

# **WATERAX**



## **MARK-3<sup>®</sup> Watson Edition Owner's Manual**

Publication Date: 11/2023  
Publication Number: 702135, Rev.4



**WE MOVE  
WATER**

This document provides information proprietary to *WATERAX* Inc. and cannot be used or disclosed without *WATERAX*'s written authorization.

*WATERAX* Inc. reserves the right to make changes without notice in its products or components as research and development or marketing conditions warrant. Changes affecting the operation of any component in this manual will be reflected in a subsequent revision. *WATERAX* Inc. assumes no responsibility for any omissions or errors that may appear in this document or for any damages that may result from the use of information contained herein.

The following are trademarks or brand names of *WATERAX* Inc.: *WATERAX*, '*WE MOVE WATER*'.

All other trademarks used in this manual are the exclusive property of their owner.

### **MARK-3® Watson Edition Owner's Manual**

Publication No.: 702135, Rev. 4

Publication Date: November 2023

First Edition: June 2023

#### **Published by:**

*WATERAX* Inc.

6635 Henri-Bourassa W.

Montreal, Quebec H4R 1E1

CANADA

© 2023 *WATERAX* Inc.

All rights reserved

Printed in Canada



# Contents

<b>Important Safety Instructions .....</b>	<b>4</b>
Personal Safety Advisory .....	4
Warnings.....	4
<b>Preventing Damage to Equipment .....</b>	<b>5</b>
<b>Introduction .....</b>	<b>6</b>
About this Manual .....	6
About the MARK-3 Watson Edition .....	6
Parts Identification .....	7
<b>Pump Operation .....</b>	<b>8</b>
Pre-Operation Checklist .....	8
User Interface (UI) .....	8
Fuel Supply.....	9
Pump Connection and Priming.....	11
Engine Startup.....	12
Discharge.....	13
Shutdown.....	13
Cold Weather Operation.....	13
Removing or Attaching the Pump End .....	14
Basic Care and Storage .....	14
Troubleshooting.....	16
<b>Maintenance .....</b>	<b>19</b>
<b>Service.....</b>	<b>20</b>
Recoil Starter .....	20
Fan Cowl Assembly .....	24
Flywheel & Ignition .....	25
Electronics .....	28
Air Filter & Throttle.....	31
Carburetor.....	32
Fuel Connector & Purge Bulb.....	35
Muffler Assembly .....	36
Pump Hub.....	37
Pump Clamp.....	37
Frame Assembly.....	38
Decals.....	38
Engine.....	39
Pump End.....	48
Pump Test kit.....	52
Fuel Line.....	53
Fuel Tank.....	53
Tools .....	54
<b>Technical Data .....</b>	<b>56</b>
<b>Trademark.....</b>	<b>59</b>
<b>Notes .....</b>	<b>60</b>
<b>Warranty.....</b>	<b>63</b>



# IMPORTANT SAFETY INSTRUCTIONS

## Personal Safety Advisory



### READ THIS MANUAL BEFORE OPERATING YOUR PUMP!

The improper use of the *WATERAX* pump could result in serious injuries as well as damage to the pump. This manual contains very important safety information that **MUST** be read, understood, and followed to safeguard you and your equipment from harm, as well as specific information on the proper use and care of your engine. Any operator should familiarize himself with the apparatus and its capabilities before trying to operate the equipment in an emergency situation. Please read this entire manual before using your *WATERAX* pump and follow all Personal Safety Advisories. **This pump must only be operated by trained personnel.**



## Warnings



- Do not operate if mentally or physically fatigued.
- Always inspect hoses and piping to avoid burst injuries.
- No modification and/or alteration may be made to the pump. Any such modification not only voids the pump warranty but can endanger pump operators.
- Do not operate the pump higher than the maximum rated pressure. Always run the unit at the lowest pressure required for the application to enhance operator and equipment safety.
- Use only pipe, hose, and fittings that are rated at or above the maximum pressure rating of the pump, or according to what maximum pressure the system was designed for, whichever is lower.
- Maximum Pressure Rating: 600 PSI (41 bar)
- Maximum Allowable Pump Intake Pressure: 200 PSI (13.8 bar)
- Slowly close valves and use slow close valves wherever possible to prevent danger to other line operators and to prevent water hammer which could damage the pump and its piping components.



- **Always wear eye and ear protection** when operating the pump unit.

- Ensure sufficient lighting (5 lx min.) during operation.



- **Never run the engine in a closed or confined area.** Exhaust gas contains carbon monoxide which is poisonous. Avoid inhalation of exhaust gas.



- **Refuel engine with care.** Gasoline is extremely flammable, and gasoline vapor can explode. Refuel in a well-ventilated area, with the engine stopped. Use only fuel and oil type as recommended.



- **Be alert and never touch any part of the engine exhaust system while the engine is running.** Always allow enough time, after stopping the unit, for proper cooling of these parts and surrounding area. Wear protective gloves.

- Leaving the pump running with all the discharge valves closed is called deadheading the pump (shut-off). **The pump should not be left in this mode for more than a minute.** Leaving in this condition for any length of time will cause the pump to overheat and can damage the pump. Additionally, the pump end and the water inside it can become extremely hot and cause severe burns. **Be careful when opening the discharge valve and avoid touching the pump end.** To avoid overheating the pump, a re-circulation line

(if provided) should be opened, or a discharge line left slightly open to allow fresh water to continue to enter the pump.



- **Be careful not to pinch your fingers.** Do not place your fingers near the cooling fan and engine output shaft when the engine is running. **Never operate without the fan shield.**
- Relieve all system pressure before doing any service work on the pump.

## PREVENTING DAMAGE TO EQUIPMENT

The following recommendations will help avoid damage to your equipment:

- Always use the proper fuel mixture.
- Do not run the engine at full speed until thoroughly warmed up.
- Do not lift strainer out of the water while pump is operating.
- Do not run engine with pump disconnected.
- Do not run the pump when dry.
- Always draft water using a foot valve suction hose strainer.
- Position the foot valve to avoid drawing any type of sediments into the pump. Sand, silt, and mud are abrasive: do not allow the foot valve strainer to rest on bottom of lake or riverbed.
- Position the foot valve to avoid drawing air into the pump. Keep foot valve approximately 1 foot (30 cm) below the water surface. Securely attach in the presence of waves.
- Check strainer frequently to make sure that it is not clogged with moss, leaves, etc.
- Flush the pump with fresh water if the pump has been used to pump salty, brackish, high mineral content water, water containing debris, or foam injected water. Check that debris is cleared before using pump again.
- Drain pump after final use.
- During freezing weather, drain the pump and lines of all water. You can also pour some plumbing antifreeze into the pump and circulate it through the pump and plumbing system.
- Pumps should not be operated without water for any extended period of time or without discharging water. Operating the pump in such a manner can overheat the pump causing damage to seals, or pump internals.
- It is recommended that all parts be replaced with genuine *WATERAX* parts.

# INTRODUCTION

## About this Manual

This manual contains important safety, operation, troubleshooting and servicing procedures for the MARK-3® Watson Edition. The first part of the manual is dedicated to the operation of the unit. The second part is dedicated to the maintenance and servicing of the unit.

It is recommended that all information provided in this manual be carefully read and understood before performing any operation or maintenance to the pump.

The procedures listed in this manual are general operating and maintenance procedures. They should be taken in addition to any procedures, policies and guidelines established by the authority having jurisdiction or the apparatus manufacturer. Where conflicts arise, all parties (authority having jurisdiction, the apparatus manufacturer, and *WATERAX* Inc.) will need to be contacted to determine the best resolution. The solution will need to address the safety of the operator along with the proper performance and life expectancy of the unit.

These instructions cover most wildland pump applications. If the application the pump is being used for does not fall into these general guidelines, consult *WATERAX* for any additional safeguards, operating, or maintenance considerations that may be required.

Please consult [www.waterax.com](http://www.waterax.com) for additional documentation related to this product such as the *WATERAX* product guide, parts catalog, technical notes, news, and other updates about *WATERAX* and its goods and services. Refer to “Tech-Notes” for the latest engineering changes and recommendations, which have been introduced since the publication of this manual.

## About the MARK-3® Watson Edition

The MARK-3® Watson Edition provides unparalleled performance, reliability, and ease of operation in a lightweight and compact design.

It couples a lightweight 4-stage high-pressure pump end with a purpose-built 140cc high-performance two-stroke engine. It includes an intuitive user interface with advanced safety and protection features. A built-in fuel priming system significantly improves startability.

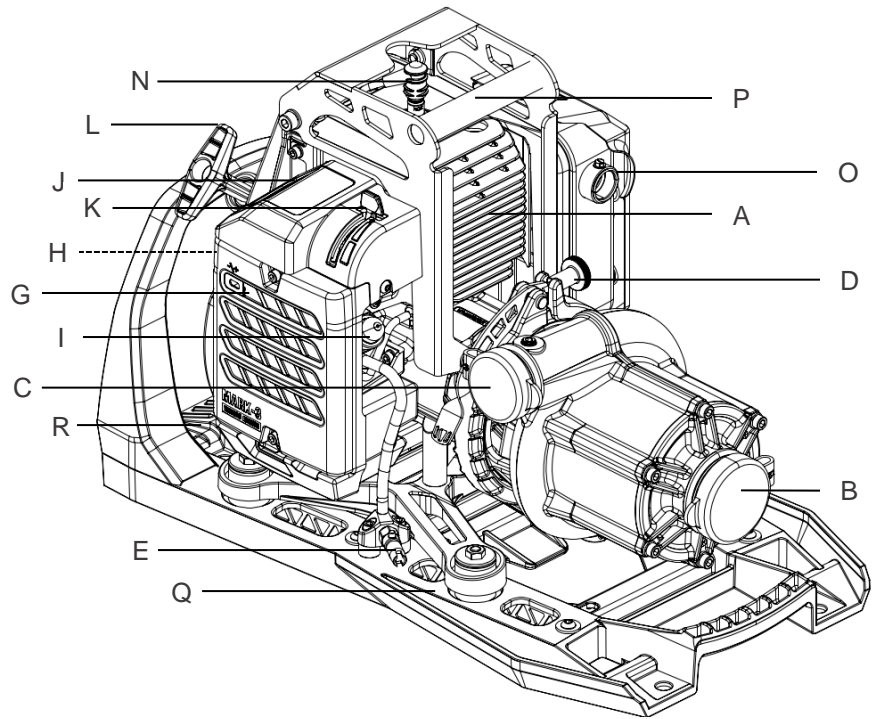
The MARK-3® Watson Edition pump unit has been designed to meet all the requirements of advanced techniques in forest fire control, including **USDA Forest Service Specifications 5100-274e**. The pump is officially qualified under USDA Forest Service Specifications 5100-274e.

Considered an emergency rescue equipment, the MARK-3 Watson Edition pump is exempt from EPA emissions standards under 40 CFR 1054.660.



## Parts Identification

- A. Engine
- B. Pump Intake (suction)
- C. Pump Discharge
- D. Quick Release Pump Clamp
- E. Fuel Connection
- F. Engine Drain Plug (not shown)
- G. Air Filter
- H. Choke (not shown)
- I. Carburetor Purge Bulb
- J. User Interface (UI)
- K. Throttle
- L. Rewind Starter
- M. Manual Start Pulley (not shown)
- N. Spark Plug
- O. Muffler & Heat Shield
- P. Carry Handle
- Q. Backpack Frame
- R. Foot Hold





# PUMP OPERATION

## Pre-Operation Checklist

Before using your pump, follow this verification procedure:

1. Visually inspect product. When you first receive your pump, inspect the product and check for any damage. Notify the supplier if any damage is found.
2. Check that all suction and discharge hoses are structurally sound and do not leak.
3. Inspect all safety features and verify that they are in good order before using the pump.
4. Each time you plan to use the pump, check for damage that may have occurred during previous use. Notify your manager that the equipment requires repair. Remember that damaged equipment can expose you to safety hazards.

## User Interface (UI)

The User Interface Module (UIM) continuously monitors the engine speed and operating temperature. In the event of an overspeed condition (e.g., loss of prime), or overheat condition, the UIM will automatically shut down the engine to prevent the risk of damage.

The UI has an integrated multi-color LED to display operating status and an OFF switch to manually shut down the engine. When the engine is stopped, the UIM will store the last operating status and display it when restarting. This is useful in troubleshooting scenarios.



OFF button

### LED States

<b>Green Flashing</b>	■ Engine in warm-up stage.
<b>Green Solid</b>	■ Engine is warmed up. ■ Can safely operate at wide open throttle.
<b>Yellow Flashing</b>	■ Engine speed below 1,000 rpm (low speed condition): <b>engine shut down.</b> ■ Engine likely ran out of fuel.
<b>Yellow Solid</b>	■ Wiring issue. ■ Engine temperature sensor disconnected. ■ Engine temperature sensor shorted. ■ Off button disconnected or loose contact. ■ <b>Such conditions will never shut down the engine.</b>
<b>Blue Flashing</b>	■ Engine speed above 9,000 rpm (overspeed): <b>engine shut down.</b> ■ Loss of prime condition.
<b>Red Flashing</b>	■ Engine temperature exceeds warning temperature threshold: <b>warning.</b> ■ Engine temperature exceeds max. allowed temperature: <b>engine shut down.</b>
<b>Red Solid</b>	■ Engine temperature gradient too high: <b>engine shut down.</b> ■ Very lean adjustment. ■ No oil in fuel.



## Fuel Supply

### Fuel mixture

The MARK-3® is powered by a 140cc two-cycle (two-stroke) engine. For lubrication, the engine requires a premixed fuel mixture of gasoline and oil.

**GASOLINE:** Minimum 87 octane unleaded quality automotive grade gasoline (maximum 10% ethanol)

**OIL:** High quality two-cycle mixing oil specifically designed for use on **air cooled** engines with **API-TC, JASO-FD and ISO-L-EGD** certification. *WATERAX* recommends **Amsoil Saber® Professional Synthetic**.



**FUEL MIX RATIO:** 50:1 (gas to oil)



**Important:** Not enough emphasis can be placed on the use of the correct gasoline and oil mixture. Using less than the recommended portion of oil will cause overheating and possible engine damage. Using more than the recommended proportion of oil will cause spark plug fouling, erratic carburetion, excessive exhaust smoke and rapid carbon deposits.



**Important:** Do not use two-cycle mixing oil made for water cooled engines (TCW).

### Gasoline, octane, and ethanol

*WATERAX* recommends using high quality automotive grade gasoline with a minimum octane rating of 87 (AKI) and a maximum ethanol concentration of 10% in its fuel mix for the MARK-3®.

It is important to note that gasoline has a shelf life. Depending on storage conditions, gasoline can go stale in a matter of weeks. Gasoline will deteriorate in three ways:

1. The more volatile components of the gasoline evaporate, leaving behind a heavier gasoline which can lead to inferior engine performance and a more difficult engine to start.
2. Certain hydrocarbons in the gas react with oxygen (oxidation) producing new and harmful compounds. The stale gasoline will smell sour, its color will go dark, and gummy particles can appear in the gas. This can lead to poor engine performance and reliability issues with the carburetor.
3. Water contamination, which is normally caused by condensation, can be catastrophic to the engine. Gasoline containing ethanol is more susceptible to that problem. Ethanol is hydrophilic, which means that it tends to draw in moisture. If the water contamination is severe enough, the ethanol will separate from the gasoline and drop to the bottom of the fuel tank. Since water and oil do not mix well, this ethanol and water blend can cause severe engine problems due to the lack of lubrication.

To prevent any damage to the engine, it is highly recommended to only use **fresh gasoline**. Depending on storage conditions and ethanol content, gasoline typically has a shelf life of three to six months. Gas stabilizers (e.g., STA-BIL®) can be used to increase the gasoline's shelf life; however, it will not restore back bad gasoline.

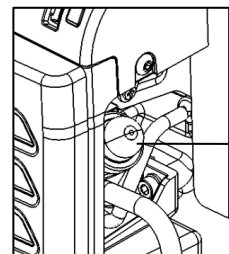
### Winter vs. summer-grade gasoline

Winter-grade gasoline has a higher Reid Vapor Pressure (RVP), which is a measure of how easily petroleum liquids evaporate. The RVP changes to accommodate seasonal temperature variations that affect both the performance of gasoline in an internal combustion

engine and emissions. In the winter, higher RVP ensures that gasoline combusts quickly at low ambient temperatures. In the spring and summer when ambient temperatures are warm, a lower-RVP gasoline prevents vapor lock, when too much vapor may prevent an engine from starting or running properly. Thus, **WATERAX strongly recommends using summer-grade gasoline** with the MARK-3®, especially when ambient temperatures are hot, to ensure optimal startability, operation and performance.

### Supply recommended fuel to engine

1. Carefully mix the fuel as recommended in the Fuel mixture section. Mix well.
2. Connect fuel supply line to fuel tank.
3. Prime fuel supply line by recirculating excess fuel into tank to eliminate air bubbles and avoid air locks.
4. Connect fuel supply line to engine fuel connection.
5. Prime carburetor by pressing purge bulb (I) successively until fuel travels up the clear fuel line and appears in the purge bulb.



**Important:** The use of the purge bulb will not flood the engine. However, excessive use of the purge bulb will cause excess fuel to drip down the air filter.



**Important:** When refueling the fuel tank, it is recommended to use a fine strainer to capture particles and prevent damage and/or clogging of the carburetor.



**Important:** It is recommended to keep the fuel tank at the same level as the pump unit to help prevent fuel cavitation. Ensure that the height between the bottom of the fuel tank and the carburetor does not exceed 2 ft (0.6 m).



**Important:** It is recommended to keep the length of the fuel line to a maximum of 6 ft (1.8 m) to help prevent fuel cavitation. The fuel line should be just long enough to allow to position the fuel tank in a secure location, away from a heat source (i.e., muffler).



**Warning:** Ensure that the fuel tank is positioned away and at a safe distance from the muffler to avoid any potential accident. Always refuel with care.

### Flooded engine

Flooding an engine refers to an accumulation of excess fuel in the cylinder and crankcase due to an excessive use of the choke. This condition makes the engine nearly impossible to start without clearing the engine of the excess fuel.

### Clearing a flooded engine

1. Disconnect the spark plug cable and remove the spark plug.
2. Re-connect the spark plug cable to the spark plug. Place the spark plug in contact with the cylinder head to ground the spark plug.



**Important:** Failure to ground the spark plug can damage the ignition when cranking the engine.

3. With both choke and throttle in fully open position, pull starter rope several times until excess fuel is exhausted.

4. Before reinstalling spark plug, clean and dry the electrode and insulator tip.
5. If engine is severely flooded, remove the engine drain plug and drain engine.

## Pump Connection and Priming

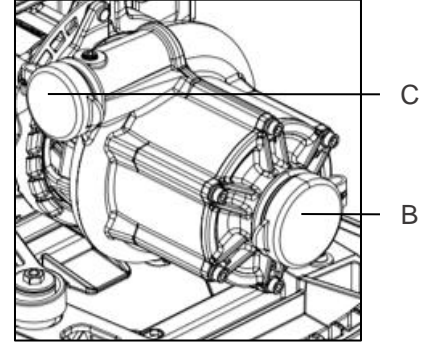
1. Connect foot valve strainer to male end of suction hose, then fill suction hose with water. Connect hose to the pump intake (B). Tighten coupling firmly with coupling wrench.

