MAINTENANCE Manual
SPIRIT engines
and SPIRIT TURBO

Before starting any maintenance work, carefully read the regular maintenance manual and the overhaul maintenance manual: these documents contain important information for carrying out checks and repairs in compliance and in safety.
The information contained in them must be evaluated and integrated by technicians with adequate experience and with specific training on the engine.
The interventions must be carried out with professional equipment, supplemented by tools specifically designed to work on the engine components.

This manual is an integral part of the propeller, and must be kept with it, even if it is sold.
The original document is written in Italian, which is valid for any dispute of a technical or legal nature.

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01-00-00 INTRODUCTION

The SPIRIT and SPIRIT Turbo series of engines are designed and manufactured using the most modern motor technology with the purpose of achieving good performance combined with a high level of passive safety. If the engine is used correctly it will return years of pleasure and reliable service.

Please read this manual carefully before using the engine and apply all safety standards contained in it, in addition to those that your experience and common sense suggest.

Remember that regular maintenance and a thorough inspection before take-off are essential safety factors.

MWfly will be happy to provide additional information and all the technical support you will need.

This manual collects the essential information to be able to carry out maintenance work on SPIRIT and SPIRIT Turbo engines. The operating, installation, extraordinary maintenance manual and anything else published by MWfly, completes the information contained in this manual, which must be taken into account to carry out maintenance work. The technician who performs maintenance is also required to have specific theoretical and experimental training on the type of engine.

All of this forms the basis for carrying out maintenance safely and without compromising the reliability of the engine.

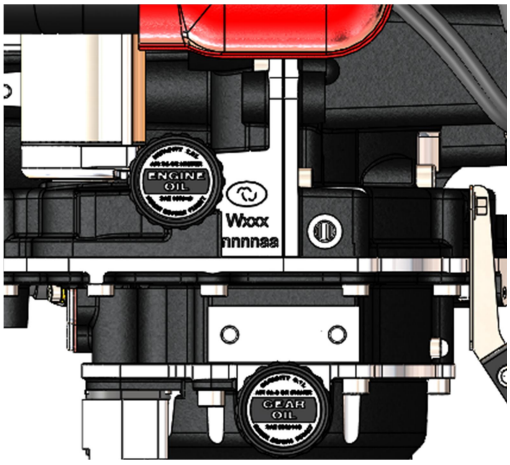
Scrupulously follow all the instructions provided in this manual and request further information or clarification if deemed necessary for carrying out the maintenance operations in safety.

This engine has not received any certification for suitability for aeronautical use.
Its use is intended exclusively for experimental or non-certified aircraft, on which a possible engine failure does not compromise flight safety.

For engine maintenance, follow any rules and laws in force in the country where the engine is used.

01-01-00 Identification data

The engine serial number is stamped on the top of the engine, near the gearbox. It consists of the model identification code (72-02-C) followed by a six-digit number, of which the first four indicate the serial number and the last two indicate the year of manufacture.



01-01-P

Removing or modifying the serial number will revoke any warranty and obligation by MWfly toward current owner.

Provide the serial number on any request for an engine part or technical information.

01-01-01 Standard or non-standard motor definition

In some maintenance operations described in this manual, reference is made to standard motor versions (abbreviated STD) or non-standard motors (abbreviated NOSTD).

This definition complies with the SAE J824-199506 standard according to which an engine is standard if, when viewed from the power take-off side, it rotates counter clockwise.

For greater clarity, the following table shows the type of motor (STD or NOSTD) for each motor model of the Spirit series: the product code is present on the identification plate of each motor. "x" must be replaced with "0" in the case of tractor applications or "1" in the case of pushing applications.

Name	Product code	Engine type
Spirit 100 Direct L	Wx11	STD
Spirit 100 Direct R	Wx12	NOSTD
Spirit 115 Direct L	Wx13	STD
Spirit 115 Direct R	Wx14	NOSTD
Spirit 135 Direct L	Wx17	STD
Spirit 135 Direct R	Wx18	NOSTD
Spirit 160 Direct L	Wx23	STD
Spirit 160 Direct R	Wx24	NOSTD
Spirit Turbo 180 Direct L	Wx33	STD
Spirit Turbo 180 Direct R	Wx34	NOSTD
Spirit Turbo 210 Direct L	Wx35	STD
Spirit Turbo 210 Direct R	Wx36	NOSTD
Spirit Turbo 240 Direct L	Wx37	STD D
Spirit Turbo 240 Direct R	Wx38	NOSTD
Spirit 122 PSRU L	Wx15	NOSTD
Spirit 122 PSRU R	Wx16	STD
Spirit 135 PSRU L	Wx19	NOSTD
Spirit 135 PSRU R	Wx20	STD
Spirit 140 PSRU L	Wx21	NOSTD
Spirit 140 PSRU R	Wx22	STD
Spirit 160 PSRU L	Wx25	NOSTD
Spirit 160 PSRU R	Wx26	STD
Spirit Turbo180 PSRU L	Wx27	NOSTD
Spirit Turbo 180 PSRU R	Wx28	STD
Spirit Turbo 210 PSRU L	Wx29	NOSTD
Spirit Turbo 210 PSRU R	Wx30	STD
Spirit Turbo 240 PSRU L	Wx31	NOSTD
Spirit Turbo 240 PSRU R	Wx32	STD

01-02-00 Documentation

01-02-01 Notes for consultation

This manual was originally issue in Italian. This will be the only language used for any reference or dispute.

The manual is divided into chapters; each chapter is divided into sections; each section is divided into paragraphs; within each paragraph there may be a further subdivision into topics. The title of each chapter, section, paragraph or topic is highlighted as follows.

CHAPTER

Section

Paragraph

Topic

The numbering system of the contents of the manual consists of a numerical code using the following criterion.
The content of each document is numbered and divided as follows.

CC-SS-PP

where:

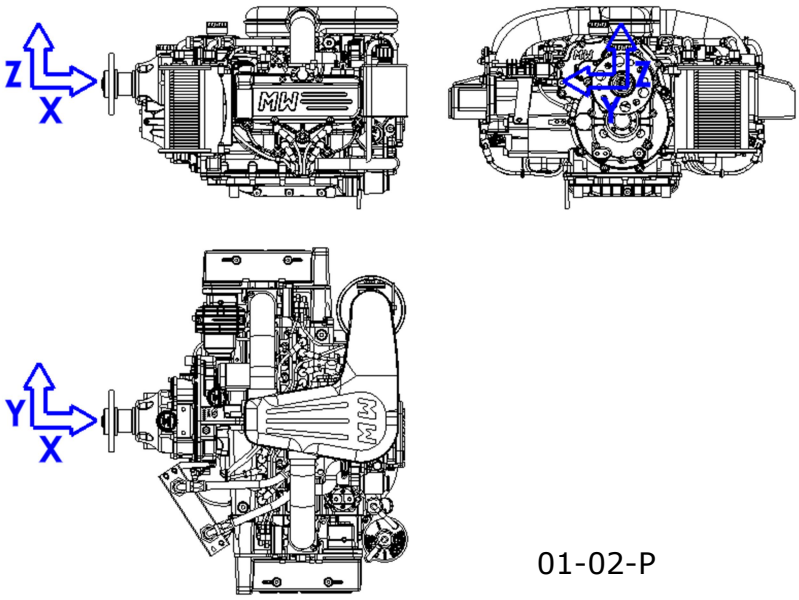
CC indicates the chapter of the document
SS indicates the section of the document
PP indicates the paragraph of the document

The subdivision into CC (chapters) will follow the ATA-100 scheme. The subdivision of the first digit of each section will also respect the ATA 100 scheme; the second digit of each section is assigned by MWfly, to correctly subdivide the topic.
Within each section, the numbering in paragraphs will follow a progressive numbering, starting from number 01.

The illustrations in this manual depict naturally aspirated engines, if the information provided is common with turbo versions; in the event that the information concerns turbo engines only, the illustrations depict the latter.

The identification of the figures and tables shows the chapter number and a progressive number, followed by the letter P for the figures and the letter C for the tables (e.g. 21-03-P).

The triad of reference axes used in the manual is a right triad that originates on the helix axis, at the intersection with the helix support plane: the x axis originates on the support plane of the flange itself and is positive in the direction of the engine, the y axis is positioned with origin on the centre line of the engine and is positive in the direction of the cylinder bank # 1, the z axis originates on the propeller shaft and is positive upwards, on the intake manifold side.



01-02-P

Symbols used in this manual have the following meaning.

WARNING: Not following this instruction can cause severe personal injury or loss of life.

CAUTION: Not following this instruction could cause severe damage to the engine or other components and cause the engine to stop.

NOTE: Refers to supplementary information to completely or fully understand the instruction.

1., 2., ... This numbering is used to list tools and consumables needed to run an installation or maintenance; it is also used to bring in parts lists or engine parts shown in the illustrations.

a., **b.**, … This lettering is used to indicate a list of actions or subjects with relation to inclusion: all of the actions or options listed must be verified.

○ This symbol is used to indicate a list of actions or subjects with relation to exclusion: only one of the actions or options listed with this symbol must be verified.

▪ This symbol is used to list the general characteristics of the engine, component specifications or options for installation or maintenance.

(…) A text enclosed in brackets clarifies an aspect, or constitutes an example or a reference to a chapter of the same or another document (e.g. DMB.E10.2.3).

01-02-02 Unit of measure

All the units of measurement reported in this and other MWfly manuals are expressed in technical units (ST), judged to be more usable and understandable than the units of the International System (SI). Table 01-01-C shows the conversion factors between the technical units used in compiling the manuals, the equivalent units of the International System and the equivalent units of the Imperial System. To obtain from the quantities expressed in technical units the corresponding value in For S.I. or Imperial simply multiply by the coefficient shown in the tables. As an example, we report some conversions.

100CV = 100*0,735kW = 73,5 kW
100CV = 100*0,986Hp = 98,6 Hp
82 Kgf = 82*9,81 N = 804,42 N
82 Kgf = 82*2,205 lb = 180,8 lb

If in doubt about the meaning of the measurements, their value or interpretation, contact an authorized MWfly service centre. If measurements made on the engine or relating to it refer, these must be expressed in units consistent with the Technical System used in the manuals, which is the only one adopted by MWfly.

CONVERSION FACTORS BETWEEN MEASUREMENT SYSTEMS			
Type of measurement	ST Unit	S.I. Unit	Anglo-Saxon unit
Length	cm mm	m = 100cm = 1000mm	ft = 30,48cm = 304,8mm in = 2,54cm = 25,4mm
Surface	cm^2 mm^2	$m^2 = 10^4 cm^2 = 10^6 mm^2$	sq ft = 77,42cm^2 = 7741,9mm^2 sq in = 6,45cm^2 = 645,16mm^2
Volume	cm^3 mm^3	$m^3 = 10^6 cm^3 = 10^9 mm^3$	cu in = 16,3871cm^3 cu ft = 28316cm^3
Capacity	L	$m^3 = 10^3 L$	gal (UK) = 4,5461L gal (US) = 3,7854L
Mass	Kg g	$Kg = 10^3 g$	lb = 0,453Kg = 453g
Weight	Kgf gf	N = 9,81Kg = 9814g	lb *f* = 2,205Kg*f* = 2205g*f*
Density	g/cm^3	$Kg/m^3 = 10^{-3} g/cm^3$	lb/ft^3 = 62.43g/cm^3
Flow Rate	m^3/h m^3/min m^3/s	m^3/s = 1/3600*m^3/h m^3/s = 1/60*m^3/min	cu ft/s = 0,0284 m^3/s
Force	N	N	lb*f* = 4,448N
Pressure	bar mbar	$Pa = 10^{-5} bar = 10^{-2} mbar$	psi = 0,0689bar = 68,9mbar in Hg = 0,0338bar = 33,8mbar
Torque	Kgm	Nm = 9,81Kgm	ft lb = 0,138Kgm
Power	CV	kW = 0,735CV	Hp = 0,986CV
Fuel Consumption	g/CVh	g/kWh = 1,359g/CVh	lb/Hph = 447,59g/CVh
Time	s min h	s = 1/60m in = 1/3600h	S
Velocity	m/s Km/h	m/s = 1/3,6Km/h	kn = 1,852Km/h = 0,514m/s
Temperature	°C	K = °C-273,15	°F = (1,8*[°C])+32

01-02-C

Table 01-03-C shows the conversion between the section of the electrical cables, expressed in square millimetres, and the corresponding AWG measurement, most commonly used by installers.

ELECTRICAL CABLES SECTION CONVERSION									
mm^2	21,200	13,300	8,350	5,270	3,310	2,080	1,310	0,820	0,519
AWG	4	6	8	10	12	14	16	18	20

01-03-C

01-02-03 Technical documentation available

The technical documentation and directives are to be considered a necessary tool for personal training, but they cannot in any way replace adequate specific instruction, both theoretical and operational

The information provided in the following manuals contains procedures and checks that can be carried out by qualified professionals operating in the sector.

- DMA.E10 - Installation manual: contains the information necessary for the proper installation of the engine.
- DMB.E10 - Operating manual: contains the information necessary for the proper use of the engine.
- DMC.E10 - Ordinary maintenance manual: contains the information necessary for the compliant execution of scheduled maintenance.
- DMD.E10 - Extraordinary maintenance manual: contains the information necessary for the execution compliant with unscheduled maintenance, i.e. determined by failures.
- DME.E10 - illustrated spare parts catalogue: contains the list of spare parts and accessories expected.
- DSL.E10 - service letter: contains information aimed at improving the product or use of the same.
- DSB.E10 - Service bulletin: reports the substitutions, checks or warnings to be applied within the indicated deadline.

The variety of installations can make the information contained in the aforementioned manuals inapplicable, inadequate or insufficient.

The illustrations in this manual do not represent in detail the details of the engine, but provide an indication of their function and structure: for these reasons it is not possible to deduce dimensional information or verify details from the published illustrations.

All further necessary documentation is however available at the MWfly authorized service centres.

01-03-00 Safety

This manual is a guide for the correct maintenance of **SPIRIT** and **SPIRIT Turbo** engines.

In addition to reading all the publications relating to the engine in use, to operate correctly and safely it is necessary to have good mechanical experience and have an in-depth knowledge of the problems connected to workshop operations. Specific preparation on the type of engine is also required.

For your safety, here are some important tips, suggested by common sense and by the usual norms of prudence, without however being able include all of the situations or behaviours that constitute opportunities for potential risk.

⚠ **Installation or any kind of adaptation not performed in accordance with the technical requirements of the manuals or by staff not authorized to operate on the product itself are a source of grave danger and releases MWfly from any obligation and responsibility to the user.**

⚠ **All maintenance work must be carried out in a suitable place, with the engine cold and off, avoiding the dispersion of liquids or polluting substances.**

⚠ **The prescribed tightening torques must be scrupulously observed to avoid the risk of detachment of components during use of the engine: non-compliance will void any form of guarantee and automatically release MWfly from any liability.**

⚠ **All safety sealing elements, such as self-locking nuts or washers must be installed according to the prescriptions and replaced at each disassembly: this serves to guarantee the function of safety elements.**

⚠ **Never carry out test engine start-ups before having totally completed the maintenance work, and having made sure that you have reassembled the propeller in all its parts.**

⚠ **Carry out an adequate inspection before starting the engine for the first time: this helps to prevent accidents or damage. In case of doubt about installation first contact an authorized service centre.**

A	Only authorized and technicians trained on the product are qualified to work on the engine. Failure to comply with this rule voids any type of product warranty and releases MWfly from any further obligation and liability towards the user.
A	This engine has received no airworthiness certification, nor is it subject to any aeronautical standards. Its use is intended for experimental aircraft or certificates, on which a possible engine failure does not affect the flight safety. You assume all risks arising from the use of the engine and recognize and are aware of the foregoing.
A	Do not start the thruster without the propeller: this can cause serious damage to the thruster.
A	To work properly and safely on the engine, adequate workshop equipment is required, including specific tools designed to work on engine components.
A	It is good practice to avoid interrupting any operation on the engine before completion: one of the main causes of failure is represented by oversights or omissions committed during maintenance.
A	As spare parts it is necessary to use only original MWfly components: the use of non-original components and not expressly approved in writing by MWfly automatically invalidates any form of product warranty and releases MWfly from any liability.
A	Always keep the engine in perfect working order by following the maintenance table contained in this manual and performing the coupons at the envisaged intervals.
A	Replace the sealing elements (gaskets), the fixing elements (screws, bolts) and all the details which, upon disassembly, show damage or reduced functionality, even if not explicitly prescribed in the manual.
i	The description and illustration of components or parts of the engine refer to the configuration at the time of publication of the manuals. The sole purpose of the illustrations is to allow the identification of the parts and to assist in the manual operations: they are not to be interpreted as technical drawings or as representations of reality.

When there are differences between what is specified in this manual and local regulations, you must proceed under the more stringent rule.

In case of doubts or difficulty in interpreting what is written, it is necessary to ask for clarification from an authorized MWfly assistance center before proceeding.

It is the responsibility of the user and the installer to observe all the safety recommendations contained in the manuals, applying them in compliance with the regulations in force regarding safety in the workplace. These recommendations constitute important warnings and instructions on how to operate the engine in safety, making its use compliant with the requirements: non-observance can cause malfunctions, damage to people or things and sometimes death.

The recommendations and instructions given in the manuals are not exhaustive, nor do they eliminate other safety standards that current legislation, common sense and experience impose: the user and the installer must inform themselves by any possible means regarding the method of operate in safety, for themselves and for others, with regard to the methods of carrying out ordinary and extraordinary maintenance work, as well as pre-flight checks.

Reading the manuals alone does not eliminate the risks connected to the use of the engine for the project purposes, nor the damages that a possible malfunction can cause to people or things: the user, with the use of the engine, accepts the resulting risks.

01-04-00 Maintenance criteria

Information regarding maintenance can be collected in two categories: regular maintenance and overhaul maintenance. This subdivision is respected in the drafting of the two respective maintenance manuals.

All maintenance work must be carried out in accordance with what is specified in the maintenance manuals.

Any interventions carried out with criteria other than those described in the maintenance manuals can be very dangerous for safety and harmful for the integrity of the engine, and must be absolutely avoided.
Non-compliant maintenance operations involve the revocation of the guarantee on the engine and its components and release MWfly from any obligation or liability.

At the end of the maintenance operations, both ordinary and extraordinary, it is necessary to carry out the engine test on the ground.

01-04-01 Regular maintenance

The purpose of regular maintenance is to perform checks and adjustments, install engine components, or perform consumable changes (e.g. lubricant) that do not necessarily involve removing the engine from the aircraft.

In some cases, regular maintenance operations must be completed with overhaul maintenance operations, for which it is necessary to consult the appropriate manual.

The regular maintenance operations are described in detail in this regular maintenance manual (DMC.E10), together with the equipment and consumables necessary for its execution.

01-04-02 Overhaul maintenance

The purpose of overhaul maintenance is to carry out operations for the removal, control or replacement of engine components not contemplated in regular maintenance since they are caused by breakdowns or malfunctions; overhaul maintenance operations often require a prolonged stop or the removal of the engine from the aircraft.

In some cases, overhaul maintenance operations must be completed with regular maintenance interventions, for which it is necessary to consult the appropriate manual.

The overhaul maintenance operations are described in detail in the overhaul maintenance manual (DMD.E10), together with the equipment and consumables necessary for its execution.

01-05-00 Maintenance equipment

The workshop tools and tools specifically designed to perform routine maintenance on the engine are listed below. The same equipment is listed and numbered at the beginning of each paragraph describing maintenance operations: the number will be recalled in square brackets to indicate the use of the associated equipment, in the specific maintenance action; in the case of combined use of several tools, they will be recalled separated by the semicolon sign; in the case of combined use of torque wrench and insert, they will be recalled separated by the + sign.

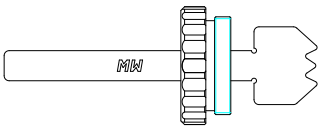
01-05-01 Workshop tools

- Torque wrench from 50 and from 150 Nm
- Blade screwdriver from 2 mm
- 4 mm Phillips screwdriver
- 6 mm blade screwdriver
- 7, 8, 10, 13, 16, 17, 19, 32, 36 mm fixed-polygonal wrench
- 10 mm hexagonal socket wrench
- Allen key 3, 4, 5, 6, 8 mm
- 3mm Allen key
- 3mm Allen key with ball head
- 8mm Allen key with ball head
- Swivel wrench for 16 mm spark plugs
- Needle nose pliers

- Pliers for seeger assembly for holes with 1.5 mm pins
- Scraper for floors
- Hammer with plastic knockers
- Air compressor

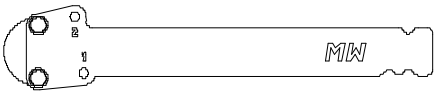
01-05-02 Special tools

- Reducer locking tool cod. X278



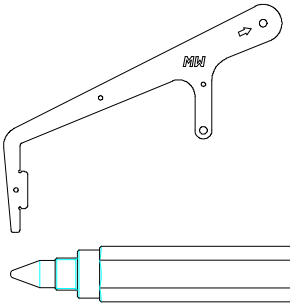
- Oil filler cap tightening lever cod. X283

- Chain tension control lever cod. X298



- Propeller flange locking lever cod. X290

- Engine lifting tool
  cod. X299 for motors with gearbox
  cod. X342 for motors without gearbox



- Crankshaft locking screw cod. X300

- Differential pressure gauge with compensation orifice with 1 mm diameter and 10 mm length
- M10 spark plug adapter for differential pressure gauge

If the use of a torque wrench is prescribed in the description of maintenance operations, all the tools listed must be supplemented with the corresponding inserts required to perform torque tightening.

01-05-03 Consumables

Use only the specified components and consumables, or technically equivalent components and materials for carrying out maintenance work; the spare parts of the engine must be original in order not to void the warranty and not to compromise reliability and safety.

When using chemical materials, it is necessary to comply with the local legislation in force for disposal, as they are special waste. When using, take the utmost care to protect yourself and the environment from possible contamination.

- Denatured alcohol for domestic use
- Absorbent paper cloth
- White petroleum
- Fibre brush for diameters 50 ÷ 60 mm
- Weak red threadlocker
- Medium blue threadlocker
- Strong green threadlocker
- Strong blocker
- High temperature gasket form
- Copper-based high temperature grease
- Anti-corrosion compound
- Antioxidant for electrical contacts

Consumables are also listed and numbered at the beginning of each paragraph describing maintenance operations and referred to during the description of the maintenance phases.

01-06-00 Prolonged inactivity

All external surfaces of the engine are protected against corrosion produced by humidity in the air: the components made of aluminum are painted or anodized, the steel components are galvanized or made of stainless steel. However, in case of long periods of inactivity (more than 4 months), it is necessary to carry out engine preservation, as described below. The resumption of service after a prolonged stop must also take place after the prescriptions listed below.

Necessary material

1. Torque wrench 50 Nm
2. Socket wrench for 16 mm spark plugs
3. 17 mm hex wrench
4. Kerosene or white petroleum (3 litres)
5. 2 x 5 later liquid container
6. Nylon hose clamps
7. Charger
8. Plastic bag D140
9. 2 x rubber plug D35-40
10. Scotch tape
11. 5 meters of 8 mm internal D fuel hose
12. 2 x M12 banjo screw eyelet with D8 tube holder

13. Spray silicone-based anticorrosive

01-06-01 Preservation

a. Carry out a slow recharge [7] of the battery.

b. Connect approximately 2.5 meters of pipe [11] to each eyelet [12].

c. Remove [3] the fuel inlet pipe from the pump unit and screw one of the two preparations to the prescribed torque [1 + 3], leaving the opposite end free.

d. Remove [3] the fuel return pipe to the tank from the fuel shunt and screw it to the prescribed torque [1 + 3] one with the opposite end free.

e. Pour about a litre of kerosene [5] into a container [4].

f. Introduce the free end of the tube connected to the pump group into this container.

g. Introduce the free end of the tube connected to the shunt into a second container.

h. Remove [2] both spark plugs from each cylinder. The spark plug cables must be kept at a distance from the engine block and from each other using clamps [6].

i. Feed the auxiliary fuel pump until all the kerosene in the container is used up: in this way the petrol residues will be completely removed from the fuel circuit and from the pump unit.

j. Pour about two litres of kerosene [4] into the first container [5].

k. Move the pipe connected to the branch from the second to the first container [5].

l. Move the kill switches of both injection control units to the "on" position.

m. Power the auxiliary fuel pump and, at the same time, the starter motor for about 5 seconds: in this way the petrol residues will also be completely removed from the injectors.

When operating the starter motor, avoid touching the spark plug cables, keeping a safe distance from them: possible electric shock.

During the activation of the starter motor, there must be no electric arcs in the vicinity of the spark plug caps: otherwise it is necessary to isolate them better.

n. Repeat the previous action three times, at intervals of about 10 seconds, each time switching off and on the master relay.

o. Keep the auxiliary pump powered for about 1 additional minute.

p. Turn off the master relay.

The procedure described above helps to avoid blocking of the fuel pumps and injectors due to encrustations or residues caused by the evaporation of the petrol.

q. Apply an airtight cap [9] to each of the silencer terminals to prevent moisture from entering the engine.

r. Apply a plastic bag [8] to the air filter and fix it with adhesive tape [10], in order to prevent moisture from entering the engine.

s. Pour about 5 cl of new engine oil into each cylinder through the spark plug holes.

t. Make sure you have removed all electrical connections to the system, and turn the propeller by hand about 5 turns, in order to distribute the oil inside the combustion chamber.

u. Refit the spark plugs and turn the crankshaft by hand using the propeller.

v. Make sure that the throttle control is in the fully closed position.

w. Top up engine oil and gearbox oil up to the maximum level.

x. Spray a spray [13] on all external surfaces of the engine, after having checked its compatibility for rubber and plastic parts.

In the event of long periods of inactivity, oxidation of some parts may occur: in the event of severe corrosion it is necessary to replace the parts concerned.

y. Repeat the above procedure every 4 months.

01-06-02 Resumption of service

a. Carry out a slow recharge [7] of the battery.

b. Remove the caps [9] on the silencer tailpipes.

c. Remove the plastic bag [8] from the air filter.

d. Remove the spark plugs from each cylinder

e. Flush the fuel system with petrol, following the procedure used for preservation (points **b.** to **o.**), in such a way as to eliminate all kerosene residues.

f. After carefully checking them, tighten [1 + 3] the fuel pipes to the fuel shunt and to the pump unit inlet to the prescribed torque.

g. Fill the fuel system.

h. Refit the used spark plugs.

i. Warm up the engine to operating temperature, then turn it off.

j. Replace the spark plugs.

k. Change the engine oil.

l. Change the gear oil.

m. In case of doubts regarding their efficiency, remove the fuel pumps and carry out their cleaning and instrumental check of electrical absorption, of the flow rate and operating pressure.

n. Replace the fuel filters.

o. In case of doubts about their efficiency, remove the injectors and carry out their cleaning and instrumental check of the flow rate.

p. Check all the connections of the cooling circuit and the pipes of the fuel circuit: they must not show leaks or cracks of any kind, or bites by rodents.

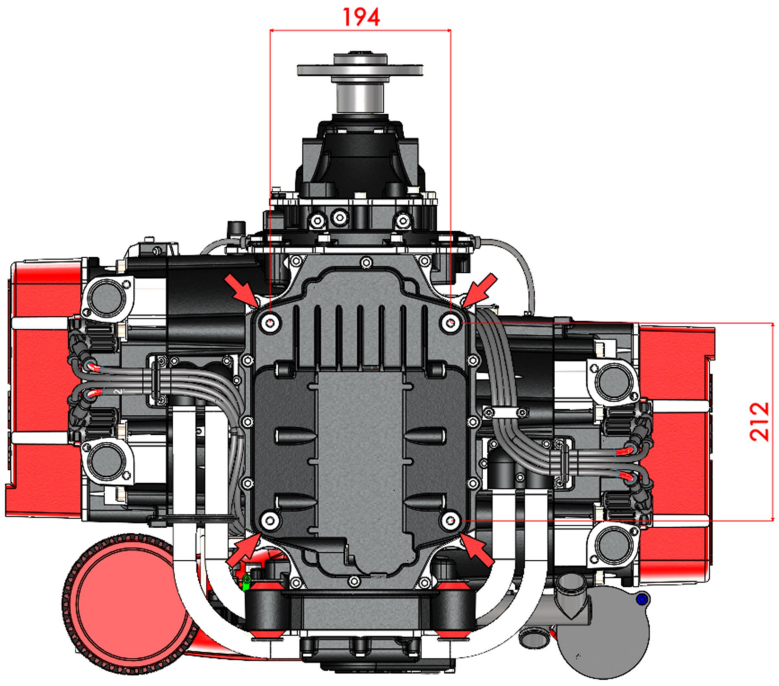
q. Perform a ground engine test.

01-07-00 Motor shipping precautions

In case of sending to a service centre, the engine must be prepared as described below.

a. The engine must be delivered empty of liquids, sending in sealed containers a small amount of engine oil, gear oil and coolant removed before shipment.

b. The engine must be suitably protected against accidental impacts: fix it in the lower part to the transport case pallet, using the four special M8x1.25 threads provided on the oil pan.



01-03-P

c. All openings must be protected with covers that prevent the entry of foreign bodies or moisture: preferably use the covers installed on the new engine, and removed after installation.

d. The engine must be delivered with all accessories that may be installed, excluding the propeller.

e. The engine must be delivered clean, highlighting the areas affected by any leaks.

In the event that the motors are sent to the service centre prepared in a different way from what is recommended above, no guarantee will be recognized on damage potentially attributable to transport, even if previous and not caused by the same.

Unless otherwise specified in writing, the transport costs for sending the engine to the service centre and the subsequent return are entirely borne by the owner of the engine.

01-08-00 MWfly authorized service centres

For more information on maintenance or on the spare parts, please contact the nearest MWfly service centre (check on www.mwfly.it).

04-00-00 AIRWORTHINESS LIMITATIONS

At the date of publication of this manual there are no limitations regarding the installation of **SPIRIT** and **SPIRIT Turbo** engines on any type of aircraft, both fixed-wing and rotary-wing. However, the airworthiness of the engines is subject to compliance with the operating limits set out in the DMB.E10 operating manual, as well as compliance with the scheduled maintenance interventions provided for in this manual.

In case of deviations from what is prescribed, for an engine to regain the airworthiness requirements it must be subjected to an inspection by an authorized centre.

05-00-00 PERIODIC MAINTENANCE

This chapter shows the periodic inspection program to be carried out on the **SPIRIT** and **SPIRIT Turbo** motors.

Some general rules for carrying out maintenance work are mentioned below.

- The information given in this manual is based on theoretical and experimental data, which must be considered applicable by technicians with proven experience and instruction on the specific engine.
- Before starting maintenance work, make sure you have all the material and equipment required.
- All non-original spare parts cannot be used and automatically invalidate any form of guarantee. The use of these spare parts can cause serious damage to the engine and can make its use dangerous.
- Maintenance work not performed in a workmanlike manner and in accordance with the prescriptions provided by MWfly automatically voids any form of warranty on the product.
- In addition to the safety and use rules contained in the manuals, it is necessary to observe all the rules and regulations set by the aeronautical authorities of the country in which the engine is used.
- The procedures and operating limits collected in the manuals constitute the official reference for the use of the engine.

05-01-00 Authorized personnel

Only personnel with adequate mechanical training, in possession of the certificate of "MWfly authorized maintenance technician" (who therefore has followed the specific training courses to operate on the type of engine) and who has the appropriate workshop equipment required for each specific intervention is authorized to operate on engines.
Maintenance must be carried out by scrupulously observing all the warnings contained in the manuals, summarizing the information with one's own personal experience gained in the aeronautical engine sector.
The manuals are written in such a way as to list in detail all the phases to be performed: it is essential to follow each step step-by-step, in order to be sure not to forget any phase. If any information is not clear or exhaustive, it is necessary to request additional information or clarifications from an authorized service centre or MWfly.

A fundamental rule for carrying out maintenance work safely is to never interrupt a phase before it has finished, or to write the breakpoint.

All maintenance operations must be conducted in compliance with local regulations, especially with regard to the possible use or disposal of polluting or otherwise dangerous products for the operator.

05-02-00 Preparing the aircraft for maintenance

To carry out maintenance work safely, the following safety instructions must be observed.

a. Main switch in off position.

b. Both injection switch (kill switch) in the off position.

c. Negative battery cable removed (if welding is carried out on the aircraft, also remove the positive cable).

d. Airplane firmly fixed to the ground.

Some operations must be performed with some electrical components powered. In this case, observe the following rules.

a. If possible, remove the propeller.

b. If it is not possible to remove the propeller, disconnect all the ignition pipes from the 8 spark plugs, and make sure that the propeller cannot accidentally rotate: in any case, keep out of the range of action of the blades during each check carried out in these conditions.

c. Take any additional precautions that can prevent accidental starting of the engine.

Failure to observe the rules listed above is the cause of potential serious danger.

All maintenance operations must be carried out with the engine cold and off, unless otherwise specified. In the event of accidental contact with hot parts of the engine, serious burns can be reported: be extremely careful to avoid contact, in particular with the exhaust pipes, the silencer and the cylinder head covers.

If required, apply threadlocker or other types of technical agents intended to clean, lubricate or secure engine components.

During maintenance operations, always take care to avoid any potentially dangerous situation arising from the presence in the work area of harmful or flammable substances and the use of pointed, cutting tools or in some way harmful to personal safety.

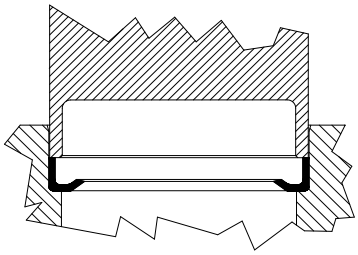
During maintenance or fluid replacement operations, be careful to protect any open holes from the ingress of foreign bodies.

Observe the prescribed tightening torques and all indications regarding assembly procedures.

05-03-00 Safety locks and seals

All safety locks, such as self-locking nuts, washers, special screws, seeger rings, etc. once removed they must be replaced; the same is true for all gaskets and sealing elements.

