ROTAX®

AIRCRAFT ENGINES

Installation Manual

for

ROTAX 912 S Aircraft Engine

▲ WARNING

Before starting with the engine installation, please, read the Installation Manual completely as it contains important safety-relevant information.

The Manual must remain with the engine / aircraft in case of sale.

Edition: 0 of 1998 09 01

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Recommended price: ATS 200,--

part no. 899 376

0) Preface

Congratulation on your decision to use a ROTAX® aircraft engine.

Before starting with the engine installation, read this Installation Manual carefully. The Manual will provide you with basic information on correct engine installation, a requirement for safe engine operation.

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

We wish you much pleasure and satisfaction flying your aircraft powered by this ROTAX® engine.

0.1) Remarks

This Installation Manual is to acquaint the owner/user of this aircraft engine with basic installation instructions and safety information.

For more detailed information on operation, maintenance, safety- or flight, consult the documentation provided by the aircraft builder and dealer.

For further information on maintenance and spare part service contact the nearest ROTAX® distributor (see chapter of Service Partners).

0.2) 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.

1) Safety

Although the mere reading of these instructions will not eliminate a hazard, the understanding and application of the information herein will promote the proper installation and use of the engine.

The information and components-/system descriptions contained in this Installation Manual are correct at the time of publication. 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.

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

The fig.s in this Installation 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.

1.1) 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.

1.2) Safety information

▲ WARNING: Only certified technicians (authorized by the local airworthiness authorities) and trained on this product are qualified to work on these engines.

▲ WARNING: Never fly the aircraft equipped with this engine at locations, airspeeds, altitudes, of 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.

☞ This engine is designed for possible application on aircraft used in VFR conditions which have the capability of controlled gliding without engine power.

☞ This engine is not suitable for acrobatics (inverted flight, etc.).

☞ This engine shall not be used on rotor wing aircraft (helicopters, gyrocopters, etc.) or any similar aircraft.

☞ 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, ROTAX® makes no warranty or representation on the suitability of its engine's use on any particular aircraft. Further, 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.

☞ Whether you are a qualified pilot or a novice, complete knowledge of the aircraft, its controls and operation is mandatory before venturing solo. Flying any type of aircraft involves a certain amount of risk. Be informed and prepared for any situation or hazard associated with flying. A recognized training program and continued education for piloting an aircraft is absolutely necessary for all aircraft pilots. Make sure you also obtain as much information as possible about your aircraft, its maintenance and operation from your dealer.

☞ 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 with the maintenance and operation and any additional information which may be given to you by your dealer.

☞ Respect all government or local rules pertaining to flight operation in your flying area. Fly only when and where conditions, topography, and airspeeds are safest.

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

☞ Before flight, ensure all engine controls are operative. Make sure all controls can be easily reached in case of an emergency.

☞ 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 ROTAX® engine dealer or a qualified trained mechanic approved by the local airworthiness authority.
- ☞ To eliminate possible injury or damage, ensure that 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.
- ☞ Certain areas, altitudes and conditions present greater risk than others. The engine may require carburetor recalibration or humidity or dust/sand preventative equipment, or additional maintenance may be required. Consult your aircraft dealer or manufacturer and obtain the necessary information, especially before flying in new areas.
- ☞ Never operate the engine and gearbox without sufficient quantities of lubricating oil.
- ☞ Periodically verify level of coolant.
- ☞ Never exceed maximum rated rpm. 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 rpm. with throttle position.
- ☞ The engine should only be installed and placed into operation by persons familiar with the use of the engine and informed with regard to possible hazards.
- ☞ Never run the engine without a propeller as this will inevitably cause engine damage and present a hazard of explosion.
- ☞ Propeller and its attachment with a moment of inertia in excess of the specified value must not be used and releases engine manufacturer from any liability.
- ☞ Improper engine installation and use of unsuitable piping for fuel,- cooling,- and lubrication system releases engine manufacturer from any liability.
- ☞ Unauthorized modifications of engine or aircraft will automatically exclude any liability of the manufacturer for sequential damage.
- ☞ In addition to observing the instructions in our Manual, general safety and accident preventative measures, legal regulations and regulations of any aeronautical authority must be observed.
- ☞ Where differences exist between this Manual and regulations provided by any authority, the more stringent regulation should be applied.
- ☞ 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.

1.3) 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.

☞ All technical directives relevant for safety are especially emphasized. Pass on safety instructions to other users, without fail.

☞ This engine must only be operated with accessories supplied, recommended and released by ROTAX. Modifications are only allowed after consent by the engine manufacturer.

■ 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.

The use of anything other than genuine ROTAX® spare parts and/or accessories will render any warranty relating to this engine null and void (see Warranty Conditions).

▲ WARNING: Engine and gear box are delivered in "dry" conditions (without oil). Before putting engine in operation it must be filled with oil. Use only oil as specified (consult Operator‘s Manual).

☞ For longer periods (longer than 2 months) of engine stop, preservation of engine is recommended (see chapter **engine preservation** in Operator‘s Manual).

▲ WARNING: Exclusively use tools and supplementary materials as listed in the spare parts list.

▲ WARNING: This Manual for engine installation is only part of the Technical Documentation and will be supplemented by the respective Operator‘s Manual, Maintenance Manual and Spare Parts List.

Pay attention to references to other documentation, found in various parts of this Manual.

1.4) Technical documentation

The information given in the

- ☞ Installation Manual
- ☞ Operator‘s Manual
- ☞ Maintenance Manual
- ☞ Overhaul Manual
- ☞ Spare parts list
- ☞ Technical bulletins
- ☞ Service Informations

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

The fast technical progress and variations of installation might render present laws and regulations inapplicable or inadequate.

◆ 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. 00288) is of no significance for the content.

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2) Table of contents

0) Preface ..... 0 - 2

0.1) Remarks ..... 0 - 2
0.2) Engine serial number ..... 0 - 2

1) Safety ..... 1 - 1

1.1) Repeating symbols ..... 1 - 1
1.2) Safety information ..... 1 - 2
1.3) Instruction ..... 1 - 4
1.4) Technical documentation ..... 1 - 5

2) Table of contents ..... 2 - 1

3) Index ..... 3 - 1

4) List of the current pages ..... 4 - 1

5) Table of amendments ..... 5 - 1

6) Description of design ..... 6 - 1

6.1) Designation of type ..... 6 - 1
6.2) Standard engine design ..... 6 - 1
6.3) Engine components and views, numbering of cyl., definition of main axes ..... 6 - 3

7) Technical data ..... 7 - 1

7.1) Operating limits ..... 7 - 1
7.2) Installation dimensions (all dimensions in mm) ..... 7 - 2
7.3) Weights ..... 7 - 2
7.4) Centre of gravity of engine and standard equipment ..... 7 - 2
7.5) Moments of inertia in kg cm2 ..... 7 - 2

8) Preparations for engine installation ..... 8 - 1

8.1) Transport ..... 8 - 1
8.2) State of delivery ..... 8 - 1
8.3) Engine preservation ..... 8 - 1
8.4) Protective covering ..... 8 - 2

9) Engine suspension and position ..... 9 - 1

9.1) Definition of attachment points ..... 9 - 1
9.2) Permissible fitting positions ..... 9 - 2
9.3) General directives for engine suspension ..... 9 - 3

10) Exhaust system ..... 10 - 1

10.1) Requirements on the exhaust system ..... 10 - 1
10.2) General directives for exhaust-system ..... 10 - 2

11) Cooling system ..... 11 - 1

11.1) Requirements on the cooling system ..... 11 - 1
11.2) Size and position of connections ..... 11 - 1
11.3) Coolant capacity ..... 11 - 2
11.4) Feasible location of radiator ..... 11 - 3
11.5) General directives for the cooling system ..... 11 - 4
11.6) Operating limits ..... 11 - 5
11.6.1) Water-free coolant ..... 11 - 6
11.6.2) Conventional Glycol / Water coolant mixture ..... 11 - 6

12) Cooling air ducting ..... 12 - 1

12.1) General directives for ducting of the cooling air ..... 12 - 1

13) Lubrication system (oil system) ..... 13 - 1
13.1) Requirements on the lubrication system ..... 13 - 1
13.2) Size and position of connections ..... 13 - 2
13.3) Feasible position and location of the oil tank ..... 13 - 4
13.4) Feasible position and location of the oil cooler ..... 13 - 5
13.5) Filling capacity ..... 13 - 5
13.6) Venting of the lubrication system ..... 13 - 5

14) Fuel system ..... 14 - 1
14.1) Requirements on the fuel system ..... 14 - 2
14.2) Definition and size of connection ..... 14 - 3

15) Carburetor ..... 15 - 1
15.1) Requirements on the carburetor ..... 15 - 1
15.2) Dimensions for installation and limit load ..... 15 - 1
15.3) General directives ..... 15 - 2

16) Air intake system ..... 16 - 1
16.1) Requirement on the intake system ..... 16 - 1

17) Electric system ..... 17 - 1
17.1) Technical data and connection of the electric components ..... 17 - 2

18) Propeller drive ..... 18 - 1
18.1) Technical data: ..... 18 - 1

19) Vacuum pump ..... 19 - 1
19.1) Technical data: ..... 19 - 1

20) Hydraulic governor for constant speed propeller ..... 20 - 1
20.1) Technical data: ..... 20 - 1

21) Connections for instrumentation ..... 21 - 1
21.1) Sensor for cylinder head temperature: ..... 21 - 1
21.2) Sensor for oil temperature: ..... 21 - 2
21.3) Oil pressure pick-up: ..... 21 - 3
21.4) Mechanical rev-counter or hour-meter: ..... 21 - 4
20.5) Monitoring of the intake manifold pressure ..... 21 - 4

22) Preparations for trial run of engine ..... 22 - 1

23) ROTAX Authorized Distributors for Aircraft Engines ..... 23 - 1

3) Index

A

Ambient temperature 7 - 1
attachment points 9 - 1
Auxiliary equipment 6 - 2
Auxiliary generator 17 - 5

B

back pressure 10 - 1
Battery 17 - 7

C

Carburetor 15 - 1
Carburetor flange 15 - 1
Carburetor venting lines 15 - 1
Centre of gravity 7 - 2
choke 15 - 2
Coarse filter 14 - 2
Colour code 17 - 1
constant speed propeller 20 - 1
continuous speed 7 - 1
Coolant capacity 11 - 2
Coolant hoses 11 - 1
cooling air 12 - 1
Cooling air ducting 12 - 1
Cooling system 11 - 1
coordinates 6 - 3
cyl. head temperature 7 - 1, 21 - 1
Cylinder wall temperature 12 - 2

D

Delivery rate 14 - 2
denomination of cylinders 6 - 3
Description of design 6 - 1
Designation of type 6 - 1
Distributors 23 - 1
Drain holes 16 - 2

E

EGT 7 - 1, 10 - 1
electric rev-counter 17 - 6
electric rev-counter connection 17 - 6
electric system 17 - 1
electric-starter 17 - 3
EMC 17 - 7
EMI 17 - 7
Engine components 6 - 3
engine design 6 - 1
engine installation 8 - 1
Engine position 9 - 1
Engine preservation 8 - 1
Engine serial number 0 - 2
engine suspension 9 - 1, 9 - 3
engine trial run 22 - 1
engine views 6 - 3
exhaust bend 10 - 1
exhaust gas temperature 7 - 1, 10 - 1
exhaust socket 10 - 1
exhaust system 10 - 1
expansion tank 11 - 1

F

Fine filter 14 - 1, 14 - 2
Fuel filter 14 - 2
Fuel lines 14 - 2
Fuel manifold 14 - 3
Fuel pressure 7 - 1, 14 - 2
Fuel system 14 - 1
Fuel temperature 14 - 2

G

governor 20 - 1

H

hour-meter 21 - 4
Hydraulic governor for constant speed propeller 20 - 1

I

idle speed 7 - 1
Ignition switch 17 - 3
Index 3 - 1
Installation dimensions 7 - 2
Instruction 1 - 4
instrumentation 21 - 1
Instrumentation connection 21 - 1
Intake manifold pressure 21 - 4
Integrated generator 17 - 2

L

List of the current pages 4 - 1

M

main axes 6 - 3
Manifold pressure 16 - 2
manifold pressure 21 - 4
Mechanical rev-counter 21 - 4
Moments of inertia 7 - 2
muffler volume 10 - 1

N

negative gravity 7 - 1
negative gravity acceleration 7 - 1
numbering of cylinders 6 - 3

O

Oil pressure 7 - 1
Oil pressure pick-up 21 - 3
Oil temperature 7 - 1
oil temperature sensor 21 - 2
On-Off switch 17 - 3
Operating limits 7 - 1
operating temperature 7 - 1
Optional extras 6 - 1
Overflow bottle 11 - 3
overflow bottle 11 - 3

P

Permissible fitting positions 9 - 2
Preface 0 - 2
Preparations for engine installation 8 - 1
preservation (engine) 8 - 1
Propeller drive 18 - 1
Protective covering 8 - 2
protective covering 8 - 2

R

radiator location 11 - 3
Range of operating temperature 7 - 1
Rectifier-regulator 17 - 2
Remarks 0 - 2
Repeating symbols 1 - 1
Rev-counter drive 21 - 4

S

Safety 1 - 1
Safety information 1 - 2
Sensor for oil temperature 21 - 2
Shorting switch 17 - 3
Standard engine design 6 - 1
Start relais 17 - 4
Start relay 17 - 4
State of delivery 8 - 1

T

Table of amendments 5 - 1
Table of contents 2 - 1
Take-off speed 7 - 1
Takeoff speed 7 - 1
Technical data 7 - 1
Technical documentation 1 - 5
Transport 8 - 1
Trial run 22 - 1

V

Vacuum pump 19 - 1

W

Water inlet bend 11 - 2
Weights 7 - 2

Blank page

4) List of the current pages 07046

chapter	page	date
0	0 - 2	98 07 01
1	1 - 1	98 07 01
	1 - 2	98 07 01
	1 - 3	98 07 01
	1 - 4	98 07 01
	1 - 5	98 07 01
	1 - 6	98 07 01
2	2 - 1	2004 07 01
	2 - 2	98 07 01
3	3 - 1	98 07 01
	3 - 2	98 07 01
4	4 - 1	2004 07 01
	4 - 2	98 07 01
5	5 - 1	2004 07 01
	5 - 2	98 07 01
6	6 - 1	98 07 01
	6 - 2	98 07 01
	6 - 3	98 07 01
	6 - 4	98 07 01
7	7 - 1	2004 07 01
	7 - 2	98 07 01
8	8 - 1	98 07 01
	8 - 2	98 07 01
9	9 - 1	98 07 01
	9 - 2	98 07 01
	9 - 3	98 07 01
	9 - 4	98 07 01
10	10 - 1	98 07 01
	10 - 2	98 07 01
11	11 - 1	98 07 01
	11 - 2	98 07 01
	11 - 3	98 07 01
	11 - 4	98 07 01
	11 - 5	2004 07 01
	11 - 6	2004 07 01

chapter	page	date
12	12 - 1	98 07 01
	12 - 2	98 07 01
13	13 - 1	98 07 01
	13 - 2	98 07 01
	13 - 3	98 07 01
	13 - 4	98 07 01
	13 - 5	98 07 01
	13 - 6	98 07 01
14	14 - 1	98 07 01
	14 - 2	98 07 01
	14 - 3	98 07 01
	14 - 4	98 07 01
15	15 - 1	98 07 01
	15 - 2	98 07 01
16	16 - 1	98 07 01
	16 - 2	98 07 01
17	17 - 1	98 07 01
	17 - 2	98 07 01
	17 - 3	98 07 01
	17 - 4	98 07 01
	17 - 5	98 07 01
	17 - 6	98 07 01
	17 - 7	98 07 01
18	18 - 1	98 07 01
19	19 - 1	98 07 01
20	20 - 1	98 07 01
21	21 - 1	98 07 01
	21 - 2	98 07 01
	21 - 3	98 07 01
	21 - 4	98 07 01
22	22 - 1	98 07 01
23	23 - 1	2004 07 01
	23 - 2	2004 07 01
	23 - 3	2004 07 01

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5) Table of amendments

00159

lfd. Nr.	Ab-schnitt	Seiten	Datum der Berichtigung	Anerkennungs-Vermerk	Datum Anerk. der genehm. Behörde	Datum der Einarbeitung	Zeichen/ Unterschrift
0	0-23	all	1998 09 01	not required	1998 09 01		AS/Me
1	2,4,5,7, 11,23	2-1,4-1,5-1,7-1, 11-5,11-6,23-1, 23-2,23-3	2004 07 01	not required			

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6) Description of design

6.1) Designation of type

Basic type:

e.g. ROTAX 912 S 2

S2: with prop flange for fix pitch propeller

S3: with prop flange with drive of hydraulic governor for constant speed propeller

S4: with prop flange for fix pitch propeller, but prepared for retrofit of hydraulic governor for constant speed prop

02016

	auxiliary alternator	vacuum-pump	drive for revcounter / hour meter
for S2	yes	yes	yes
for S3	yes	no	yes
for S4	yes	yes	yes

Optional extras to the above stated basic type:

◆ NOTE: Conversion of the types S2, S4 to type S3 may be accomplished by the manufacturer (ROTAX®).

