



MARK-3

Owner's Manual



Publication Date: 03/2016
Publication Number: 701247, Rev. 5

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Publication No.: 701247, Rev. 5
Publication Date: 03/2016
First Edition: March 2015

Published by:
WATERAX Inc.
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Montreal, Quebec, CANADA
H4R 1E1

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Printed in Canada

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Important Safety Instructions

It is recommended that all information provided in this manual be carefully read and understood before performing any operation of 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.

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.

Warnings



- Always wear eye and ear protection when operating the pump unit.
- Do not operate if mentally or physically fatigued.
- Always inspect hoses and piping to avoid burst injuries.
- Use only pipe, hose, and fittings that are rated at or above the maximum pressure rating of the pump shown below, or according to what maximum pressure the system was designed for, whichever is lower.
 - Maximum Allowable Pressure: 600 PSI (41 bar)
 - Maximum Allow Pump Intake Pressure: 200 PSI (13.8 bar)
- No modifications and/or alterations may be made to the pump. Any such modifications not only void the pump warranty but can make the unit dangerous to anyone operating the pump.
- 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.
- 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.
- Relieve system pressure before doing any service work on the pump.
- Never run the pump in a closed or confined area. Exhaust gas contains carbon monoxide which is poisonous to humans. 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.
- 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 the muffler and surrounding parts.
- Careful not to pinch your fingers around the cooling fan and engine output shaft.

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 footvalve suction hose strainer.
- 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 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 fasteners be replaced with genuine *WATERAX* parts.

Introduction

About this Manual

This manual contains general operation, care and servicing procedures for the *WATERAX* MARK-3 high pressure 4-stage centrifugal pump.

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* Inc. for any additional safeguards, operating, or maintenance considerations that may be required.

For full service and maintenance instructions regarding the engine and the pump, please refer to the Service section.

Please see www.waterax.com additional documentation related to this product such as the *WATERAX* product guide, technical notes, news and other updates about *WATERAX* and its goods and services.

About the MARK-3

Features

For full specifications and performance curves, see the Product Data Sheet for your pump end model.

Applications of the *WATERAX* MARK-3 series include:

- Attack line firefighting
- Long hose lay for remote watering during firefighting operations
- High elevation firefighting in mountainous areas
- Accuracy in flow trajectory when structure firefighting
- Tandem pumping over long distances
- Parallel pumping for higher volumes

Features and Benefits of the *WATERAX* MARK-3 series include:

- Quick release clamp and swappable pump ends for minimal equipment downtime and inventory
- Sealed bearing to eliminate pump end greasing in the field
- Aluminum alloy pump components and anodized parts for lighter weight and greater resistance to corrosion
- Compatible with foam applications
- Blister resistant mechanical rotary seal
- Comprehensive manuals

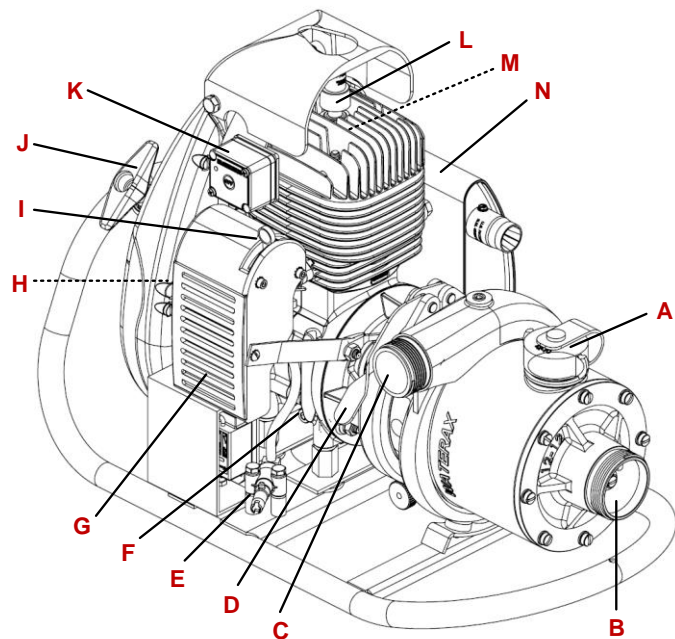
The MARK-3 unit has been designed to meet all the requirements of advanced techniques in forest fire control, including **USDA Forest Service Specifications No. 5100-274C**.

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

Parts Identification

- A. Priming cap
- B. Pump intake (suction)
- C. Pump discharge
- D. Quick release pump clamp
- E. Fuel connection*
- F. Engine drain plug
- G. Air filter
- H. Choke (not shown)
- I. Throttle
- J. Rewind starter
- K. Digital Overspeed Switch (DOS)
- L. Spark plug
- M. Decompression switch – optional (not shown)
- N. Muffler

* Mercury fuel fitting shown



Operating MARK-3 Series Pumps

Pre-Operation Checklist

Before using your pump, follow this verification procedure:

1. Visually inspect product. When you first receive your MARK-3 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.

Fuel Supply

Fuel mixture

The MARK-3 is powered by a 185cc two-cycle (two-stroke) engine. For lubrication, the engine requires a premixed fuel mixture of gasoline and oil.

GASOLINE: 87 octane unleaded automotive gasoline (maximum 10% ethanol)

OIL: High quality two-cycle mixing oil with **API-TC, JASO-FD and ISO-L-EGD certification** (e.g., Amsoil Saber® Professional Synthetic)

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



Note: Not enough emphasis can be placed on the use of 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.

Note: This fuel mixture is compatible with both Nikasil and cast iron sleeve cylinder engines. For engine **break-in** fuel mixture, refer to the Service section.

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:

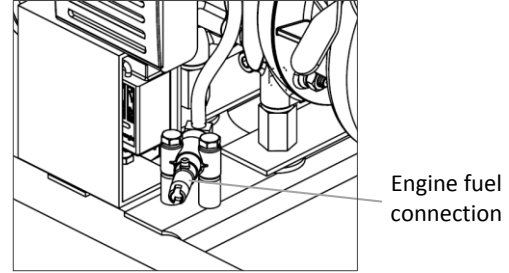
1. The more volatile components of the gasoline evaporate, leaving behind a heavier gasoline which can lead to inferior engine performance and a more difficult engine to start.
2. Certain hydrocarbons in the gas react with oxygen (oxidation) producing new and harmful compounds. The stale gasoline will 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. Gas stabilizers can be used to increase the gasoline's shelf life; however, it will not restore back bad gasoline.

Supply recommended fuel to engine

1. Carefully mix the fuel as recommended in the Fuel Mixture section.
2. Connect fuel supply line to fuel tank.
3. Prime fuel supply line to evacuate air bubbles.
4. Connect fuel supply line to engine fuel connection.
5. Pump fuel up to carburetor.



Note:	Careful not to flood the engine when pumping fuel up to the carburetor; gently squeeze the priming bulb.
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Warning:	Ensure that the fuel tank is positioned away and at a safe distance of the muffler to avoid any potential accident. Always refuel with care.
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Flooded engine

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

Clearing a flooded engine:

- a) Disconnect the spark plug cable and remove the spark plug.
- b) Re-connect the spark plug cable to the spark plug. Place the spark plug in contact with the cylinder head in order to ground the spark plug.

Note:	Failure to ground the spark plug can lead to damage of the CDI ignition coil when cranking the engine.
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- c) With both choke and throttle in fully open position, pull starter rope several times until excess fuel is exhausted.
- d) Before reinstalling spark plug, clean and dry electrode and insulator tip.
- e) If engine is severely flooded, remove the engine drain plug and drain engine.

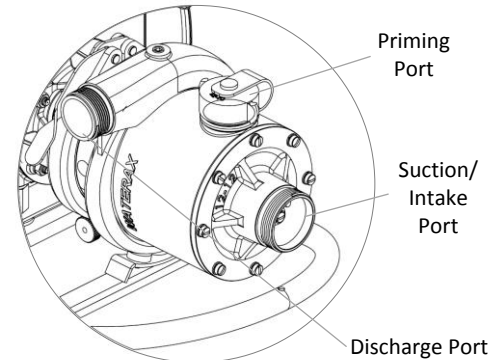
Pump Connections and Priming

1. Connect footvalve strainer to male end of suction hose, then fill suction hose with water. Connect hose to the pump intake. Use universal hose coupling wrench to tighten coupling firmly.

Manual Priming:

- a) Open the priming cap and fill pump with water manually.
- b) Firmly tighten priming cap.
- c) Pump can also be primed by “jerking” the suction hose until water flows from the pump’s discharge port.

WATERAX Hand Primer: Connect hand primer to discharge port or priming port and pump until water is drawn into the pump. Firmly tighten priming cap.



2. Connect discharge hose, nozzles, etc. to pump using universal hose coupling wrench to tighten coupling firmly.

Note:

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 when dry.

DO NOT allow footvalve 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, i.e., 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.
- Footvalve suction strainers should be fitted to prevent foreign matter from entering the pump.
- Where practicable, 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.

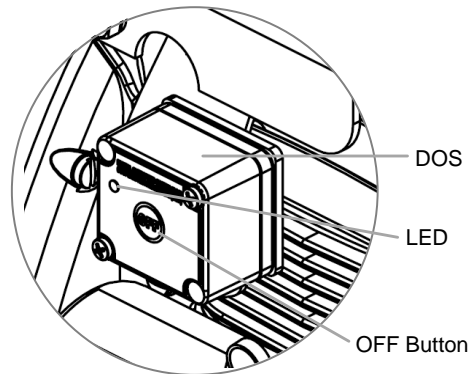
Limitations

Several factors can affect the pump's ability to efficiently draft water. The following limitations should be taken into account.

- Water temperatures above 35 °C (95 °F) can cause noticeable loss in pump performance.
- Barometric pressures below 98 kPa (29 in of Hg) can also cause noticeable loss in pump performance (specifically elevations >2000 feet above sea level).
- Pump performance curves are based off a 5 foot lift (top of water source to impeller center). Lifts greater than 5 feet will decrease the pump's performance.
- Hose and strainer sizes that are too restrictive can significantly decrease the pump's performance.
- Intake hose runs in excess of 10 feet can also reduce pump performance.

Engine Startup

1. Power up DOS: crank engine 1-2 times; DOS LED will blink.
2. Close/engage choke, if engine is cold.
3. Move throttle lever to "START"/"WARM UP" position (approximately 3 increments from idle position).
4. If equipped with a decompression switch (located on the cylinder head), push down the valve. The valve will close automatically upon engine startup.
5. Slowly crank engine until resistance (past compression).
6. Give starter cord a quick and steady pull.
7. Once engine starts, slowly open/disengage choke and allow engine to warm up for a **minimum of 2 minutes** before using full throttle.



Note: 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.

Note: If the rewind starter should break while the unit is on the fire line, the complete rewind starter assembly can be easily removed, thereby gaining access to a manual starter pulley which is mounted on the flywheel. Using a rope, wrap around the starter pulley and pull. Make sure rope wrapping will ensure clockwise rotation (from starter view)

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 has not been fully primed. Prime the pump again
- b) The engine works best at wide open throttle. Vary the discharge nozzle opening to adjust the pump performance.

Important: Do not use a nozzle larger than ½" (12.7 mm).

Note:	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 damage the pump. 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.
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Note:	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.
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Shutdown

1. After completing the pump operation, gradually reduce the engine speed and move throttle to "STOP" position.
2. Allow unit to run for approximately 2 minutes with throttle in this position for proper cool down.
3. 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.
4. Press and hold the "OFF" button on the DOS until engine shuts down.
5. Drain the pump after final use.

Operating the Digital Overspeed Switch (DOS)

The Digital Overspeed Switch continuously monitors the engine's speed. In the event of an overspeed condition which will occur during a loss of prime, the DOS will automatically shut down the engine to prevent the risk of damage to the engine and pump.

The DOS has an integrated LED for troubleshooting and an OFF switch to manually shut down the engine.

Important: Cut-out switch must not be made inoperative.

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. Drain the pump priming line if a primer has been used.
3. After use, drain the pump, manifolds, and lines of all water. You can also pour some antifreeze into the pump and circulate it through the pump and plumbing system.