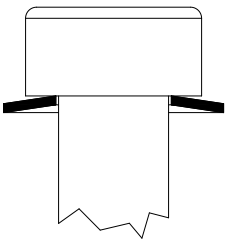
For the locking or installation of these elements, respect the methodology reported in the manuals. In particular, respect the torque and the tightening sequence provided: the tightening torque indicated refers to couplings with lubricated thread and support surface (if the use of thread locker is not foreseen).



05-01-P

All oil seals must be fitted with suitable pads that push on the external metal casing, without stressing the sealing lip; before introduction, lubricate the sealing lip with a long-lasting grease.

All O-ring type seals must be fitted by lubricating the surface with petroleum jelly.



05-02-P

All disc springs used as safety elements under threaded couplings must be mounted with the narrow part in contact with the head of the fastening element, and the wider part in contact with the piece to be tightened.

Failure to comply with this simple rule can cause accidental loosening of the parts during engine operation.

05-04-00 Troubleshooting

In the operating manual and in paragraph 12-34-00 of this manual, possible problems related to the use of the engine are listed, indicating for each the interventions to be carried out for the identification and elimination.

05-10-00 Operational limits

Compliance with operating limits is a key factor in ensuring safe and effective use of the engine.

All materials used in mechanical constructions are subject to wear and degradation, due to the stresses induced by use, but also due to environmental factors: from this it follows that even engines that are not used or used sporadically must necessarily undergo maintenance. prescribed time intervals.

05-10-01 Hourly Operating Limit

The hourly operating limit of the engine is specified by the TBO. The TBO is reached at a predetermined number of hours of operation, or after a period of time from the date of production or overhaul of the engine: of the two conditions, the first that occurs must be considered valid.

The following table lists the expected TBO depending on the engine model, in the hypothesis of use on fixed-wing aircraft.

Model	*TBO [hours of operation]*	*TBO [years from production*]*
Spirit 100 Direct R/L	2200	12
Spirit 115 Direct R/L	2200	12
Spirit 135 Direct R/L	1200	12
Spirit 160 Direct R/L	1200	12
Spirit Turbo 180 Direct R/L	1500	12
Spirit Turbo 210 Direct R/L	1200	12
Spirit Turbo 240 Direct R/L	1000	12
Spirit 122 PSRU R/L	2000	12
Spirit 135 PSRU R/L	1800	12
Spirit 140 PSRU R/L	2000	12
Spirit 160 PSRU R/L	1800	12
Spirit Turbo 180 PSRU R/L	2000	12
Spirit Turbo 210 PSRU R/L	1800	12
Spirit Turbo 240 PSRU R/L	1500	12

05-01-C

* calculate the data by verifying the production date entered in the engine logbook

With the exception of the Spirit 135 Direct and Spirit 160 Direct models, any other engines used on helicopters or aircraft comparable to them have an hourly TBO equal to 65% of what is declared in the table; for these installations the calendar TBO is reduced to 8 years.

It is possible to extend the TBO, which is eventually communicated through a service bulletin, together with the necessary adjustments for the purpose.

Engines that have reached TBO should no longer be used until overhaul.

05-10-02 Calendar operating limit

Some engine components are subject to wear linked to environmental parameters, such as the presence of salt or humidity, ultraviolet rays or ozone. In particular, all parts made of plastic or rubber are subject to environmental deterioration, therefore independent of the frequency of use. Other components are subject to corrosion or chemical attack by the operating fluids. For this reason, all these components must be inspected every year and some of them replaced in advance at the indicated deadlines, even in the event of total or partial inactivity of the engine.

Non-fulfilment of calendar replacements can cause sudden breakage of engine components, resulting in serious damage to the engine or danger to people.

To find out on which engine components the annual inspection must be carried out, refer to paragraph 12-22-08 of the present manual

05-10-03 Operational limit of lubricants

The oil contained in the engine (and its filter) and in the reducer must be replaced at the deadlines set out in the maintenance program and in any case every year. It is good practice to replace both lubricants before a prolonged period of inactivity of the engine.

05-10-04 Operating limit of the refrigerant

It is necessary to replace the coolant every two years or earlier, if the manufacturer prescribes it. The replacement is aimed at avoiding damage to the components of the cooling circuit, induced by the decay of the corrosion inhibitors of the liquid itself. However, the coolant must be replaced once it has been removed from the engine.

05-10-05 Operating limit of plastic parts

All engine components made of plastic or rubber and mounted externally to it must be replaced at the calendar term specified below.

Every 2 years

a. Engine suspensions
b. Oil cooler pipes
c. Fuel pipes
d. Cooling system connecting pipes

Every 4 years

a. Expansion vessel connection
b. Expansion vessel breather pipes
c. Expansion tank caps
d. Crankcase vapor vent pipe
e. Cooling pump inlet manifold
f. Cooling pump outlet manifold
g. Turbo engines - Intake system silicone fittings
h. Mechanical seal breather pipe
i. Anti-vibration elements for fixing the liquid and oil radiator

05-10-06 Operating limit of other components

In addition to the plastic parts and operating fluids, other components of the engine are subject to preventive replacement (regardless of the hours of actual operation), as specified below.

Every two years

a. Fuel filters
b. Air filter
c. Cooling circuit pipes if made of rubber other than silicone

Every four years

a. Fuel pumps

A If the engine is stopped for more than 6 months, the pumps can be damaged due to the formulation of the petrol used: in this case they must be replaced.

b. Cooling circuit pipes of the CR-m kit or in any case if they are made of silicone
c. Throttle control
d. Main fuel pump control relay
e. Battery charging circuit capacitor

f. AG-m drive belt (optional)

If, during the annual inspection, any of the above components subject to calendar replacement are found to be deteriorated, a preventive replacement will be necessary.

In case of use of the propeller in brackish areas or of prolonged exposure to sunlight, the calendar replacement intervals must be halved.

05-20-00 Periodic maintenance program

This section lists the periodic inspections to be carried out at the end of a certain number of operating hours.

The 25-hour inspection must be performed only after the first 25 hours of operation from a new or overhauled engine.

Periodic inspections of 50, 100, 200, 500 hours are to be carried out at the end of the hours indicated and at the respective multiples of hours; in detail:

- 50-hour inspection: perform at 50, 100, 150, 200,…. hours
- 100-hour inspection: perform at 100, 200, 300, 400,…. hours
- 200-hour inspection: perform at 200, 400, 600, 800,…. hours
- 500-hour inspection: perform at 500, 1000, 1500,… hours
- 900-hour inspection: perform at 900, 1800 hours

At each periodic inspection, the checks envisaged by all the inspection intervals provided or by multiples of the same must be carried out: for example, at the 500-hour inspection, the checks provided for by the 500-hour inspection must be carried out, but also those provided for by the inspection of 100 and 50 (excluding those expected after the first 10 hours).
The prescribed intervals are applicable to engines used in temperate climates and with operating cycles that comply with the specifications in the manuals: in the case of intensive use (e.g. driving schools) or in areas with extreme climates (arid areas or areas with a harsh climate) intervals should be halved.

In addition to the periodic checks, the following checks must be carried out:

a. Inspection and possible tightening of the nuts fixing the exhaust manifolds to the engine after the first 10 hours of operation and every 25 hours (letter T2 in table 05-02-C).

b. Check after the first 10 hours and every 50 hours of operation of the tightening of the periodically checked screws marked with the letter T in table 05-02-C.

In addition to these checks, it is necessary to carry out the pre-flight checks specified in the maintenance table 05-02-C and as recommended by common aeronautical practice.

05-20-01 General rules for maintenance

The interventions envisaged in the scheduled maintenance table must be carried out according to the criteria specified below.

- All activities must be carried out within the maintenance deadline, with a maximum tolerance of 10 hours
- If the tolerance hours are in excess, they cannot be combined: this means that, for example, if the 100-hour intervention was performed at 110 hours, the next 200-hour intervention cannot be performed at 210 + 10 hours, but at most at 200 + 10 hours.
- If the hours of tolerance are at a loss, the subsequent intervention must be performed at a maximum interval of hours equal to what there would be without considering that the tolerance has been applied: this means that, for example, if the intervention of 100 hours is was performed at 90 hours, the next 200-hour intervention cannot be performed at 200 ± 10 hours, but at most at 190 ± 10 hours.
- All the activities foreseen in the maintenance table must be carried out in compliance with what is specified in this manual. If doubts or doubts arise, it is necessary to integrate the information with what is reported in the other manuals or contact an authorized service centre.

05-20-02 Engine logbook

The engine logbook is delivered together with each engine and must also accompany it in case of sale.

The loss of the engine logbook or the incomplete compilation of the same causes the revocation of any form of guarantee, as it makes the operating and maintenance history of the engine uncertain.

The following information must be noted in the engine logbook by the service centre in the appropriate spaces.

- Scheduled regular maintenance operations
- Unscheduled regular maintenance operations
- Overhaul maintenance operations
- Total or partial revision
- Replacement of components not included in the regular maintenance plan
- Change of ownership
- Application of service bulletins or alert bulletins

Engines or components eventually disembarked from the aircraft and sent to service centres for maintenance or overhaul must be accompanied by the engine logbook.

05-20-03 Scheduled maintenance table

Perform the checks and replacements listed in table 05-02-C at the indicated intervals and in accordance with the previous paragraphs.

Unless otherwise specified, the applicability of the prescribed terms is valid for all engine models.

The scheduled maintenance operations scheduled at 900 hours are described in detail in the extraordinary maintenance manual.

Legend

- X = carry out when the indicated hours are reached
- P = pre-flight check
- (T) = referred to turbocharged versions only
- 25 = perform after the first 25 hours of operation from new or after disassembly
- * = replace every year or at the indicated operating hours: of the two deadlines apply the more stringent
- ** = replace every two years or at the indicated operating hours: of the two deadlines apply the more stringent
- *** = replace every four years or at the indicated operating hours: of the two deadlines apply the more stringent

	Activities	Term (hours)						
		P	*25*	*50*	*100*	*200*	*500*	*900*
GENERAL	Engine cleaning			X				
	Visual check to identify oil, petrol or coolant leaks or areas of overheating of the bonnet	X						
	Inspection of anti-vibration mounts and engine fixing bolts: identify abrasions, cuts or any overheating	X						
	Inspection and possible tightening of all screws and nuts external to the motor for fixing components and accessories		X		X			
	Check the tightness of the hose clamps in the fuel circuit, cooling circuit, intake and exhaust system (T)		X	X				
	General endoscopic inspection					X		
	Visual inspection of the propeller: check the tightening bolts and the absence of cracks or impact areas	X						
	Check general smoothness				X			
	Pre-flight engine test: check pick-up, fuel pumps, recharge circuit, maximum power	X						
	Engine test after periodic inspection		X	X	X	X	X	X
	Replacement of fastening elements: castle screws, anti-vibration mounts, spacers, exhaust system springs **						X	
	Check the tightness of the manifolds and the integrity of the exhaust system		X	X				
	Check the supercharging system tightening (T)		X	X				

Activities		Term (hours)						
		P	*25*	*50*	*100*	*200*	*500*	*900*
COOLING SYSTEM	Pre-flight inspection: liquid level check in expansion tank, absence of leaks from system and mechanical seal vent, radiator integrity and retained clamp tension	X						
	Replacement of the rubber components of the expansion tank ***							X
	Replacement of expansion tank caps ***						X	
	Cooling pump inlet and outlet manifold replacement ***						X	
	Replacement of cooling system connection pipes and radiator anti-vibration mounts**						X	
	Thermostatic valve replacement							X
	Coolant replacement **						X	
	Cooling circuit cleaning							X
	Check pump impeller and mechanical seal wear: replace if necessary							X
LUBRICATION SYSTEM	Pre-flight inspection: check engine oil level	X						
	Engine oil change and particulate check on magnetic filter*		X	X				
	Oil filter change and filter material inspection*		X	X				
	Oil spectrographic analysis		X		X			
	Cleaning the engine oil suction strainer							X
	Check integrity of radiator oil, pipes and anti-vibration mounts**		X					X
	Check integrity and tightening of turbine oil circulation pipes (T)		X	X				

Activities		Term (hours)						
		P	*25*	*50*	*100*	*200*	*500*	*900*
FUEL SYSTEM	Pre-flight inspection: check for the absence of leaks from the circuit and purge the decanter filter	X						
	Change fuel filter **		X		X			
	Fuel pumps replacement ***							X
	Check the fuel distributor: clean and replace the pressure regulator if necessary							X
	Fuel pipes replacement **							X
AIR INTAKE SYSTEM	Pre-flight inspection: check gas control and filter	X						
	Prior replacement of throttle control *** and throttle check							X
	Air filter replacement **				X			
	Check and replace the throttle potentiometer if necessary							X
	Check the integrity of the intercooler and BOV valve (T)		X		X			
ELECTRICAL SYSTEM	Pre-flight inspection: check the integrity of the wiring, double ignition circuit and battery recharge	X						
	Spark plug replacement				X			
	Check and clean injectors							X
	Check battery charging circuit					X		
	Check starter and contactor							X
	Replace the recharge capacitor *** and check the current regulator and spark plug cables							X
	Check injection and ignition control unit group							X
	Check tightening of the auxiliary generator (optional) and change the belt		X				X	

Activities		Term (hours)						
		P	*25*	*50*	*100*	*200*	*500*	*900*
CRANKCASE	Boroscopic inspection of crankshaft						X	
	Qualitative verification of piston thermal fatigue						X	
	Check cylinder compression						X	
	Starter inspection: check free wheel, gears and starter clutch wear							X
TIMING	Check the wear of the tensioner shoes and the timing chain tension					X		
	Check camshaft and tappets							X
	Check and if necessary restore valve clearance					X		
	Replacement of chain and tensioner shoes							X
	Check the decompression system wear							X
GEARBOX	Pre-flight inspection: check of play, smoothness and wear of gears	X						
	Damper slip torque control		X		X			
	Gearbox oil level check			X				
	Visual check integrity of the reduction gear	X						
	Gearbox oil change and particulate check on magnetic filter and governor filter if present *		X		X			
	Oil spectrographic analysis		X		X			
	Check tightness of screws and transmission keying					X		
	Dynamic governor seal replacement, pump and hydraulic valve wear check							X
	Check reducer breather					X		

12-00-00 INSTRUCTIONS FOR MAINTENANCE

This chapter contains the instructions for carrying out the refuelling and routine maintenance operations on the engines **SPIRIT** and **SPIRIT Turbo**.

12-01-00 Tightening torques

All tightening must be performed with a torque wrench, respecting the prescribed torque.

⚠ **Failure to comply with the torques or the tightening requirements indicated may cause loosening or accidental disassembly of engine parts during operation.**

A The systematic use of the torque wrench for tightening the threads protects the threads from wear, extending their operating life.

Unless otherwise indicated, the torque to be applied depends on the thread of the screw or nut, as listed below.

- M4 – 4 Nm
- M5 – 6 Nm
- M6 – 10 Nm
- M8 – 22 Nm
- M10 – 42 Nm

A Check the tightening torque of the bolts with the engine cold and off, and applying the torque in the normal direction of screwing.

A The screws for fixing the engine to the aircraft are not supplied: however, the most appropriate tightening torque is indicated for standard applications. The specific tightening torque for each application must be identified case by case by the customer (installer) or must be taken from the aircraft service manual. It is also advisable to replace the aforementioned screws as a precaution every 500 hours of operation or at each disassembly.

Below is the table 12-01-C, which indicates the main tightening torques of the engine: for the check it is necessary to use a torque wrench and make sure that the ambient temperature (and of the engine) is between 10 and 30 ° C .

	Type of Screw or Nut		Tightening Torque [Nm]
GENERAL	Ignition coil screw (M4)		3 + FM
	Rpm sensor screw (M5)		6 + FD
	Screw fixing coil brackets (M5)	[P]	6 + FD
	Expansion vessel fixing screw (M5)	[P]	6 + FD
	Anti-vibration fixing radiator cooling and oil	[O]	By hand
	Radiator fixing screw (water, oil) (M5)	[O]	6
	Fuel shunt fixing screw (M6)		10 + FD
	Cooling system breather screw (M6)		6 + FD
	Remote control switch and reg. bracket fixing screw (M6)	[P]	10 + FM
	Current regulator tightening screw (M8)	[P]	20 + FM
	Fuel system collar screw (M8)	[P]	12
	Motor fixing screw (M10)	[P,S]	35 + FM
	Service cap for inspection (M10)		15 +FD
	Collar screw tightening fuel pipes (M12)	[P]	30
	Service cap for inspection (M12)		20 + FD
	Coolant and oil temperature sensor (M12)	[O]	20 + FD
	Oil and fuel pressure sensor (1/4" gas)	[O]	25 + FD
	Fuel filter FD-m (M10-M16)	[P,O]	15 + FD
CRANKCASE	Tensioner slide cover screw (M5)		6 + FD
	Oil intake bulkhead fixing screw (M5)		6 + FM
	Oil pump fixing screw to intake bulkhead (M5)		6 + FM
	Oil intake bulkhead screw to crankcase (M6)		10 + FM
	Secondary shaft gear fixing screw (M6)		15 + FM
	Fixing screw of the refrigerant manifold (M6)		10
	Crankcase stiffening screw (M6)		12 + FM
	Screw fixing starter to base (M8)	[P]	15 + FM
	Timing chain guide fixing screw and nut (M8)		18 + FM
	Fixing screw of cooling circuit manifold to the base (M6)		12 + FM
	Crankcase closing screw (M8)		22
	Crankcase closing screw (M10)		42
	Engine oil filter and filler cap	[P]	By hand
	Tightening oil pump shaft to secondary shaft (M19)		50 + FF
HEAD	Unloaded prisoner		10 + FF
	Nut fixing exhaust manifold (M8)	[P]	20 + FF
	Timing chain guide fixing screw (M8)		18 + FM
	Tappet cover screw (M8)	[P]	18
	Head closing screw (M10)	[P]	25 (5min) + 35 + 90°
	Chain compartment closing screw (M10)		42
	Spark plug (M10)	[P]	15
	Cap for reverse flight preparation		25 + FM
	Chain sprocket screw and camshaft washer (M16)		60

	Type of Screw or Nut		Tightening Torque [Nm]
AIR INTAKE	Shaft butterfly screw (M4)		4 + FM
	TPS sensor tightening screw (M4)		4 + FD
	Fuel rail injector tightening screw		4 + FD
	Accelerator control bracket fixing screw (M5)	[P]	6 + FM
	Screw fixing MAP sensor and air temperature (M6)		6 + FM
	Grub screw and nut for throttle cam stroke adj. (M6)		8 + FM
	Throttle cam nut (M8)		10 + FM
	Screw fixing intake manifold to head (M8)	[P]	15 + FM
	Airbox to rear cover tightening screws (M8)		22 + FM
COVERS AND OIL SUMP	Cooling pump manifold ring nut fixing screw. (M4)		4 + FD
	Strainer fixing screw (M5)		6 + FM
	Cable exit cover closing screw (M5)		6 + FD
	Generator stator fixing screw (M5)		8 + FM
	Cooling pump cover screw (M6)		10
	Screw fixing lower engine supports (M8)	[P,O]	22 + FM
	Screw front and back cover or gearbox (M8)		22 + FM
	Screw front and back cover or gearbox (M10)		35 + FM
	Cooling pump tightening nut (M10)		30 + FM
	Engine oil drain plug (M12)		22 + FD
	Generator rotor tightening nut (M14)		120 + FM
GEARBOX	Screw fixing actuator or PVV cover (M5)	[P]	8 + FM
	RPM sensor fixing screw (M5)		6 + FD
	Bearing nut fixing screw and dynamic seal (M6)		10 + FM
	Reducer pump cover or pump screw (M6)	[P]	10 + FD
	Reducer oil level screw (M6)		6 + FD
	Screw processing (M6)		10 +FD
	Reducer cover screw (M8)		25 + FM
	Propeller fixing screw (M8, ½ UNF)	[P,S,V]	22,35 + FM
	Screw processing (M10)		12 + FD
	Screw processing filter for governor (M10)		15 + FD
	Reducer breather screw or valve (M10)		12+ FM
	Screw processing (M12)		22 + FM
	Closed circuit PVV propeller radiator fitting (M12)	[P,O]	22 + FM
	Governor breather valve plug in reducer (M12)		22 + FM
	Reducer oil drain plug (M12)		22 + FD
	Reduction oil filler cap	[P]	By hand
	Screw fixing driving shaft to motor shaft (M14)		180 + FM
	Driving shaft tightening screw or pump shaft (M27)	[V]	120
	Driven shaft tightening screw (M27)		450 + FM
	Propeller flange tightening nut direct drive engine (M30)		290 + FM

Legend

- FD = weak thread lock
- FM = medium threadlocker
- FF = strong threadlocker
- P = tightening subjected to periodic control
- O = optional
- V = present only on some versions
- S = suggested (refer to the manufacturer's manual)

In the event that even a single screw of a series is loosened, the entire group of screws must be loosened and tightened in pairs, respecting the order, if prescribed.

12-02-00 Locking the crankshaft

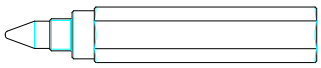
During tightening or maintenance operations on the engine, it may be necessary to block the rotation of the crankshaft.

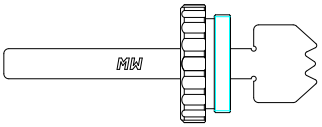
Avoid blocking rotation in ways other than those prescribed to avoid damage or detachment of vital engine components.

Attempting to start with the crankshaft blocked can cause damage to the free wheel or the starter gears.

Necessary Material

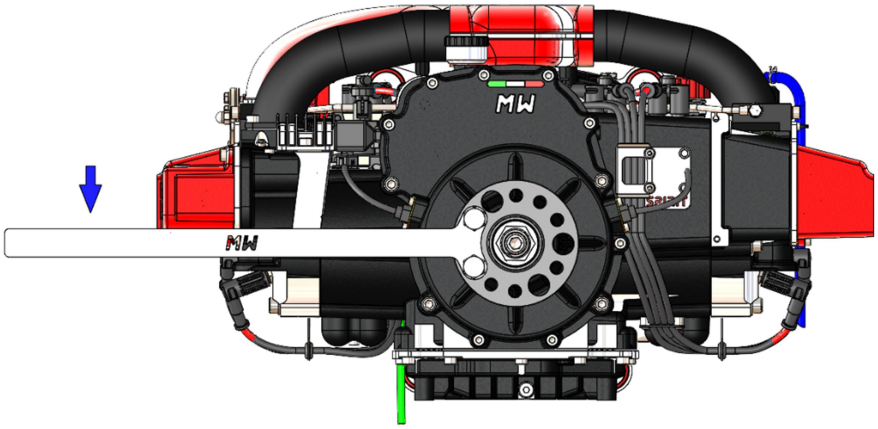
1. Crankshaft locking screw (cod. X300)
2. Torque wrench 50 Nm
3. 5 mm Allen key
4. 15 mm hex wrench
5. Oil filler cap tightening tool (cod. X283)
6. Locking tool for reducer (cod. X278)
7. Propeller flange locking tool (cod. X290)





12-02-01 Motors without gearbox

a. Unscrew the screws from the propeller and remove it from the flange.



12-01-P

b. Screw [3] the flange locking tool [7] to the propeller flange, using the provided screws and washers.

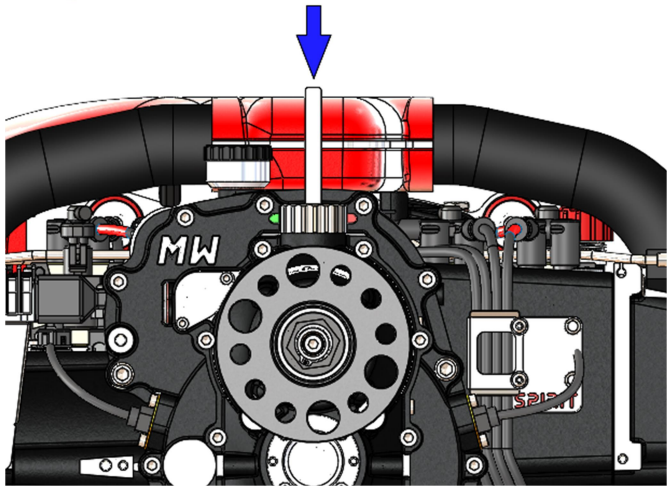
c. Hold the tool lever [7] while applying the tightening torque, to prevent rotation of the crankshaft.

d. Screw the propeller back on, tightening [2 + 3] to the torque prescribed by the manufacturer.

12-02-02 Motors with gearbox

a. Unscrew [5] the gearbox oil filler cap.

b. Insert the comb of the locking device [6] into the refuelling hole, moving the propeller by hand in the direction of travel to facilitate its engagement on the transmission crown gear.



12-02-P

c. Tighten the locking device nut by hand, simultaneously moving the comb back and forth so that it can adapt to the gear.

d. Check the effective tightening of the ring nut during operations on the engine, retightening if necessary.

Before starting the engine, remember to remove the locking device [6] of the crankshaft and screw [5] the gearbox oil filler cap: it is good practice to always rotate the propeller by hand, to check that rotation occurs freely.

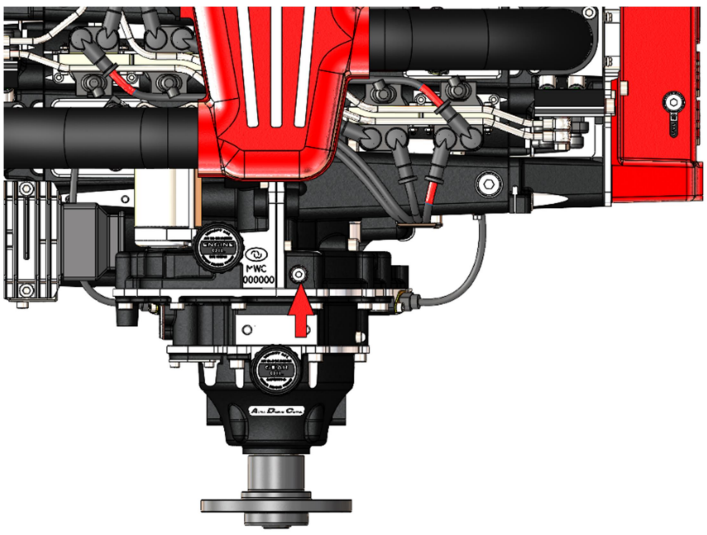
Avoid applying the crankshaft locking procedure relating to motors without reducer to motors with reducer, as the torque to be opposed would be multiplied by the reduction ratio, damaging the rotation locking device.

12-02-03 Locking for timing without removing the reducer or front cover

By blocking the rotation of the crankshaft as described below, the disassembly and subsequent reassembly of the camshafts will not require the removal of the front cover or the reducer to check the phase references printed on the tone wheel.

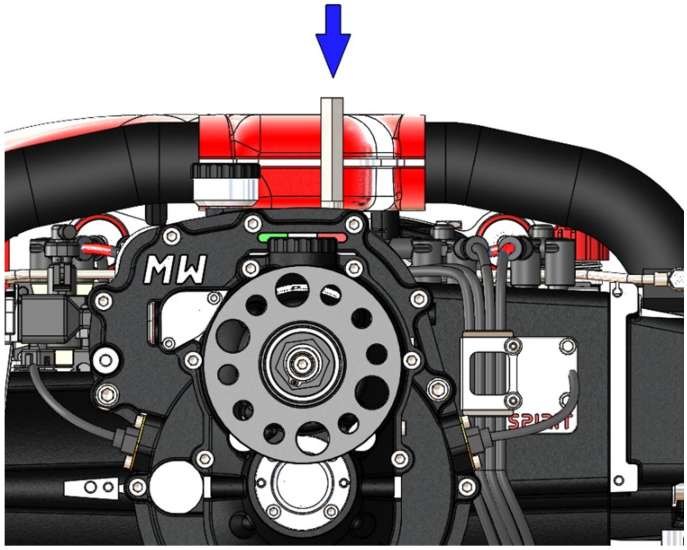
a. Immobilize the camshafts with the appropriate equipment and with the methods described in the extraordinary maintenance manual.

b. Unscrew [3] the M10 service cap located on the upper side of the engine next to the engine identification number.



12-03-P

c. Screw [4] the locking screw [1] into the hole in place of the removed service cap: slightly rotate the shaft to facilitate the insertion of the tip of the screw into a tooth space.



12-04-P

d. Check the effective locking of the shaft during operations on the engine, retightening the screw if necessary.

e. At the end of the work, remove the locking screw and screw the service screw back to a torque of 15 Nm. The copper washer placed as a gasket must be replaced.

The maximum torque, considered applied to the motor shaft, which can be supported by the screw locking is 80 Nm: avoid overloading the tightening by applying higher torques.

If you want to intervene on the transmission tightening elements (propeller flange nut, reduction gear driven shaft locking screw, PVV pump shaft) it is not possible to use the procedure described above, as the torque to be applied would be higher than the maximum tolerable by the locking device. To prevent rotation of the motor it is therefore necessary to operate as follows.

12-03-00 Engine test after maintenance or periodic inspection

At the end of the maintenance on the engine, it is necessary to carry out a ground engine test.

Carry out the tests in an airy place and out of the reach of children or onlookers.

Carry out all observations on the thruster in a safe place. Place the aircraft on a horizontal, stable and clean ground: the propeller, rotating, can throw objects collected from the ground at high speed, causing danger for those in the vicinity.

Never leave the aircraft with the engine running.

a. Before starting, check that the engine has no detached or not completely fixed components.

b. Also check that there are no forgotten tools near or on the engine.

c. Check and, if necessary, replenish the operating fluids (lubricants, coolant).

d. Check the correct fixing of the propeller.

e. Secure the aircraft to the ground and place chocks under the wheels. Make sure that the propeller area is free of obstacles before starting the propeller.

f. Carry out some rotation of the propeller by hand, to check its smoothness and the absence of jamming, which could indicate poorly executed assembly.

g. Open the petrol tap (if present).

h. Place the throttle control on minimum.

i. Main switch (master) in on position.

j. Injection switches (kill switch) in the on position. Wait for the fuel pump to pressurize the fuel circuit to at least 3.2 bar: the main fuel pump works for about 2.5 seconds, after which, if the engine is stopped, it stops, to restart as soon as the engine speed exceeds the 200 laps. If the aircraft has been stopped for a long time, or if it has undergone maintenance work on the fuel circuit, it is possible that the petrol pressure does not reach the minimum value for starting: in this case, operate the auxiliary pump until the correct pressure is read to goodwill. If the fuel system still does not go under pressure, carry out the bleeding procedure of the petrol circuit.

k. Press the start button for no more than 10 continuous seconds: in case of failure to start, wait at least 1 minute before trying again.

l. As soon as the engine has started, check the oil pressure, which in about 5 seconds must be above the minimum expected value.

m. Wait for the engine to reach operating temperature.

n. During heating, check the temperature of the lubricant and the coolant and the pressure of the fuel and the lubricant: the values must comply with the indications given in the operating manual. Also check the conformity of the electrical absorption of the recharging system.

o. Check the operation of the redundancies and the auxiliary pump, as described in the operating manual.

p. Turn off the engine by first acting on the kill switch of the auxiliary control unit, and then on the kill switch of the main control unit. With the engine off, also turn off the main switch (master); if fitted with a key, remove it from its seat.

q. Check the oil and coolant levels: if necessary, top up with fluids of the same type and quality, as indicated in the operating manual.

A	Never open the cap of the pressurized cooling circuit when the engine is hot. If it is necessary to carry out checks, unscrew the cap slowly, holding it with a rag soaked in cold water; vent the circuit gradually, stopping during opening.

r. In case of replacement of the oil filter, check that it is tightened by hand; the filter is equipped with a rubber gasket, which undergoes a small adaptation after the first moments of engine operation.

s. Check that there are no oil, water or petrol leaks: in the event there are leaks, proceed with the repair.

t. If maintenance work has been carried out on the cooling system, vent the system.

u. Restart the engine and wait again for the pressure and temperature values to reach full speed.

v. Check at various speeds that there are no vibrations or abnormal noises. In case you are locate the source to fix the problem.

w. Operate the throttle lever to the maximum opening position and check that the engine reaches the maximum number of revolutions expected according to the installed propeller.

x. Suddenly bring the accelerator lever to the minimum opening position and check that the engine turns regularly at idle speed without hesitation.

y. If installed, check the correct operation of the variable pitch propeller, according to the procedure indicated by the propeller manufacturer.

z. Check the correct operation of both injection systems by repeating the test at maximum and minimum throttle opening.

aa. Keep the engine running for about 20 minutes in total, avoiding situations that could induce overheating.

bb. Check the tightness of the exhaust or supercharging system.

cc. Check the tightness of all fuel, cooling, lubrication and fuel system connections.

dd. At the end of the test, turn off the engine by first running it at low rpm for about a minute: this serves to make the temperatures uniform, to avoid thermal stress.

ee. If the spark plugs have been replaced, check their tightness and if necessary restore it to the correct value.

ff. If the propeller has been removed to facilitate maintenance work, check and possibly restore the tightening according to the procedure indicated by the propeller manufacturer.

gg. If the engine has been removed from the aircraft, after the test, check the tightness of the fixing screws to the castle and the position of the anti-vibration elements.

hh. Check the tightness of all accessories.

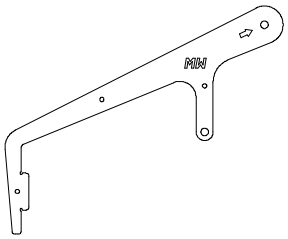
12-04-00 Removal and reassembly of the engine from the aircraft

For some maintenance operations or to carry out the overhaul at the end of the hour, it may be necessary to disembark the engine from the aircraft.

Disassembly and reassembly can be carried out in a short time and with minimal equipment, operating as described below.

Necessary material

1. Torque wrench 50 Nm
2. 3mm Allen T-handle wrench
3. 5mm Allen T-handle wrench
4. 6 mm Allen key with ball head
5. 8mm Allen T-handle wrench
6. 13 mm hex wrench
7. 12mm hex wrench
8. 17 mm hex wrench
9. Engine lifting tool
   (X299 for motors with gearbox)
   (X342 for motors without gearbox)



10. Engine lifting crane with maximum load >150 Kg
11. Height-adjustable aircraft support stand
12. Other tools according to the materials chosen during installation.