6.2) Standard engine design

- ☞ 4 stroke, 4 cyl. horizontally opposed, spark ignition engine, single central camshaft hydraulic tappets - push rods - OHV
- ☞ liquid cooled cylinder heads
- ☞ ram air cooled cylinders
- ☞ dry sump, forced lubrication
- ☞ ROTAX dual ignition, breakerless, capacitor discharge, interference suppression
- ☞ 2 constant depression carburetors
- ☞ mechanical fuel pump
- ☞ oil tank
- ☞ expansion tank (coolant)
- ☞ propeller drive via integrated gear box with torsional shock absorber and overload clutch
- ☞ electric starter
- ☞ external start relay
- ☞ integrated AC generator
- ☞ external rectifier-regulator
- ☞ hydraulic governor for constant speed prop (for S3 only)
- ☞ intake silencer

☞ auxiliary generator (optional extra)

☞ vacuum pump (optional extra)

☞ drive for rev-counter / hour-meter (optional extra)

☞ engine suspension frame (optional extra)

Auxiliary equipment

■ ATTENTION: Any equipment not included as part of the standard engine version and thus not a fix component of the engine is not in the scope of supply.

Components especially developed and tested for this engine are readily available at ROTAX®.

▲ WARNING: **This equipment has not been tested for safety and durability to the standards of aviation.** The user assumes all risks possibly arising by utilizing auxiliary equipment.

The furnishing of proof in accordance to the latest FAR or JAR has to be conducted by the aircraft or fuselage manufacturer.

☞ Exhaust system

☞ Intake filter

☞ Oil cooler

☞ Coolant radiator

☞ Flydat

☞ Mechanical rev counter

☞ Electric rev counter

☞ Hour-meter

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

See fig. 2, 3 and 4.

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

x,y,z axes for system of coordinates

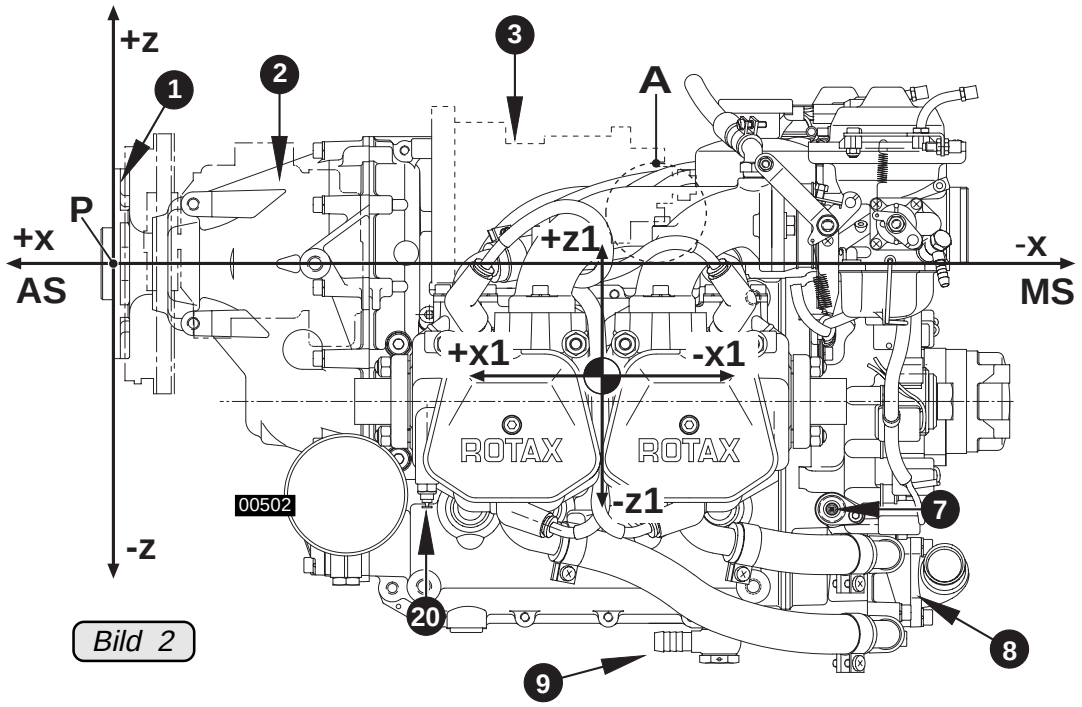
Cyl. 1 cylinder 1

Cyl. 2 cylinder 2

Cyl. 3 cylinder 3

Cyl. 4 cylinder 4

1. propeller flange
2. propeller gear
3. vacuum pump or hydraulic governor for constant speed propeller
4. intake manifold
5. constant depr. carburetor cyl. 1/3
6. constant depr. carburetor cyl. 2/4
7. connection for mechanical rev-counter
8. coolant pump
9. connection for oil return line
10. mechanical fuel pump
11. exhaust socket
12. electric starter
13. expansion tank
14. oil filter
15. oil pump
16. fly wheel fixation screw
17. pressure compensating tube
18. sensor for oil pressure
19. sensor for oil temperature
20. sensor for cylinder head temperature
21. electronic modules of ignition unit
22. connection for intake manifold pressure
23. ignition housing
24. external alternator



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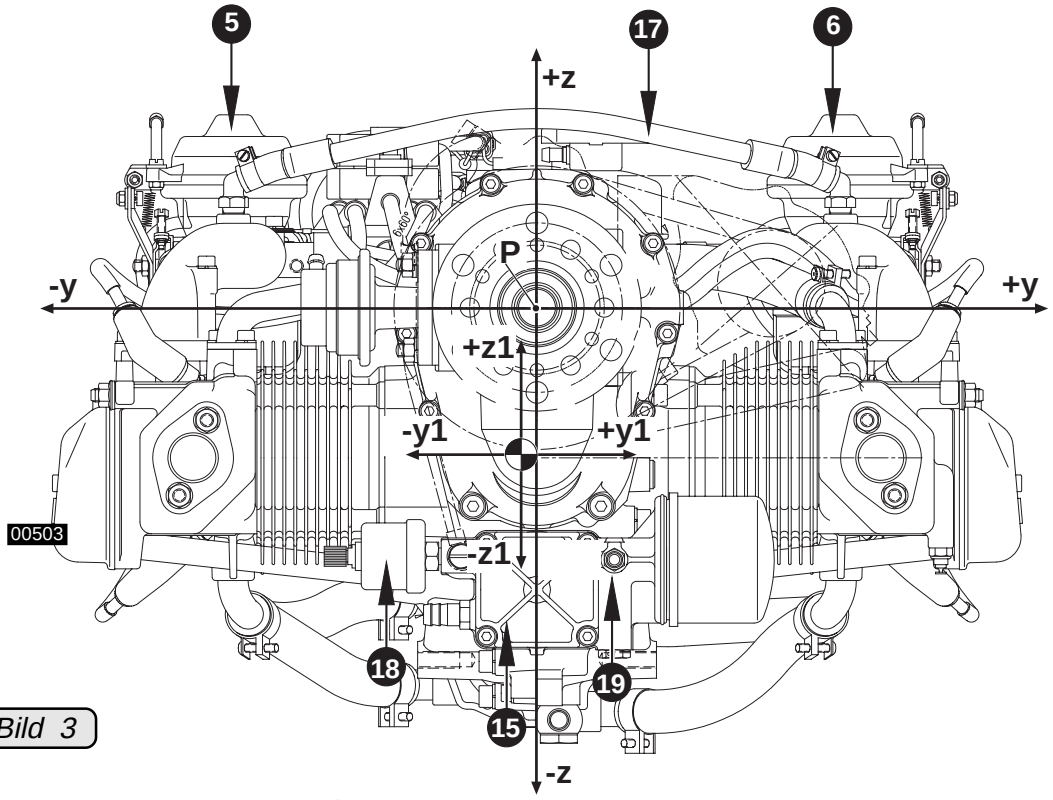

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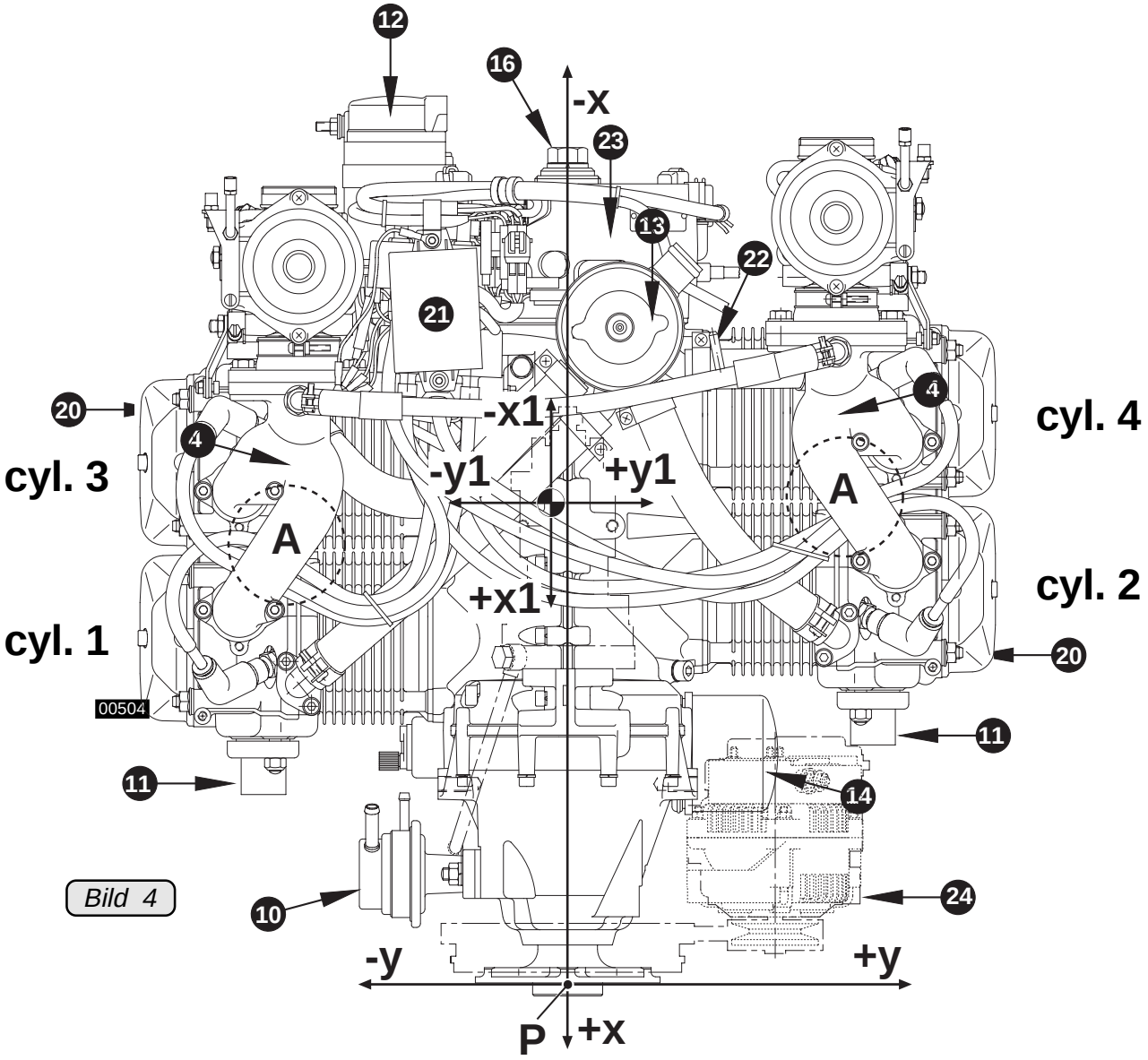

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Page	Install	Preference	Date	Modification no.
6 - 4	912 S		1998 09 01	- 0 -

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7) Technical data

To maintain clarify, only data relevant for engine installation and operation will be stated in the Manual.

◆ NOTE: Connecting dimensions, filling capacities, drive and reduction ratios, electric output etc. can be found in the respective chapter of engine installation.

7.1) Operating limits

1. Takeoff speed: ..... 5800 rpm. (5 min.)
   max. continuous speed: ..... 5500 rpm.
   idle speed: ..... around 1400 rpm.
2. Time limit for engine operation at weightless condition and with negative gravity acceleration: ..... max. 5 sec at max. -0,5 g
3. Oil pressure: see fig. 46
   max. 7 bar (100 psi) ..... (at cold start a pressure of up to 7 bar =100 psi, is permitted for a short period).
   min. ..... 0,8 bar (12 psi) (below 3500 RPM)
   normal ..... 2,0 - 5,0 bar (29-73 psi)(over 3500 RPM)
4. Oil temperature (see fig. 45) reading
   in feed line to engine: ..... min. 50° C (120° F)
   max. 130° C (266° F)
   normal operating temperature: ..... 90 ÷ 110° C (190 ÷ 250° F)
5. Cylinder head temperature: ..... see section 11.6.2
6. Exhaust gas temperature (EGT): ..... max. 880° C (1620° F) at take off
   max. 850° C (1560° F)
   normal operat. 800°C (1470° F)
   (reading c. 70 mm = 2,75 in. after exhaust flange)
7. Range of operating temperature: ..... +50 (120°F) to -25° C (-13° F)
8. Ambient temperature for electric components: (fig.4, pos. ⑳) max. 80° C (176° F)
9. Fuel pressure: ..... 0,15 ÷ 0,4 bar (2,2 ÷ 5,8 psi.)

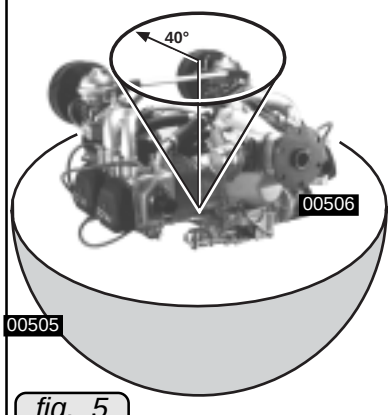


fig. 5

(see fig. 22 and 23) ..... max. 0,4 bar (5,8 psi.)10.Banking of plane: (if not stated otherwise) deviation from the effective vertical ..... max. 40°

Up to this inclination the dry sump lubrication system warrants adequate lubrication in every flight situation.

7.2) Installation dimensions (all dimensions in mm)

See fig. 2, 3 and 4.

02017

	standard engine version		
	pos. (+)	neg. (-)	total
max. dimension in x axis	8,5	-581	589,5
max. dimension in y axis	288	-288	576,0
max. dimension in z axis	118	-276	394,0

◆ NOTE: Dimensions to point of reference (P). See fig. 2, 3 and 4.

7.3) Weights

Weight of engine defined to the following conditions:

☞ **Engine dry** from serial production (see chapter description of design)

Engine weight Version S2 and S4: ..... 58,3 kg (128 lb.)
Version S3: ..... 61 kg (134 lb.)

Weight of external generator assy.: ..... 3,0 kg (6,6 lb.)
vacuum pump assy.: ..... 0,8 kg (1,76 lb.)
hydraulic governor assy.: ..... 2,7 kg (6 lb.)
engine suspension frame: ..... 2,0 kg (4 lb.)

02018

7.4) Centre of gravity of engine and standard equipment

See fig. 2, 3 and 4.

	engine from serial production S2	auxiliary alternator	hydraulic governor	vacuum-pump
centre of gravity in x-axis	-316	-100	-276	-255
centre of gravity in y-axis	-5	139	0	0
centre of gravity in z-axis	-83	6	56	56

◆ NOTE: Dimensions to point of reference (P). See fig. 2, 3 and 4. 02019

7.5) Moments of inertia in kg cm2

See fig. 2, 3 and 4.

	version S2 / S4	version S3
moment of inertia around axis x1 - x1 (kg cm2)	11 100	11 600
moment of inertia around axis y1 - y1 (kg cm2)	10 900	11 390
moment of inertia around axis z1 - z1 (kg cm2)	17 400	18 200

8) Preparations for engine installation

■ ATTENTION: The stated directives are measures to pay attention to at engine installation to prevent any accidents and engine damage.

8.1) Transport

The engine to be lifted by two hooks or straps around the middle of the intake manifolds.

See chapter engine views, numbering of cylinders and definition of main axes.

8.2) State of delivery

The engine is attached with 4 Allen screws M10x20 to steel angles anchored on a timber plate.

8.3) Engine preservation

The engine is preserved at ROTAX thus warranting proper protection against corrosion for at least **12** month after date of delivery from ROTAX®.

This warranty is subject to the following conditions:

☞ the engine has to be stored in the packing as supplied by ROTAX.

☞ the covers on various openings must not be removed (see chapter of protective covering)

☞ engine has to be stored in a suitable place.

If the engine is stored for a period longer than 12 month the following tasks have to be performed every three months:

☞ crank the engine by hand on attachment screw of flywheel two complete turns anticlockwise (viewed from Magneto side). See fig. 4.

☞ inspect for corrosion (e.g. prop shaft). At detection of corrosion, send the engine to the overhauler without delay.

▲ WARNING: The engine must not be put into service.

☞ repack engine into original packaging and seal properly.

▲ WARNING: The maximum storage period is limited to 24 month!

Preservation for periods of longer than 24 months is only possible after a written permission of ROTAX®. Should the situation arise send engine for inspection to ROTAX.

◆ NOTE: No trouble to put engine back into operation after preservation.

8.4) Protective covering

All openings are protected against ingress of contamination and dampness. It is recommended not to remove these plugs until installation of the specific feed line.

◆ NOTE: If the engine will be sent to the manufacturer or distributor reuse transport equipment and replug openings.