Removing or Attaching the Pump End

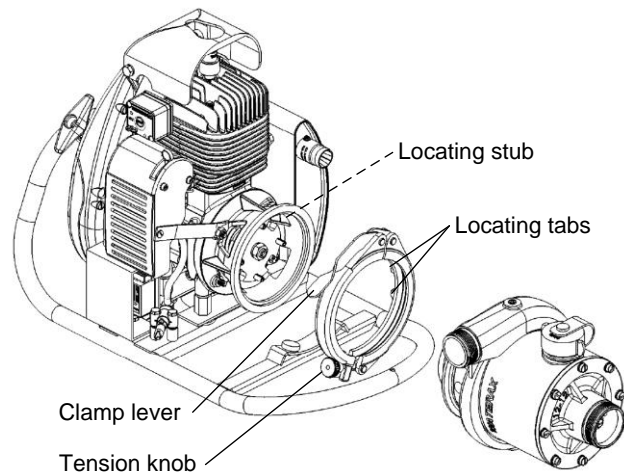
The MARK-3 pump has a quick release pump clamp and detachable pump end which facilitates the servicing of pump units and minimizes down-time in the field by allowing the quick replacement of pump ends.

To remove pump from engine:

1. Lift pump clamp lever.
2. Release tension-adjusting knob at bottom of clamp.
3. Remove clamp by tapping bottom end of each half clamp.
4. Remove pump from engine.

To attach the pump end to the engine:

1. Place flexible buffer coupling on engine coupling pins.
2. Align flexible buffer coupling holes to pump end coupling pins and install.
3. Install pump clamp with the lever on the top side (tension knob at the bottom). Align clamp locating tabs with pump flange locating stub.
4. Finger tighten tension knob located at bottom of clamp to obtain a light pressure on clamp ring.



CAUTION: 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.



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 in regards to locking out the equipment.

Regular maintenance

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



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

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 flexible buffer coupling. Replace if worn. See instructions for removing the pump end from the engine using the quick release pump clamp.
5. Check the engine for leaks.
6. Clean any dirt or debris from the pump unit. If necessary, a mild soap and water solution can be used.
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.
10. Check throttle and choke control for proper operation.
11. Check fuel line and fittings for signs of wear, etc.
12. Check starter rope and mechanisms and replace if there are signs of wear.
13. Make sure electronic ignition module is free of debris. Verify condition of wiring and connectors.
14. Note and report any performance irregularities or any abnormal mechanical sounds.
15. 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 5 mL (0.17 oz.) of 4-cycle engine oil (any viscosity will do). 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

Air Leaks	<ul style="list-style-type: none"> ■ Verify that suction hose coupling is securely tightened. ■ Check suction hose gasket. ■ Check sealing face on pump end suction cover.
Air Trapped in Suction Line	<ul style="list-style-type: none"> ■ 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.
Blocked or Restricted Intake Hose or Strainer	<ul style="list-style-type: none"> ■ Remove blockage from the intake hose or strainer. ■ 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).
Pump Suction Lift Requirements are Too High	<ul style="list-style-type: none"> ■ DO NOT attempt pump lifts exceeding 22 feet (6.7 meters) except at elevations lower than 2000 feet above sea level. ■ As elevation increases above 2000 feet 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.

Pump Does Not Meet Performance

Incompatible Suction Hose	<ul style="list-style-type: none"> ■ Verify suction hose diameter is at a minimum of 2". Any smaller diameter hose will negatively impact the pump performance and suction lift.
Gauge or Instrument Failure	<ul style="list-style-type: none"> ■ 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.
Blockage	<ul style="list-style-type: none"> ■ Check hoses and suction strainer; remove any obstructions found. ■ Check for debris wedged or caught in the impeller, distributor and suction cover. Remove any obstructions found.
Insufficient Power to the Pump	<ul style="list-style-type: none"> ■ Check engine compression and complete engine repairs if required. ■ An engine tune up may be needed to bring engine back to peak performance. ■ An engine will lose approximately 3.5% of its power per every 1000 feet above sea level. Adjust carburetor accordingly.

Pump Cavitating

Lift Too High	<ul style="list-style-type: none"> ■ Move pump closer to water source. ■ Decrease pump's intake hose length. ■ Increase pump's intake hose size.
Restrictions	<ul style="list-style-type: none"> ■ 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. ■ 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.

Engine Does Not Start, Runs Irregularly or Misses

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

Engine Backfires

Spark Plug Fouled or Defective	Clean or replace.	Defective Carburetor	Repair or replace.
Improper Timing	See "Ignition System".		

Engine Sounds Like a Four-Stroke

Engine Not Warmed Up Properly	Allow longer warm-up period.	High Speed Mixture Jet Misadjusted	See "Carburetor"
Too Much Oil in Fuel Mixture	See "Fuel mixture".	Air Filter Dirty	Clean or replace.
Improper Timing	See "Ignition System".		

Engine Does Not Develop Normal Power And/Or Overheats

Wrong Oil	See "Fuel mixture".	Air Filter Dirty	Clean or replace.
Wrong Gasoline	See "Fuel mixture".	Muffler Blocked	Replace muffler and/or spark arrestor
Fuel Mixture Too Lean	See "Fuel mixture".	Low Speed Mixture Jet Misadjusted	See "Carburetor"
Fuel Mixture Too Rich	See "Fuel mixture".	High Speed Mixture Jet Misadjusted	See "Carburetor"
Cooling System Dirty	Clean cooling system.	Improper Timing	See "Ignition System".

Service

This section includes instructions for overhaul and maintenance requiring disassembly of the 185cc engine and 4-stage pump end model 12-16S.

Note: It is recommended that all fasteners be replaced with genuine *WATERAX* parts.

Carburetor

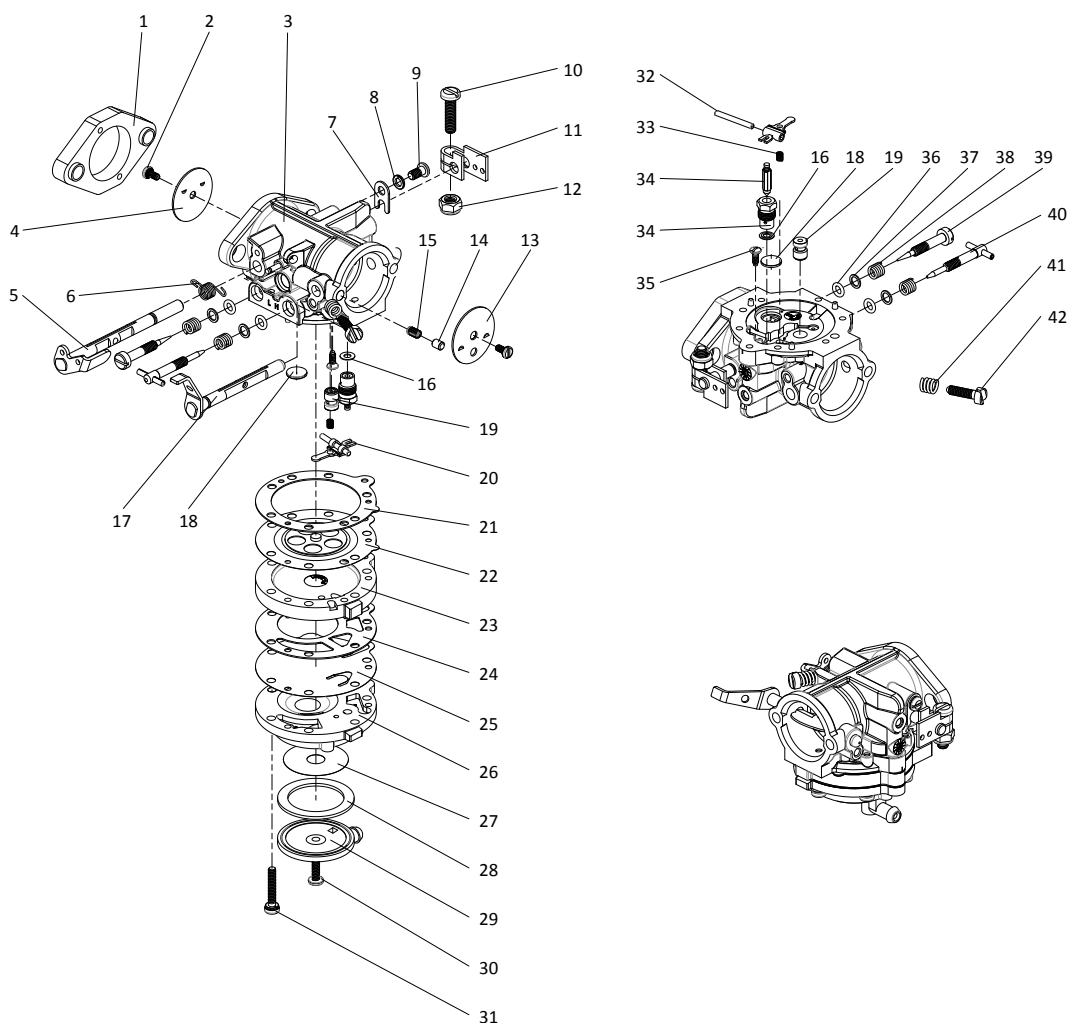
Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
-	800152	R-1115 CARBURETOR	-
1	600540*†	R-1113N GASKET CARBURETOR	1
2	--	R-1041 MACHINE SCREW WITH LOCK WASHER	2
3	--	R-1045 BODY	1
4	--	R-1040 THROTTLE SHUTTER	1
5	301314	R-1035 BRASS AND STEEL THROTTLE SHAFT AND LEVER	1
6	301327	R-1039 STEEL THROTTLE SHAFT RETURN SPRING	1
7	301325	R-1036 THROTTLE SHAFT CLIP	1
8	301326	R-1037 LOCK WASHER 1/4 OD X .15 ID	1
9	--	R-1038 MACHINE SCREW	1
10	800550	R-1111 BOLT	1
11	--	THROTTLE LINK LEVER	1
12	--	R-1110 NUT	1
13	301315	R-1005 BRASS CHOKE SHUTTER	1
14	--	R-1002 CHOKE FRICTION PIN	1
15	301334	R-1003 PLATED STEEL SPRING FOR CHOKE FRICTION	1
16	301331	R-1047 BRONZE INLET SEAT GASKET	1
17	301322	R-1004 CHOKE SHAFT AND LEVER	1
18	800160*†	R-1001 BODY CHANNEL WELCH PLUG	1
19	800154†	R-1034 NOZZLE CHECK VALVE	1
20	800157*†	R-1025N INLET CONTROL LEVER	1
21	800161*†	R-1008 DIAPHRAGM GASKET	1

* Included in R-1050 MARK-3 Carburetor Repair Kit (600178)

† Included in R-1049A Carburetor Repair Kit (600162)

ID	ITEM NO	DESCRIPTION	QTY
22	800163*†	R-1009 DIAPHRAGM "SB"	1
23	301316	R-1010 DIAPHRAGM COVER	1
24	800162*†	R-1011 FUEL PUMP GASKET	1
25	800164*†	R-1012 FUEL PUMP DIAPHRAGM	1
26	301317	R-1013 ALUMINUM FUEL PUMP BODY	1
27	800155†	R-1015 FUEL STRAINER SCREEN	1
28	800159*†	R-1016 FUEL STRAINER COVER GASKET	1
29	301318	R-1017 FUEL STRAINER COVER	1
30	301319	R-1018 PLATED STEEL MACHINE SCREW ROUND SLOTTED	1
31	--	R-1014 MACHINED SCREW WITH LOCK WASHER	6
32	301266	R-1025NA INLET CONTROL LEVER FULCRUM PIN	1
33	800156†	R-1029 INLET TENSION SPRING	1
34	800153*†	R-1046N INLET NEEDLE, SEAT AND GASKET	1
35	301333	R-1026 INLET CONTROL LEVER PINION SCREW	1
36	800158†	R-1022 MIXTURE SCREW O-RING	2
37	301335	R-1021 SS STEEL FLAT WASHER 1/4"OD X 3/16"ID	2
38	301321	R-1020 STAINLESS STEEL MIXTURE SCREW SPRING	2
39	301324	R-1019 PLATED STEEL LOW SPEED MIXTURE SCREW	1
40	301323	R-1030 PLATED STEEL HIGH SPEED MIXTURE SCREW	1
41	--	R-1024 IDLE SPEED SCREW SPRING	1
42	--	R-1023 IDLE SPEED SCREW	1
-	301330*	R-1046N-L LONG NEEDLE, SEAT AND GASKET	-



Maintenance

The carburetor can be cleaned with a minimum of tools. Before disassembling the carburetor, it is **imperative** to flush it clean of dirt by using proper carburetor cleaner.