12-04-01 Removal

a. Remove [12] both contacts from the battery (first the negative and then the positive).

b. Remove [12] the propeller, according to the procedure indicated by the manufacturer.

c. Drain the engine lubrication and gearbox lubrication oil from the engine, only if necessary: if the OC-m is used, the removal of engine oil is not necessary to remove the engine from the aircraft.

d. Empty the cooling system only if necessary: if the CR-m STD is used, emptying the system is not necessary to remove the engine from the aircraft.

e. Remove [7] the fuel lines from the shunt. Before disconnecting the pipes, mark the delivery and return branches to the tank to facilitate reassembly operations.

f. Remove the throttle control.

g. Remove the engine ground cable [4].

h. Unscrew [6] the tightening nut of the power cable on the remote-control switch.

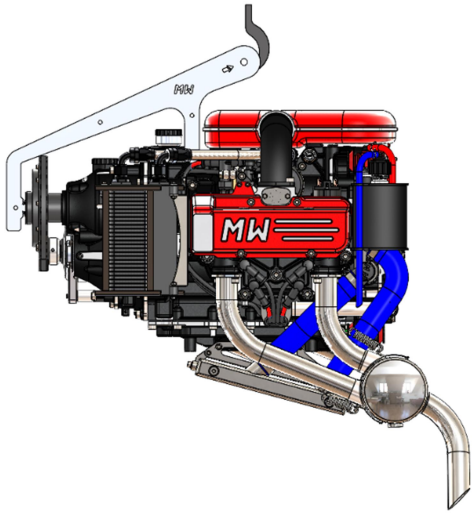
i. Disconnect the engine wiring from the aircraft electrical system, using the flying connector.

j. Remove [4] the exhaust system only if necessary: for turbo engine or if the EX-m is used, removal is not necessary to disassemble the engine from the aircraft. If using a non-original exhaust system, follow the instructions of the aircraft manufacturer.

k. Remove [2] the cooling radiator only if necessary. If using a non-original radiator, follow the instructions of the aircraft manufacturer.

l. Remove the lubricant cooler, only if necessary.

m. Screw [5] the lifting tool [9] to the engine. Alternatively, provide a system for lifting the engine, making sure that no parts of the wiring or spark plug cables are stressed during operations.



12-05-P

n. Engage the hook of a small crane or hoist [10] on the lifting tool, without lifting the engine, but adjusting the hook to the height of the engine.

o. Arrange a height-adjustable stand [11] under the tail of the aircraft which, once the engine has been removed, prevents the aircraft from touching the ground.

p. Unscrew [5; 8] the motor support screws gradually. If wall mounting is used, first unscrew and remove the lower screws from their housing.

12-04-02 Installation

All original accessories can be installed on the engine before the engine itself is installed on the aircraft: in case of non-original accessories, follow the manufacturer's instructions.

a. Mount [4] the lifting tool [9] on the engine. Alternatively, provide a system for lifting the engine, making sure that no parts of the wiring or the spark plug cables are stressed during the operations.

b. Approach the engine to the aircraft, adjusting the height of the crane [10] in such a way as to make the fixing holes on the engine coincide with those on the engine mount. In the case of shelf mounting, adjust the height to about 2 centimetres above the mounting surface.

c. Insert the anti-vibration pads in the seats on the motor. Insert the spacers into the pads. Check the service status of the buffers and spacers and, if necessary, replace them.

d. Insert the four fixing screws in the holes in the engine mount and on the engine mounts.

e. Screw [1 + 8; 5] to the torque prescribed by the aircraft manufacturer (between 35 and 45 Nm), ensuring tightening with thread lock.

f. Remove [4] the lifting tool.

g. Install all accessories, if not already installed.

h. Turbo Engines - Install the intercooler, BOV valve and fuel system fittings.

i. Hook the engine wiring connector to the counterpart on the injection system, making sure that the safety ring nut is properly tightened.

j. Screw the engine ground eye and tighten [1 + 4].

k. Screw the eyelet of the positive power cable to the contactor, respecting the position of the safety washers. Tighten [1 + 6] to torque (15 Nm).

l. Connect [1 + 8] the two fuel pipes to the fuel shunt, respecting the correct position of delivery and return to the tank: tightening must take place at 30 Nm.

m. Connect the throttle control.

n. Install [12] the propeller following the procedure indicated by the manufacturer.

o. Top up the engine oil and gearbox oil.

p. Fill the cooling system.

q. Connect [12] the battery to the system, respecting the polarity of the cables and after making sure that the main switch (master) is in the off position.

r. Carry out the engine test on the ground, according to the procedure described in this manual.

12-10-00 Supplies

The following paragraphs describe how to check the level and possibly add operating fluids.

Carry out the checks with a cold engine and fluids at ambient temperatures: observe this precaution to avoid burns or even serious burns.

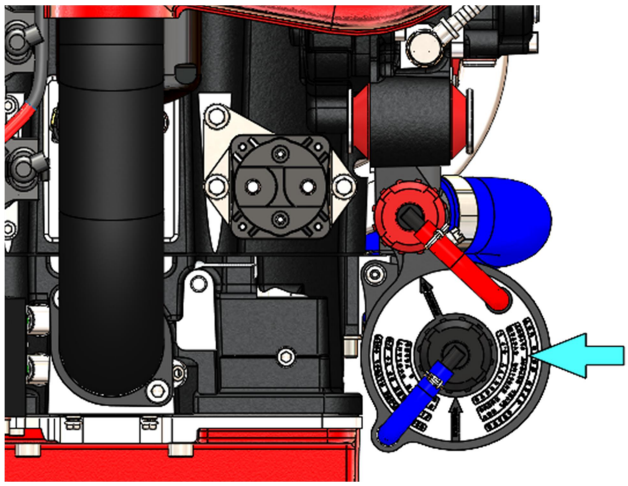
Before carrying out the checks, move the injection switch and the main switch to the off position; disconnect the negative cable from the battery.

12-10-01 Cooling liquid

a. With the engine off, unscrew the black cap of the cooling circuit expansion cap counter clockwise.

b. Check that it is full for at least 2/3 of the height by inserting a finger or the shaft of a screwdriver inside.

c. If necessary, top up the correct level with a coolant identical to that present in the engine.



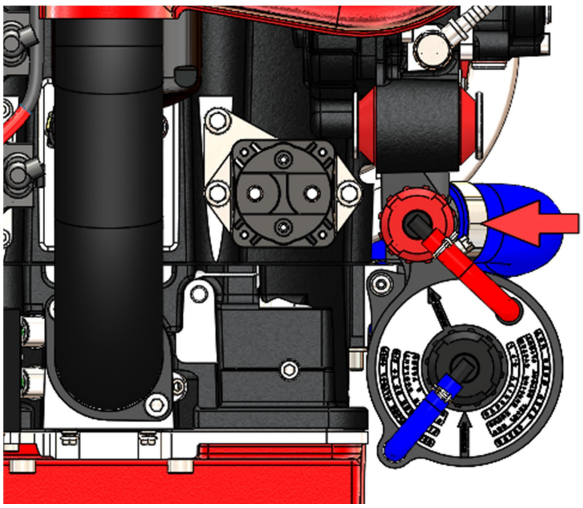
12-06-P

Using unsuitable coolants can cause erosion of the internal parts of the engine; It is particularly dangerous to mix coolants of different types or brands, as chemical incompatibility may occur.

For an indication of the type of antifreeze to be used, refer to the installation manual.

d. In the event that the level of the expansion tank is less than 2 centimeters from the bottom, it is necessary to check for the presence of liquid in the pressurized system, removing the red cap after waiting for the engine to cool completely.

- If the level inside the system filling pipe is flush with the cap or below no more than 2 centimeters, restore the level.
- Otherwise it is necessary to bleed the system according to the procedures described in paragraph 12-23-06 of the present manual.



12-07-P

e. Screw the caps removed by hand, until you feel a certain friction, due to the friction of the gasket placed as a seal on the cap itself.

12-10-02 Motor oil

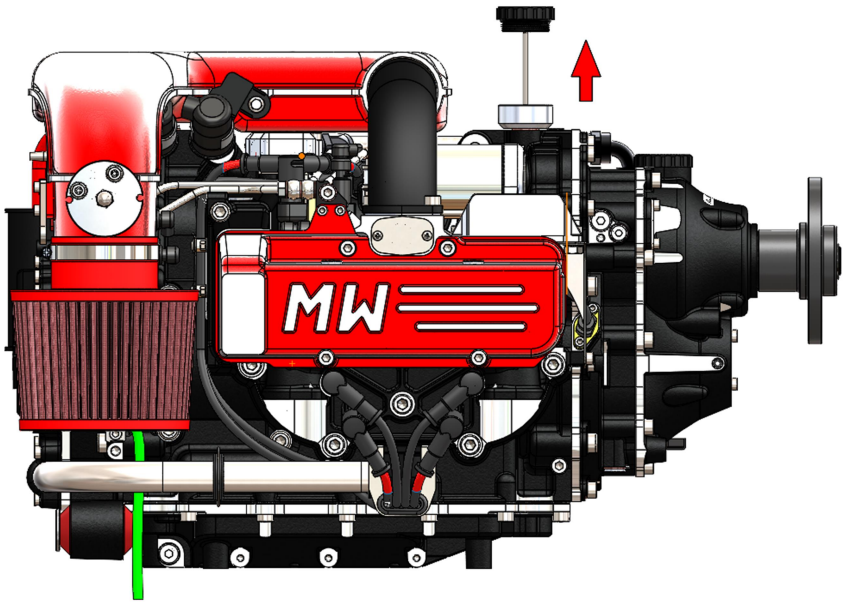
Necessary material

1. Oil filler cap tightening tool (X283)

2. Blotting paper

a. Place the aircraft in an area where a horizontal engine position is guaranteed. Bear in mind that the engine is not always mounted in such a way that with the aircraft on a horizontal plane it is also horizontal. If necessary, use a level resting on the oil plug. Once an appropriate area for level control has been identified, it will be sufficient for subsequent checks to reposition the aircraft in the same place.

b. Unscrew [1] the oil cap located on the top of the front part.



12-08-P

The cap is equipped with a dipstick for checking the quantity of oil in the sump; the level must be between the lower and upper notch (under the O-ring).

12-09-P

c. Clean the dipstick with absorbent paper [2] and reinsert the dipstick in its seat, without screwing the cap back on.

d. Remove the cap with the dipstick from its seat again.

e. Check that the level is between the bottom of the rod and the notch; in case of doubts about the actual level, use absorbent paper [2] to check up to what level the dipstick is wet with oil.

f. If necessary, top up using oil of the same type. After waiting at least 5 minutes, check the level again.

g. Screw the cap back on by hand or with the specific lever [1] (tighten slightly), taking care to check that it has reached the stop. It is normal to feel a certain resistance in screwing about halfway, due to the friction of the gasket in the seat: this prevents accidental loosening of the cap.

Avoid mixing different lubricants: this can cause chemical incompatibility between the additives, with unpredictable consequences on the mechanical parts and on the lubrication efficiency.

Any excess oil is expelled through the breather system, causing contamination of the air filter and spark plugs. Defective oil can cause power gaps, especially in extreme flight conditions.

The total oil quantity must conform to table 12-06-C of this manual. The difference in oil quantity between the minimum and maximum level is 0.5 liters.

12-10-03 Gearbox oil

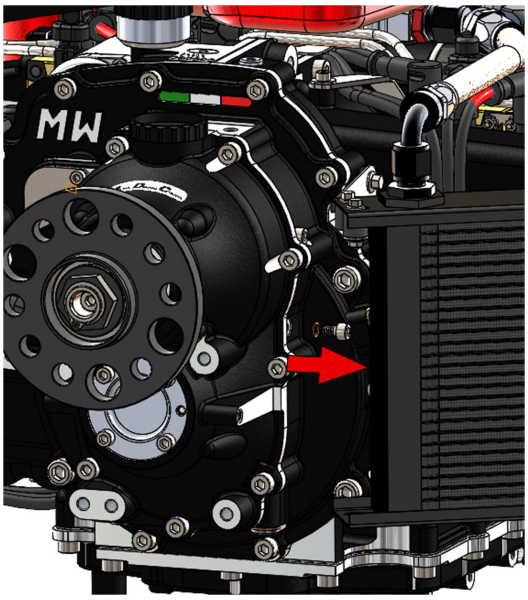
Necessary material

1. Torque wrench 50 Nm
2. 5 mm Allen key
3. Oil filler cap tightening tool (X283)

4. 6 mm Allen key

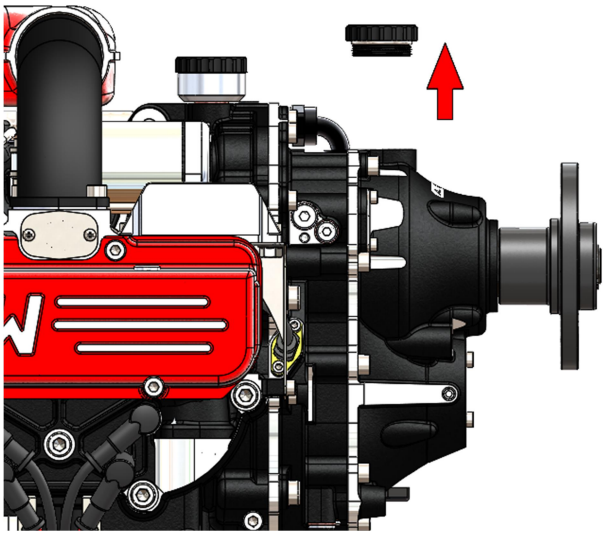
The check must be carried out with a cold and horizontal engine, at least every 50 hours of operation.

a. Loosen [2] the screw on the reducer (bank side # 2) and wait for a film of oil to come out, indicating that the oil is above the minimum level.



12-10-P

b. If the oil does not come out, slowly add oil of the prescribed type until you see oil coming out of the inspection hole, after removing [3] the filler cap.



12-11-P

c. If the engine has been used with the gearbox oil level below the minimum level by more than 150cc, it is necessary to remove [4] the drain plug with magnetic filter and inspect the collected particulate to identify any damage ~~(12-20-5)~~. Normally use for short periods in oil conditions below the level is well tolerated and does not cause damage.

d. Tighten [1 + 2] the level screw to a torque of 10 Nm after replacing the copper sealing washer.

The total oil quantity must comply with table 12-11-C of this manual.

12-20-00 Scheduled maintenance

This chapter collects inspections or ordinary maintenance operations.

All the checks described in this section must be carried out with the engine off, after having waited for it to cool completely.

Before carrying out the checks, move the injection switch and the main switch to the off position; disconnect the negative cable from the battery.

12-21-00 Engine cleaning

Regularly clean the engine to avoid the accumulation of sludge, dust, mud and anything else that could worsen the heat exchange or infiltrate inside the engine. Thorough cleaning also allows you to inspect the various parts of the engine, facilitating the identification of any states of wear, anomalies, leaks or damage..

During washing, many pollutants mix with the water: prevent these substances from being released into the environment. It is advisable to place the aircraft above a collection basin so as not to disperse liquids and dispose of them in accordance with current legislation.

a. Carefully inspect the gas can for any leaks.

b. Protect the air filter by placing a tight plastic bag over it with a rubber band.

c. Make sure that the throttle control is in the fully closed position.

d. Clean the engine with a rain jet of cold water under pressure from the mains, sponge and detergent, avoiding directing the flow on parts of the wiring, on the injection control unit and on the air filters: these components in fact have a degree of protection against the penetration of not total liquids. In areas that are particularly difficult to reach or with persistent dirt, it is possible to use an abrasive sponge and detergent.

Do not use caustic or flammable substances to wash the engine.

Avoid using aerosol cleaning products, which may contain solvents that attack the gasket material.

Wait until the engine has cooled completely before washing.

If it is installed inside the engine hood, avoid directing the water jet on the injection control unit, to prevent any infiltrations.

e. After washing, provide adequate rinsing to remove all traces of detergent from the engine.

f. Dry the engine in the sun or with compressed air, paying particular attention to electrical installations.

Do not use waxing products, neither on plastic parts, nor on metal parts.

g. Remove the plastic bag from the air filter and start the engine, letting it idle for a few minutes, to check its perfect efficiency.

After each wash, before carrying out a flight, it is necessary to make sure that the injection system and the battery recharge system are in perfect working order, letting the engine run for a few minutes at various speeds: in the event of irregular operation, difficulty keep the idle speed or discrepancy in the battery charging voltage avoid flying and contact an authorized service center for the necessary checks.

12-22-00 General checks

By checking the crankcase breather, it is possible to obtain information on the state of health of the engine.

12-22-01 Check tightening

Some tightenings are particularly stressed or critical for flight safety: these tightenings are indicated in table 12-01-C of this manual, which also shows the torque prescribed for each tightening.
The tightenings must be checked with the engine cold.
The check is done by setting the torque wrench (where prescribed) to the prescribed torque and trying to further tighten the screw or nut being checked: no movement must be felt. Otherwise, tighten up to the expected torque and note the anomaly in the engine logbook: the same tightening must be rechecked after a period half that expected. If a tightening is frequently out of torque, it is necessary to investigate the cause of the anomaly.

Avoid checking tightening torques by trying to unscrew the connection, as this may give misleading results.

In addition to the connections for which the tightening check is provided in table 12-01-C, it is also important to periodically check all the metal clamps closing the cooling circuit hoses, the intercooler (Turbo engines) and the air filter: the check must be carried out without a torque wrench, but avoiding excessive tightening, so as not to damage the hose itself; after tightening, always check that the connection is secure, by trying to extract the hose. Always check that the clamp is correctly positioned on the hose itself, i.e. with the closing axis aligned with the axis of the hose; also check that the clamp is positioned beyond the edge of the coupling tube, and not astride the edge itself.

12-22-02 Check for leaks

Visually inspect the entire engine for any leaks before making a flight: pay attention to the fact that the presence of the propeller can cause the leakage fluids to flow even far from the point where the leak occurs, making it difficult to individuation.

If there are doubts about the effectiveness of some leaks, it is appropriate to proceed as described below.

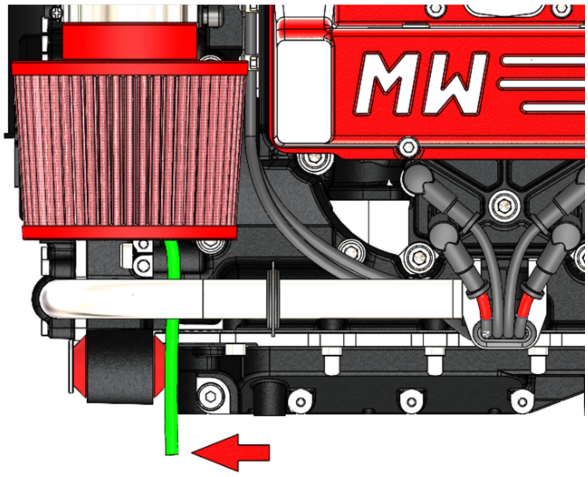
a. Clean as much as possible any trace of any leakage.

b. Start the engine and bring it to operating temperature.

c. Let the engine run for a further 5 minutes.

d. Stop the engine and prepare the aircraft for safe operation.

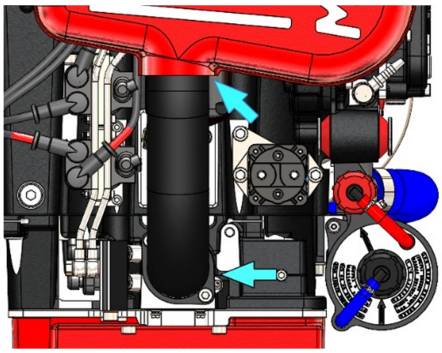
e. Check for coolant or oil drips from the mechanical seal breather pipe located at the bottom of the engine. However, a modest refrigerant leakage in the first hours of operation is normal due to the mechanical seal running in. In case of persistent leakage, it is necessary to replace the mechanical seal and the oil seal of the rear cover.



12-12-P

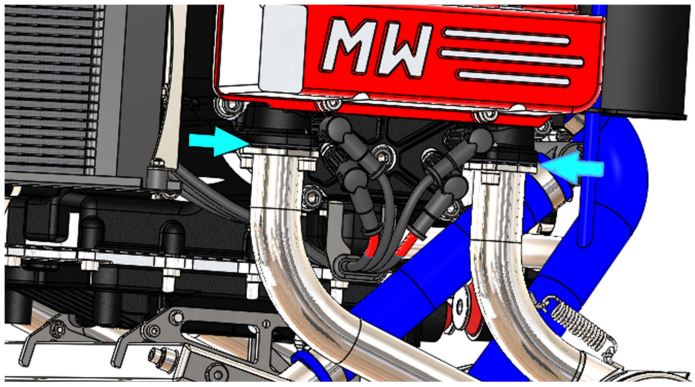
f. Check for oozing from the copper washers of the fuel system fittings: if necessary, retighten the eyebolts in pairs or replace both washers of each fitting.

g. Check the presence of leaks from the clamping flange of the intake manifolds: if necessary, replace the sealing gaskets.



12-13-P

h. Perform the same check on the exhaust system: if necessary, retighten the screws locking the manifolds to the head; if the leak is persistent, unscrew the manifolds from the head, replace the gaskets and lock them again. The dark halo caused by the exhaust gas vent can be removed using an abrasive sponge and denatured alcohol.



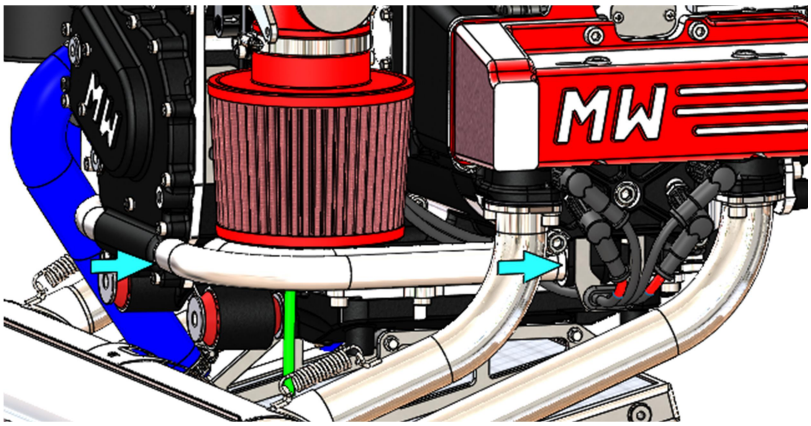
12-14-P

i. Turbo Engines - Check the tightness of the turbocharger inlet and outlet manifolds and of the compressor itself to the oil sump; also check that there are no leaks from the turbocharger tank, or from the fittings connected to it.

j. Check the entire lower part of the engine and the connecting flanges of the rear covers to the crankcase: there must be no visible accumulations of dirt or oily areas, a symptom of lubricant leaks.

k. Check the lower area of the flange joining the tappet covers to the cylinder head: if there is any leakage of lubricant, retighten the closing screws to the prescribed torque; if the leak persists, replace the tappet cover sealing gasket.

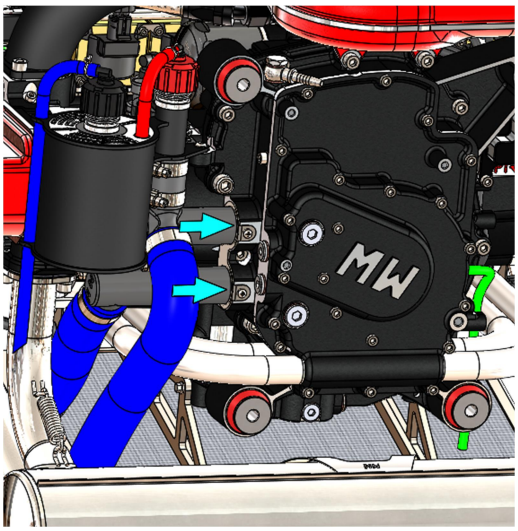
l. Examine the coupling areas of the coolant distribution pipes to the banks located in the lower part of the engine.



12-15-P

There should be no drips or areas with bluish spots. If necessary, replace the sealing O-rings.

m. In the same way, check the coupling area of the inlet and outlet manifolds of the pump cover.



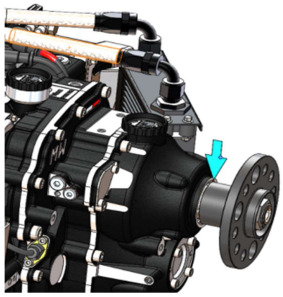
12-16-P

n. Check the area near the filler caps on the expansion tank: any leaks must be resolved by replacing the caps.

o. Check the engine oil and gearbox oil filler cap: in the event of leaks it is necessary to replace the sealing O-ring placed on the cap itself.

p. Check the rubber fittings between the engine and the cooling radiator: any dripping or oozing must be solved by retightening the sealing clamp or replacing the hose.

q. Check the propeller shaft oil seal at the outlet of the reducer (or of the front cover for direct versions): in the event of leaks, check the static and dynamic balance of the propeller; if the leakage persists, the sealing element must be replaced.



12-17-P

12-22-03 Check crankcase breather

The check must be done with a cold engine after a normal flight. Alternatively, it is possible to carry out the check after a ground engine test. Check the nature and extent of deposits inside the pipe or inside the collection vessel (if installed) and compare it with the references in the following table.

Type of Fluid	Quantity	Possible Problem	Control or Remedy
Oil	Slight greasiness	None	None
Oil	Slight deposit	Operating temperature too high	Lower the operating temperature
Oil	Slight deposit	Elastic bands deterioration	Compression test
Oil	Slight deposit	Valve oil seals deterioration	Compression test
Oil	Strong oil deposit or leakage during operation	Too much oil in the cup	Lower the oil level
Oil	Strong oil deposit or leakage during operation	Seizure	Engine overhaul
Water	Absent	None	None
Water	Slight deposit	High environmental humidity	None
Water	Slight deposit	Operating temperature too low	Raise the operating temperature
Water	Strong deposit	Broken head gasket	Engine overhaul

12-03-C

If the check has been carried out without having brought the engine to operating temperature, it is normal to find small traces of water in the breather pipe.

Turbo Engines - Turbo engines have operating pressures in the combustion chamber that are significantly higher than naturally aspirated engines: for this reason, also in relation to environmental or installation conditions, these engines may have a higher blow by, and therefore present small leaks of lubricant from the vent pipe, even without there being any anomaly. In this case, it is advisable to use a tank to collect the blow by vapours, to be installed downstream of the vent pipe.

12-22-04 Engine suspension check

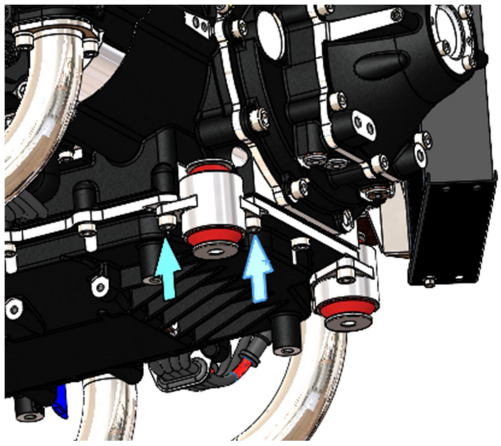
Necessary material

1. Torque wrench 50 Nm
2. 17 mm fixed wrench
3. 8 mm Allen key
4. 6 mm Allen key

a. Check the integrity of the anti-vibration elements. These components are made of plastic material, which can degrade in the event of prolonged exposure to the sun or excessive temperatures or in the event of contamination by hydrocarbons.

b. Check the tightening [1 + 2; 3] of the screws fixing the motor to the yoke. Loose connections can usually be easily identified due to the blackening of the area surrounding the screw head or nut. The tightening torque is defined by the installer or by the manufacturer of the aircraft: it is usually set between 35 and 45 Nm.

c. Check the motor fixing slots on the rear cover (wall mounting): they must be free from cracks or distortions; cracks can be identified because they contrast with the black colour of the engine. In the case of bracket mounting, check the tightening [1 + 4] of the fixing screws of the engine supports to the oil pan: the prescribed torque is 22 Nm.



12-18-P

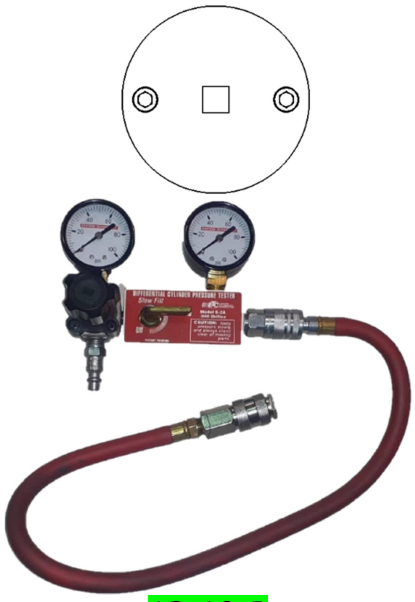
d. Each time the engine is removed from the aircraft, replace the fixing screws to the yoke and the anti-vibration elements as a precaution.

12-22-05 Cylinder Compression Control

The maintenance program provides for the periodic check of cylinder compression; the same check must be carried out if the engine has overheated or shows a drop in performance.

Necessary Material

1. Torque wrench 50 Nm
2. 16 mm spark plug wrench
3. Black permanent marker
4. 36mm hex socket wrench (direct drive version)
5. 700mm lever with ¾" square (PSRU versions)
6. Propeller shaft rotation key (PSRU versions) (X546)
7. Differential pressure gauge with compensation orifice with 1 mm diameter and length 6 mm



12-19-P

8. Differential pressure gauge adapter with spark plug socket M10x1
9. Air compressor with minimum operating pressure 8 bar

a. Start the engine and bring it to operating temperature.

b. Unscrew the secondary plant spark plug of each cylinder with the special key [2] (spark plug tilted down), after having marked it [3] with the cylinder identification number.

c. Screw the adapter for differential pressure gauge [8] to cylinder # 1 and tighten it [2].

d. Rotate the propeller until the piston of cylinder #1 reaches the top dead center: this position is easily identifiable as it produces a small movement of the needle

located downstream of the orifice on the pressure gauge. If the propeller is disassembled, it is still possible to perform the test in the following way.
Direct engines: rotate the shaft by acting on the propeller hub tightening nut [4+5].
PSRU engines: fit the tool [6] on the propeller flange engaged on the operating lever [5] and then rotate the crankshaft to the dead center of cylinder #1.

e. Connect the air compressor [9] to the input port of the differential pressure gauge [7] and then connect the output port to the adapter [6] on the cylinder: act on the regulation valve in such a way as to obtain the test pressure (6 bar) on the reference pressure gauge. Keep the propeller (or the key [4]) firmly to prevent shaft rotation.

During this operation the propeller or the control key [5] must be held with force, to overcome the considerable torque produced by the compressed air.

f. Take the reading on the measuring pressure gauge by slightly moving the propeller, in both directions: the correct reading is the maximum verifiable, corresponding to the real top dead center of the piston under test; write down the reading.

g. Repeat the steps in sequence for the other three cylinders, noting the readings.

h. Also check the colour of the candles, as reported in paragraph 12-28-02 of the present manual.

i. Verify that the values read in each cylinder conform to the following.

- Test pressure 6 bar
- Minimum admissible value 4.5 bar
- Typical value 5.6 bar
- Limit value 5 bar
- Maximum difference between the cylinders 0.8 bar

If the values of even one cylinder are lower than the minimum admissible, or if the maximum difference between the cylinders is greater than the admissible one, it is necessary to contact an authorized service center to carry out the necessary checks. If the measured values are within the minimum admissible value but lower than the limit value, it is necessary to carry out the compression check again after 25 hours to evaluate any improvements in the adaptation of the mechanical parts: if the trend is worse, it is necessary to monitor the compression every 25 hours, as it is likely that it will be necessary to intervene on the engine to replace mechanical parts; if vice versa the trend is improving, repeat the compression test upon reaching the hours indicated in the periodic maintenance program.

j. Reassemble the spark plugs on the same cylinder from which they were removed or replace them if necessary. Tighten [1 + 2] to the prescribed torque.

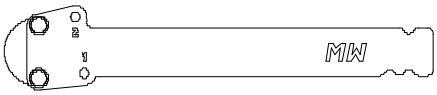
k. Carry out the engine test.

12-22-06 Check the tension of the distribution chain

For the definition of Standard (STD) and Non-standard (NOSTD) motor used below, consult paragraph 01-01-01 of this manual.

Necessary material

1. Tool for checking the chain tension (X298)



2. Torque wrench 50 Nm
3. 8mm hex wrench
4. 3 mm Allen key
5. 5 mm Allen key
6. 6 mm blade screwdriver

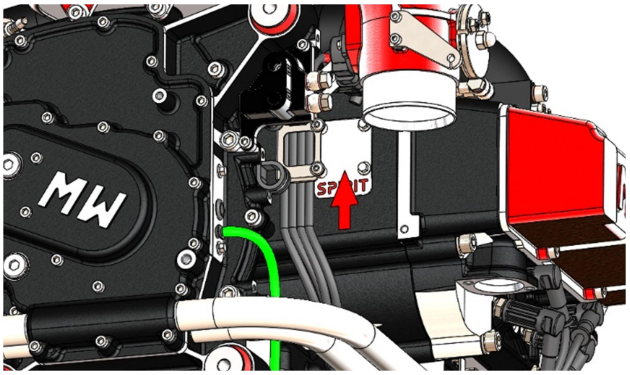
a. Wait for the engine to cool down.

b. Remove [6] the air filter by loosening the metal clamp retaining the airbox.

c. Remove the fuel pressure and temperature sensor connectors.