### Manual Priming:

- a) Loosen pump clamp and rotate pump so the discharge is pointing upwards.
- b) Prime by pouring water into the discharge until full.
- c) Pump can also be primed by “jerking” the suction hose until water flows from pump’s discharge port.

**WATERAX Hand Primer:** Connect hand primer to discharge port and pump until water is drawn into pump.

2. Connect discharge hose, nozzles, etc. to pump discharge (C); tighten coupling firmly with wrench.



**Important:** To provide proper operation of the pump, the suction hose/strainer should be submerged a minimum of 4 to 6 times the hose diameter into the water source.

**DO NOT** run pump dry.

**DO NOT** allow foot valve strainer to rest on bottom of lake or riverbed. Check strainer frequently to make sure that it is not clogged with moss, leaves, etc.

**DO NOT** lift strainer from water while the pump is operating. Use a rope or other means to keep strainer at proper height, approximately 1 foot (30 cm) below water surface. If strainer is too close to the water surface, it will draw air and pump may lose prime.

To maintain optimum performance from your pump, follow these recommendations for selecting and installing your **suction hose**:

- Use the shortest length possible; place the pump as close to the water as possible.
- Select reinforced crush resistant (non-collapsible) hose.
- To avoid air locks, flexible hose should rise gently from the water source to the suction/inlet port without excessive dips, bumps, sharp angles or rise in its lay.
- Fit a foot valve suction strainer to prevent foreign matter from entering the pump.
- The installation and use of a suction float will aid in the performance of your pump, by keeping suction away from the debris on the bottom of the dam or river.
- Ensure that the suction hose is completely submersed.

## Limitations

Several factors can affect the pump’s ability to efficiently draft water. The following limitations should be considered:

- Water temperatures above 95 °F (35 °C) can cause noticeable loss in performance.
- Barometric pressures below 29 in Hg (98 kPa) can also cause noticeable loss in pump performance (specifically elevations > 2000 feet (610 m) above sea level).
- Restrictive hose and strainers can significantly decrease pump performance.
- Intake hose runs in excess of 10 feet (3 m) can reduce pump performance.
- Minimize the suction lift to prevent cavitation and minimize performance degradation. In high suction lift setup, reduce the throttle to prevent tripping the overspeed cut-off.

## Engine Startup

1. Close/engage choke (H), if engine is cold.
2. Move throttle lever to "START/WARM UP" (3 increments from "IDLE").
3. Slowly crank engine until resistance (past compression).
4. Pull the rope until recoil pawl engages the pulley, then give starter cord a quick and steady pull.
5. Once engine fires, disengage choke and pull start again if necessary.
6. Allow engine to warm up while UI LED blinks green (approx. 2 min.).
7. Once UI LED becomes solid green, the unit can be throttled up.



CLOSED/  
ENGAGED  
POSITION

H



START/  
WARM UP  
POSITION



**Important:** The MARK-3® engine is broken-in at the factory. Full throttle operation can be used provided the engine is given a thorough warm-up period beforehand.

**Failure to allow engine to warm up may lead to piston scoring and possibly more serious engine damage.**

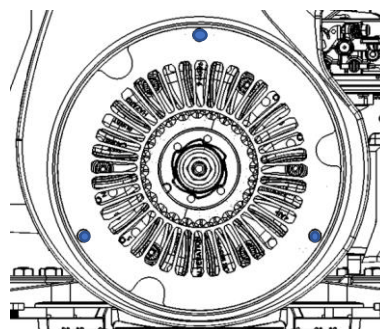
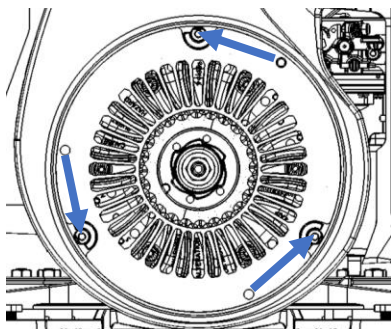
### Recoil Starter Failure

If the recoil starter should break while the unit is on the fire line, the recoil starter can be removed, thereby gaining access to a manual starter pulley which is part of the flywheel.

1. Remove the recoil starter.
  - a. Remove three 4 mm bolts holding on recoil starter. Keep bolts in a safe place.
  - b. Remove recoil starter.
  - c. Keep fan shield in place and rotate so that three holes are in line with mounting points for recoil starter. (See images below)
  - d. Replace the three bolts to hold fan shield and fan cowl in place during operation.
2. Rotate piston to top dead center by hand.
3. Tie a single knot at the end of a starter rope. Hook the knot of the notch on the manual start pulley. **Knot must face outwards.** Wrap the starter rope clockwise (from starter view) for **three turns** around the manual start pulley and pull. Repeat until engine starts.



**Warning:** To reduce the risk of the rope getting caught on the pulley once the engine starts, ensure knot is facing outwards and do not exceed three turns of the rope around the pulley.



**Warning:** Never operate the pump without fan shield in place to avoid injury or damage to the unit.

## Discharge

Once the pump is primed, and with the engine running, you can begin to discharge water.

- a) If pressure does not build in the discharge hose, the pump is not fully primed. Verify that there is no leak between the suction hose and the pump end. Prime the pump again.
- b) The engine works best at wide open throttle. Vary the discharge nozzle opening to adjust the pump performance.



**Warning:** Leaving the pump running with all the discharge valves closed is called deadheading the pump (**shut-off**). The pump should not be left in this mode for more than a minute. Leaving in this condition for any length of time will cause the pump to overheat and can damage the pump. Additionally, the pump end and the water inside it can become extremely hot and cause severe burns. **Be careful when opening the discharge valve and avoid touching the pump end.** To avoid overheating the pump, a re-circulation line (if provided) should be opened, or a discharge line left slightly open to allow fresh water to continue to enter the pump.



**Important:** If the engine throttle is increased and the engine RPM increases without an increase in pump pressure, the pump may be **cavitating**. Refer to the limitations listed at the beginning of this section and see the troubleshooting section for a verification checklist and possible solutions. **Avoid running at WOT above a 12.7 mm (1/2") nozzle size.** If running a larger nozzle, reduce the throttle to avoid cavitation and tripping the overspeed protection.



**Warning:** Avoid running out of fuel when the engine is running at wide open throttle to avoid lean conditions and potential engine premature wear.

## Shutdown

### Shut down the pump

1. After completing the pump operation, gradually reduce the engine speed and move throttle to "IDLE" position.
2. Allow unit to run for approximately 2 minutes with throttle in this position for proper cool down.
3. Press and hold the "OFF" button on the UI until engine shuts down.

### After final use

4. Drain the carburetor. Run at idle with the fuel line disconnected until the engine stops to drain the fuel system.
5. Drain the pump end. If the pump was last run with foam or water that is salty, brackish, or high in mineral content, **flush the pump with fresh water** for a minimum of 2 minutes or until the water is clear, and **drain the pump end**.

## Cold Weather Operation

The pump can be run in below freezing temperatures if certain precautions are taken to avoid the formation of ice in the pump.

1. After priming the pump, the unit should be run at low speed for a short period of time to allow all components to warm up before continuing with the remaining operating procedures.
2. Unless wrapped in a heater, drain the pump of all water if it is stopped for any length of time. The engine/drive unit should be turned over a few revolutions to make sure all water has been removed from the pump.
3. After use, drain the pump, manifolds, and lines of all water. You can also pour plumbing antifreeze into the pump and circulate it through the pump and plumbing system.



## Removing or Attaching the Pump End

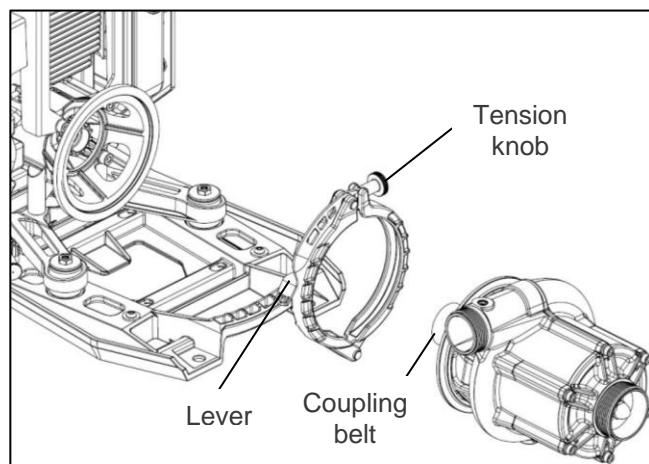
The MARK-3® Watson Edition pump has a quick release pump clamp and detachable pump end which facilitates the servicing of pump units and minimizes down-time in the field by allowing the quick replacement of pump ends.

### To remove pump from engine:

1. Lift pump clamp lever.
2. Release tension-adjusting knob.
3. Remove clamp.
4. Remove pump from engine.

### To attach the pump end to the engine:

1. Install the coupling belt on the engine or pump end coupling drive.
2. Align the teeth of the pump end coupling drive with the coupling belt and install.
3. Install pump clamp with the lever on the top side, with the tension knob orientated towards the muffler.
4. Finger tighten tension knob to obtain a light pressure on clamp link and close lever.



**Important:** Apply **FINGER PRESSURE ONLY** to close pump clamp lever. Excessive pressure will damage or break the clamp link.

## Basic Care and Storage

The basic care described in this section does not require any disassembly of the pump. For any servicing procedures that require removing any part of the pump to access a component, please see the Service section.

After each use:

1. Visually inspect the pump unit.
2. Make sure the mechanical rotary seal is not leaking.
3. Check the pump for external leaks.
4. Check the condition of the coupling belt. Replace if worn.
5. Check the engine for leaks.
6. Clean any dirt or debris from the pump unit. Use a mild soap and water solution.
7. Clean air filter.
8. Make sure cooling passages and cylinder fins are clean.
9. Make sure that spark plug is cleaned and has proper gap setting. If the spark plug gap exceeds the recommended value of .020"-.024" (0.5-0.6 mm), replace.
10. Check throttle and choke control for proper operation.
11. Check the muffler for excessive carbon build-up. Clean if necessary.
12. Check the spark arrestor for excessive carbon build-up. Clean or replace if necessary.
13. Check fuel line and fittings for signs of wear, etc.
14. Check starter rope and mechanisms and replace if there are signs of wear.
15. Make sure UIM is free of dirt and debris. Verify condition of wiring and connectors.

16. Note and report any performance irregularities or any abnormal mechanical sounds.
17. Make sure all necessary tools, spares, and accessories are with the pump.

**Long-term storage**

1. Completely drain the pump of all water.
2. Drain the carburetor. The engine can be run at idle with the fuel line disconnected until the engine stops to drain the system.
3. Pour 0.17 oz. (5 mL) of 4-cycle engine oil (any viscosity will do) through the spark plug hole in the cylinder head. Slowly crank the engine to cover the piston rings, cylinder, and crankshaft with oil to protect the components from corrosion. Storage seal fogging oil can also be used.



**Important:** 2-cycle mixing oil is not recommended as preservation oil; it tends to attract moisture.

4. Follow any other products, components, apparatus, and departmental procedures and/or guidelines before placing the unit in storage.



## Troubleshooting

This section provides brief troubleshooting instructions for verifying the set-up and operation of the pump. Each section describes a condition and lists possible causes along with a list of items to check to identify the source of the problem and resolve it.

### Pump Loses Prime or Will Not Prime

<b>Air Leaks</b>	<ul style="list-style-type: none"> <li>■ Verify that suction hose coupling is securely tightened.</li> <li>■ Check suction hose gasket.</li> <li>■ Check sealing face on pump end suction cover.</li> </ul>
<b>Air Trapped in Suction Line</b>	<ul style="list-style-type: none"> <li>■ Check that no part of the suction hose is higher than the pump intake. Pump suction hose must be laid out with a continuous decline to the water source from the pump intake.</li> </ul>
<b>Blocked or Restricted Intake Hose or Strainer</b>	<ul style="list-style-type: none"> <li>■ Remove blockage from the intake hose or strainer.</li> <li>■ Strainer should not be sitting at the bottom of the water source where debris can be picked up. Clean off the strainer and raise to a position that is off the bottom of the water source (floating strainers are available).</li> </ul>
<b>Pump Suction Lift Requirements are Too High</b>	<ul style="list-style-type: none"> <li>■ DO NOT attempt pump lifts exceeding 22 feet (6.7 meters) except at elevations lower than 2000 feet (610 meters) above sea level.</li> <li>■ As elevation increases above 2000 ft (610 meters) above sea level, maximum lift heights will diminish. Check that the lift for the elevation the pump is being required to operate at is achievable.</li> </ul>
<b>Air Lock in the Discharge</b>	<ul style="list-style-type: none"> <li>■ Open the discharge valve to allow for the air to evacuate during the priming operation.</li> </ul>

### Pump Does Not Meet Performance

<b>Incompatible Suction Hose</b>	<ul style="list-style-type: none"> <li>■ Verify suction hose diameter is at a minimum of 2" (51 mm). Any smaller diameter hose will negatively impact the pump performance and suction lift.</li> </ul>
<b>Pump End Low Performance</b>	<ul style="list-style-type: none"> <li>■ Pump end impellers and diffusers are worn off and require replacement.</li> <li>■ Debris in the pump end. Clean.</li> </ul>
<b>Insufficient Engine Power</b>	<ul style="list-style-type: none"> <li>■ See Section "Engine Does Not Develop Normal Power And/Or Overheats"</li> <li>■ Check engine compression and complete engine repairs if required.</li> <li>■ An engine tune up may be needed to bring engine back to peak performance.</li> </ul>
<b>Gauge or Instrument Failure</b>	<ul style="list-style-type: none"> <li>■ Check that all gauges are calibrated, and that all equipment is in proper condition. Nozzles with dented edges and bent or damaged pitot tubes will produce faulty readings.</li> </ul>
<b>Blockage</b>	<ul style="list-style-type: none"> <li>■ Check hoses and suction strainer; remove any obstructions found.</li> <li>■ Check for debris wedged or caught in the impeller, diffuser, and suction cover. Remove any obstruction found.</li> </ul>
<b>Ambient Conditions</b>	<ul style="list-style-type: none"> <li>■ An engine will lose approximately 3.5% of its power per every 1000 feet (305 meters) above sea level (lower air density). Adjust carburetor accordingly.</li> <li>■ High ambient temperatures, low barometric pressure, and high humidity will negatively affect pump performance (lower air density). Adjust carburetor accordingly.</li> </ul>

**Pump Cavitating**

<b>Lift Too High</b>	<ul style="list-style-type: none"> <li>■ Restrictive or malfunctioning foot valve. Replace.</li> <li>■ Clogged strainer. Clean.</li> <li>■ Move pump closer to water source.</li> <li>■ Decrease pump's intake hose length.</li> <li>■ Increase pump's intake hose size.</li> </ul>
<b>Restrictions</b>	<ul style="list-style-type: none"> <li>■ Check that the bottom of the suction hose at a minimum of 2 feet (0.6 meters) from the bottom of the water source and correct if necessary.</li> <li>■ Check that the bottom of the suction hose/strainer is 4 to 6 times the hose diameter below the water supply surface level and correct if necessary.</li> </ul>

**Engine Does Not Start, Runs Irregularly or Misses**

<b>Fuel Supply Tank Empty</b>	Refill fuel tank.	<b>Carburetor Loose</b>	Tighten nuts and/or studs.
<b>Fuel Supply Valve Closed</b>	Open supply valve.	<b>Defective Carburetor</b>	Repair or replace.
<b>Air Vent on Fuel Tank Closed</b>	Open air vent or unscrew cap.	<b>Low Speed Mixture Jet Misadjusted</b>	See "Carburetor."
<b>Defective Fuel Supply Hose</b>	Replace.	<b>High Speed Mixture Jet Misadjusted</b>	See "Carburetor."
<b>Dirty Fuel Strainer Screen</b>	Clean or replace.	<b>Air Filter Dirty</b>	Clean or replace.
<b>Leak in Fuel Supply System</b>	Tighten or replace fittings.	<b>Spark Plug Fouled or Defective</b>	Clean or replace.
<b>Fuel Mixture Too Rich</b>	See "Fuel Supply."	<b>No Spark</b>	See "Flywheel & Ignition."
<b>Wrong Gasoline in Fuel Mixture</b>	See "Fuel Supply."	<b>Wrong Type of Spark Plug</b>	Use recommended spark plug.
<b>Water or Dirt in Fuel System</b>	Drain; flush thoroughly.	<b>Improper Timing</b>	See "Flywheel & Ignition."

**Engine Backfires**

<b>Spark Plug Fouled or Defective</b>	Clean or replace.	<b>Defective Carburetor</b>	Repair or replace.
<b>Improper Timing</b>	See "Flywheel & Ignition."		

**Engine Sounds Like a Four-Stroke**

<b>Engine Not Warmed Up Properly</b>	Allow longer warm-up period.	<b>High Speed Mixture Jet Misadjusted</b>	See "Carburetor"
<b>Too Much Oil in Fuel Mixture</b>	See "Fuel Supply."	<b>Air Filter Dirty</b>	Clean or replace.
<b>Improper Timing</b>	See "Flywheel & Ignition."		



**Engine Does Not Develop Normal Power and/or Overheats**

<b>Wrong Oil</b>	See "Fuel Supply."	<b>Air Filter Dirty</b>	Clean or replace.
<b>Wrong Gasoline</b>	See "Fuel Supply."	<b>Muffler Blocked</b>	Replace muffler and/or spark arrestor.
<b>Fuel Mixture Too Lean</b>	See "Fuel Supply."	<b>Low Speed Mixture Jet Misadjusted</b>	See "Carburetor."
<b>Fuel Mixture Too Rich</b>	See "Fuel Supply."	<b>High Speed Mixture Jet Misadjusted</b>	See "Carburetor."
<b>Cooling System Dirty</b>	Clean cooling system.	<b>Improper Timing</b>	See "Flywheel & Ignition."
<b>Cooling System Blocked</b>	Remove any debris blocking the cooling fan.	<b>"Winter-Grade" Gasoline: Vapor Lock</b>	See "Fuel Supply."

**Carburetor Flooding or Runs Rich With High Speed (Main) Adjustment Shut Off**

<b>Dirt or Foreign Particles Preventing Inlet Needle From Seating</b>	Remove, clean and/or replace. Press purge bulb and marine bulb to clear out the particles.	<b>Diaphragm Lever Spring Not Seated on Lever Dimple</b>	Remove lever and reinstall.
<b>Diaphragm Improperly Installed in Carburetor</b>	Replace diaphragm or correct installation.	<b>Improper Use of Choke</b>	Disengage/Open choke.

**Engine Will Not Accelerate**

<b>Low Speed Mixture Set Too Lean</b>	Enrich low speed adjustment.	<b>Diaphragm Gasket Leaking</b>	Replace.
<b>Incorrect Setting On Diaphragm Lever</b>	Reset.	<b>Main Fuel Orifice Plugged</b>	Remove diaphragm cover, diaphragm, diaphragm lever and high-speed adjusting screw. Clean out.
<b>Diaphragm Cover Plate Loose</b>	Tighten.	<b>Pulse Hole Partially Blocked</b>	Inspect intake side and resolve cause of blockage.

