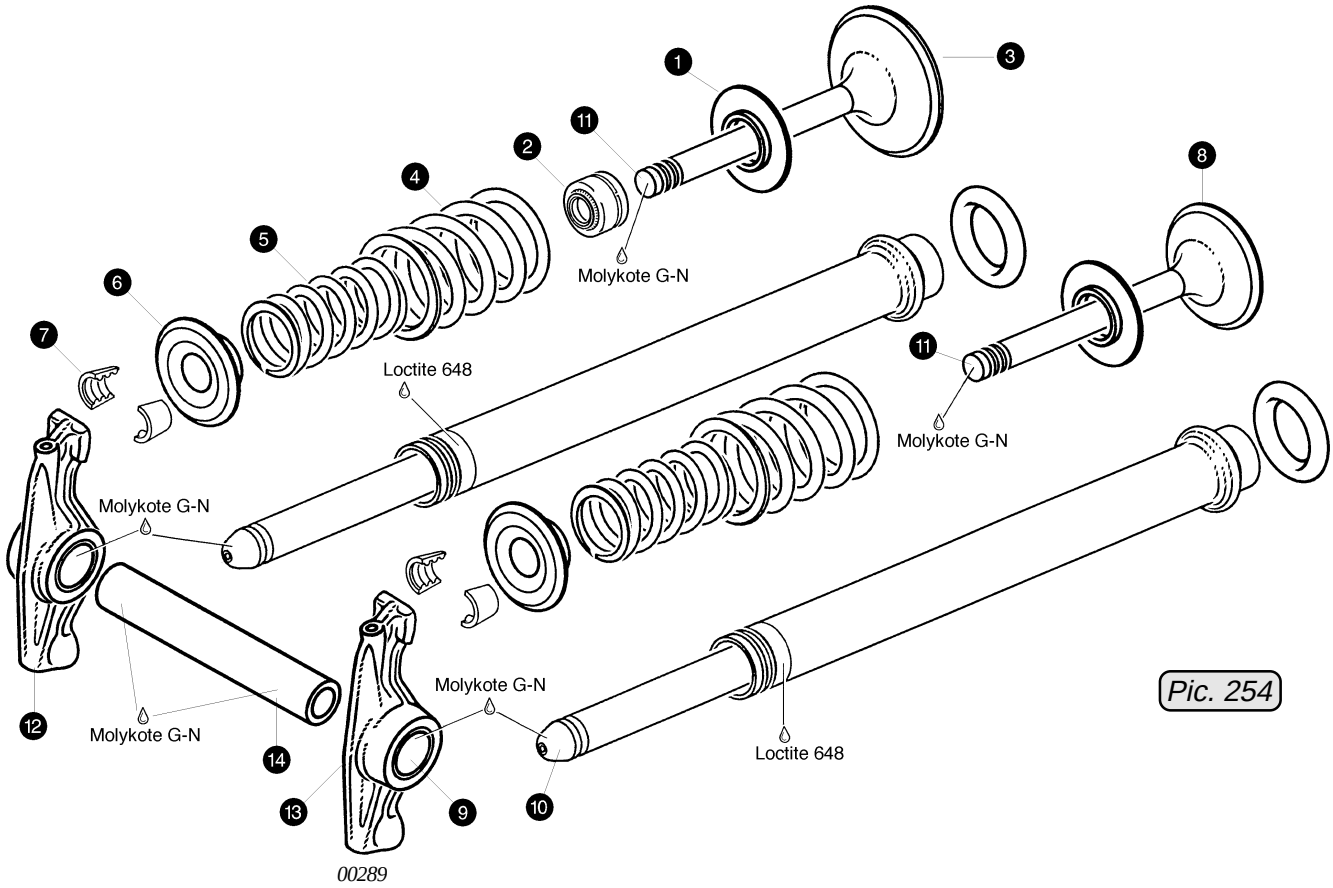
See Wear Limits, Chapter 15).

14.5.7) Re-assembly of cylinder head

See Pic. 254.

Place valve spring support ❶ in position and fit new valve stem seal ❷ on inlet side only. Insert pre-oiled inlet valve ❸ from outside into valve guide, place both valve springs (outer ❹ and inner ❺) and spring retainer ❻ in position. Compress valve springs by utilizing fitting jig and clamp. Insert valve cotters ❼ and release springs (see Chapter 14.5.1). Apply same procedure for outlet valve ❽.

◆ NOTE: Ensure correct positioning and equal gap of valve cotters.



Pic. 254

Apply MOLYKOTE G-N on rocker arm bore ❾, push rod head ❿, and valve contact surface ⓫. Position inlet rocker arm ⓬ and outlet rocker arm ⓭, apply MOLYKOTE G-N to both ends of rocker arm shaft ⓮ and push it into bearing support, see Chapter 11.7.5).

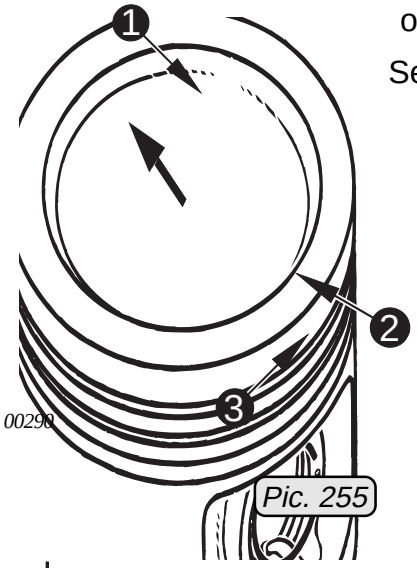
◆ NOTE: The rocker arm bearing support is a slide fit. Do not act with force!

Lubricate all moving internal parts with engine oil (see Chapter 11.7.1, 13.2.10 and 13.2.11).

14.6) Cylinder and piston - removal

See Pic. 255 and 256.

◆ NOTE: Prior to removal, mark cylinders and pistons to ensure correct coordination at re-assembly. Cylinders are identical, pistons have offset centres of pin to piston!

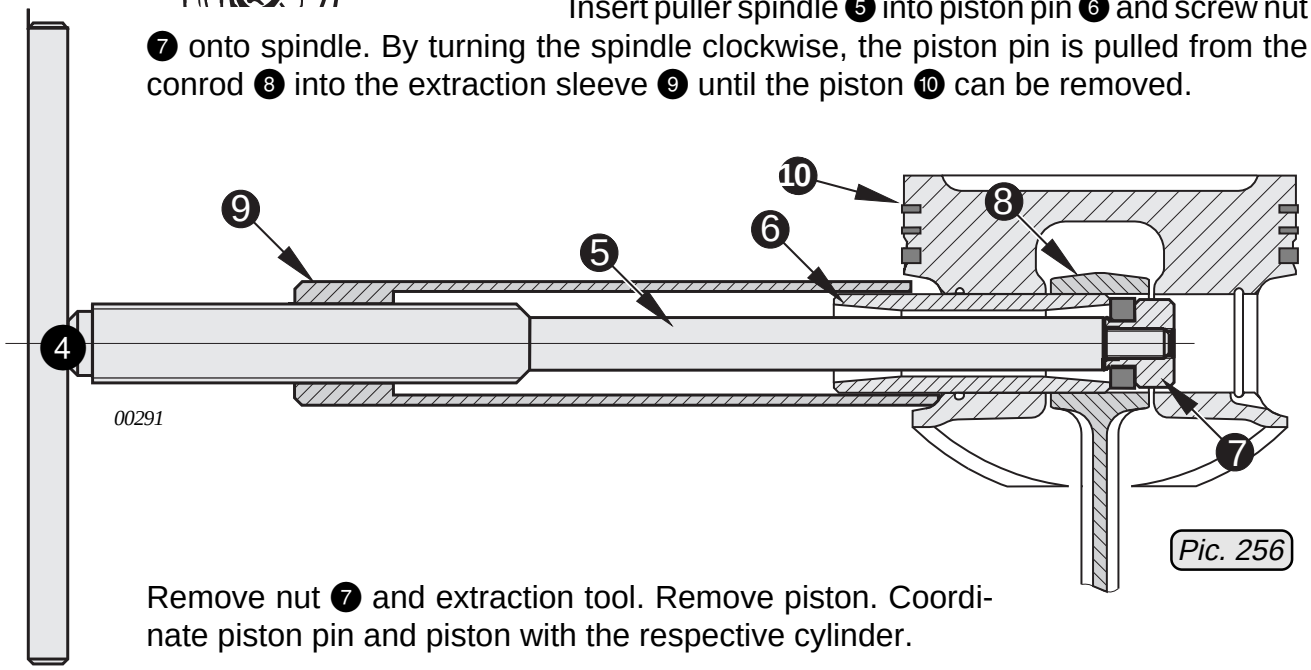


Pic. 255

Set piston to top dead centre position and make an arrow ❶ facing towards gearbox. This arrow faces on all 4 cylinders towards gearbox and serves for correct installation of the pistons with offset centres.

Withdraw cylinder carefully, support it by hand to avoid damaging piston and piston rings. After moving circlips ❷ in the groove to 9 o`clock or 3 o`clock position, remove piston pin circlips by a specially shaped screw-driver ❸, see Chapter 11.4).