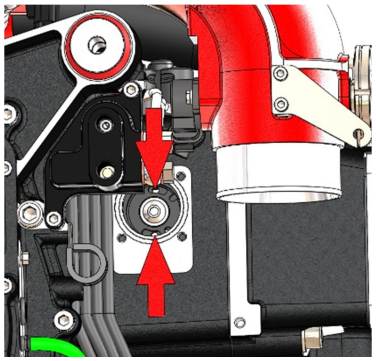
d. Unscrew [4] the two fixing screws of the spark plug cable fixing bracket and the 2 fixing screws [3] of the inspection hole cover of cylinder bank # 1.

e. Remove the cover of the tensioner compartment, paying attention to the or installed below it.



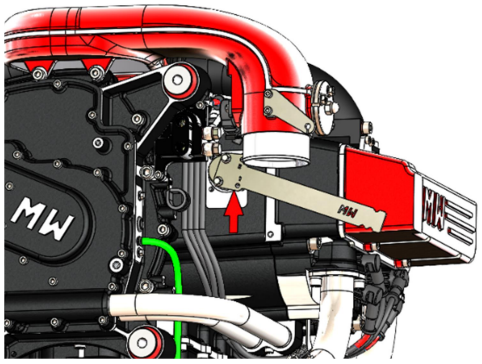
12-20-P

f. Insert the tool [1] into the inspection hole, keeping the handle facing the engine head in an almost horizontal position. During insertion, slightly rotate the lever in such a way as to facilitate the introduction of the two operating pins into the seats on the chain slide.



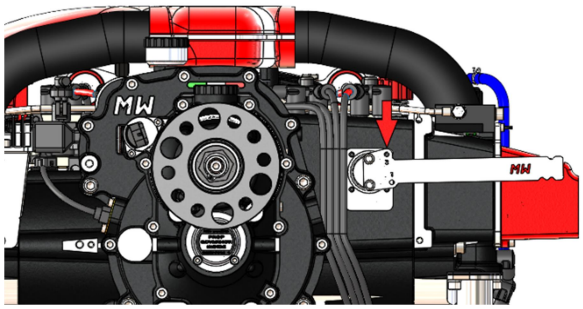
12-21-P

g. Rotate upwards (STD motors) or downwards (NOSTD motors) to check if rotation is possible: otherwise it is necessary to replace the chain and the chain tensioner. For the definition of STD and NOSTD motor refer to table 12-02-C.



12-22-P

h. Return the lever to the rest position and check if it is possible to screw [5] the supplied screw to the crankcase by inserting it in the hole in the lever marked with # 1 (STD motors) or # 2 (NOSTD motors). If it is possible to tighten the screw, it is necessary to replace the chain and chain tensioner; otherwise the wear is within the limits set by the maintenance program.



12-23-P

i. Replace the orb placed behind the inspection cover and screw [2+3, 2+4] the four screws back to the prescribed torque (8 Nm).

j. Remove the OC-m kit if installed, and repeat the same operations on the chain of the bank # 2, positioned in the front part of the base: in this case the verification rotation is performed downwards (for the STD versions) and towards the high for NOSTD versions; the screw for checking must be introduced into the hole of the control lever marked with # 2 (STD motors) and with # 1 (NOSTD motors).

12-22-07 Check general smoothness

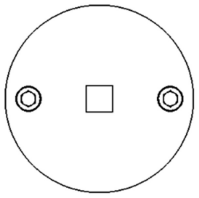
Checking the general smoothness consists in measuring the torque required to rotate the engine without the spark plugs and acting on the propeller shaft. This measurement allows us to evaluate the following.

- Misalignment of the crankshaft following an accidental impact of the propeller on the ground
- Abnormal wear of reduction gears
- Increased friction resulting from seizure
- Internal contact of parts in mutual movement
- Damage to the main or connecting rod supports
- Damage to distribution organs

The verification of the general smoothness must be carried out within the prescribed deadlines or following accidents or doubts about the efficiency of the engine.

Necessary material

1. Torque wrench with reading of the applied torque
2. 16 mm spark plug wrench
3. 36 mm hex wrench (direct version)
4. Rotation key propeller axel (PSRU version)



5. 6 mm Allen key T

6. Other tools according to the materials chosen during installation

Operate with a warm engine.

Remove the power supply to the motor to prevent accidental start-ups.

a. Remove [6] the propeller, according to the procedure indicated by the manufacturer.

b. Remove [2] the spark plugs from the main system (circuit A).

c. Direct engines: engage the torque wrench [1+3] on the propeller flange tightening nut. PSRU engines: insert the tool [4] into two holes of the propeller flange and then engage the torque wrench [1+4] on it.

d. Rotate the propeller shaft in the direction of travel of the motor using the key [1 + 3] and read the maximum torque applied: motors in normal efficiency have the following values.

	Minimum value	Maximum value
Direct Drive Motors	20	50
PSRU Motors	30	60

12-04-C

The maximum value read during the continuous rotation of the motor must be considered as the value (therefore do not consider the data at the start of rotation).
Values below the limit indicate probable wear above the norm; values above the limit indicate mechanical problems.

Avoid performing the smoothness check in the first hours of engine operation as misleading results could be generated due to the incomplete mechanical adaptation of the components.

It is completely normal that in correspondence with the top dead center of each piston, there is a slight increase in the drag torque, of the order of about 10 Nm: this situation therefore occurs about every 90° (motors with type B gearbox) o approximately every 105° (motors with type A gearbox) of rotation of the propeller shaft.

In case of hardening higher than what is prescribed, it is possible to infer the nature of the problem by operating in the following way.

a. Insert the key [5] into the spark plug hole of cylinder # 1.

b. Rotate the propeller shaft in the direction of travel of the motor by acting on the key [1 + 4] and at the same time supporting the key [6] in a horizontal position, to prevent it from getting stuck in the thread during the ascent of the piston.

c. Stop the rotation in correspondence of hardening and qualitatively check the position of the piston (TDC, PMI, half stroke).

d. Rotate the propeller shaft again and qualitatively check in which position the subsequent hardening of the same entity occurs.

The following table summarizes the main defects found with the general smoothness test in relation to the frequency, measured on the propeller shaft, and the position of the piston in which hardening is verified; the frequency refers to the versions of the motor with type B gearbox (in brackets the frequency refers to the versions with type A gearbox). For Direct motors, double the angles shown in the table for motors with type B gearbox.

Frequency on propeller shaft	Piston position	Probable problem
<90° (<105°)	Any	Reduction gear damage
90° (105°)	Half race	Seizure of one or more pistons
90° (105°)	PMS or PMI	Crankshaft misalignment
180° (210°)	Any	Misalignment of generator or water pump
180° (210°)	Any	Damage to pinion or reduction gear pump
180° (210°)	PMS and PMI	Wrong timing of a bank
300° (350°)	Any	Damage to timing gears or oil pump
360° (420°)	PMS or PMI	Stem distortion or valve jamming
360° (420°)	Any	Gear reducer damage

12-05-C

12-22-08 Endoscopic inspection

Appropriate inspection holes are provided on the engine, through which it is possible to introduce an endoscope, to perform checks on mechanical parts without performing any disassembly, or removing engine oil or other liquids.

A Before carrying out the endoscopic inspection, remove the ground contact from the negative pole of the battery.

A The endoscopic inspection must be carried out with a cold engine and the aircraft fixed to the ground in such a way as to prevent accidental movements.

To rotate the crankshaft during the endoscopic inspection, act on the propeller, or by engaging a 36mm socket wrench into the propeller flange the tightening nut (Direct motors) or the dedicated wrench and a control lever (PSRU motors); avoid rotating the shaft in the opposite direction to normal rotation.

To carry out the endoscopic inspection it is necessary to have an endoscope with the following minimum characteristics.

▪ Probe length	500 mm
▪ Probe diameter	<6,5 mm
▪ Probe movement	180° around two axes
▪ Focus	from 10 to 60 mm
▪ Lighting	autonomous with led

Necessary material

1. Torque wrench 50 Nm
2. 5mm Allen T-handle wrench
3. 6mm Allen T-handle wrench
4. Oil filler cap tightening tool (X283)

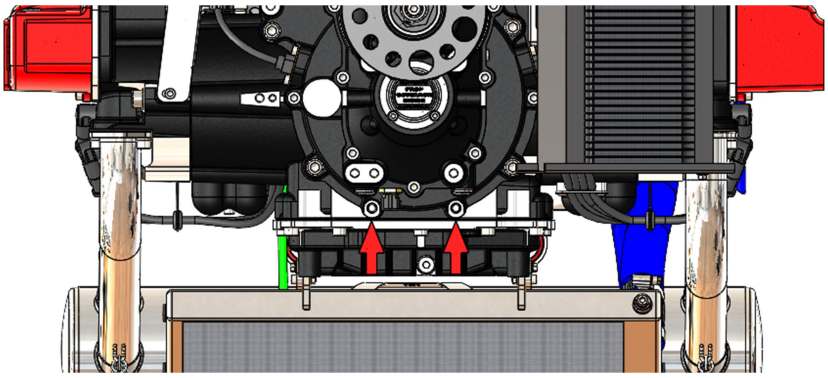
5. 7mm hex wrench
6. 8mm hex wrench
7. 10mm hex wrench
8. 16 mm spark plug wrench

Crankshaft

a. Position the propeller so that the crankshaft is horizontal or, better, with the propeller shaft turned slightly upwards.

Using this trick it is normally not necessary to remove the oil from the engine.

b. Unscrew [3] one of the two lower screws fastening the reducer or the front cover to the base.



12-24-P

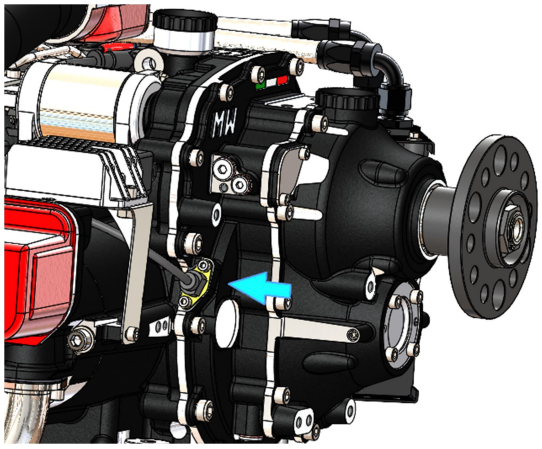
c. Insert the endoscope probe into the hole. The hole allows access to the inside of the crankcase between the crankshaft and the partition of the oil pan.

d. Rotate the crankshaft and check the integrity of the cylinder liners, pistons, main and connecting rod bearings and finally the timing chains of both banks.

e. Once the check is complete, tighten [1 + 3] the removed screws to a torque of 22 Nm after replacing the sealing washers.

Timing and starting gears

a. Remove [6] the rpm sensor located on the side of the reducer.



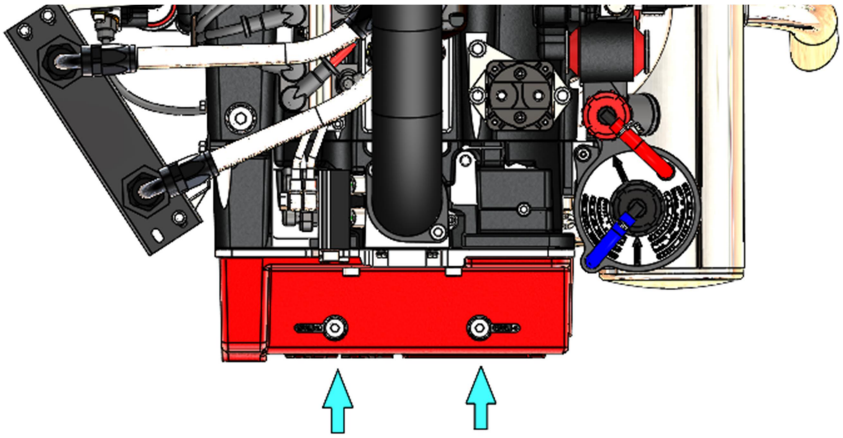
12-25-P

b. Introduce the endoscopic probe and check the service status of the distribution and starting gears, the phonic wheel, the starter freewheel and the transmission shaft engagement on the crankshaft. If the tooth of the tone wheel faces the opening of the pick-up, before inserting the probe, slightly rotate the shaft, in order to free the hole.

c. When reassembling, tighten [1 + 6] the fastening screws of the rpm sensor to the prescribed torque (6 Nm) and apply medium threadlocker.

Tappets and camshafts

a. Remove [2] the threaded plug placed on the cylinder head # 1.



12-26-P

b. Introduce the endoscopic probe and check the service status of the camshaft, tappets and tips of the decompression device. As regards the camshafts, check that there are no scoring or seizure marks at the point of maximum lift of the eccentrics. If the endoscope in use allows it, it is also possible to visually check the operating play of the tappets.

c. When reassembling, tighten [1+2] the inspection cap to the prescribed torque (12 Nm) after replacing the washer placed on the gasket.

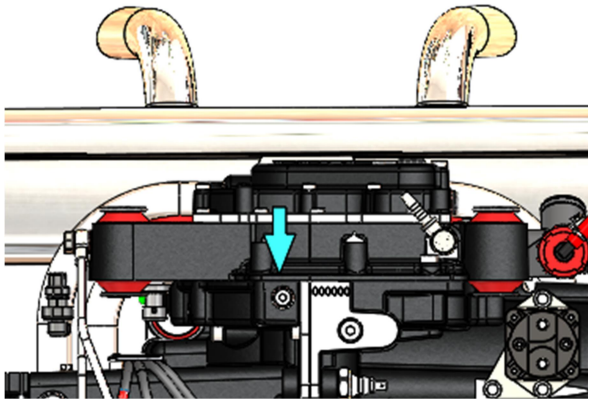
d. Repeat the same procedure to inspect the cylinder head of cylinder bank # 2.

Generator

The inspection of the generator is not included in the scheduled maintenance program, but must be carried out in the event that malfunctions occur on the generator.

a. Remove [3] the suction unit.

b. Below the suction unit there is an inspection cap which must be removed [2].



12-27-P

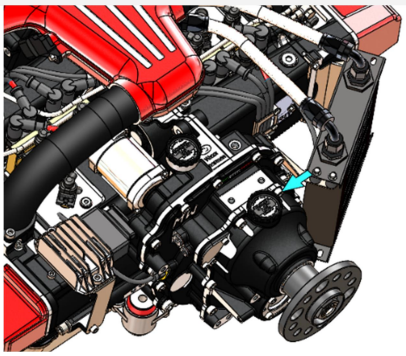
c. Introduce the endoscopic probe to check for any overheating of the generator stator.

d. To reassemble, follow the disassembly operations in reverse order, considering that the tightening torque of the inspection screw is equal to 12Nm and that of the fixing screws of the suction unit is equal to 22 Nm; the copper gasket located under the inspection cap must be replaced; use threadlocker where required by table 12-01-C.

Gearbox

a. Remove [4] the gearbox oil filler cap.

b. Introduce the endoscopic probe through the hole to check the state of wear of the transmission rim and of the front coupling of the torsional damping device: these parts must not show any scratches or colour variations due to overheating.



12-28-P

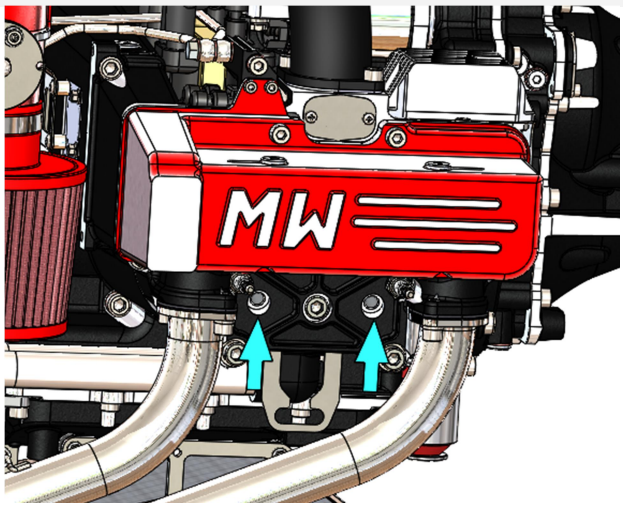
c. Screw the reduction gear oil filler cap back on, tightening it slightly [4].

Combustion chamber and valves

a. Remove [5] the lower spark plug from each cylinder.

b. Introduce the endoscope probe into the hole and carefully bring the respective piston to the bottom dead center by turning the propeller by hand in the direction of travel.

c. Check the condition of the barrel (absence of scratches or signs of seizure), the condition of the peripheral part of the combustion chamber, in the area of the head gasket (absence of signs of knocking).



12-29-P

d. Also check the piston crown, especially in the peripheral part: there must be no pitting or upsetting of material, sign of detonation.

e. By rotating the endoscope head 180°, check the condition of the valve stems, seats and head, especially in the squish area near the barrel: in this case too, there should be no pitting.

f. By turning the propeller by hand in the direction of travel, bring the intake and exhaust valve to the maximum raised position and check the sealing surface and the lower part of the stem: there must be no signs of overheating, wear, scratches or accumulations of carbon deposits.

g. Repeat the same operations on each of the 4 cylinders.

h. After inspection, tighten [1+5] each removed spark plug to a torque of 15 Nm.

i. A more accurate inspection of the state of the valves can be obtained by introducing the endoscopic probe through the intake and exhaust ports.

Turbo compressor

a. Remove [5] the air filter by loosening the retaining strap.

b. Introduce the endoscope probe into the exhaust terminal on the opposite side of the turbocharger, until it reaches the edge of the turbine impeller: the impeller blades must not appear damaged or bent; to better check the state of wear, rotate them during the inspection, acting on the compressor impeller shaft (air filter side).

c. There must be no oily or liquid residues.

d. Similarly, check the service condition of the compressor impeller on the air filter side.

e. Before each flight, check that there are no dark, grainy deposits on the exhaust manifolds, on the union flanges or on the engine heads, near the exhaust ports, which would indicate exhaust gas leaks from joints or cracks. Also check that all

fastening devices are correctly tightened: in particular, check that the oil sump connection bracket is correctly screwed and free of cracks.

12-22-09 Annual inspection

The inspection must be carried out with the engine cold and in daylight, possibly in a place sheltered from direct sunlight. The inspection must be carried out with the naked eye and, in cases of doubt or hidden details, using a magnifying glass and moderate intensity white light (LED).

A Failure to comply with the annual inspection can cause sudden breakage of engine components, resulting in serious damage to the engine or danger to people.

Any deterioration of the plastic or rubbery details is highlighted by surface cracks, small notches, variations in colour or hardness of the material. Cracks or triggers of breakage of metal components are usually highlighted by small deposits of oxide (black) in the vicinity of the defect: in this case a more minute observation conducted with the magnifying glass is useful. If in doubt about the actual state of conservation of the components subject to inspection, do not hesitate to replace them, so as not to compromise safety.

The components to be inspected annually are listed below; for inspection refer to the dedicated paragraphs.

- Fuel system: check in particular the fuel pipes in the areas close to the couplings on the pump unit and on the fuel shunt and in the sections adjacent to hot parts of the engine; check for leaks or greenish streaks on the fuel shunt and near the injectors on the cylinder heads.
- Cooling circuit: check for the absence of colour variations and permanent deformations on the cooling pump manifolds; check the circuit pipes, especially in the areas near the exhaust pipes.
- Radiator: check the support antivibration mounts; check that there are no small leaks or cracks in the radiant pack, highlighted respectively by blue spots and grey halos.
- Expansion vessel: check the breather pipes, the caps, the connection for fixing to the pump manifolds and the tightening of the fixing bushings.
- Crankcase vent: there must be no oil residue or obstructions.
- Mechanical seal vent tube: there must be no liquid residue (antifreeze or oil) or obstructions.
- Air filter: check the area of the fixing sleeve to the airbox or turbocharger, which must be intact.
- Cooling pipe sealing clamps: check that they are properly tightened and the area of the pipe underneath them, which must not be notched or cracked.
- Gearbox oil seal or front cover: check for small leaks of lubricant.
- Throttle control: check the absence of deterioration on the sheath and fraying of the control cable near the control cam; check the smoothness of the rotation of the cam itself by placing the control in the maximum opening position and moving the cam by hand in the opposite direction; check the absence of breakages in the return springs.

- Spark plug cables: check in particular the area near the heads and the spark plug caps.
- Engine support anti-vibration pads. Check the state of conservation of the rubber elements: there must be no cuts or discoloration of the material.

12-23-00 Cooling system

⚠ **Before carrying out checks or maintenance operations on the cooling system, wait for the engine to cool down to avoid serious burns.**

⚠ **Sudden opening of the pressurized cap causes the liquid to boil, with serious danger of burns and burns.**

12-23-01 Control and cleaning

a. Check that there are no coolant leaks along the entire circuit, paying particular attention to the connection points between the pipe and sleeves: any leakage is recognizable by the presence of blue salty-looking deposits.

b. Also check that all the pipes in the circuit are not overheated due to contact or proximity to the exhaust manifolds: overheating is recognizable by the presence of cracks or swelling on the surface of the pipe.

c. Periodically, check the quality of the coolant using a hydrometer: in case the liquid is discoloured or thickened it must be changed (see the manufacturer's specifications for the reference density). In any case, the coolant must be changed at the prescribed intervals, even if the engine is not used.

A Never open the cap of the pressurized cooling circuit when the engine is hot. If it is necessary to carry out checks, unscrew the cap slowly, holding it with a rag soaked in cold water; vent the circuit gradually, stopping during opening.

d. At the scheduled intervals, clean the circuit using an aluminum engine descaler. The operation is performed by replacing the coolant with a mixture consisting of the descaler and water (according to the proportions indicated by the product manufacturer). After a short period of engine operation, it is necessary to replace the liquid again with the prescribed antifreeze.

A The cleaning of the cooling circuit significantly improves the heat exchange between the liquid and the cooling surfaces, favouring the cooling of the engine and the maintenance of the operating temperature.

12-23-02 Emptying

The coolant (ethylene glycol) is a pollutant: do not disperse it in the environment but store it in sealed containers to be given to the collection centres.

Necessary material

1. Basin for collecting liquids of at least 10 litres
2. 7 mm hex socket screwdriver
3. Torque wrench 50 Nm
4. 5mm Allen T-handle wrench
5. Syringe
6. Silicone tube with 4 mm internal diameter and 300 mm length

a. Wait for the engine to cool down to room temperature.

b. Position the aircraft so that all pipes and circuit components are higher than the coolant drain point.

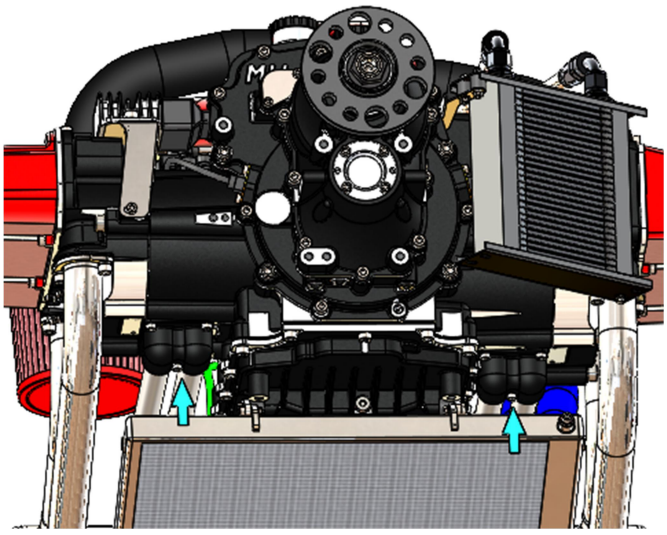
c. Place a pan [1] under the engine to contain the liquid escaping from the engine.

d. Remove the 4 cooling system bleed screws from the cylinder heads.

e. Open the pressurized circuit cap located on the expansion tank (red cap). If the radiator used has a drain plug, remove it; otherwise, using a screwdriver [2], remove the coolant outlet pipe (lower pipe) from the radiator and wait a few minutes for the circuit to empty completely.

f. Close the drain plug and tighten it to the prescribed torque; reposition the tube removed for drainage and tighten the sealing band.

g. Slightly loosen [4] the three fastening screws of the coolant manifold of bank # 1 (right), after having positioned the drip pan under it: the liquid will come out of the engine with some energy. Repeat the operation on bank # 2. If necessary, remove the radiator, the exhaust system, the spark plug cables.



12-30-P

h. When all the liquid has come out, tighten [3 + 4] the three retaining screws to the required torque (10 Nm). Pay attention to the two O rings present between each manifold and the monobloc, which must be correctly positioned.

i. Remove the screw cap of the expansion vessel and aspirate the liquid it contains with a syringe [5], introducing a tube [6] connected to it inside the vessel.

j. Check the condition of the two caps located on the expansion tank: in case of signs of overheating, oxidation on the valve or leakage from the gasket, replace them; in any case, the caps must be replaced every four years.

Avoid starting the engine, even for short moments, in the absence of coolant in the system, as this could cause serious damage to the mechanics.

12-23-03 Check expansion tank

The expansion tank is a fundamental component for the efficiency of the engine cooling system, as it guarantees an adequate amount of coolant in the circuit in all thermal and operating conditions. Failures to the expansion tank are possible following the use of unsuitable coolants or long periods of inactivity and are often a source of engine overheating.

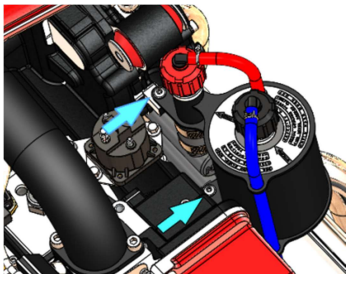
Necessary material

1. 7 mm hex socket screwdriver
2. 3mm Allen key with ball head
3. Weak threadlocker

Disassembly

a. Empty (even partially) the cooling system.

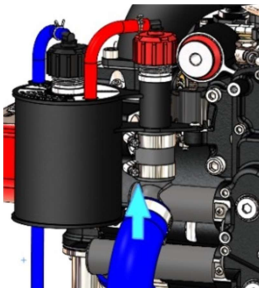
b. Completely unscrew [2] the two screws holding the vessel. These screws are screwed with threadlocker, so a certain force may be required for loosening.



12-31-P

c. Unscrew [1] the clamp from the pipe connecting the expansion tank to the pump inlet manifold

d. Extract the expansion tank from its seat by pulling it upwards.



12-32-P

Control and recovery

Some components of the expansion tank are subject to preventive replacement.

a. Check the condition of the rubber fitting that joins the expansion tank to the inlet manifold to the cooling pump: there must be no visible cracks, swellings or notches caused by tightening the fixing clamp; in any case, replace it at the prescribed deadline.

b. Unscrew both plastic caps: check the integrity of the rubber sealing washer placed inside; also check that, in the internal part of the pressurization cap, the brass surfaces of the valve are not encrusted or eroded: in case of non-compliance and calendar expiration, replace the cap.

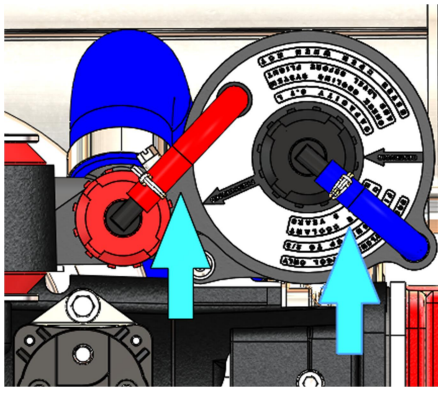
c. Check the efficiency of the valve in the cap with the red tube: when blowing from the tube the air must be able to pass almost freely, when blowing in the opposite direction the air must come out with difficulty.
The valve calibration values are respectively the following:

- filling cap valve opening depression 0.05 bar
- filling cap valve opening pressure 1±0.05 bar

A

The cap with valve maintains the pressure in the cooling circuit: too high pressure values (caused by the failure to open the breather valve) can cause the rubber hoses to detach from the fittings, with consequent loss of the coolant, or damage to the mechanical seal; values that are too low do not ensure the correct distribution of coolant inside the engine and can cause localized overheating or the loss of all the coolant. Keeping the pressurized cap efficient is a fundamental requirement for safety.

d. Check the transfer hose near the rubber holder placed on each cap and check that there are no cuts or weakening of the hose: if necessary, and in any case at the expiry date, replace the hose.



12-33-P

Reassembly

a. Insert the rubber fitting on the expansion tank pipe holder, having previously removed any encrustations with an abrasive sponge. The insertion must be complete, until the base of the expansion tank rests on the anti-vibration mounts.

b. Screw [2] the two retaining screws of the expansion tank, using the thread-locking compound [3].

c. Insert the clamp on the fitting and screw it [1].

d. After the first flight, restore the correct tightening of the sealing bands.

12-23-04 Thermostatic valve and pump manifolds

The thermostatic valve controls the amount of coolant that passes through the radiator: its failure is highlighted by difficulty in heating or by overheating of the engine and can be caused by the use of improper coolants, by impurities in the cooling system or from long periods of inactivity of the engine. In applications with particularly high operating temperatures, the removal of the thermostatic valve can be advantageous: in this way the pressure drops in the cooling circuit are reduced in favour of a lowering of the operating temperature by a few degrees.

If not strictly necessary, avoid removing the thermostatic valve so as not to worsen the thermal regulation of the motor.

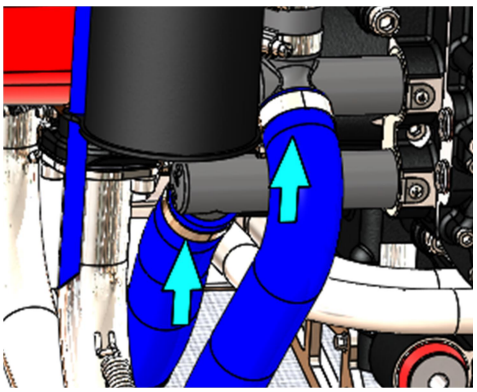
Necessary material

1. 7 mm hex socket screwdriver
2. 2 mm blade screwdriver
3. 4 mm Phillips screwdriver
4. Needle nose pliers
5. Medium threadlocker
6. Vaseline

Disassembly

a. Empty (even partially) the cooling system.

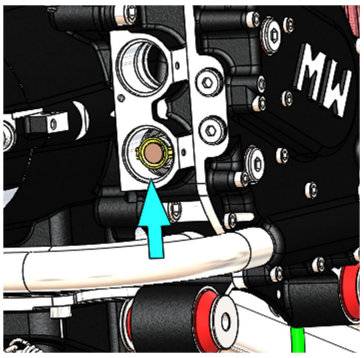
b. Remove [1] the two connecting pipes between the radiator and the engine.



12-34-P

c. Completely unscrew [4] the three screws of the manifold fixing bracket.

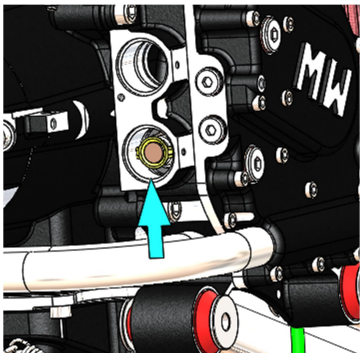
d. Rotate the two collectors by hand and at the same time pull forcefully outwards to extract them from their seat: the collectors can be very forced due to any encrustations and the fact that with use the material they are made of tends to swell. In case of difficulty, spray a descaling lubricant at the mouth of the tubes on the lid.



12-35-P

e. Once the tube has been removed, extract the sealing ring from its seat, which is located inside the hole on the rear cover. To facilitate extraction, use a small screwdriver [2] or a marking tip.

f. Remove [4] the thermostatic valve from the housing on the cover.



12-36-P

Control and recovery

a. Remove any encrustations inside the collector housing using a rag soaked in alcohol. In case of persistent encrustations, use a descaling liquid in moderation, taking care to apply it only locally.

b. Check the service status of the manifolds: in the event of severe fouling, damage to the external surface and in any case within the deadlines set by the calendar maintenance plan, it is necessary to replace them.

c. Check the efficiency of the valve by placing it in a container with water and heating the latter: the valve opening must begin at about 73 ° C; full opening must occur at about 88 ° C. If there is a deviation from these values greater than 5°C, the valve must be replaced.

d. The valve must not have limescale deposits, nor of any other type: in case of negative verification or doubts, it must be replaced.

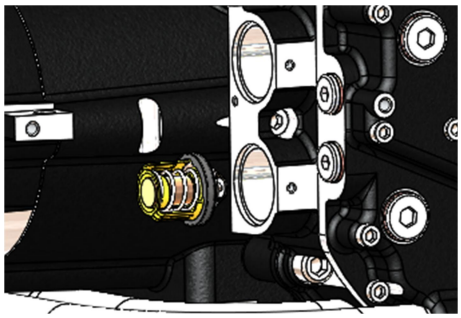
e. If there are many incrustations on the thermostatic valve, it is advisable to proceed with cleaning the cooling circuit: the incrustations in fact greatly worsen the heat exchange, and therefore increase the operating temperature of the engine.

f. In any case, the thermostatic valve must be replaced at the prescribed times.

Reassembly

a. Insert the thermostatic valve into the seat of the outlet manifold from the rear cover (bottom), pushing it up to the stop: pay attention to the direction of insertion, which must be the one shown below.

b. Insert the sealing O-rings of the manifolds into the seats inside the holes: use new gaskets for this purpose.



12-37-P

c. Spread a thread of Vaseline [6] on the external surface of the manifolds and insert them in their respective seats, pushing and rotating at the same time.

d. Position the manifold locking ring nut and tighten [3] the three screws: use the thread locking compound [5] on the thread.

e. Refit the two connecting pipes between the engine and the radiator, tightening [1] the sealing clamps.

g. Fill the system with new coolant, bleeding it before making a flight.

h. After the first flight, check and if necessary restore the correct tightening of the sealing clamps of the connecting pipes with the radiator.

12-23-05 Radiator

To check and maintain the original radiator and fittings, follow the instructions below. In case of use of non-original radiator and fittings, for maintenance and checks it is necessary to follow the instructions of the installer or the aircraft service manual.

