

# General Operating Manual for 3W Engines



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# 1. PREFACE AND WARRANTY

## Introduction

*Dear customer,*

*For more than 35 years we've been building and delivering 2-stroke engines ,made in Germany' for unmanned aircraft. Our employees develop, construct, manufacture, and distribute a broad variety of one- to four-cylinder engines.*

*We're glad that you've decided in favour of a product from our house and we wish you much fun and success.*

*Your 3W Team*

## Warranty notice

The warranty period for our engines is 36 months or 1200 hours of operation beginning with the date of purchase. This warranty is restricted to the replacement of defective parts if they were damaged due to faulty materials or faulty installation during production. This warranty claim lapses if the defect was caused by improper handling or repair, or through the use of unapproved components and consumables.

Thus only 3W mufflers or third-party products approved by us may be used. Only original 3W ignitions may be used to operate 3W engines. Otherwise the warranty lapses.

Unauthorized changes, modifications, or additions cause the warranty to lapse automatically.

## Exclusion of liability

Since we cannot control the proper application of our products, we assume no liability for any type of damage or injury resulting from their use.

## Service contract

You're welcome to personally deliver your engines for maintenance or repair to our service team. Please note our workshop's business hours:

Monday to Thursday from 8:00 a.m. to 4:00 p.m.

Friday 8:00 a.m. to 1:00 p.m.

Please note that repairs can only be conducted in our workshop with prior appointment arrangement. So contact us in advance to arrange an appointment:

Hotline or email:

+49 (0)6181 56868 or support@3w-modellmotoren.com

Mailing address:

3W Service

Lise-Meitner-Straße 33

D-63457 Hanau

Please indicate the item number when you contact us if you'd like to order spare parts:

- Phone Order hotline: +49 (0)6181/956679 (Mon.-Thu. 8:00 a.m.-4:00 p.m., Fri. 8:00 a.m.-1:00 p.m.)
- Fax order hotline: +49 (0)6181/956689
- Email: sales@3w-modellmotoren.com

Please note that there is a €20.00 minimum order.

## 2. SAFETY NOTICE

### Personal safety

The items below must be strictly observed for your safety and the safety of persons in your vicinity. We urgently recommend that you read these items thoroughly before you start the engine.

#### **Please observe the following items in order to avert personal injuries:**

- All persons and animals must be located behind the running propeller while the engine is running.
- Loose objects that the propeller could attract must not be lying around.
- No objects may be thrown into or held in the running propeller.
- Body parts must be kept away from the propeller.
- Do not wear any loose clothing such as gloves, ties, jewellery, scarves, key rings, or the like that could be caught in the running propeller.
- Use eye protection when the engine is started.

- The engine must not be brought into operation if you are under the influence of drugs, alcohol, or medications because these impair your ability to react.
- Do not operate the engine in the vicinity of loose objects such as sand, gravel, powder, cords, ropes, and the like. Any loose material can be sucked in resulting in injuries and damage.

***The engines are not toys! Faulty usage or improper handling can lead to serious or fatal injuries. Read through this operating manual carefully before start-up and familiarize yourself with possible sources of error.***

## **Engine safety**

The aspects of engine safety must be strictly observed!

### **Observe the following items in particular:**

- Only balanced, precisely bored propellers may be used for operation. The propellers must basically be bored from behind (use a standard boring machine). If you don't possess the experience or the necessary tool, then have an expert support you or take advantage of our service.
- Pay strict attention to firm seating and evenly tightened screws.
- The propeller blades must be absolutely identical in length and thickness.
- Test the propeller's flatness. Only 100% even flatness is permissible for operation.
- The blade tips' heights must be checked on a level surface. Heights may differ by at most 0.5 mm.
- The propeller-blade tips must be tested during flight. This is particularly important with 3- and 4-blade propellers. The geometries must correct.
- Use only 100% balanced propellers.

Non-observance of the above-listed instructions can cause disturbances to arise that can lead to anything from bearing damage to crankshaft breakage caused by vibration of the unbalanced propeller. The propeller can also be destroyed through inexact retaining bores.

Please call our service if you still have questions.

### **Moreover the following items must be strictly observed:**

- Read the operating manual carefully before you bring the engine into operation.
- Consider that you alone are responsible for the engine's safe operation and handling.
- The engine must be safely fixed and secured.
- Ensure that the engine is adequately cooled.
- Ensure that the muffler and exhaust manifold are well cooled.
- Only use approved propellers and spinners. Spinners must always be balanced with the propeller.