Push out piston pin using guide punch, part no. *877 016*. If the piston pin is tight, it can be withdrawn with extraction tool ❹, part no. *877 090*, see Chapter 11.6). Insert puller spindle ❺ into piston pin ❻ and screw nut ❼ onto spindle. By turning the spindle clockwise, the piston pin is pulled from the conrod ❽ into the extraction sleeve ❾ until the piston ❿ can be removed.



Pic. 256

Remove nut ❼ and extraction tool. Remove piston. Coordinate piston pin and piston with the respective cylinder.

14.6.1) Piston checking

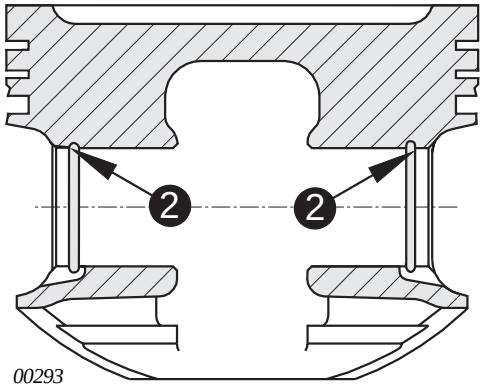
See Pic. 257 and 258.

On engine type 914 F cast light alloy, full skirt pistons are used. The piston axis is offset by 1 mm (.039 in.).

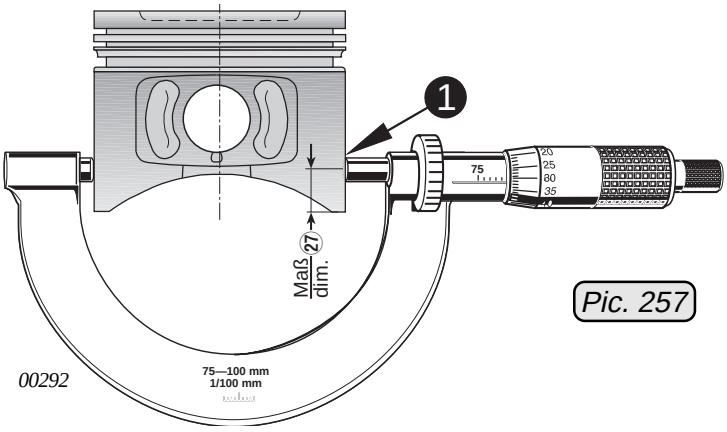
Remove piston rings using a pair of piston ring pliers. Make absolutely sure to re-fit rings in their initial position. Check piston rings and ring grooves for oil carbon residues. The best way to clean piston ring grooves is by using a piece of a broken ring. Increased amount of residue is to be expected when using AVGAS 100LL. Remove carbon deposits from piston crown.

Visually check and measure piston. Piston and/or cylinder must be renewed if piston to wall clearance exceeds 0,1 mm (.004 in.). To determine this clearance, measure cylinder bore by internal caliper with dial gauge, to find the biggest piston dia. use micrometer (most probably found at the position ❶ depicted), see dimension ㉗ in Chapter 15).

Comparing the 2 dimensions — smallest cylinder dia. less biggest piston skirt dia. — is the piston to cylinder wall.



Pic. 258



Pic. 257

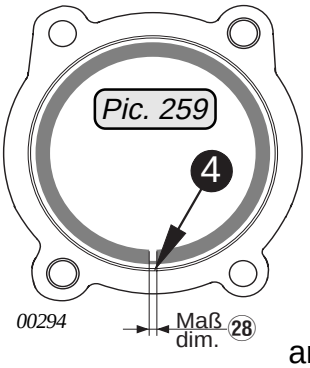
Check the groove ❷ for piston pin securing. At presence of a burr remove it carefully. If the groove is excessively worn (> 0,3 mm = .012 in.), renew piston.

There are 2 tolerance groups, red and green (piston marked with a red or green colour dot). Difference is 0,01 mm. The "red" piston is the smaller one. Oversize pistons are not planned. The piston is supplied only complete with 3 rings.

14.6.2) Piston ring checking

See Pic. 259, 260 and 261.

Check cleaned piston rings for correct end gap and flank clearance. With the rings ❶ fitted on piston, measure flank clearance with a feeler gauge ❷. Increased amount of residues in the spiral spring ❸ of oil scraper ring indicates use of AVGAS 100LL.

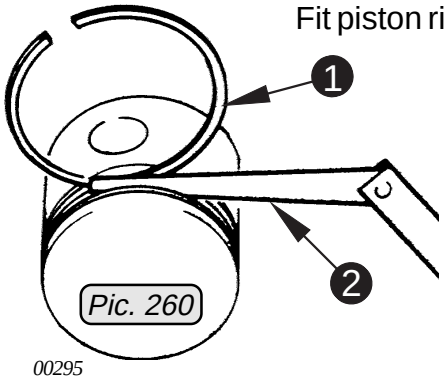


Pic. 259

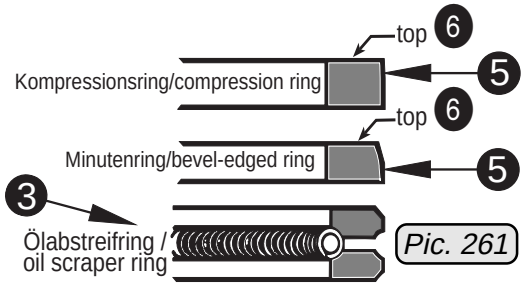
To determine ring end gap ❹, remove ring from the piston using piston ring pliers, insert cleaned ring into a new cylinder. Use a piston as pusher to align piston squarely in cylinder. Push ring down to approx. 10 mm (3/8 ") from top rim of cylinder, measure ring end gap ❹ by feeler gauge ❷, see dimension ㉘ in Chapter 15).

At inspection of ring surface ❺ the portion of surface contact can be seen and indicates the wear.

Fit piston rings using piston ring pliers, with marking ❻ "TOP" or the dot mark towards piston crown.



Pic. 260



Pic. 261

00296

14.6.3) Dimensions of pistons and piston rings

See Pic. 256, 259, 260 and 261.

dimensions	new	wear limit

See Wear Limits, Chapter 15).

14.6.4) Piston pin

Measure piston pin and check for traces of seizure in area of con-rod seat. In case of distinct traces of seizure, renew piston pin even if dimensions are correct.

dimensions	new	wear limit

See Wear Limits, Chapter 15).

The circlips for axial piston pin securing must be used only once and therefore must be renewed.

14.6.5) Cylinder checking

See Pic. 262 and 263.

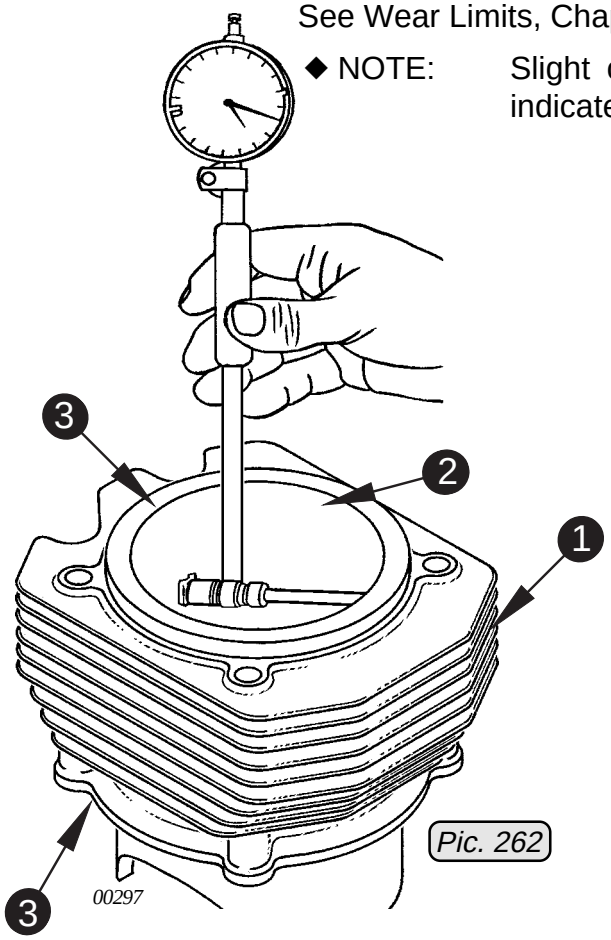
Nickel-silicon coated cylinder wall. All 4 cylinders are identical. Clean cooling fins ❶ of cylinder. Remove carbon deposits from top end ❷ of cylinder bore. Clean sealing faces ❸ on top and bottom side and inspect cylinder.

Measure cylinders as per illustration and record dimensions in the Dimension Sheet, Chapter 16). Determine piston to wall clearance, see Chapter 14.6.1). If the wear limit of the cylinder is reached, renew cylinder and piston.