List of protective covering:

☞ exhaust sockets: ..... 1 each cone plug

☞ carburetor inlet: ..... 1 each cover

☞ intake silencer: ..... 2 caps

☞ fuel pump inlet: ..... 1 cap

☞ connection for fuel return: ..... 1 plug

☞ connection for fuel pressure: ..... 1 plug

☞ oil supply and oil return: ..... 1 each cap

☞ supply and return of coolant: ..... 1 each cone plug

☞ prop shaft on version S3 and S4: ..... 1 disc plug

▲ WARNING: Protective covering to be utilized for transport and at engine installation only. For engine operation remove these protections.

9) Engine suspension and position

■ ATTENTION: At installation of engine be aware of engine weight and assure careful handling.

The engine suspension is determined essentially by the aircraft design. Eight attachment points are provided on the engine.

▲ WARNING: At least four of the eight anchorage points must be used in a side-symmetrical pattern of left (L) and right (R) side.

9.1) Definition of attachment points

See fig. 6.

00512

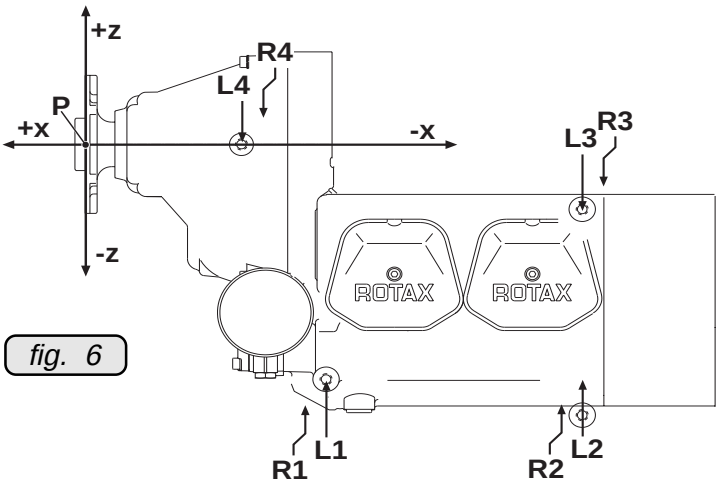


fig. 6

02020

attachment point	coordinates [mm]		
	x axis	y axis	z axis
L1	-200,8	-71,0	-211,0
R1	-200,8	71,0	-211,0
L2	-414,3	-71,0	-211,0
R2	-414,3	71,0	-211,0
L3	-414,3	-71,0	-22,0
R3	-414,3	71,0	-22,0
L4	-128,3	-71,0	0,0
R4	-128,3	71,0	0,0

▲ WARNING: The engine suspension to be designed by the aircraft or fuselage builder such that it will carry safely the maximum occurring operational loads without exceeding the max. allowable-forces and moments on the engine attachment points.

02021

	attachment point							
	1L	1R	2L	2R	3L	3R	4L	4R
max. allowable forces (limit load) in (N) in x,y and z axis	5 000						1 900	
max. allowable bending moment (limit load) in (Nm) in x,y and z axis	77						39	
min. length of thread engagement (mm)	25							

▲ WARNING: Tighten all engine suspension screws as specified by the aircraft builder.

9.2) Permissible fitting positions

See fig. 7, 8 and 9.

To simplify the matter, only reference is made to the 4 lower attachment points R1, L1, R2 and L2.

◆ NOTE: The system of coordinates remains unchanged.

The following details of engine position are with reference to aircraft on ground, ready for take off.

☞ engine suitable for propeller in tractor- or pusher arrangement.

☞ prop shaft above cylinders (as depicted)

i.e. prop shaft ..... distance of Z-axis 0.
cylinder ..... distance of Z-axis minus

☞ centre of attachment points L1 and L2 on axis x2 parallel to x-axis of the system of coordinates.

Allowable pitch deviation of parallelism of axes: ... max. 6° counter clockwise
max. 30° clockwise (see fig.)

00513

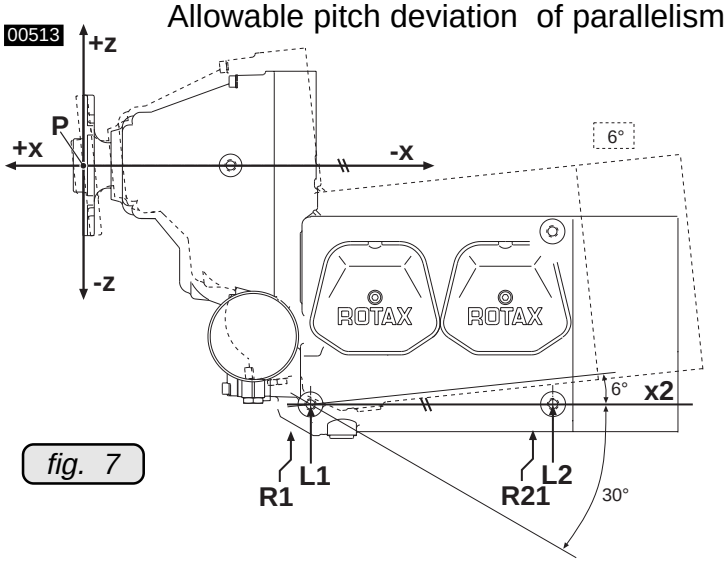


fig. 7

▲ WARNING: A counter clockwise deviation of parallelism of more than 6° could lead to unwanted accumulation of fuel in the engine. See JAR requirements and FAR § 33.17

☞ centre of attachment points L1 and R1 have to be on a axis y2 parallel to axis y of the system of coordinates.

00514

Tolerated roll deviation of parallelism: ± 5° (see fig.).

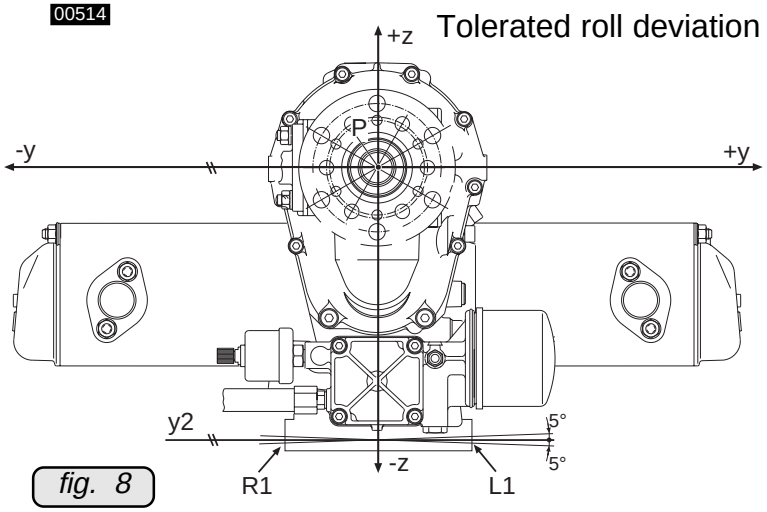


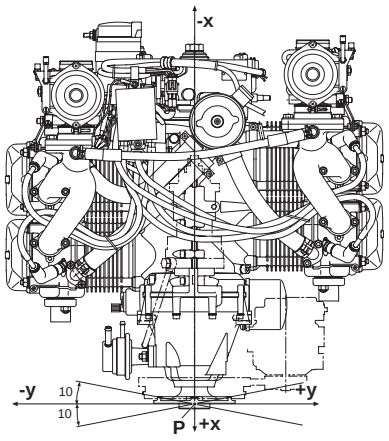
fig. 8

☞ y-axis has to be square to the longitudinal axis of the aircraft.

Yaw tolerance: ..... ± 10° (see fig.).

fig. 9

00515



d00176

9.3) General directives for engine suspension

See fig. 6.

Isolation mounts to be used between engine and aircraft frame to neutralize vibrations.

Damping elements as generally used in the aircraft industry (e.g. LORD) are suitable.

◆ NOTE: The engine suspension has to be designed to prevent any excessive engine movement and to minimize noise emission and vibration on air frame side.

With suspension on the 4 top lugs 3L, 3R, 4L and 4R only, the tilting moment due to the pull of the propeller will be avoided while, if attached on the bottom lugs only, the moment of tilting has to be taken care of accordingly.

◆ NOTE: A certified engine suspension frame has been developed by ROTAX®, especially for the magneto side engine attachment to the fireproof bulk head.

▲ WARNING: The engine installation must by ground run tested to the specified loads and for vibration behaviour. Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft- or fuselage builder.

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10) Exhaust system

02022

location	coordinates [mm] x axis	y axis	z axis
cylinder 1	-160	-196	-82
	-160	-212	-113
cylinder 2	-192	196	-82
	-192	212	-113
cylinder 3	-408	-196	-82
	-408	-212	-113
cylinder 4	-438	196	-82
	-438	212	-113

See fig. 2, 3 and 4.

The shape and execution of the exhaust system is determined essentially by the free space available in the aircraft.

For attaching, the exhaust system two studs M8x23 are provided on each cylinder.

Location of the studs:

◆ NOTE: All dimension to point of reference (P).

02023

	points of attachment
max. allowable forces (limit load) in (N) in x,y and z axis	1 000
max. allowable bending (limit load) in (N) in x,y and z axis	40

▲ WARNING: The exhaust system has to be designed by the aircraft or fuselage builder such, that the limit loads on the points of attachment will not by exceeded. Additional support of exhaust system may be necessary.

10.1) Requirements on the exhaust system

See fig. 10.

☞ mean bending radius of exhaust bend : ..... min. 40 mm (1,6 in.)

☞ exhaust bend, inside dia.: ..... min. 28 mm (1,1 in.)

☞ muffler volume: ..... c. 5 l (1,32 US gal)

☞ back pressure at takeoff performance: ..... max. 0,2 bar (2,9 psi.) (readings taken c. 70 mm (2,76 in.) from flange connections)

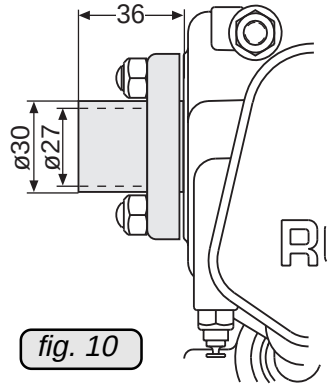
☞ exhaust gas temperature (EGT):
(both ignition circuits active) ..... nominal c. 800° C (1470° F)

max. 850° C (1616° F)
max. 880° C (1616° F) at take off performance (readings taken c. 70 mm = 2,76 in. down stream of exh. flange).

The exhaust gas temperatures (EGT) have to measured at the initial engine installation in an aircraft and must be verified in the course of test flights.

▲ WARNING: The exhaust system has to be designed and built such, that the operating temperatures are maintained and the max. exhaust gas temperatures will never be exceeded.

☞ The 4 exhaust sockets included in the supply scope have to be used without exception.



00776 *fig. 10*

Material of the exhaust sockets: ..... X 6 CrNiTi 1810 (DIN 1.4541)

Tightening torque of the lock nut M8
for the exhaust flange: ..... 12-20 Nm (106 -177 in.lb.) Pay also attention on SI 5 UL 97

■ ATTENTION: Fit heat shields near carburetors or as required.

Because of the high temperatures occurring, provide suitable protection against unintentional contact.

■ ATTENTION: Secure exhaust system by suitable means according to installation.

10.2) General directives for exhaust-system

See fig. 11.

A exhaust system, especially for universal application has been developed by ROTAX®. Certification to the latest requirements to FAR or JAR has to be conducted by the aircraft- or fuselage builder.

The following recommendations should help the aircraft builder to plan a suitable exhaust system.

◆ NOTE: These recommendations derive from years of experience and the results achieved are generally very good.

☞ A common transversal muffler serving all 4 cylinders and positioned under the engine is favourable.

Distribution of the exhaust gases into 2 separate systems is not recommended. Single mufflers on either side cause power loss and increased noise emission.

☞ The 4 ball joints must be used to avoid damage due to vibration.

Be aware that locked up stresses cause cracks!

Attachment of exhaust bends by springs!

Springs to be secured!

All ball joints have to be greased regularly with heat resistant lubricant (e.g. LOCTITE ANTISEIZE) to avoid gripping and seizing of the joints.

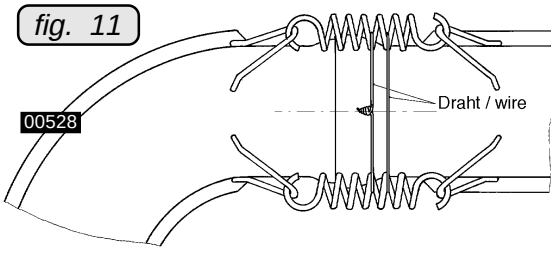
■ ATTENTION: Vibrations due to improper installation and maintenance is the most common reason for damage of the exhaust system.

The sketch illustrates a possibility how to interconnect the exhaust springs to prevent the vibration of these springs and thus premature wear.

It is also recommended to fill the springs with Silastic for additional damping of vibrations.

■ ATTENTION: Appropriate to the installation a vibration damping support for the exhaust system has to be provided on the air frame side.

fig. 11



11) Cooling system

The shape, size and location of one or more radiators depend mainly on the space available.

No provision is made for attachment of the radiator(s) on the engine.

11.1) Requirements on the cooling system

■ ATTENTION: All components of the cooling system have to be secured suitably.

▲ WARNING: The size and layout of the cooling system must be designed to keep the operating temperatures within the specified limits.

Coolant hoses:

☞ temperature durability: ..... min. 125°C (257° F)

☞ pressure durability: ..... min. 5 bar (73 psi.)

☞ nom. inside dia : ..... 25 mm (1 in.)

☞ bending radius: ..... min. 175 mm (6,9 in.)

☞ material: ..... Suitable for 100 % Glycol and antifreeze agents. Pay attention to ozone stability!

◆ NOTE: If installations require a longer distance use aluminium pipes (25 mm (1in.) inside dia.) instead of hoses.

11.2) Size and position of connections

See fig. 12, 13 and 14.

☞ expansion tank ❶ with radiator cap ❷

to radiator ❸: ..... outside dia. ..... 25 mm (1 in.)
slip-on length ..... max. 22 mm (.87 in.)

to overflow bottle ❹: ..... outside dia. ..... 8 mm (.31 in.)
slip-on length ..... max. 15 mm (.59 in.)

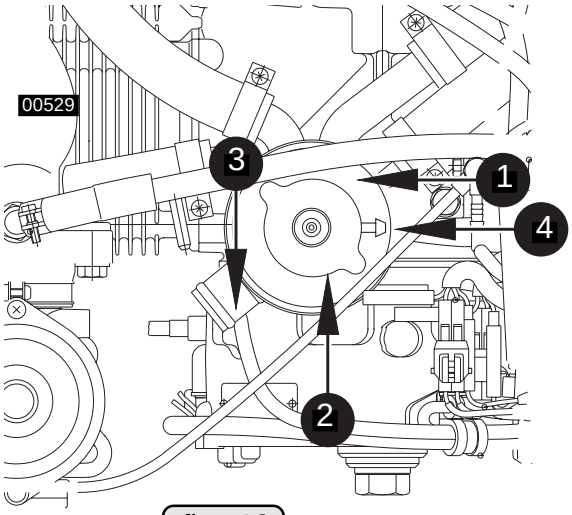


fig. 12

☞ water inlet bend ❺: ..... outside dia. ..... 27 mm (1,06 in.)
slip-on length ..... max. 19 mm (.75 in.)

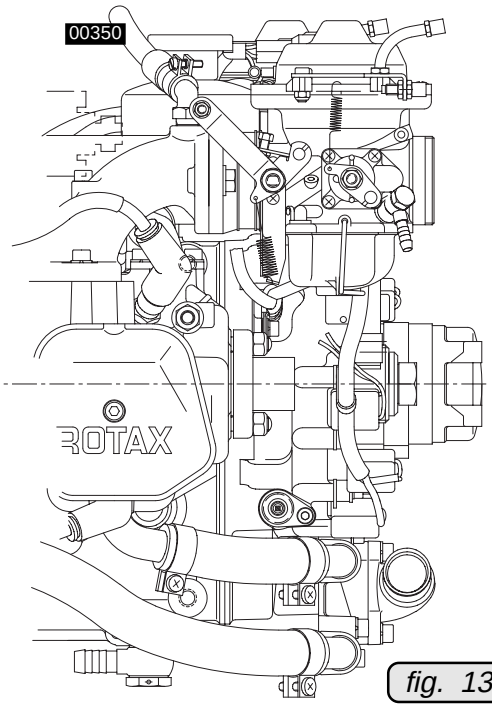


fig. 13

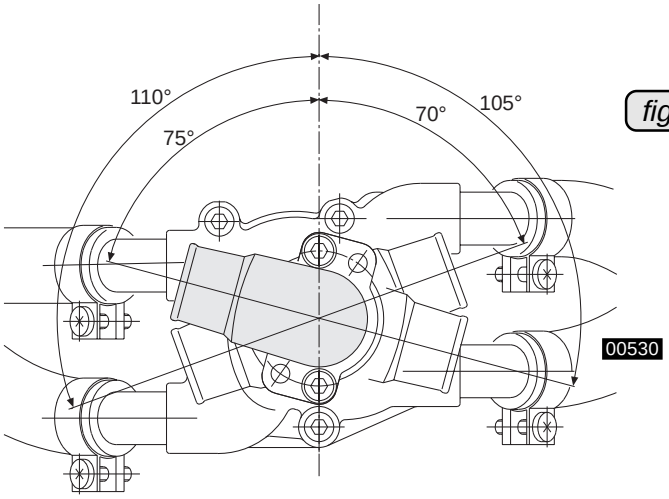


fig. 14

◆ NOTE: Choose between four possible fitting positions of water inlet bend ❺ appropriate to specific installation (see fig.). The inlet bend is attached to the water pump by two Allen screws M6x20 and lock washers. Tighten screws to 10 Nm (90 in.lb.).