**Engine Will Not Idle**

<b>Incorrect Idle Speed Adjustment</b>	Adjust idle speed.	<b>Welch Plug Covering Idle Discharge Ports Not Sealing</b>	Replace welch plug.
--	--------------------	---	---------------------

**Engine Runs Out Lean**

<b>Fuel Tank Vent Not Working Properly</b>	Clean or replace.	<b>Ruptured Fuel Pump Diaphragm</b>	Replace.
<b>Leak in Fuel System from Tank to Pump</b>	Tighten or replace fittings and lines.	<b>Main Fuel Orifice Plugged</b>	Clean.
<b>"Winter-Grade" Gasoline: Vapor Lock</b>	See "Fuel Supply".		



# MAINTENANCE

## Regular maintenance

Regular maintenance is a schedule of continuous systematic maintenance, designed to prevent frequent or major breakdowns before they occur.



**Warning:** Before doing any maintenance to the pump, always ensure that the equipment cannot be accidentally started. Follow any apparatus and/or departmental procedures or guidelines regarding locking out the equipment.



**Important:** Maintenance on a fire pump should not be done on the fire line. Always check your pump unit immediately after use.

## Maintenance chart

<p>The following maintenance intervals apply for normal operating conditions only. If the unit is operated in harsh conditions (very dusty environment, extreme temperatures, abrasive water), shorten the intervals accordingly.</p> <p>Servicing should be completed by a trained mechanic from an authorized Service Center.</p> <p><b>Only use WATERAX Genuine spare parts.</b></p>		Before daily operation	After deployment	After fire season	125 hours	If problem	If damaged
Air filter	Clean		X	X		X	
	Replace						X
Ember separator	Clean		X	X			
	Replace						X
Fuel block / fuel adaptor	Inspect	X	X	X			
	Replace					X	X
External fuel tank	Clean		X				
Spark plug	Replace					X	X
Spark arrestor	Clean			X			
	Replace					X	
Recoil starter	Clean			X		X	
	Service						X
Cylinder cooling fins	Clean		X			X	
Piston kit	Replace				X		
Pump end	Inspect	X	X	X			
	Service					X	X
Frame	Inspect		X	X			
	Service					X	X
Vibration dampeners	Inspect		X	X			
	Service					X	X

## SERVICE

This section includes instructions for the complete overhaul of the unit. Servicing should be completed by a trained and experienced mechanic/technician. For any question regarding servicing, contact *WATERAX* technical support.



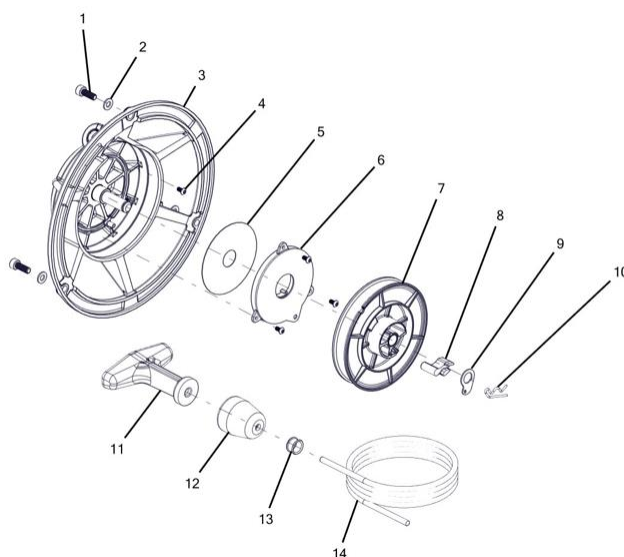
**Warning:** It is important to respect the specified torque and application of Loctite® where specified. **Refer to the torque table at the end of the manual for torque values and Loctite® requirements.**

### Recoil Starter

The recoil starter assembly requires regular maintenance for optimal operation. Regular cleaning is recommended, especially when the pump is operated in dusty conditions.

#### Parts Breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	600632	RECOIL STARTER ASSEMBLY WATSON	--
1	701744	SCREW M5X0.8X14 HEX SOCKET CAP SS DIN912	3
2	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	3
3	701778	HOUSING RECOIL STARTER WATSON	1
4	701885	SCREW M3X0.5X6 BUTTON HEAD TORX SS	4
5	701780	DISK LOW FRICTION RECOIL STARTER WATSON	1
6	701781	SPRING WITH CASING RECOIL STARTER WATSON	1
7	701783	PULLEY RECOIL STARTER WATSON	1
8	701787	PAWL RECOIL STARTER WATSON	1
9	701884	WASHER FRICTION RECOIL STARTER WATSON	1
10	702003	COTTER PIN HAIRPIN RECOIL STARTER WATSON	1
11	701978	HANDLE RECOIL STARTER WATSON	1
12	800128	R-544 BUFFER - RUBBER	1
13	800127	R-533 GUIDE FOR STARTER ROPE	1
14	701974	ROPE BLACK/RED 1500MM LG RECOIL STARTER WATSON	1



#### Troubleshooting

<b>Pawl slips on flywheel</b>	<ul style="list-style-type: none"> <li>■ Pawl is worn out. Replace.</li> </ul>
<b>Pawl doesn't open when cranking</b>	<ul style="list-style-type: none"> <li>■ Excessive friction between pawl and pulley. Clean or replace.</li> <li>■ Lack of friction between hairpin and shaft. Clean the shaft. Replace the cotter hairpin.</li> </ul>
<b>Rope doesn't rewind back</b>	<ul style="list-style-type: none"> <li>■ Lack of tension on the spring. Ensure 10 turns of tension on the spring.</li> <li>■ Interference between rope and housing: rope is too long, too large, or not wound properly in the pulley. Re-assemble. Use approved rope size of 11/64" (4.4 mm) and length of 59" (1500 mm).</li> <li>■ Excessive friction between pulley and shaft. Clean and lubricate with MOLYKOTE® 1122 grease. Replace pulley if necessary.</li> <li>■ Rewind spring is jammed. Lubricate with light machine oil or silicon-based lubricant. Replace if necessary.</li> <li>■ Rewind spring interferes with the housing. Ensure low friction disk is installed. Replace if worn.</li> <li>■ Pulley not engaged on the spring. Re-assemble and engage pulley with</li> </ul>

spring.

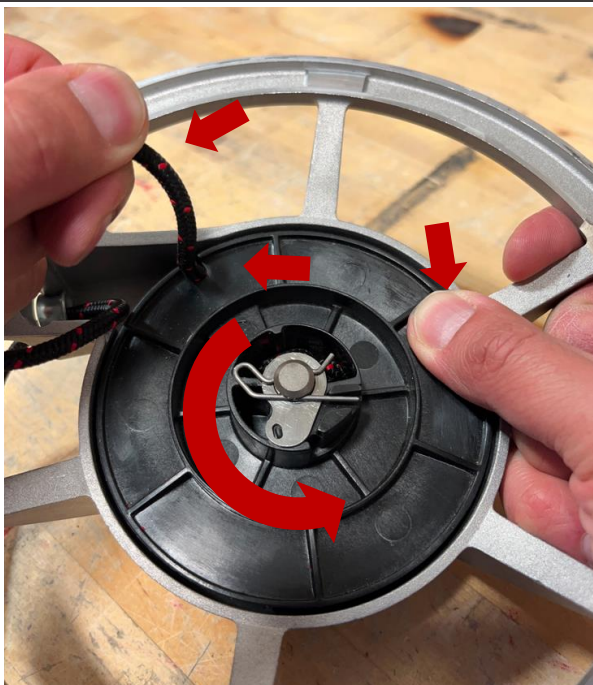
- Spring housing screws too tight. Torque at 5 lb-in (0.6 Nm).

## Disassembly



**Warning:** Wear safety goggles during the disassembly and assembly of the rewind starter. Special attention must be paid to the rewind spring.

1. Remove the rewind starter from the fan cowl bracket by removing three screws #1.
2. Before removing the pulley, relieve tension on the spring:
  - a. Pull the rope so that the pulley rotates approximately 1.5 turn and the notch on the pulley is accessible.
  - b. Maintain the pulley in position with your thumb. Create a loop with the rope. This will allow enough rope length to rotate freely.
  - c. Hook the rope on the notch and **slowly** unwind the pulley by rotating it **counterclockwise**.
3. Remove cotter hairpin #10 and remove friction washer, pawl, and pulley.
4. Remove 3x screws #4 that hold down the spring casing to remove recoil spring and low friction disk.
5. Untie the knot or cut the rope if necessary to remove the rope, guide, buffer, and handle.



**Warning:** Be careful when removing recoil spring! **Risk of injury** if rewind spring comes loose and unwinds! Ensure that spring is secured in its casing. Secure spring in its plastic casing with cable ties to prevent spring from coming loose during manipulation.

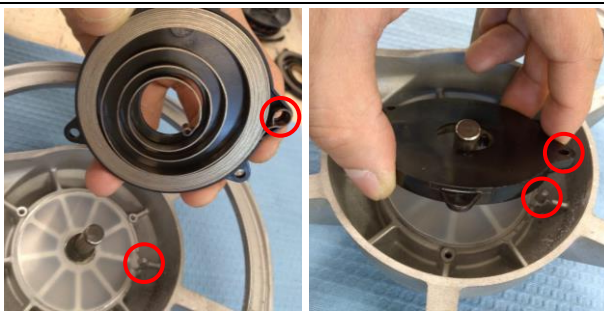
## Assembly

1. Install low friction disk. Ensure that it is centered in the housing.
2. Apply a small amount of lubricating oil (light machine oil or silicon-based lubricant) on the surface of the spring.





3. Align the spring retaining loop with the post in the housing and install the spring in the housing.
4. Apply Loctite 222 and tighten three screws #4 to a torque of 5 lb-in (0.6 Nm) to secure the spring in the housing. **Do not overtighten!**



5. Position the rope guide in the housing.
6. Press the rope guide down into the housing.
7. Apply Loctite 222 and hand tight screw #4 to secure the rope guide in the housing. **Do not overtighten!**



8. Insert the rope in the pulley through the hole. Push the rope through.
9. Tie a **single** overhand knot at the extremity of the rope. **Tighten firmly.**
10. Burn the end of the rope using a heat gun.



11. Pull the rope into the pulley cavity and push the knot firmly. Ensure that the rope is not protruding out.



12. Tightly wind the rope counterclockwise.
13. Leave approximately **8-10 inches (20-25 cm)** of unwound rope. Secure the rope by passing it through the notch on the pulley.

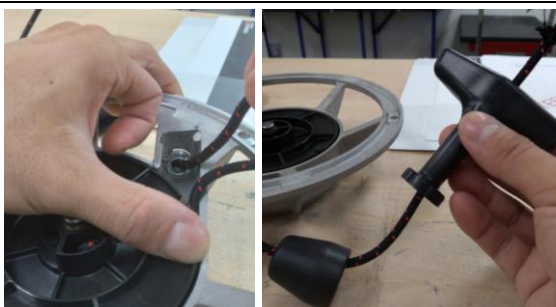




14. Apply a small amount MOLYKOTE 1122 on the shaft. **Be careful not to apply grease on the circlip groove.** Clean the groove if necessary.
15. Align the opening in the pulley with the spring end and install the pulley.
16. Rotate the pulley counterclockwise and ensure that it is **engaged with the spring**.



17. Pass the rope through the rope guide.
18. Install the buffer and the handle.



19. Tie a **double overhand knot** at the extremity of the rope. **Tighten firmly.**
20. Burn the end of the rope using a heat gun.
21. Secure the knot inside the handle.
22. Secure the handle in the buffer.



23. Install the pawl.
24. Install the washer. Ensure that the washer is properly located on the pulley tab.
25. Install the circlip. Ensure that the long end of the circlip is inserted in the pawl channel.



26. With the unwound rope passing through the pulley notch, wind the pulley **clockwise** for **three turns**. Do **not exceed** the number of turns specified: **damage to the spring will occur.**
27. Release the rope from the notch and **carefully** allow the pulley to come to a rest.
28. Test out the pulley by cranking it a few times. Observe that the pawl opens and closes freely.

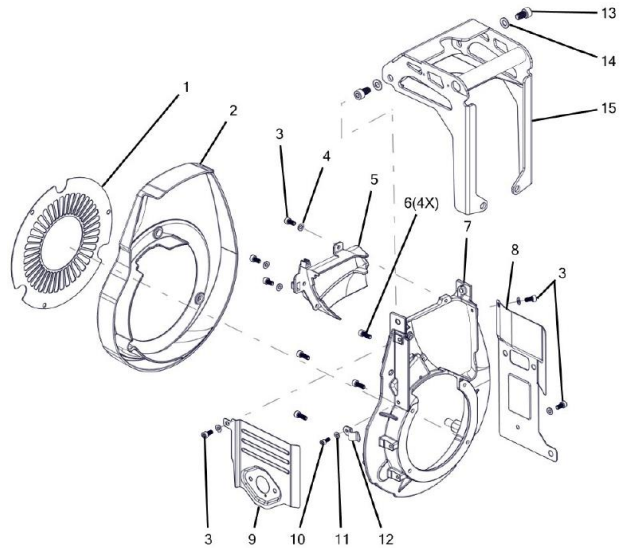


## Fan Cowl Assembly

In the event of a physical shock, inspect the fan cowl, fan cowl bracket, and carry handle for cracks. Replace if necessary.

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701773	SHIELD FAN WATSON	1
2	701770	FAN COWL WATSON	1
3	701772	SCREW M5X0.8X10 HEX SOCKET CAP SS DIN912	6
4	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	6
5	701771	DEFLECTOR FAN COWL WATSON	1
6	701744	SCREW M5X0.8X14 HEX SOCKET CAP SS DIN912	4
7	701768	BRACKET FAN COWL WATSON	1
8	701775	DEFLECTOR EXHAUST WATSON	1
9	701958	DEFLECTOR INTAKE WATSON	1
10	701988	SCREW M4X0.7X10 HEX SOCKET CAP SS DIN 912	1
11	702033	WASHER M4 FLAT 4.3MM X 9MM SS DIN125	1
12	702001	CABLE HOLDER N STYLE 1/2 X 1-3/8 NO.8 NYLON	1
13	701804	SCREW M8X1.25X14 HEX SOCKET CAP SS DIN912	2
14	701814	WASHER M8 FLAT 8.4MM X 15MM SS	2
15	701803	CARRY HANDLE WATSON	1



### Cooling

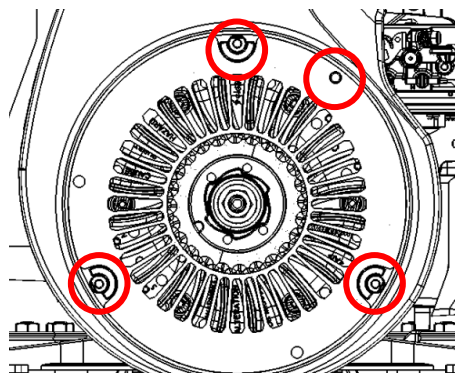
Engine cooling is accomplished by a fan attached to the flywheel. The fan draws air through the fan shield and forces the air around the cylinder and cylinder head cooling fins.

In time, the cooling air passages can become partially clogged with dirt, thus reducing cooling efficiency. Whenever this condition occurs, remove the recoil starter, fan shield, and fan cowl; use a damp cloth with soapy water to remove all dirt deposits from the fan shield, fan cowl, deflectors, and engine cooling fins. Regular cleaning will ensure optimal engine cooling and prolong engine life.

Additionally, inspect the fan cowl for any damage or excessive warping as this could cause the cooling air to escape through a crack or between the fan cowl and fan cowl bracket. Replace the fan cowl if necessary.

### Fan shield

Ensure that the fan shield is **properly installed** on the fan cowl before installing the recoil starter. The three cutouts and alignment hole should match with the corresponding features on the fan cowl:



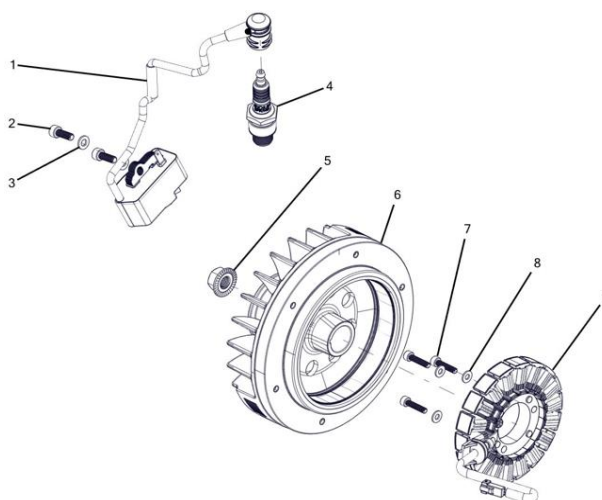
**Warning:** The fan shield should always be installed to prevent potential pinching injuries and damage to the fan and flywheel during pump operation.

## Flywheel & Ignition

The flywheel and stator provide AC power to the batteryless module, which in turn, regulates and rectifies it into DC power to feed the User Interface Module (UIM).

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701741	CDIM W140	1
2	701744	SCREW M5X0.8X14 HEX SOCKET CAP SS DIN912	2
3	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	2
4	701730	SPARK PLUG W140	1
5	701728	NUT M10X1.25 SERRATED LOCK FLANGE CL8 DIN6923	1
6	701740	FLYWHEEL/MAGNETO/FAN ASSEMBLY W140	1
7	701932	SCREW M4X0.7X18 HEX SOCKET CAP SS DIN912	3
8	702033	WASHER M4 FLAT 4.3MM X 9MM SS DIN125	3
9	701882	STATOR W140	1



### Capacitive Discharge Ignition Module (CDIM)

The CDIM provides the energy to the spark plug at a predefined advance ignition timing. The CDIM also has a built-in engine overspeed protection in the event the UIM fails. Besides the air gap, no adjustment is necessary.

### Flywheel and stator

The flywheel possesses a magnet on the outer diameter for the CDIM and a set of inner magnets for the stator and power generation. The flywheel assembly is balanced to minimize vibrations during engine operation. The flywheel doesn't require any special maintenance. Inspect for physical damage; replace if necessary.

The stator doesn't require any special maintenance. Inspect for physical damage and signs of burning; replace if necessary.



**Important:** To prevent debris from being attracted to the inner magnets, always place the flywheel with the inner magnets facing upwards.

The best way to troubleshoot the flywheel and stator is by visually inspecting for damage. Alternatively, disconnect the batteryless module and measure the AC voltage using an oscilloscope at the terminals of the stator output while pulling the starter rope. Expected voltage: 5 V<sub>rms</sub> at 650 rpm; 7 V<sub>rms</sub> at 900 rpm.



**Warning:** When manipulating the flywheel, be careful not to slide your bare fingers on the inner magnets. The magnet casing is **sharp** and could cause an injury.



**Warning:** Each flywheel assembly is balanced to prevent dangerous vibrations during engine operation. If the flywheel is physically damaged (e.g., broken fan blade), the engine must be stopped, and the flywheel replaced to prevent damage to the unit and potential injuries.



**Warning:** The cooling fan should not be removed and/or replaced. Since the entire assembly is balanced, any modification or change to the assembly can affect the balancing and cause dangerous vibrations during engine operation.

## Spark plug

The engine uses a premium iridium spark plug for improved startability and durability. Operating with a defective or incorrect spark plug will affect the engine's performance and can cause hard starting, fouling, missing, overheating, pre ignition and/or lack of power. To service and inspect the spark plug:

1. Disconnect the spark plug cable and remove the spark plug.
2. Clean the spark plug and inspect carefully. If tip of insulator core is rough, cracked, broken, or blistered, or if electrodes are burned away, replace with new plug.
3. Reinstall the spark plug. Start threads one or two turns with fingers to avoid danger of cross threading. Tighten the spark plug to recommended torque of 27 Nm (19.9 lb-ft).
4. Connect the spark plug cable.