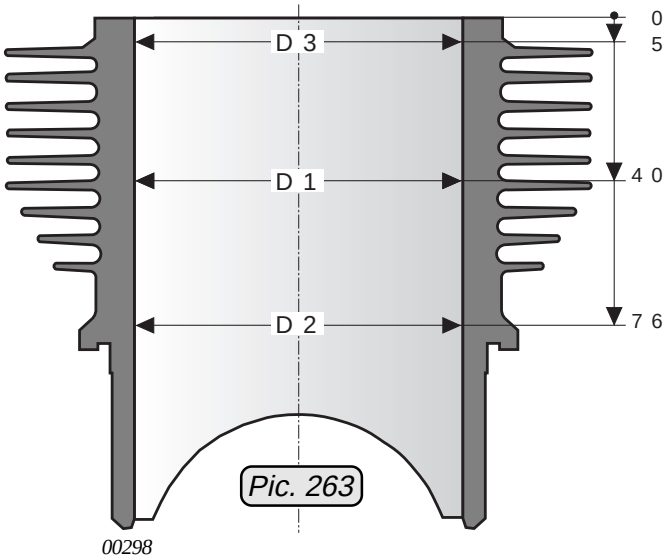
Dimensions	new	wear limit

See Wear Limits, Chapter 15).

◆ NOTE: Slight oil carbon residues on the cylinder sealing face indicate leakage. True up cylinder along with cylinder head.



Pic. 262



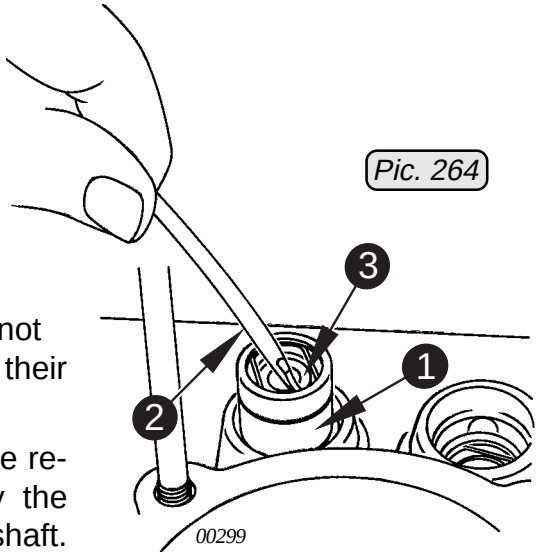
Pic. 263

14.7) Hydraulic valve tappets

See Pic. 264, 265 and 266.

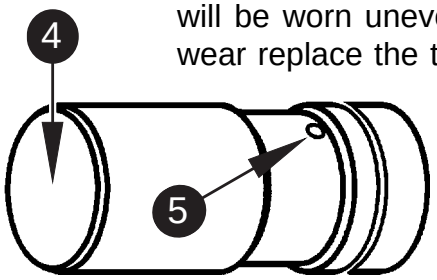
Remove valve tappet ❶ from crankcase using a specially shaped screwdriver ❷. Never engage at circlip ❸. This could cause valve tappet to fall apart.

■ ATTENTION: Lay aside tappets in a manner to ensure refitting in their initial place.



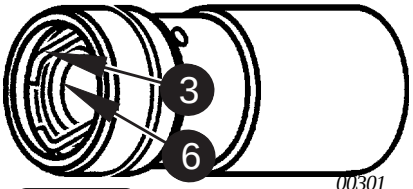
Pic. 264

Check valve tappet visually. The tappet rotates during operation. Therefore the cam contact surface ❹ is worn evenly. If the tappet does not rotate, the contact face will be worn unevenly. In case of uneven wear replace the tappet. The tappets are not allowed to be ground on their face!



Pic. 265

If a valve tappet must be replaced, check carefully the respective cam on camshaft. Taking apart valve tappets is not planned and not necessary.



Pic. 266

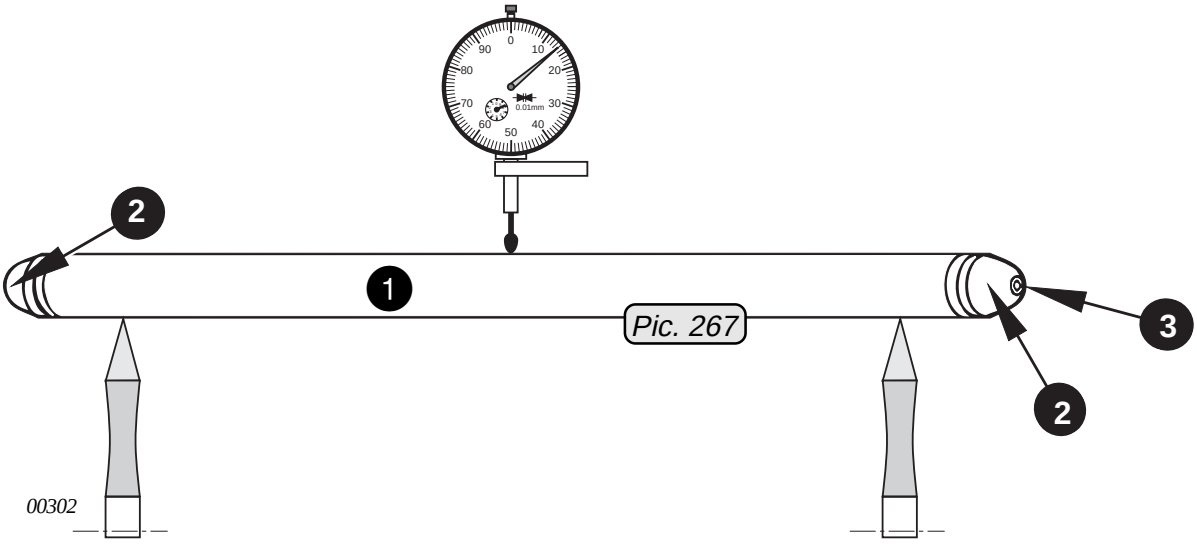
The new valve tappet is supplied dry and will fill itself full with oil during starting procedure. Oil enters the valve tappet through bore ❺. The securing ring ❸ keeps the valve tappet plunger ❻ in position when the tappet is removed.

■ ATTENTION: The first cranking of a repaired engine should be without ignition, until the required oil pressure is built up.

14.8) Push rods

See Pic. 267.

Clean push rods ❶ and inspect them visually. Pay attention to tight fit of the two ball heads ❷ pressed into the rod. Excessive engine speed may have caused bending of the push rods. Check push rods for straightness. Through the bores ❸ oil passes from the valve tappet to the rocker arm.



Pic. 267

14.9) Fitting of piston and cylinder assembly

14.9.1) Fitting of hydraulic valve tappets

Lubricate bearing bore for valve tappets in crankcase. Apply LOCTITE Anti-Seize to the contact surfaces of the valve tappets, lubricate their outside and insert them according to the recorded position into the crankcase. The valve tappet must be able to turn in the crankcase without resistance.

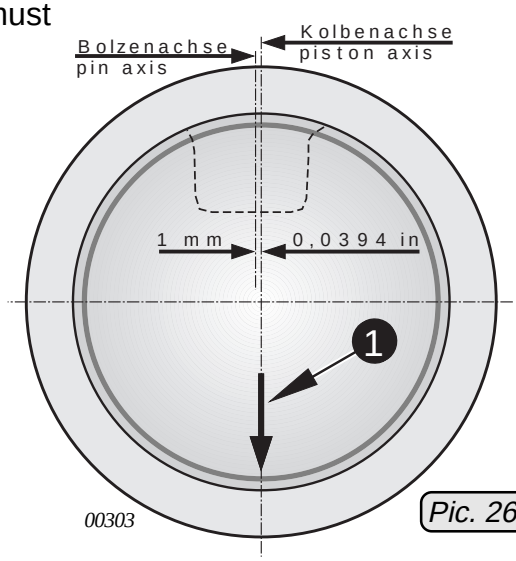
14.9.2) Fitting of pistons

See Pic. 268, 269, 270, 271, 272 and 273.

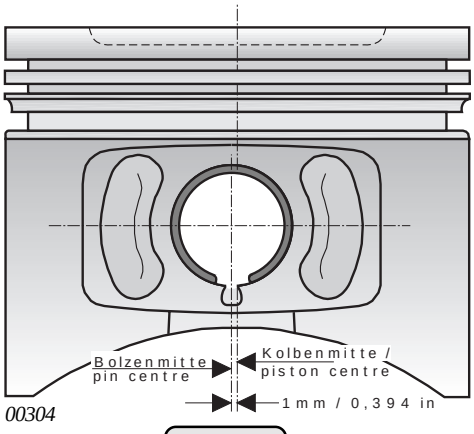
The piston pin centre is offset from piston centre. At installation of the pistons the arrow ❶ on the piston crown has to point toward prop shaft. Therefore on the pistons for cylinder no. **1** and **3** the offsetting (narrower side ❷) of piston faces downwards, on cylinders **2** and **4** the offsetting (narrower side ❸) faces upwards.

Install the piston as shown on Pic. beside. The offsetting of piston pin bore is 1 mm (.039 in.).