■ ATTENTION: Utilize total slip-on length for hose connection. Secure hoses with suitable screw clamp or by crimp connection.

11.3) Coolant capacity

4 cylinder heads: ..... 560 cm^3 (.15 gal us)

water pump: ..... 100 cm^3 (.03 gal us)

expansion tank: ..... 250 cm^3 (.07 gal us)

2 m coolant hose (18 mm inside dia.) : ..... 500 cm^3 (.13 gal us)

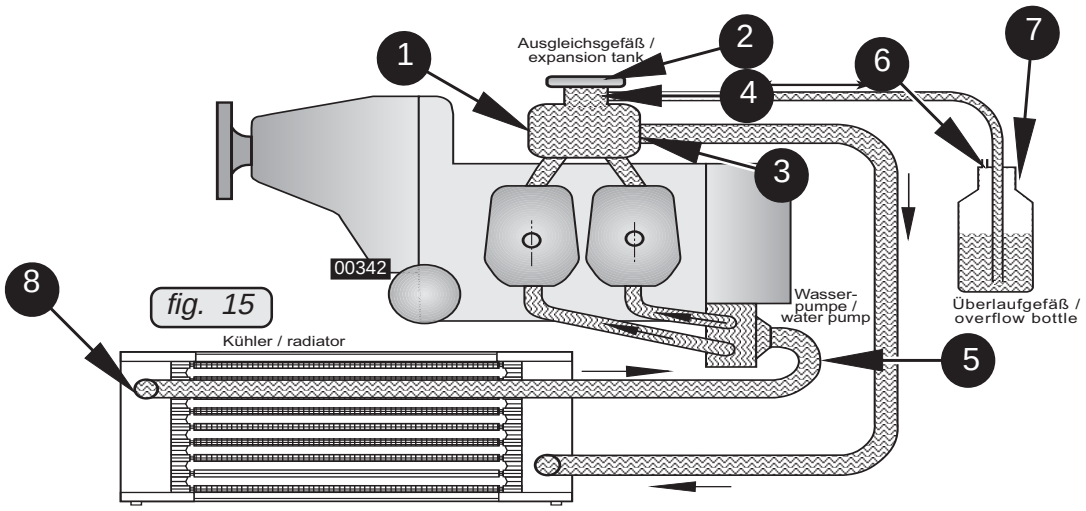
total coolant quantity in engine: ..... c. 1400 cm^3 (.37 gal us)

11.4) Feasible location of radiator

See fig. 15.

The expansion tank ❶ must always be positioned at the highest point of the cooling system.

■ ATTENTION: If necessary, the radiator outlet opening ❽ may be max. **1,5 m** (5 ft.) above or below water inlet bend ❺ on water pump (see fig. 15).



◆ NOTE: On the standard engine version the expansion tank ❶ is fitted on top of the engine (see fig. 15).

For proper operation of the cooling system the expansion tank ❶ with pressure cap ❷ has to remain for all possible engine positions on the highest point of the cooling circuit.

Additionally the system needs an overflow bottle ❼ where surplus coolant is collected and returned back into the circuit at the cooling down period.

◆ NOTE: For proper operation keep hose to overflow bottle as short and small as possible.

■ ATTENTION: To warrant the proper operation of the cooling system the delivery head between overflow bottle and expansion tank must not exceed 250 mm (10 in.).

Requirements on the overflow bottle ❼

☞ transparent material

☞ unaffected by temperatures from -40° C (-40° F) to +125° C (257° F)

☞ resistant against 100% Glycol and any other anti freeze agent

☞ possible to vent ❻

☞ volume c . 0,5 l (.13 us gal)

◆ NOTE: The overflow bottle ought to be furnished with a label indicating function and content.

▲ WARNING: Ensure that the overflow bottle will never be empty, otherwise air will be sucked into cooling circuit with ill effect to safe operation of the engine.

11.5) General directives for the cooling system

See fig. 16.

ROTAX® offers essential parts of the cooling system for this engine such as radiator, overflow bottle etc. (see spare parts list) in the non-certified state. Certification to the latest requirements to FAR or JAR has to be conducted by the aircraft or airframe builder.

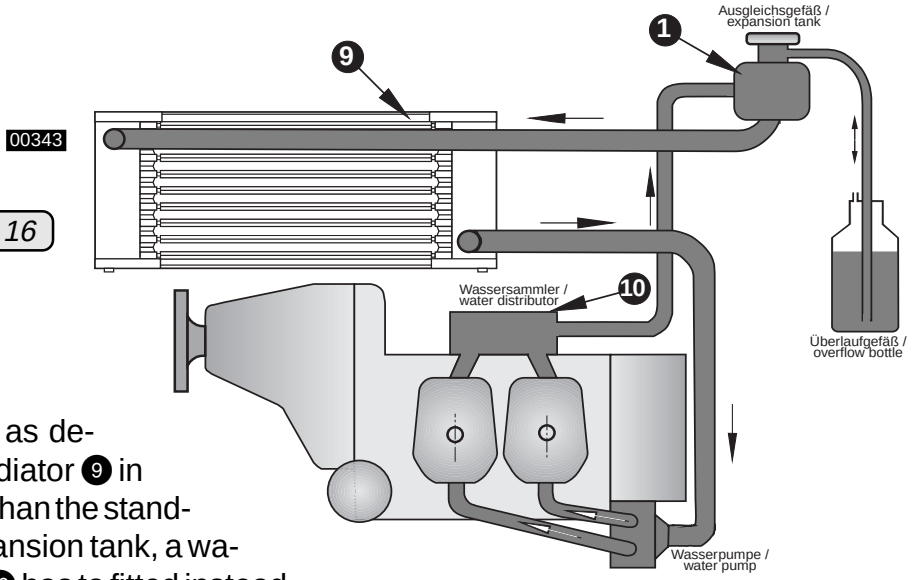


fig. 16

In an installation as depicted with the radiator ❾ in a higher position than the standard supplied expansion tank, a water accumulator ❿ has to fitted instead of the expansion tank. Additionally a suitable expansion tank ❶ has to be installed at the highest point of the cooling circuit.

■ ATTENTION: The size and type of radiator should be adequate to transfer thermal energy of c. 28 kW (26,5 BTU/s) at takeoff power.

◆ NOTE: Assessment data by experience. For troublefree operation at good airflow a radiator of at least 500 cm^2 (78 in^2) area has to be used.

The flowrate of coolant in the cooling system can be assumed with c. 55 l/min (16 US gal/min) at 5500 rpm.

11.6) Operating Limits

The operating limits (max. permissible cylinder head temperature) are dependent on the engine design but also essentially on the coolant used.

The hottest measuring point (cylinder 2 or 3) is to be specified by testing. For this purpose, see section 6.3 Engine Views. This is dependent on the installation (pulling or pushing propeller design).

The coolant to be used is defined clearly in the Operators Manual. Depending on the installation conditions, conventional coolants can also be used. The provision of proof about the max. reachable cylinder head temperature and thus the coolant to be used is the responsibility of the airplane manufacturer in regard to 11.6.1 and 11.6.2

■ CAUTION: The coolant to be used and its concentration is to be communicated in written form to the owner.

◆ NOTE: From ROTAX® a warning sticker is to be delivered for the water-free coolant which is mounted separately on the expansion tank. When using this coolant, the warning sticker is to be mounted on the radiator cap in such a manner prior to delivery that the opening pressure (3) applied on the radiator cap remains visible. For this purpose, see fig. 16/1.

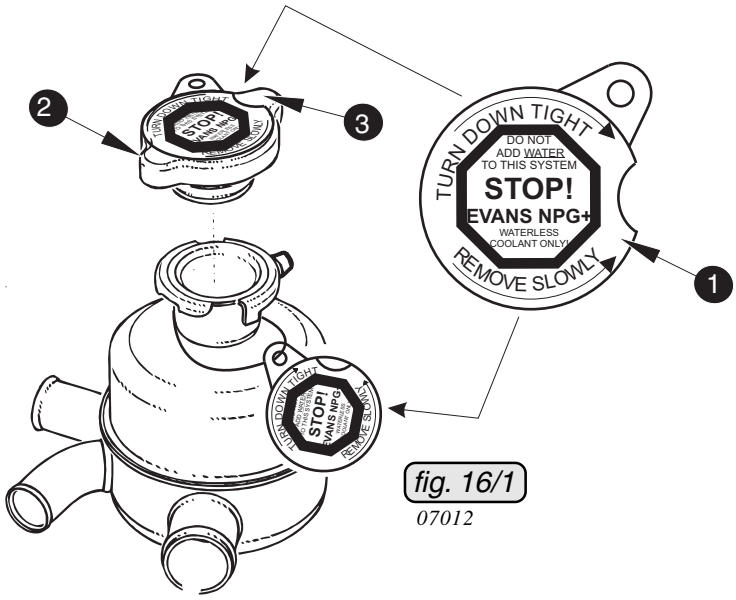


fig. 16/1
07012

1 Warning sticker
2 Radiator cap
3 Excess-pressure information of radiator cap

11.6.1) Water-free Coolant

- max. permissible cylinder head temperature
  see Operator's Manual section 10.1) General limits of operation.
- Coolant
  see Operator's Manual section 10.2.1) Coolant.

11.6.2) Conventional Glycol / Water Coolant Mixture

The boiling point of conventional glycol / water coolant concentrate depends on the mixture ratio and on the system pressure, i.e. radiator cap.

Corresponding to the following table, the max. permissible cylinder head temperature is limited depending on the coolant concentrate used and may not be exceeded.

radiator cap	max. permissible cylinder head temperature
0.9 bar (13psi)	115 °C (239 °F)
1.2 bar (17.5psi)	120 °C (248 °F)

07030

During exclusive operation within the max. permissible cylinder head temperature, the following coolant can be used in the corresponding mixture ratio:

	Mixture ratio %**	
Description	**concentrate**	**water**
BASF Glysantine Anticorrosion*	50	50

07001

* or equivalent

** 50% antifreeze concentrate and 50% pure water, or an equivalent premixed liquid

■ CAUTION: The antifreeze (frost protection) of this mixture is to be observed according to the manufacturer's specifications.

■ CAUTION: The correct mixture ratio is to be observed since otherwise the coolant can thicken and as a result can lead to damages to the cooling system.

12) Cooling air ducting

Contrary to the cylinder heads, the cylinders are ram air cooled. Plan cooling air ducting according to installation requirement.

▲ WARNING: The cooling air ducting has to be designed and built such, that the operating temperatures are kept within the specified limits, warranted even at **hot day conditions**.

12.1) General directives for ducting of the cooling air

See fig. 2, 3 and 4.

For front installation in a closed fuselage, ducting of cooling air to the cylinders is highly recommended. In this case a costly horizontal partitioning can be avoided.

◆ NOTE: The engine remains in this case completely on the warm side of the engine compartment and is very well accessible. In special cases a separate cold air supply to the air intake filters has to be provided.

ROTAX® developed especially for this application a non-certified cooling air ducting. Certification to the latest requirement like FAR or JAR has to be conducted by the aircraft builder.

The following recommendations should assist the aircraft builder at the planning of a suitable cooling air ducting.

◆ NOTE: These recommendations derive from years of experience and the result achieved are generally very good.

■ ATTENTION: The cooling air ducting to be adequate to transfer thermal energy of c. 6 kW (5,7 BTU/s) at takeoff power.

☞ required cross section of air duct: ..... at least 100 cm^2 (16 in^2)

☞ material:
glass fibre reinforced plastic or heat resistant non-inflammable material.

☞ attachment:
formlocking on engine case and cylinders

◆ NOTE: In case formlocking attachment won`t be adequate, additional attachment is possible on two threaded lugs M8 on top side of engine.

02024

	axis		
attachment points	x axis	y axis	z axis
	-300,0	-30,0	-14,0
	-300,0	30,0	-14,0

02025

	attachment points
max. allowable forces (limit load) in (N) in x,y and z axis	2 000
max. allowable moment (limit load) in (Nm) in x,y and z axis	50
min. length of thread engagement (mm)	15

■ ATTENTION: The stated limit loads are valid only at utilization of min specified thread length, and must never be exceeded.

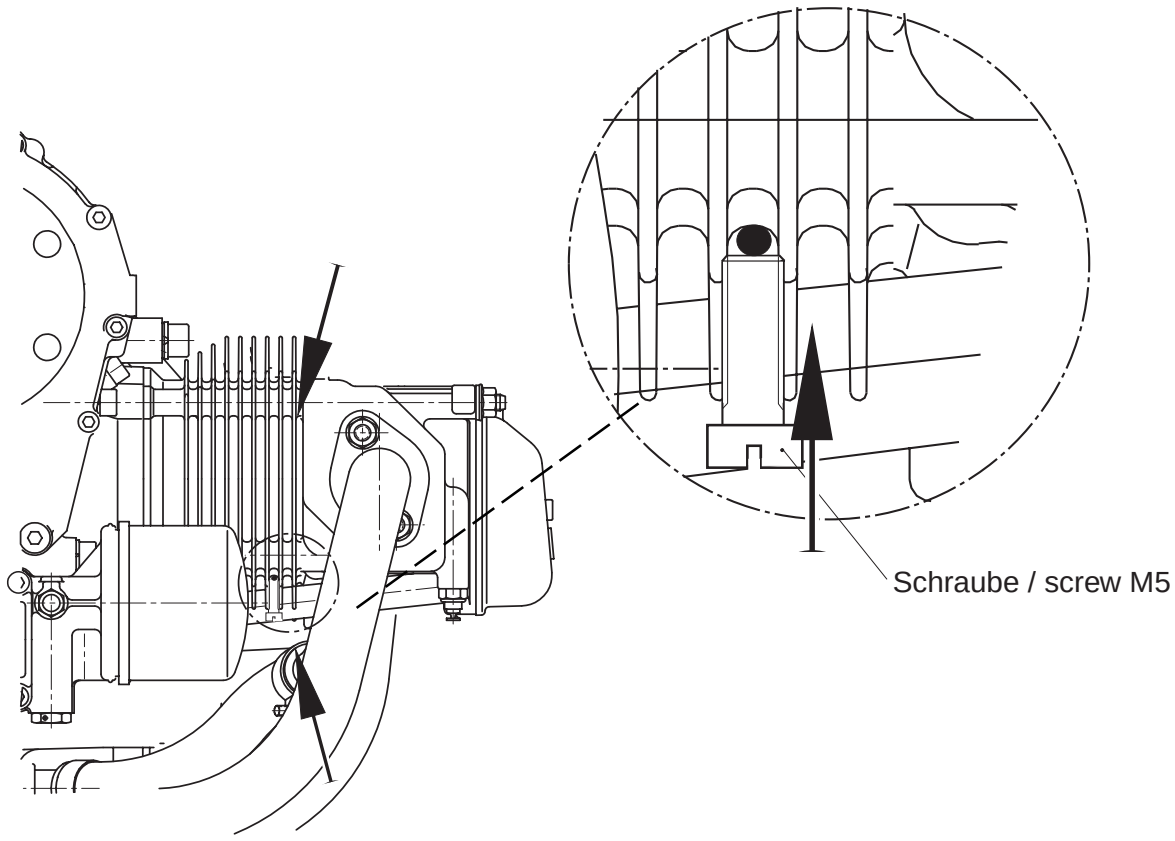
Depth of thread ..... 18 mm (.71 in.).

12.1.1) Cylinder wall temperature

Cylinder wall temperature ..... max. 190 °C (374 °F)

To verify the efficiency of the cooling system the cylinder wall temperature has to be measured. The temperature reading of the cylinder wall can either be taken on top side or on bottom side of cylinder 2. The temperature sensor has to be located on the cylinder wall between the second and third cooling fin.

◆ NOTE: To clamp a thermo couple on the cylinder wall it is recommended to cut a thread M5 between the cooling fins.



13) Lubrication system (oil system)

In the standard engine version an oil tank is included. For the closed lubrication circuit an oil cooler and connecting lines are needed as well.

The certification of the oil cooler and connecting lines to the latest requirements such as FAR and JAR has to be conducted by the aircraft builder.

No provision has been made for attaching the oil cooler on the engine.

13.1) Requirements on the lubrication system

▲ WARNING: The lubrication system has to be designed such that operating temperatures will not exceed the specified limits.

Oil pressure see fig. 46.

max. ..... 7 bar (at cold start a pressure of up to 7 bar (100 psi) is permitted)

min. ..... 0,8 bar (12 psi) (below 3500 1/min)

nominal ..... 2,0 ÷ 5,0 bar (29 - 73 psi) (above 3500 1/min)

■ ATTENTION: At full throttle operation the max. allowed depression at pump inlet is 0,3 bar (4,4 psi.) below the ambient pressure. Reading must be taken at a distance of max. 100 mm (4 in.) before pump inlet.

Oil temperature

☞ nominal-operating temperature ..... c. 90 ÷ 110° C (190 ÷ 250° F)

min. 50° C (120° F),

max. 130° C (266° F)

▲ WARNING: At operation below nominal oil temperature formation of condensate in the lubrication system might influence oil quality.

Oil lines

☞ Temperature durability: ..... min . 140° C (285° F)

☞ Pressure durability: ..... min. 10 bar (145 psi.)

☞ Bending radius: ..... min. 70 mm (2,76 in.)

☞ Minimum inside dia of oil lines in reference to total length

length up to 1m (3') ..... min. 11 mm ø (.43 in.)

length up to 2 m (6'-6 in.) ..... min. 12 mm ø (.47 in.)

length up to 3 m (10') ..... min. 13 mm ø (.51 in.)