- Never use damaged or repaired propellers.
- The propeller must be correctly balanced without exception in order to attenuate vibrations that can cause bearing damage.
- Ensure that the propeller is safely fixed. Test the propeller's screws for firm seating and inspect them regularly.
- Install the ignition(s) so that no overheating can occur. Ensure that there is sufficient cooling air.
- Use the right battery for the ignition.
- Use only quality switches for the ignition.
- Use only suitable, fuel-resistant tanks and hoses. Ensure correct installation. Hoses must not be kinked because otherwise the fuel supply could be interrupted.
- Use only specified oil for and after breaking in. Observe the correct mixing ratio.
- Use only filtered fuel. The tank must be provided with a filter that is installed without kinks.
- Start the engine with the starter<sup>1</sup> instead of fingers or hands.
- Adjust the carburettor correctly.
- The carburettor must not be adjusted while the engine is running since doing so leads to a very great danger of injury.
- Observe that the spark plug is in proper condition and securely screwed in.
- The ignition cable's shield must be undamaged, as interference may occur. Adequate protection must be ensured.
- The spark plug connector must be seated securely in contact with the spark plug.
- The engine must not be operated in closed spaces without vacuum extraction.
- Use an ignition-off switch in order to stop the engine.
- Use our starter (see recommended accessories) or an electrical starter to start the engine.
- Maintain the engine carefully and regularly.
- Use a check-list for the engine and aircraft before you fly.
- Secure the aircraft from rolling away before starting the engine.

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<sup>1</sup>5. Recommended consumables

## 3. OPERATION (ENGINE USE)

### 3.1 Important notes before start-up

#### The engine's technical condition

**The engine should be thoroughly tested for use. The following items must be strictly observed for the engine's safe operation:**

- Don't hold your fingers or any other parts of your body or objects in the rotating propeller.
- Secure your aircraft before starting. Ask one, two, or several assistants to secure your aircraft regardless of its size. Emphasize to your assistants that the engine is started at full throttle.
- Never change the carburettor's settings while the engine is running. Shut the engine off and then undertake the changes. Repeat the procedure until you are satisfied with the running behaviour.
- Ensure that no fuel gets onto the hot muffler.
- Use only ignitions recommended by us.

### 3.2 Installation

#### Engine

The engine can be screwed on directly or be fixed to the engine frame on spacers. A tension-free mounting is necessary because the crankcase is made of aluminium. Screw the engine onto a plate (plywood or composite) and undercut it in order to produce the necessary down and side thrust or use a suitable engine mount (see image).

A functioning cooling system is important for your air-cooled engine's function. In order to guarantee this you must ensure that incoming air is also discharged again from the engine's bonnet. Air backed up behind the cylinder can cause turbulences. This is to be strictly avoided. Observe that the orifice for exiting air should be four times the size of that for incoming air.

### Example:

- 20 square centimetre intake orifice
- 80 square centimetre exit orifice

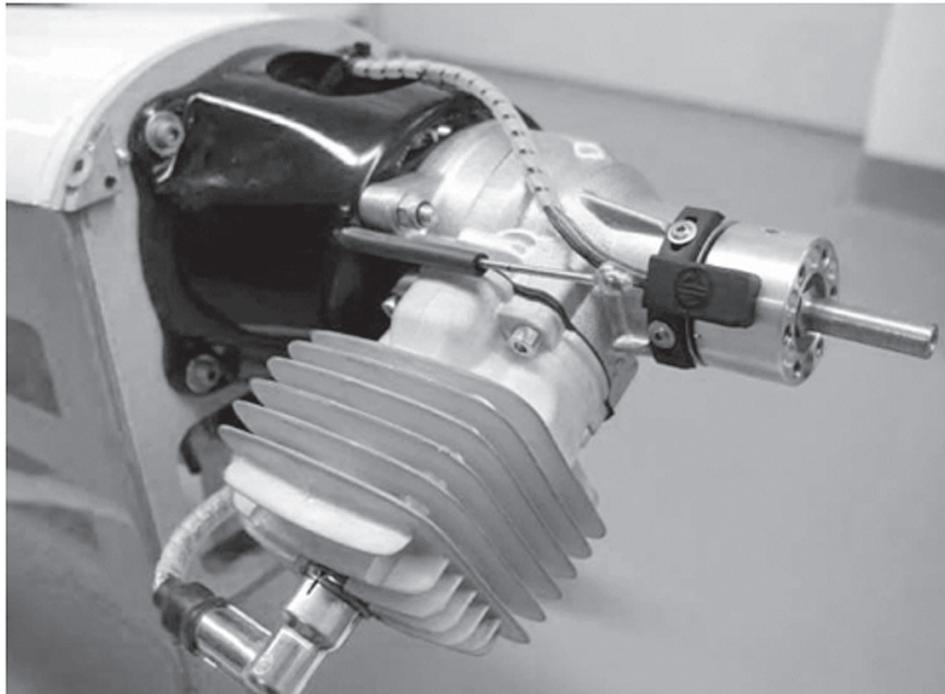


Figure 1: Installed engine on engine mount (Example)

Observe the notes for the air guide if problems arise with the cooling system.