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 8 mm (5/16") hex socket, carefully remove the inlet seat. Remove inlet seat gasket. When reinstalling seat, tighten only to 3-4 Nm [25-35 in-lbs].
10. Remove low speed and high speed mixture screws.
11. The ball check type main nozzle can be removed by tapping it out of the body casting into the venture with a small punch. A replacement ball check nozzle should be pressed into the casting. The brass cage should be pressed flush with the metering chamber casting.

Before reassembling the carburetor (in reverse order as outlined previously), wash **all** component parts in carburetor cleaner and blow off with compressed air. The channels in the metering body should be cleaned by blowing through the low and high speed adjusting orifices. All fuel passages in the three castings should be cleaned with compressed air.

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.

To test the carburetor:

- Pop-off pressure: 8-12 psi
- Reseating pressure: 4-5 psi

Carburetor adjustments

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

A. Low speed (idle) mixture adjustment screw ("L")

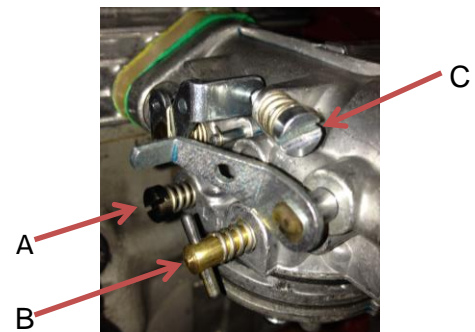
The low speed mixture screw controls the air-to-fuel mixture ratio at idle and low speeds.

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 counter-clockwise (**CCW**) will open up the jets and richen up the mixture (less air, more fuel).

1. Before starting the pump unit, close both high and low speed adjustment screws by turning **CW** until they just touch the seat.

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

2. The entry settings are as follows:
 - High speed: open jet by turning one (1) turn **CCW** from fully closed.
 - Low speed: open jet by turning one (1) 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 the engine to properly warm up (minimum of 2 minutes) before proceeding with the adjustments.

Note: Do not run the engine with the choke engaged for long periods of time to warm up the engine

6. When engine is warmed up, return throttle to idle position. Adjust the idle speed regulating screw until engine idles between 2,000-2,200 rpm for low speed jet adjustment. The pump pressure will be around 30-35 psi.
7. To adjust the **low speed** mixture, quickly increase the throttle and observe the engine response (return back to idle);
 - If the engine is running roughly and does not accelerate smoothly, slightly close the low speed jet by turning the low speed mixture adjustment screw **CW** to lean out the mixture.
 - If the engine hesitates to accelerate, slightly open the low speed jet by turning the low speed mixture adjustment screw **CCW** to enrich the mixture.
 - Repeat the procedure until the engine reacts smoothly when opening up the throttle.

Note:	The engine at idle should run a bit roughly (richer mixture), but not be on the verge of “choking” due to an excessive amount of fuel. This will provide adequate lubrication at low engine speeds where the engine fan cooling is reduced. If the engine runs “too” smoothly (similar to a 4-cycle engine), this indicates that the mixture is too lean. Adjust immediately.
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8. Increase the speed gradually to full throttle setting. Adjust the **high speed** mixture:
 - Turn the high speed mixture adjustment screw **CW** and reach the maximum engine speed (maximum pump pressure). **Note:** at this point, a slight turn **CW** would cause the engine speed to drop resulting in a dangerously lean condition. **Adjust immediately.**
 - To obtain an optimal and safe mixture, open the high speed jet by turning the high speed mixture adjustment screw ¼ turn **CCW** from the maximum engine speed setting obtained in last step. There will be a slight decrease in engine speed (~100-150 rpm) and pump pressure (~5-10 psi).
9. Return back to idle and verify idle speed and low speed mixture adjustment. Correct if necessary. If low speed mixture was adjusted, increase the speed back to full throttle and adjust the high speed mixture.

Note:	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.
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Note:	It will be necessary to readjust the carburetor when operating the pump at different altitudes.
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A special offset screwdriver is available. It allows for an easy adjustment of the low speed jet on the MARK-3 carburetor. Item number is 801147.



Troubleshooting

Carburetor Flooding

Dirt or Foreign Particles Preventing Inlet Needle From Seating	Remove, clean and/or replace.	Diaphragm Lever Spring Not Seated on Lever Dimple	Remove lever and reinstall.
Diaphragm Improperly Installed in Carburetor	Replace diaphragm or correct installation.	Improper Use of Choke	Disengage/Open choke.

Engine Will Not Accelerate

Low Speed Mixture Set Too Lean	Enrich low speed adjustment.	Diaphragm Gasket Leaking	Replace.
Incorrect Setting On Diaphragm Lever	Reset.	Main Fuel Orifice Plugged	Remove diaphragm cover, diaphragm, diaphragm lever and high speed adjusting screw. Clean out orifice by blowing air through high speed adjustment threaded hole.
Diaphragm Cover Plate Loose	Tighten.		

Engine Will Not Idle

Incorrect Idle Speed Adjustment	Adjust idle speed.	Dirty Nozzle Check Valve	Clean or replace.
Idle Discharge Ports or Channels Clogged	Blow out with compressed air or flush with gasoline.	Welch Plug Covering Idle Discharge Ports Not Sealing	Replace welch plug.
Throttle Shutter Cocked in the Throttle Bore Causing Fast Idle	Reset.		

Engine Runs Out Lean

Fuel Tank Vent Not Working Properly	Clean or replace.	Ruptured Fuel Pump Diaphragm	Replace.
Leak in Fuel System from Tank to Pump	Tighten or replace fittings and lines.	Main Fuel Orifice Plugged	Clean.

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

The Nozzle Channel Plug or Nozzle Check Valve Cage Is Not Sealing	Install new plug or new cage.		
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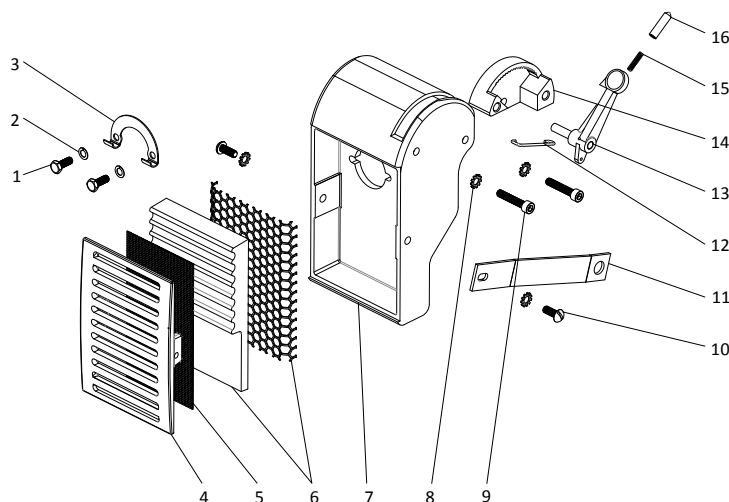
Air Filter

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	600165	R-793 MACHINE SCREW MODIFIED, S.S.	2
2	800489	R-791 LOCKWASHER #10 SPLIT ZINC	2
3	600177	R-1044 LOCK PLATE FOR MARK-3	1
4	600169	R-794 AIR FILTER COVER FOR MARK-3	1
5	701286**	EMBER SEPARATOR FOR MARK-3	1
6	700810	R-955 AIR FILTER	1
7	600519	R-790 CARBURETOR SHROUD, WITH DECAL	1
8	800352*	12-79 LOCKWASHER #10 EXTERNAL TOOTH	4
9	800441*	B-4036-12 SCREW #10-32X1 HEX SOCKET BLACK OXYDE	2
10	800487	R-774 SCREW #10-32X1/2 FLAT/SQ ROUND	2
11	600173	R-799 BRACKET FOR MARK-3	1
12	700808*	R-1102 LINK FOR THROTTLE	1
13	600159*	R-1107 THROTTLE LEVER SUB-ASSEMBLY	1
14	700033*	B-4024 QUADRANT FOR THROTTLE LEVER	1
15	800316*	A-4028 SPRING SS	1
16	700011*	A-4027 INDEX PIN, BRASS	1

* Included in R-792 Throttle Assy (600529)

** Ember separator screen standard on GSA/DLA model only



Servicing

Regularly clean and/or replace the air filter. The air filter works best when oiled. A tackifier spray can be used on the air filter to help the oil adhere to the air filter.

Note: Apply multi-purpose grease on the quadrant teeth when installing the throttle lever sub-assembly into the quadrant to facilitate installation and operation.

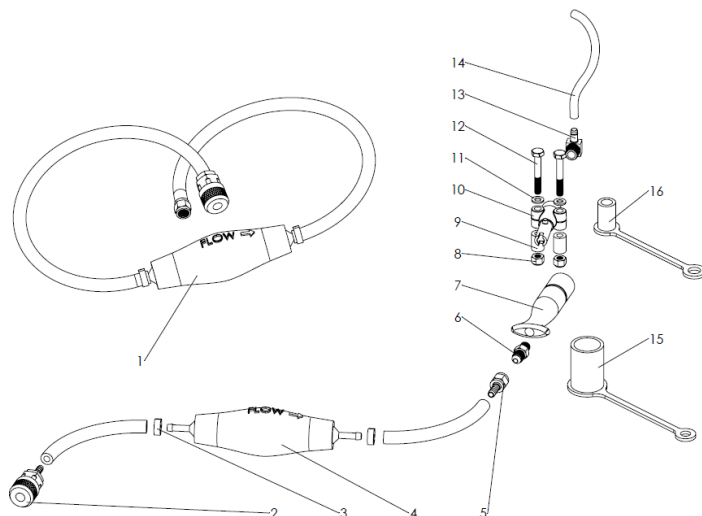
Fuel Line

Parts breakdown (Mercury fuel connection)

ID	ITEM NO	DESCRIPTION	QTY
1	600390*	12-401B-NS FUEL LINE, STANDARD STYLE	1
2	800864	FA-451 FEM QUICK-CONNECT	1
3	800440	12-406N SINGLE EAR OETIKER CLAMP	2
4	600389	12-405-1 FUEL LINE PRIMING BULB	1
5	700017	12-65 COUPLING SWIVEL	1
6	800814**	R-732 CONNECTOR 1/4" TUBE X 1/8" NPT	1
7	800802**	R-712 HANDLE QUICK CONNECT, FEM	1
8	800419**	C-6650-14 NUT 1/4-20 HEX NYLON LOCK ZINC	2
9	600081**	C-5200-7R SPACER-RUBBER	2
10	800805**	R-706 BODY QUICK-CONNECT M	1
11	800474**	D-5269-7 WASHER 1/4 FLAT SS	2
12	800422**	C-5200-8 SCREW 1/4-20X1-3/4 HEX CAP SS	2
13	800804**	R-709 ELBOW 90, 3/8" TUBE X 1/4" NPT M	1
14	600172**	R-798 PLASTIC TUBING (FUEL LINE)	1
15	700100	A-7487 DUST CAP - FEM CONNECTOR, NITRILE	1
16	700080	A-7486 DUST CAP - M. CONNECTOR, NITRILE	1