**Important:** The spark plug air gap doesn't require any adjustment. Replace the spark plug if gap is no longer as per specification.



**Important:** Ceramic insulation of spark plug is easily damaged by shock stresses or bending stresses as may be imposed by dropping, striking with hard objects, or overtightening. Therefore, if spark plug has been subjected to such accidental abuse, it should be carefully inspected and tested before further use.

## Troubleshooting

### No Spark

- Defective spark plug. Replace.
- Disconnect wires to CDIM. Reconnect.
- Incorrect air gap between CDIM and flywheel. Adjust.
- Defective CDIM. Replace.
- Defective/damaged flywheel. Replace.

## Disassembly

1. Remove the spark plug.
2. Install the **piston locking tool**.
3. Rotate the flywheel by hand counterclockwise (CCW) until piston crown contacts the piston locking tool.
4. **Remove the flywheel nut.**



5. Rotate the flywheel by hand clockwise (CW) until the piston crown contacts the piston locking tool.
6. Install the flywheel removal tool. **Thread all the way.**
7. Tighten the bolt to remove the flywheel.
8. Remove the flywheel removal tool off the flywheel.
9. Remove the stator by removing the three screws.

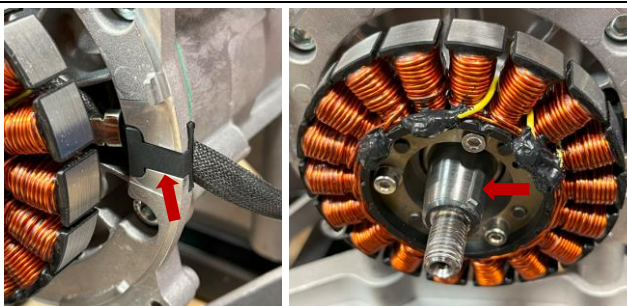




10. Push out the grommet to pass the wire.

### Assembly

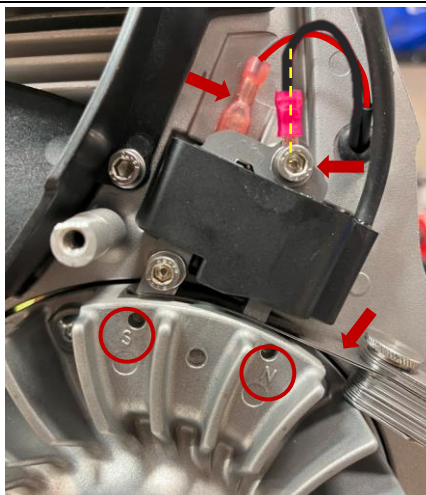
1. Install the grommet in the crankcase. **Be careful not to use a sharp tool to prevent damaging the grommet.**
2. Install the stator with the cable facing the intake. Apply Loctite 222 and tighten the three M4 screws with the **flat washers** to 16.2 lb-in (1.8 Nm).
3. Install the woodruff key. Ensure that it is properly installed and **won't fall** during the installation of the flywheel. Failure to install the woodruff key will lead to improper ignition timing.



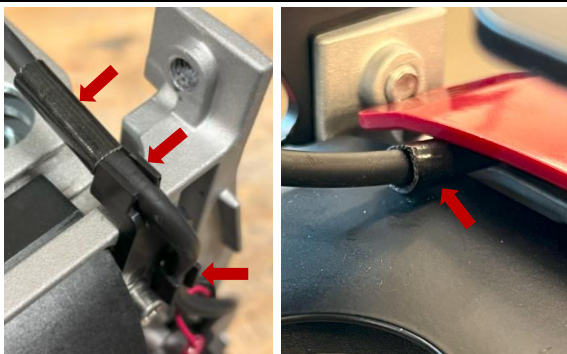
**Important:** Ensure that the flywheel and crankshaft tapers are **free of grease and are clean** to prevent slippage and damage to the key, crankshaft, and flywheel. Use a degreaser (e.g., brake cleaner) to clean the tapers.

4. Align the keyway on the flywheel with the woodruff key on the crankshaft and slide the flywheel on the crankshaft.
5. Apply Loctite 243 and tighten the flywheel nut to 40.6 lb-ft (55 Nm).

6. Install the ground wire (ring terminal) on the top screw of the CDIM.
7. Install the stop wire on the CDIM tab.
8. **Loosely** install the CDIM on the fan cowl bracket.
9. Insert a feeler gauge set at .020" (0.5 mm) between the flywheel **magnet** ("S"- "N") and both CDIM pickups and adjust the air gap. Apply Loctite 243 and tighten the screws to 35.4 lb-in (4 Nm). **Note:** for a softer bend, use a .009" and .011" blades.
10. **Position the wires to avoid damage and contact with the fan cowl.** The ground cable should be oriented between 12 and 1 o'clock.



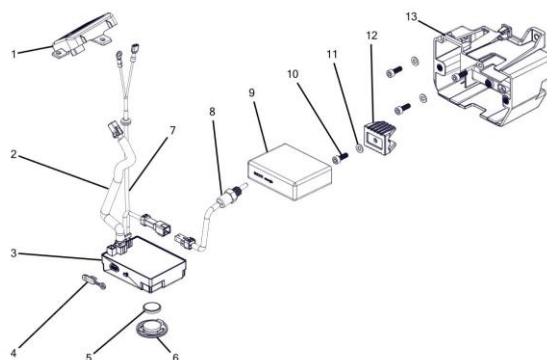
11. Secure the spark plug cable. Apply P-80® Emulsion Temporary Assembly Lubricant on the cable to facilitate the installation of the cable in the clips.
12. Position the protective sleeve **after** the top cable clip.
13. When installing the fan cowl, position the **protective sleeve between the fan cowl and the carry handle top deflector** to provide protection.



## Electronics

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701881	BUTTON AND LED USER INTERFACE WATSON	1
2	701797	HARNESS BUTTON 6 WIRES WATSON	1
3	701979	USER INTERFACE MODULE UIM	1
4	701980	UIM DUST COVER	1
5	--	BATTERY CR2032	1
6	701981	UIM BATTERY COVER	1
7	701792	HARNESS UIM SPLITTER 4 WIRES WATSON	1
8	701796	SENSOR CYLINDER TEMP WITH JST CONN. WATSON	1
9	701880	BATTERYLESS MODULE WATSON	1
10	701744	SCREW M5X0.8X14 HEX SOCKET CAP SS DIN912	4
11	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	4
12	701812	DAMPENER RUBBER AIR BOX ELECTRONICS WATSON	1
13	701991	HOUSING ELECTRONICS WATSON	1



### Troubleshooting

#### UIM LED Not Lighting Up

- 6-wire harness not connected. Connect the harness.
- Stator not connected to batteryless module. Connect.
- Defective button and LED UI module. Replace the Button and LED UI module.
- Broken connector on the button and LED UI module. Replace the Button and LED UI module.
- Broken connector(s) on the UIM. Replace UIM.
- Defective UIM. Replace the UIM.
- Defective batteryless module. Replace the batteryless module.
- Defective stator. Replace the stator.

#### OFF Button Not Shutting Down The Engine, But LED Is Working

- Defective button and LED UI module. Replace button and LED UI module.
- See LED States section for further troubleshooting details.

#### LED Solid Yellow

- See LED States section for troubleshooting details.

### Batteryless module

To troubleshoot the batteryless module, measure the voltage at the output. A value of 13.1 V should be obtained when the engine is running (above 1,000 rpm).

### Disassembly

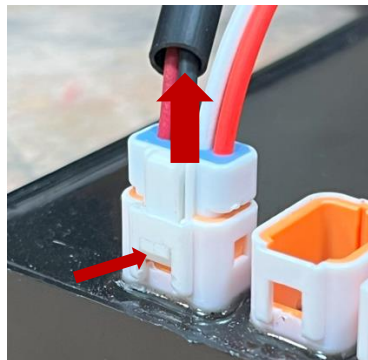
1. Remove the air filter inner cover to access the electronics housing.
2. Remove the two side screws that are holding the Button and LED cover assembly to the carburetor bracket.
3. Release the cables from the cable holder clip.



4. Move the throttle lever to the idle position.
5. Using finger pressure, bend the side walls of the Button and LED cover assembly and pull it (upwards) off the carburetor bracket.



6. Detach the temperature sensor connector off its clip.
7. Remove the three screws holding the electronics housing to the unit.
8. Using a small flat screwdriver, **carefully** press on connector locking tab and pull on cable to disconnect temperature sensor.
9. Detach the stator connector off its clip.
10. Using a small flat screwdriver, **carefully** press on the connector locking tab and pull on the stator cable to disconnect it from the batteryless module.
11. Using a small flat screwdriver, **carefully** press on connector locking tab and pull on the cables to disconnect them from the UIM.



**Important: Be careful when pressing the connector locking tab** to avoid damaging the connectors on both the wire harness and the modules.

12. Remove the screw holding the rubber dampener.
13. Remove the rubber dampener.
14. Remove the UIM and batteryless module.



## Assembly

1. Slide the batteryless module and UIM in the electronics housing.
2. To help with the insertion, apply P-80® Emulsion Temporary Assembly Lubricant on the rubber dampener. Slide the rubber dampener with the locking tab positioned to the right.
3. Apply Loctite 243 and install the rubber dampener screw and flat washer to 35.4 Lb-in (4 Nm).





4. When installing the temperature sensor: apply a small amount of thermal paste (e.g., DOWSIL™ 340) on the tip of the temperature sensor. Ensure that the O-ring is installed on the sensor. Firmly tighten on the cylinder using a 14 mm wrench.
5. Route the batteryless module output cable on the rear of the electronics housing.
6. Install the stator and temperature sensor connectors on the clips. Ensure that the locking tab is facing **outwards**.
7. Connect the stator and batteryless module cables.



8. Install the electronics housing sub-assembly on the unit using the three screws and flat washers. Apply Loctite 243 and tighten to 35.4 lb-in (4 Nm).
9. Connect in this order: splitter 4-cable wire harness, temperature sensor, UIM 6-cable wire harness, and 2-cable power generation wire harness.
10. Feed the CDIM wires through the hole in the fan cowl bracket. Install the grommet.
11. Install the remaining components in reverse order. Secure the cables to the clip located on the fan cowl bracket.

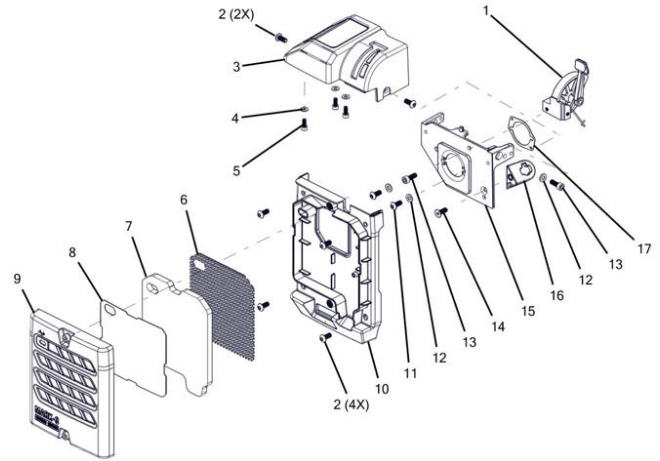


**Important:** Verify that all connectors are properly installed and ensure that cables are securely routed.

## Air Filter & Throttle

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701847	THROTTLE ASSEMBLY WATSON	1
2	701987	SCREW M5X0.8X12 HEX SOCKET BUTTON SS BLACK OXYDE	6
3	701892	COVER UIM BUTTON WATSON	1
4	702033	WASHER M4 FLAT 4.3MM X 9MM SS DIN125	3
5	701988	SCREW M4X0.7X10 HEX SOCKET CAP SS DIN 912	3
6	701994	GRILL AIR BOX WATSON	1
7	701759	AIR FILTER FOAM WATSON	1
8	702004	EMBER SEPARATOR WATSON	1
9	701894	COVER ASSEMBLY AIR FILTER WATSON	1
10	701757	COVER INNER AIR FILTER WATSON	1
11	702042	SCREW M5X0.8X12 HEX SOCKET BUTTON SS	2
12	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	3
13	701744	SCREW M5X0.8X14 HEX SOCKET CAP SS DIN912	2
14	702039	SCREW M5X0.8X14 HEX SOCKET FLAT SS DIN7991	1
15	701986	BRACKET CARBURETOR TO AIR FILTER WATSON	1
16	701989	BRACKET PURGE BULB WATSON	1
17	701752	GASKET AIR FILTER	1



### Air filter

Regularly clean and/or replace the air filter. The air filter works best when oiled. A tackifier foam oil filter spray (e.g., UNI® FILTER foam filter oil) can be used on the air filter to help the oil adhere to the air filter.

### Servicing

Apply MOLYKOTE 1122 grease on the quadrant teeth, indexing pin and throttle lever shaft when installing the throttle lever into the quadrant to facilitate installation and operation.

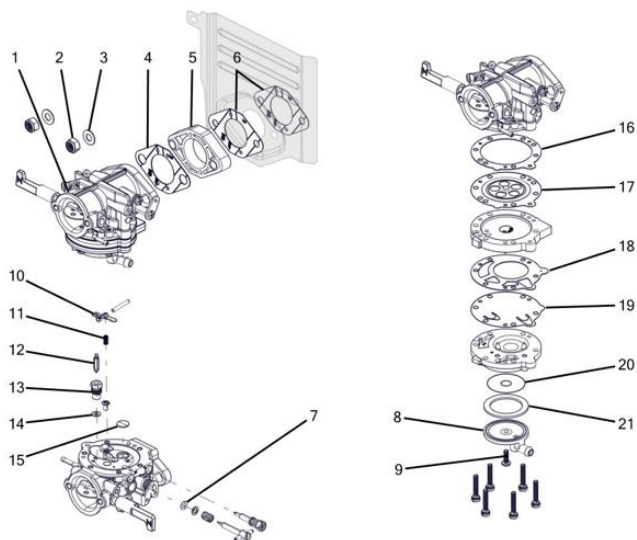
## Carburetor

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701904	CARBURETOR WITH PURGE PORT WATSON	1
2	800544	R-150 NUT M6X1.0 HEX FUJI LOCK ZINC	2
3	800545	R-149 LOCKWASHER M6 SPRING ZINC	2
4	701766	GASKET INTAKE CARBURETOR SIDE WATSON	1
5	701905	ISOLATING FLANGE INTAKE WATSON	1
6	701765	GASKET INTAKE ENGINE SIDE WATSON	2

ID	ITEM NO	DESCRIPTION	QTY
7	702088	O-RING MIXTURE SCREW CARB W140	2
8	702089	COVER FUEL PUMP CARB W140	1
9	702090	SCREW COVER FUEL PUMP CARB W140	1

ID	ITEM NO	DESCRIPTION	QTY
--	702085	CARBURETOR REPAIR KIT W140	--
10	--	LEVER INLET CARB W140	1
11	--	SPRING INLET CARB W140	1
12	--	NEEDLE INLET CARB W140	1
13	--	SEAT INLET CARB W140	1
14	--	GASKET COPPER INLET CARB W140	1
15	--	WELCH PLUG CARB W140	1
16	--	GASKET METERING CARB W140	1
17	--	DIAPHRAGM METERING CARB W140	1
18	--	GASKET FUEL PUMP CARB W140	1
19	--	DIAPHRAGM FUEL PUMP CARB W140	1
20	702086	STRAINER SCREEN FUEL PUMP CARB W140	1
21	702087	GASKET COVER FUEL PUMP CARB W140	1



### Leak test

A leak test is done on a wet carburetor. This will ensure everything is sealed and mimics running conditions. Apply 5.8 psi (40 kPa) on the inlet fuel connector. If the pressure does not drop more than 0.07 psi (0.5 kPa) after 30 seconds, it is considered a "pass."

### Maintenance

The carburetor can be cleaned and serviced with a minimum of tools.

1. Remove strainer cover retaining screw and plastic cover.
2. Remove strainer cover gasket and strainer screen.
3. Remove screws and fuel pump body.
4. Remove fuel pump diaphragm and gasket.
5. Remove main diaphragm cover plate.
6. Remove main diaphragm and main diaphragm gasket.
7. Remove inlet control lever fulcrum pin, lever, and tension spring.
8. Remove inlet needle.
9. With a thin wall 5/16" (8 mm) hex socket, carefully remove the inlet seat. Remove inlet seat gasket. When reinstalling seat, tighten to 43.4 lb-in (4.9 Nm).
10. Remove low speed and high-speed mixture screws.



**Important:** Do not soak the gaskets and diaphragms to avoid swelling. A gentle cleaning is recommended before reinstallation.



**Important:** It is **not recommended to blow compressed air** inside the carburetor as this can damage the various check valves, further worsening the problem.

Before reassembling the carburetor (in reverse order as outlined previously), it is recommended to soak the carburetor in carburetor cleaner for one hour with gaskets and diaphragms removed. This penetrates gunk and dissolves the build-up. An ultrasonic cleaner can also be used. Mix 30% Simple Green® cleaner with 70% water. Do not soak for more than 10 minutes.



**Important:** Do not clean orifices or passages with wires or drills as this might damage and cause incorrect operation of the carburetor.

When reinstalling O-ring type adjusting screws, lubricate with SAE-30 oil to prevent seizing. Packing spring type adjustments do not require lubrication.

When reassembling the inlet control lever and spring, make sure that the spring rests in the well of the metering body and locates on the dimple of the inlet control lever.

**Do not** stretch spring. Inlet control lever is properly set when flush with floor of diaphragm chamber. Be certain main diaphragm, gasket and cover casting are carefully fitted over the three small pins cast in rim at bottom of metering body. The fuel pump gasket, diaphragm and fuel pump body are placed over similar pins at bottom rim of main diaphragm cover casting. Evenly tighten fuel pump body retaining screws to insure complete seal of casting separations of both diaphragms.

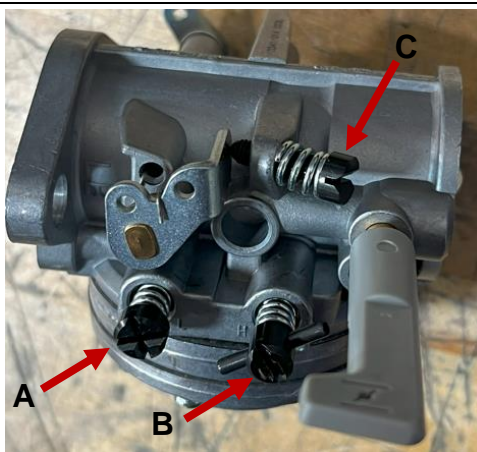
Frequent cleaning or replacement of the fuel strainer screen will aid satisfactory operation of the carburetor.

### Carburetor adjustments

There are three adjustments on the carburetor (see image):

- A.** Low-speed (idle) mixture adjustment screw ("L")  
*The low-speed mixture screw controls the air-to-fuel mixture ratio at idle and low speeds.*
- B.** High-speed (main) mixture adjustment screw ("H")  
*The high-speed mixture jet screw controls the air-to-fuel mixture ratio at high speeds.*
- C.** Idle speed adjustment screw  
*The idle speed regulating screw controls the idle speed.*

Turning the mixture screws clockwise (**CW**) will close the jets and lean out the mixture (more air, less fuel). Turning the screws counterclockwise (**CCW**) will open the jets and richen up the mixture (less air, more fuel).