### Air guide

Incoming air must be directed straight onto the cylinder with the air guide. A continuous air stream over the cylinder's cooling fins is hereby guaranteed. Such an air guide offers the greatest possible cooling for your engine. Without an air guide, the air takes the path of least resistance and only part of the incoming air flows over the cylinder.

The air guide must lie close to the engine so that the cool air can flow only over the cylinder down-wards in the direction of the exhaust-air orifice. That the head fins and the spark plug as well as the spark plug's connector are cooled is also important here. It is furthermore important to ensure that the crankcase is also cooled. The greatest permissible temperature is 55 °C.

It must be noted that the engine can be damaged even with forced cooling. This can be induced for instance by allowing the engine to run too long while on the ground, an incorrect carburettor setting, too little air exhaust, or incorrect or too small exhaust manifold.

## Operating temperature

You'll need a thermocouple that fits under the spark plug (M10 thread) in order to correctly measure the cylinder head's temperature. The optimal operating temperature depends on the engine. Piston, spark plug, and combustion chamber remain free of combustion deposits in this temperature range. The temperature can be 250 °C for a certain time during full throttle.

The spark plug's colour should lie between light and medium brown. Grey colouration is a typical sign of overheating or too lean a carburettor setting. Temperatures greater than 270 °C are critical - the piston may seize thereby destroying the engine.

Carbon deposits on the piston at temperatures below 180 °C. Increasing deposition on the cylinder causes abnormal running noises. The hammering stresses the needle bearings and can destroy them. This can cause engine failure.

## Carburettor

Front and tail carburettors require constant fresh air.

Orifices bored into the fuselage in the vicinity of the carburettor have the opposite effect: the creation of under pressure on the outside of the fuselage draws the air out of the fuselage away from the carburettor. So direct fresh air into the fuselage with an air scoop. To avoid over-pressure, you must discharge air again from the fuselage with compensation holes in the fuselage in order to avert over-pressure.

Please consider that small amounts of fuel can escape from the carburettor.

## Carburettor linkage

Your engine is equipped with a metal linkage, which is used to fix the rudder rod. Install this on the carburettor lever with an M2.5 screw (DIN 8.8) and a nut (DIN 8.8). Then solder the two as shown in the following figure.

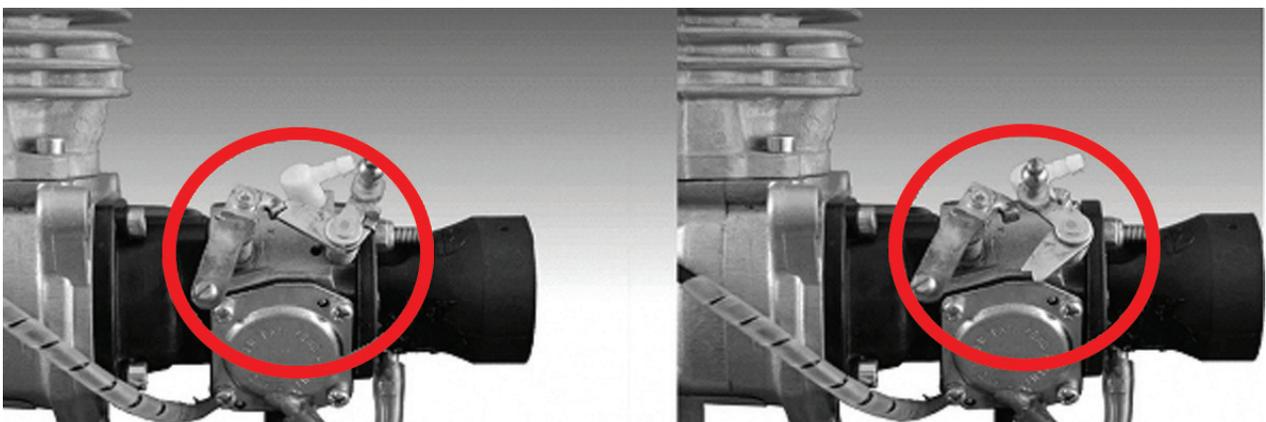


Figure 2: Engine with linkage (Example)

Observe the following: we recommend manufacturing the rudder rod out of metal.