Necessary material

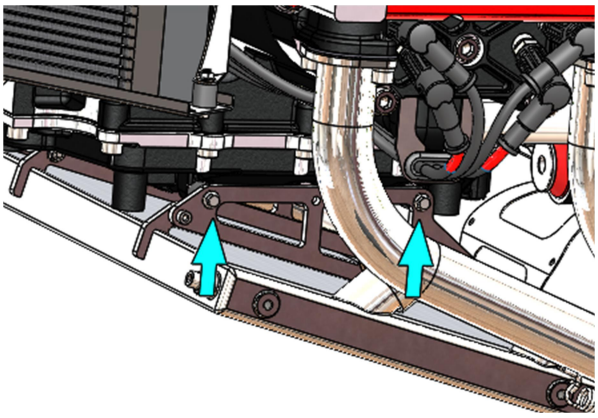
1. 7 mm hex socket screwdriver
2. 3 mm Allen key

Disassembly

a. Empty the cooling system.

b. Remove [1] the sealing clamps of the connecting pipes between the radiator and the engine and the pipes themselves.

c. Unscrew [2] the four screws holding the radiator to the oil pan; you may feel some resistance caused by the final part of the screw engaging the rubber to prevent accidental loosening.



12-38-P

d. Pull the radiator downwards, at the same time removing the connecting pipes from the manifolds.

e. At the scheduled deadlines or if they are deteriorated, it is necessary to replace the anti-vibration elements securing the radiator by unscrewing them from their seat on the oil pan; in case of difficulty, help yourself with a parrot pliers.

Control and recovery

a. Check the external surface of the connection pipes, which must not show swelling or cracks; even in case of doubt, replace the components.

b. Check the internal surface of the pipes and the radiator, which must not have traces of limestone or sandy deposits: otherwise, clean the circuit.

c. Check the fins of the radiator: there must be no dents or signs of impact from foreign bodies.

d. Check the two fixing brackets of the radiator: there must be no notches, a clear sign of fatigue overload; otherwise, replace the component.

e. To clean the radiator core, use a compound for the removal of insects readily available on the market, and rinse thoroughly with water; avoid using pressurized water, which could damage the fragile fins.

f. Check the deterioration of the anti-vibration elements securing the radiator to the sump by bending them downwards by hand: the material must not show variations in colour or surface cracks, nor be cut.

Reassembly

Install the radiator and fittings as described in paragraph 72-20-03 of the installation manual.

12-23-06 System filling and venting

Refer to paragraphs 75-26-00 of the installation manual.

12-24-00 Engine lubrication system

12-24-01 Oil change

A After the first 25 hours of operation, the engine oil must be changed.

For the indication of the recommended engine lubricant, refer to 79-00-05 of the installation manual.

Before proceeding with the oil change, it is advisable to check the level, to get information on oil consumption.

The oil must be replaced after a brief warm-up of the engine, until a lubricant temperature between 40 and 50 ° C is reached: this is necessary to ensure adequate drainage without risking burns or burns due to contact with hot parts of the engine or with the oil itself during maintenance operations. Any leaks must be dried with paper rags and cleaned with alcohol.

The lubricant and its filter are highly polluting: do not disperse them in the environment but give them to the collection centres.

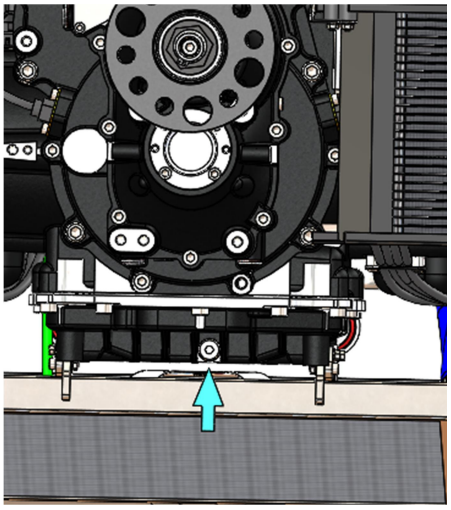
Necessary material

1. 5 litre basin for the collection of fluids
2. Torque wrench 50 Nm
3. 6mm Allen T-handle wrench
4. Oil filler cap tightening tool (X283)

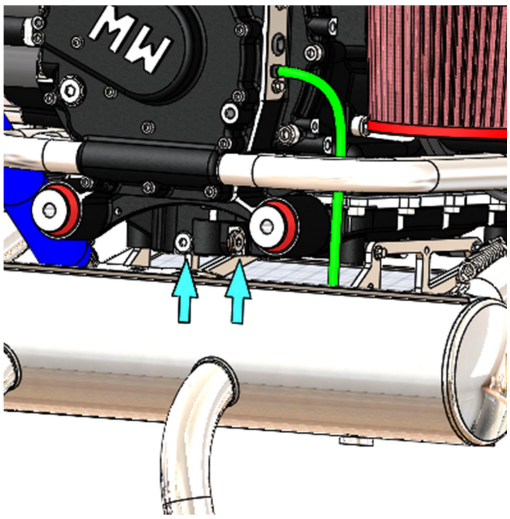
5. Weak threadlocker

a. Place a basin [1] under the liquid drainage points: any leaks must be dried with paper rags and cleaned with running water.

b. There are 3 drainage points on the oil sump: choose the most congenial one to avoid disassembly and contamination.



12-39-P



12-40-P

c. Unscrew [3] the drain plug with magnetic filter.

d. Wait about 5 minutes, so that all the oil in the engine can come out.

The drain plug is equipped with a magnetic filter, necessary to collect metal dust that can develop during the use of the engine, especially during the running-in phase. Observing the accumulation of these powders on the magnet is important to get information on the state of the engine, as described below.

e. Observe the oil removed from the engine: no metal fragments should appear, nor should a silver colour be seen on the surface, a sign of aluminum contamination.

In case of doubts or the obvious presence of foreign bodies in the oil or on the magnetic filter, do not use the engine for any reason and have it checked.

The oil removed from the engine must not be reused for any reason.

f. Screw the drain plug into its seat after replacing the sealing washer and tighten it [2+3] to a torque of 22 Nm and applying the thread locker [5].

g. Change the oil filter as follows after changing the oil.

h. Fill up with oil as described in paragraph 12-10-02 of the present manual. The recommended oil quality, depending on the environmental conditions of use, is given in paragraph 79-00-05 of the installation manual. In case of particularly cold ambient temperatures, heat the oil before introducing it into the engine, to decrease its viscosity and facilitate its flow. The quantities of oil to be added at the oil change are shown in the following table.

Engine oil quantity [cm³]		
	Min	Max
Nominal quantity of the system (with standard OC-m)	3,1	3,6
Quantity present in cup with dipstick	2,4	2,9
Quantity between min and max level	0,50	
Contained in the oil filter	~0,20	
Contained in radiator and OC-m tubes	~0,50	
Quantity at oil and filter change	3	

12-06-C

i. After the oil change and before a flight, it is necessary to carry out a test cycle of the engine on the ground and check the operating pressure and temperature. At the end of the test, carefully examine the engine in search of any leaks or leaks of lubricant from the circuit.

Under no circumstances should the engine be started without oil in the sump or with the replacement work not completed.

12-24-02 Oil filter replacement

After the first 25 hours of operation it is necessary to replace the engine oil filter: in the event of failure to replace it may result in deterioration of performance and damage to the engine.

The oil filter must be replaced when the engine is cold and stopped for at least two hours.

The oil filter is highly polluting: avoid dispersing it in the environment, but deliver it to the designated collection points.

The oil filter must be replaced at each oil change and in any case at the intervals set out in the maintenance program.

Necessary material

1. Wrench for oil filters diameter 80 mm
2. 2 mm blade screwdriver
3. Blotting paper

4. Alcohol

a. Remove the suction unit.

b. Disconnect the sensors connectors on bank # 2 and move the relative branches of the wiring away from the place including the branches below the oil filter.

To facilitate the removal of the filter, it may be convenient, although not necessary, to remove the fittings of the two pipes connecting to the oil radiator.

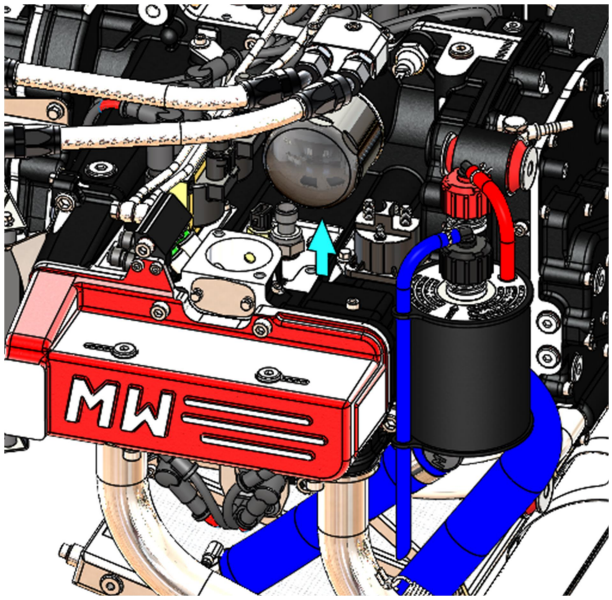
c. Arrange an abundant amount of absorbent paper under the oil filter, to prevent the oil coming out of the filter compartment and from the filter itself from dirtying the surfaces of the engine or the engine wiring. Any oil stains must be cleaned with paper [3] soaked in alcohol [4].

d. Unscrew [1] the filter.

e. Remove the paper towel and clean the area underneath the filter.

f. Clean the contact surface between filter and crankcase with a clean cloth and lubricate the sealing gasket on the replacement filter with a thin layer of lubricant.

g. Screw the new filter into its seat by hand, until friction is felt on the gasket: from the moment of contact to tightening it is necessary to turn at least three quarters of a turn. Only install new filters.



12-41-P

If there are doubts about the actual tightening of the filter by hand, use the wrench, taking care not to damage the sheet metal casing of the filter.

h. Arrange the wiring branches as originally and insert the connectors onto the respective sensors until you feel the safety clip engage.

i. After the engine test that follows each maintenance operation, check the correct tightening of the filter, the presence of any leaks from the gasket and, if necessary, carry out a second tightening.

12-24-03 Oil sump cleaning

At the scheduled deadlines or if suspicious debris has been found on the magnetic filter or in the filter cartridge, it is mandatory to clean the oil sump. The disassembly of the oil pan also allows you to inspect the crank mechanism to qualitatively check the service status of the bench supports, the foot and the connecting rod head, as well as the alignment of the crankshaft.

Necessary material

1. Torque wrench 50 Nm
2. Basin for the collection of fluids of at least 5 litres
3. 5mm Allen T-handle wrench
4. 6mm Allen T-handle wrench
5. 4 mm Phillips screwdriver
6. 12mm socket wrench
7. 17mm socket wrench
8. Hammer with rubber knockers
9. Blotting paper
10. Alcohol
11. Scraper for floors
12. Medium threadlocker
13. Vaseline
14. Remove ether-based spray seals

Removal

It is possible to remove the cup without disassembling the engine from the aircraft only in the case of wall mounting (4 rear attachments); otherwise (bracket attachment), the sump inspection is possible only by removing the engine from the aircraft.

a. Place the aircraft on a stable and horizontal plane, and secure it with chocks placed under the wheels of the main landing gear.

b. If it interferes with the removal of the oil pan, the radiator of the cooling system must be removed; if the CR-m STD kit is used, the radiator must still be removed.

c. Natural aspired engine- If the original exhaust system is used, it is not necessary to disassemble it, both in the case of pulling applications and in the case of pushing applications. If not, the exhaust system may need to be removed.
Turbo Engines – It is necessary in any case to remove the exhaust system, the turbocharger and its lubrication pipes (refer to section 12-27 of this manual).

d. Drain the engine oil.

e. Disconnect the connector of any additional oil temperature sensor.

f. Place a suitable bowl [2] under the engine sump.

g. Unscrew [4] the M8 screws holding the sump to the crankcase.

h. The sump must separate from the rest of the engine along with the internal bulkhead; if necessary, use light hammer blows [8] to remove the gaskets from the sealing surfaces.

Control and recovery

a. Examine the particulate deposited in the cup and on the holes of the strainer: check that there are no residuals of luminescent metal, a sign of premature wear; on the other hand, the presence of sludge consisting of a gelatinous substance impregnated with opaque metal powders is tolerated: these deposits are due to the necessary adaptation of the parts, which occurs above all in the first hours of operation. For an accurate description of the deposits and their meaning, consult table 12-07-C of the present manual.

A If there are deposits that do not correspond to what is described, the engine must be inspected by an authorized service center.

b. It is also possible to inspect the main and connecting rod supports: there must be no obvious signs of overheating, with their characteristic golden colour. Evaluate the play of the connecting rod supports by rotating the crankshaft in such a way as to place each connecting rod, in turn, at the bottom dead center; from this position, push the big end sideways: you should feel a very slight movement, estimated at about 3 hundredths of a millimetre.

c. Clean the inside of the oil pan, the separation bulkhead and the strainer with a rag [9] slightly soaked in alcohol [10].

d. Apply the solvent [14], both on the oil pan and on the counterpart of the base, and remove any gasket residues with a sharp spatula [11], working flat to avoid damaging the sealing surfaces.

e. Turbo Engines - Rotate the turbine oil collection tank so that all the oil inside it comes out: check the nature of the particulate matter (12-07-C), in particular if there is any bronze-coloured debris, which would indicate damage to the turbocharger bearing.

f. Turbo Engines - Clean the tank by introducing alcohol [8] or a small quantity of white petrol into it.

Installation

a. When reassembling, both cup gaskets must be replaced, which are identical to each other. Sprinkle Vaseline [13] on the sealing surfaces to prevent the gasket from sticking.

b. Place the first gasket on the oil pan: pay attention to the direction of assembly, since the shape of the gasket must match that of the sealing surface of the sump. Hold the gasket in place by inserting two locking screws in opposite corners of the cup.

c. Place the oil separation bulkhead on top of the first gasket: also, in this case it is necessary to respect the correct direction of assembly; it is also necessary to apply petroleum jelly [13] on both planes.

d. Overlap the second seal on the bulkhead, respecting the correct direction.

e. Apply petroleum jelly [13] on the sealing surface of the crankcase.

f. Bring the oil pan to the base and screw [4+12] the two screws already inserted, without tightening them.

g. Insert all the screws provided and tighten them [1+4] proceeding from the inside to the outside to a torque of 22 Nm. All screws are the same, and thread locker [12] must be applied to all of them.

h. Turbo Engines – Refit the oil collection tank to the turbocharger by tightening [1+3] the two retaining screws to 10 Nm: apply threadlocker [12] to the thread; insert a new sealing O-ring.

i. Turbo Engines – Refit the turbocharger lubrication lines, fitting new sealing washers (refer to section 12-27 of this manual).

j. Reassemble the exhaust system and the cooling circuit radiator, if they have been removed, following the appropriate procedures.

k. Fill the cooling circuit.

l. Fill the engine with oil.

m. Subject the engine to a ground test and check for any oil leaks or leaks from the gasket.

12-24-04 Check for the presence of particulate matter

At each oil and filter change it is very important to check for the presence of particulate matter in the lubricant accumulated in the cartridge filter and on the magnetic filter placed on the drain plug. On the oil pan there is a second magnetic cap, screwed in the rear area: it is good practice to remove this second cap as well, and also check for the accumulation of particulates on this.

Necessary material

1. White blotting paper
2. Cartridge filter cutting tool

a. After removing the engine oil drain screw, check the amount of deposit on the magnetic filter. The accumulation must not be excessive and must consist only of minute powders with an opaque appearance, and not metal fragments. In the following image on the left there is a normal accumulation of particulates, on the right an excessive accumulation with large fragments.

12-42-P

b. Clean the magnetic filter of the engine oil drain plug with a white paper cloth [1] and wait about 15 minutes, so that the oil can separate from the metal particles by capillarity.

The magnetic filter can only collect ferrous metal particles. As for particles of non-ferrous materials (aluminum, nylon, bronze) it is necessary to inspect the filter material of the oil cartridge.

c. Place the engine oil filter cartridge on the base on another absorbent cloth [1] and let the contents drain for about 15 minutes.

d. Cut [2] the filter cartridge at the base and top, taking great care not to drop metal filings inside the filter, which could alter the control over the particulate.

e. Remove the filter element from inside the oil filter and unroll it on a third sheet of absorbent paper [1], letting the contents drain for about 15 minutes. Check for any metal particles or any foreign element, both on the three sheets of absorbent paper and on the filter element. The particulate must appear with a dark and opaque colour: moving the cloths under the light should not highlight reflective surfaces, not even very small ones.

The following table summarizes the possible finds and their origin, as well as the likely interventions to be carried out to restore the efficiency of the engine.

Find	Origin	Activities
Particles of steel	Distribution gears Distribution chain Piston pin Cylinder liners Drive shaft coupling	Check the gear service status Check chain tension Check the pin and small end Check for seizures Compression check Check play on propeller shaft
Aluminum particles	Pistons Timing chain cover Generator breaker Mechanical moving parts in contact with castings	Compression check Check for seizures Check for any contact between the chain and the castings (marks on the outside of the chain); check chain tension Check breaker-generator tightening Check the main and connecting rod supports and crankshaft support
Bronze particles	Main or connecting rod bearings Connecting rod shoulder washer Free wheel starter Stator winding Pick-up winding Turbo bearings	Check support service status Check crankshaft Check free wheel Check generator Check pick-up integrity Check turbocompressor
Plastic particles	O-rings or oil seals Chain tensioner Base sealing sealant	Check for any leaks of lubricant from the engine Check chain tensioner wear Cup cleaning

12-07-C

Usually a moderate amount of particulate is present in the filter, especially during the first two changes: this is due to the normal adaptation of the mechanical components; the particulate must appear with a dark and opaque colour and must not have reflective surfaces.

In case of doubts about the nature of the findings, it is advisable to mount a new filter and perform a ground engine test: after this test, re-check the filter element, trying to identify and classify the particulate matter found. If a further accumulation of elements of an unclear nature is found, it is necessary to subject the engine to overhaul, before any use in flight.

In case of doubts or evident presence of foreign bodies in the cartridge filter, do not use the engine for any reason and have it overhauled.

The oil filter is a polluting waste: avoid dispersing it in the environment, but deliver it to the designated collection points.

The oil filter is equipped with an integrated bypass valve: even in the event of total obstruction of the filter element, the circulation of lubricant is possible.

12-24-05 Spectrographic analysis of engine oil

The spectrographic analysis of engine oil is a recommended activity in the routine maintenance program, as it allows to anticipate and often resolve operating anomalies in advance, which could become potentially dangerous in case of underestimation.

The spectrographic control is carried out in appropriate analysis laboratories: a sample of the removed oil (about 100cc) must be collected in a container and sent to the laboratory.

Through the spectrographic analysis it is possible to verify which elements are present in the lubricant and in what quantities; furthermore, the residual viscosity is verifiable, that is, after use. This analysis allows you to evaluate the state of wear of the engine or the onset of any overheating, even localized.

It is advisable to carry out a spectrographic analysis of the engine oil and gearbox oil every two oil changes, or more frequently if abnormal residues are identified in the removed oil..

12-25-00 Fuel System

The fuel system is under pressure: use the utmost caution in disconnecting components from the system and limiting the leakage of fuel.

Before carrying out any checks involving fuel spill, disconnect the ground cable from the negative terminal of the battery to avoid any risk of ignition.

Unleaded gasoline contains benzene, a carcinogenic and toxic substance: protect yourself adequately to avoid accidental inhalation and ingestion of fuel during maintenance operations.

Before performing flights following interventions on the fuel system or its components, it is essential to check its perfect efficiency and the absence of leaks.

12-25-01 Check

a. Switch on the booster pump.

b. Check on the appropriate indicator that the fuel pressure, with the engine stopped, reaches at least 3.0 bar.

c. Turn off the fuel pump.

d. After about 1 minute from switching off, check on the appropriate indicator that the pressure in the petrol circuit has remained the same as that read with the pump on, or has dropped to a maximum of 0.5bar. If the drop is greater, it is likely that there is a small leak in the system or that the non-return valve of the fuel pump is damaged.

e. Check the entire circuit that there are no fuel leaks, paying particular attention to the injectors and system eyelet fittings; leaks often generate deposits of an oily nature and green colour, easily identifiable.

f. If there are leaks from the fuel pipes, it is necessary to completely replace the pipes, verifying their suitability for use on injection systems.

12-25-02 System depressurization

Petrol is a pollutant: do not dispose of it in the environment.

In case of interventions on the fuel system it is first necessary to eliminate the pressure: proceed as follows.

Necessary material

1. Torque wrench 50 Nm
2. Key according to the type of fuel connection used
3. Blotting paper

a. Bring the main switch (master) and the injection switches (kill switch) to the closed position; if possible, disconnect the battery from the electrical system.

b. Wrap absorbent paper [3] in quantity around the connection of the fuel supply pipe on the fuel shunt (lower position), in order to avoid jets or dripping of fuel once the tightening screw has been loosened.

c. Loosen [2] the fuel pipe union.

d. Re-tighten [1+2] the swivel screw after replacing the two gasket washers; tighten to the prescribed torque.

12-25-03 FD-m

The procedures for keeping the fuel pumps and filters from the FD-m unit replaced at the scheduled intervals or in case of malfunction are described below.

Replace the fuel filter at the intervals set out in the routine maintenance program: failure to replace it can cause poor performance or sudden engine shutdown.

Necessary material

1. Torque wrench 50 Nm
2. Socket wrench 22 mm
3. Allen key 3 mm
4. Fixed hexagonal wrench 7 mm
5. Fixed hexagonal wrench 12 mm
6. Fixed hexagonal wrench 14 mm
7. Fixed hexagonal wrench 15 mm
8. Fixed hexagonal wrench 21 mm
9. Fixed hexagonal wrench 22 mm
10. Fixed hexagonal wrench 26 mm
11. 6 mm blade screwdriver
12. Scissors
13. Technical Vaseline
14. Weak threadlocker
15. Medium threadlocker

Pump control

In case of doubts about the efficiency of the fuel pump it is necessary to replace it, as the pump is a fundamental component for the operation of the engine and the safe conduct of flight activity.

If the presence of water has been found in the fuel system, the pumps must be checked and replaced if necessary.

Petrol pumps are particularly sensitive to the presence of water in the fuel, as the rolling elements have very narrow tolerances and tend to seize with water. It is therefore very appropriate to equip the fuel system with a special water decanter. Fuel pumps can also be damaged by prolonged idle operation (difficulty in priming the fuel) or by using unsuitable fuel. A final cause of failure of the fuel pumps is due to long periods of inactivity, a circumstance that leads to the degradation of the fuel contained in the pump and the consequent blocking of the pump itself.

Before proceeding with the check, check that the battery is fully efficient and charged.

Operate one fuel pump at a time and check the following.

a. There should be no audible squealing or excessive and irregular noise.

b. The system pressure must be between 3.0 and 3.6 bar.

c. The maximum electrical load must be less than 5.5 A.

d. By removing the power supply, the system pressure must drop to a maximum of 0.5 bar after 10 minutes: otherwise it is likely that the non-return valve is damaged.

Even if the above checks are positive, it is necessary to replace the pumps beforehand at the prescribed intervals, as these components are subject to wear and are also critical components for flight safety.

Filter removal

a. Close the fuel cock.

b. Eliminate the system pressure.

c. Remove power from the electrical system by disconnecting both terminals from the battery (first the negative and then the positive).

d. Loosen the knurled closing knobs of the FD-m unit cover by hand.

e. Remove the cover by rotating it outwards and sliding it downwards.

f. Loosen [10] the two hexagonal nuts fixing the upper fuel duct (out) to the cabinet, keeping the fuel rail still with the wrench [5].

g. Remove [7] the swivel screws securing the fuel duct to the filters, opposing the rotation of the filters with a wrench [8] engaged on the upper operating hexagon of the filter.

12-43-P

h. Remove the fuel duct from the front of the cabinet: above and below it there are gasket washers, which must be replaced upon reassembly.

i. Using the wrench [6] on the lower operating hexagon of the filter, loosen both filters, keeping [7] in position the connection with the fuel pump.

Pump removal

To check the efficiency of the fuel pumps, disassembly from the FD-m unit is not required: they must therefore be removed only if they need to be replaced.

a. Remove the fuel filters as described above.

b. Prevent the rotation of the fuel pump by engaging the wrench [6] on the operating hexagon, and loosen [9] the connection between the pump and the fuel filter.

c. Using the screwdriver [11], remove the two rubber caps placed to protect the pump contacts from their seat.

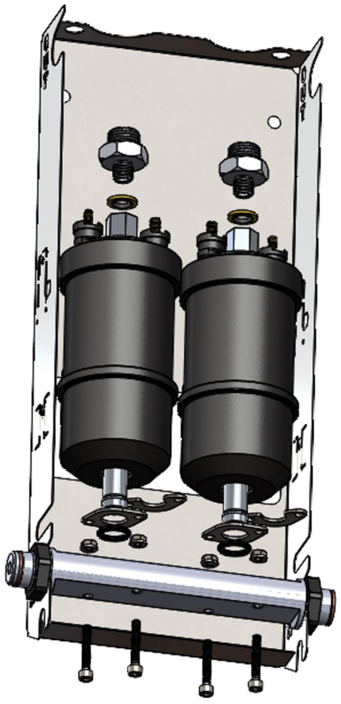
d. Unscrew [4] and remove the electric control cables from the pump.

e. Cut [12] the fastening clamp and remove the pump from the cabinet.

f. Loosen [10] the two hexagonal nuts fixing the upper fuel pipe (out) to the cabinet, holding the fuel rail still with the wrench [7].

g. Unscrew [3 + 4] the tightening ring nut between the pump and the fuel inlet manifold.

h. Slightly rotate the pump forward to release it from the rear support cradle and extract it from



12-44-P

the fuel inlet manifold.

i. Repeat the same operations for the second pump.

Check the fuel filter

The fuel filter must be replaced at the scheduled intervals: do not try to wash it or blow it with compressed air.

In case of doubts about the presence of metal or plastic residues in the fuel system, it is possible to examine the filter material inside the fuel filter, cutting [2] with sheet metal shears the outer casing of the filter itself. Keeping in mind that the flow inside the filter body occurs from the external to the internal surface, check for the presence of particles on the protection grid of the filter material. In the event of heavy accumulation of residues, it is advisable to clean the fuel system and check the efficiency of the fuel pumps before carrying out any activity. The origin of the metal particles is generally the tank or the fuel tap; plastic residues, on the other hand, originate from unsuitable or degraded fuel pipes, from faults to the fuel pump or fuel tap. On the other hand, oily paraffinic residues are attributable to long periods of inactivity, to dirty or degraded tanks (in the case of plastic resin tanks).

If the presence of substantial residues has been found inside the fuel filter, before carrying out any activity it is necessary to check and clean the entire system, to avoid the possibility of sudden engine shutdowns.

Pump installation

Refer to Figure 12-44-P

a. Insert the nylon sealing bands of the two pumps into the appropriate slots at the base of the V-shaped cradle for housing the pumps inside the cabinet. The sealing band must have a length of not less than 220 mm.

b. Screw [9] the middle fitting to the pump, tightening [1+9] to a torque of 25 Nm, interposing a new gasket and applying thread lock [15]: during tightening the pump must be kept in position by engaging a wrench [6] on the operating hexagon on the upper part (near the contacts) of the pump itself.

c. First insert the tightening ring nut and then the rubber gasket on the pump inlet pipe (it must be new).

d. Insert the pump into one of the two housings of the lower fuel rail.

e. Place the sealing ring in the counterbore on the fuel inlet manifold, and lay the tightening ring above it.

f. Overlap the bayonet ring nut, aligning the holes with those of the manifold.

g. Thread the two fixing screws from the bottom and hold them in place with the two nuts.First screw by hand and then tighten [3+4] the fixing ring nut. The tightening must take place at a torque of 4Nm.

h. Repeat the same operations with the second pump.

i. Place the pump inside the cabinet: the pump must be correctly housed in the rear V-cradle, so that the edges of the V are contained between the two ridges on the rubber cap of the pump. Be careful to arrange the nylon strap in such a way that it can be tightened later

j. Tighten the sealing clamps on the pumps, placing the closing point in an area that can be inspected: do not exceed the clamping load.

k. Insert the respective cable lugs on the terminals of each pump: d4 mm for the positive, d5 mm for the negative terminal. Tighten [1+3] the nuts to 3 Nm and 5 Nm respectively.

l. Put the protective rubber caps on the contacts: in case of difficulty, use Vaseline [13].

Filter installation

Refer to figure 12-43-P

a. Hold the pump in position by engaging the wrench [9] on the fitting, and screw the fuel filter, tightening it [1+8] to a torque of 17 Nm: act on the lower operating hexagon of the filter; between the filter and the fitting, place a new sealing gasket and apply the thread locker [14].

b. Repeat the same operations for fitting the second fuel filter.

c. Insert the fuel outlet duct into the slots in the upper part of the cabinet.

d. Manually screw the swivel screws of the fuel outlet duct to the pumps, interposing new gasket washers above and below the holes in the duct; apply the threadlocker [14].

e. Screw [10] the fixing nuts of the manifold to the cabinet: tighten [1+10] to a torque of 10 Nm.

f. Tighten [1+7] the swivel screws to a torque of 17 Nm: tightening must be done while holding the filter with a wrench [8] engaged on the upper operating hexagon of the filter itself.

g. Open the fuel cock and bleed the system.

h. Operate both pumps and check the absence of leaks: carry out the check in an open place, away from open flames or sparks.

i. Reassemble the cover of the pump unit, approaching it to the cabinet from below and then turning it to the closed position.

j. Screw the locking knobs by hand until a slight resistance is felt.

12-25-04 Fuel shunt and pressure regulator

The pressure regulator is installed in the fuel shunt, housed in the rear of the engine, under the upper right engine support. The pressure regulator and the fuel shunt are essential components of the fuel system, and must be checked carefully at the scheduled intervals: any failure of these components can cause irregular operation of the engine, an increase in consumption, fuel leaks. and also, the accidental shutdown of the engine.

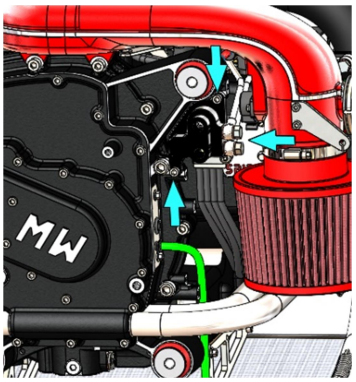
Necessary material

1. Torque wrench 50 Nm
2. 12 mm hex wrench
3. 19 mm hex wrench
4. 24 mm hex wrench
5. 5 mm Allen key
6. 6 mm Allen key
7. Seeger mounting pliers for holes with 1.5 mm pins
8. Vaseline
9. Other tools according to the materials chosen during installation

Removal

a. Remove pressure from the fuel system.

b. Remove [9] the connections of the fuel delivery and return pipes to the tank. In order not to confuse the two branches when reassembling them, it is advisable to mark them, referring to the arrows applied on the shunt.



12-45-P

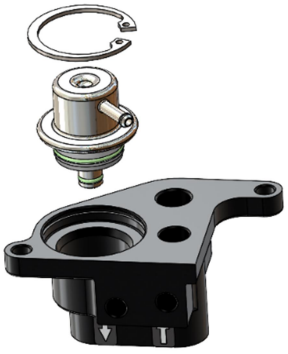
c. Also remove [2] the two swivel screws of the fuel delivery and return pipes to the banks; disconnect the connector of any fuel pressure and temperature sensor.

d. Loosen [5] the two screws fixing the shunt to the base.

e. Remove the fuel shunt from its seat on the crankcase.

f. Using the seeger-lever pliers [7], remove the pressure regulator retaining seeger from the throat.

g. Remove the pressure regulator by hand from the seat on the shunt, pulling forcefully outwards; to facilitate extraction, rotate it, pulling at the same time. Be careful not to dent the regulator body or to bend the fitting for the vacuum intake.


12-46-P

h. Unscrew any pressure sensor [4] and fuel temperature [3]; if there are no sensors, unscrew [6] the caps .

Control and recovery

A The efficiency of the fuel regulator is essential for flight safety: in case of doubts about efficiency, avoid flight activities and submit the component for verification.

The fuel pressure regulator must be checked and replaced if necessary if the fuel pressure with the pump running is not within the prescribed limits. More specifically, a higher pressure than expected almost certainly means that the pressure regulator has

lost its calibration and must therefore be replaced. A lower pressure instead usually originates from an accumulation of residues on the fuel filter or mesh filter installed on the regulator itself, or from a faulty fuel pump.

Before replacing the pressure regulator, check the fuel pump and filter.

The regulator mesh filter can be cleaned with a rag, dipping the regulator in petrol to dissolve any persistent build-up; avoid using compressed air which could damage the control valve and introduce residues inside the regulator.
The fuel shunt can be cleaned, once removed from all its components, by blowing it with compressed air.

Installation

a. Insert the pressure regulator in the seat on the shunt, after having spread the Vaseline [8] abundantly on both sealing O-rings. The introduction must take place without knocks on the pressure regulator, as in this way it is very easy to damage the O-rings: in case of difficulty, help yourself by turning the regulator while applying pressure for introduction.

b. Screw the fuel pressure sensor tightening [1+4] to the prescribed torque (22 Nm); the fuel temperature sensor must be tightened [1+3] also to 22 Nm; both sensor replacement caps must be screwed [1+6] to a torque of 22 Nm; the two caps have different threads.

c. Place the fuel shunt in the seat on the rear cover.

d. Tighten [1+5] the two fixing screws of the shunt to the prescribed torque (10Nm).

e. Rotate the regulator in its seat until the nozzle of the vacuum intake is directed downwards, to avoid the accumulation of water or humidity inside it.

f. Tighten [1+2] the swivel screws of the two fuel delivery and return pipes to the heads. Each tightening must take place at a torque of 22 Nm, placing a copper washer between the head of the swivel screw and the eyelet and between the eyelet and the fixing surface on the shunt. When reassembling, use only new washers.

g. Screw the fittings of the fuel inlet and outlet pipes to the shunt, tightening [1+9] to the prescribed torque and replacing any gaskets present.