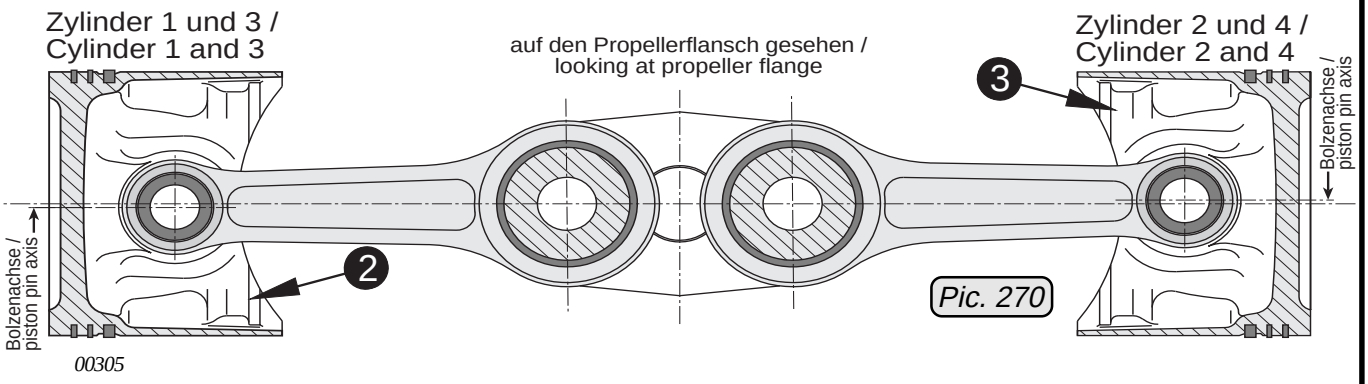
If the arrow ❶ on piston crown is no more visible, the piston must be measured.



Pic. 268



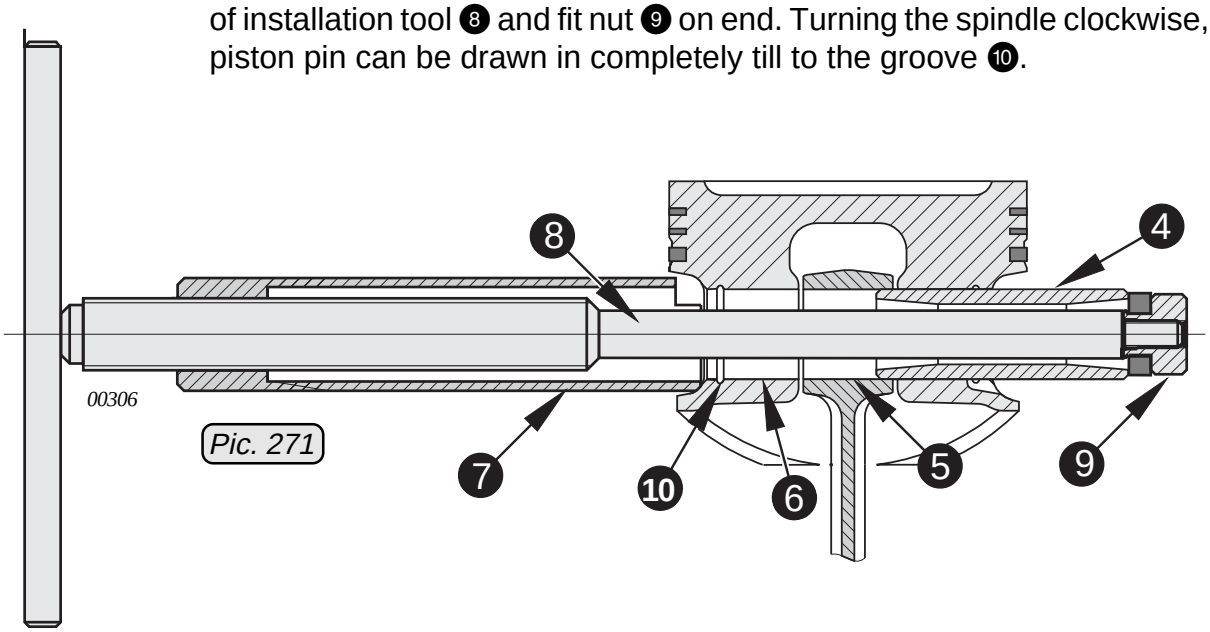
Pic. 269



Pic. 270

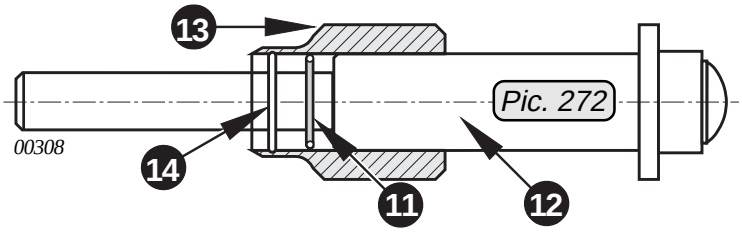
Apply MOLYKOTE G-N slide paste on the piston pin ❹. Also coat bore ❺ in conrod and bore ❻ in piston with MOLYKOTE G-N. Insert piston pin with guide punch *877 011* (slide fit).

If this is not possible, the piston pin can be pulled in with the installation tool ❼ *877 016*. Insert piston pin into one side of the piston bore, insert spindle of installation tool ❽ and fit nut ❾ on end. Turning the spindle clockwise, the piston pin can be drawn in completely till to the groove ❿.



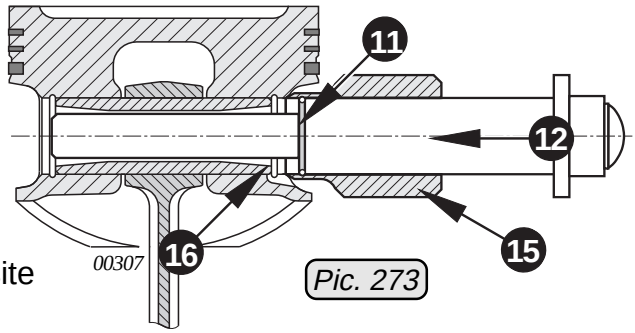
Pic. 271

Fit piston pin circlips with circlip installation tool *877 016*. For this procedure push the circlip ⓫ with the insertion jig ⓬ into the locating sleeve ⓭ until it engages in the groove ⓮.



Pic. 272

Now position the complete circlip installation tool ⓯ on the piston. Support piston with hand and push circlip ⓫ with a strike to the insertion jig ⓬ into the groove ⓰ of the piston. Apply same procedure on the opposite side of the piston.



Pic. 273

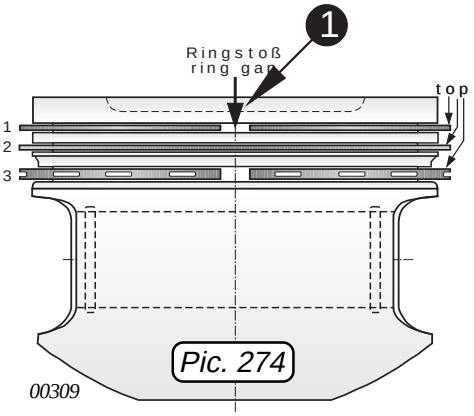
■ ATTENTION: The opening of circlip must show downward, to 6^{h} position, to maintain tangential force of the circlip.

▲ WARNING: Always use new piston pin circlips!

14.9.3) Fitting of cylinder

See Pic. 274.

Place O-ring 87x2 on cylinder spigot and lubricate cylinder. Pay attention to position of piston ring gaps ❶. The gap of the 1st and 3rd piston ring should be in the middle of piston skirt, and the 2nd ring be turned by 180°. The ring gap should never be in the area of the piston pin bore.



Pic. 274

Check whether piston pin circlips are installed. Lubricate piston, compress rings with piston ring spanner and fit the coordinated cylinder with care. Same procedure with the other cylinders.

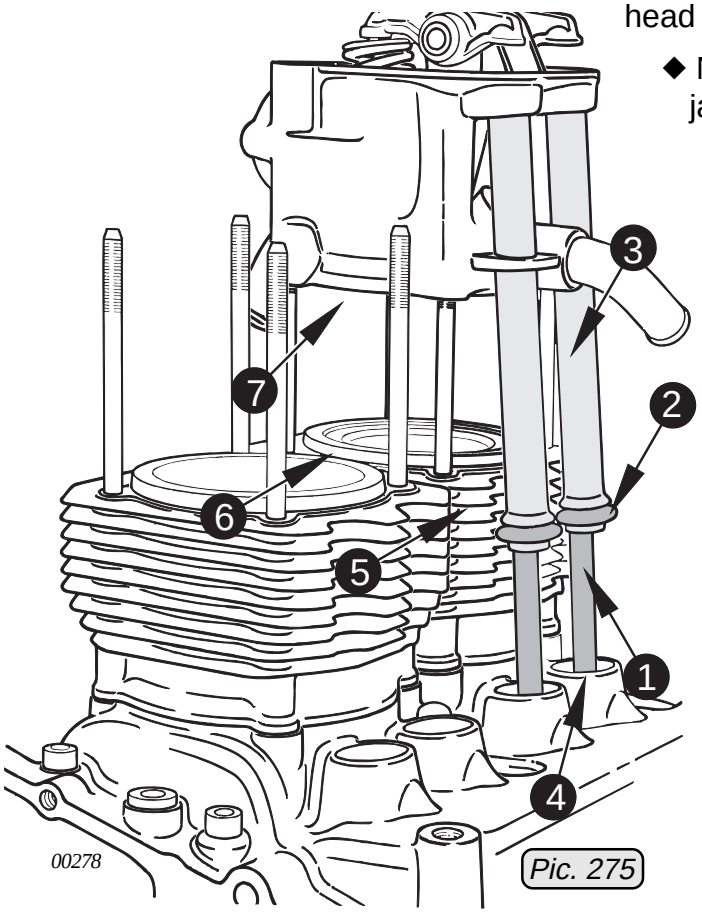
■ ATTENTION: To avoid ring breakage, use piston ring spanner, part no. *876 978.*

14.9.4) Fitting of cylinder head

See Pic. 275, 276 and 277.