**Important:** Turn adjustment screws carefully and gently. Do not force needle into seat; otherwise, both needle and seat may be permanently damaged.

1. Before starting the pump unit, close both high and low speed adjustment screws by turning **CW** until they just touch the seat. **Note:** carburetors supplied as spare parts come pre-adjusted.
2. The entry settings are as follows:
  - High speed: open jet by turning one and three eighths (1-3/8) turn **CCW** from fully closed.
  - Low speed: open jet by turning one and three eighths (1-3/8) turn **CCW** from fully closed.
3. Turn idle speed regulating screw until throttle shutter is slightly open.
4. Install a **1/4" (6.35 mm) nozzle tip** at the discharge hose.
5. Start unit. Allow engine to properly warm up until LED is solid green.
6. Increase the speed gradually to full throttle setting. Run for **5 minutes**. Ensure the engine is not running too lean during this period.
7. Adjust the **low-speed** mixture:
  - Return the throttle to idle and wait 1 minute for engine to cool down.
  - Proceed with **400 rpm rich-down procedure**.
    - a) Find best power using the L-mixture needle. Best power is where rpm is highest.
    - b) Using the idle speed adjustment screw, bring the engine rpm down to **2500±50 rpm**.
    - c) Check if "L" screw is still at best power. If not, repeat steps a) and b) until "L" screw is at best power and the engine is at **2500±50 rpm**.
    - d) Turn "L" screw to the **rich side (CCW)** to bring engine speed down to **2100±50 rpm**.
8. Go to WOT and warm up the engine for **2 minutes**.
9. Adjust the **high-speed** mixture:
  - Turn the high-speed mixture adjustment screw **CW** until engine speed **noticeably** drops.
  - **Immediately**, turn the "H" to the **rich side (CCW) for half a turn**.
  - There will be a slight decrease in engine speed and pump pressure. With a 1/4" nozzle tip, the pressure drop will be approximately **5 psi**. **If no performance drop is detected, repeat the adjustment procedure.**



**Important:** Do not adjust the low-speed and high-speed mixture **too lean** for the sake of performance; improper adjustment will result in insufficient lubrication, higher engine temperatures, and premature engine failure.



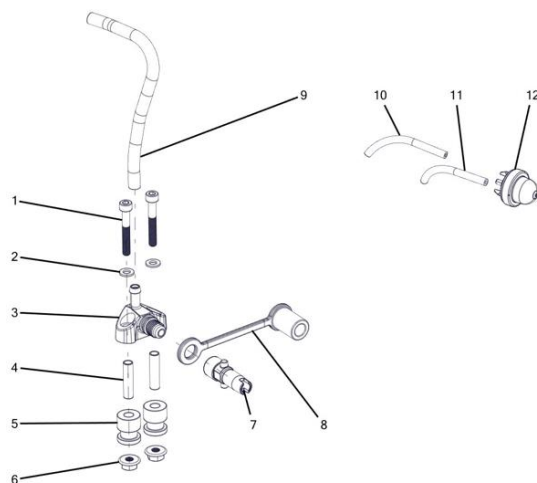
**Important:** It will be necessary to readjust the carburetor when operating the pump at different elevations and ambient conditions.



## Fuel Connector & Purge Bulb

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701957	SCREW M5X0.8X35 HEX SOCKET CAP SS DIN912	2
2	701927	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	2
3	702058	BODY FUEL BLOCK ALU WATSON	1
4	702044	COMPRESSION LIMITER FUEL BLOCK WATSON	2
5	702045	ISOLATOR NEOPRENE FUEL BLOCK WATSON	2
6	702070	NUT M5X0.8 HEX FLANGE ZINC	2
7	702057	CONNECTOR FUEL MERCURY MALE TO SAE FEM. WATSON	1
8	701903	DUST CAP FUEL CONNECTOR WATSON	1
9	702051	TUBING FUEL CARBURETOR 3/16 X 6.125 WATSON	1
10	702061	TUBING FUEL PURGE BULB 3/32 X 3.875 WATSON	1
11	701898	TUBING FUEL PURGE BULB 3/32 X 2.500 WATSON	1
12	701750	PURGE BULB FOR CARBURETOR WATSON	1



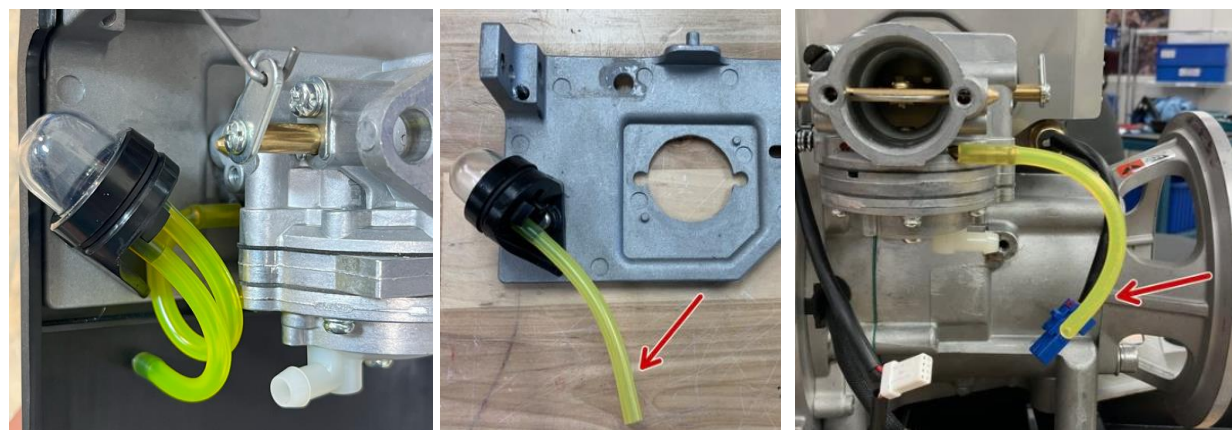
### Mercury fitting

If using a fuel line with a Mercury quick-connect fitting, install the male Mercury quick-connect fitting on the fuel block. Tighten firmly using an adjustable wrench.

### Purge bulb

The purge bulb draws the fuel into the carburetor and expels the excess air and fuel into the air box and air filter. This prevents flooding of the engine.

To allow proper functioning of the purge bulb, ensure that the **Tygon hoses are not kinked**. The purge bulb inlet is the short barb; the outlet is the long barb. Route the hoses in this manner:



The Tygon tubing has a natural curvature. To help prevent kinking, pre-install the **short** Tygon tubing on the purge bulb **long barb** with the curve pointing **downwards**. Pre-install the **long** Tygon tubing on the carburetor purge port elbow with the curve pointing **downwards**.

### Servicing

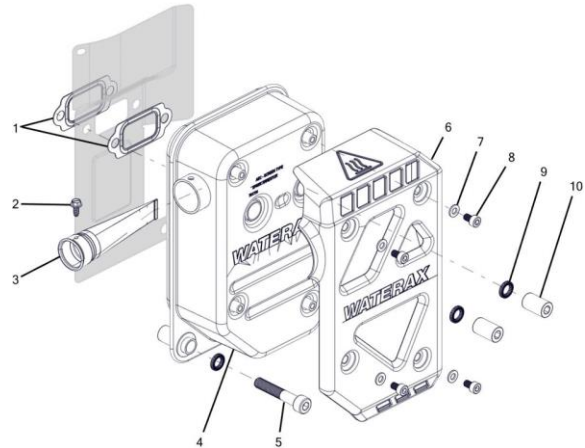
Replace the Mercury connector if the locking tabs or the connector surface is damaged to prevent air leak. Replace the Tygon (F-4040-A) hoses if they become hard.

## Muffler Assembly

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701729	GASKET EXHAUST FLANGE W140	2
2	701735*	SCREW SPARK ARRESTOR	1
3	701734*	SPARK ARRESTOR W140	1
4	701960*	MUFFLER W140	1
5	701800	SCREW M8X1.25X50 HEX SOCKET CAP ZINC CL12.9 DIN912	1
6	701961*	HEAT SHIELD MUFFLER W140	1
7	701927*	WASHER M5 FLAT 5.3MM X 10MM SS DIN125	4
8	701738*	SCREW M5X0.8X8 HEX SOCKET CAP SS DIN 912	4
9	701737	LOCKWASHER M8 WEDGE ZINC	3
10	701736	SOCKET NUT M8X1.25 FOR W140 MUFFLER	2

\* Included in Watson Muffler Assembly (701875)



### Servicing

No special maintenance is required on the muffler assembly. Replace the muffler heat shield if damaged. Replace the spark arrestor if it is clogged or damaged.



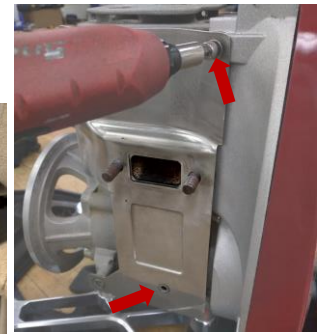
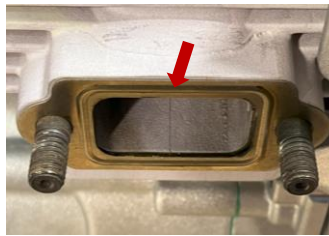
**Warning:** Carefully inspect the spark arrestor and replace if it becomes restrictive. A clogged spark arrestor will affect performance and can cause excessive temperatures in the exhaust.



**Warning:** To prevent starting fires, always operate with the spark arrestor installed. The spark arrestor has been qualified and approved under specifications MIL-STD-100G.

### Assembly

1. Install the first muffler gasket on the cylinder port. Ensure that the **“bump” is facing outward** towards the exhaust deflector.
2. Install the exhaust deflector using two M5 screws and flat washers. Torque to 35.4 lb-in (4 Nm). See Fan Cowl Assembly parts breakdown for details.



3. Install the second muffler gasket on the exhaust deflector. Ensure that the **“bump” is facing outward** towards the muffler.
4. Install the muffler. Tighten the muffler nuts and screw with the wedge lock washers to 19.9 lb-ft (27 Nm).

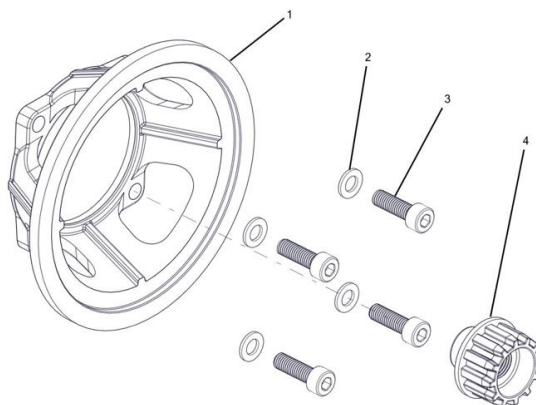




## Pump Hub

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701816	MOUNTING FLANGE PUMP WATSON	1
2	701814	WASHER M8 FLAT 8.4MM X 15MM SS	4
3	701815	SCREW M8X1.25X25 HEX SOCKET CAP SS DIN912	4
4	701818	COUPLING DRIVE 12 TEETH M16X1.5 ENGINE WATSON	1



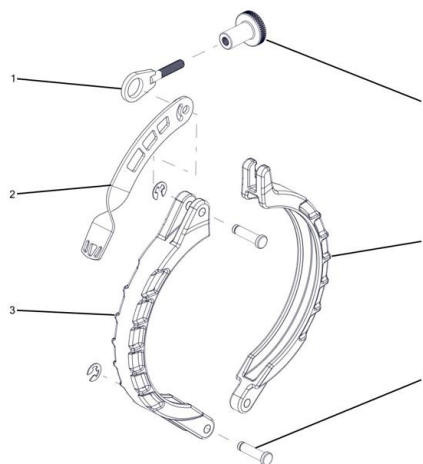
### Servicing

Regularly inspect the pump hub for cracks. Replace if necessary. Use the piston locking tool to remove and install the coupling drive at the specified torque of 29 lb-ft (40 Nm).

## Pump Clamp

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	600630	PUMP CLAMP ASSEMBLY WATSON	--
1	701851	LINK CLAMP WATSON	1
2	701852	LEVER CLAMP WATSON	1
3	701782	CLAMP HALF AIR BOX SIDE WATSON	1
4	701810	THUMB SCREW CLAMP WATSON	1
5	701784	CLAMP HALF MUFFLER SIDE WATSON	1
6	701813	CLEVIS PIN WITH RETAIN. RING 1/4 DIA 7/8 LG SS	2



### Servicing

The quick release pump clamp should be inspected on a regular basis. If components appear to be worn, replace them immediately.

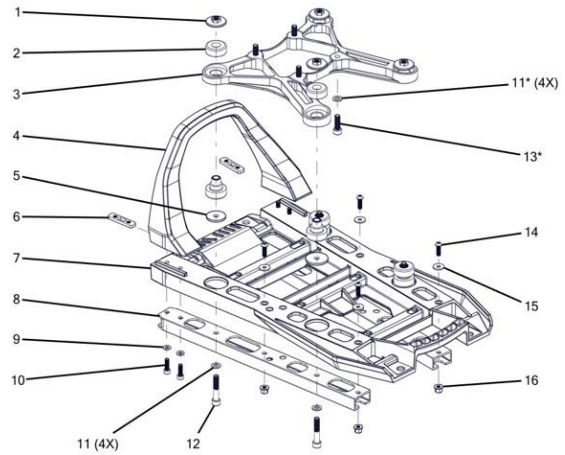


**Important:** Apply **FINGER PRESSURE ONLY** to close pump clamp lever. Excessive pressure will damage or break the clamp link.

## Frame Assembly

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	600629	FRAME ASSEMBLY WITH CROSS-MEMBER WATSON	--
1	702025	NUT FLANGE CUSTOM M8 SS ISOLATOR MOUNT WATSON	4
2	702066	ISOLATOR MOUNT 30 DURO 1.313X.402 FRAME WATSON	4
3	702026	CROSS-MEMBER FRAME WATSON	1
4	702047	FRAME HANDLE HDPE WATSON	1
5	702041	SPACER FOR ISOLATOR MOUNTS ALU WATSON	4
6	702027	PLATE THREADED HANDLE FRAME WATSON	2
7	701794	FRAME BASE HDPE WATSON	1
8	702063	SUPPORT CHANNEL ALU FRAME WATSON	2
9	701935	WASHER M6 FLAT 6.3MM X 12MM SS DIN125	4
10	702067	SCREW M6X1.0X20 HEX SOCKET ZINC C12.9 DIN912	4
11	701814	WASHER M8 FLAT 8.4MM X 15MM SS	4
11	701814*	WASHER M8 FLAT 8.4MM X 15MM SS	4
12	702024	SCREW M8X1.25X45 HEX SOCKET CAP ZINC CL12.9	4
13	701815*	SCREW M8X1.25X25 HEX SOCKET CAP SS DIN912	4
14	702068	SCREW M6X1.0X20 HEX SOCKET BUTTON HEAD SS BLACK	4
15	702056	WASHER M6 FLAT 6.4MM X 18MM SS BLACK OXYDE	4
16	702069	NUT M6X1.0 HEX NYLON LOCK FLANGE ZINC	4



\*Not included in Frame Assembly with Cross-Member Watson (600629)

### Servicing

If the unit shows signs of a severe drop or impact, inspect the frame, support channels, and cross-member for cracks or distortion: replace if necessary. Regularly inspect the vibration mounts: replace if necessary. The HDPE frame will wear with usage. The wear rate will depend on the ground it is operated. Replace if the frame is too worn out and is structurally compromised.

### Decals

#### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701897	DECAL USER INTERFACE WATSON	1
2	701677	DECAL THROTTLE POSITION WATSON	1
3	701761	DECAL START/STOP AND SETUP INSTRUCTIONS WATSON	1
4	702079	DECAL FINGER PINCHING WATSON	1
5	702065	DECAL CHOKE WATSON	1
6	701895	DECAL WARNING AIR BOX WATSON	1
7	702078	DECAL CAUTION WATSON	1



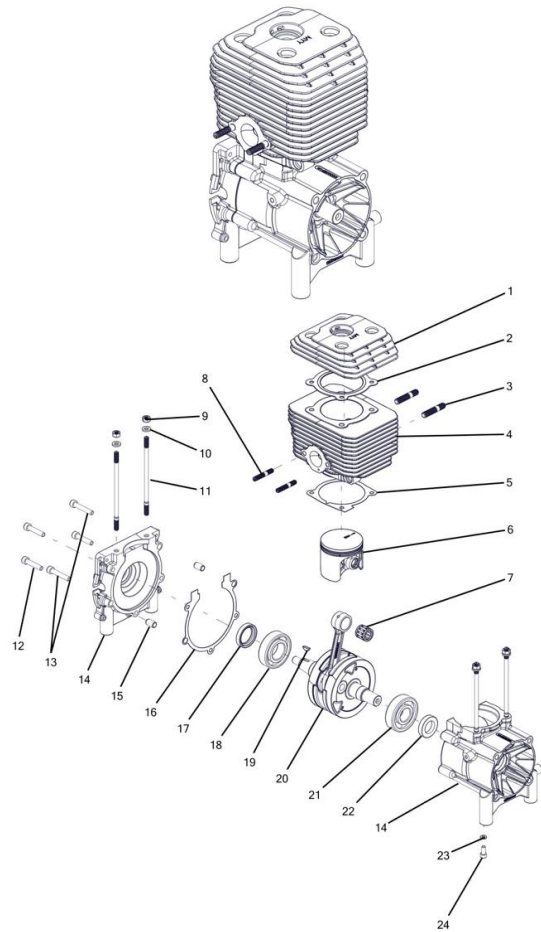
### Servicing

To ensure proper adhesion of the decals, thoroughly clean the surfaces with isopropyl alcohol.

## Engine

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	701710	ENGINE, W140 COMPLETE 140CC	--
1	701716	CYLINDER HEAD W140	1
2	701717	GASKET HEAD W140	1
3	702036	STUD EXHAUST M8X1.25 W140	2
4	701715	CYLINDER W140	1
5	701727	GASKET CYLINDER BASE W140	1
6	701721	PISTON KIT 60MM W140	1
7	701725	BEARING NEEDLE W140	1
8	702035	STUD INTAKE M6X1.0 W140	2
9	701719	NUT M6X1.0 HEX ZINC CLASS 8 DIN934	4
10	701935	WASHER M6 FLAT 6.3MM X 12MM SS DIN125	4
11	701718	STUD CYLINDER M6X1.0 W140	4
12	701714	SCREW M6X30MM LG CRANKCASE W140	3
13	702091	SCREW M6X35MM LG CRANKCASE W140	2
14	702092	CRANKCASE SET W140	1
15	701713	DOWEL PIN HOLLOW	2
16	701726	GASKET CRANKCASE W140	1
17	702093	SEAL CRANKSHAFT MAG SIDE W140	1
18	702094	BALL BEARING CRANKSHAFT MAG W140	1
19	800019	R-305 WOODRUFF KEY 3MMX5MMX12.7MM FOR 13MM DIA	1
20	701720	CRANKSHAFT CONN ROD ASSEMBLY W140	1
21	701724	BALL BEARING CRANKSHAFT PTO W140	1
22	701723	SEAL CRANKSHAFT PTO SIDE W140	1
23	702095	WASHER 5MM X 9MM COPPER	1
24	702096	SCREW M5X12MM SCHS	1



The following section outlines how to conduct major overhaul service on the MARK-3 Watson Edition engine. **Refer to the Engine Tool Kit for specialised disassembly and assembly tools.**

### Piston

It is recommended to replace the piston, piston pin, needle bearing and circlips at **125 hours**. This servicing step is recommended to ensure optimal durability and performance of the engine.