Use a plastic ball head and a high-quality servo. You can thereby control your rotational speed with special constancy and precision.

## Ignition

When positioning the ignition you should take care not to install it in the cylinder's hot-air stream.

### **The following things should generally be observed:**

- Install receiver and ignition storage battery at least 10 cm away from each other.
- Protect the ignition cable with plastic spiral tape only.
- Do not pull off the spark plug connector with mechanical means (pliers).
- Pull the spark plug connector off with a twist-turn motion.
- The spark plug connector must be firmly seated on the plug base (hexagonal).
- System disruptions can occur if this is not the case.
- Use recommended ignition switch.
- Use no switch with a voltage regulator.

## Tank

Bind the felt pendulum in the tank together with fuel-proof cable tape. A fuel-proof tube (e.g. brass) must be incorporated into the pendulum conduit in order to prevent the pendulum from rotating.

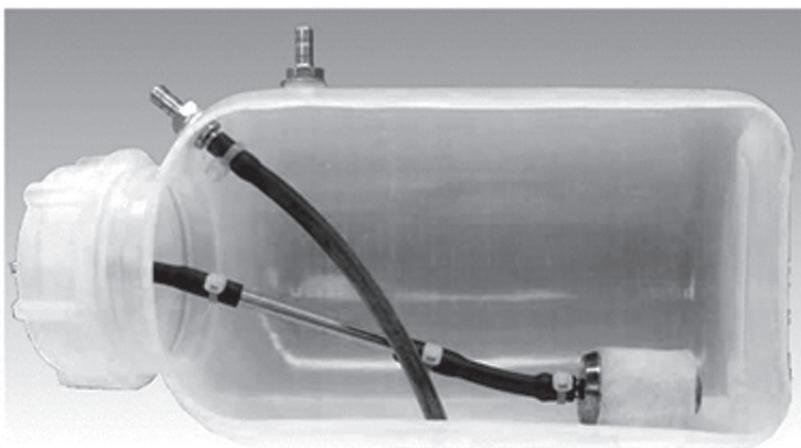


Figure 3: Tank interior view (Example)

The same diameter must be used for both the tank's ventilation and the carburettor's supply line.

## Mufflers

Flexible muffler brackets are to be used in order to protect the manifold from damage.

These should be mounted at the strengthened part of the muffler. 3W mufflers have their own reinforcement ring for this to apply force.

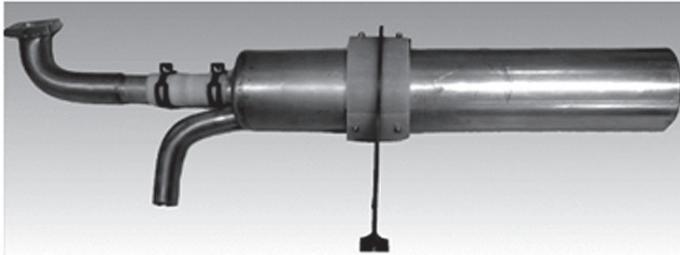


Figure 4: Muffler (Example)

We recommend using a horizontal plate to divide the forward fuselage area into two areas. Fuel tanks, storage batteries, and components can be mounted above on this plate. The mufflers are mounted underneath. Close off the rear end's lower area with an air guide angled downward.

Create openings on the mufflers' rear end through which the air is directed out again.

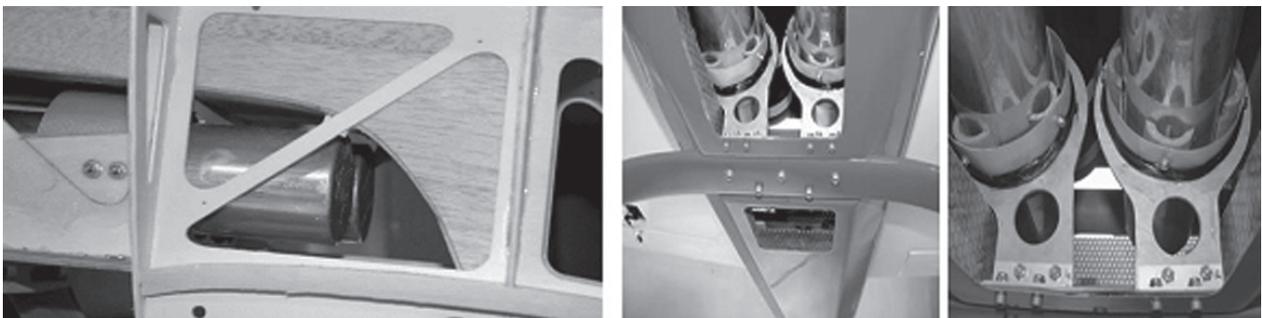


Figure 5: Installation example (Example)