Apply a thin film of LOCTITE 221 to sealing face of cylinder. Install respective pushrod ❶ in both oil return tubes on pre-assembled cylinder head and place pre-oiled O-ring ❷ 16x5 on oil return tube ❸.

Fit cylinder head until O-rings ❷ on both oil return tubes rest in crankcase ❹. Now lift cylinder ❺ until the centering ❻ of cylinder engages in the cylinder head recess ❼.



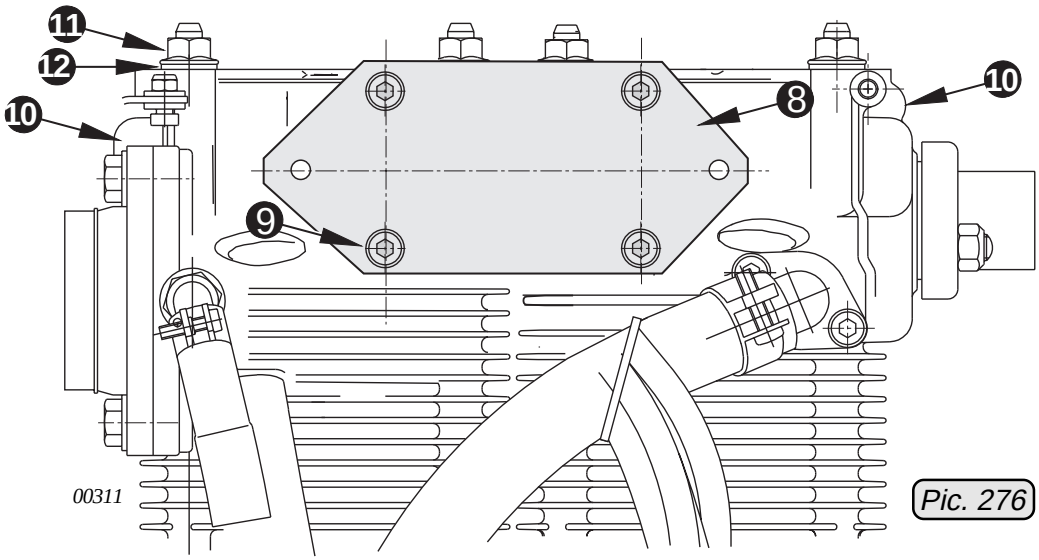
Pic. 275

◆ NOTE: This is a safety measure to prevent jamming of cylinder head resulting in leakage.

Fit cylinder head and cylinder together on crankcase. Tighten cylinder head crosswise with 2 cap nuts M8 and 2 hex. nuts M8 along with washers, tightening slightly only! Ensure to squeeze O-rings ❷ evenly into crankcase.

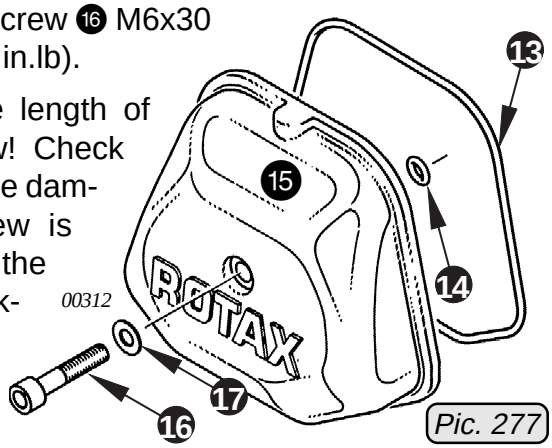
Repeat this procedure on the other cylinder heads.

Attach cylinder aligning tool ❽, part no. *877 260,* to intake flange of cylinder heads ❿ by 4 screws ❾ M6x25. Align cylinder heads, thus warranting a plane support for intake manifold. Fit cap nut and collar nut ⓫ along with washer ⓬ and tighten cylinder heads crosswise to 22 Nm (195 in.lb). Remove 4 screws ❾ and cylinder aligning tool.



Pic. 276

Lubricate all moving parts in rocker arm compartment. Place O-ring ⓭ 105x2,5 and O-ring ⓮ 6,4x1,8 on valve cover ⓯, put cover in position and tighten Allen screw ⓰ M6x30 along with washer ⓱ to 10 Nm (90 in.lb).



Pic. 277

■ ATTENTION: Never change the length of valve cover screw! Check whether threads are damaged. If this screw is loose or worn or if the valve cover is leaking, the oil return to the oil tank by "blow-by gas" will not work at all or only only insuffiently.

Screw in resistance spark plugs and tighten to 20 Nm (180 in.lb). Fit spark plug connectors according to coding sleeves on spark plugs, see Chapter 13.4.14).

◆ NOTE: Proceed as per Wiring Diagram.

14.10) Fitting of coolant hoses

See Pic. 5.

Fix all coolant hoses coming from expansion tank to the coolant exit on cylinder heads with hose clamps 23 mm (.905 in.). Also fit the coolant hoses between water pump and coolant entry into cylinder heads with hose clamps 23 mm (.905 in.).

◆ NOTE: Position the hose clamps so that no neighbouring coolant hoses can be damaged.

14.11) Fitting of intake manifolds

See Pic. 012 and 106.

Place both intake manifolds showing inwards, together with O-rings 34-2 on cylinder head and attach with Allen screws M6x25 and M6x70. Torque to 10 Nm (90 in.lb), see also Chapter 13.4.15).

Tighten compensating tube and the hoses on both ends with hose clamps 15/9. Attach fuel manifold with fuel lines on compensating tube, see also Chapter 13.1.5 and 13.1.8).

15) Wear limits for ROTAX 914 F

Designation	*new* mm	*new* (in.)	*wear limit* mm	*wear limit* (in.)	*actual dim.* int. / exh.
Cylinder/Piston					
cylinder bore **Cyl. 1**	79,50 ÷ 79,524	(3,13 ÷ 3,131)	79,58	(3,13)	
ovality	0,000 ÷ 0,007	(0,000÷ 0,0003)	0,05	(0,002)	
conicity	0,000 ÷ 0,030	(0,000÷ 0,001)	0,06	(0,002)	
piston dia. (at height 15 mm) ㉗	79,495 ÷ 79,515	(3,130÷ 3,131)	79,39	(3,126)	
piston to cylinder clearance	0,000 ÷ 0,020	(0,000÷0,0008)	0,13	(0,005)	
cylinder bore **Cyl. 2**	79,50 ÷ 79,524	(3,13 ÷ 3,131)	79,58	(3,13)	
ovality	0,000 ÷ 0,007	(0,000÷ 0,0003)	0,05	(0,002)	
conicity	0,000 ÷ 0,030	(0,000÷ 0,001)	0,06	(0,002)	
piston dia. (at height 15 mm) ㉗	79,495 ÷ 79,515	(3,130÷ 3,131)	79,39	(3,126)	
piston to cylinder clearance	0,000 ÷ 0,020	(0,000÷0,0008)	0,13	(0,005)	
cylinder bore **Cyl. 3**	79,50 ÷ 79,524	(3,13 ÷ 3,131)	79,58	(3,13)	
ovality	0,000 ÷ 0,007	(0,000÷ 0,0003)	0,05	(0,002)	
conicity	0,000 ÷ 0,030	(0,000÷ 0,001)	0,06	(0,002)	
piston dia. (at height 15 mm) ㉗	79,495 ÷ 79,515	(3,130÷ 3,131)	79,39	(3,126)	
piston to cylinder clearance	0,000 ÷ 0,020	(0,000÷0,0008)	0,13	(0,005)	
cylinder bore **Cyl. 4**	79,50 ÷ 79,524	(3,13 ÷ 3,131)	79,58	(3,13)	
ovality	0,000 ÷ 0,007	(0,000÷ 0,0003)	0,05	(0,002)	
conicity	0,000 ÷ 0,030	(0,000÷ 0,001)	0,06	(0,002)	
piston dia. (at height 15 mm) ㉗	79,495 ÷ 79,515	(3,130÷ 3,131)	79,39	(3,126)	
piston to cylinder clearance	0,000 ÷ 0,020	(0,000÷0,0008)	0,13	(0,005)	
piston pin bore **Cyl. 1**	20,001 ÷ 20,005	(0,7874÷0,7876)	20,04	(0,789)	
piston pin	19,992 ÷ 19,995	(0,7870÷0,7872)	19,97	(0,786)	
clearance, pin in piston	0,006 ÷ 0,013	(0,0002÷0,0005)	0,05	(0,002)	
con-rod bore, small end	20,010 ÷ 20,020	(0,787÷ 0,788)	20,04	(0,789)	
clearance, pin in con-rod	0,015 ÷ 0,028	(0,0006÷0,001)	0,05	(0,002)	
piston pin bore **Cyl. 2**	20,001 ÷ 20,005	(0,7874÷0,7876)	20,04	(0,789)	
piston pin	19,992 ÷ 19,995	(0,7870÷0,7872)	19,97	(0,786)	
clearance, pin in piston	0,006 ÷ 0,013	(0,0002÷0,0005)	0,05	(0,002)	
con-rod bore, small end	20,010 ÷ 20,020	(0,787÷ 0,788)	20,04	(0,789)	
clearance, pin in con-rod	0,015 ÷ 0,028	(0,0006÷0,001)	0,05	(0,002)	
piston pin bore **Cyl. 3**	20,001 ÷ 20,005	(0,7874÷0,7876)	20,04	(0,789)	
piston pin	19,992 ÷ 19,995	(0,7870÷0,7872)	19,97	(0,786)	
clearance, pin in piston	0,006 ÷ 0,013	(0,0002÷0,0005)	0,05	(0,002)	
con-rod bore, small end	20,010 ÷ 20,020	(0,787÷ 0,788)	20,04	(0,789)	
clearance, pin in con-rod	0,015 ÷ 0,028	(0,0006÷0,001)	0,05	(0,002)	
piston pin bore **Cyl. 4**	20,001 ÷ 20,005	(0,7874÷0,7876)	20,04	(0,789)	
piston pin	19,992 ÷ 19,995	(0,7870÷0,7872)	19,97	(0,786)	
clearance, pin in piston	0,006 ÷ 0,013	(0,0002÷0,0005)	0,05	(0,002)	
con-rod bore, small end	20,010 ÷ 20,020	(0,787÷ 0,788)	20,04	(0,789)	
clearance, pin in con-rod	0,015 ÷ 0,028	(0,0006÷0,001)	0,05	(0,002)	
Piston rings, Cyl.1					
1st compression ring					
height of groove	1,52 ÷ 1,54	(0,059÷0,061)	1,6	(0,063)	
height of ring	1,478 ÷ 1,49	(0,058÷0,059)	1,45	(0,057)	
ring / groove clearance	0,03 ÷ 0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15 ÷ 0,35	(0,006÷0,014)	1,0	(0,04)	