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

** Included in R-1114 Quick-connect fuel line assy (600155)

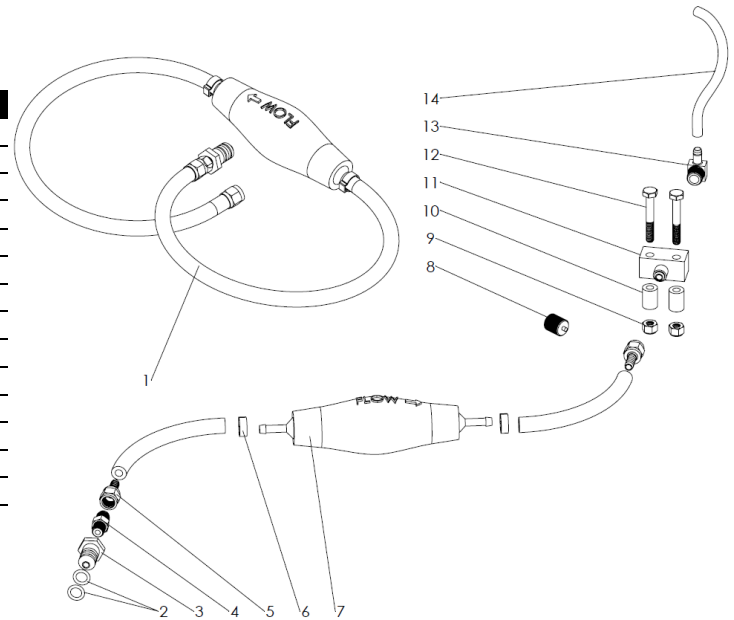


Parts breakdown (USFS)

ID	ITEM NO	DESCRIPTION	QTY
1	600136*	R-1206A-GSA 5' FUEL LINE PRIMING BULB	1
2	700715**	O-RING-10 O-RING 9/16"ODX3/8"IDX3/32"THK	2
3	700660**	A-7505 MALE PLUG	1
4	800814	R-732 CONNECTOR 1/4" TUBE X 1/8" NPT	1
5	700017	12-65 COUPLING SWIVEL	2
6	800440	12-406N SINGLE EAR OETIKER CLAMP	2
7	600389	12-405-1 FUEL LINE PRIMING BULB	1
8	700018	A-4428 OUTLET CAP FOR A-4427	1
9	800419	C-6650-14 NUT 1/4-20 HEX NYLON LOCK	2
10	600081	C-5200-7R SPACER-RUBBER	2
11	700092	A-7288 FUEL BLOCK FOR MK-3-WP, BRASS	1
12	800422	C-5200-8 SCREW 1/4-20X1-3/4 HEX CAP SS	2
13	800804	R-709 ELBOW 90, 3/8" TUBE X 1/4" NPT M	1
14	600172	R-798 PLASTIC TUBING (FUEL LINE)	1

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

** Included in B-7527 Male Plug With O-rings (600426)

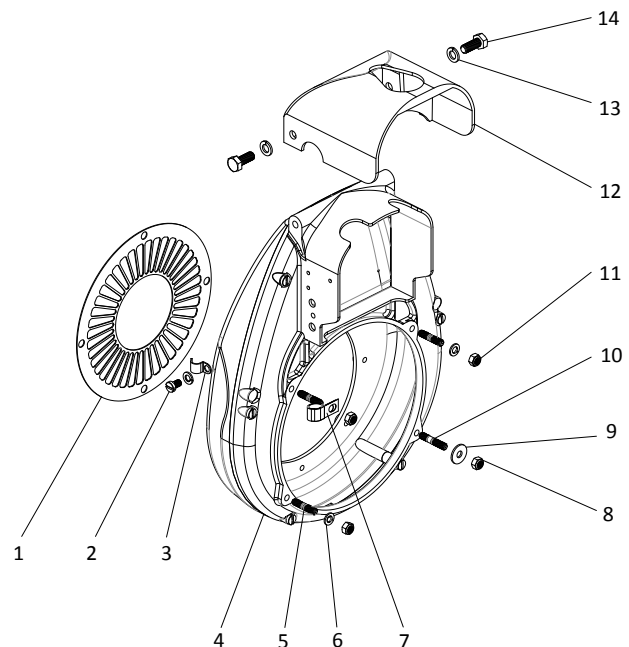


Fan Cowl (Housing)

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	800088	R-418 SHIELD - FAN	1
2	800530	R-408 SCREW M6X1.0X10 SLOT CHEESEHEAD ZINC	1
3	800075	CLAMP - IGNITION CABLE	1
4	800077	R-411P COWL - FAN W/STUDS PAINTED	1
5	800047*	R-115 STUD, M6 X 1.0 X 30 MM LG	3
6	801107	LOCKWASHER M6 SPLIT BOWED ZINC DICHROMATE DIN128A	3
7	800408	B-5562-18 CLAMP PLASTIC COATED 9/16" ID	1
8	800544	R-150 NUT M6X1.0 HEX FUJI LOCK ZINC	2
9	800543	R-151 WASHER 1/4 FLAT ZINC	1
10	800103*	R-402 STUD M6 X 1.0 X 32.5 MM LG	1
11	800292	TY-1811 NUT M6-1 LOCK ZINC	2
12	600158	R-413 COVER FOR SPARK PLUG, ALU. PAINTED	1
13	800548	R-119 LOCKWASHER M8 SPLIT ZINC	2
14	800520	R-414 SCREW M8X1.25X20 HEX CAP CADM	2

* Included in R-411P Cowl - Fan w/ Studs Painted (800077)



Cleaning

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

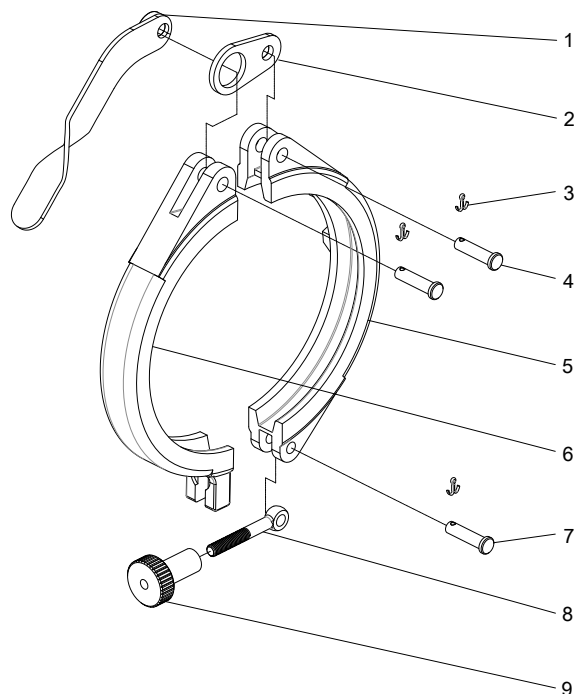
In time, the cooling air passages can become partially clogged with dirt, thereby reducing the cooling efficiency.

Whenever this condition occurs, remove the rewind starter and the fan cowl; use compressed air or a stiff bristle brush and appropriate cleaning solution to remove all dirt deposits from cooling fins and from inside the fan cowl.

Pump Clamp

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	700581	A-4460 LEVER, ZINC PLATED	1
2	600122	A-4452 SIDE LINK FOR LEVER, ZINC PLATED	1
3	800426	C-4462-5 COTTER PIN DIN 94 2.5MM X 16MM	3
4	800263	A-4455 CLEVIS PIN FOR LEVER SIDE	2
5	700889	B-4457 PUMP CLAMP BOTTOM HALF	1
6	600110	B-4461 PUMP CLAMP TOP HALF	1
7	800405	A-4454 CLEVIS PIN	1
8	700004	A-4453 EYE BOLT, PLATED STEEL	1
9	700035	A-4456 KNOB FOR TENSION ADJUSTMENT, ALU.	1

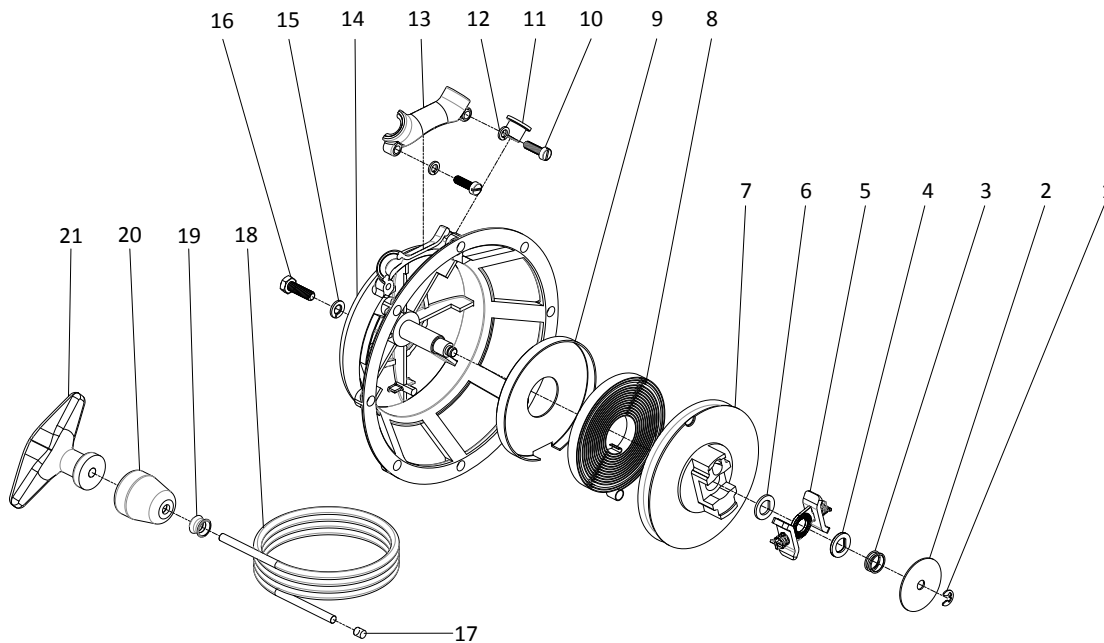


The quick release pump clamp should be inspected on a regular basis. If components appear to be worn, replace them immediately.

Rewind Starter

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
-	800131	R-529 REWIND STARTER COMPLETE	-
1	800083	R-518 CIRCLIP 5MM, DIN 6799.5, BLACK	1
2	800101	R-517 FLAT WASHER	1
3	800086	R-516 SPRING - FRICTION	1
4	800100	R-526 WASHER - FRICTION	1
5	600531	R-528 PAWL ASSEMBLY	1
6	800092	R-510 FLAT "D" WASHER	1
7	800099	R-504 ALUM. SHEAVE, STARTER ROPE	1
8	800098	R-506 SPRING - REWIND	1
9	800125	R-531 RETAINER - SPRING	1
10	800115	R-524 MACH. SCREW SHEESE SLOTTED	2
11	800097	R-509 PLUG - RUBBER	1
12	800553	R-523 LOCKWASHER M5 SPLIT CADM	2
13	800126	R-532 REWIND STARTER REAR COVER	1
14	800117	R-530 HOUSING FOR REWIND STARTER (W/ R-531) 185CC	1
15	801107	LOCKWASHER M6 SPLIT BOWED ZINC DICHROMATE DIN128A	4
16	800554	R-522 SCREW M6X1.0X20 HEX CAP ZINC	4
17	700118	R-505 LOCK PIN 5.5MM DIA X 6MM LG, STEEL	1
18	801106	R-502N #6 NYLON STARTER ROPE 4.8MM 6 FIL 1400MM LG	1
19	800127	R-533 GUIDE FOR STARTER ROPE	1
20	800128	R-544 BUFFER - RUBBER	1
21	800089	R-501 HANDLE FOR STARTER ROPE	1



Disassembly

1. Remove the rewind starter from the fan cowl.

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

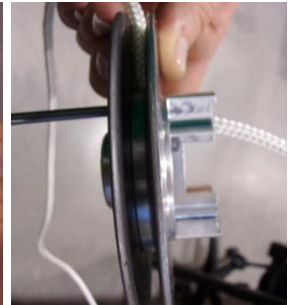
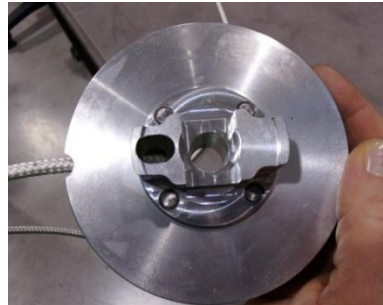
2. Remove the circlip #1 and flat washer #2.
3. Remove the spring #3, friction washer #4, pawl assembly #5 and flat "D" thrust washer #6.
4. **Securely** hold the rope sheave #7 in place and remove the two screws #10, lock washers #12 and the rear cover #13.