The piston should be replaced if:

- The horizontal machining grooves are worn off;
- The piston rings are stuck;
- The piston pin is loose inside the piston pin bosses;
- The piston ring end gaps exceed the limits.
- There is structural damage.

### Decarbonising

After several hours of normal operation, carbon deposits will form on the piston crown, cylinder head, in the cylinder exhaust port and around piston rings and in the ring grooves. The piston skirt may also show signs of gum and varnish deposits. This can cause erratic and faulty operation. The rate of carbonisation depends on several factors such as the fuel mix ratio, the carburetor adjustments, and the throttle position during operation. **If a loss of power is observed, the engine should be decarbonised.**

To decarbonise the engine, proceed as follows:

1. Remove muffler. If muffler is very dirty internally or appears burned or cracked, it should be replaced with a new muffler.
2. Remove cylinder head, cylinder head gasket and cylinder.
3. Remove all carbon deposits from cylinder head.
4. Using a brass scraper tool, carefully scrape carbon deposit from cylinder exhaust port.
5. Block the top of the crankcase opening to prevent any carbon deposit from falling inside the crankcase.
6. Use a stiff (not wire) brush to remove loose, flakey carbon from top of piston. Do not remove hard deposit of carbon, as this layer forms a natural heat insulator to protect the piston crown.
7. Verify that the piston rings are free to move. Otherwise, replace the piston.
8. Install cylinder with new base gasket.
9. Install cylinder head with new cylinder head gasket. Tighten nuts uniformly to recommended torque value of 4.1 lb-ft (5.5 Nm) + 60° rotation.
10. Reinstall muffler with new gasket.
11. If piston or cylinder was replaced, proceed with a cylinder deglazing and an engine break-in to ensure proper seal between rings and cylinder.

### Deglazing

When installing a new piston and/or piston rings on a used Nikasil cylinder, the cylinder surface must be prepared and deglazed.

1. Clean the cylinder bore surface.
2. Using a "ball-hone" (e.g., BRM Flex-Hone® model BC212240AO – 240 grit, aluminum oxide) and suitable honing lubrication, hone the surface to achieve a cross-hatch of 25-35°. This is accomplished with approximately 10 strokes with 1 stroke per second and a drill speed of 100 rpm.
3. Thoroughly clean the cylinder bore surface.

### Break-in

Engine break-in is a crucial step in the successful repair of an engine. In essence, the repair is only as good as the break-in. The purpose of the break-in is to GRADUALLY wear down the "high" spots on the piston, rings, and cylinder; this will allow for the piston rings and cylinder to physically mate to each other at controlled engine temperatures.

Moreover, the break-in process flattens the peaks of the cylinder honing to create a "plateau" for a proper cylinder surface and ring seal. Failure to properly break in an engine can result in leaks, bore glazing, loss of performance, poor longevity, and even piston seizure.

All machined parts are imperfect to a certain degree and will have "high" and "low" areas that must be mated to their counterpart to achieve a good running fit. The biggest enemy of a proper engine break-in is excessive engine temperature. The issue resides with the abnormally high friction that is created when these "high" spots are "rubbed/worn down."

*Friction generates heat; heat creates material expansion; expansion reduces running clearances which in turn increases friction.*

The result of an engine that is broken-in too aggressively: more friction, more heat, more expansion, less clearance, etc. Eventually, more than just the *high* spots will be rubbed down; premature wear will occur on the other areas of the engine components.

During the engine break-in process (required whenever a new piston or cylinder is installed), it is recommended to run with a fuel mix ratio of **24:1**. The richer ratio will allow the engine to break-in normally. Once the break-in process is completed, the fuel mixture can be switched to 50:1.

1. Adjust the carburetor as per the Carburetor adjustments section.
2. Once carburetor adjustments are completed, run at WOT for 15 minutes.

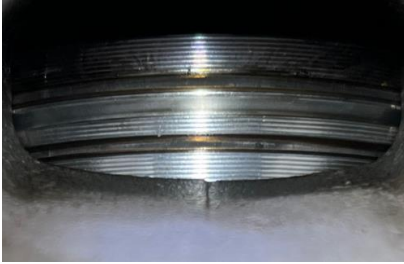


3. After the first 5 minutes, validate high speed adjustment.
4. At the end of the 15 minutes, verify carburetor adjustments. Adjust low speed, high speed, and idle speed if necessary.
5. Allow engine to cool down for 1-2 minutes.
6. Shut down the engine.

### Inspection

It is good practice to inspect the piston through the exhaust port after the break-in process. Below is a table with pictures of the piston and the spark plug after a successful break-in.

**Piston rings**



Uniform wear on both rings.  
No scoring.  
No sign of blow-by gases.

**Piston barrel/skirt**



No scuffing or scoring. Horizontal machine marks remain present on piston. No sign of premature wear.

**Spark plug**



Tan color on both electrodes indicates proper carburetor adjustment.



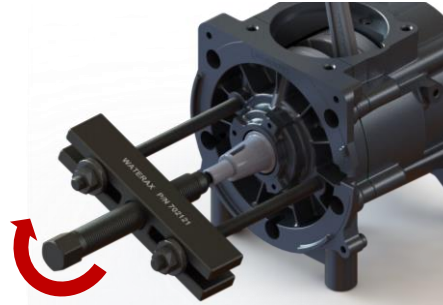
## Disassembly

1. Strip unit until only engine remains.
2. Install piston locking tool 702106.
3. Unscrew coupling drive from PTO side using gear coupling socket 701863.
4. Remove head nuts
5. Pull off head, head gasket and cylinder.
6. Rest the piston on tool 702134.
7. Use a pick to carefully remove one circlip.
8. Push out piston pin and remove. If piston pin is tight, use a piston pin removal tool.
9. Remove piston and needle bearing.
10. Remove base gasket



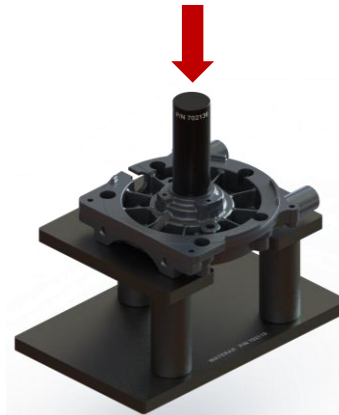
**Warning:** Be careful when removing the circlip to avoid eye injury. Wear safety glasses.

11. Remove the five machine screws, which fasten crankcase halves together.
12. Use puller 702121 to separate the engine crankcase halves from the crankshaft. Use the crankcase M8 holes to secure studs. The bearings will remain in the crankcase halves.
13. Remove the center gasket.
14. Clean the crankcase halves with brake cleaner to remove excess oil.
15. Using an oven, heat both case halves to **338 °F (170 °C)** for **30 minutes**. Place the halves with the bearings facing down.



**Important:** Do not leave engine components for prolonged periods of time in the oven.

16. Remove one case half from the oven and place on the crankcase support tool 702119 with the bearing facing downwards.
17. Using tool 702136 and a rubber mallet, lightly tap the crankshaft seal until both the seal and bearing fall through. The bearing should fall easily. **Wear heat resistant gloves!**
18. Repeat for the other crankcase half. **Note:** Use a flat screwdriver to carefully remove the **MAG** side seal. **Careful not to damage the seal bore.**



**Warning:** Wear heat resistant gloves when manipulating the hot engine components.



## Assembly

1. Apply a small amount of high-temperature copper anti-seize on both crankshaft bearing seats to facilitate installation of ball bearings.
2. Place crankshaft on support 702138.
3. Press the ball bearing (25 mm ID) on the crankshaft **flywheel side** using the pressing tool 702137.



**Important:** Ensure that the crankshaft is properly supported to avoid squeezing the crankshaft webs during the pressing operation. The web should be supported on its inner face.

4. Using an oven, heat both case halves to **302 °F (150 °C)** for at least **30 minutes**.
5. Install protective sleeves 702128 and 702127 on the crankshaft ends. Oil with 10W40 motor oil.
6. Place the seals on pressing tools 701349 and 701350 with the **spring facing inwards**.
7. Oil the seals and center gasket with 10W40 motor oil.



**Warning:** Wear heat resistant gloves when manipulating the hot engine components.

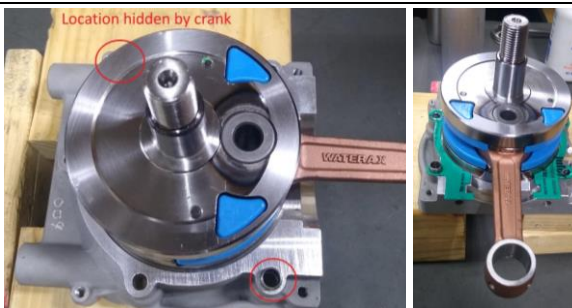


**Important:** The following steps should be completed **quickly** to avoid the crankcase from cooling too much.

8. Remove **smaller case half (MAG side)** from the oven once heated and place on support tool 702119 with bearing bore facing up.
9. Oil the crankcase seal and bearing bores with 10W40 motor oil.
10. Press the seal (25 mm ID) using pressing tool. **The seal spring must face inward.**
11. **Slide** the crank shaft into **MAG case**. **Do not press the crankshaft into the crankcase.**



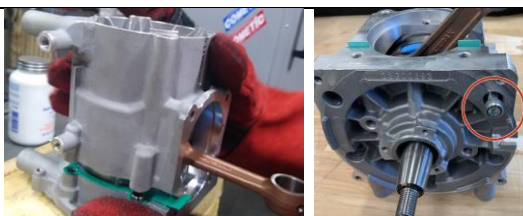
12. Install the two dowel tubes on the crankcase.
13. Install the oiled center gasket.



14. Oil installation tool 702120 and slide the **PTO** crank bearing on the tool.
15. Remove the other crankcase half (**PTO side**) from the oven.
16. Oil the crankcase seal and bearing bores with 10W40 motor oil.
17. Press the oiled seal (**20 mm ID**) using pressing tool into PTO side crankcase. **The seal spring must face inward.**
18. Holding the crankshaft bearing installation tool with one hand, **carefully align** and slide the crankcase over the ball bearing (20 mm ID). **Do not press.**



19. Align case halves together.
20. Remove crankshaft protective sleeves.
21. Slide (**do not tighten**) one short crankcase screw in the **top right** crankcase mounting hole to prevent slippage of the center gasket during the pulling operation.



22. Install crankshaft puller 702132 onto PTO side crankshaft.
23. Install crankshaft rotation hold tool 702122 and place pin through the connecting rod to prevent the crankshaft from rotating
24. Firmly hold the engine and **tighten the crankshaft puller nut just enough to ensure that the cases are together and tight.**
25. Remove engine assembly tools.



26. Apply **Loctite 243** on the threads of the five crankcase screws.
27. Install by hand the two 35 mm M6 and three 30 mm M6 screws in the case by in the listed locations. Note: Red circles denote dowel locations: use **35 mm screws**. Blue circles denote 30 mm screw location.
28. Tighten the screws uniformly in a criss-cross pattern to **5.9 lb-ft (8 Nm)**.



29. Verify if the crankshaft spins freely. If not, the tension in the crankshaft needs to be relieved.
30. Install crankshaft puller 702132 onto PTO side crankshaft.
31. Install crankshaft rotation hold tool 702122 and place pin through the connecting rod to prevent the crankshaft from rotating during the **tension releasing process**.
32. Tighten crankshaft puller nut **1/8 of a turn**.



33. Loosen the nut and spin the crank by hand. If the crank does not spin easily, tighten the nut again, this time rotating another **1/8 of a turn** beyond last time. **Repeat as often as necessary until crank rotates easily by hand.**
34. Remove the nut and other engine assembly tools.

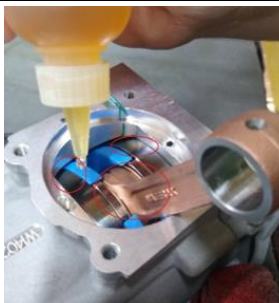


**Important:** The crankshaft is biased towards the MAG side crankcase by design.

35. Install drain screw with copper washer. Tighten to **4.1 lb-ft (5.5 Nm)**.
36. Install woodruff key.
37. Wipe crankshaft clean of contaminants.



38. Lubricate the crankshaft bearings, crank cheeks and connecting rod bearing using 10W40 motor oil.
39. Using right angle hook pick, install a wrist pin circlip into the PTO side of the piston. **Note:** arrow on the piston crown points towards exhaust side.



**Important:** Visually inspect that the circlip is correctly installed and that the circlip opening is not pointing towards the slot on the piston.

40. Apply 10W40 motor oil to the wrist pin bearing and connecting rod small end and install in the connecting rod.
41. Apply 10W40 motor oil to the wrist pin bores of the piston and the wrist pin and partially insert the pin in through the MAG side.
42. Align the piston over the connecting rod with the **exhaust arrow pointing toward the exhaust** and push the pin through until it stops on the other side clip. Use piston support tool 702134. **Note:** Confirm that the pin pushes sufficiently far enough in to install the second circlip.
43. Install the second circlip on the MAG side of the piston with a right angle hook pick.



**Important:** If cylinder studs are already installed, use protective sleeves to protect the piston from getting damaged on the studs.

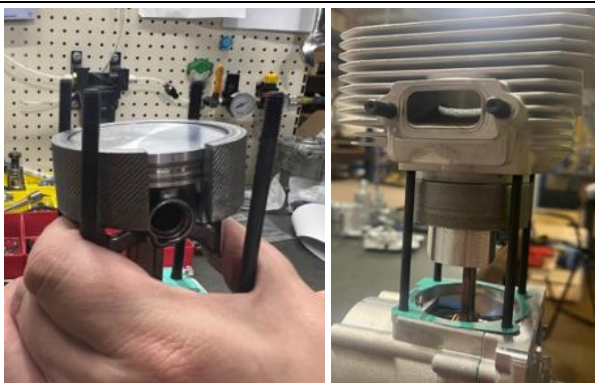


44. Apply a **very light** dab of Permatex Ultra Grey gasket maker on the crankcase gasket face where the two cases intersect with the cylinder.
45. Apply **Loctite 243** on threads and install the four long (M6) cylinder studs. Tighten to **22.1 lb-in (2.5 Nm)**. Wipe off excess Loctite.
46. Install base gasket. Careful not to damage the gasket during installation. **Ensure that the pulse hole is correctly aligned.**



**Important:** The rectangular shape extension on the gasket should be positioned on the Intake-PTO corner. That portion of the gasket is visible after the cylinder is installed.

47. Liberally apply 10W40 motor oil on the piston skirt, piston rings, spanner ring tool 702126, and cylinder bore.
48. Install the spanner ring 702126 over the piston rings taking care to align the ring end gaps with the ring indexing pins.
49. Slide the cylinder over the piston, rings (removing the ring compressor), and cylinder base studs with the exhaust pointed towards the correct side.
50. Rotate the engine over twice stopping at TDC holding down the cylinder to keep it still. Use crankshaft rotation aid 702123.
51. Wipe away excess oil from piston crown and top of cylinder.
52. Confirm piston arrow is pointed towards the exhaust and that the cylinder is also correctly installed.



53. Apply Copper gasket seal (e.g., Permatex Copper Spray-A-Gasket High-Temperature Sealant) to both sides of the head gasket and install it over the studs.
54. Orient the cylinder head over the cylinder head studs, observing that the outer most shape will only align with the cylinder fins in one orientation.
55. Install the four 6 mm flat washers and nuts on the studs and torque to specification in a criss-cross pattern. Torque value: **4.1±0.4 lb-ft (5.5±0.5 Nm) + 60° rotation.**
56. Rotate the crankshaft by hand for two revolutions to ensure smooth operation and stop with the piston crown visible in the exhaust port.



57. Apply **Loctite 243** on M6 intake studs short side.

- 
58. Using stud installation tool or double nut, install the intake studs until they protrude **25 mm** from the intake flange. **Dot mark will be facing outward.**
  59. Wipe off excess Loctite.
  60. Apply **Loctite 2422** on M8 exhaust studs long side.
  61. Using stud installation tool or double nut, install the exhaust studs. Tighten to **5.9 lb-ft (8 Nm)**. The studs will protrude **17.5 mm** from the exhaust flange. **Dot mark will be facing outward.**
  62. Wipe off excess Loctite.
- 

63. Cap off the cylinder intake and exhaust ports.
  64. Using a small manual air pump for leak testing, pressurize the engine to a pressure of **8 psi (55 kPa)** from the spark plug opening on the cylinder head. **Note:** Do not exceed recommended pressure; excessive pressure could cause the crankshaft seals to pop out.
  65. Spray soapy water near the gaskets and seals and look for leaks. **No foaming from cylinder deck or cases is acceptable.**
  66. Use leakdown tools 702124, 702125, 702129, 702130 and 702131.
- 





## Pump End

The pump end does not require any special maintenance. The frequency of the part replacement will largely depend on the fluid that is pumped through. Pumping water with high concentrations of abrasive material (e.g.: sand, pebbles) and corrosive agents (e.g.: brackish water, salt water, chlorinated water) will eventually wear out the components. Performance will degrade and servicing will be necessary.

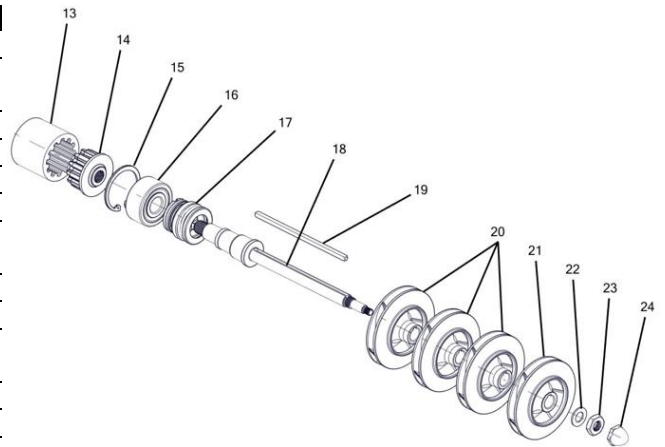
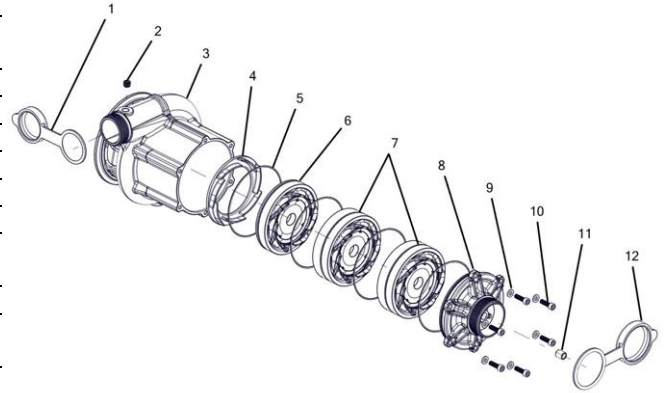
With the composite impellers and diffusers, galvanic corrosion in the pump end is greatly reduced. However, it is highly recommended to flush with clean water and to dry the pump to avoid corrosion of the metal parts.