Designation	*new* mm			*new* (in.)	*wear limit* mm	*wear limit* (in.)	*actual dim.* int. / exh.
2nd compression ring (bevel-edged)							
height of groove	1,27	÷	1,29	(0,050÷0,051)	1,35	(0,053)	
height of ring	1,228	÷	1,24	(0,048÷0,049)	1,20	(0,047)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,3	÷	0,5	(0,011÷0,02)	1,0	(0,04)	
3rd ring (oil scraper ring)							
height of groove	3,01	÷	3,03	(0,118 ÷0,119)	3,1	(0,122)	
height of ring	2,975	÷	2,99	(0,117 ÷0,118)	2,95	(0,116)	
ring / groove clearance	0,02	÷	0,045	(0,0008÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,40	(0,006 ÷0,016)	1,0	(0,04)	
Piston rings, Cyl.2							
1st compression ring							
height of groove	1,52	÷	1,54	(0,059÷0,061)	1,6	(0,063)	
height of ring	1,478	÷	1,49	(0,058÷0,059)	1,45	(0,057)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,35	(0,006÷0,014)	1,0	(0,04)	
2nd compression ring (bevel-edged)							
height of groove	1,27	÷	1,29	(0,050÷0,051)	1,35	(0,053)	
height of ring	1,228	÷	1,24	(0,048÷0,049)	1,20	(0,047)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,3	÷	0,5	(0,011÷0,02)	1,0	(0,04)	
3rd ring (oil scraper ring)							
height of groove	3,01	÷	3,03	(0,118 ÷0,119)	3,1	(0,122)	
height of ring	2,975	÷	2,99	(0,117 ÷0,118)	2,95	(0,116)	
ring / groove clearance	0,02	÷	0,045	(0,0008÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,40	(0,006 ÷0,016)	1,0	(0,04)	
Piston rings, Cyl. 3							
1st compression ring							
height of groove	1,52	÷	1,54	(0,059÷0,061)	1,6	(0,063)	
height of ring	1,478	÷	1,49	(0,058÷0,059)	1,45	(0,057)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,35	(0,006÷0,014)	1,0	(0,04)	
2nd compression ring (bevel-edged)							
height of groove	1,27	÷	1,29	(0,050÷0,051)	1,35	(0,053)	
height of ring	1,228	÷	1,24	(0,048÷0,049)	1,20	(0,047)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,3	÷	0,5	(0,011÷0,02)	1,0	(0,04)	
3rd ring (oil scraper ring)							
height of groove	3,01	÷	3,03	(0,118 ÷0,119)	3,1	(0,122)	
height of ring	2,975	÷	2,99	(0,117 ÷0,118)	2,95	(0,116)	
ring / groove clearance	0,02	÷	0,045	(0,0008÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,40	(0,006 ÷0,016)	1,0	(0,04)	
Piston rings, Cyl. 4							
1st compression ring							
height of groove	1,52	÷	1,54	(0,059÷0,061)	1,6	(0,063)	
height of ring	1,478	÷	1,49	(0,058÷0,059)	1,45	(0,057)	
ring / groove clearance	0,03	÷	0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15	÷	0,35	(0,006÷0,014)	1,0	(0,04)	

Designation	*new* mm	*new* (in.)	*wear limit* mm	*wear limit* (in.)	*actual dim.* int. / exh.
2nd compression ring (bevel-edged)					
height of groove	1,27 ÷ 1,29	(0,050÷0,051)	1,35	(0,053)	
height of ring	1,228 ÷ 1,24	(0,048÷0,049)	1,20	(0,047)	
ring / groove clearance	0,03 ÷ 0,062	(0,001÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,3 ÷ 0,5	(0,011÷0,02)	1,0	(0,04)	
3rd ring (oil scraper ring)					
height of groove	3,01 ÷ 3,03	(0,118 ÷0,119)	3,1	(0,122)	
height of ring	2,975 ÷ 2,99	(0,117 ÷0,118)	2,95	(0,116)	
ring / groove clearance	0,02 ÷ 0,045	(0,0008÷0,002)	0,1	(0,004)	
ring end gap ㉘	0,15 ÷ 0,40	(0,006 ÷0,016)	1,0	(0,04)	
Cylinder head 1					
wear on valve seat	0		max. 0,3	(0,012)	
valve guide bore ㉑	7,006 ÷ 7,018	(0,275÷0,276)	7,15	(0,282)	
valve stem ㉒	6,965 ÷ 6,98	(0,274÷0,275)	6,94	(0,273)	
stem clearance	0,026 ÷ 0,053	(0,001÷0,002)	0,15	(0,006)	
sealing face width, inlet valve ㉓	1,40 ÷ 2,00	(0,055 ÷ 0,079)	2,40	(0,094)	
sealing face width, exhaust valve ㉓	1,50 ÷ 1,90	(0,059 ÷ 0,075)	2,50	(0,098)	
out-of-true on valve head ㉔	0,00 ÷ 0,01	(0,0 ÷0,0004)	0,03	(0,0012)	
rocker arm bore ㉖	12,000 ÷ 12,027	(0,472÷0,4735)	12,09	(0,476)	
rocker arm shaft	11,983 ÷ 11,994	(0,471÷0,472)	11,95	(0,470)	
rocker arm, radial clearance	0,006 ÷ 0,035	(0,0002÷0,001)	0,10	(0,004)	
depth of wear on contact face of valve stem	0		0,25	(0,01)	
free length, inner spring ㉕	35,0	(1,378)	34,0	(1,338)	
free length, outer spring ㉕	37,0	(1,457)	36,0	(1,417)	
spring rate, inner spring	13,25 N/mm				
spring rate, outer spring	33,25 N/mm				
Cylinder head 2					
wear on valve seat	0		max. 0,3	(0,012)	
valve guide bore ㉑	7,006 ÷ 7,018	(0,275÷0,276)	7,15	(0,282)	
valve stem ㉒	6,965 ÷ 6,98	(0,274÷0,275)	6,94	(0,273)	
stem clearance	0,026 ÷ 0,053	(0,001÷0,002)	0,15	(0,006)	
sealing face width, inlet valve ㉓	1,40 ÷ 2,00	(0,055 ÷ 0,079)	2,40	(0,094)	
sealing face width, exhaust valve ㉓	1,50 ÷ 1,90	(0,059 ÷ 0,075)	2,50	(0,098)	
out-of-true on valve head ㉔	0,00 ÷ 0,01	(0,0 ÷0,0004)	0,03	(0,0012)	
rocker arm bore ㉖	12,000 ÷ 12,027	(0,472÷0,4735)	12,15	(0,478)	
rocker arm shaft	11,983 ÷ 11,994	(0,471÷0,472)	11,95	(0,470)	
rocker arm, radial clearance	0,006 ÷ 0,035	(0,0002÷0,001)	0,15	(0,006)	
depth of wear on contact face of valve stem	0		0,25	(0,01)	
free length, inner spring ㉕	35,0	(1,378)	34,0	(1,338)	
free length, outer spring ㉕	37,0	(1,457)	36,0	(1,417)	
spring rate, inner spring	13,25 N/mm				
spring rate, outer spring	33,25 N/mm				
Cylinder head 3					
wear on valve seat	0		max. 0,3	(0,012)	
valve guide bore ㉑	7,006 ÷ 7,018	(0,275÷0,276)	7,15	(0,282)	
valve stem ㉒	6,965 ÷ 6,98	(0,274÷0,275)	6,94	(0,273)	
stem clearance	0,026 ÷ 0,053	(0,001÷0,002)	0,15	(0,006)	
sealing face width, inlet valve ㉓	1,40 ÷ 2,00	(0,055 ÷ 0,079)	2,40	(0,094)	
sealing face width, exhaust valve ㉓	1,50 ÷ 1,90	(0,059 ÷ 0,075)	2,50	(0,098)	
out-of-true on valve head ㉔	0,00 ÷ 0,01	(0,0 ÷0,0004)	0,03	(0,0012)	