Warning: Keep rope sheave firmly in hands! Risk of injury when rewind spring unwinds!

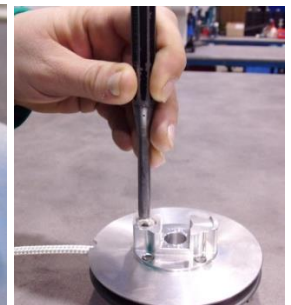
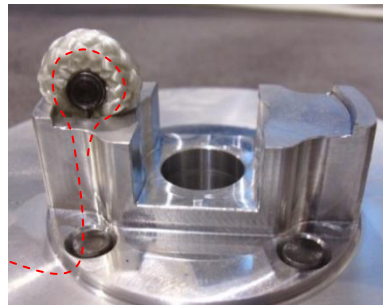
5. Pass the starter handle #21 through the opening in the starter housing #14. While still maintaining pressure on the rope sheave, slowly let the rope sheave rotate counterclockwise to allow for the rewind spring #8 to safely unwind.
6. Remove rope sheave with the starter rope and starter handle.
7. Check the rewind starter shaft for excessive wear. Replace the housing if wear is too severe.
8. Check the bore of the rope sheave for excessive wear. Replace rope sheave if wear is too severe.
9. If damaged, replace rewind starter spring, starter rope, starter handle, rope guide and pawl assembly.

Assembly

1. Install the rope in the sheave:
 - a. Pass rope in the sheave.



- b. Lock the rope in place with the lock pin #17. A minimum rope length of 15 mm [19/32"] should be looped inside the hole. Pull the rope until the lock pin enters the hole. With a round punch, press the lock pin to secure the rope.



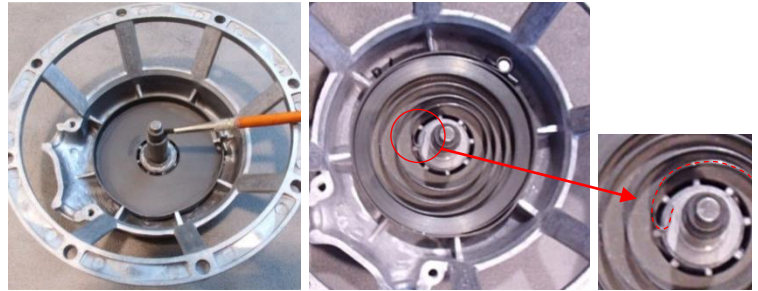
2. Wrap the rope counterclockwise (turn the rope sheave clockwise).



3. Slide in the rope guide, rubber buffer and starter handle on the rope.
4. Tie a knot to secure the starter handle in place.



5. Apply a small amount of Molykote G-N grease on the starter housing shaft.
6. Install the rewind spring (see spring orientation in picture). Lubricate the rewind spring with a light amount of engine oil (4-stroke engine oil).



7. Apply a light amount of Molykote G-N on the rope sheave surface that will be in contact with the rewind spring. Install the rope sheave on the shaft. Engage the sheave on the spring by rotating it slightly counterclockwise.
8. Re-apply a small amount of Molykote G-N grease on the starter housing shaft
9. Install the flat "D" thrust washer with the sharp edge toward the bottom



10. Install the pawl assembly. Make sure to orientate the pawl assembly (as per picture) in order for the pawls to function properly.
11. Install the friction washer with the serrated teeth facing the pawl assembly pivot arm.
12. Install the spring, flat washer and circlip.

13. To wind the spring, position the rope on the notch located on the rope sheave. Allow for approximately 20 cm [8 in] of free rope. Using the notch, pull the rope and turn the sheave counterclockwise 4-5 turns.
14. Carefully pass the rope with the starter handle, rubber buffer and rope guide through the correct starter housing opening.
15. Position the rope guide and in the appropriate slot and install the rear cover using the two lockwashers and screws.



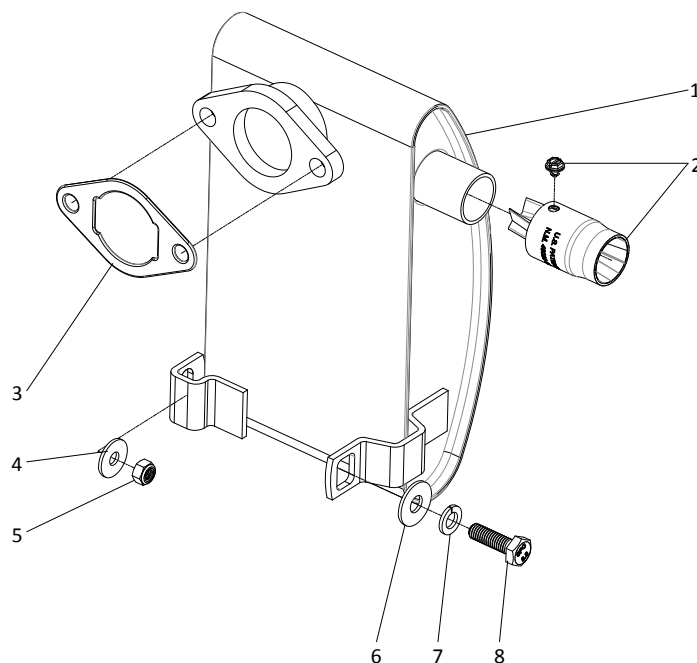
16. Install the plug #11.
17. Install the handle into the rubber buffer.
18. Verify the assembly. Pull the starter rope:
 - a. Pawls should move outwards.
 - b. When releasing the starter handle, the rope should wind back into its idle position.

Muffler

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	600166	R-229 MUFFLER FOR MARK-3	1
2	700811*	PART-205 SPARK ARRESTOR, MARK-3	1
3	800067	R-237 GASKET MUFFLER	1
4	800543	R-151 WASHER 1/4 FLAT ZINC	1
5	800544	R-150 NUT M6X1.0 HEX FUJI LOCK ZINC	1
6	700071	C-5370-11 WASHER 7/8"OD X 1 1/32"ID X 1/16"TH, S.S.	1
7	800548	R-119 LOCKWASHER M8 SPLIT ZINC	1
8	800416	RA-108 SCREW M8X1.25X25 HEX CAP ZINC	1

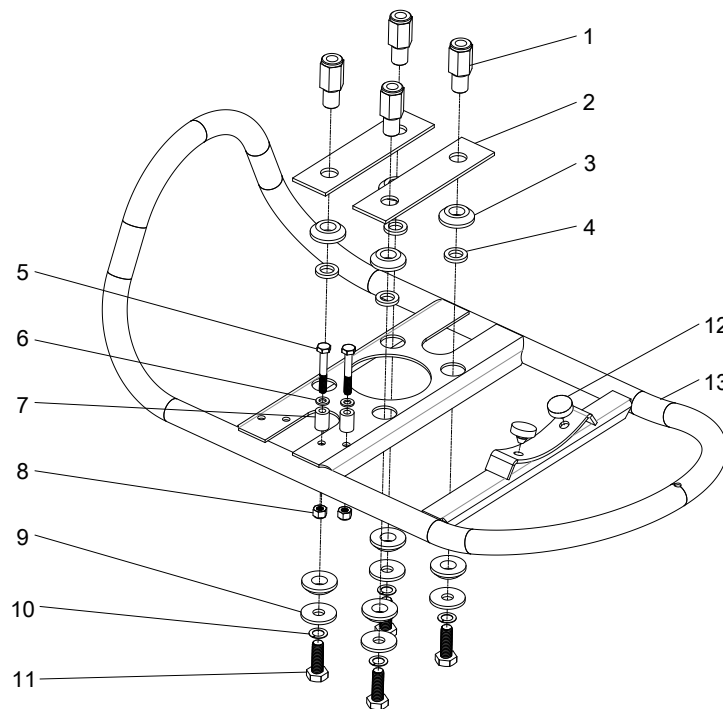
* USFS approved spark arrestor



Frame

Parts breakdown

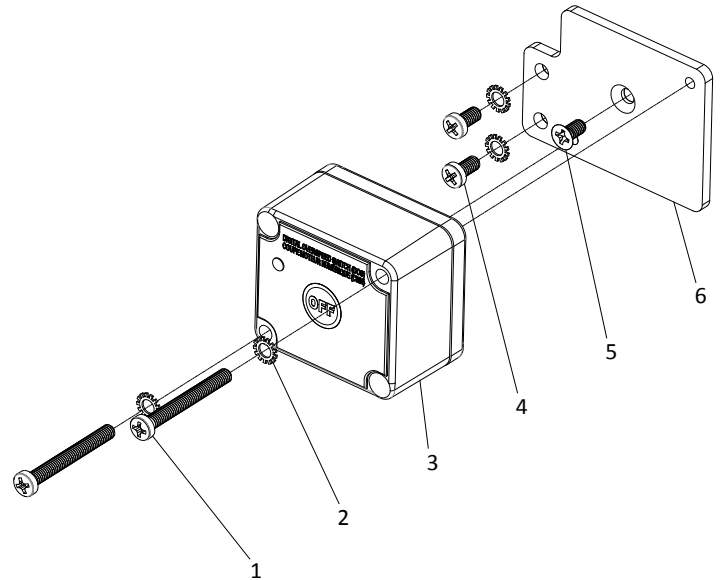
ID	ITEM NO	DESCRIPTION	QTY
-	600095	C-5200N MOUNTING FRAME WITH HARDWARE	-
-	600082	C-5200N-15 HARWARE KIT FOR C-5200N FRAME (INCL. ALL PARTS EXCEPT C-5201 FRAME)	-
1	600037	A-6149P MARK-3 MOUNTING LEG, PLATED	4
2	600108	A-4005 MOUNTING PAD, PLATED	2
3	700021	A-6179 RING, RUBBER	8
4	700652	C-5200-5 WASHER, 13/16"ODX1/2"IDX1/8"THK	4
5	800422	C-5200-8 SCREW 1/4-20X1-3/4 HEX CAP SS	2
6	800474	D-5269-7 WASHER 1/4 FLAT SS	2
7	600081	C-5200-7R SPACER-RUBBER	2
8	800419	C-6650-14 NUT 1/4-20 HEX NYLON LOCK ZINC	2
9	800435	C-5200-6 WASHER 3/8 FENDER ZINC	4
10	800536	R-111 LOCKWASHER M10 SPLIT ZINC	4
11	800424	C-5200-12 SCREW M10X1.5X30 ZINC	4
12	700769	C-4506-3 BUMPER, RUBBER	2
13	700072	C-5201 MK-3 FRAME, STEEL PAINTED	1



Digital Overspeed Switch (DOS)

Parts breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	800443	B-6289-3 SCREW M4X0.7X35 PHILLIPS CHEESE HEAD ZINC	2
2	800400	B-6289-6 LOCKWASHER M4 EXTERNAL TOOTH ZINC	4
3	700593	B-6289-1 DOS PRODUCTION UNIT	1
4	800402	B-6289-4 SCREW M4X0.7X8 PHILLIPS RAISED CHEESE ZINC	2
5	800413	B-6289-5 SCREW M4X0.7X8 PHILLIPS FLAT ZINC	1
6	700616	B-6289-2 DOS MK-3 BRACKET	1

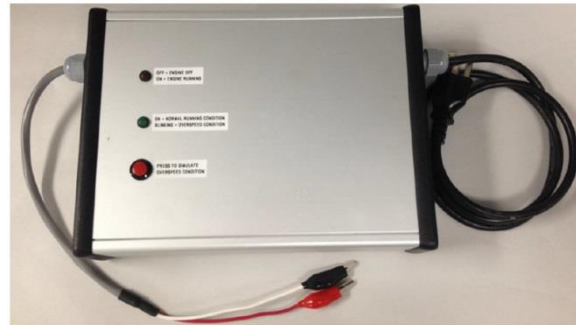


Installation

Install the DOS on the fan cowl. The DOS enclosure serves as the ground. Connect the DOS cable to the "STOP" tab (far right) on the CDI module.