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	600631	PUMP END HIGH-PRESSURE WATSON	--
1	700023	A-5536 PROTECTIVE CAP FOR 1-1/2" DISCHARGE	1
2	800366	12-73 PLUG, 1/8" BRASS	1
3	701952	PUMP BODY WITH PIN WATSON	1
4	701828	VANE INSERT PUMP WATSON	1
5	701841	O-RING #046, BUNA-N, 70 DURO	4
6	701826	DISTRIBUTOR 3 WATSON	1
7	701824	DISTRIBUTOR 1-2 WATSON	2
8	701953	SUCTION COVER WITH BUSHING BEARING WATSON	1
9	701935	WASHER M6 FLAT 6.3MM X 12MM SS DIN125	6
10	701843	SCREW M6X1.0X20 HEX SOCKET CAP SS DIN912	6
11	701837*	BUSHING BEARING SUCTION COVER WATSON	1
12	700022	A-5537 PROTECTIVE CAP FOR 2" SUCTION	1

\*Included in Suction Cover Watson (701953)

ID	ITEM NO	DESCRIPTION	QTY
13	701819	COUPLING BELT WATSON	1
14	701835	COUPLING DRIVE 12 TEETH M12X1.5 PUMP WATSON	1
15	702016	RETAINING RING INTERNAL 1-5/8 15-7 PH SS	1
16	702015	BALL BEARING SEALED PUMP WATSON	1
17	702014	MECHANICAL ROTARY SEAL PUMP WATSON	1
18	701831	SHAFT PUMP WATSON	1
19	701834	MACHINE KEY 4MMX4MMX115.6MM SS WATSON	1
20	701829	IMPELLER 2-4 WATSON	3
21	701870	IMPELLER 1 WATSON	1
22	701832	WASHER PUMP SHAFT 18.2MM X 10.1MM SS WATSON	1
23	701833	NUT M10X1.25 THIN HEX LOCK SS DIN439B	1
24	701871	NOSE SUCTION WATSON	1



### Disassembly

1. Place the pump end on the assembly fixture 701860.
2. Remove the suction nose.
3. Remove the suction cover screws.
4. Remove the suction cover using puller tool 600079.
5. Remove the nut and **discard** the flat washer.





**Important:** Do not use flat screwdrivers to remove the suction cover: this could cause a misalignment of the bronze bearing bushing.

6. Remove the first impeller.
7. Place the pump end upside down on the shaft assembly fixture 701859, aligning the shaft key with the keyway.
8. Unscrew the coupling drive using gear coupling socket and 17 mm socket.
9. Remove the retaining ring.

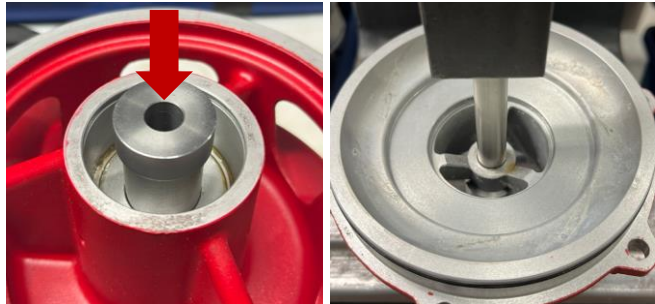


10. Place the pump upside down on the disassembly fixture 702113.
11. Using pressing pin 702109, press out the shaft and internal components.
12. Flip the volute upright. Using the large end of the pressing pin, press out the bearing.



**Important:** A light amount of grease may have seeped out from the bearing seal. This is normal and not cause for concern.

13. Flip the volute upside down. Using the seal seat removal tool 702111, press out the seal seat.
14. To remove the bronze bearing bushing, use tool 702118 and press out using the pressing pin.



**Important:** It is recommended to discard all O-rings and replace with new ones.



**Important:** The mechanical rotary seal should be replaced after pump end disassembly to prevent the risk of leakage.



**Important:** When reusing components, carefully inspect the parts. Ensure that key dimensions are within acceptable limits. Visually inspect the parts for pitting, worn vanes, damaged threads, damaged gasket faces, excessive corrosion, deformation, etc. Discard any component that is not within acceptable standards. Ensure that the components are clean before installing.

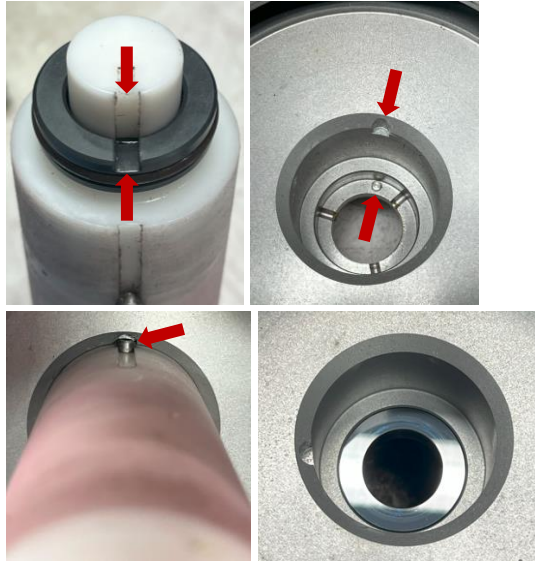


**Warning:** It is important to respect the specified torque and application of Loctite® where specified. **Refer to the torque table at the end of the manual for torque values and Loctite requirements.**

## Assembly

### 1. Install the seal seat.

- a) Place the seal seat on the pressing tool 701861. Align the slot on the seal seat with the notch on the pressing tool.
- b) Apply **P-80 lubricant** on the O-ring.
- c) Align the pin on the pressing tool with the notch inside the volute. This will align the seal seat slot with the anti-rotation dowel pin pre-installed in the volute.
- d) **Carefully** press the seal seat until it bottoms out. **Verify that the seat is properly seated.**
- e) Using a lint free wipe and 99% isopropyl alcohol, clean the seal seat face to remove any trace of contaminants.



**Important:** Do not apply grease as a lubricant. Grease can contaminate the sealing face and cause the seal to leak.

### 2. Install the rotary portion of the seal.

- a) Install the key on the shaft.
- b) Flip the shaft upside down and slide it in the shaft assembly fixture 701859.
- c) Apply P-80 lubricant on the seal Viton® bellows and the pump shaft.
- d) Carefully slide and set the seal onto the shaft. Ensure that spring cup is present.
- e) Using a lint free wipe and 99% isopropyl alcohol, clean the seal carbon face to remove any trace of contaminants.



**Important:** P-80 is a temporary lubricant that dries off. Install the components quickly; otherwise, the seal could get damaged during the installation.

3. **Carefully** slide the volute on to the seal and shaft.
4. Position the bearing on the shaft and the volute bearing bore. To prevent damage to the bearing bore during the pressing operation, **ensure that the bearing is squarely positioned with respect to the bearing bore.**

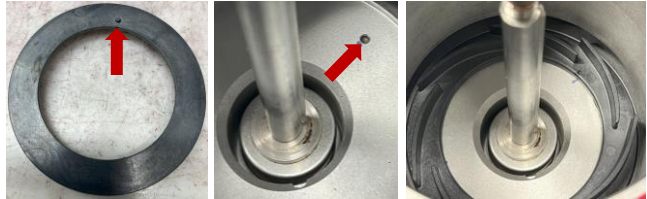




5. Align the bearing pressing tool 701862 with the bearing inner race and press the bearing all the way down.
6. Install the retaining ring.
7. Apply **Loctite 243** on coupling drive threads. Using the gear coupling socket 701863 and a 17 mm socket, tighten the coupling drive to **18.4 lb-ft (25 Nm)**.



8. Place the pump end on the assembly fixture 701860.
9. Install the volute vane insert in the volute. **Align the position post to the corresponding hole in the volute.**



10. Slide the impeller 701829 on the shaft until it bottoms out.
11. Apply a light amount of O-ring lubricant (Molykote 55) and install the O-rings on the three diffusers and the suction cover.
12. Apply P-80 lubricant on the interior wall of the volute.
13. Place diffuser 701826 on the volute until the O-ring rests on the volute entry chamfer.
14. Using diffuser pressing tool 701865, **carefully** press the diffuser until it bottoms on the volute vane insert.
15. Repeat for the remaining three impellers and two diffusers.



**Important:** The last impeller to be installed is 701870. It is the shorter impeller.

16. Install washer and shaft nut. Center the washer as much as possible on the impeller to avoid impeding the incoming water flow. Apply **Loctite 243** and tighten to **18.4 lb-ft (25 Nm)**.
17. Align suction cover holes with corresponding threaded holes in the volute. Press suction cover using diffuser pressing tool.
18. Install the suction cover screws using a **pre-torque of 5.2 lb-ft (7 Nm)** in a crisscross pattern. Tighten to the recommended final torque of **9.6 lb-ft (13 Nm)**.
19. Install the suction nose. Apply **Loctite 243** and tighten to **5.2 lb-ft (7 Nm)**.



## Pump Test

The simplest way to verify the condition of your pump unit is to proceed with an actual performance test on an engine.

Nozzle Size	1/2" [12.7 mm]	3/8" [9.53 mm]	1/4" [6.35 mm]
Min. Pressure	100-105 psi	165-170 psi	255-260 psi
Range	6.9-7.2 bar	11.4-11.7 bar	17.6-17.9 bar
Speed	5950 rpm	6350 rpm	7300 rpm

Note: Performance can vary depending on test conditions and test equipment.

## Pump Test kit

### Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
--	250137	A-2388 PUMP TEST KIT	--
1	700555	A-2389 TOOL AND ACCESSORY BOX	1
2	700548	A-2395B CALIBRATED NOZZLE TIP 1/4"	1
3	700546	A-2395D CALIBRATED NOZZLE TIP 3/8"	1
4	600427	C-1933 NOZZLE 1-1/2"NPSH, ALU.	1
5	700545	A-2391 RUBBER HOSE ASSEMBLY 27" LG	1
6	700552	A-2391B ADP, FEM NPT - SWIVEL FEM	1
7	700560	A-2392 PRESSURE GAUGE (DRY) 0-400 PSI	1
8	600061	A-2390 PRESSURE GAUGE ADAPTOR 1-1/2" NPSH	1
9	400022	HOSE SPEC 187 1.5 NPSH X 10' CPLG AL	1



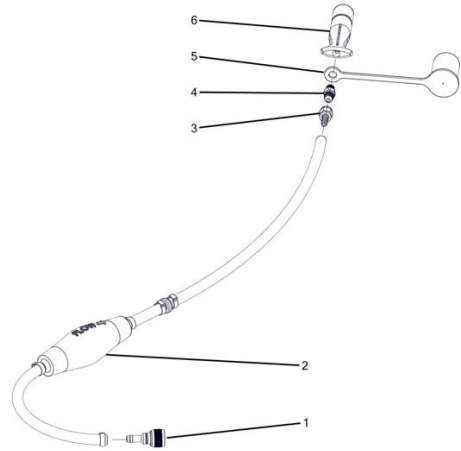


## Fuel Line

### Parts breakdown (Mercury)

ID	ITEM NO	DESCRIPTION	QTY
--	600605*	12-401B-NSC COMPLETE FUEL LINE, STANDARD STYLE	--
1	800864	FA-451 FEM QUICK-CONNECT	1
2	600389	12-405-1 FUEL LINE PRIMING BULB	1
3	700017	12-65 COUPLING SWIVEL	1
4	800814	R-732 CONNECTOR 1/4" TUBE X 1/8" NPT	1
5	700100	A-7487 DUST CAP - FEM CONNECTOR, NITRILE	1
6	800802	R-712 HANDLE QUICK CONNECT, FEM	1

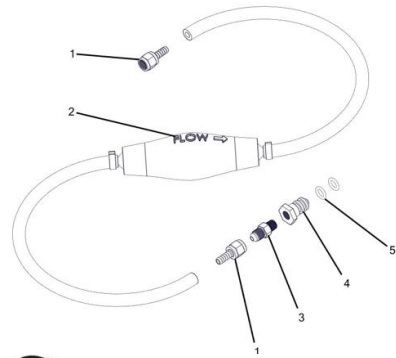
\* Fuel line compatible with FA-552Q fuel air transport tank (600429)



### Parts breakdown (USFS)

ID	ITEM NO	DESCRIPTION	QTY
--	600136	R-1206A-GSA 5' FUEL LINE PRIMING BULB SAE FEM END	--
1	700017	12-65 COUPLING SWIVEL	2
2	600389	12-405-1 FUEL LINE PRIMING BULB	1
3	800814	R-732 CONNECTOR 1/4" TUBE X 1/8" NPT	1
4	700660	A-7505 MALE PLUG	1
5	700715	O-RING-10 O-RING 9/16" O.D X 3/8" I.D X 3/32" THK	2

\* Fuel line compatible with FA-352GSA-N jerry can (600376)



## Fuel Tank

### Parts breakdown (Mercury)

ID	ITEM NO	DESCRIPTION	QTY
--	600429	FA-552Q FUEL AIR TRANSPORT TANK WITH QUICK CONNECT	--
1	700698	FA-131M FUEL TANK, OLIVE DRAB	1
2	600064	B-7462 FUEL LINE SUB-ASSEMBLY FOR FA-552Q	1



### Parts breakdown (USFS)

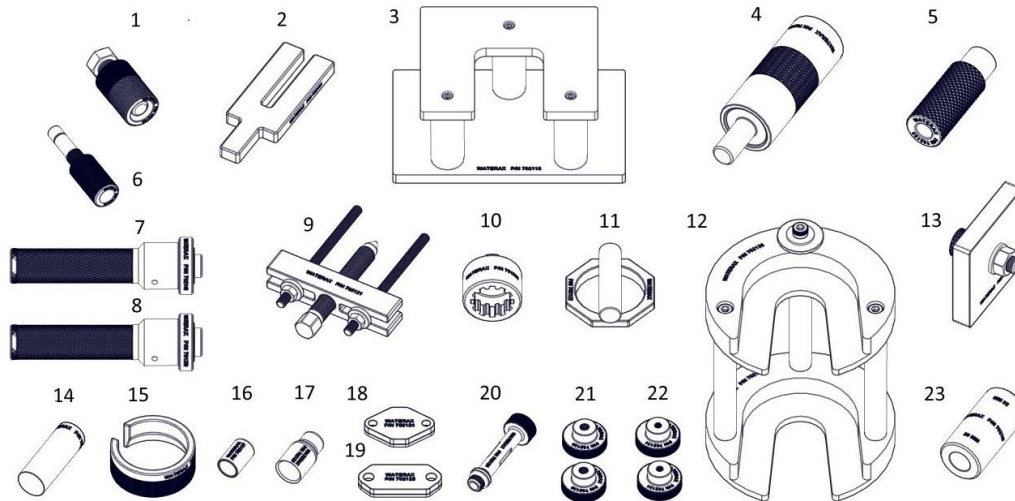
ID	ITEM NO	DESCRIPTION	QTY
1	600376	FA-352GSA-N 5 GAL (19L) JERRY CAN, METAL	1



## Tools

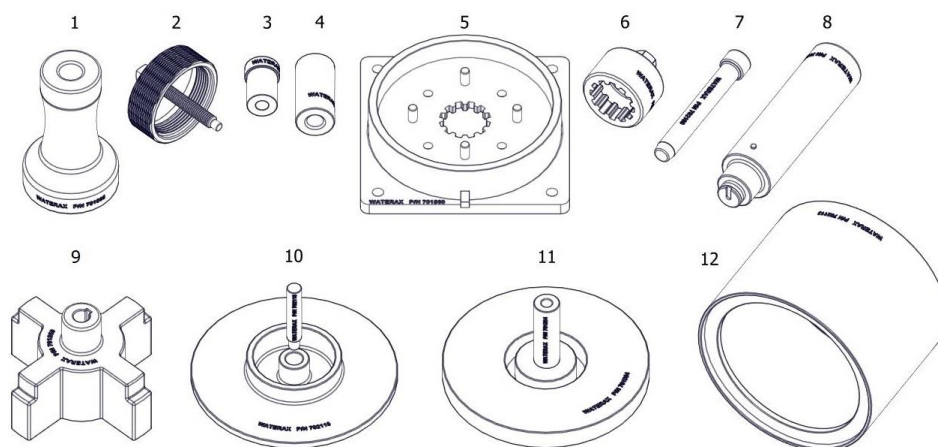
### Parts breakdown – Engine tool kit

ID	ITEM NO	DESCRIPTION	QTY
--	702108	TOOL KIT ENGINE W140	--
1	702105	TOOL FLYWHEEL PULLER W140	1
2	702134	TOOL PISTON SUPPORT W140	1
3	702119	FIXTURE ASSEMBLY CRANKCASE W140	1
4	702120	TOOL INSTALLER BEARING CRANKSHAFT PTO SIDE W140	1
5	702123	TOOL ROTATION AID CRANKSHAFT W140	1
6	702106	TOOL PISTON LOCKING W140	1
7	702140	TOOL OIL SEAL 20MM CRANKCASE PRESSING WATSON	1
8	701350	TOOL OIL SEAL 25MM CRANKCASE PRESSING	1
9	702121	TOOL CRANKCASE PULLER W140	1
10	701863	TOOL GEAR COUPLING SOCKET WATSON	1
11	702122	TOOL ROTATION HOLD CRANKSHAFT W140	1
12	702138	TOOL CRANKSHAFT SUPPORT W140	1
13	702132	TOOL CRANKSHAFT PULLER W140	1
14	702136	TOOL BEARING AND OIL SEAL CRANKSHAFT REMOVAL W140	1
15	702126	TOOL SPANNER RING PISTON W140	1
16	702127	TOOL PROTECTIVE SLEEVE CRANKSHAFT PTO SIDE W140	1
17	702128	TOOL PROTECTIVE SLEEVE CRANKSHAFT MAG SIDE W140	1
18	702124	TOOL FLANGE INTAKE LEAKDOWN W140	1
19	702125	TOOL FLANGE EXHAUST LEAKDOWN W140	1
20	702129	TOOL SPARK PLUG PORT LEAKDOWN W140	1
21	702130	TOOL KNURLED NUT M8 LEAKDOWN W140	2
22	702131	TOOL KNURLED NUT M6 LEAKDOWN W140	2
23	702137	TOOL BEARING PRESSING CRANKSHAFT W140	1



**Parts breakdown – Pump end tool kit**

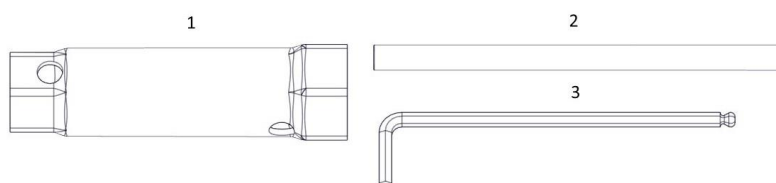
ID	ITEM NO	DESCRIPTION	QTY
--	702114	TOOL KIT PUMP END WATSON	--
1	701865	WATSON DISTRIBUTOR PRESSING TOOL	1
2	600079	A-1888 TOOL SUCTION COVER PULLER	1
3	702111	TOOL SEAL SEAT REMOVAL PUMP END WATSON	1
4	701862	TOOL BEARING PRESSING PUMP END WATSON	1
5	701860	FIXTURE ASSEMBLY PUMP END WATSON	1
6	701863	TOOL GEAR COUPLING SOCKET WATSON	1
7	702109	TOOL PRESSING PIN DISASSEMBLY PUMP END WATSON	1
8	701861	SEAL SEAT INSTALLATION TOOL	1
9	701859	FIXTURE SHAFT ASSEMBLY PUMP END WATSON	1
10	702118	FIXTURE BEARING BUSH. DISASSEMBLY PUMP END WATSON	1
11	701864	FIXTURE BEARING BUSHING PUMP END WATSON	1
12	702113	FIXTURE DISASSEMBLY PUMP END WATSON	1