Designation	new mm	new (in.)	wear limit mm	wear limit (in.)	actual dim. int. / exh.
Cylinder head 3 (continued)					
rocker arm bore ㉖	12,000 ÷ 12,027	(0,472 ÷0,4735)	12,09	(0,476)	
rocker arm shaft	11,983 ÷ 11,994	(0,471 ÷0,472)	11,95	(0,470)	
rocker arm, radial clearance	0,006 ÷ 0,035	(0,0002÷0,001)	0,10	(0,004)	
depth of wear on contact face of valve stem	0		0,25	(0,01)	
free length, inner spring ㉕	35,0	(1,378)	34,0	(1,338)	
free length, outer spring ㉕	37,0	(1,457)	36,0	(1,417)	
spring rate, inner spring	13,25 N/mm				
spring rate, outer spring	33,25 N/mm				
Cylinder head 4					
wear on valve seat	0		max. 0,3	(0,012)	
valve guide bore ㉑	7,006 ÷ 7,018	(0,275 ÷0,276)	7,15	(0,282)	
valve stem ㉒	6,965 ÷ 6,98	(0,274 ÷0,275)	6,94	(0,273)	
stem clearance	0,026 ÷ 0,053	(0,001 ÷0,002)	0,15	(0,006)	
sealing face width, inlet valve ㉓	1,40 ÷ 2,00	(0,055 ÷ 0,079)	2,40	(0,094)	
sealing face width, exhaust valve ㉓	1,50 ÷ 1,90	(0,059 ÷ 0,075)	2,50	(0,098)	
out-of-true on valve head ㉔	0,00 ÷ 0,01	(0,0 ÷0,0004)	0,03	(0,0012)	
rocker arm bore ㉖	12,000 ÷ 12,027	(0,472 ÷0,4735)	12,09	(0,476)	
rocker arm shaft	11,983 ÷ 11,994	(0,471 ÷0,472)	11,95	(0,470)	
rocker arm, radial clearance	0,006 ÷ 0,035	(0,0002÷0,001)	0,10	(0,004)	
depth of wear on contact face of valve stem	0		0,25	(0,01)	
free length, inner spring ㉕	35,0	(1,378)	34,0	(1,338)	
free length, outer spring ㉕	37,0	(1,457)	36,0	(1,417)	
spring rate, inner spring	13,25 N/mm				
spring rate, outer spring	33,25 N/mm				
Propeller gearbox					
wear depth on dogs	÷	0,00	0,20	(0,008)	
clearance dog ramp to valley ⑯	0,80 ÷ 1,20	(0,032 ÷ 0,047)	1,50	(0,059)	
thickness of thrust washer ⑰	1,075 ÷ 1,325	(0,042 ÷0,052)	1,00	(0,039)	
length of bearing sleeve, dog gear	29,6 ÷ 29,8	(1,165 ÷1,173)	29,0	(1,142)	
axial clearance of propeller shaft	0,02 ÷ 0,07	(0,0008÷0,0028)	0,30	(0,012)	
propeller shaft ø 35 mm ⑫	35,009 ÷ 35,02	(1,378 ÷1,379)	35,003	(1,378)	
propeller shaft ø 31,5 mm ⑬	31,491 ÷ 31,48	(1,240 ÷1,239)	31,460	(1,239)	
propeller shaft, internal dia. ⑮	11,00 ÷ 11,02	(0,433 ÷0,434)	11,05	(0,435)	
oil inlet flange, journal dia. ⑮	10,935 ÷ 10,96	(0,430 ÷0,431)	10,88	(0,428)	
radial clearance	0,04 ÷ 0,085	(0,0016÷0,003)	0,16	(0,006)	
prop. flange, axial out-of-true ø 122 ⑭	0,00 ÷ 0,05	(0,00 ÷0,002)	0,06	(0,002)	
dog clearance ⑯	1,00 ÷ 1,20	(0,039 ÷0,047)	0,50	(0,019)	
disk spring, free length ⑱	5,20 ÷ 5,40	(0,205 ÷0,213)	4,50	(0,177)	
gear backlash ⑳	0,07 ÷ 0,15	(0,003 ÷0,006)	0,20	(0,008)	
Crankshaft					
out-of-round, magneto side ①	0,00 ÷ 0,03	(0,00 ÷0,0012)	0,06	(0,002)	
out-of-round, p.t.o. side ②	0,00 ÷ 0,03	(0,00 ÷0,0012)	0,06	(0,002)	
bearing,magneto side ④	31,99 ÷ 32,00	(1,259 ÷1,260)	31,95	(1,258)	
ignition housing ③	32,02 ÷ 32,03	(1,261 ÷1,261)	32,10	(1,264)	
radial clearance, magneto side	0,02 ÷ 0,04	(0,0008÷0,0016)	0,12	(0,005)	
bearing, p.t.o. side ⑲	27,99 ÷ 28,00	(1,102 ÷1,102)	27,95	(1,100)	
gearbox cover ⑪	28,02 ÷ 28,03	(1,103 ÷1,104)	28,10	(1,106)	
radial clearance, p.t.o. side	0,02 ÷ 0,04	(0,0008÷0,0016)	0,12	(0,005)	

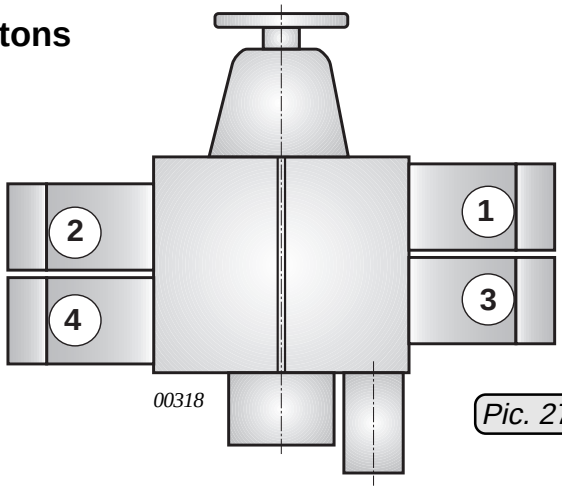
Designation	*new*				*wear limit*		*actual dim.*
	mm		*(in.)*		*mm*	*(in.)*	*int. / exh.*
Sprag clutch							
axial clearance ⑩	0,30	÷ 0,50	(0,012	÷0,019)	0,7	(0,028)	
Water pump							
impeller clearance ⑤	0,40	÷ 0,50	(0,016	÷0,019)	0,7	(0,028)	
Oil pump							
pump plunger, axial clearance ②	0,00	÷ 0,07	(0,0	÷0,028)	0,2	(0,008)	
Ignition unit							
spark plug, electrode gap ⑥	0,6	÷ 0,7	(0,024	÷0,028)	0,9	(0,035)	
gap ⑦ for "old type" trigger coil	0,4	÷ 0,5	(0,016	÷0,020)	0,5	(0,020)	
gap ⑦ for trigger coil with clamps	0,3	÷ 0,4	(0,012	÷0,016)	0,4	(0,016)	
trigger coil, axial offsetting ⑧	0,0	÷ 0,2	(0,000	÷0,008)	0,3	(0,012)	
Electric starter							
armature, axial clearance ⑨	0,1	÷ 0,2	(0,004	÷0,008)	0,3	(0,012)	
Push rod							
out of round ㉙	0,0	÷ 0,1	(0,0	÷ 0,004)	0,2	(0,008)	

16) Form Sheets — Rotax 914 ___ for engine no.: _____

16.1) Form Sheet for Cylinders and Pistons

Cylinder and piston position

(mark appropriate position on illustration ➔)