Be careful not to interchange the two branches of the fuel circuit; for correct positioning refer to the arrows applied on the shunt body.

h. Install the connectors on any pressure and temperature sensors, making sure the safety clips are hooked.

i. Fill the fuel system.

j. Check for any leaks from the system.

12-26-00 Air intake system

During maintenance operations, pay particular attention to prevent small parts or dirt from falling into the engine through the intake manifold.

12-26-01 Removal

Necessary material

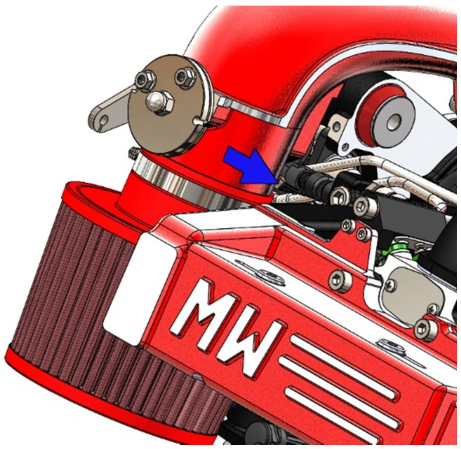
1. 4 mm blade screwdriver
2. 4 mm Allen key
3. 6 mm Allen key
4. 7 mm socket wrench

a. Remove [4] the air filter fixing clamp or the silicone air supply fitting from the intercooler (Turbo engines).

b. Remove the connector from the air pressure and temperature sensor by levering [1] under the retaining clip on the connector itself.

c. Remove the connector from the TPS sensor by lifting [1] the clip located on the sensor itself (12-47-P).

d. Remove the throttle control cable by unscrewing [2] the two retaining screws of the sheath striker bracket (12-48-P) and disengaging the cable lug from the cam.



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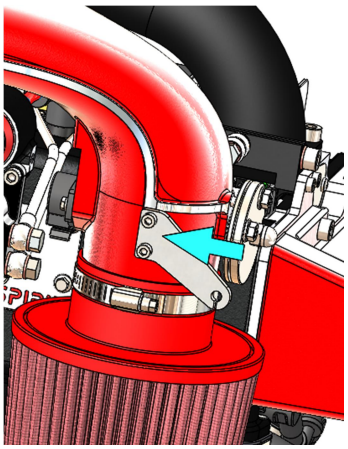
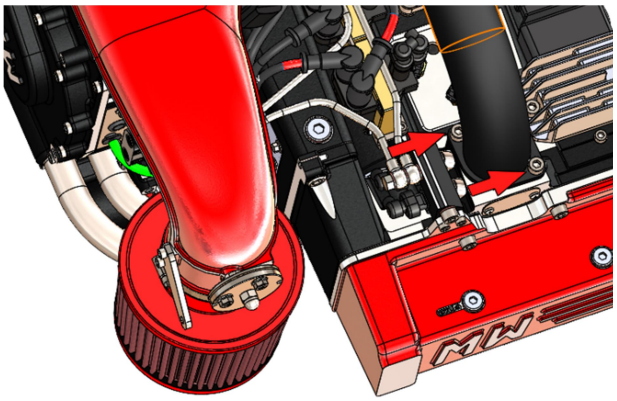


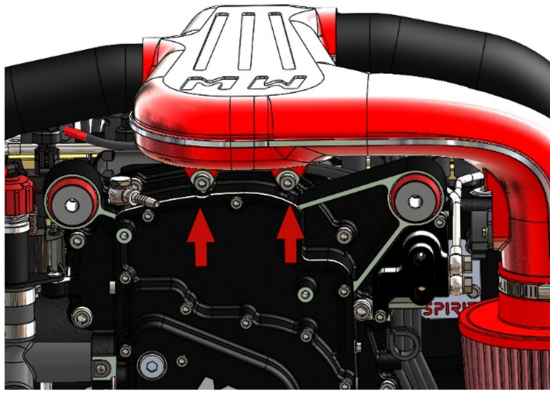
12-48-P

e. Unscrew [3] the two manifolds from the heads, progressively proceeding on both fixing screws. Be careful not to lose the gasket located under the manifold flange (12-49-P).

f. Unscrew [3] the two rear fixing screws of the airbox (12-50-P).



12-49-P



12-50-P

g. Protect the intake port on the head from any entry of foreign bodies, by inserting the appropriate plastic cover [3] or a clean cloth over the throttle valve.

h. Pull each of the two intake manifolds outwards to separate it from the airbox; the coupling is free, with a little friction ensured by the presence of an or in the seat on the airbox. Take note of the position of each manifold to reposition it correctly when reassembling.

If not necessary, avoid moving or extracting the intake manifolds from their respective seats on the airbox.

12-26-02 Reassembly

Necessary material

1. Torque wrench 0-50 Nm
2. 4 mm blade screwdriver
3. 4 mm Allen key
4. 6 mm Allen key
5. 7 mm socket wrench
6. Medium threadlocker
7. Vaseline

Refer to the figures in the previous paragraph.

a. If the two manifolds have separated from the airbox, it is necessary to replace the sealing O-rings inside the airbox: to remove them, pry them with a blade screwdriver [2] inserted in the seat. The new ones must be inserted into the seat and coated with petroleum jelly [7].

b. Insert each of the two intake manifolds in the same seat on the airbox from which it was extracted for about 30 mm: there is no stop. To facilitate insertion, rotate them slightly while pushing them into place.

c. Overlap the suction unit on the heads and keep it in position by slightly screwing [4] the rear screws of the airbox after applying the thread locker [6].

d. Place the two gaskets of the manifolds on the fixing surface placed on each cylinder head, having previously checked their integrity: in case of damage, they must be replaced to prevent the engine from accelerating to idle speed.

e. Insert the two fixing screws in the holes on each manifold after applying the thread locker [6]; in the event that the holes on the manifolds do not match, it is necessary to insert them or extract them slightly from their seat on the airbox.

f. Tighten [4] the manifold screws, starting with the innermost screw and proceeding progressively on both manifolds.

g. Tighten [1+4] the two rear M8 screws of the airbox to a torque of 22 Nm; if the screws do not match the seat on the rear cover, it is necessary to slide the airbox on the two manifolds, in such a way as to center it on the holes.

h. Tighten [1+4] the two screws of each manifold, taking care to check that the surface of the manifold itself reaches the end of the head surface: otherwise, slightly unscrew the rear screws of the airbox; the tightening torque is 15Nm.

i. Engage the connector on the air pressure and temperature sensor mounted on the airbox: check after engagement that the safety spring is correctly engaged on the connector itself.

j. Similarly, mount the connector on the throttle angle sensor, making sure the safety clip is engaged.

k. Screw [3] the support bracket of the throttle control sheath to the airbox and tighten it [1+3] to 6 Nm. A thread locking compound [6] must be applied to the thread.

l. Engage the terminal cylinder of the control cable in the seat on the accelerator cam.

m. Fit the air filter (aspirated engines) or the silicone fitting (Turbo engines) onto the airbox; tighten [5] the clamp

n. After the first ignition and heating, check the tightening [1+4] of the fixing screws and the possible presence of leaks from the gaskets on the cylinder head.

12-26-03 Air filter replacement

Using the engine without an air filter or with an unsuitable filter can cause serious damage and sudden engine shutdown.

Using the engine with a dirty filter reduces the life of the mechanical parts, limits their maximum performance and increases their consumption. If the engine is used in dusty areas, the filter change intervals must be shortened.

In case of washing the aircraft or the engine, protect the air filter from water by wrapping it in a plastic bag tied with an elastic band on the filter itself.

Although the air filter is made of washable material, it should still be replaced to ensure the integrity of the engine.

Necessary material

1. 7 mm socket wrench or blade screwdriver 8 mm

a. Loosen [1] the metal clamp securing the air filter to the airbox (natual aspirated engine) or to the compressor (turbo engine).
b. Pull the filter down to remove it from its seat.
c. When reassembling, insert the filter in its seat.
d. Tighten [1] the sealing band without overtightening to avoid the risk of cutting the filter material.
e. Make sure the filter is installed correctly by trying to pull it out of its position.

12-26-04 Intercooler cleaning

Cleaning the intercooler periodically improves cooling and performance of turbo engines.

Necessary material

1. Socket wrench 7 mm
2. White petroleum
3. Compressor

a. Remove [1] the manifolds from the intercooler, loosening the metal clamps.
b. Introduce a certain quantity of white petroleum [2] into the intercooler and shake repeatedly: this will remove any oily residues that may be present inside the intercooler. Repeat the operation several times.
c. Blow [3] the inside of the intercooler to dry any liquid residues.
d. Wait another 2 hours before reassembling it: if possible, heat the intercooler to 40 degrees, to speed up drying.
e. Reassemble the intercooler in position, tightening [1] the metal retaining clamps.

12-27-00 Exhaust system

Before working on the exhaust system, wait at least 30 minutes from the last start of the engine to avoid severe burns when in contact with hot parts.

The instructions below refer to the original EX-m exhaust system (aspirated engines, par. 1-3) or to the Turbo engine system (par. 4-6). For exhaust systems other than the original, follow the maintenance instructions provided by the aircraft or system manufacturer.

12-27-01 Removal

Necessary material

1. Hook for assembly of tension springs
2. T-handle Allen key from 6 mm
3. Hammer with plastic knockers

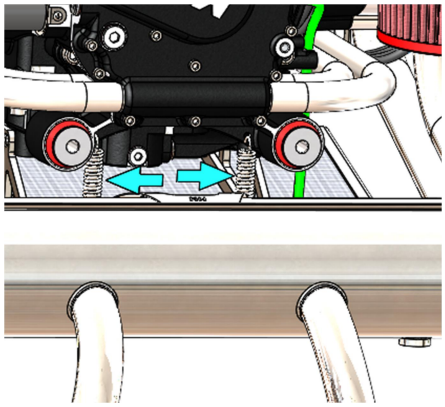
a. Turn the main switch (master) to the off position.

b. If the original radiator (CR-m) is fitted, it does not need to be removed. Otherwise it is possible that to remove the exhaust system it is necessary to first remove the cooling system or parts of it.

c. Unscrew [2] the fixing nuts of the manifolds to the head, starting with the manifolds of cylinders # 2 and # 4, and proceeding gradually. A certain hardness in unscrewing can be caused by the use of thread locker. Below each nut is a lock washer, which can be reused; the gasket between the manifold and the exhaust port must be replaced.

d. Remove the fixing flanges from the studs fixed on the heads and extract the manifolds from their respective seats with the help, if necessary, with light hammer blows [3].

e. Remove [1] the two springs supporting the silencer on the engine. For extraction it is necessary to use a hook or a flat-tip screwdriver to be inserted under the end of the spring inserted in the hole provided on the motor.



12-51-P

f. To complete the disassembly of the exhaust system, it is necessary to remove [1] the four fixing springs of the exhaust manifolds to the silencer.

When reassembling it is advisable to replace all the fixing springs, even if they are apparently in good condition.

12-27-02 Ex-m control and recovery

Exposure to operating temperatures above the limit can produce tensions in the exhaust system near the welded areas, which in the long run will cause cracks or breaks. A good way to determine if the drain works at a suitable temperature is to check its colour: dull grey areas indicate a correct operating temperature of the drain; on the contrary, areas of iridescent bluish dark colour are unequivocally the symptom of an excessive working temperature. If there are cracks or breaks in the exhaust system, it is necessary to replace the damaged component before making new flights.

Before each flight, check that there are no dark-coloured and grainy-looking deposits on the exhaust pipes, silencer or engine heads near the exhaust ports, which would indicate exhaust gas leaks from joints or cracks. Also check that all the fixing springs are in place and under tension.
Any gasket residues present on the manifolds and on the respective seats on the heads must be removed using an abrasive sponge before reassembly, in order to ensure adequate gas tightness.

Using the engine with a damaged exhaust system is potentially very dangerous as the exhaust gases are harmful to inhalation and can cause fainting or death. Avoid any activity, in flight and on the ground if the exhaust system is not in perfect working order.

Any gas leaks from the area of the exhaust flanges must be eliminated as they can cause the spark plug cables to burn, with consequent engine malfunction or shutdown.

During the heating and especially cooling phase of the exhaust system with the engine off, metal clicking sounds are audible: all this is perfectly normal, and is caused by the mutual sliding of the hot surfaces of the manifolds and silencer.

12-27-03 EX-m installation

For the installation of the original exhaust system refer to 78-23-00 of installation manual.

12-27-04 Turbo Engine Exhaust System Removal

Materials needed

1. 5mm Allen T-wrench
2. 6mm Allen T-wrench
3. 7mm Socket Wrench

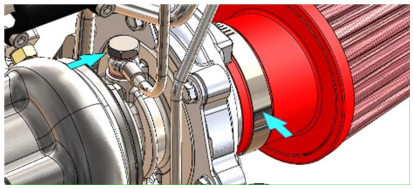
4. 10mm Socket Wrench
5. 11mm Socket Wrench
6. 12mm Socket Wrench
7. 13mm Open End Wrench
8. 14mm Socket Wrench
9. 17mm Socket Wrench
10. Plastic Hammer
11. Permanent Marker

a. Turn the main switch (master) to the off position.

b. If the original radiator (CR-m) is mounted, it must be removed.

c. Unscrew [3] the hose clamp securing the air filter and remove the filter.

d. Unscrew [8] the swivel screw of the oil supply pipes to the turbocharger

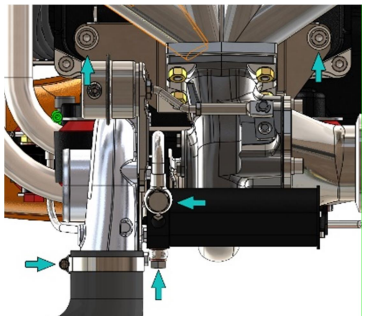


12-52-P

e. Unscrew [3] the hose clamp securing the silicone fitting exiting the compressor.

f. Unscrew [6, 9] the two swivel screws of the oil drain pipes from the turbocharger.

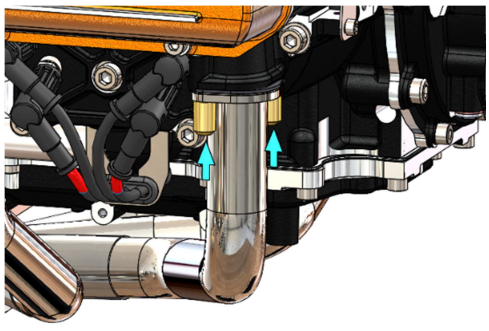
g. Unscrew [2] the two screws from the bracket securing the turbocharger to the oil pan.



12-53-P

h. Unscrew [2] the nuts securing the manifolds to the cylinder head, starting with the manifolds of cylinders #2 and #4, and proceeding gradually. A certain hardness in unscrewing may be caused by the use of threadlocker. Under each nut there is a safety washer, which can be reused; the gasket between the manifold and the exhaust port must instead be replaced.

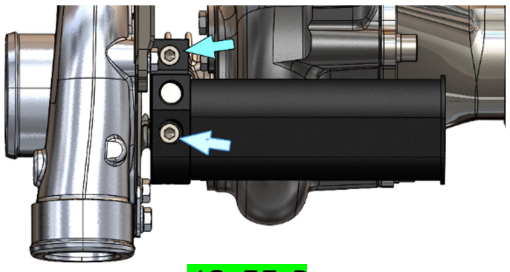
i. Remove the exhaust assembly from the engine



12-54-P

If necessary, completely disassemble the exhaust assembly, proceeding as follows.

j. Unscrew [1] the 2 retaining screws of the turbocharger oil collection tank: underneath each one there is a safety washer, which can be reused; the o-ring that seals the drainage hole must be replaced.

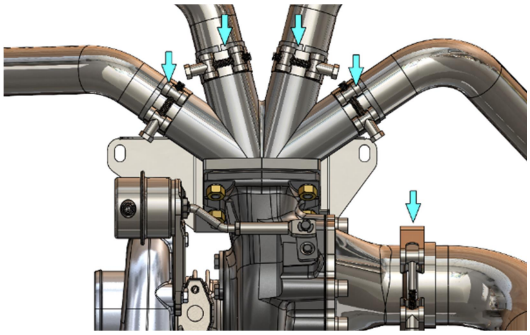


12-55-P

k. Remove the exhaust terminal from the turbocharger, removing [5] the retaining clamp.

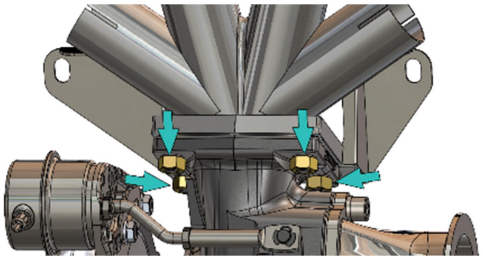
l. Mark [11] the position of each exhaust manifold, to facilitate reassembly.

m. Unscrew [4] the 4 retaining clamps of the exhaust manifolds: to facilitate the extraction of the pipes from the 4-in-1 manifold, rotate them in their seat and help yourself with small blows [10].



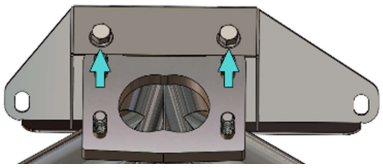
12-56-P

n. Unscrew [7] the 4 union nuts between the turbocharger and the 4-in-1 manifold: underneath each nut there is a safety washer, which can be reused.



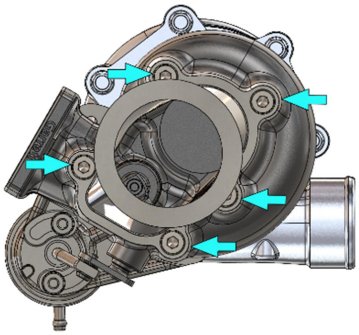
12-57-P

o. Unscrew [4] the 2 fixing screws of the 4-in-1 manifold attachment bracket.



12-58-P

p. Unscrew [2] the 5 fixing screws of the turbocharger exhaust manifold: under each screw there is a safety washer.



12-59-P

12-27-05 Check and restore turbo engine exhaust system

The exhaust system of turbocharged engines is subjected to very strong thermal and mechanical stress during use, and for this reason it is good practice to periodically check its service status.
The most common failure involves cracks in the exhaust manifolds or the unscrewing of the union flange between the manifolds and the turbocharger.
A good way to establish whether the exhaust is working at the right temperature is to check its colour: areas of opaque greyish colour indicate a correct operating temperature of the exhaust; on the contrary, areas of dark bluish iridescent colour are unmistakably the symptom of an excessive working temperature. If cracks or breakages occur in the exhaust system, it is necessary to replace the damaged component before making new flights.

a. Before cleaning, check the contents of the turbocharger oil collection tank, as specified in section 12-24.

b. Check that there is no oil inside the turbocharger, neither on the compressor side nor on the turbine side: if there is, check the engine oil level and blow by. If the problem persists, the turbocharger must be overhauled.

c. Check that there are no strong carbon residues on the turbine impeller, which could alter its dynamic balance: any residues must be removed.

d. Check that the impellers can rotate freely.

e. Check the play of the impellers inside the turbocharger. Move the shaft sideways, acting on the compressor impeller side: a certain play must be felt (about 1 mm in total). Also check that there are no signs of contact between the impeller and the seat, either on the compression side or on the exhaust side: if there is contact, the turbocharger must be overhauled.

f. Check that the Waste Gate valve opens properly by removing the connection pipe to the compressor and introducing compressed air until the control rod moves.

g. Check the levers of the Waste Gate valve: there should be no play between the parts; the valve door should be fixed in the closed position if the rod is in the rest position.

Any gasket residues present on the manifolds and their respective seats on the cylinder heads must be removed using an abrasive sponge before reassembly, in order to ensure adequate gas sealing.

Using the engine with a damaged exhaust system is potentially very dangerous as the exhaust gases are harmful to inhalation and can cause fainting or death. Avoid any activity, in flight and on the ground if the exhaust system is not in perfect working order.

Any gas leaks upstream of the turbocharger can cause a significant drop in performance, and must therefore be promptly removed.

During the heating and especially cooling phase of the exhaust system with the engine off, metal clicking sounds are audible: all this is perfectly normal, and is caused by the mutual sliding of the hot surfaces of the manifolds and silencer.

12-27-06 Turbo engine exhaust system installation

Refer to the figures in paragraph 12-27-04.

Required material

1. Torque wrench 0-50 Nm
2. 5 mm Allen T-wrench
3. 6 mm Allen T-wrench
4. 7 mm socket wrench
5. 10 mm socket wrench
6. 11 mm socket wrench
7. 12 mm socket wrench
8. 13 mm open-end wrench
9. 14 mm socket wrench
10. 17 mm socket wrench
11. Plastic hammer
12. Medium thread lock
13. Strong thread lock

If the exhaust has not been disassembled, skip to step **g**.

a. Place the exhaust manifold against the turbine side flange, inserting a new gasket: tighten [1+3] the 5 screws to 22Nm after applying threadlock [13] and inserting the safety washers.

b. Insert a new o-ring into the oil drain tank seat and screw it [1+2] to the turbocharger: tighten the two screws to 10Nm and use threadlock [12]; insert a safety washer underneath each one.

c. Screw [1+5] the load assembly fixing bracket to the 4-in-1 manifold flange: the screws must be tightened to 10Nm; apply threadlock [12] to the thread.

d. Insert the 4 hose clamps onto the 4-in-1 manifold and then the exhaust manifolds into their respective positions: to make insertion easier, help them with small blows [11], rotating at the same time; avoid tightening the clamps for now.

e. Fit the V-clamp and the exhaust terminal onto the turbocharger exhaust manifold: do not tighten the clamp for now.

f. Join the 4-in-1 manifold to the turbocharger, placing a new gasket between them. Tighten [1+8] the 4 retaining nuts to 22 Nm; apply threadlocker [13] and place the safety washer underneath each nut.

g. Bring the 4 exhaust manifolds closer to the flanges on the cylinder head, placing 4 new gaskets between them: keep the assembly in position, screwing [3] without tightening the two fixing screws of the bracket to the oil sump: the safety washers must be placed underneath and threadlocker must be applied [12].

h. Screw [3] the 2 special nuts of each exhaust manifold gradually, until they are tightened [1+3] at 22Nm: a safety washer must be placed under the nuts and the threadlocker must be applied [13].

i. Tighten [1+3] the two fixing screws of the bracket at 22Nm.

j. Tighten [5] the 4 fixing clamps of the exhaust manifolds, positioning the part with the screw towards the lower part of the engine.

k. Rotate the exhaust terminal to the desired position and tighten [6] the V-clamp.

l. Tighten [1+9] the swivel screw of the oil delivery pipe to the turbocharger at 15 Nm: on the surfaces of the eyelet, place 2 new copper washers.

m. Tighten [1+7] to 12 Nm the swivel screw of the oil vent pipe from the turbocharger tank: place 2 new copper washers on the eyelet surfaces.

n. Tighten [1+10] to 30 Nm the swivel screw of the oil drain pipe from the turbocharger tank: place 2 new copper washers on the eyelet surfaces.

o. Fit the silicone tube of the intercooler on the compressor and tighten [4] the retaining clamp.

p. Fit the air filter on the compressor inlet and tighten [4] the retaining clamp.

12-28-00 Electrical components

12-28-01 Wiring check

A careful and periodic inspection is an important precaution to prevent problems on the electrical wiring. In particular, it is necessary to inspect the wiring before each flight and in any case a few hours after the installation of the engine, to identify any interference between the wiring and the parts of the aircraft.

Necessary material

1. Torque wrench 50 Nm
2. Hex socket from 12 mm
3. Allen key from 5 mm
4. Allen key from 6 mm

a. Inspect all the electrical connectors and especially the condition of the cables coming out of the connectors; the cable must have the usual stiffness and must not show folds, abrasions or overheating; check that all the clips or safety clips are correctly engaged on the counterpart.

b. Check the ground cables, verifying their tightness [1+4] and the state of oxidation: replace them if necessary.

c. Check the tightness [1+2] of the positive power cable on the remote-control switch.

d. Check the generator cables output from the engine and the condition of the cables themselves: there must be no overheating or variations in the colour of the cables, signs of problems with the current regulator or with the connections between the generator and current regulator. If such signs are present, do not use the engine and replace the current regulator and generator.

e. Check that the current regulator connector is correctly inserted on the regulator itself: to facilitate the check, move the rubber cap.

f. Check the spark plug cables and the fit of the pipette on the spark plug: there should be no signs of overheating or abrasion. Remove the pipettes from the spark plugs and check that the contact inside is not oxidized, a sign of incorrect insertion of the pipette on the spark plug nipple: in this case it is necessary to replace the cable and the spark plug.

g. Check that all the fixing points of the wiring to the motor are correctly tightened [1+3].

h. Check that the ring nut of the main connector between the engine and the injection system is correctly tightened.

i. Check the support bracket of the injection control unit group: check that the surfaces are free from notches, blackening, signs of cracks in the material or permanent deformations; also check the condition of the 4 fixing antivibration mounts.

j. In case of removal of the fastening elements for the inspection of the wiring, pay the utmost attention to reassemble them in the same position: a wiring subjected to vibrations or in contact with the surfaces of the motor is a wiring destined to have reliability problems.

12-28-02 Spark plugs

Necessary material

1. Torque wrench 50 Nm
2. Socket for spark plug 16 mm
3. Air compressor
4. Black permanent marker
5. Paper cloth

Removal

a. Remove the spark plug cables by acting on the rubber part of the pipette; you can feel some resistance to detachment, and then pull firmly.

b. Blow with compressed air [3] the insertion area of the spark plugs in the cylinder head, to remove all traces of dirt.

c. If they need to be reused, mark [4] each spark plug, giving the code of the corresponding spark plug lead, so that they can be reassembled in the same position.

d. Loosen the spark plugs with the wrench [2], starting with those of circuit "A". Continue the removal by hand, in order not to risk damaging the thread.

Check

Reading the spark plugs provides valid information on the health of the engine and on the correctness of use. At the prescribed deadlines or in any case in case of ignition anomalies, it is necessary to remove the spark plugs from the engine to check the colour and the distance between the electrodes.
The spark plug reading must be carried out after the engine has been running at cruising speed of at least 15 minutes, avoiding letting it idle when returning to the ground.

- Spark plugs with dark brown and uniform colour indicate a perfect state of efficiency of the engine.

12-60-P

- Spark plugs with whitish colour indicate a probable carburation defect, a too high combustion temperature or imperfect valve seal.

12-61-P

- Spark plugs with dark velvety-looking deposits indicate operating temperatures that are too low: in this case it is necessary to act on the engine cooling system. This discoloration can also be a sign of a dirty air filter.

12-62-P

- Spark plugs with substantial traces of oil indicate a bad condition of the piston rings or a leakage from the valve guide: in this case it is advisable to check the compression of the cylinders. Another cause can be identified in the engine oil level that is too high.

In case of doubts about the efficiency of the candles it is advisable to replace them.

It is possible to find a colour difference between the spark plug of one cylinder and that of another if, before stopping to read the spark plugs, the engine has been running at idle for a few minutes: this difference, if not marked, is all normal.

For no reason clean the spark plugs, or rub them with metal brushes, as they would be irreparably damaged.

After reading, check the air gap between the spark plug electrodes and, if necessary, decrease the distance with small taps on the ground electrode. Values must conform to the following table.

Spark plug gap values	
Electrode distance	0,65 ÷ 0,75 mm
Wear limit	0,9 mm

12-08-C

Installation

If the spark plugs have been removed for reading, when reassembling it is necessary to reposition each spark plug in exactly the same position from which it was removed. At the deadlines set in the maintenance program, all spark plugs and ignition cables must be replaced.
The spark plugs to be used are the same for circuit A (high position) and B (low position) and for all engine models, as shown in the following table.

	All models
Standard	Champion RG6YC NGK CR8EB
Hot climates	Champion RG4HC NGK CR9E

12-09-C

It is not allowed to use spark plugs of a thermal grade and brand other than those prescribed. The use of spark plugs other than those prescribed causes the cancellation of the guarantee and can cause serious damage to the engine.

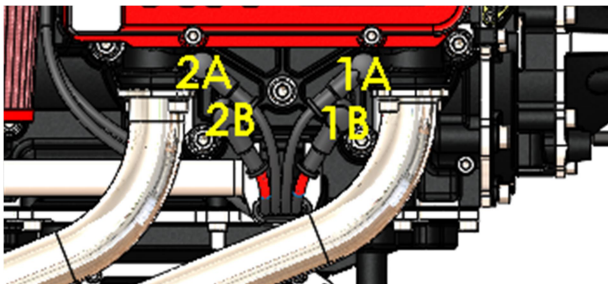
a. Carefully clean [3] the support surface of the spark plug.

b. Screw the spark plug into its seat by hand, starting with the high spark plug, for at least 4 turns; in the event that hardening is felt during screwing, it is necessary to remove the candle and reposition it.

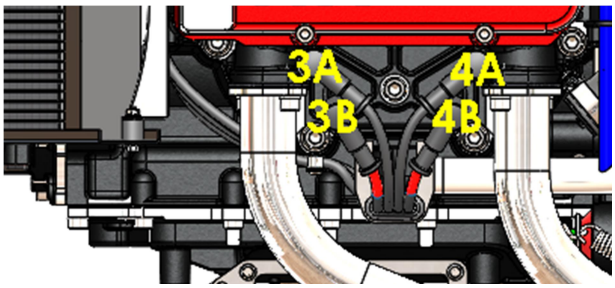
c. Complete the assembly by tightening [1 + 2] to a torque of 15 Nm.

d. Install the spark plug cables on the spark plugs, respecting the numbering on the engine and on the cable itself, and considering that the cables with red marking are those of the auxiliary circuit; the main circuit is called "A", and is attributed

to the spark plugs in the high position; the auxiliary circuit is called "B", and is attributed to the spark plugs in the low position (inclined). Refer to the following figures, valid for bank 1 and bank 2 respectively.



12-55-P



12-56-P

Make sure that each pipette is inserted correctly, until you hear the click with the spark plug nipple: for greater safety, after insertion, lightly pull the pipette outwards to check that it is engaged.

The tightening of the spark plugs must be carried out with the engine cold; after the first hour from repositioning it is necessary to check its tightness.

An important note is the observance of the tightening torque between the spark plug and the cylinder head: the spark plug dissipates most of the combustion heat through the contact on the support surface with the cylinder head.

A Insufficient tightening of the spark plugs can cause them to overheat, with serious damage to the engine; tightening the spark plugs above the prescribed torque can cause the electrode or ceramic insulation to break.

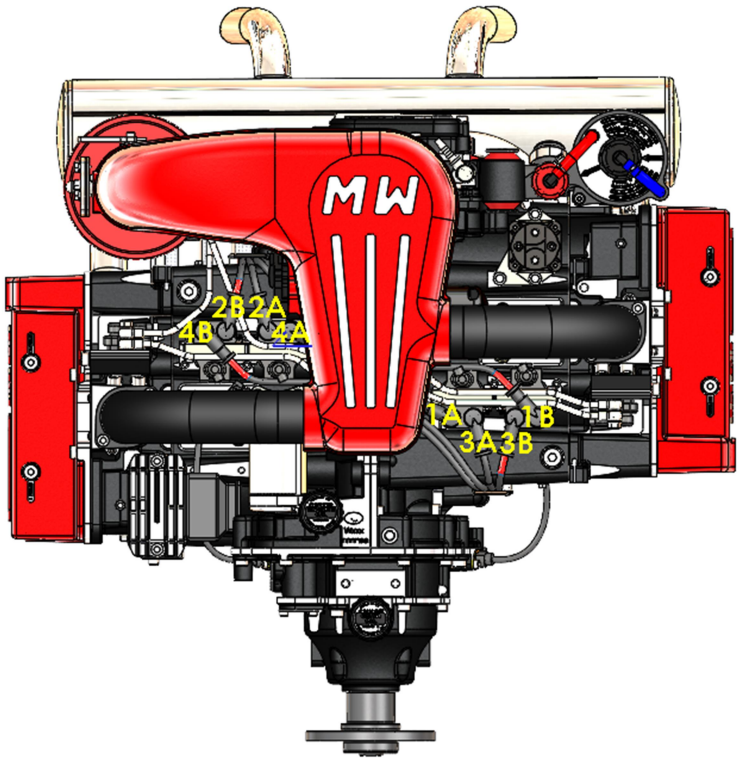
A If a spark plug falls to the ground during assembly, it must be replaced.

A Avoid cleaning with solvents or brushing the candles in order to clean them: it is a useless operation as well as damaging the integrity of the candles. Candles found to be dirty or defective must be replaced without delay.

12-28-03 Ignition coils and cables

The ignition coils and the high voltage cables of the spark plugs are vital components for the engine: damage to these components can cause even serious malfunctions, which can be found in starting difficulties, loss of power, running irregularities and inconsistent performance. In case of doubts or necessarily within the prescribed deadlines, these components must be replaced.

There are 4 ignition coils on the engine, installed in groups of 2 on the banks and fixed to special brackets. The mutual arrangement of the coils and spark plug cables is that shown schematically in the figure.



12-65-P

Necessary material

1. Torque wrench 50 Nm
2. Allen key T 3 mm
3. Allen key T 4 mm
4. Fixed wrench from 7 mm
5. Phillips screwdriver 4 mm
6. Needle nose pliers
7. Medium threadlocker
8. Digital Ohmmeter
9. Technical Vaseline

Removal

a. Remove the suction unit.

b. Disconnect the control connector from each coil by pulling the plastic tab outwards.

c. Remove both terminals of the high voltage cables from each coil, pulling firmly towards the outside.

d. Unscrew [3] the lower and upper coil fixing brackets [3] from the crankcase.

e. If necessary, unscrew [2; 4] the coils from their respective brackets.

f. Extract the high voltage cable pipettes from the spark plugs, pulling hard to release the internal retaining clip.

g. Unscrew [5] the two screws of the spark plug cable passage bracket, fixed on the cylinder head: the screws are also secured with threadlocker, and therefore can be quite tough when unscrewing.

h. Unscrew [2] the two rounded head screws of the brackets for fixing cables to the base, in correspondence with the inspection window of the chain tension: two spacers are positioned underneath them; also, in this case the screws are secured with threadlocker.

i. On bank # 2 alone, the cables are held by a bracket, located in the lower part of the base, in front of the cooling pipes manifold: unscrew [2] the two tightening screws.

j. Note the routing of the high voltage cables and then remove them from the motor.

k. To remove the fixing bracket to the head from the cables, it is necessary to remove the oval rubber cable passage ring from the housing, sliding it towards the central part of the bracket.