■ ATTENTION: The suction lines must be secured against folding.

Venting line of oil tank

See fig. 17 and 20.

☞ Route the line without kinks and avoid sharp bends.

◆ NOTE: Water is a by-product of combustion. Most of this water will dissipate from the combustion chamber with the exhaust gases.

A small amount will reach the crankcase and has to be disposed through the venting line of oil tank via oil return line.

☞ The venting line must be routed in a continuous decline or furnished with a drain bore at it's lowest point to drain possible condensate.

☞ The venting line has to be protected from any kind of ice formation in the condensate. Protection by insulation, or routing in a hose with hot air flow or by furnishing venting line with a bypass opening ❶ before passing through cowling ❷.

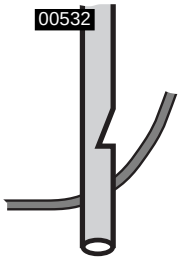


fig. 17

13.2) Size and position of connections

See fig. 18, 19 and 20.

☞ **oil pump** inlet nipple ❸. outside dia ..... 13,2 mm
slip-on length ..... max. 21 mm (.83 in.)

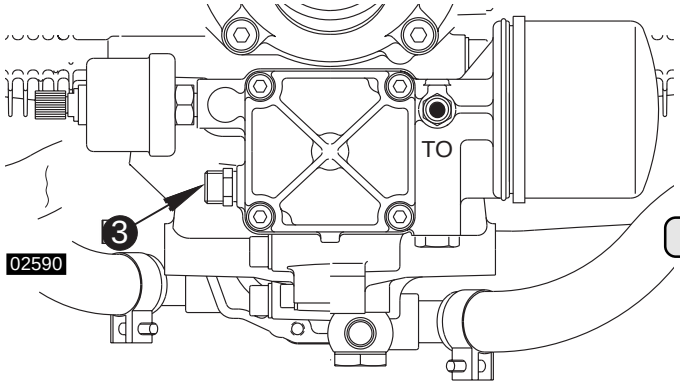


fig. 18

☞ **nipple for oil return line** ❹. ... outside dia. ..... 13,5 mm (.53 in.)
slip-on length ... max. 24 mm. (.95 in.)

Tightening torque of Banjo bolt ❺ M16x1,5 ..... 35 Nm (310 in.lb.).

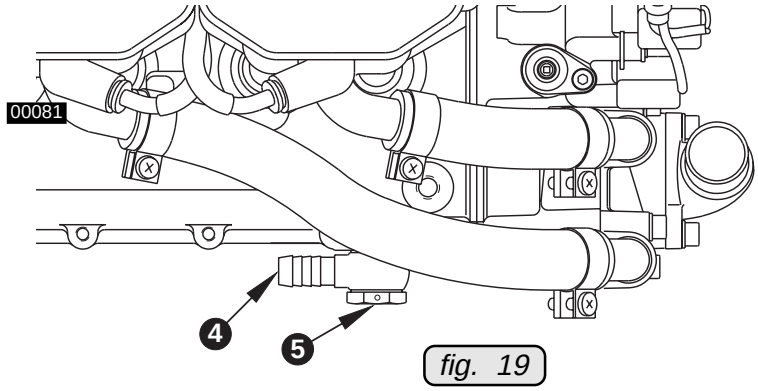


fig. 19

☞ **oil tank**

Inlet ❻ and outlet ❼ with screw connection

outside dia. ..... 12 mm (.47 in.)

slip-on length ..... max. 24 mm (.95 in.)

Tightening torque ..... 25 Nm (220 in.lb.).

◆ NOTE: Inlet and outlet, standard version with swivel joint ❾ and 90° connecting bend.

venting nipple ❽. ..... outside dia. ..... 8 mm (.32 in.)

slip-on length ..... max. 15 mm (.59 in.)

■ ATTENTION: Utilize total slip-on length for hose connection. Secure hose with suitable screw clamp or by crimp connection.

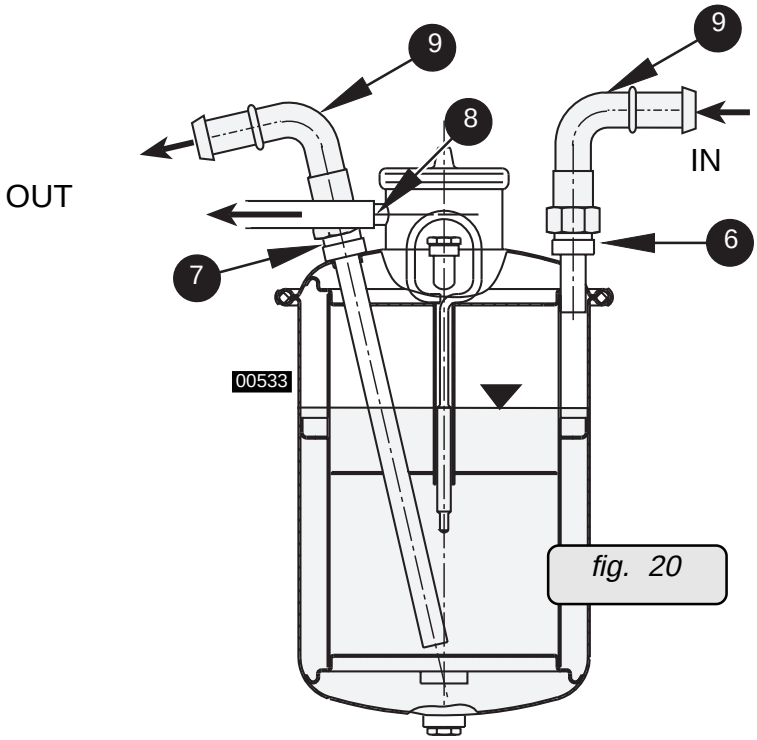


fig. 20

13.3) Feasible position and location of the oil tank

See fig. 21.

☞ The longitudinal axis z3 to be parallel to z-axis of the system of coordinates.

Tolerated deviation of parallelism: ..... ± 10°

◆ NOTE: Above notice is valid for both planes.

☞ The oil tank has to be positioned in it's z-axis such that the oil level ❶ is always between 0 and -400 mm on the z-axis.

▲ WARNING: At higher location of the oil tank oil might trickle through clearances at bearings into crankcase during longer periods of engine stop. If fitted too low it might badly effect the oil circuit.

☞ Install the oil tank free of vibrations.

☞ Oil tank cover, oil drain plug and oil filter to be easily accessible.

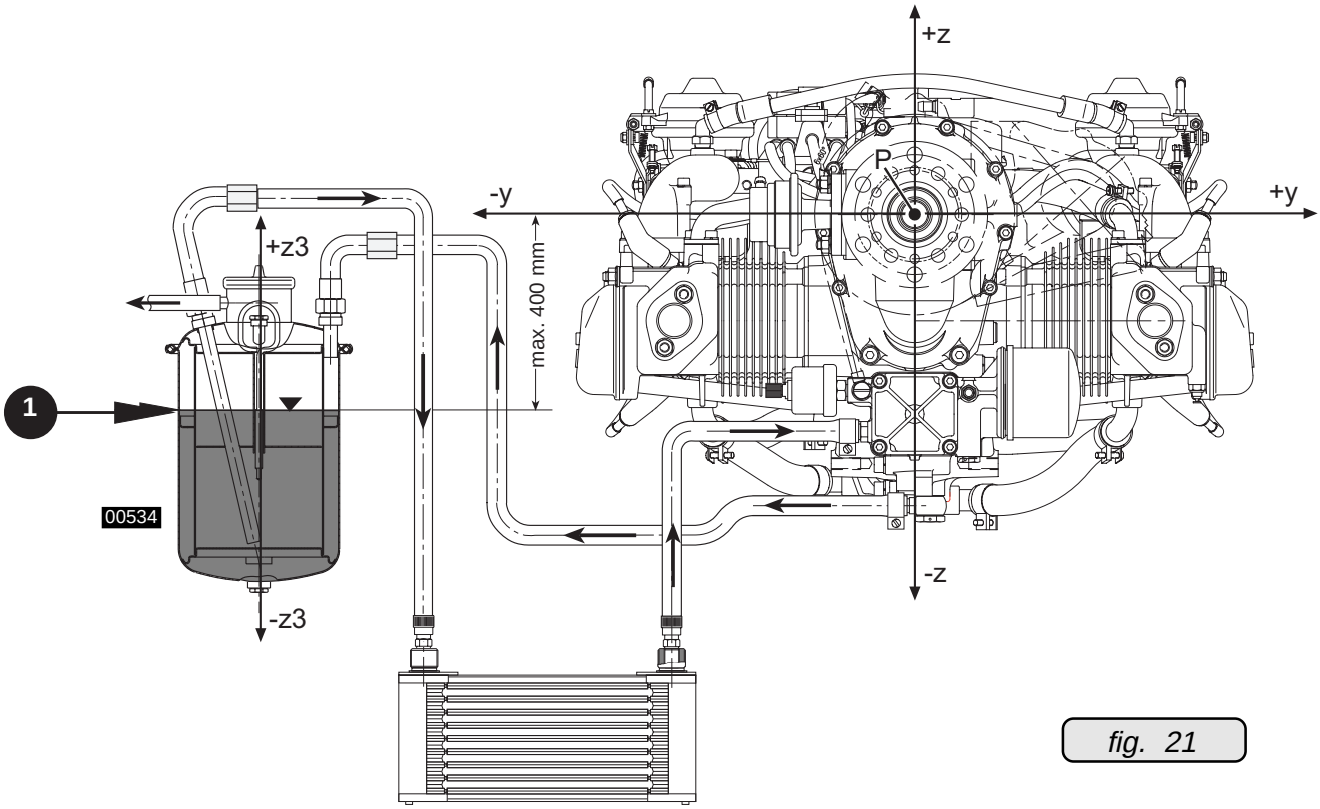


fig. 21

d00180

13.4) Feasible position and location of the oil cooler

See fig. 20 and 21.

☞ On principle the oil cooler has to be installed below the engine. See fig.21.

■ ATTENTION: If this position is not be practicable, install with connections upwards i.e. in positive direction on z-axis. See fig. This will prevent an unintentional draining of the oil cooler at longer engine stop.

■ ATTENTION: The oil cooler has to be designed to dissipate c. 8 kW (7,58 BTU/s) heat energy at takeoff power.

◆ NOTE: From years of experience we recommend an oil cooler size of at least 160 cm^2 (25 in^2), provided that air flow is adequate.

▲ WARNING: Adhere to limits of oil temperature.
Consult chapters 7.1 and 13.1.
If need be take appropriate measures like changing size of radiator, partial covering of oil cooler etc.

13.5) Filling capacity

☞ Oil quantity without oil cooler and connecting lines, 3l (0,8 US gal) min. 2l (0,5 US gal).

13.6) Venting of the lubrication system

See fig. 21

Venting of the lubrication system is extremely important for operation and life of engine and therefore it has to be followed meticulously.

Fill oil tank with approx. 2 Litres (0,53 gal. US) of motor oil. See chapter 10.2.3 of Operator's Manual.

▲ WARNING: For safety's sake, switch off ignition and remove ignition key.

Disconnect suction hose from oil tank and fill the oil hose with oil utilizing a suitable funnel. By cranking the engine with a few turn of the propeller oil will be sucked in by the oil pump.

■ ATTENTION: If in the suction line of the oil pump an oil cooler is installed this procedure will take a bit longer as the cooler has to filled with oil first.

Reconnect oil suction line on tank and crank engine with starter but **with ignition 'OFF'** until steady min. oil pressure is indicated on oil pressure gauge.

Switch on ignition and start engine and observe oil pressure.

The oil pressure must rise within 10 seconds to at least 2 bar (30 psi.). If not stop the engine instantly and vent suction line between oil tank and oil pump again as stated above.

After positive oil pressure indication start engine under observation of oil pressure. After short idling, stop engine and replenish oil to max. mark on tank. Never overfill, otherwise oil would escape through venting bore during operation. At oil level check the max. mark must not be exceeded.

▲ WARNING: Always observe the engine whilst running from a safe place.

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14) Fuel system

On the standard engine version the two BING constant depression carburetors are already fitted and the fuel lines to manifold installed.

Installation of the system from the fuel tank to the inlet of engine-driven fuel pump has to be established by the aircraft- or fuselage builder.

The assembly consist of the following items:

- ☞ fuel tank
- ☞ coarse filter
- ☞ water trap
- ☞ fire cock
- ☞ electrical supplementary pump, if arrangement is without gravity feed (electric fuel pump with proper capacity and maximal 0,35 bar operating pressure)
- ☞ pressure gauge
- ☞ fuel lines as required

The fuel pump will be supplied complete with fuel lines and connections.

■ ATTENTION: A fine filter with mesh size 0,1 mm has to be installed upstream of the fuel pump.

Dry type filter elements (paper filter) are not permitted as they could absorb water and thus reducing flowrate.

■ ATTENTION: Certification of components not included in the supply scope have to be conducted to the latest requirements such as FAR and JAR by the aircraft builder.

14.1) Requirements on the fuel system

▲ WARNING: Design and layout of the fuel system has to warrant engine operation within the specified limits.

☞ **Fuel pressure:** see fig. 23

nominal pressure of mechanical fuel pump: ..... 0,3 bar (4,4 psi.)

tolerated fuel pressure range: ..... max. 0,4 bar (5,8 psi.)

min. 0,15 bar (2,2 psi.)

▲ WARNING: Fuel pressure in excess of 0,4 bar can lead to an override of the float valve with subsequent engine stop.

◆ NOTE: Readings of the fuel pressure are taken at the pressure gauge connection ❻ on fuel manifold ❹.

☞ **Delivery rate:**

min. 35 l/h (8,2 US gal/h) of mechanical or electric fuel pump.

☞ **Fuel lines:**

According to valid certification or national specifications.

■ ATTENTION: For prevention of vapour locks, all the fuel lines on the suction side of the fuel pump have to be insulated against heat in the engine compartment and routed at distance from hot engine components, without kinks and protected appropriately.

At very critical conditions e.g. problems with vapour formation the fuel lines could be routed in a hose with cold air flow.

☞ **Fuel filter:** see fig. 22

Coarse filter: ..... on fuel tank as per valid certification

Fine filter: ..... in the feed line between fuel tank and fuel pump, mesh size 0,1 mm (.004 in.).

◆ NOTE: The integrated filter in the fuel pump is with mesh size 0,3 mm (.012 in.).

☞ **Fuel temperature:**

To prevent vapour locks temperatures in excess of 36° C are not permissible in the vicinity of fuel lines, float chamber and such.

14.2) Definition and size of connection

See fig. 2, 3, 4 and 24.

☞ position of z4 axis of the fuel manifold:

02772

	coordinates [mm]		
	x axis	y axis	z axis
clamp block	-385,0	-50,0	ca.110

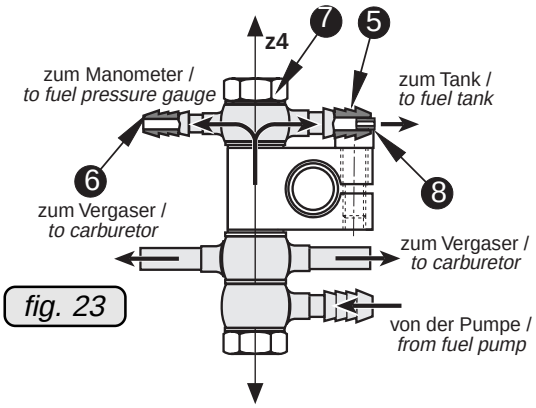

fig. 23

◆ NOTE: Dimensions always from point of reference (P).

☞ return line to tank ❺:

outside dia. ..... 7 mm (.28 in.)

slip-on length: ..... max. 17 mm (.67 in.)

☞ pressure gauge connection ❻:

outside dia. ..... 6 mm (.24 in.)

slip-on length: ..... max. 17 mm (.67 in.)

■ ATTENTION: At loosening or tightening of the banjo bolt ❼ (tightening torque 10 Nm = 90 in.lb.) support the fuel manifold appropriately.

◆ NOTE: The connection nipple ❺ is furnished with an orifice ❽ (0,35 mm = 0,014 in.) essential for operation of the fuel system.

■ ATTENTION: Utilize max. slip on length. Secure hoses with suitable screw clamps.

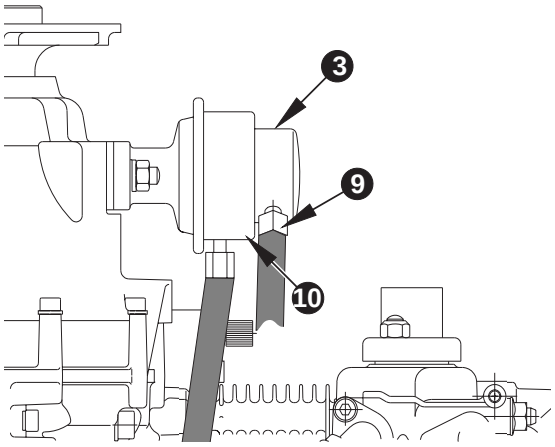

fig. 24 02064

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15) Carburetor

See fig. 25.

The carburetors on the standard engine are already attached by a flexibly flange. Only connections of the Bowden cable for throttle and starting carburetor as well as fuel connections have to be established.

▲ WARNING: The carburetor flange assembly has to carry the weight of the carburetor and intake system. Ensure that the screw of the clamp is positioned on the underside as supplied and the gap between the clamp plates is 7 mm.