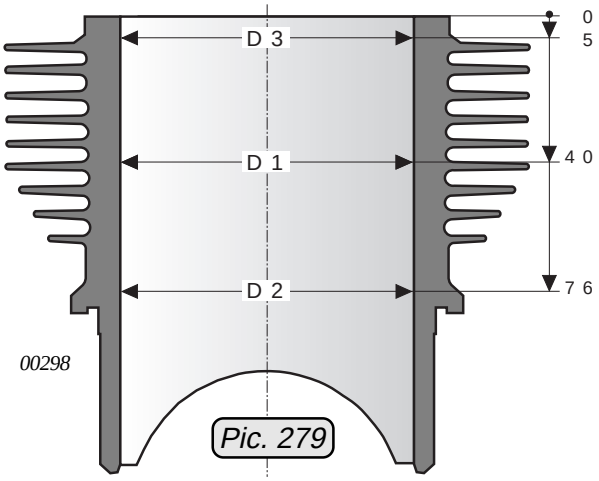


00318

Pic. 278

1) Cylinder

Checking of the dia. D_1, D_2 and D_3



00298

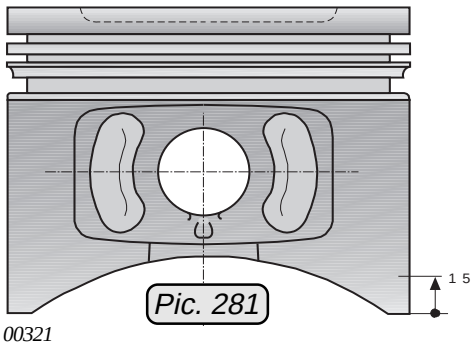
Pic. 279

dim.	nominal min.	nominal max.	wear limit	actual	re.
D_1 A	79,50 (3,12)	79,512 (3,13)	79,58 (3,1331)		
D_1 B	79,512 (3,13)	79,524 (3,131)	79,59 (3,1335)		
D_2	D_1 act.	D_1 act. +0,015 (+0,0006)			
D_3	D_1 act. -0,008 (-0,0003)	D_1 act +0,008 (+0,0003)			

00319

2) Piston

Weight with rings, but without piston pin ____g



Pic. 281

00321

Pic. 282

DN	nominal min. / max. mm (in.)	wear limit mm (in.)	actual	re.
red	79,495 / 79,505 (3,129 / 3,130)	79,39 (3,1256)		
green	79,505 / 79,515 (3,130 / 3,131)	79,40 (3,1260)		

00322

3) Grading and clearance

	clearance nominal	clearance wear limit mm (in.)	clearance actual	re.
cylinder A with piston "red"	0,00 ÷ 0,017 (÷ 0,001)	0,13 (0,05)		
cylinder B with piston "green"	0,00 ÷ 0,019 (÷ 0,001)	0,13 (0,05)		

00323

Pic. 283

Mechanic: _____ Date: _____

Tester: _____ Date: _____

Prüfprotokoll für Zündanlage / *Inspection protocol for ignition unit*

(mit "Klammergeber" / *with "clamps pick*

Formblatt Nr. KD-17-045/E-97 02 26

00320

Motor / ***Engine type:***	_____
Motor / ***Engine serial No.:***	_____
Zündanlage, Serien-Nr: / ***Ignition unit, serial no.:***	_____ **TSN:** _____ **TSO:** _____
Sichtkontrolle: / ***Visual check:***	_____

Geber-Zuordnung: / ***Pick-up coordination:***					
Zündspule: Einschaltdrehzahl		1T / 2T	3B / 4B	1B / 2B	3T / 4T
max. 220 1/min		1T / 2T	3T / 4T	1B / 2B	3B / 4B
Ignition coil: *start r.p.m. max. 220 r.p.m.*		_____	_____	_____	_____

Abstellkontrolle: Kreis **A** / ***Ignition stop check:*** *Circuit **A***	Zündfunke "AUS" / *Spark "OFF"*		
Abstellkontrolle: Kreis **B** / ***Ignition stop check:*** *Circuit **B***		Zündfunke "AUS" / *Spark "OFF"*	
Zündverstellung bei: (max. 1000 1/min) / ***Ignition variation at:*** *(max. 1000 r.p.m.)*	_____	_____	_____	_____

Elektronikmodul, oben: S/N.: / ***Electronic box**, top: serial no.:*	
Elektronikmodul, unten: S/N.: / ***Electronic box**, bottom: serial no.:*	

Bemerkungen / *Remarks:* _____

HV-Test: Geprüft mit 5 kΩ Stecker und 50 pF Kondensator, offen, kein Funkenüberschlag / *Tested with 5 kΩ spark plug connector and 50 pF capacitor, open, no flash over.*

Zündkabel / ***Ignition cable***	**n = 250**	**Zündspannung / kV** / ***Ignition Voltage / kV*** **n = 500**	**n = 5000**
1 TOP			
2 TOP			
3 TOP			
4 TOP			
1 BOTTOM			
2 BOTTOM			
3 BOTTOM			
4 BOTTOM			
Mindestwerte / *min. values (kV)*	14	20	20

Stator mit Ohmmeter geprüft / ***Stator tested with Ohmmeter:***

Ladespulen (2 Stück) / *Charging coils (2 pieces)*	Kreis **A** / *circuit **B***	gegen Masse / *against ground*	soll / *nom.* 3,2 ÷ 4,5	_____ _____
Lichtspulen (8 Stk.) / *Lighting coils (8 pieces)*		in Serie (gelb-gelb) / *in series (yel-yel)*	0,1 ÷ 0,8	_____
		gegen Masse / *against ground*	∞	_____

Prüflauf mit Fremdregler und 12V 36 Ah Batterie (geladen)
test run with external regulator and 12V 36 Ah (loaded)

Drehzahl / *speed R.P.M.*	Lampenbelastung / *load / bulbs*	Spannungsanzeige soll / *voltage nomin.*	Spannungsanzeige ist / *voltage actual*
4000 1/min	—	14,0 ± 0,3 V	_____
4000 1/min	150W	13,2 ± 0,5 V	_____

Geberwiderstand (weiß/gelb – blau/gelb)						
Pick-up resistance (white/yel.– blue/yel.)	230÷250					
(bei offener Steckverbindung / *with open connector)*		_____	_____	_____	_____	_____

Auftr. Nr. / *order no.:* Vert. / *Co.*: Halter

Unterschrift Prüfer / *Signature Tester:* _____ Datum / *Date*: _____ Abt. / *Dept.*: _____ _____

ACG, RP, KD

Pic. 284

Modification no. - 0 -

Reference

Main 914 F

Date 1997 02 01

Page 267

Formblatt Nr. KD-17-039/C—96 07 06

Prüfprotokoll für Elektrostarter / Inspection Protocol for Electric Starter

Elektrostarter, Teile Nr.: / Electric starter, part no.: _____
Elektrostarter, Serien Nr.: / Electric starter, serial no.: _____
Eingebaut in Motor Nr.: / Installed in engine no.: _____
Blatt Nr.: / Page no.: ____

Anker / Armature:

Kollektor / Commutator: neu: ø 28 mm min: ø 27,5 mm ist: ø mm Bemerkung / Remark

Ankerwelle, Sichtkontrolle kollektorseitig / Armature shaft, visual check commut. side:

Ankerwelle abtriebseitig / Armature shaft, drive side: Verzahnung / Teeth:

Bemerkung / Remark:

Kohlebürsten / Carbon brushes:	neu / new	min.	ist / actual
Länge der Plus-Kohle / Plus brush:	12,0 mm	8,5 mm	mm
Länge der Minus-Kohle / Minus brush:	12,0 mm	8,5mm	mm

Beide Kohlen werden bei der Grundüberholung erneuert! / *Both brushes are renewed at general overhaul!*

Bemerkung / Remark:

Kollektorlager / Commutator bearing:	neu / new	ist / actual	Radialspiel / radial clearance	Bem./Rem.
Lagerbüchse / Bearing bushing:	ø 9,82 mm	ø mm	max. 0,06 mm	
Ankerwelle / Armature shaft:	ø 9,79 mm	ø mm	ist mm	

Abtriebslager / Drive bearing:	neu / new	ist / actual	Radialspiel / radial clearance	Bem./Rem.
Lagerflansch / Bearing shield:	ø 32,0 mm	ø mm	max. 0,06 mm	
Lagersitz d. Welle / Bearing seat on shaft:	ø 15,02 mm	ø mm	Preßsitz / pressfit	

Rk-Lager / Ball bearing:

Startergehäuse / Starter housing:

Prüflauf / Test Run:

Bemerkungen / Remarks:

Unterschrift Prüfer / Signature Tester: **Datum / Date:** **Abt. / Dep.:**

00518

Pic. 285

16.4) Form sheet for crack detection

00519 Pic. 206

Formblatt Nr. KD-17-038/B—95 05 08

Magnetpulver-Rißprüfung für Motortype:
Magnaflux - inspection for engine type: . . . . . _____

Motor Nr. / Engine serial no: . . . . . _____

Kurbelwellen Nr. / Crankshaft serial no.: . . . . . _____

Propeller-Getriebe Nr. / Propeller gear no.: . . . . . _____

Bezeichnung Description	Teile Nr. Part no.	Anzeichen / Findings nein/no	ja/yes	Bemerkung Remark
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
		❐	❐	_____
Klauenrad / Dog gear		❐	❐	_____
Propellerwelle / Propeller shaft		❐	❐	_____
Magnetnabe / Magneto flywheel		❐	❐	_____
Antriebsrad / Drive gear		❐	❐	_____

Prüfer / Tester _____ Datum / Date _____

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E-mail: sballoon@ritsec1.com.eg
Contact person: Weaam Salem, General Manager

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➤ ***AVIATION ENGINES AND ACCESSORIES (PTY) LTD***
Private Bag X10021, Edenvale 1610, South Africa
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E-mail: flying@iafrica.com
Contact person: Mike Blyth

5) ASIA

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➤ ***BERT FLOOD IMPORTS PTY. LTD.***
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