Troubleshooting

The troubleshooting of the DOS can be done while the MARK-3 is in operation or by using the DTM DOS Testing Module (700773).



Below is the normal behavior of the DOS when running on a MARK-3:

DOS LED	Start the engine. The DOS LED shall flash 4 times at engine start up and shall flash continuously to indicate that the DOS is powered up.
Maximum Engine Speed Setting	Run the engine at wide open throttle (WOT) and close the nozzle (shut-off). The DOS shall not shut down the engine.
DOS OFF button	With the engine running, press and hold the OFF button until the engine shuts down. Engine shall shut down. LED shall flash red and turn off.
Overspeed condition	With the engine running at WOT, create a loss of prime condition. The engine will overspeed; the DOS shall immediately shut down the engine. LED shall turn off.

Ignition System

Spark plug

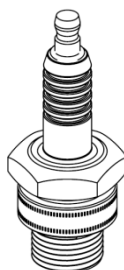
Operating with a defective or incorrect spark plug will affect the engine's performance and can cause hard starting, fouling, missing, overheating, pre ignition and/or lack of power. To service and inspect the spark plug, the following steps must be performed.

1. Disconnect spark plug cable and remove spark plug.
2. Clean spark plug and inspect carefully. If tip of insulator core is rough, cracked, broken or blistered, or if electrodes are burned away to the extent that they are too thin and cannot be satisfactorily adjusted to recommended gap of 0.5-0.6 mm [0.020-0.024 in], replace with new plug.
3. Reinstall spark plug. Start threads one or two turns with fingers to avoid danger of cross threading. Tighten spark plug to recommended torque of 35-40 Nm [310-354 in-lbs].
4. Connect spark plug cable.

Caution: 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.

ID	ITEM NO	DESCRIPTION	QTY
-	800850*	R-629 SPARK PLUG 18 MM	-

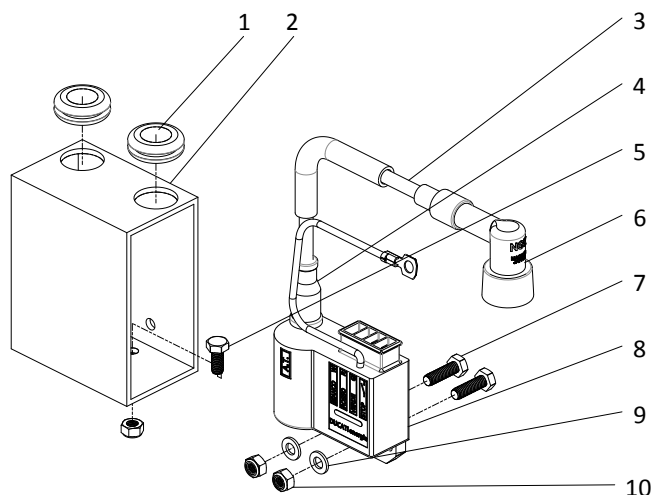
Note: For 14 mm cylinder head, spark plug R-629-14 (800851) is available.



CDI box assembly breakdown

ID	ITEM NO	DESCRIPTION	QTY
-	600125	B-7592 ELECTRONIC IGNITION BOX ASSY	-
1	800685	D-2902-9 GROMMET	2
2	700757	A-7589 MOUNTING BLOCK/ELECT. IGNITION	1
3	800039	R-274 IGNITION CABLE 500MM	1
4	800056	R-275 PROTECTION CAP	1
5	800529	FAST-18 HEX CAP SCREW M6 X 1 X 14MM LG	2
6	800121	R-650 PROTECTOR, SPARK PLUG	1
7	800526	FAST-20 HEX CAP SCREW M6 X 1 X 20MM LG	2
8	800057	R-273 ELECTRONIC BOX F/IGNITION	1
9	800549	FAST-510 FLAT WASHER M6, ZINC PLATED	2
10	800544	R-150 NUT M6X1.0 HEX FUJI LOCK ZINC	4

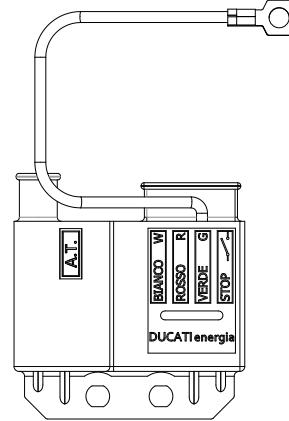
Note: To retrofit engines from point ignition to CDI and DOS, refer to the Digital Ignition Solution (DIS) conversion kit (600556). User Instructions and jigs are available.



CDI module diagnostic

	"STOP"	"VERDE"	GROUND (red wire)	A.T. (high voltage)
"STOP"	-	$\leq 0.1 \Omega$	$\geq 50 M\Omega$	$\geq 50 M\Omega$
"VERDE"	$\leq 0.1 \Omega$	-	$\geq 50 M\Omega$	$\geq 50 M\Omega$
GROUND (red wire)	$\geq 50 M\Omega$	$\geq 50 M\Omega$	-	4.7 – 5.5 k Ω
A.T. (high voltage)	$\geq 50 M\Omega$	$\geq 50 M\Omega$	4.7 – 5.5 k Ω	-

Note: The above values are not always a guarantee of perfect efficiency of the part.



Stator breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	800497*	R-655 SCREW M4X0.7X20 PHILLIPS PAN ZINC W/ WASHER	2
2	800110	R-638 MACH. SCREW, PAN SLOTTED	3
3	800540	R-611 LOCKWASHER M4 SPLIT ZINC	3
4	800551	R-637 WASHER M4 FLAT ZINC	3
5	800073	R-661-CDI STATOR, COIL/ARMATURE ASSEMBLY	1

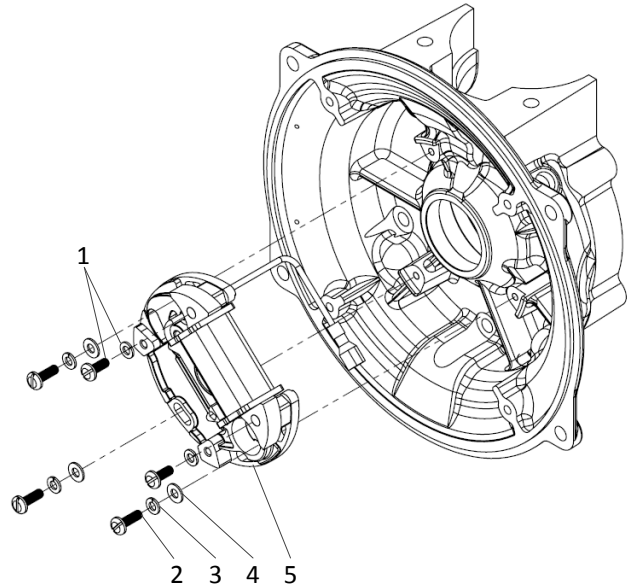
* Included in R-661 CDI STATOR (800073)

Note: R-636 Grommet (800074) not shown.

Stator diagnostics

	GREEN WIRE FROM COIL
GROUND (STATOR)	225 – 255 Ω

Note: The above values are not always a guarantee of perfect efficiency of the part.

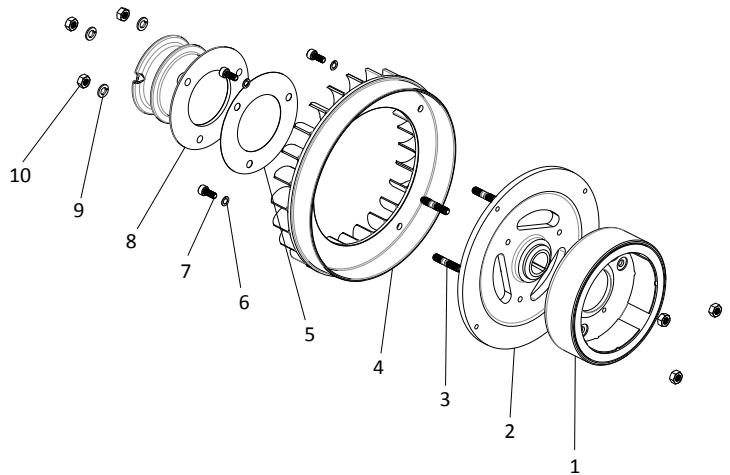


Magneto breakdown

ID	ITEM NO	DESCRIPTION	QTY
1	701109*	R-668E MAGNETO CDI FOR 185CC	1
2	600534*	R-669 MAGNETO HOUSING FOR 185CC WITH MACH. KEYWAY	1
3	800123*	R-602 STUD M6 X 1.0 X 31 MM LG	3
4	701110*	R-603N COMPOSITE FAN FOR 185CC	1
5	800102	R-653 PULLEY GASKET	1
6	801163*†	LOCKWASHER M5 TEETH SERRATED ZINC DIN 6798	4
7	800058*	R-146 ALLEN SCREW M5X12	4
8	800130	R-601 PULLEY FOR MANUAL START	1
9	801107	LOCKWASHER M6 SPLIT BOWED ZINC DICHROMATE DIN128A	3
10	800045*	R-116 HEX NUT M6X 1.0	6

* Included in R-667N-ES Flywheel/Magneto/Fan Assy CDI (600535)

† For aluminum fan, use R-523 lockwasher M5 split (800553)



Ignition timing

The stator must be positioned adequately in order to have the appropriate ignition timing. An ignition timing tool (801146) is available.

1. To position the stator, remove labyrinth ring and install ignition timing adjustment tool. Turn stator clockwise until coil rests on adjustment tool. Tighten the three screws with flat and lock washers. Tightening torque: 2.5-3 Nm [22-27 in-lbs]. Be careful not to squeeze/pinch the green wire.



2. If you are not equipped with the timing adjustment tool, fit the stator plate so that the oblong holes are centered with the crankcase threaded holes; then rotate the stator plate 1-1.5 mm counter-clockwise and tighten the three screws.



3. First pass the green wire through the crankcase hole and then through the grommet. Install the grommet on the crankcase.
4. Pull the green wire through the grommet and apply a dab of RTV silicone sealant.



5. To verify that the ignition timing is correct, you will require a stroboscopic lamp, a tachometer and a dial gauge.
 - a) Turn the crankshaft until the piston is **3.75 mm [.147"] before top dead center**.
 - b) Mark the coupling buffer and pump flange with a marker.
 - c) Start the engine and check ignition timing with the stroboscopic lamp. The two marks made previously shall correspond when engine speed is between **3,000-4,000 rpm**.
 - d) If marks do not correspond, re-adjust stator plate position. Turning the stator clockwise will "retard" the timing. Turning the stator counterclockwise will "advance" the timing.

Engine Overhaul Procedures

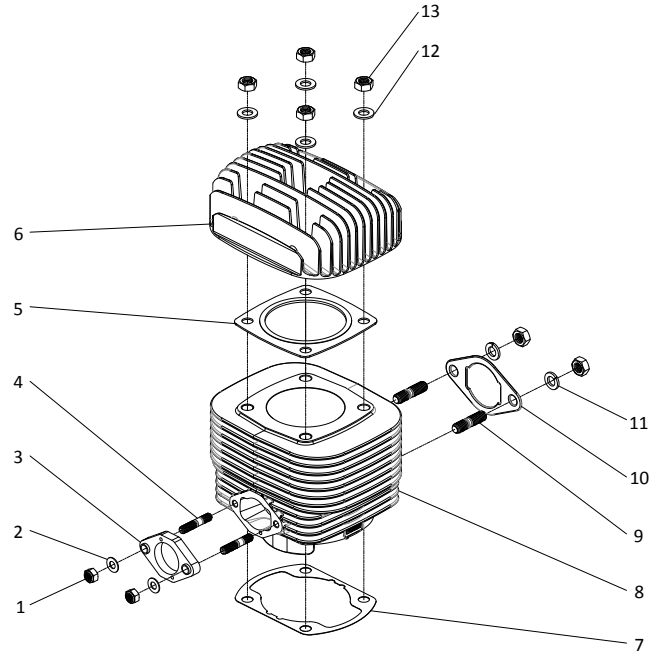
The following outlines how to conduct major overhaul service on the MARK-3 engine. It lists all instructions to replace or service the following components:

- Cylinder;
- Crankshaft-connecting rod assembly;
- Crankshaft ball bearings;
- Crankcase;
- Oil seals.