Check

a. Check the external surface of the high voltage cables: there must be no notches, cracks or signs of overheating.

b. Check the service status of the fixing clip inside the pipettes for attachment to the coil and spark plug: there must be no signs of oxidation or blackening.

c. Check the coupling of the pipette on a test spark plug: a click should be heard and, pulling the cable slightly after insertion, it must release with some effort. If the graft toughness is insufficient, tighten the clip inside the pipette using pliers [6]; then try the coupling again.

d. Check [8] the impedance of each cable, placing the tester terminals at the two ends of the cables themselves: the measured value must be between 4.5 and 5.5 Kohm, depending on the length of the cable.

e. Check the appearance of the ignition coils: the pack of laminations that surround the plastic body must not be oxidized or separated; the plastic body must not show swellings, colour variations or signs of contact with foreign bodies; the internal part of the high-power cable connection must be copper-coloured, without dark colours, a sign of inadequate contact with the cable.

f. Check [8] the impedance of the coils. Place the instrument terminals on the two coil control contacts: the value must be between 0.8 and 1.2 ohm. Place the instrument terminals between the two outputs of the high voltage cables: the value must be between 7.1 and 7.7 Kohm.

g. Check the condition of the coil fixing and cable fixing brackets: there must be no cracks or dark areas near the bend.

h. Check the condition of the rubber ring passing the spark plug cables inside the head fixing bracket: the surface must not be cracked or overheated; the internal circumference must be free of notches or abrasions; the fixing slot must be

intact. Any replacement must be carried out by removing the spark plug cables from the side of the coil connector (the smallest); to insert the cables into the new ring, use petroleum jelly [9], making sure to arrange the cables flat and respecting the fixing sequence of the spark plug caps on the cylinder head.

Installation

a. Insert the cable fixing ring in the bracket, sliding it from the central part of the slot towards the outside: at the end of the operation, the cables must be arranged in the ring according to the fixing sequence on the head, without crossing.

b. Fasten each cable to the respective spark plug, pressing firmly on the pipette until you hear a click: the cables are printed with the numbering of the cylinder to which they must be connected (refer to figures 12-63-P and 12-64-P); in addition, a red reference identifies the cables of the secondary ignition system (circuit B, spark plugs inclined downwards).

c. Fix [5 + 7] the cable support brackets on the heads.

d. Route the cables behind the cooling pipes on cylinder bank # 1.

e. Fix [2], without tightening, the cables to the lower part of bank # 2, using the appropriate bracket.

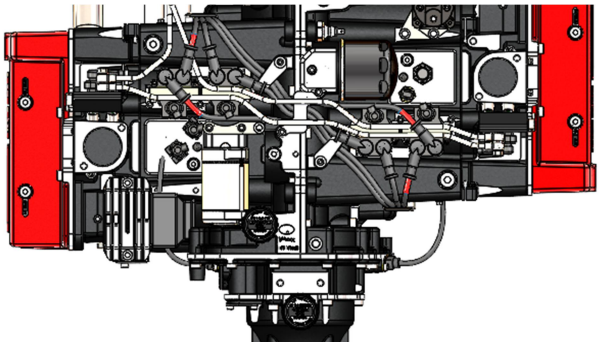
f. Screw [2 + 7], without tightening, the cable fixing brackets to the base in correspondence with the inspection windows of the chain tensioner: the appropriate spacers must be positioned behind the bracket. The cables must be arranged in such a way as not to have crossings from the bracket to the coils.

g. Screw [2; 4] the coils to the support brackets: the coils are all identical, but it is a good idea not to swap their positions. The tightening torque is 3 Nm.

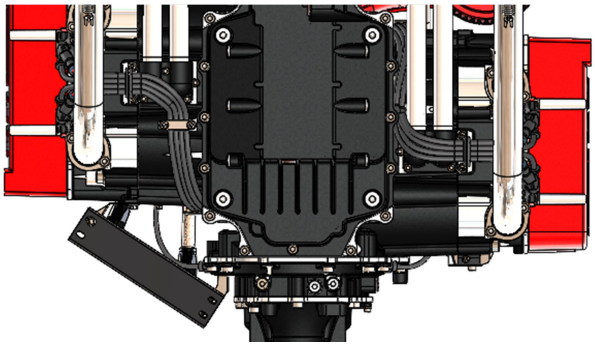
h. Screw [3] the coil brackets to the base: tighten [1 + 3] to a torque of 6 Nm and use threadlocker [7].

i. Insert the respective spark plug cables on each coil, pressing firmly on the pipette until a click is heard and helping the insertion of the protective cap with Vaseline [9]. Respect the layout of the diagram in figure 12-65-P.

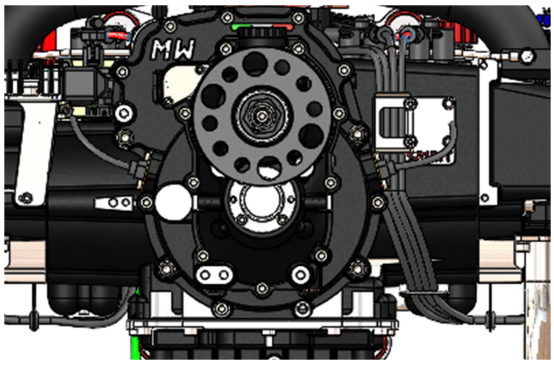
j. Arrange the cables on the castings, so as to obtain an orderly arrangement as in the following figures.



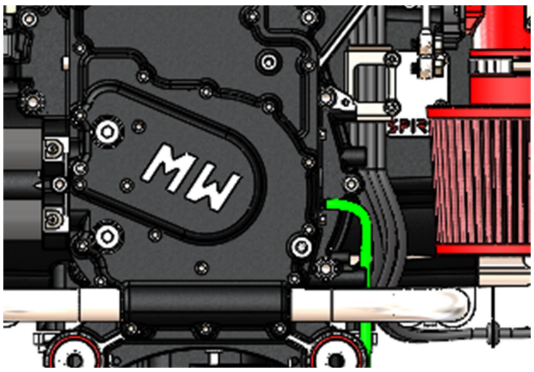
12-66-P



12-67-P



12-68-P



12-69-P

k. Insert the ignition control connectors on the respective coils, making sure that the safety clip is engaged. The connectors with a red marking are to be inserted on the coils of the auxiliary system (circuit B, coils near the head), the black connectors without marking are to be inserted on the coils of the main system (circuit A, internal coils).

l. Reinstall the suction assembly.

12-28-04 Battery and charging system

The recharging system can be damaged in the event of prolonged running of the engine with the battery disconnected from the system: therefore, never disconnect the battery contact with the engine running outside of the pre-flight checks or if not strictly necessary for the safety of flight; also, the disconnection of the connector from the voltage regulator causes serious damage to the generator. Another reason for damage may be the consequence of overheating, due to an installation of the motor that does not guarantee sufficient ventilation to the regulator.

Necessary material

1. Torque wrench 50 Nm
2. Digital tester
3. Blade screwdriver from 6 mm
4. Phillips screwdriver from 4 mm
5. Allen key from 5 mm
6. Allen key T 6 mm
7. Fixed wrench from 13 mm

Check battery charge status

Every 200 hours or in the event of long periods of inactivity, it is necessary to check, in addition to the state of charge of the battery, the operation of the recharging circuit.

A battery in good efficiency increases passive safety considerably as it guarantees a greater number of minutes of operation in the event of a fault in the charging circuit. In case of doubts about the state of efficiency and in any case every four years it is highly advisable to replace the battery.

If during a starting attempt the voltage of the electrical system drops below 9 volts due to the absorption of the starter motor, any further starting attempt is completely useless, as the injection system prevents starting below of the 9 volts.

The resting voltage of the battery at an atmospheric temperature above 10 ° C, measured [2] between the two terminals, must be between 11.7 and 12.3 volts: in case of lower temperature, the voltage drops, evenly consistent (depending on the age of the battery itself). If the battery charge is insufficient, avoid starting the engine: instead, recharge slowly.

Charging the battery releases hydrogen, a highly flammable gas. It is necessary to recharge by placing the battery in a well-ventilated place, lying horizontally and promptly drying any transfer of sulfuric acid, which could affect metal parts.

In case of failure of the charging system (generator and voltage regulator) resulting in overheating of the battery, it is advisable to replace the latter.

It is possible that the battery is damaged even if the voltage value read is within the normal range.

Check the charging system

The current regulator and the capacitor (provided in the system and present within the control unit group) must be replaced in advance within the prescribed deadlines, and in any case in case of doubts about their efficiency.

a. With the engine off, remove the rubber cap protecting the current regulator connector.

b. Observe the incoming cables and the plastic connector body: there should be no variations in colour or appearance in the material, a sign of overheating.

If the operating temperature of the current regulator is too high, it is necessary to modify the ventilation air intakes.

c. Unscrew [5; 6] the two screws fixing the regulator support bracket to the motor.

d. Unscrew [6; 7] the screw with nut fixing the regulator to the bracket.

e. Inserting a screwdriver [3] on the connector side, pry to remove the connector from the current regulator.

f. Check that there are no oily residues on the contacts of the regulator and of the connector: otherwise it is necessary to inspect the sealing system of the generator cable.

g. On the current regulator connector, measure [2] the resistance between the two small contacts on the right in the photo (marked "G") and between one of them and the large contact on the right in the photo (marked "R"): the value must be less than 1 ohm (LE04 value).

12-70-P

h. On the current regulator connector, check [2] that there is no continuity between each of the three contacts located on the right of the photo and the engine ground (1 large contact and two identical small ones).

12-71-P

i. On the current regulator check [2] the resistance between the contacts (marked "~", two small contacts and one large one above): there must be a very high impedance value or no continuity.

12-72-P

j. Check [2] for continuity between the large contacts, corresponding to the "~" and "+B" positions.

12-73-P

k. Finally check [2] that among all the other contact combinations there is neither continuity nor any resistance value.

l. Insert the connector into the regulator housing, first approaching it on one side: push firmly on the opposite side until you hear a click to ensure locking.

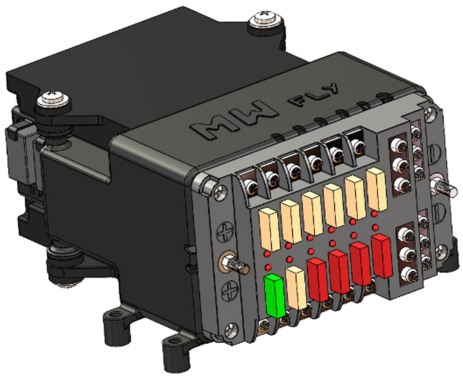
m. Put the rubber cap back in the correct position, fitting the lip of the cap underneath the connector.

n. Screw [1+6; 7] the regulator to the support bracket, tightening the screw on the nut to a torque of 15 Nm.

o. Screw the regulator support bracket to the motor and tighten [1 + 5; 1 + 6] the screw above 15 Nm and the screw below 10 Nm.

12-28-05 IJ-m

The breaking of a fuse or the detachment of a breaker, even if signalled by the diagnostic system, does not necessarily cause an evident malfunction of the engine, due to the redundancy of the electrical system, which could mask the failure. It is therefore good practice to always apply the pre-flight redundancy check procedures that highlight any failure and check the status of the IJ-m injection and ignition control unit assembly at the deadlines set by the maintenance program.

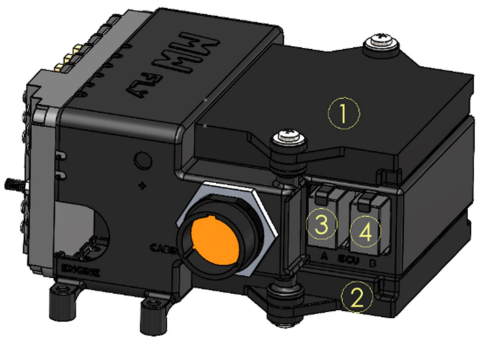


12-74-P

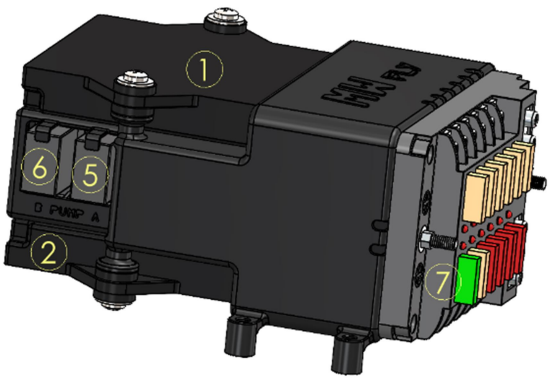
Necessary material

1. Phillips screwdriver from 3 mm
2. Antioxidant for electrical circuits
3. Needle nose pliers

Check components



12-75-P



12-76-P

1. Master ECU (ECU A)
2. AUX ECU (ECU B)
3. Main relay ECU A
4. Main relay ECU B
5. Main fuel pump relay (Pump A)
6. Aux fuel pump relay (Pump B)
7. Fuses Consolle

a. Check that all component fixing screws [1] are tight.

b. Set the master switch to the on position.

c. Check that all the LEDs on the fuse console are off: if not, replace the blown fuse, as shown below.

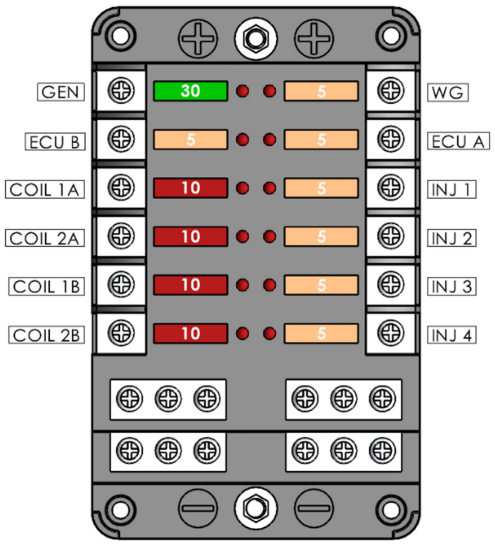
d. Start the engine and, once warmed up, disconnect the main fuel pump breaker: after a small drop, the fuel pressure should return to the value before switching off; the engine should still continue to run.

System fuses

The fuses of the IJ-m group have the purpose of preserving the components of the injection system from electrical overloads or short circuits; they are collected in a console clearly visible above the IJ-m group.

The breaking of a fuse is signalled by the lighting of the red LED located next to it.

The fuses present in the fuse console are listed below, together with their disconnection value.



12-77-P

Do not change the value of the fuses or breakers, so as not to cause unnecessary overloads in the electrical system or accidental disconnections, a source of potential danger.

Function	Value [A]
GEN = generator	30
ECU B = circuit control unit B	5
COIL 1A = coil #1 ignition circuit A	10
COIL 2A = coil #2 ignition circuit A	10
COIL 1B = coil #1 ignition circuit B	10
COIL 2B = coil #2 ignition circuit B	10
WG = Waste Gate turbo	5
ECU A = circuit control unit A	5
INJ 1 = injector #1	5
INJ 2 = injector #2	5
INJ 3 = injector #3	5
INJ 4 = injector #4	5

12-10-C

a. Turn on the master switch and check that all the diagnostic LEDs on the fuse console mounted on the control unit are off: otherwise the fuse in correspondence with the signalling LED on must be replaced.

b. Turn off the master switch.

c. Remove the protective cover of the fuse holder by releasing the safety clips.

d. Remove the damaged fuse by pulling [8] upwards.

e. Spray the contacts of the fuse holder with the spray [7].

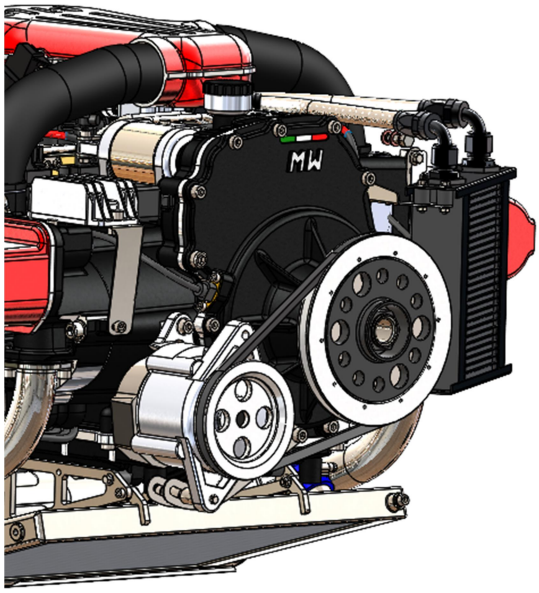
f. Insert the spare fuse in the housing, pushing down.

g. Refit the fuse holder cover and secure it with the safety clip.

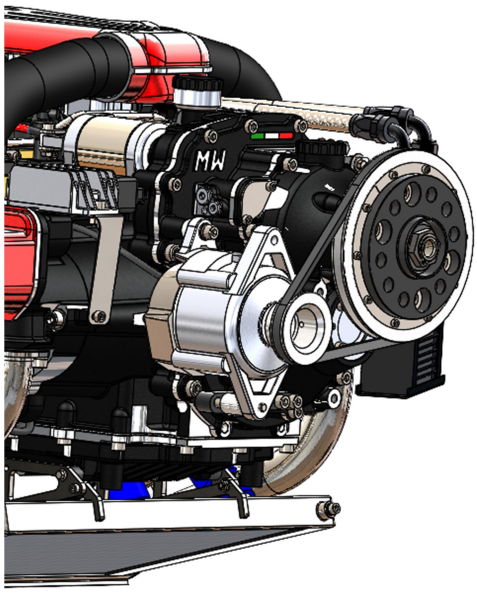
If the electrical system is well made, breaking a fuse is never accidental: always investigate the causes that determine it.

12-28-06 AG-m

If the AG-m auxiliary generator is installed, the adjustments described below must be made at the deadlines set by the maintenance program. The procedure is valid for both direct (12-78-P) and PSRU (12-79-P) versions.



12-78-P



12-79-P

Necessary material

1. Torque wrench 1 ÷ 10 Nm
2. Torque wrench 20 ÷ 100 Nm
3. 3 mm Allen key
4. 6 mm Allen key
5. 13 mm fixed wrench
6. Medium threadlocker
7. Sockets in relation to the type of propeller mounted

8. Nitro thinner

a. Check [1+3] the tightening of the union screws between pulley and half-moon on the propeller flange; for this operation it may be necessary to remove [7] the propeller. The prescribed torque is 3 Nm.

b. Remove [5] the safety nut present in the protruding part of the lower screw.

c. Slightly unscrew [4] the upper fixing screw of the generator.

d. Also unscrew [4] the lower locking screw.

e. Rotate the generator inwards, so as to cancel the tension of the belt.

f. Remove the belt from the two pulleys.

g. Clean [8] the tracks of the two pulleys from the rubber residues of the belt.

h. Check the integrity of the pulleys.

i. Check the condition of the belt: there must be no abrasions, fraying or overheating. In any case, the belt must be replaced at the due dates.

j. Fit the belt over the two pulleys.

k. Tension the transmission belt by moving the generator outwards: a correct tension is the one that allows the belt to have a maximum deflection of about 8 mm in the intermediate part.

l. Once the correct voltage has been found, tighten [4+2] the upper screw of the generator and then [5+2] also the lower one; for both the prescribed torque is 22 Nm.

m. Screw [5] the supplied nut to the protruding part of the lower screw, and tighten [5+2] to 22 Nm keeping the screw in position with a second wrench.

n. If the screws are removed, the thread locker [6] must be applied to all threads before tightening.

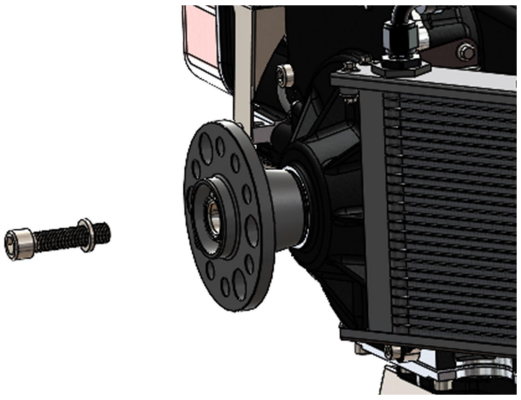
Threadlocker [6] must be applied to all threads before tightening.

12-29-00 Transmission

12-29-01 Direct engine tightening

This paragraph is applicable only to models **not** equipped with a speed reducer.

In engines with direct transmission, it is necessary to check the tightening of the fixing nut of the propeller flange and of the union screw between the front cover and the crankshaft at the scheduled deadlines: the latter is housed inside the propeller shaft.



12-67-P

Necessary material

1. Torque wrench 300 Nm
2. 12 mm Allen key with extension
3. 36 mm socket wrench
4. Propeller flange locking lever (X290)

5. Medium threadlocker
6. Burin D3 mm

It is necessary to get help from a second person.

a. Remove the propeller [5], according to the instructions provided by the manufacturer.

b. Insert the supplied bushings into the tool [4] and into two adjacent holes of the propeller flange.

c. Keeping the lever [4] in position, check [1+2] the tightening torque of the union nut of the propeller shaft with the crankshaft: the correct torque is 180 Nm.

d. If the screw is removed or replaced, a thread locking compound [5] must be applied to the thread; under the head of the screw, the lock washer must be inserted, which can be reused.

e. Keeping the lever [4] in position, check [1+3] the tightening torque of the fixing nut of the propeller flange: the correct torque is 290 Nm. Also check that there are no marks at the base of the keying between the flange and the propeller shaft of overheating.

f. In the event that the nut has moved, it is necessary to redo [6] the safety marking of the nut on the propeller shaft.

12-29-02 PSRU engine tightening's

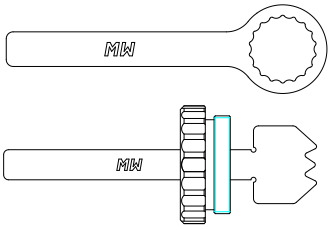
This paragraph is applicable only to models equipped with a speed reducer.

A The use of propellers with inadequate structural rigidity can cause dangerous vibrations in the transmission system, with consequent damage to the gearbox.

A If you hear an increase in the noise of the reducer, you must abandon the flight and carry out a check in an authorized service center.

Necessary material

1. Torque wrench 300 Nm
2. Socket wrench 19 mm
3. Allen key T 4 mm
4. Allen key T 5 mm
5. Allen key T 6 mm
6. Allen key T 12 mm
7. Socket wrench 32 mm
8. Oil filler cap tightening tool (X283)
9. Locking tool for reducer (X327)

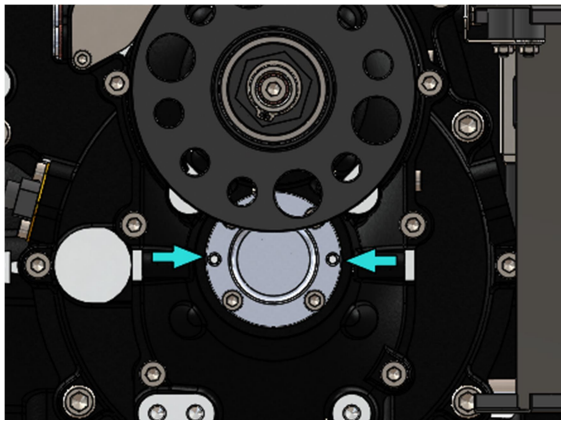


10. Technical Vaseline
11. Medium threadlocker
12. Weak threadlocker

a. Remove the gear oil.

b. Remove [8] the reduction gear oil filler cap. Insert the comb of the tool [9] into the gearbox oil supply compartment and screw the fixing ring nut by hand: if the comb does not fit properly and causes difficulties in screwing the ring nut, move the propeller shaft slightly.

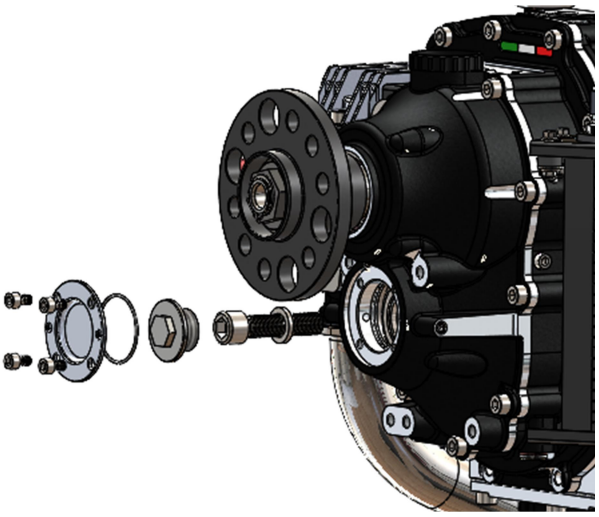
c. Remove [4] the four screws joining the pump cover. The extraction is facilitated by screwing [3] into the two threaded holes provided with two M5 screws with a minimum length of 30 mm. If the propeller governor is mounted, remove the two impellers and the pump body from the compartment by hand and then the governor pump body, screwing [3] two M5 screws with a minimum length of 30 mm into the two threaded holes provided.



12-68-P

d. Unscrew [2] the special bearing tightening screw; if the governor is installed, instead of the special screw there is the governor pump shaft, which must be unscrewed [2].

e. Inside the lower reducer shaft check [1 + 6] the tightening of the union screw between the reducer shaft and the motor shaft: the correct tightening is 180 Nm.



12-69-P

If the screw is tightened less than that prescribed, the screw itself must be replaced.

f. If the screw is removed or replaced, a thread locking compound [11] must be applied to the thread; under the head of the screw, the lock washer must be inserted, which can be reused.

g. Screw and tighten [1+2] the bearing tightening screw or governor pump shaft: the prescribed torque is 120 Nm.

h. Replace the sealing O-ring located on the compartment cover. In the case of governor motors replace the O-rings from the governor body and pump cover as well as the one placed inside the reducer itself.

i. Apply Vaseline [10] to the gaskets and insert the pump body into the pump compartment, respecting the direction: the narrowest part of the diffusers must be inserted downwards.

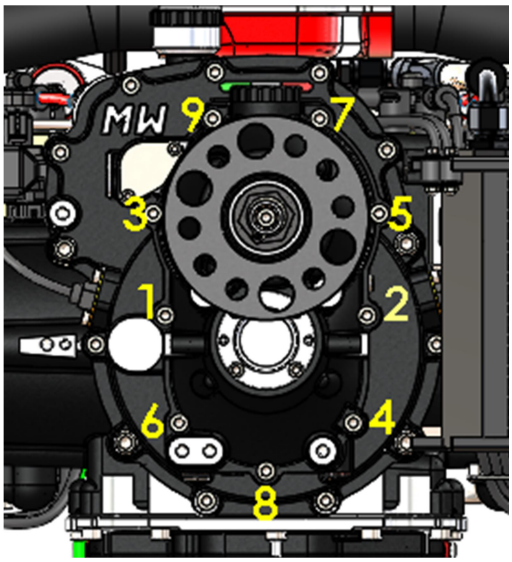
j. First insert the external impeller in the compartment on the pump body, then mount the internal impeller on the pump shaft.

k. Generously apply petroleum jelly [10] on the sealing ring of the pump cover to keep it in position, and fit the latter onto the impellers; the cover does not have a preferential mounting direction. In the case of motors not equipped with propeller governor, place the cover on the compartment; also, in this case there is no preferential mounting direction.

l. Tighten the closing screws of the pump cover or the pump compartment cover to a torque [1+4; 12]: the torque to be applied is 10 Nm.

m. ~~Check [1+7] the tightening of the propeller flange retaining nut: for the check it is not necessary to remove the safety seeger. The prescribed torque is 290 Nm. Also check that there are no signs of overheating at the base of the keying between the flange and the propeller shaft.~~

n. Check [1+5] the tightening of the 9 union screws between the cover and the reducer body in the order indicated in the figure: the prescribed torque is 25 Nm.



12-70-P

If loose screws are found, they must be removed, replaced and tightened to torque, using medium-strength threadlocker. Then the tightening check on the remaining screws must be repeated.

In case of loosening of the screws, before performing a further flight, it is necessary to check the balance and tracking of the propeller; when using variable pitch propellers, it is also necessary to check the keying error between the blades.

o. Remove the tool [9].

p. Fill the gearbox with oil.

q. Screw the gear oil cap by hand.

12-29-03 Oil change

After the first 25 hours of operation it is necessary to change the engine oil.

For the indication of the recommended engine lubricant refer to 61-03-00 of the installation manual.

Before proceeding with the oil change, it is advisable to check the oil level, to obtain information on oil consumption.

The oil must be replaced after a brief warm-up of the engine, until a lubricant temperature between 40 and 50 ° C is reached: this is necessary to ensure adequate drainage without risking burns or burns due to contact with hot parts of the engine or with the oil itself during maintenance operations. Any leaks must be dried with paper rags and cleaned with alcohol.

The lubricant is highly polluting: do not dispose of it in the environment but give it to the collection centres.

Necessary material

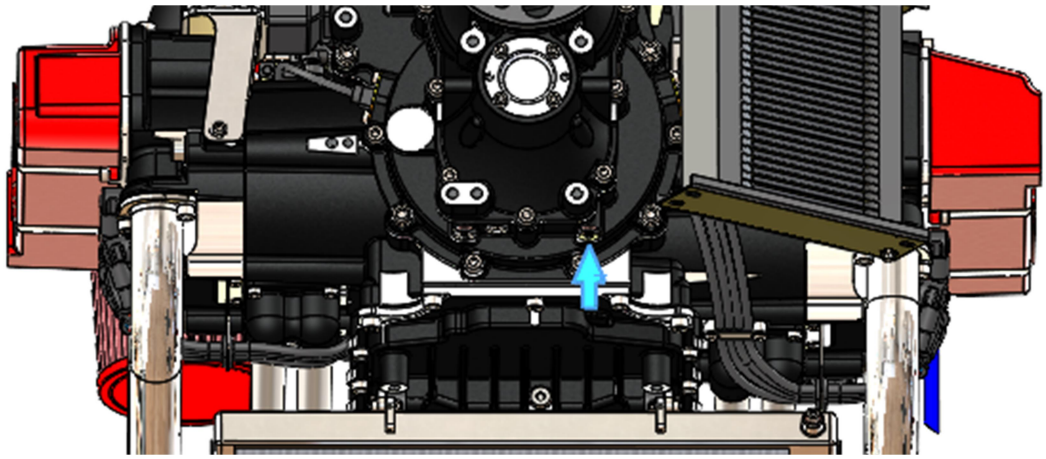
1. 2 litre basin for the collection of fluids
2. Torque wrench 50 Nm
3. Allen key from 6 mm
4. Oil filler cap tightening tool (X283)

5. Weak threadlocker

a. Place a basin [1] under the liquid drainage points: any leaks must be dried with paper rags.

b. Unscrew [4] the oil filler cap located on the top of the reducer.

c. Unscrew [3] the drain plug located in the lower part of the reducer and collect the oil at the outlet. Wait about 5 minutes, so that all the oil in the reducer can come out.



12-71-P

Pay the utmost attention to avoid getting burned with hot oil.

The drain plug is equipped with a magnetic filter, necessary to collect metal dust that can develop during the use of the engine, especially during the running-in phase. Observing the accumulation of these powders on the magnet is important to obtain information on the state of the gearbox gears, as described below.

A The oil removed from the gearbox must not be reused for any reason.

A Under no circumstances should the engine be started without oil in the gearbox or with the replacement work not completed.

d. Screw [3] the drain plug into its seat after replacing the sealing washer and tighten it [2+3] to the prescribed torque (22Nm), applying thread locker [5].

e. Fill up with oil as described in paragraph 12-10-03 of the present manual. The recommended oil quality, depending on the environmental conditions of use, is given in paragraph 61-03-00 of the installation manual. In case of particularly cold ambient temperatures, heat the oil before introducing it into the engine, to decrease its viscosity and facilitate its flow.
The quantities of oil to be added at the oil change are shown in the following table.

Gearbox Oil Quantity *[cm³]*	
Quantity without governor	400
Quantity with governor and HydroPitch propeller without spacer	550
Tolerance level	±50

12-11-C

f. Observe the O-ring on the filler cap: in case of damage, it must be replaced.

g. Screw the gear oil cap by hand.

h. After an oil change and before a flight, an engine test run on the ground must be performed. At the end of the test, carefully examine the gearbox to identify any leaks or leaks of lubricant from the caps.

12-29-04 Check oil fiter VPP

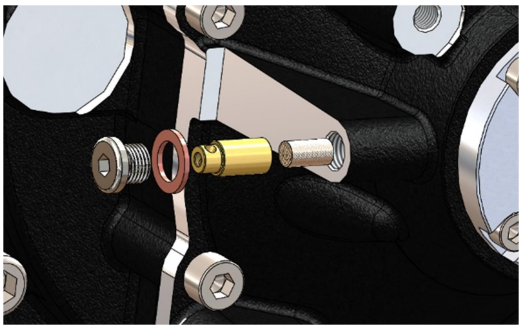
If you use the constant speed hydraulic governor, there is a wire mesh filter in the gearbox, which must be inspected and cleaned when changing the oil.

Required material

1. Torque wrench 0-50Nm
2. Allen key 3mm
3. Allen key 5mm
4. White absorbent paper
5. Compressed air
6. Nitro thinner
7. Permanent marker
8. Weak threadlocker

a. Unscrew [3] the filter compartment closing cap.

b. Screw [2] an M4 Allen screw into the thread on the brass filter holder for about 5 turns; remove the filter holder from its seat.