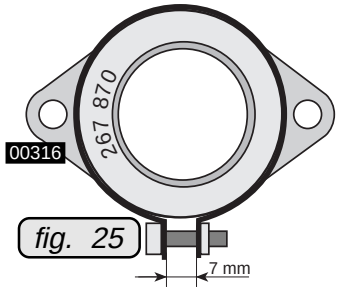

fig. 25

15.1) Requirements on the carburetor

▲ WARNING: The carburetor is positioned above the exhaust socket. Therefore fit a suitable plate under the carburetor serving as trip pan and heat shield.

■ ATTENTION: The carburetor venting lines have to be routed into the air intake silencer as specified and approved by ROTAX®. Consult also chapter 16.

After the fuel lines are connected on the carburetor put paint on banjo bolt ❹ of swivel joint.

The certification to the latest requirements such as JAR or FAR has to be conducted by the aircraft builder.

15.2) Dimensions for installation and limit load

See fig. 2, 3, 4, 2 and 27.

☞ centre position of carburetor socket (P1) of the respective carburetor:

	coordinates [mm] (02027)		
carburetor for	x axis	y axis	z axis
cylinder 1/3	-553	180	25
cylinder 2/4	-521	-180	25

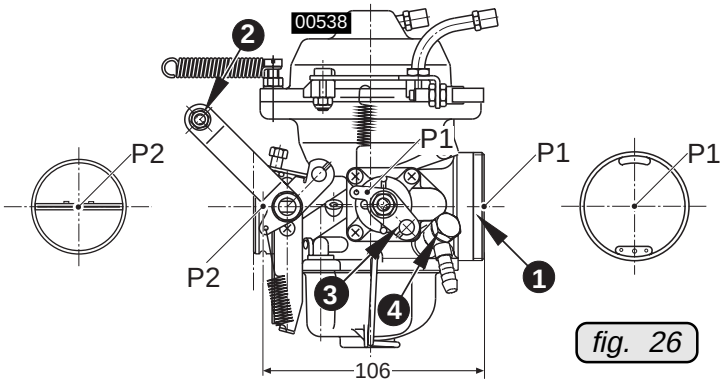

fig. 26

◆ NOTE: All dimensions to point of reference (P)

☞ limit load on point of reference P2

■ ATTENTION: The specified limit loads must never be exceeded.

(02028)	reference point P2
max. allowable forces (limit load) in (N) in x,y and z axis	60
max. allowable bending moments (limit load) in (Nm) in x,y and z axis	4

☞ **connection ❶ for air filter or intake silencer**

outside dia.: ..... 50 mm (2 in.)

slip-on length: ..... 12 mm (.47 in.)

☞ **connection for throttle actuation ❷**

connection on throttle lever: ..... set screw M 5x12

tightening torque: ..... 4 Nm (35 in.lb) (suitable for 1,5 mm = .06 in. steel wire)

action travel: ..... 65 mm (2,6 in.)

actuating force: ..... min. 1,5 N (.3 lb.)
max. 8 N (1,8 lb.)

limit load: ..... 20 N (4,5 lb.)

☞ **connection for starting carburetor (choke) actuation ❸**

connection on choke lever: ..... clamping nipple 6 (suitable for 1,5 mm steel wire)

action travel: ..... 23 mm (.9 in.)

actuating force: ..... min. 10 N (2,2 lb.)
max. 24 N (5,4 lb.)

limit load: ..... 100 N (22 lb.)

15.3) General directives

See fig. 26 and 27.

The choke shaft ❹ is marked ❺. This mark has to point towards cable engagement ❻.

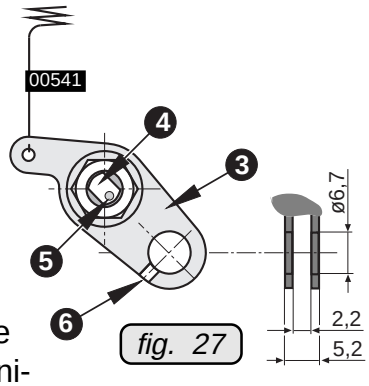

fig. 27

▲ WARNING: Route Bowden cable in such a way that carburetor actuation will not be influenced by any movement of engine or air frame, thus possibly falsifying idle speed setting and carburetor synchronisation.

Adjust Bowden cable such that throttle and choke can be fully opened and closed. Use Bowden cable with minimized friction so that the spring on the throttle can open the throttle completely. Otherwise a stronger return spring or a cable with pull-push action would have to be used.

The throttles have to be actuated by two synchronous working cables.

◆ NOTE: Spring opens throttle.

▲ WARNING: With throttle lever not connected the carburetor will remain fully open. Therefore never start the engine without connecting the Bowden cables first.

16) Air intake system

See fig. 28.

The intake system is determined essentially by the demands of engine and of the acceptable noise emission on the intake side. In the standard ROTAX® engine supply volume an airbox is included.

Performance data as specified and limits of operation can only be warranted by employment of the genuine ROTAX® airbox.

If it will be necessary to use a different airbox or a modified genuine ROTAX® airbox, for reasons of installation the actual airbox employed has to be sent to ROTAX® for verification.

Nevertheless, the certification of the modified airbox to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

16.1) Requirement on the intake system

▲ WARNING: Carburetor icing is a common reason for engine trouble. In the airbox offered by ROTAX® provisions have been made for intake air preheating.

If an airbox of not ROTAX® origin is used provisions for preheating the intake air have to be made to prevent formation of ice in the intake system.

Preheating of the intake air will lead to a reduction of engine performance by low of nature!

▲ WARNING: All intake components have to be secured against loss.

The certification to the latest requirements such as FAR or JAR have to be conducted by the aircraft builder.

☞ **Air filter**:

■ ATTENTION: A minimum flow rate of 220 m^3/h has to be warranted for all conditions.

The pressure loss in intake ducting must not exceed 2 hPa (0.03 psi).

▲ WARNING: Use only filter elements which will not tend to restrict flow when in contact with water.

Air filter:

☞ material: ..... four-fold cotton fabric,

☞ face: ..... covered with aluminium screen,

☞ total filter area: ..... at least 1400 cm^2 (220 in^2)

Airbox: See fig. 28.

☞ volume: ..... at least 2,5 l (.66 US gal)

☞ outline dimension: ..... see fig. 28.

Draining lines

▲ WARNING: To connect the draining lines is absolute necessary otherwise flooding fuel from leakage could end up on the exhaust system. RISK OF FIRE!

- These lines have to be routed such that in case of damage the surplus fuel will be drained to a suitable place.
- Route the lines without kinking and avoid narrow bends.
- The lines must be installed with continuous inclination.
- The lines have to be protected against any kind of blockage, for instance by formation of ice.

■ ATTENTION: If the draining lines are closed or blocked, fuel could end up on the exhaust system. RISK OF FIRE!

Nipples ❺ for connection of draining lines

Outside diameter ..... 6 mm (.24 in.)

Slip-on length ..... 17 mm (.67 in.)

■ ATTENTION: The float chamber venting must never be exposed to velocity pressure.

Provide connection to take readings of manifold pressure ❸.

Provide connections for temperature sensor ❹.

Outside diameter ..... 6 mm (.24 in.)

Slip-on length ..... 17 mm (.67 in.)

■ ATTENTION: If the engine has been installed without employment of the ROTAX® engine frame which includes also support of the airbox, than provide an appropriaty support for the airbox.

◆ NOTE: Make sure that the air intake tubes of the airbox for fresh air and preheated air are connected correctly.

◆ NOTE: Fig. 28 shows the genuine ROTAX® airbox.

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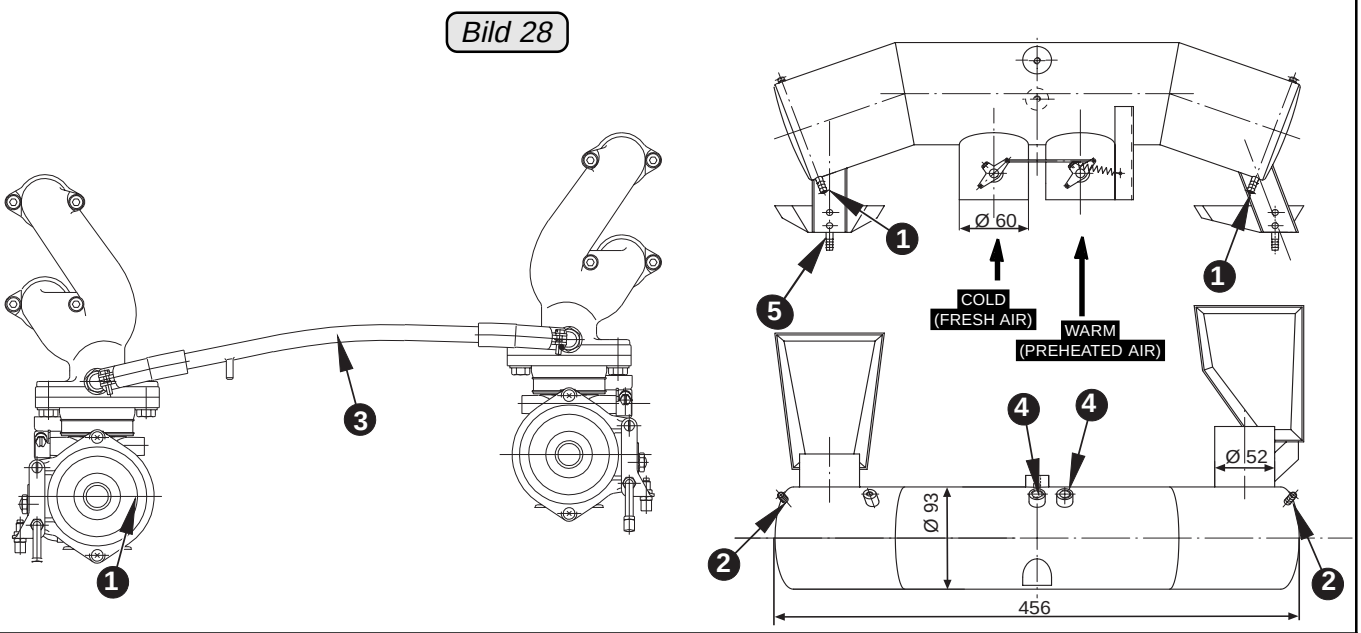


17) Electric system

See fig. 29.

The engine is supplied with the wiring completed and ready to operate. Only the following connections to the aircraft have to be established.

integrated generator ❶ Þ external rectifier-regulator ❷

electronic module ❸ Þ shorting button ❹ (grounding)

electric starter ❺ Þ start relay ❻

if required:

rev-counter pick-up ❼ Þ electric rev-counter ❽

auxiliary generator (optional extra) ❾ Þ consumer (battery)

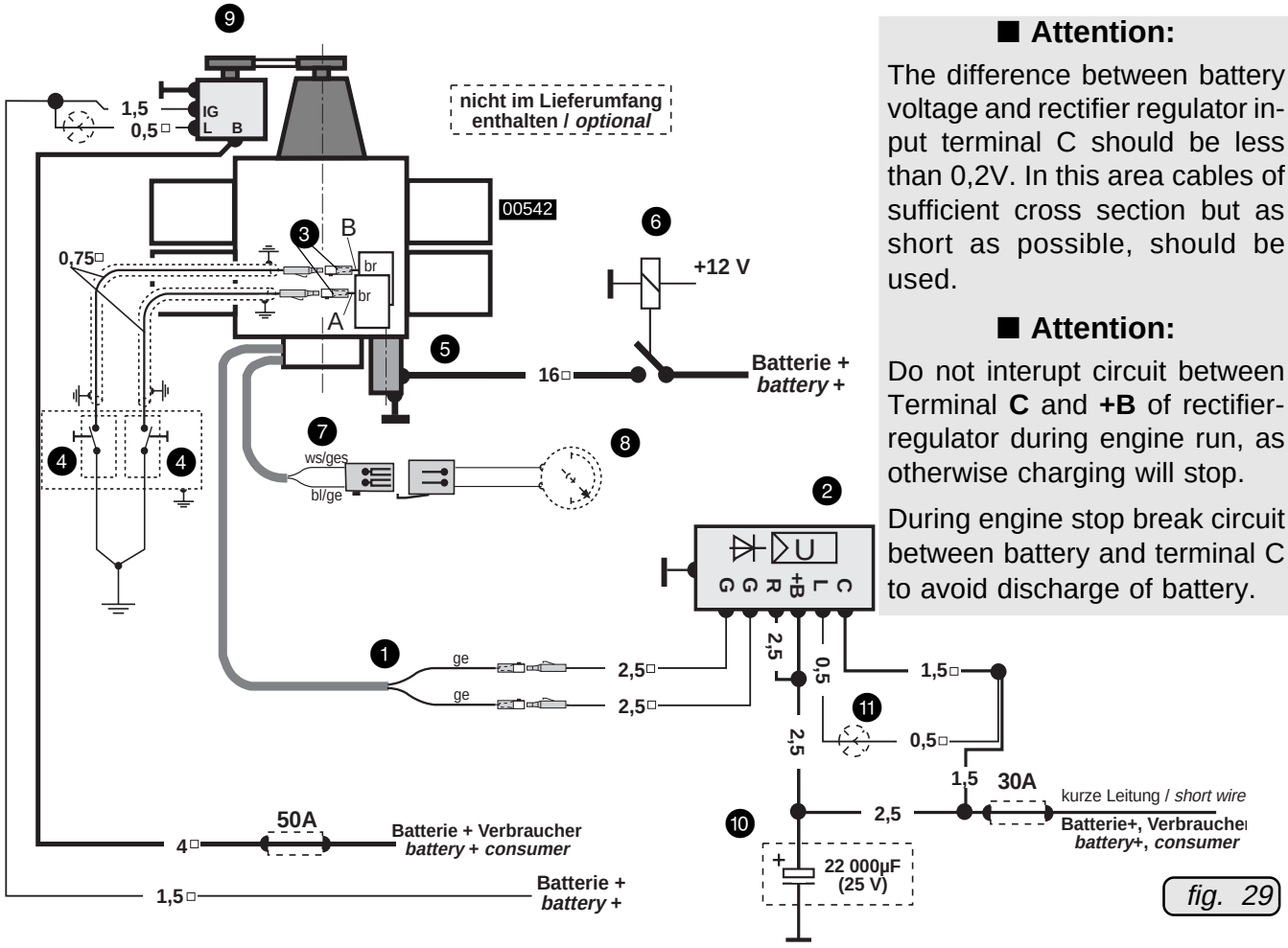
■ ATTENTION: The connections have to be completed by the aircraft builder in accordance to effective certification and wiring diagram.

The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) is greatly affected by the wiring and has to be checked for each installation.

▲ WARNING: The supply to the various consumers (e.g. battery) has to be protected adequately by fuses (consult wiring diagram). When using a fuse too large damage to electric equipment may result.

Under no circumstances route consumers cables (e.g. battery) side by side with ignition cable. Induction could cause problems.

Colour code: ws Þ white bl Þ blue ge Þ yellow br Þ brown



■ Attention:

The difference between battery voltage and rectifier regulator input terminal C should be less than 0,2V. In this area cables of sufficient cross section but as short as possible, should be used.

■ Attention:

Do not interupt circuit between Terminal **C** and **+B** of rectifier-regulator during engine run, as otherwise charging will stop.

During engine stop break circuit between battery and terminal C to avoid discharge of battery.

fig. 29

17.1) Technical data and connection of the electric components

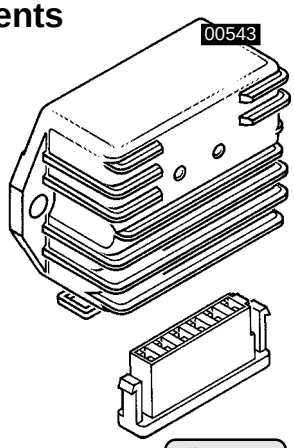


fig. 30

Integrated generator: see fig. 29 and 31

Feeding wires to rectifier-regulator on left side of ignition housing (see wiring diagram)

☞ 2 flexible cables, 1,5 mm² yellow (in shielding metal braid)

☞ length approx. 660 mm (26 in) starting from ignition housing

☞ with on each plug socket 6,3 x 0,8 to DIN 46247

◆ NOTE: 250W output at 5800 rpm.

Rectifier-regulator: see fig. 30

☞ type: ..... electronic full-wave rectifier regulator

☞ effective voltage: ..... 14 ± 0,3 V (from 1000 ± 250 rpm.)

☞ current limit: ..... max. 28 A

☞ ambient temperature range: ..... min. -25° C (- 13° F) max. +90° C (194° F)

☞ weight ..... 0,3 kg (.66 lb.)

■ ATTENTION: Flawless operation of the rectifier-regulator needs a capacitor of 22000 µF / 25 V.