Don't forget to use a suitable frame to restore lost stability caused by the openings.

## 3.3 Operation

### Starting the engine

***The engine must not be started by hand.*** Serious injuries could result during manual starting if the engine backfires. So use our starter without fail for safety reasons.

**You should observe the following sequence when starting the engine:**

- Close the choke flap.
- Switch on the ignition.
- Actuate the engine on the propeller. Ignition occurs after some three to five rotations (de-pending on the fuel line's length) and the engine stalls again after running briefly.
- Open the choke flap after the propeller comes to rest.
- Increase the idle somewhat.
- Actuate the engine and let it run warm a while (about 30 sec.).
- At least one person must hold the aircraft steady for safety reasons. Two or three persons might be necessary depending on engine type.

The carburettor is basically adjusted and still needs to be fine tuned. Read the notes for adjusting the carburettor to do this.

### Breaking in the engine

We recommend undertaking a break-in process on a test bench because you can best familiarize yourself with the engine here.

**You should observe the following sequence when breaking in the engine:**

- Use a mineral-based 2-stroke engine oil in a 1:30 mixing ratio.
- Start the engine, set it to 2000 to 2500 rpm, and let run for two hours.
- Due to the rich mixture, it is advisable to operate the engine for the recommended break-in time without a muffler or with an old muffler.
- The additives contained engender a honing effect with the result that more dirt exits the ex-haust.
- After the break-in phase switch to a fully synthetic engine oil in a 1:50 ratio.
- When the break-in phase is over, mount the engine in the aircraft according to our installation instructions.
- Do not conduct long engine runs with completely open throttle flap as long as the engine hasn't completed its break-in period.

Your engine is broken in after a total run time of about 9 to 15 hours. Now use fully synthetic, 2-stroke oil with a mixing ratio according to manufacturer's specification 1:50/2% mix. We recommend a fuel with at least 92 octane and ethanol addition.

## **Carburettor setting**

You need an tachometer to set the carburettor.

**You should observe the following sequence when setting the carburettor:**

- Start the engine for warming up.
- Set the engine for maximum power with the main nozzle needle (H).
- Measure the rotational speed.
- Rotate the main nozzle needle out until the rotational speed falls back to about 100 to 200 rpm.
- That way the engine always runs with the correct mixture.
- Measure the rotational speed.
- Bring the engine to a safe, low idle and let run for about 30 to 50 seconds.
- Check to see whether the rotational speed is constant.
- The idle nozzle needle (L) is incorrectly set if the rotational speed drops or the engine shuts down slowly.
- Rotate the idle nozzle needle in until the low idle is constant.
- If the engine runs faster, then it's set incorrectly.
- Rotate the idle nozzle needle out until the rotational speed remains constant.
- Give quick gas to check the transition again and readjust the nozzle needles as required.
- An optimally adjusted engine doesn't take gas during the first seconds of cold start.

### **Basic carburettor setting**

Please check test protocol

## 4. MAINTENANCE

**We recommend the following maintenance steps after each engine use:**

- Check the spark plug for electrode cleanliness.
- The electrode gap must be 0.4 mm.
- Check for the correct needle setting on the carburettor (see sec. 3.2).
- Clean the air filter regularly.
- Check the muffler for possible oil-carbon deposits.
- Check the manifold for possible oil-carbon deposits.

## 5. RECOMMENDED CONSUMABLES

Description	Item number
Spark plug	20.010.580
Spark plug connector	20.010.575
mineral-based oil for break-in	10.100.852
Fully synthetic oil for operation	10.100.851
Spiral protection to protect the ignition cable (chromium)	10.102.580
Shielding braid for the ignition cable	10.010.550
Fuelling system	10.101.201
Spark plug spanner	10.102.040
Starter	10.102.990

## 6. ANNEXES

**Annexe A: Technical data sheets**

**Annexe B: Replacement parts list**





3W