Cylinder

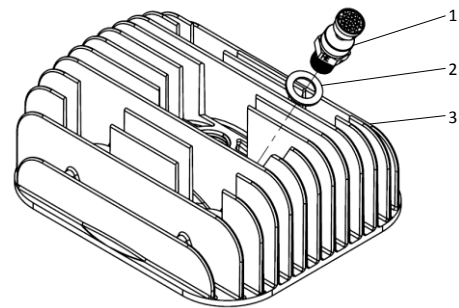
ID	ITEM NO	DESCRIPTION	QTY
1	800544	R-150 NUT M6X1.0 HEX FUJI LOCK ZINC	2
2	800545	R-149 LOCKWASHER M6 SPRING ZINC	2
3	600540*	R-1113N GASKET CARBURATOR	1
4	800103	R-402 STUD M6 X 1.0 X 32.5 MM LG	2
5	800066*	R-238 GASKET CYLINDER HEAD	1
6	800038	R-233 CYLINDER HEAD, 18 MM THREADS	1
7	800046*	R-235 GASKET CYLINDER BASE	1
8	701233	R-257NR NIKASIL CYLINDER RED GRADE 185CC	1
8	701232	R-257NG NIKASIL CYLINDER GREEN GRADE 185CC	1
9	800062	R-117 STUD M8 X 1.25 X 32 MM LG	2
10	800067*	R-237 GASKET MUFFLER	1
11	800548	R-119 LOCKWASHER M8 SPLIT ZINC	2
12	800539	R-206 WASHER M8 FLAT ZINC	4
13	800040	R-120 HEX NUT M8 X 1.25	6

* Included in 185cc Gasket Kit Top End (600590)



Cylinder Head With Decompression Switch

ID	ITEM NO	DESCRIPTION	QTY
-	600152	R-233DS CYL HEAD W/ DECOMP SWITCH AND HEAD GASKET	-
1	600083	A-7627 DECOMPRESSION SWITCH (MODIFIED) FOR MK-3-DS	1
2	800473	A-7628 COPPER GASKET DECOMPRESSION SW	1
3	--	R-233DS-1 CYLINDER HEAD MACHINED FOR DECOMP SWITCH (NOT SOLD SEPARATELY)	1
-	800066	R-238 GASKET CYLINDER HEAD (INCLUDED IN R-233DS)	1



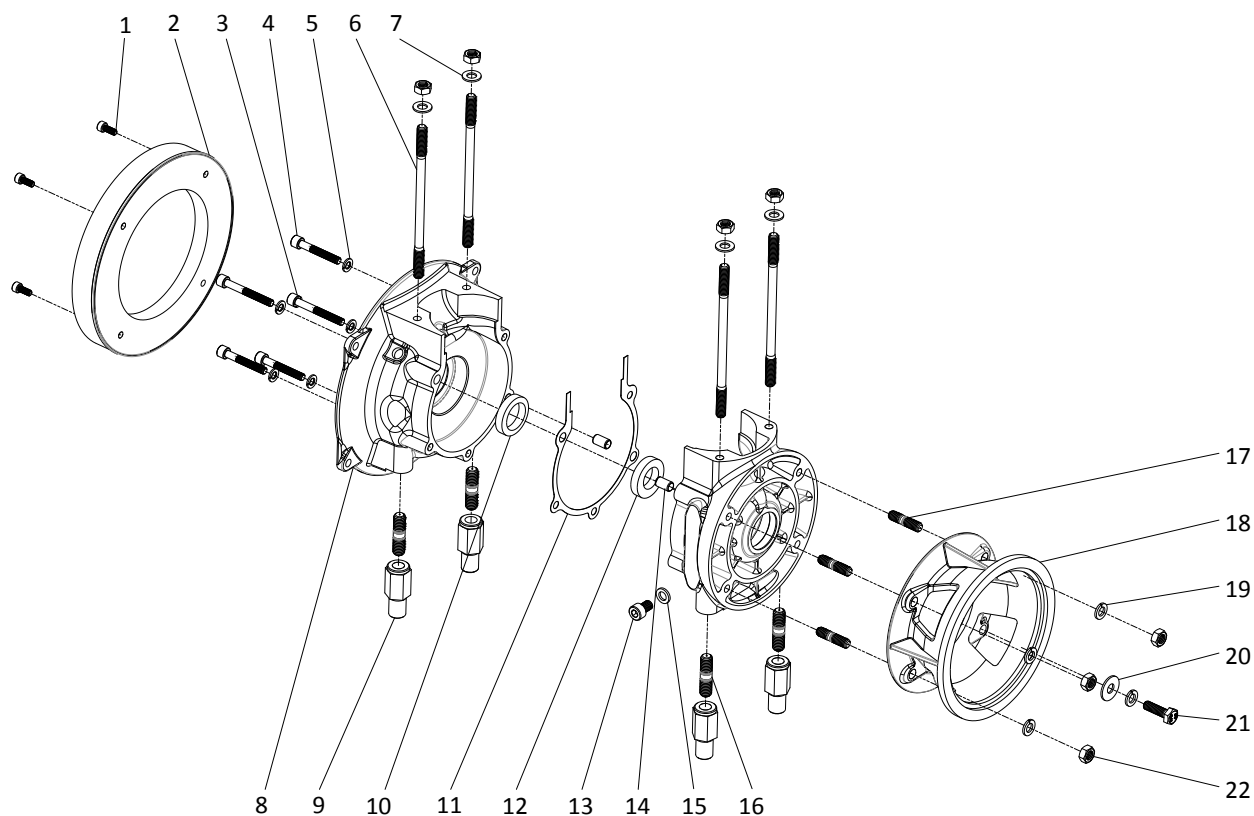
Installation notes

- Torque value for decompression switch: 190-210 in-lbs [21-24 Nm]
- Ensure that both decompression switch and cylinder head are cool prior to installation. The threads on the decompression switch and on the cylinder head must be clean

Crankcase

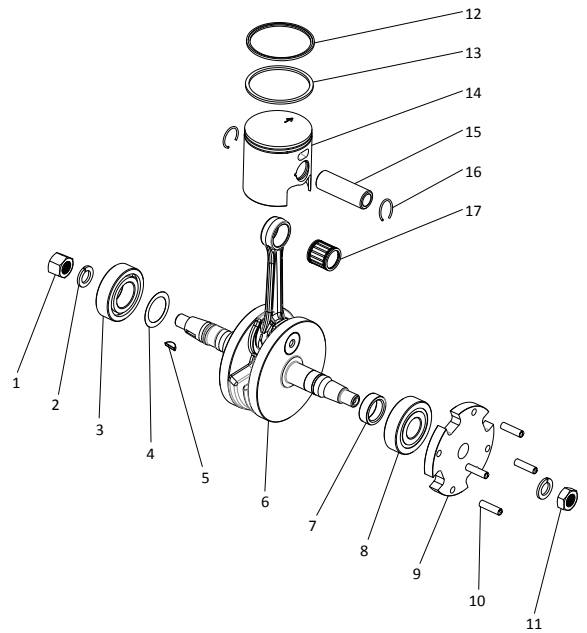
ID	ITEM NO	DESCRIPTION	QTY
1	800058	R-146 ALLEN SCREW M5X12	4
2	800053	R-144 SHIELD – DUST (LABYRINTH RING)	1
3	800556	R-105 SCREW M6X1.0X50 HEX SOCKET CAP ZINC DIN912	2
4	800044	R-132 SCREW M6X1.0X40 HEX SOCKET CAP ZINC DIN912	3
5	801107	LOCKWASHER M6 SPLIT BOWED ZINC DICHROMATE DIN128A	5
6	800041	R-236 STUD M8 X 1.25 X 151 MM LG	4
7	800539	R-206 WASHER M8 FLAT ZINC	4
8	701111	R-152N CRANKCASE HALVES SET (W/ DOWELS)	1
9	600037	A-6149P MARK-3 MOUNTING LEG, PLATED	4
10	800501	R-342 OIL SEAL 0.983"	1
11	800054	R-133 GASKET FOR CRANKCASE	1

ID	ITEM NO	DESCRIPTION	QTY
12	800547	R-123 OIL SEAL 0.788"	1
13	800509	FAST-51 SCREW M8X1.25X12 HEX SOCKET	1
14	800036	R-103 DOWEL TUBE 8.4 OD X 7 ID X 14 LG (MM)	2
15	800069	R-113 GASKET, METAL	1
16	800043	R-130 STUD M10 X 1.5 X 39 MM LG	4
17	800062	R-117 STUD M8 X 1.25 X 32 MM LG	3
18	700124	R-136 PUMP MOUNTING FLANGE FOR MARK-3, ALU.	4
19	800548	R-119 LOCKWASHER M8 SPLIT ZINC	4
20	700071	C-5370-11 WASHER 7/8"OD X 11/32"ID X 1/16"TH, S.S.	1
21	800416	RA-108 SCREW M8X1.25X25 HEX CAP ZINC	1
22	800040	R-120 HEX NUT M8 X 1.25	7



Crankshaft Assembly, Pistons and Shims

ID	ITEM NO	DESCRIPTION	QTY
1	800018	R-303 HEX NUT M12 X 1.0 X 12 MM THK	1
2	800064	R-301 WAVE LOCKWASHER, 12 MM BLACK	2
3	800502	R-343 BALL BEARING 0.983"ID	1
4	--	SHIM(S) (FLYWHEEL SIDE)	-
5	800019	R-305 KEY, 3 MM X 5 MM	1
6	801196	R-341N CRANKSHAFT/CONN. ROD ASSY	1
7	800029	R-334 CRANKSHAFT STEEL SPACER	1
8	800507	R-333 BALL BEARING 0.788"ID	1
9	800011	R-315 COLLAR COUPLING	1
10	800362	12-18 COILED SPRING PIN 1/4" X 7/8"	4
11	800035	R-302 HEX NUT M12 X 1.0 X 8 MM THK	1
12	800032	R-331-1 L-TYPE PISTON RING	1
13	800017	R-331 PISTON RING 0.078"	1
14	801270	R-332R PISTON WITH RINGS STANDARD SIZE RED GRADE	1
14	801269	R-332G PISTON WITH RINGS STANDARD SIZE GREEN GRADE	1
15	800030	R-328 GUDGEON PIN	1
16	800028	R-329 CIRCLIP	2
17	800009	R-324 NEEDLE BEARING	1



ID	ITEM NO	DESCRIPTION	QTY
-	800025	R-344 SHIM .004" (FLYWHEEL SIDE)	As req'd
-	800024	R-345 SHIM .012" (FLYWHEEL SIDE)	As req'd
-	800023	R-346 SHIM .020" (FLYWHEEL SIDE)	As req'd
-	800049	R-347 SHIM .039" (FLYWHEEL SIDE)	As req'd
-	800014*	R-307 SHIM .008" (COUPLING SIDE)	As req'd
-	800007*	R-308 SHIM .012" (COUPLING SIDE)	As req'd
-	800015*	R-309 SHIM .016" (COUPLING SIDE)	As req'd
-	800021*	R-310 SHIM .020" (COUPLING SIDE)	As req'd
-	800012*	R-312 SHIM .040" (COUPLING SIDE)	As req'd

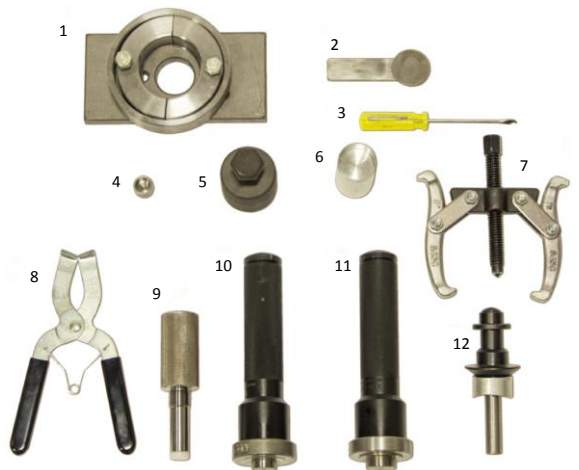
* For older engines (20 mm ID)