**Parts breakdown – Special tools**

ID	ITEM NO	DESCRIPTION	QTY
1	702133	TOOL INSTALLER UIM BATTERY COVER W140	1

**Parts breakdown – Standard tools (included with pump unit)**

ID	ITEM NO	DESCRIPTION	QTY
1	800084	R-904 WRENCH - SPARK PLUG	1
2	800082	R-905 HANDLE - ROD	1
3	702081	HEX L-KEY 4MM BALL END 4-1/2" LG	1



# TECHNICAL DATA

## Specifications – Pump Unit

Dimensions (L x W x H)	21.6 x 12 x 14.6 in	549 x 305 x 371 mm
Weight (dry)	44 lbs	20 kg
Sound level	Maximum 107 dBA	
Exhaust	Painted stainless steel with protective heat shield and with USDA Forest Service 5100-01 approved spark arrestor	
Air filter	Foam	
Fuel system	Zama® diaphragm carburetor with integrated fuel pump and stand-alone purge bulb	
Fuel	87 octane unleaded automotive gasoline, max. 10% ethanol Two-cycle mixing oil for air cooled engine. Recommended certification: API-TC, JASO-FD and ISO-L-EGD. Approved: Amsoil Saber® Professional Synthetic Fuel mix ratio: 50:1 (gasoline to oil)	
Fuel connection	SAE 45° with Mercury adaptor	
Starter	Mechanical rewind starter with manual rope starter backup	
Spark plug	NGK BPR7HIX Iridium, M14	
Ignition	Prufrex® CDIM, capacitive discharge ignition module with overspeed safety cut-off	
User Interface Module	Off button with daylight visible LEDs Prufrex ESG with overspeed and overheat protection USB-C connection and Bluetooth® wireless connection	
Bluetooth®	5.0	
Power generation	DUCATI Energia 20W, 13V, 1.5A with voltage regulator module	
Backpack frame	Composite frame with integrated backboard, aluminum cross-member and vibration mounts	
Straps (optional)	Padded strap with military grade Fidlock® quick release system	
Carry handle	Aluminum powder coated black	

## Specifications – Engine

Bore	2.362 in	60 mm
Stroke	1.969 in	50 mm
Displacement	8.63 cu in	141 cc
Maximum power	10.7 hp @ 8,000 rpm	8 kW @ 8,000 rpm
Maximum torque	7.6 lb-ft @ 7,050 rpm	10 Nm @ 7,050 rpm
Maximum speed	9,000 rpm (cut-out)	
Idle speed	2,000-2,200 rpm	
Direction of rotation	Counterclockwise (from output shaft)	
Cooling	Air cooled	
Fuel consumption (WOT)	1.4 US gph	5.3 L/hr

## Specifications – Pump End

Type	Centrifugal, detachable	
Number of stages	Four	
Suction (intake) port	2" [51 mm] NPSH male	
Discharge port	1-1/2" [38 mm] NPSH male	
Maximum head	877 ft	267 m
Maximum pressure	380 psi	26.2 bar
Maximum flow	100 US gpm	379 L/min
Volute and cover	Anodized aluminum alloy	
Impellers	Composite PPS GF reinforced	
Diffusers	Composite PPS GF reinforced crossover design with marine grade aluminum vane tips	
Seal	Balanced elastomeric bellows and silicon carbide mechanical rotary seal	
Bearing	Maintenance-free 12 mm double row sealed ball bearing	
Shaft	Stainless steel	
Coupling	Reinforced flexible coupling belt	
Pump clamp	Quick release lightweight aluminum	

**Torque Values**

Component	Fastener	Thread Size	Torque			Loctite®
			Nm	Lb-in	Lb-ft	
Frame Channel Support	Screw	M6-Button	4	35.4	2.9	243
Frame Handle	Screw	M6	7	62	5.2	243
Cross-Member to Frame	Screw	M8	35	319	26.5	-
Cross-Member to Engine	Screw	M8	27	239	19.9	-
Fuel Block	Screw	M5	4	35.4	2.9	-
UIM Button and LED	Screw	M4	1.8	16.2	1.3	222
Cover UIM Button	Screw	M5-Button	3	26.5	2.2	222
Deflector Intake	Screw	M5	4	35.4	2.9	243
Bracket Carburetor	Screw	M5	4	35.4	2.9	243
Quadrant Throttle	Screw	M5	4	35.4	2.9	243
Bracket Purge Bulb	Screw	M5-Flat	3	26.5	2.2	222
Inner Cover Air Filter	Screw	M5-Button	3	26.5	2.2	222
Outer Cover Air Filter	Screw	M5	4	35.4	2.9	-
Housing Electronics	Screw	M5	4	35.4	2.9	243
Dampener Rubber Electronics	Screw	M5	4	35.4	2.9	243
Deflector Exhaust	Screw	M5	4	35.4	2.9	243
Muffler Top Nuts	Socket Nut	M8	27	239	19.9	-
Muffler Bottom Screw	Screw	M8	27	239	19.9	-
Heat Shield Muffler	Screw	M5	4	35.4	2.9	LB-8023
Spark Arrestor	Screw	-	6	53.1	4.4	-
Bracket Fan Cowl	Screw	M5	4	35.4	2.9	243
Deflector Fan Cowl	Screw	M5	4	35.4	2.9	243
Cable Holder Nylon	Screw	M4	1.8	16.2	1.3	222
Stator	Screw	M4	1.8	16.2	1.3	222
Flywheel	Nut	M10	55	487	40.6	243
CDIM	Screw	M5	4	35.4	2.9	243
Housing Recoil Starter	Screw	M5	7	62	5.2	-
Spring Recoil Starter	Screw	M3-Torx	-	5	-	222
Guide Starter Rope	Screw	M3-Torx	Hand tight			222
Spark Plug	-	M14	27	239	19.9	-
Pump Hub	Screw	M8	21	186	15.4	243
Coupling Drive Engine	-	M16	40	354	29	243
Carry Handle	Screw	M8	21	186	15.4	243
Pump End – Coupling Drive	-	M12	25	221	18.4	243
Pump End – Shaft Nut	Nut	M10	25	221	18.4	243
Pump End – Nose Suction	-	M6	7	62	5.2	243
Pump End – Suction Cover	Screw	M6	13	115	9.6	-
Carburetor – Strainer Cover	Screw	-	0.44	3.9	-	-
Carburetor – Fuel Pump Body	Screw	-	0.44	3.9	-	-
Carburetor – Inlet Seat	-	-	4.9	43.4	-	-
Engine – Crankcase Screws	Screw	M6	8	70.8	5.9	243
Engine – Cylinder Studs	Stud	M6	2.5	22.1	1.8	243
Engine – Intake Studs	Stud	M6	Protrude 25 mm			243
Engine – Exhaust Studs	Stud	M8	8	70.8	5.9	2422
Engine – Head Nut	Nut	M6	5.5±0.5 Nm (4.1±0.4 lb-ft)+60°			-
Engine – Drain Screw	Screw	M4	5.5	48.7	4.1	-



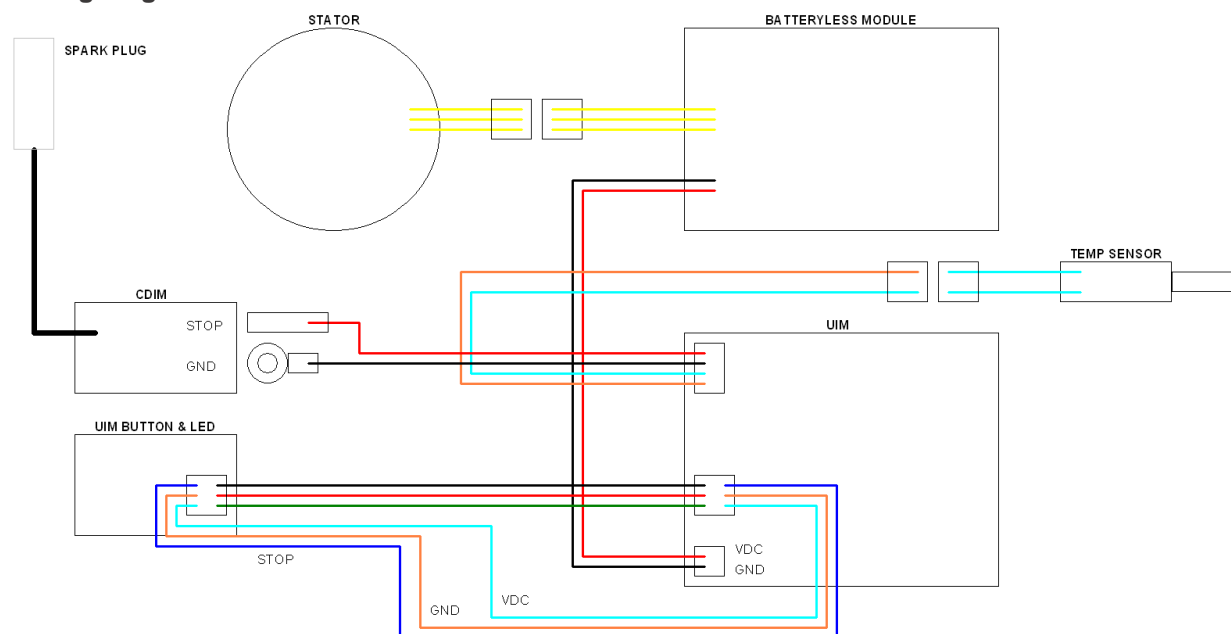
**Clearance Data and Limits – Engine**

Spark plug gap	.020-.024 in	0.5-0.6 mm
CDIM to flywheel air gap	.020-.024 in	0.5-0.6 mm
<b>Crankcase</b>		
Main bearing bore (new)	2.0453-2.0457 in	51.95-51.96 mm
Main bearing bore wear limit	2.0469 in	51.99 mm
<b>Cylinder</b>		
Bore	2.3622-2.3626 in	60.000-60.010 mm
Surface roughness	-	Rz 1.5-3.0 / Ra 0.1-0.3 $\mu$ m
Honing cross hatch angle	25-35 degrees	25-35 degrees
Cylinder / piston clearance	.0016-.0024 in	0.04-0.06 mm
Cylinder / piston wear limit	.005 in	0.127 mm
Cylinder / piston ring end gap (new)	.007-.013 in	0.18-0.33 mm
Cylinder / piston ring end gap wear limit	.019 in	0.48 mm
<b>Piston</b>		
Diameter	2.3604 +/- 0.0004 in	59.954 +/- 0.010 mm
<b>Crankshaft</b>		
Conrod bearing big end, radial clearance (new)	0.0006-0.0010 in	0.015-0.026 mm
Conrod bearing big end, axial clearance (new)	0.0051-0.0235 in	0.130-0.597 mm
Conrod bearing big end, axial clearance wear limit	0.031 in	0.8 mm
Main bearing journal diameter, magneto side (new)	0.9843-0.9847 in	25.002-25.011 mm
Main bearing journal diameter, magneto side wear limit	0.9843 in	25.00 mm
Main bearing journal diameter, pump side (new)	0.7875-0.7878 in	20.002-20.011 mm
Main bearing journal diameter, pump side wear limit	0.7874 in	20.00 mm
Oil seal lip area, groove deepness wear limit	0.002 in	0.05 mm
Crankshaft halves run-out (new)	0.001 in	0.03 mm
Crankshaft halves run-out wear limit	0.003 in	0.08 mm

**Clearance Data and Limits – Pump End**

Impeller outside diameter	2.990-3.012 in	75.95-76.50 mm
Impeller hub outside diameter	1.846-1.860 in	46.89-47.24 mm
Impeller bore	.473-.476 in	12.01-12.09 mm
Impeller front and rear shroud diameter	.718-.730 in	18.24-18.54 mm
Diffuser vane diameter	3.030-3.040 in	76.96-77.22 mm
Diffuser bore	.750-.764 in	19.05-19.41 mm
Diffuser shroud diameter	3.030-3.040 in	76.96-77.22 mm
Diffuser rear hub diameter	1.870-1.884 in	47.50-47.85 mm
Volute ball bearing housing bore	1.6535-1.6549 in	42.000-42.036 mm
Volute mechanical rotary seal housing bore	1.248-1.252 in	31.70-31.80 mm
Suction cover hub diameter	1.870-1.884 in	47.50-47.85 mm
Suction cover bronze bearing bushing bore	.438-.439 in	11.13-11.15 mm
Suction cover shroud diameter	3.030-3.040 in	76.96-77.22 mm
Suction cover rear face & bronze bushing perpendicularity	.004 in	0.10 mm
Bronze bushing bearing bore	.3125-.3145 in	7.938-7.988 mm
Shaft ball bearing diameter	.5903-.05909 in	14.994-15.007 mm
Shaft bronze bushing bearing diameter	.308-.310 in	7.82-7.87 mm
Shaft maximum run-out	.004 in	0.10 mm

## Wiring diagram



# TRADEMARK

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc., and any use of such marks by *WATERAX* is under license.



## NOTES

This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

[illegible]

[illegible]



# WARRANTY

**WHEREAS** subject to the following general and specific terms and conditions, WATERAX Inc. (the “**Seller**”) hereby warrants to the original purchaser of the products from WATERAX, (the “**Purchaser**”) that its products, including any pump parts products manufactured by WATERAX (the “**Products**”) sold under Seller's brands will be free of defects in material and workmanship for the applicable Warranty Period (as set out in full at [www.waterax.com/eng/warranty](http://www.waterax.com/eng/warranty)).

Product	Warranty Period	Coverage
4-Stroke Powered Pumps	Two (2) Years	Limited
2-Stroke Powered Pumps	Earlier of One (1) Year or One hundred (100) run hours	Limited
Backpack Pumps	One (1) Year	Limited
Skid Units	One (1) Year	Limited
Control Panels, Electronics Manifolds	One (1) Year	Limited
Genuine Parts	Ninety (90) Days	Limited

## 1. Limitations, exclusions and other terms and conditions applicable for all Products:

- a. The Warranty shall be voided upon the occurrence of any of the following events: (a) the Product is used for an application, with products or in a manner other than the application, products and manner for which such Product is designed and intended; (b) the Product is subjected to a use, service, condition or environment other than a use, service, condition or environment for which such Product is designed and intended; (c) the Product is not properly installed by the Purchaser or its agent or representative; (d) the Product is not properly tested and maintained in accordance with Seller's product manuals and supplemental instructions and guidelines, applicable industry standards and guidelines, and applicable legal and regulatory requirements; (e) the Product is altered, modified, serviced (with the exception of routine maintenance performed in accordance with the Seller's product manuals and supplemental instructions as set out in full at [www.waterax.com/eng/warranty](http://www.waterax.com/eng/warranty), and industry accepted standards and guidelines), or repaired by a person other than the Seller or a person authorized by the Seller to make such alteration or modification or perform such service or repair; (f) the Seller is not paid the full amount of the purchase price for the Product when due; (g) any bad faith invocation of a warranty claim or breach of a purchase agreement by the Purchaser.
- b. The following are excluded from Warranty coverage: (a) non-defective parts worn, exhausted or consumed through normal usage of the Product; (b) any consumable parts normally subject to routine replacement, including but not limited to pump packing, O- rings, gaskets, intake screens, anodes or filters; (c) routine maintenance as specified and in accordance with the Seller's product manuals and supplemental instructions and guidelines as set out in full at [www.waterax.com/eng/warranty](http://www.waterax.com/eng/warranty); (d) failure due to compliance with a specification or design provided or required by Purchaser; (e) failure due to improper operation, excess pressure, excess voltage, abuse, misuse, negligence or accidents or other similar causes; (f) failure due to operator error; (g) damage during or after shipment and failure attributable thereto or resulting there from; (h) failure attributable to or resulting from the failure or substandard, inadequate or improper performance of any part, component or equipment not supplied by the Seller; (i) failure attributable to or resulting from the failure or substandard, inadequate or improper performance of any third party part, component, product or equipment, whether or not combined, packaged, incorporated, installed or used with a Seller brand part, component, product or equipment.

2. **Claim Procedure.** The claim procedure applicable under this warranty, including any applicable notice and documentation requirements, are set out in full at [www.waterax.com/eng/warranty](http://www.waterax.com/eng/warranty) and constitute an essential term of this Warranty.

3. **Repaired and Replacement Product.** If requested to do so by the Purchaser the Seller may, at its sole option and in its sole discretion, supply a replacement Product or part to the Purchaser prior to making a final determination as to whether Warranty Coverage is available.

If the Seller ultimately determines that no Warranty Coverage is available for a Product claimed to be defective, the Purchaser shall have the option of either (a) having the Product returned to it freight collect without repair or replacement; or (b) if Seller determines that the Product is repairable, have the Product repaired by Seller or another party designated by it on a time and materials basis at Seller's then current standard charges for non-warranty repairs and then returned to Purchaser freight collect. The Seller reserves the right to use reconditioned parts for Warranty repairs and to use reconditioned Products for Warranty replacements. Repaired Product and replacement Product shall be warranted only for the remainder of the original Warranty Period.

4. **Limitation of Liability:** SELLER'S WARRANTY AS SET FORTH HEREIN IS SELLER'S SOLE AND EXCLUSIVE WARRANTY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF MERCHANTABILITY, QUALITY, COURSE OF DEALING, USAGE OF TRADE, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT. THE RIGHTS AND REMEDIES SET FORTH HEREIN ARE THE SOLE AND EXCLUSIVE RIGHTS AND REMEDIES AGAINST SELLER, EXCEPT FOR THE SPECIFIC LIABILITIES AND OBLIGATIONS PROVIDED HEREIN, SELLER SHALL HAVE NO LIABILITY OR OBLIGATION WITH RESPECT TO ANY PRODUCT CLAIMED TO BE DEFECTIVE IN ANY MANNER



# **WATERAX**

All information contained in this document including drawings is proprietary to *WATERAX* and may not be copied, reproduced or used in whole or in part without our prior written permission. The information in this document is subject to change without notice. Model displayed with multiple options. Weight and dimensions are approximated and may vary depending on options.

**WATERAX INC.**

6635 Henri-Bourassa W.  
Montreal, QC H4R 1E1

T 514 637-1818

F 514 637-3985

TF 1 855 616-1818

[info@waterax.com](mailto:info@waterax.com)

**waterax.com**

To help you stay **#ReadyForWildfires**, we've made a few changes, placing 100% of our focus on manufacturing our core products, portable fire pumps.

To do so, we've established a network of trusted supply and distribution partners that can help us provide *WATERAX* pumps quickly in addition to water-handling equipment and accessories.

For immediate assistance when it comes to pumps and water-handling accessories, please [contact your local dealer](#).

For genuine spare parts, visit our [online store](#).