The rectifier-regulator ⑩ is protected by a slow blowing 30A fuse

■ ATTENTION: The graph current over engine speed has been determined and is valid only at the following conditions.

ambient temperature: ..... 20 °C (68° F)

voltage: ..... permanent 13,5 V

tolerance: ..... max ± 5%

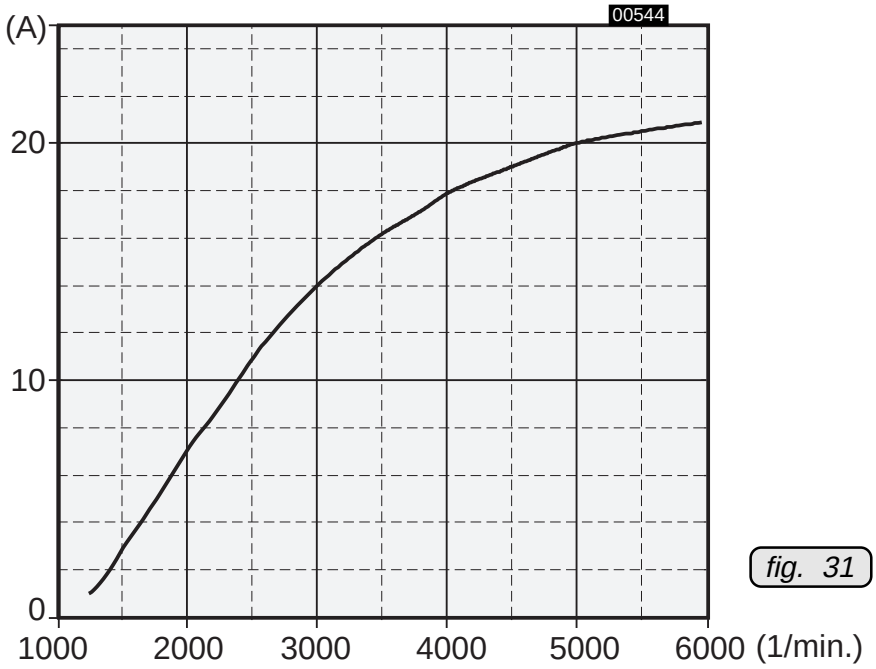


fig. 31

◆ NOTE: A charge-indicating lamp ⑪ 3W/12V may be fitted.

Ignition switches (on-off switch): see fig. 29

☞ type: ..... two separate, suitable on-off switches

☞ switching voltage: ..... min. 250 V

☞ switching current: ..... min. 0,5 A

Feeding lines to on-off switches on the electronic module (see wiring diagram).

☞ 1 each flexible cable ..... 0,75 mm^2, brown

Length approx. 50 mm (2 in.) from electronic modules.

with one each plug connector Sumitomo 6187-1171

◆ NOTE: One each quick-connector assy. for shorting cable supplied loose.

☞ Shorting cable of top electronic module (marked "A") for ignition circuit A.

Shorting cable of bottom electronic module (marked "B") for ignition circuit B.

◆ NOTE: Ignition circuit **A** serves: top spark plugs of cyl. 1 and 2
lower spark plugs of cyl. 3 and 4

Ignition circuit **B** serves: top spark plugs of cyl. 3 and 4
lower spark plugs of cyl. 1 and 2

■ ATTENTION: The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) depends essentially on the shorting cables used.

Min. section area: 2x 0,75 mm^2 (shielded flexible cable, shielding braid on both ends grounded).

■ ATTENTION: The metal base of each ignition switch must be grounded to air craft frame.

Electric-starter: see fig. 29 and 32

☞ output: ..... 0,6 kW

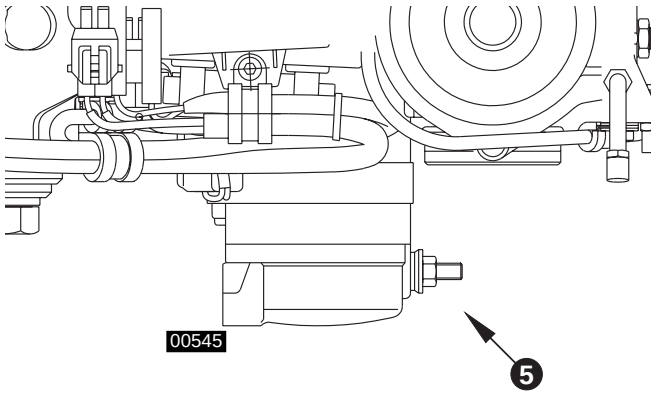


fig. 32

feeding lines to electric starter on right side of ignition housing.

☞ plus terminal ❺: ..... M6 screw suitable for cable eyes to DIN 46225

☞ grounding: ..... via engine block

■ ATTENTION: Duration of starting period is limited. Consult Operator's Manual, Chapter "engine operation".

Start relay: see fig. 29 and 33

☞ nominal voltage: ..... 12 V

☞ control voltage: ..... min. 6 V
max. 18 V

☞ switching current: ..... max. 75 A (permanent)
max. 300 A (for 1 sec.)

☞ ambient temperature range: ..... min - 40° C (-40° F)
max. +100° C (214° F)

☞ weight: ..... 0,145 kg (.32 lb.)

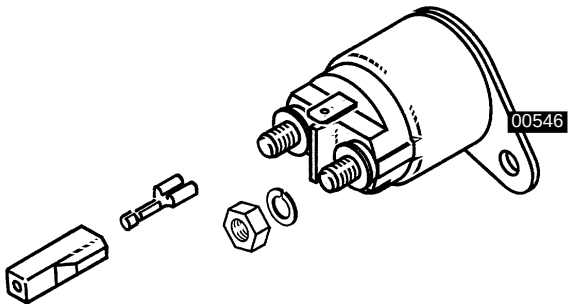


fig. 33

☞ current connections: ..... M6 screw suitable for cable eyes to DIN 46247

☞ control wiring: ..... plug connector 6,3x0,8 suitable for plug socket to DIN 46247

☞ grounding: ..... via housing

■ ATTENTION: Activation of start relay limited to short duration. Over a period of 4 min. operation, the duty cycle is 25%.

Auxiliary generator ❾ (as option): see fig. 29, 34 and 35.

☞ output: ..... max. 600 W DC at 6000 rpm.

☞ voltage: ..... 14,2 ÷ 14,8 V

☞ ambient temperature range: ..... min. - 30° C (-22° F)
max. +90° C (194° F)

◆ NOTE: Voltage regulator is integrated in the generator

Feeding wiring to auxiliary generator located on the outside of propeller gear

☞ plus terminal ⓭: ..... M 6 screw suitable to cable eyes to DIN 46225

☞ grounding: ..... via engine block

☞ control wiring ⓬: ..... via supplied standard plug (Sumitomo 6111-2568)

■ ATTENTION: The current over speed graph has been determined and is effective only at the following conditions:

ambient temperature: ..... 20 °C (68° F)

voltage: ..... permanent 13,5 V

tolerance: ..... ± 5%

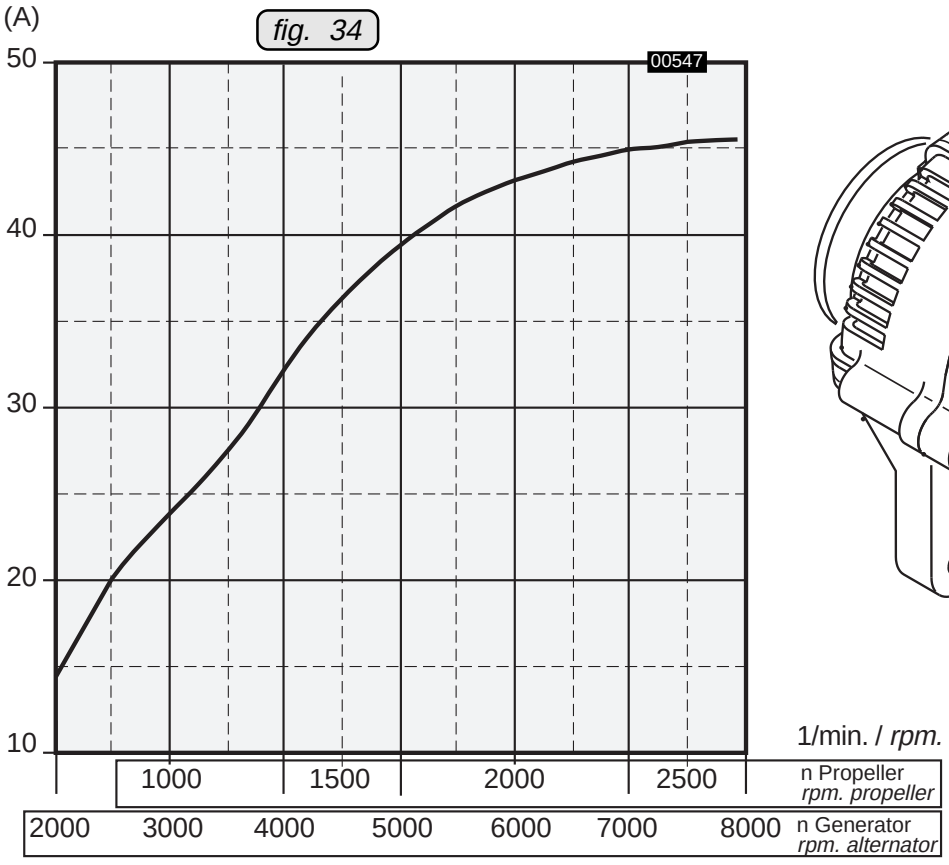


fig. 34

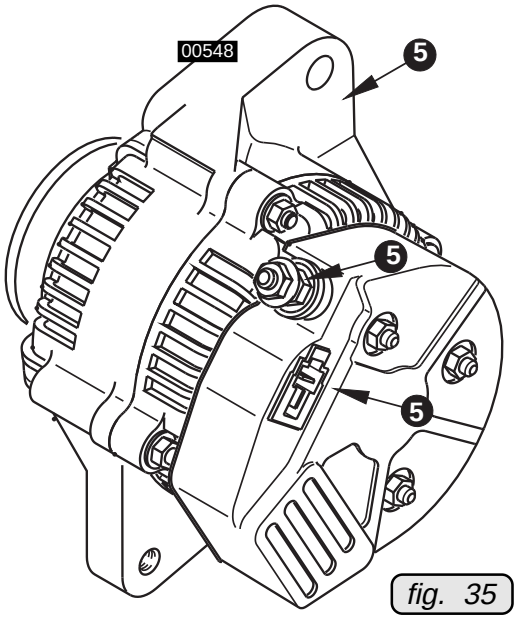


fig. 35

◆ NOTE: The speed of the auxiliary generator is 1,23 times crankshaft speed or 3 times propeller speed.

Connection of electric rev-counter: see fig. 29, 37, 38, 39 and 40.

Feeding wiring to electric rev-counter on left side of ignition housing (consult wiring diagram)

☞ material: ..... 2 flexible cables 0,5 mm², white/yellow and blue/yellow (in insulation wrap)

☞ length: ..... approx. 600 mm (24 in.) starting from ignition housing

◆ NOTE: ROTAX® developed especially for this application a non-certified electric rev-counter. Certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

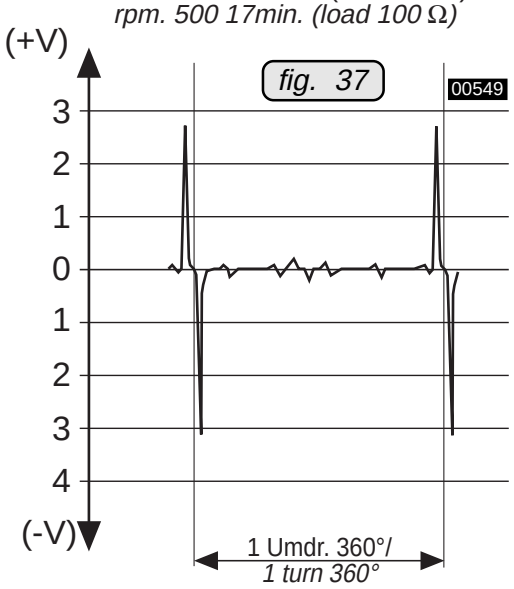
■ ATTENTION: The graphs depicting output signals have been determined and are effective only at the following conditions.

ambient temperature: ..... 20° C (68° F)

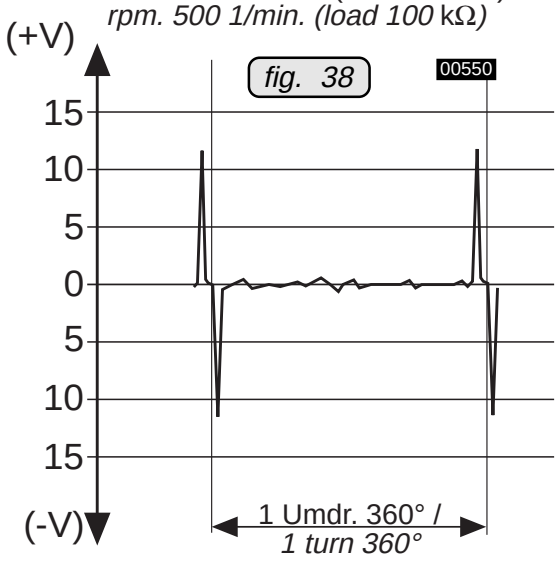
tolerance: ..... ± 5%

The pick-up for the rev-counter generates one pulse per revolution. Pulse shape and pulse voltage as per recordings (oscillogram).

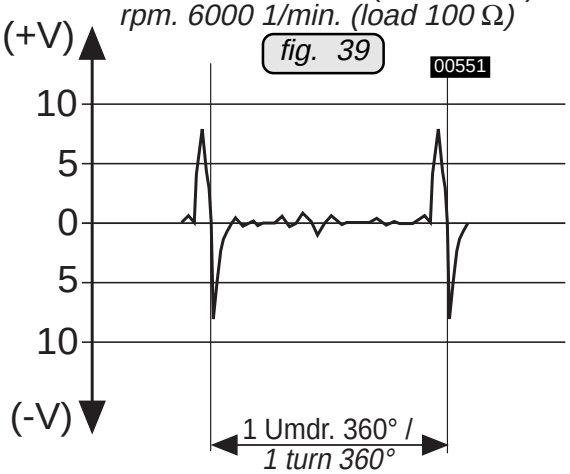
Drehzahl 500 1/min. (Last 100Ω) /
rpm. 500 17min. (load 100 Ω)



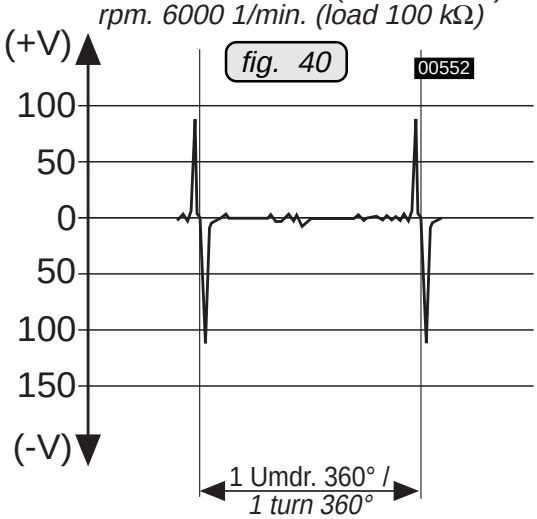
Drehzahl 500 1/min. (Last 100 kΩ) /
rpm. 500 1/min. (load 100 kΩ)



Drehzahl 6000 1/min. (Last 100 Ω) /
rpm. 6000 1/min. (load 100 Ω)



Drehzahl 6000 1/min. (Last 100 kΩ) /
rpm. 6000 1/min. (load 100 kΩ)



Battery:

■ ATTENTION: To warrant reliable engine start use a battery of at least 16Ah.

Electromagnetic compatibility (EMC/EMI):

Electromagnetic interference (EMI) and lightning:

The engine complies with the EMI and lightning requirements per DO-160C, sections 18, 20-22 as noted in the following paragraphs.

Emission

Conducted RF Interference:

Narrowband and broadband emissions meet RTCA DO160C Section 21-1 Cat. B(AZ) except in the frequency range of 150kHz ÷ 2MHz where emissions are up to 20dB higher than allowable limits.

Radiated RF Interference:

Narrowband and broadband emissions meet RTCA DO160C Section 21, Fig. 21-6 and 21-7, Cat. B except in the frequency range of 190kHz - 2MHz where emission are up to 35dB higher than allowable limits.

▲ WARNING: Consult the manufacturer if further interpretation is needed. These exceedances do not affect engine operation.

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18) Propeller drive

The propeller in tractor-or pusher arrangement has to be fitted on the propeller flange in accordance to current certification. As required utilize one of the three possible pitch circle diameters (P.C.D.) on the flange.

Certification of the propeller sizing and arrangement to the latest requirement such as FAR or JAR has to be conducted by the aircraft builder.

▲ WARNING: Never run the engine without a propeller installed as engine would suffer severe damage by overspeeding.

Never fit propeller directly on crankshaft.

18.1) Technical data:

See fig. 41.

- ☞ direction of rotation of the prop flange: ..... counter clockwise, looking towards face of flange
- ☞ location: ..... see system of coordinates
- ☞ attachment of propeller on prop shaft flange:
  - P.C.D 75 mm (2,95 in.): . ..... 6 bolt holes of 8 mm dia
  - P.C.D 80 mm (3,15 in.): . ..... 6 bolt holes of 11,5 mm dia
  - P.C.D 101,6 mm (4 in.): . ..... 6 bolt holes of 13 mm dia. and hub dia 47 mm
- ☞ ratio of gear reduction:. 2,43
- ☞ max. torque: ..... 130 Nm (96 ft.lb.)
- ☞ max. permitted out-of-balance on a prop: ..... max. 0,5 gm
- ☞ max. extension of propeller shaft: ..... 120 mm (4 3/4“).

■ ATTENTION: No modifications of propeller shaft permitted.