12-85-P

c. Clean [6] the visible surface of the filter and mark it [7]: when reassembling, the filter must be repositioned inside the filter holder in the same direction.

d. Tap the filter on the absorbent paper [4] to facilitate the release of the mesh filter from inside; if the filter does not come out, simply continue to screw the extraction screw into the filter holder.

e. Observe the nature and amount of particulate collected on the paper: normally there is only a few small pieces of aluminum debris at the first oil change after installing the PVV.

f. Clean [6] the filter and blow it [5] to remove impurities. If the filter is deformed or frayed, it must necessarily be replaced.

g. Reinsert the filter inside the filter holder respecting the original direction.

h. Insert the filter holder into the seat on the reducer and tighten [1+3] the cap to 12Nm; threadlock [8] must be applied to the thread.

12-29-05 Check magnetic filter

Necessary material

1. White blotting paper

At each oil change it is very important to check for the presence of particulate matter in the lubricant. The accumulation must not be excessive and must consist only of minute powders and not of metal fragments. In the following image on the left there is a normal accumulation, on the right an excessive accumulation with evidence of large metal fragments.

12-86-P

It is possible to carry out an inspection on the ferrous particulate matter by cleaning the magnetic filter with a white paper cloth [1], and waiting about 30 minutes, so that the oil can separate from the metal particulate by capillarity. The particulate must appear of a dark and opaque colour: moving the cloth under the light should not highlight reflective surfaces, not even very small ones. If the accumulation of particulate matter is excessive, or if there are reflective or large surfaces, it is necessary to check the service status of the transmission gears and bearings of the reducer. For maintenance and checks on these parts, refer to the specific paragraphs.

In case of large accumulation of particulates on the magnetic filter, avoid flying before having carefully inspected the gearbox.

12-29-06 Spectrographic analysis of oil

The spectrographic analysis of the reducer oil is conducted in a completely similar way to that reported in paragraph 12-20-10 of this manual.

It is advisable to carry out a spectrographic analysis of the engine oil and gearbox oil every two oil changes, or more frequently if abnormal residues are found in the removed oil.

12-29-07 Vent control

The gearbox is equipped with a relief valve set at 0.3 bar, which discharges the overpressure generated by the heating of the gearbox oil and the consequent release of gas inside it in the crankcase. It is necessary to check the functionality of the breather at the scheduled deadlines and in the event that there is an excessive consumption of gearbox oil.

Necessary material

1. Oil filler cap tightening tool cod. X283

2. Air compressor with gun and adjustable pressure gauge
3. Microfiber rag

a. Unscrew [1] the gearbox oil filler cap.

b. Check that the engine crankcase breather is within reach to check the air outlet.

c. Adjust the compressor pressure to 0.2 bar.

d. Insert the compressor gun on the inlet of the filler cap located on the reducer.

e. Roll the rag [3] around the compressor gun so that it forms a seal between the gun and the hole.

f. Introduce air into the reducer through the gun: with this pressure the bleed valve must remain closed and therefore no air must escape from the crankcase breather.

g. Adjust the compressor pressure to 0.4 bar.

h. Introduce air into the reducer through the gun: in this case, air must come out of the crankcase breather.

In the event of negative feedback, it is necessary to remove the gearbox from the motor and replace the breather valve.

12-29-08 Gear gap control

Necessary material

1. Rigid meter
2. Oil filler cap tightening tool cod. X283

a. Rotate the propeller by hand in the direction of normal operation, to identify any hardening or abnormal noises: it is necessary to make at least a couple of turns, trying to apply constant pressure on the blades.

b. Check the integrity of the propeller shaft output oil seal on the reducer: there must be no oil leaks. If the oil seal is damaged, the reducer must be dismantled.

Damage to the propeller shaft output seal is usually due to insufficient cooling.

c. Verify, by acting on the propeller flange, the total absence of axial and radial play of the shaft. A more accurate check is possible by removing the reduction unit from the motor and verifying that the drive shaft is also free from radial and axial play.

d. Perform a general smoothness test using the methods described in paragraph 12-22-07 of this manual: check in accordance with table 12-05-C whether any hardening found is attributable to damage to the reducer. If in doubt, it is necessary to check the smoothness of the gear rotation, after having removed the reducer from the engine. The test must be carried out by manually rotating the drive shaft (lower) for about ten turns: the rotation must be fluid in every position, without jamming or excessive play; also move both the drive shaft (lower) and the duct (propeller shaft) axially, to check the absence of any axial play.

e. Apply a light load to the end of a blade with your hand along the plane of rotation of the propeller, first in one direction, then in the opposite one, without rotating the crankshaft: in this way it is possible to measure [1] the play between the gearbox gears. With a cold engine, the movement of the blade tip must be about 1 and a half millimetres, and in any case not exceed three millimetres. The same operation must be repeated approximately every 10 degrees up to a complete turn: there should be no significant variations in the play on the propeller.

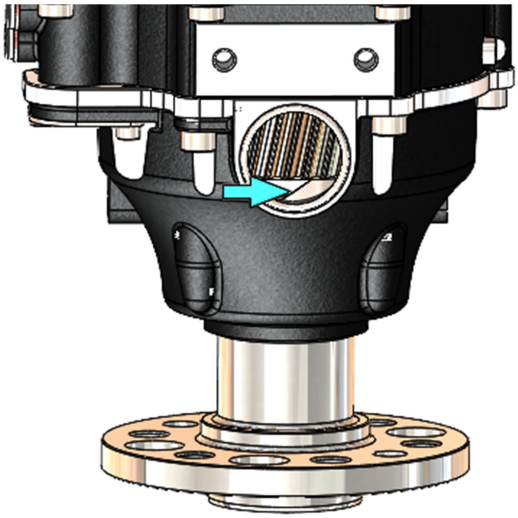
In the event of considerable play, roughness or variation in the smoothness of the rotation of the propeller, the reducer must be overhauled.

Avoid rotating the propeller in the opposite direction to that of travel, as this could damage the automatic tensioning system of the timing chain or the starting system.

f. Perform the endoscopic inspection of the reducer as described in paragraph 12-22-08 of this manual.

g. Unscrew [2] the oil filler cap, located on the top of the reducer, and visually assess the condition of the contact surfaces on the driven gear (propeller gear): they must be free from cracks, pitting or yellowing and have a uniform and shiny appearance; check various points of the gear up to complete a complete revolution.

h. Through the same hole, check the state of the sliding surfaces of the damping system: there must be no colour variations or burns. The check must be made on the 3 different sliding surfaces.



12-73-P

12-29-09 Damper torque control

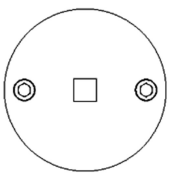
The procedure is applicable only on some engines, depending on the year of construction.

The check must be carried out with a cold and horizontal engine, after the first 25 hours of operation and at least every 100 hours.

Using the engine with improperly adjusted damping system can cause serious damage to the drive system and propeller.

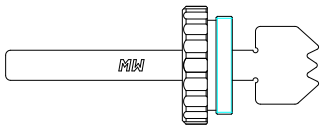
Necessary material

1. Reversible torque wrench 500 Nm
2. Propeller shaft rotation key



3. Oil filler cap tightening tool (X283)

4. Locking tool for reducer (X327)



5. Specific tool for removing the propeller

a. Remove the propeller [5], according to the instructions provided by the manufacturer.

b. Remove [3] the reduction gear oil filler cap.

c. Insert the comb of the tool [4] into the gearbox oil supply compartment and screw the fixing ring nut by hand: if the comb does not fit properly and causes difficulties in screwing the ring nut, move the propeller shaft slightly.

d. Rotate [1+2] the propeller flange in the opposite position to normal rotation, in such a way as to bring the torsional damping system to the end of its stroke on one side: in this phase the torque wrench [1] must be adjusted to 300Nm. In the event that no rotation is felt despite having exerted the torque of 300 Nm, it is likely that the mechanism is already in the end position on this side.

e. Adjust the key [1] to a torque of 150Nm and try to rotate it in the opposite direction to the previous one.

If the propeller moves before hearing the click on the key [1], the reducer must be overhauled, as the damping system is out of the minimum adjustment range

A damping system whose slip torque is below the minimum prescribed causes difficulty in starting the engine.

With 10 Nm increments of the wrench setting [1], try again: the damping system is correctly adjusted if its slip value is between the minimum and maximum values indicated in the following table.

Damper slip limits	
Minimum torque	200 Nm
Maximum torque	330 Nm
Max-min difference on the stroke	40 Nm

12-12-C

The torque can undergo a variation during the angular stroke, following the friction of the first detachment: the maximum acceptable difference is shown in the table. The torque to be considered to evaluate the efficiency of the system is the minimum one measured during the angular stroke.

f. Remove the tool [4] and screw the filler hole cap back on by hand.

g. Reinstall the propeller [5] following the manufacturer's instructions.

12-30-00 Unscheduled maintenance

The checks to be carried out in the event of the contemplated use and operating anomalies are described below, without exhausting either the possible anomalies or the possible remedies to be implemented to resolve them.
After performing the following unscheduled checks, a ground engine test must be performed.

The checks and replacements listed below must be completed and interpreted in a more restrictive manner if the maintenance technician's experience, common sense or particular findings recommend it.

12-31-00 Warnings and checks for use in extreme climatic conditions

- Using the engine in desert areas or areas with a strong presence of dust causes premature wear of many components: in these cases, it is recommended to intensify the frequency of periodic checks. In particular, every 25 hours check the condition of the air filter, the radiator, the accelerator control.
- Using the engine in particularly humid areas or in a marine environment causes oxidation of some parts of the engine. Every 50 hours check the condition of the head screws and washers, the fixing screws of the motor and propeller, the propeller shaft. Every 50 hours spray antioxidant conductive oil on the contacts of the main connectors, the control unit connector and the current regulator. Halve the replacement frequency of spark plugs. Prevent the air filter from coming into contact with water and, if necessary, protect it with a bulkhead.
- The use of the engine in areas with a very hot climate or for long climbs may make it necessary to use larger cooling radiators. Carefully take care of the ventilation of the fuel supply system, to prevent the onset of vapor lock phenomena. Properly cool the injection control unit (if installed in the engine compartment) and the current regulator with air intakes, to avoid exceeding the maximum operating temperatures. Use lubricants and spark plugs suitable for the operating conditions.
- Using the engine in cold climate areas can cause premature deterioration of the rubber or plastic parts. Check the pipes and connections of the cooling and fuel circuits, the caps of the expansion tank and the anti-vibration elements. In the case of cold starting after long exposure to very low temperatures (below -10 °

C), there may be a slight leakage from the propeller shaft oil seal and from the breather pipe of the mechanical seal: if the leak persists even with the engine hot it is necessary to replace the sealing parts. Use lubricants suitable for the operating conditions.

- The use of the engine at high altitudes facilitates the onset of vapor lock phenomena when using unleaded petrol, especially if the ambient temperature is high; in this case it is more appropriate to use aviation petrol.

12-32-00 Checks after use outside the operating limits

Good installation and good maintenance are the basis for a safe and long-lasting use of the engine. However, if contingent facts or emergencies force the user to operate outside the permitted limits, before a new use it is necessary to subject the engine to some checks or replacements: it is necessary to identify the cause that generated the anomaly, after which the must check the integrity of the engine and all its components. Before having finished all this, the motor must not be used for any reason.

A All use and operating anomalies must be noted in the engine service logbook.

A After completing the required checks, it is always necessary to carry out an engine test on the ground

12-32-01 Operation with coolant temperature too high

Search for causes

Wait for the engine to cool down for at least 30 minutes and carry out the operations described below.

- Bleed the cooling system.
- Check the coolant level inside the cooling circuit by removing the pressurized cap on the expansion tank (red).
- The liquid must be slightly below the upper edge of the filling pipe: otherwise it is necessary to supplement the level with antifreeze of the same brand and quality present in the cooling circuit.
- Check the quantity of coolant present in the expansion tank by unscrewing the non-pressurized cap (black).
- Replenish any missing liquid with antifreeze of the same brand and quality.
- Check all the pipes of the cooling system for leaks. In particular, check that all the sealing bands are tightened and that none of the rubber fittings present cracks or cuts. If necessary, replace what is not compliant or what may generate doubts regarding integrity.
- Check the correct operation of the thermostat.

- Check the section of the air intakes which may be insufficient for the climatic conditions of the flight.

Damage check

The possible damage is the burning of the cylinder head gasket. Another possibility is the overheating of the mechanics, and in particular of the piston-barrel and connecting rod-pin coupling.

a. Check the absence of water and oil emulsion by unscrewing the engine oil filler cap: the check must be made with the engine warm, as it is possible that, in the first moments of operation, a small amount of water vapor is released from the oil engine even in the absence of damage to the cylinder head gasket.

b. Check for any leaks from the crankcase breather.

c. Check the compression of the cylinders.

d. Carry out an endoscopic inspection of the crankcase to identify any overheating of the piston and the small end.

e. Carry out an endoscopic inspection of the spark plug holes to identify overheating of the valve seats or signs of detonation on the piston crown or on the cylinder head gaskets.

12-32-02 Use with too low coolant temperature

Search for causes

Wait for the engine to cool down for at least 30 minutes and carry out the operations described below.

- Check the correct operation of the thermostat.
- Check the section of the air intakes which could be excessive for the climatic conditions of the flight.
- Check at room temperature if the sensors and liquid temperature indicator show correct values. If in doubt it is necessary to remove the sensors from the engine and carry out laboratory verification or replacement.

Damage check

The possible damage is the seizure between piston and barrel, with the consequent sticking of the piston rings.

a. Turn the propeller by hand to check for the absence of friction higher than the norm.

b. Check the compression of the cylinders.

c. Carry out an endoscopic inspection to identify any seizures on the inner surface of the barrels.

12-32-03 Use with too high engine oil temperature

Search for causes

Usually the too high temperature of the lubricant is the effect of problems created by other causes.

- If accompanied by operation with high coolant temperatures, perform the checks first after "use with too high coolant temperature".
- Check the engine oil level, and if necessary add more.
- Carry out the general smoothness test.
- Check the oil cooler service condition.
- Check that the oil cooler air intake provides adequate air flow.
- Check the condition of the motor shaft with an endoscopic inspection.
- Check that the thermal grade of the lubricant used is correct in relation to the environmental operating conditions.

Damage check

Possible damage is seizure between piston and barrel or between camshaft and seat.

a. Turn the propeller by hand to check for the absence of friction higher than the norm.

b. Replace the engine oil, the filter and check the particulate matter present on the drain plug.

c. Cut the oil filter and check for particulate matter.

d. Check the service status of all the plastic components of the engine, starting with the timing chain tensioning system.

12-32-04 Use with too low engine oil temperature

Search for causes

- Check the section of the ventilation air intakes, which may be excessive for the climatic conditions of the flight. In case of use in a cold climate, consider partializing the inlet of the air intake or the heat exchange surface of the radiator with cloth tape.
- Check the operating temperature of the coolant: if necessary, increase the operating temperature of the cooling system, as a result of which the temperature of the lubricant will also increase.
- Check at room temperature if the sensor and the oil temperature indicator show correct values. In case of doubt it is necessary to remove the sensor from the engine and carry out the laboratory verification or replacement.
- Check that the thermal grade of the lubricant used is correct in relation to the environmental operating conditions.

Damage check

The possible damage is the seizure between piston and barrel.

a. Turn the propeller by hand to check for the absence of friction higher than the norm.

b. Carry out an endoscopic inspection to identify any seizures on the inner surface of the barrels.

12-32-05 Operation with gear oil temperature too high

Search for causes

- Check the oil level in the reducer.
- Hot check the existence of excessive play between the gearbox gears.
- Verify that the air intake provides adequate cooling flow to the gearbox or gearbox oil cooler.
- Check the slip torque of the torsional damping system.
- Check the moment of inertia of the propeller used and any dynamic imbalances.
- Check the state of the reducer breather valve.
- If the original constant speed governor is used, check the correct operation of the overpressure valve of the propeller control circuit and the cleaning of the filter at the pump outlet (refer to the DMA.A01 manual).

Damage check

Possible damage is damage to the gearbox gears, bearings or oil seal.

a. Check the existence and nature of particulates in the gearbox lubricant.

b. Turn the propeller by hand to check for the absence of friction higher than the norm.

c. Carry out an endoscopic inspection through the oil filling hole to check the service status of the gears and bearings.

d. Check that there are no oil leaks in the area where the propeller shaft comes out of the reducer.

e. Carry out the pressure test of the reducer.

12-32-06 Operation with too low engine oil pressure

Search for causes

- Check the engine oil level.
- Check for lubricant leaks at the gasket between cylinder head and crankcase or through the radiator fittings.
- Check the tightness of the oil filter.
- Check that the thermal grade of the lubricant used is correct in relation to the environmental operating conditions.

- Check the correct operation of the sensor and the engine oil pressure indicator. In case of doubt it is necessary to disassemble the sensor from the engine and carry out the laboratory verification or replacement.
- Check the service status of the oil pump.

Damage check

The possible damage is damage to the main and connecting rod bearings.

a. Check the existence and nature of particulate matter in the engine lubricant.

b. Cut the oil filter and check for particulate matter.

c. Check the general smoothness.

d. Endoscopic check of the crankshaft.

12-32-07 Use with too high supply air temperature

Search for causes

- Check the efficiency of the air intake on the engine hood.
- Turbo engines – Check the service status of the intercooler.
- Turbo engines – Check the service status of the BOV valve.

Damage check

The possible damage is the damage of the pistons, cylinders and engine head following detonation or pre-ignition phenomena.

a. Remove the 4 spark plugs of circuit B (lower) and perform an endoscopic inspection to check the service condition of the pistons, liners, combustion chambers and valves of each cylinder.

b. Check the integrity of the head gasket.

12-32-08 Use with Control Units and Current Regulator Temperatures Too High

What is specified below for the control unit group is applicable only if the group itself is installed in the engine compartment.

Search for causes

- Check the sizing of the extractor and the motor ventilation air intake, in relation to the environmental conditions that caused the limit to be exceeded.
- Check for damage to the exhaust system, which could raise the temperature of the engine hood.
- Check the service status of the generator.

Damage check

Permanent damage often occurs, which does not necessarily manifest itself immediately: it is therefore difficult to carry out damage checks that can guarantee long-lasting and reliable operation.

Replace the control unit or the current regulator after removing the cause of the rise in operating temperature.

The replacement must be carried out even if, in the ground tests, no malfunction occurs.

12-32-09 Exceeding the maximum number of revolutions

Search for causes

- Check the data of the propeller used: change the propeller (if with a fixed pitch) or change the keying (if with a variable pitch).
- In the case of using constant speed governors, check their correct operation
- Check the correct operation of the tachometer

Damage check

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If the rpm reached is greater than 200 rpm beyond the maximum expected or if the overspeed time below this threshold is greater than 15 seconds, the engine must be removed from the aircraft and subjected to a complete overhaul.

If the speed reached is less than 200 rpm beyond the maximum set for times of less than 15 seconds, it is necessary to carry out the checks listed below.

a. Check the condition of the big end and main bearings, and the radial play of the big end on the coupling axis.

b. Check the compression of the cylinders.

c. Carry out an endoscopic inspection of the spark plug holes to locate any bends in the valve stems (it is more likely to occur on the exhaust valve). Carry out an endoscopic inspection of the spark plug holes to identify any bends in the valve stems (this is more likely to occur on the exhaust valve).

d. Check the service status of the propeller, and possibly subject it to overhaul in relation to the manufacturer's requirements.

e. Check the crankcase breather.

12-33-00 Checks after use with unfulfilled prescriptions

Below are the checks and any replacements to be carried out if the engine has been used with non-prescribed components or operating fluids. The importance of any consequences cannot be predicted and strongly depends on the time of use: it is therefore advisable to return the engine to the prescribed operating state as soon as possible, having previously carried out the required checks.

The use of the engine with prescriptions not respected must be noted in the service logbook.

All use and operating anomalies must be noted in the engine service logbook.

Use outside of the prescriptions causes the automatic forfeiture of any form of warranty on the engine or its components.

If, after having applied the controls specified below, there are still doubts about the efficiency of the engine, it is necessary to carry out an overhaul.

After completing the required checks, it is always necessary to carry out an engine test on the ground.

12-33-01 Ignition spark plug specifications not respected

Possible damage

- With "colder" spark plugs (higher thermal degree) than prescribed: no permanent damage; it is not necessary to carry out any checks on the engine as the effects will be limited to a more irregular idle speed and gear than usual and a greater ease of soiling of the spark plugs.
- With "hotter" spark plugs (lower thermal degree) than those prescribed: self-ignition could occur, and therefore serious damage to the piston, the head and the cylinder; it is therefore necessary to carry out the checks indicated below.

Checks and remedies

a. Remove each spark plug after having marked it with the reference to the cylinder and the ignition circuit and check for any overheating of the electrodes.

b. Check the inside of the combustion chamber with an endoscope, using the low spark plug seats as the inlet hole (circuit B): inspect the piston crown, especially near the edges, the upper part of the cylinder liner, the head gasket , the valve seats and the valves themselves, the peripheral area of the combustion chamber.

c. Check the cylinder liner walls with an endoscope using the dedicated one on the crankcase as the inlet hole: check the colour of the lower part of the piston crown, which must not show overheating, and the liner walls, which must not show signs of seizure.

d. Check the compression of each cylinder.

e. Check the condition of the big end and main bearings, and the radial play of the big end on the coupling axis.

f. Check the crankcase breather.

g. Replace all spark plugs with the prescribed ones.

12-33-02 Coolant specifications not respected

Possible damage

- Corrosion due to chemical agents of parts of the engine lapped by the coolant (cooling pump, cylinder liners).
- Formation of foam or gelatinous compounds that can affect proper engine cooling.

Checks and remedies

a. Remove the coolant from the engine.
b. Carry out a thorough check of the liquid removed. After letting it rest, look at the bottom of the collection tray: there must be no metal deposits, no aluminum, no ferrous material, no gelatinous compounds or foams; the colour of the cooling fluid must be the same as the new fluid, with a variation only in the shade.
c. Check the inside of the radiator inlet and outlet with an endoscope: also, in this case, check for the absence of deposits or corrosion.
d. Examine the bottom of the expansion tank caps: there must be no deposits or signs of corrosion.
e. Perform an endoscopic check of the cylinder liners, crankshaft and valves: look for signs of overheating, even localized.
f. Wash the cooling system with running water.
g. Fill the cooling system with a liquid of the prescribed quality.

12-33-03 Engine oil specifications not respected

Possible damage

- Seizure or premature wear of piston and barrel.
- Seizure between pin and connecting rod.
- Seizure or severe wear of the main and connecting rod supports.
- Seizure between camshaft and seats.
- Seizure between secondary shaft and seats.
- Turbo Engines - Turbocharger failure

Checks and remedies

a. Check the general smoothness.
b. Remove the oil from the engine.
c. Remove the oil filter.
d. Perform the particulate check on the oil drain plug and filter.

e. Check with an endoscope the walls of the cylinder liner and the pin using the dedicated hole on the base as the inlet: check the walls of the liner, which must not show signs of seizure; check the service status of the pins and the colouring of the connecting rod end, which must not show signs of overheating.

f. Check the condition of the big end and main bearings, and the radial play of the big end on the coupling axis.

g. Turbo rngines - Check the service condition of the turbocharger.

h. Check the crankcase breather.

i. Replace the filter and engine oil with one of a quality and thermal grade recommended for the conditions of use.

j. During the ground test, at various speeds, check the correspondence of the oil pressure and temperature values with those prior to the use of improper oil: there should be no significant differences in pressure at the same temperature.

k. Carry out a second oil and oil filter change and the magnetic filter check after 10 hours of use.

12-33-04 Gearbox oil specifications not respected

Possible damage

- Damage or premature wear of the gear teeth.
- Damage or premature wear of the torsional damping system.

Checks and remedies

a. Check the damper slipping torque: in particular, check whether hardening or large variations in the measured torque exceed the maximum acceptable difference during the angular travel of the mechanism.

b. Remove the gear oil.

c. Check the particulate matter retained by the magnetic filter.

d. Check the service status of the driven gear through the oil filling hole, by rotating it for one complete revolution: in no point should you find signs of premature wear, overheating, or damage from exceeding the specific pressure (pitting).

e. Insert an endoscope inside the reducer using the oil filling hole and inspect the service status of the driving gear: in no point should you find signs of premature wear, overheating, or damage from exceeding the specific pressure (pitting).

f. Replace the gear oil with a quality and thermal grade oil recommended for the conditions of use.

g. Carry out a second oil change and check the magnetic filter after 10 hours of use.

12-33-05 Fuel specifications not respected

It is potentially very dangerous to use non-prescribed fuels as they could cause an unwanted engine stop.

Possible damage

- Detonation
- Seizure between valve and valve guide
- Seizure or blockage of fuel pump
- Injector damage
- Premature degradation of fuel lines

Checks and remedies

a. Completely empty the tanks and clean the fuel circuit.
b. Replace the fuel filter.
c. Using the specified fuel, check the main and auxiliary fuel pumps.
d. Carry out the ground test: in the event of anomalies in the power supply or in the idle speed, clean, and if necessary replace, the injectors.
e. Replace all spark plugs.
f. Replace the plastic pipes of the fuel circuit if the manufacturer's specifications do not provide for the use of the incorrectly used fuel.
g. Check the inside of each combustion chamber with an endoscope, using the low spark plug holes (circuit B): identify any signs of detonation or self-ignition on the piston crown, on the combustion chamber or on the edge of the exhaust valves; check the integrity of the head gasket.
h. Introduce the endoscope through the intake and exhaust ducts: check the absence of seizures on each of the intake and exhaust valves.
i. Insert the endoscope through the dedicated hole on the base: check the colour of the lower part of the piston crown, which must not show overheating.
j. Check the compression of each cylinder.
k. Check the crankcase breather.
l. Check the condition of the big end and main bearings, and the radial play of the big end on the coupling axis.

12-33-06 Moment of inertia and loads on the propeller shaft higher than allowed

Possible damage

- Overload damage to the gear teeth.
- Overload damage to the gearbox bearings.

Checks and remedies

a. Replacing the gearbox ball bearings.
b. Magnaflux control on the gears: complete overhaul of the gearbox.

12-34-00 Checks for anomalies

In addition to malfunctions that affect some functions or the running of the engine itself, the following events can be considered anomalies.

- Accidental impact of the propeller against the ground
- Excessive vibrations
- Difficulty starting
- Irregular running at idle
- Reduction of the maximum power (of the maximum revolutions with a fixed pitch propeller)
- Excessive noise
- Unwanted shutdown of the thruster
- Excessive consumption of engine oil
- Excessive consumption of gear oil
- Excessive accumulation of particulates on the magnetic filters of the motor and gearbox
- Excessive consumption of coolant
- Presence of water in the engine oil

Never underestimate the importance of small anomalies, which could be a sign of much more important failures.

12-34-01 Accidental impact of the propeller against the ground

In the event of a light impact on turf, with the engine at idle or with the engine RPM below 2500, carry out the following checks.

a. Check the integrity of the propeller according to the procedure indicated by the manufacturer.

b. Also inspect other engine accessories, such as radiator and cooling fittings, fuel lines, engine mount, etc., which may have been subjected to stress in excess of the maximum allowed.

c. Check the engine for damage or for any detachment of components: in the event of non-compliance, it is necessary to repair or overhaul the engine, depending on the anomalies found.

d. Carry out the general check of the smoothness of the motor.

e. Check the condition and clearance of the gear reducer gears, both with a cold engine and with a hot engine: check the toothing for cracks or abnormal wear.

f. Check the slip torque of the torsional damping system.

g. Carry out a thorough ground test: pay attention to the possible presence of abnormal vibrations or noises.

h. After the ground test, change the oil and engine filter and check for the presence of particulate matter.

i. After the ground test, change the gearbox oil and check the magnetic filter of the gearbox.

j. Perform all maintenance checks provided by the aircraft manufacturer.

In the case of an impact of the propeller with the ground at a rotation speed higher than 2500 RPM, the engine must be overhauled.

12-34-02 Excessive vibrations

- If excessive vibrations occur in flight with air temperatures below 15 ° C, it is possible that they are due to the formation of ice in the intake system: increase the power output, favouring low rpm at high MAP in case of using variable pitch propellers in flight.
- If the vibrations occur immediately after starting the engine, turn it off and on again, taking care to keep the throttle lever in the minimum position.
- Perform static balancing of the propeller as specified by the manufacturer.
- If the vibrations occur at a certain number of revolutions, also check the dynamic balancing of the propeller.
- Check and, if necessary, replace the spark plugs.
- Check the slip torque of the torsional damping system
- Checking the throttle position sensor.
- Checking the air pressure and temperature sensor.
- Verification and eventual restoration of the distribution system.
- Check and replace injectors if necessary.
- Check and, if necessary, replace the injection control unit.
- Check the crankcase breather.

If the engine has been running for long periods in the presence of strong vibrations, it must be serviced.

12-34-03 Difficult starting

- Make sure you have positioned the throttle lever below 10% open.
- Check the fuel pressure before the ignition phase.
- Vapor lock in the fuel circuit: activate the auxiliary pump or remove the engine hood and wait for about 15 minutes for the temperature to drop.
- Check and, if necessary, recharge or replace the battery.

- Check and, if necessary, replace the spark plugs.
- Checking the slip torque of the torsional damper in the gearbox.
- Check the engine rpm sensor.
- Checking the integrity of the fuses in the IJ-m.
- Replacing the fuel filter.
- Check the efficiency of the fuel pump.
- Check the efficiency of the electric starter and the contactor.
- Check the integrity of the starter freewheel.
- Check the starter clutch integrity.
- Check the crankcase breather.

12-34-04 Irregular running at idle

- Stop the engine and restart it, taking care to keep the throttle lever in the minimum position.
- Check and, if necessary, replace the spark plugs.
- If idling at a speed higher than the correct one, check the engine oil temperature sensor.
- Check the crankcase breather.
- Checking the integrity of the fuses in the IJ-m.
- Check the integrity of the injection control unit.
- Inspection and possible replacement of the air filter.
- Check the tension of the timing chain.

12-34-05 Reduction of maximum power (maximum revolutions with fixed pitch propeller)

- Check and restore the engine oil level if necessary.
- Check and, if necessary, replace spark plugs.
- Check the fuel system pressure and replace the filter and fuel pump if necessary.
- Check opening of the accelerator control.
- Check the throttle position sensor.
- Perform a inlet air pressure and temperature sensor check.
- Turbo Engines – Check charge air temperature.
- Turbo Engines – Check turbocharger and waste gate service status.
- Turbo Engines – Check BOV valve, intercooler and intake system fittings.
- Check the crankcase breather.

- Check and, if necessary, replace the air filter.
- Verification of cylinder compression.

12-34-06 Excessive or abnormal noise

- Check the exhaust system.
- Check the integrity of the reducer (gears and damping system).
- Turbo engines – Checking the integrity of the intake system and BOV valve.
- Perform the endoscopic inspection of the engine block.

12-34-07 Unwanted stopping of the thruster

- Check the fuel system pressure with the engine stopped.
- Check and replace injectors if necessary.
- Check and, if necessary, replace spark plugs.
- Check and replace the injection control unit if necessary.
- Check for the absence of water in the fuel circuit.
- Functional check of the gearbox.

A In any case, the endoscopic inspection of the engine block and gearbox must be added to these checks.

12-34-08 Excessive consumption of engine oil

- Verification of cylinder compression
- Check for any engine oil leaks.
- Check the crankcase breather system.
- Check the oil seals applied to the valves.
- Turbo Engines – Checking the service status of the turbocharger.

12-34-09 Excessive consumption of gear oil

- Check the reducer operating temperature.
- Check for the presence of gearbox oil leaks.
- Check the state of the reducer breather valve.

12-34-10 Excessive accumulation of particulates on the magnetic filters

A Overhaul the motor or gearbox as soon as possible.

12-34-11 Excessive consumption of coolant

- Check the pressurized cap of the cooling circuit.

- Check for any leaks from the cooling circuit or radiator.
- Check for the presence of water emulsion in the engine oil: the check must be carried out by unscrewing the oil filler cap after using the engine on the ground for at least 15 minutes at operating temperature.
- Check the engine operating temperature.

12-34-12 Presence of water in the engine oil

Water may be present in the oil in the form of small patches or in the form of a whitish emulsion, usually positioned under the engine oil filler cap or inside the breather pipe.

A	Carry out a ground check, keeping the engine running for at least 30 minutes at various speeds at operating temperature: if the fault persists, the engine must be overhauled.

12-35-00 Communication of operating anomalies

Any anomaly must be identified and resolved before proceeding to a new mission.

In order to improve and resolve any recursive defects, the communication by the user of the anomalies found and their possible correction, or any other consideration that could improve the safety in the use of the engine and the clarity of the information contained in the present manuals.

Communications must be produced by filling out the form reproduced below, which can be downloaded at www.mwfly.it, and send via e-mail to info@mwfly.it.

Anomaly communication form			MW FLY
Date		*Serial number*	
Last name		*First name*	
Telephone number		*E-mail*	
Aircraft manufacturer		*Aircraft model*	
Propeller model		*Number of blades*	
Appl. pulling ☐	*Appl. pushing* ☐	*Total hours*	
Main use	*School* ☐	*Missions>1 hour* ☐	*Missions<1 hour* ☐
Frequency of use	*Daily* ☐	*Weekly* ☐	*Occasional* ☐
Prevailing environmental temperature	*Less than 10 °C* ☐	*Betw. 10 and 35°C* ☐	*Greater than 35°C* ☐
Description of the anomaly			
How often?	*Permanent* ☐	*Frequent* ☐	*Occasional* ☐
Note			

12-13-C

LIST OF REVISIONS TO THE DOCUMENT

Edition/ Revision	Applicability	Chapter	Page	Modification date
A.2	From #031324	01-00-00: Introduction	All	23/04/2025
A.2	From #031324	04-00-00: Airworthiness Limitations	All	23/04/2025
A.2	From #031324	05-00-00: Periodic maintenance	All	23/04/2025
A.2	From #031324	12-00-00: Maintenance instructions	All	23/04/2025