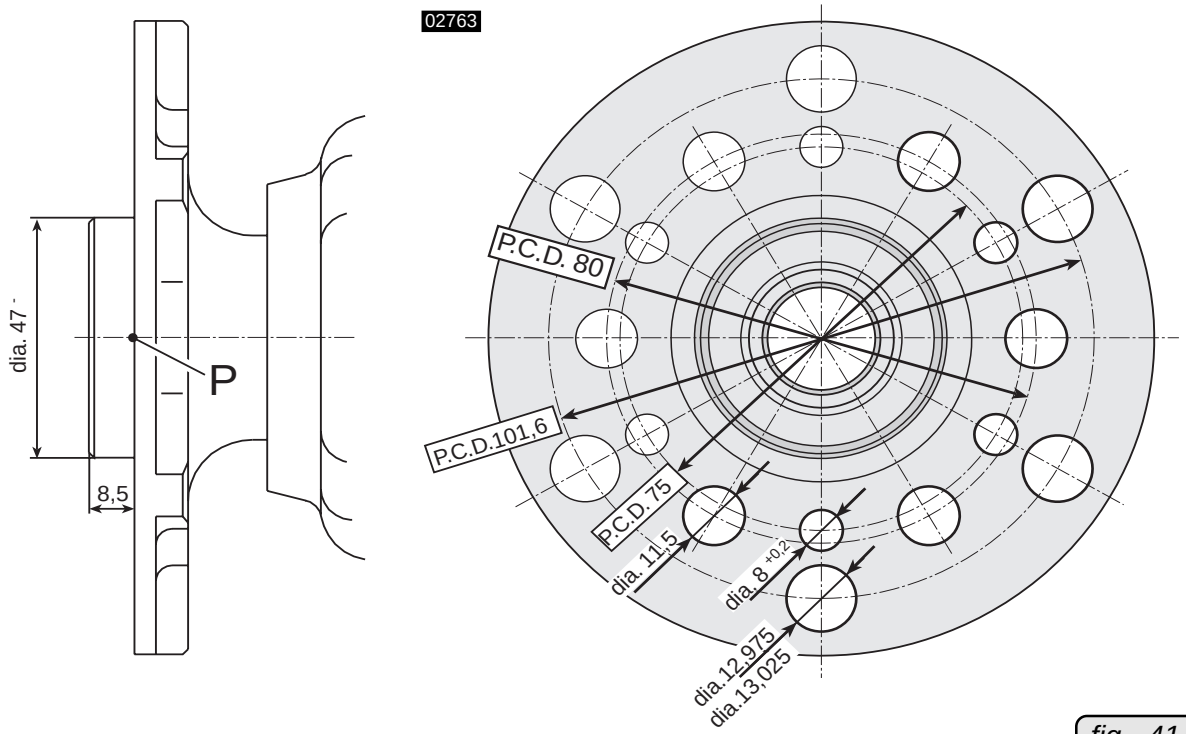

fig. 41

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19) Vacuum pump

19.1) Technical data:

See fig. 2, 3, 4 and 42.

Type: ..... Airborne 211 CC, drive via propeller gear

☞ location of the necessary connection ❶ and ❷ on the vacuum pump

	coordinates [mm]		
connection	x axis	y axis	z axis
1	226	0	98
2	293	0	98

☞ connections 02029

thread size: ..... 5/8“ 16 T.P.I.

tightening torque: ..... hand tight and tighten up by max. 1,5 turn with ring spanner.

Effective thread length: ..... max. 17 mm (.67 in.)

☞ net weight: ..... 0,8 kg (1,76 lb.)

☞ power input: ..... max. 300 W

■ ATTENTION: Take note of manufacturer’s specifications.

◆ NOTE: Speed reduction ratio from engine to vacuum pump is 1,842, i.e. the vacuum pump speed is 0,54 of the engine speed.

■ ATTENTION: The certification to the latest requirements such as FAR or JAR has to be conducted by the aircraft builder.

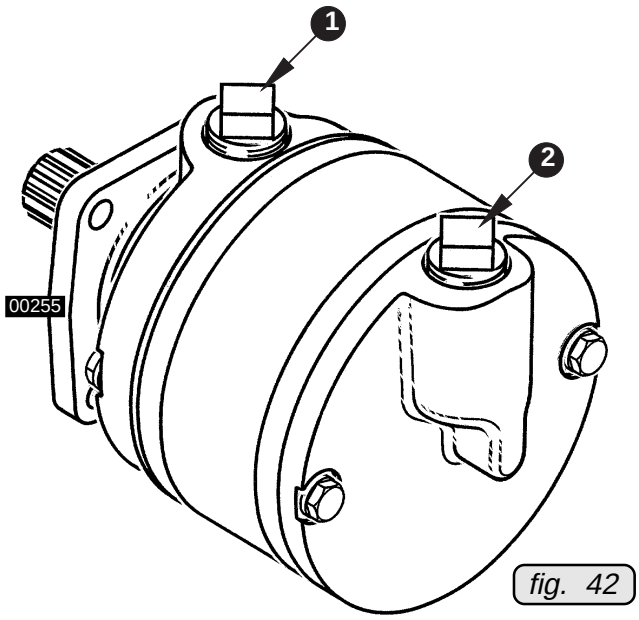

fig. 42

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20) Hydraulic governor for constant speed propeller

20.1) Technical data:

See fig. 2, 3, 4 and 43.

Type: ..... Woodward governor A210786 (for engine type S3 only), drive via prop gear

Location of centre of connection (P3):

02031

	coordinates [mm]		
Centre P3	x axis	y axis	z axis
	-373	-10	51

☞ cable connection: ..... 5 mm dia. hole (0,2 in.)

☞ cable travel: ..... approx. 54 mm (2,13 in.)

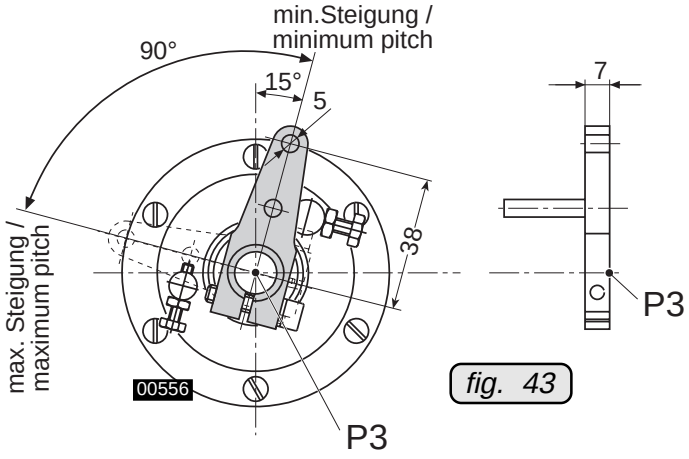

fig. 43

☞ actuating force: ..... approx. 3 N = .67 lb (during operation at max. speed)
limit load 6 N = 1,35 lb

☞ power input: ..... max. 600 W

☞ operating pressure: ..... max. 30 bar = 435 psi

☞ net weight: ..... 2,7 kg (6 lb)

◆ NOTE: Speed reduction ratio from engine to hydraulic governor is 1,842 i.e. the hydraulic governor rotates with 0,54 of engine speed.

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d00187

21) Connections for instrumentation

These connections to be established in accordance to certification and/or national specifications.

The certification for connections and connection lines have to be conducted by the aircraft builder for the latest requirement like FAR and JAR.

For notes regarding the electric rev-counter consult the chapter 17 "Electric system".

21.1) Sensor for cylinder head temperature:

See fig. 2, 3, 4 and 44.

☞ location: ..... in the cylinder head of the cylinders 2 and 3

☞ connection: ..... plug for socket 6,3x0,8 to DIN 46247

☞ grounding: ..... via engine block

02030

	coordinates [mm]		
cyl. head (botton)	x axis	y axis	z axis
2	-200,0	241,0	-157,0
3	-387,0	-241,0	-157,0

☞ graph of sensor resistance over temperature

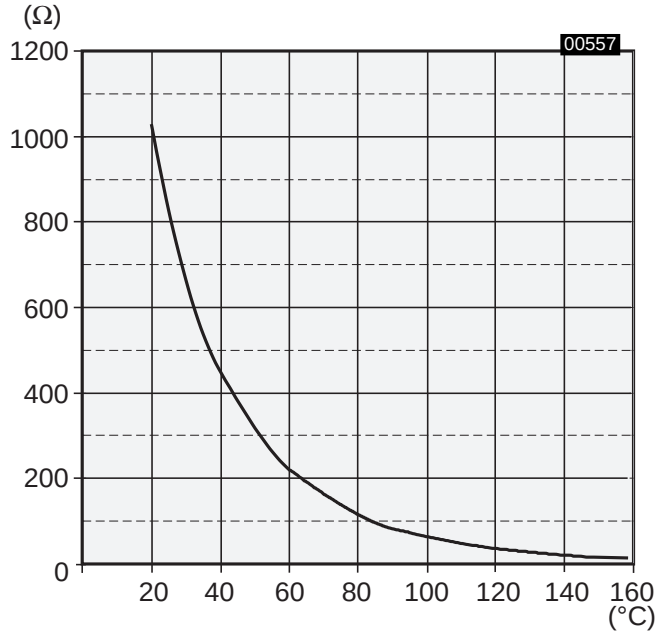

fig. 44

■ ATTENTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: ..... 20° C (68° F)

tolerance: ..... ± 10%

◆ NOTE: ROTAX® recommends the temperature indication VDO instrument "VDO 310.274/082/017" with an indicating range of 50° to 150° C (120° F - 300° F).

21.2) Sensor for oil temperature:

See fig. 2, 3, 4, 44 and 45.

☞ location: ..... oil pump housing

☞ marking ❷: marked with "TO" on oil pump flange

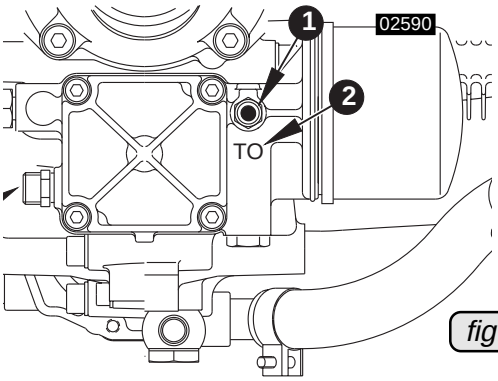

fig. 45

■ ATTENTION: To avoid any mix-up with indication wiring, mark this particular cable also with "TO".

☞ position of the temperature sensor ❶ on the oil pump flange:

02032

	coordinates [mm]		
point of support	x axis	y axis	z axis
	-115	46	-150

☞ connection of sensor wiring: ..... plug for socket 6,3 x 0,8 to DIN 46247

☞ grounding: ..... via engine block

☞ **graph of sensor resistance over temperature**

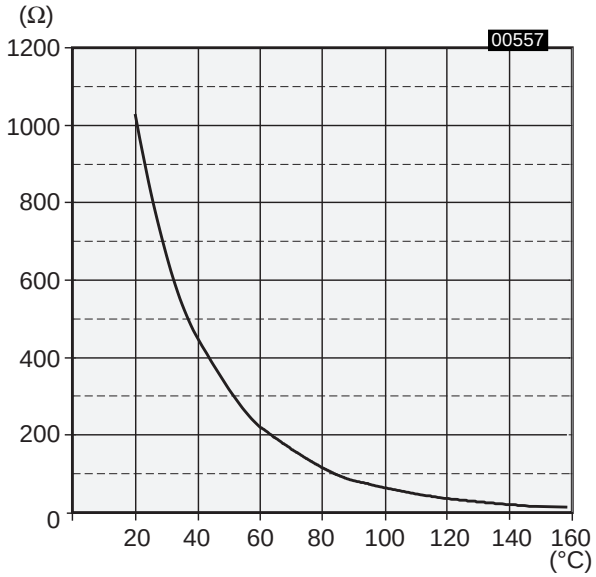

fig. 44

■ ATTENTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: ..... 20° C (68° F)

tolerance: ..... ± 10%

◆ NOTE: ROTAX® recommends the temperature indication VDO instrument "VDO 323.801/010/001" with an indicating range of 50° C to 150° C (120° F ÷ 300° F).

21.3) Oil pressure pick-up:

See fig. 2, 3, 4, 46 and 47.

☞ location: ..... oil pump housing

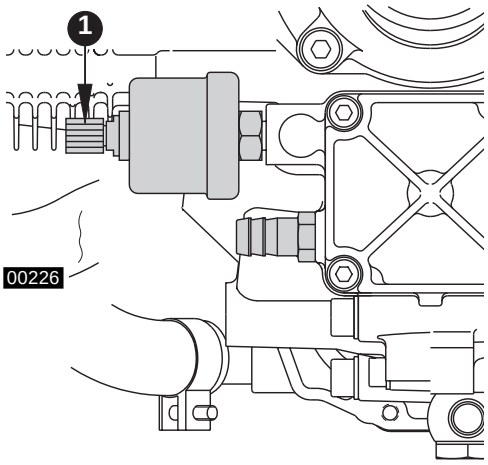

fig. 46

☞ **position of connection on oil pressure pick-up ❶**:

	coordinates [mm]		
point of connection	x axis	y axis	z axis
	ca. -100	75	ca. -150

02033

☞ connection of pick-up wiring: ..... single pole screw connection for cable eye 3 to DIN 46225

☞ grounding: ..... via engine block

☞ **graph of resistance over pressure**

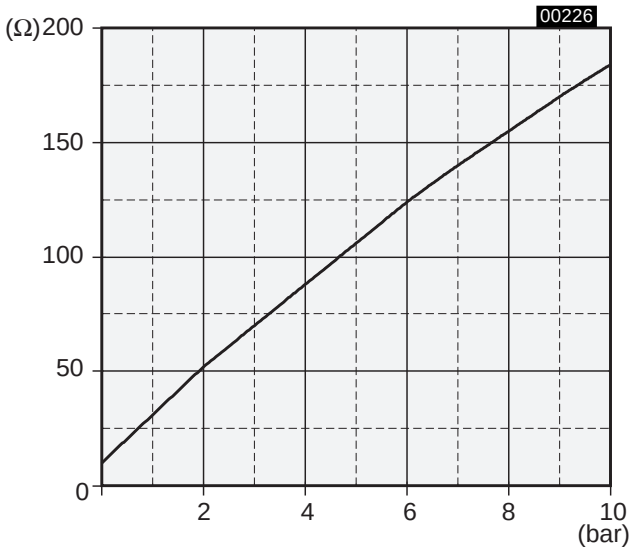

fig. 47

■ ATTENTION: The graph resistance over pressure has been determined, and is effective at the following conditions only.

ambient temperature: ..... 20° C (68° F)

voltage: ..... 12 V

tolerance: ..... max. ± 5%

21.4) Mechanical rev-counter or hour-meter:

See fig. 2, 3, 4, 48 and 49.

☞ location: ..... ignition housing ❶

☞ direction of rotation of the rev-counter shaft ❷: .. clockwise, see fig.

	coordinates [mm]		
point of engagement P4	x axis	y axis	z axis
	-465	87	-160

02034

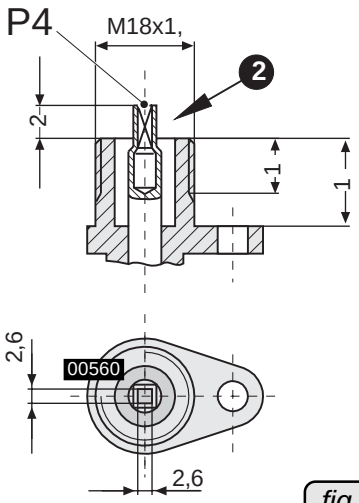

fig. 48

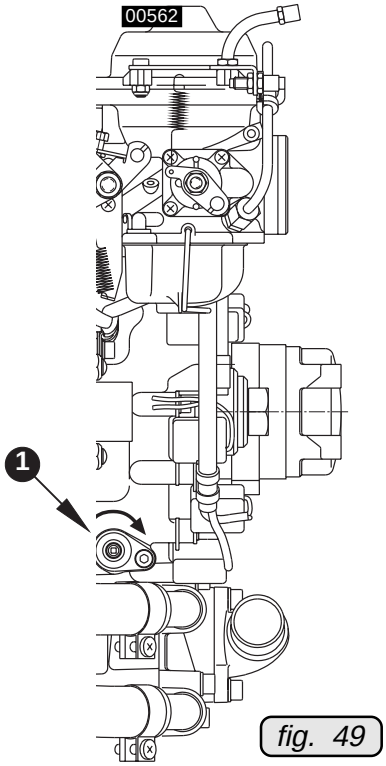

fig. 49

☞ **position of rev-counter drive:**

☞ installation dimensions: ..... see fig.

☞ reduction ratio: ..... i = 4 i.e. 1/4 of engine speed

◆ NOTE: A flexible shaft for the mechanical rev-counter is readily available from ROTAX®.

20.5) Monitoring of the intake manifold pressure

☞ connection on compensating tube: ..... outside dia. 7 mm (.276 in.)

slip-on length: ..... max. 17 mm (.67 in.)

◆ NOTE: The reading of the manifold pressure in inches Hg is taken in the compensating tube connecting the two intake manifolds. Consult chapter 16) of intake system.

■ ATTENTION: To ensure trouble free operation of the vacuum gauge it will be necessary to install a trap for gasoline condensate between engine and instrument.

22) Preparations for trial run of engine

▲ WARNING: Prior to engine start and operation review all instructions stated in the Operator's Manual.

23) ROTAX Authorized Distributors for Aircraft Engines

See current issue of Operator's Manual section 14 or in the Internet on the official website **www.rotax-aircraft-engines.com**.

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