Oversized pistons

ID	ITEM NO	DESCRIPTION	QTY
-	801272	R-332-OR PISTON WITH RINGS OVERSIZE RED GRADE	-
-	801271	R-332-OG PISTON WITH RINGS OVERSIZE GREEN GRADE	-
-	800022	R-331-O-1 OVERSIZED L-TYPE PISTON RING	-
-	800031	R-331-O OVERSIZED PISTON RING 0.078"	-

Engine Tool Kit

ID	ITEM NO	DESCRIPTION	QTY
-	250286	R-952N TOOL KIT FOR MARK-3 ENGINE	-
1	600157	R-938 PULLER, CRANKSHAFT BEARING 1-PIECE	1
2	600164	R-953 CRANKSHAFT JACK	1
3	701352	CIRCLIP REMOVAL TOOL FOR 185CC	1
4	800080	R-928 PROTECTOR CAP, SHAFT 12MM	1
5	700723	R-927 PULLER - MAGNETO (M38 X 1.5)	1
6	600161	R-933 OIL SEAL - PRESSING TOOL	1
7	700707	R-932 PULLER, COLLAR COUPLING	1
8	701343	PISTON RING INSTALLER	1
9	701159	PISTON LOCKING TOOL FOR 185CC	1
10	701349	SEAL INSTALLER 20MM FOR 185CC	1
11	701350	SEAL INSTALLER 25MM FOR 185CC	1
12	701351	CIRCLIP INSTALLER TOOL FOR 185CC	1

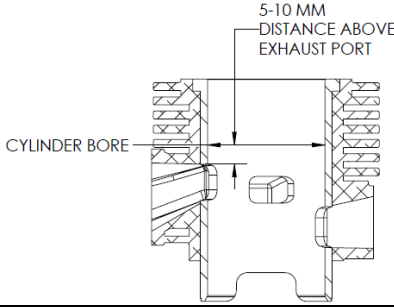
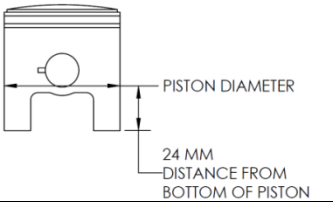


Piston/Cylinder Matching

During engine top end repair, it is highly recommended to match the piston with the cylinder in order to obtain the correct piston/cylinder clearance. To facilitate the matching process, a color scheme is used: red piston matches with red cylinder; green piston matches with green cylinder. Each piston and cylinder grade has its unique item number.

For optimal engine performance, reliability and durability, it is very important to have the correct piston/cylinder clearance. A clearance that is too tight can cause the piston to seize. An engine with a clearance that is too loose will generate less power, more noise and may accelerate engine wear.

The piston/cylinder clearance is defined as the difference between the cylinder bore and the piston diameter. See the table below for instructions on how to measure the cylinder bore and piston diameter:

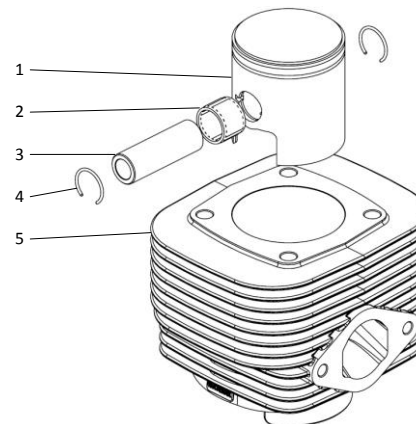
<p>To determine the cylinder bore, use a calibrated dial bore gauge and measure the cylinder bore at a distance of 5 to 10 mm above the exhaust port.</p> <p>See image.</p>	
<p>To determine the piston diameter, use a calibrated micrometer and measure the piston diameter at a distance of 24 mm from the bottom of the piston. The measurement should be taken perpendicular to the piston pin axis (piston is oval).</p> <p>See image.</p>	
<p>Notes:</p> <ul style="list-style-type: none"> Measurements should be taken in a temperature controlled room adjusted at 20 °C [68 °F]. Measuring instruments must be calibrated. 	

Depending on the type of cylinder (Nikasil coated or cast iron sleeve), the required clearance will vary:

	Piston/cylinder clearance
Cast Iron Sleeve Cylinder	0.06 - 0.08 mm .0024 - .0031 in
Nikasil Coated Cylinder	0.04 - 0.06 mm .0016 - .0024 in

ID	ITEM NO	DESCRIPTION	QTY
-	801273*	CYLINDER & PISTON KIT NIKASIL	-
1	801270*	R-332R 185CC PISTON W/RINGS STD SIZE RED GRADE	1
2	800009	R-324 185CC NEEDLE BEARING	1
3	800030	R-328 185CC GUDGEON PIN	1
4	800028	R-329 185CC CIRCLIP	2
5	701233*	R-257NR 185CC CYLINDER NIKASIL RED GRADE	1

*Note: Factory matched Nikasil cylinder and piston kit. Kit grade may be red or green.



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, causing erratic and faulty operation. The piston skirt may also show signs of gum and varnish deposits.

To decarbonise, the cylinder head and cylinder should be removed. All carbon deposits should be carefully removed, particularly from the piston ring grooves. After removing carbon, wash all parts in a suitable solvent, then dry with compressed air. On reassembly, always use new piston rings.

After every 100 hours of operation, or more often 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. If necessary, clean the piston ring grooves. Replace with new piston rings.
8. Install cylinder with new base gasket.
9. Install cylinder head with new cylinder head gasket (large band up). Tighten nuts uniformly to recommended torque 20-22 Nm [177-195 in-lbs] value.
10. Reinstall muffler with new gasket.
11. If piston rings were changed, proceed with a cylinder hone 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 30-40°. This is accomplished with approximately 10 strokes with 2 strokes per second and a drill speed of 300 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”.

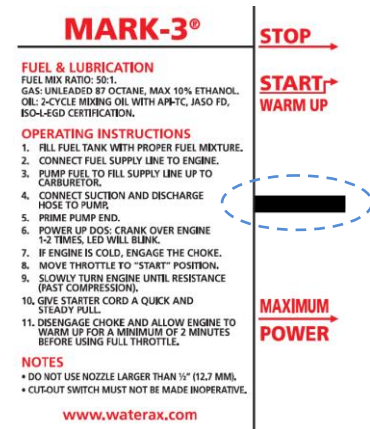
Friction generates heat; heat creates material expansion; expansion reduces running clearances which in turn increases friction.

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.

Procedures for Nikasil cylinder engine

During the engine **break-in process** (required whenever a new piston or cylinder is installed), it is recommended to use an API-TC certified **mineral** 2-cycle mixing oil (e.g.: Castrol Super Two Stroke) at a fuel mix ratio of **24:1**. The thicker oil and 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. Pre-adjust the carburetor (see Carburetor adjustments section).
2. Start the engine and allow engine to warm up (see Carburetor adjustments section).
3. Adjust the carburetor (see Carburetor adjustments section).
4. Once the carburetor has been adjusted, increase the throttle to the **BLACK** line (approximately 5 increments backwards from wide open throttle). See image.
5. Run the engine at that speed for 30 minutes.
6. After the 30 minutes, verify carburetor adjustments. Adjust low speed, high speed and idle speed if necessary.
7. Allow engine to cool down for 1-2 minutes.
8. Shut down the engine.



For break-in procedures for cast-iron sleeve cylinder engine, refer to Tech-Note.

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 of the Engine From the MARK-3

1. Remove pump end and coupling buffer.
2. Disconnect all wiring from engine.
3. Remove spark plug cable clamp.
4. Remove bracket R-799, which fastens to side of carburetor shroud to engine crankcase.
5. Remove muffler.
6. Remove spark plug cover and spark plug.
7. Using the piston locking tool 701159 to prevent the collar coupling from rotating, remove nut and lockwasher from the collar coupling.
8. Remove collar coupling using puller R-932.
9. Remove pump mounting flange.
10. Remove engine from mounting frame.
11. Remove fan cowl with rewind starter.
12. Remove manual starter rope pulley.
13. Remove flywheel nut and lockwasher using piston locking tool 701159.
14. Remove flywheel/magneto/fan assembly using magneto puller R-927 and shaft protector tool R-928.

Disassembly of the Engine

1. Remove the key R-305.
2. Mark the position of the armature plate.
3. Remove armature plate with cables.
4. Remove the rubber grommet.
5. Remove the cylinder head, the cylinder and the crankcase studs.
6. Remove piston from connecting rod.
7. Remove the five machine screws, which fasten crankcase halves together.
8. To separate crankcase halves on engine with one-piece bearing, heat both crankcase halves (on the outside face of the crankcase around the bearing housing portion) to a maximum of 120 °C (248 °F). The use of an oven is recommended for a controlled and uniform temperature.
9. Hold the engine by the end of the shaft and separate crankcase halves using a plastic or rubber mallet. Wear heat resistant gloves.
10. Remove crankshaft (with connecting rod).
11. Press out both oil seals using oil seal pressing tool R-933.
12. Remove bearings. To remove from crankshaft journals, use shaft protector tool R-928 and bearing puller tool R-938.

Reassembly of the Engine

1. Place both crankcase halves on a table with inner faces up.
2. Using a depth micrometer, carefully check the distance from the sealing face of each crankcase half to the lower face of each bearing housing.
3. For pump side crankcase half, call this dimension (A) (see image).
4. For magneto side crankcase half, call this dimension (B) (see image).
5. Add (A) + (B). Call this dimension (C).
6. Measure the thickness of ball bearing R-333. Call this dimension (D) (see image).
7. Measure the thickness of ball bearing R-343. Call this dimension (E) (see image).
8. Measure the thickness of crankshaft spacer R-334. Call this dimension (F) (see image).

9. Measure the width of the crankshaft between both bearing thrust surfaces. Call this dimension (G) (see image).
10. Add (D) + (E) + (F) + (G). Call this dimension (H).
11. Subtract (C) – (H) and call this dimension (I). The dimension (I) is total thickness of shims to be installed. **Note:** The acceptable axial clearance is between .0079" (0.2 mm) and .0118" (0.3 mm). The axial clearance will be given by the crankcase gasket thickness in a compressed (installed) condition; that said thickness is .0098" (0.25 mm).
12. Apply a small amount of high-temperature anti-seize (Copaslip or Loctite) on both crankshaft bearing seats to facilitate installation of ball bearings.
13. Put the spacer R-334 on the crankshaft (pump side).
14. Press the ball bearing R-333 on the crankshaft (pump side) using a pressing tool. **Important:** use the crankshaft jack R-953 to prevent damaging the crankshaft.
15. Slide the shims on the crankshaft magneto side (fan), starting with the thinnest shim and finishing with the thickest shim.
Note: The crankshaft used in the electronic ignition units does not have a lobe ground into the crankshaft end.
16. Press the ball bearing R-343 on the crankshaft (magneto side) using a pressing tool. **Important:** use the crankshaft jack R-953 to prevent damaging the crankshaft.
17. Install the dowel tubes on the crankcase, pump side.
18. Heat the crankcase to a temperature of 120 °C (248 °F). The use of an oven is recommended for a controlled and uniform temperature.
19. Starting with the crankcase pump side half, apply a small amount of 15W40 engine oil on the crankcase seal seat.
20. Install the new oil seal R-123 on the coupling side (pump side). The oil seal must be installed from the inside to the outside with the closed side facing the exterior of the crankcase.
21. Grease the oil seal inside lip to facilitate insertion of the shaft. Use standard multipurpose grease.
22. Slide the crankshaft pump side in the crankcase half pump side. Be careful to prevent damage to the oil seal lip. **Important:** the crankshaft should slide right in without any resistance. Light pressing may be needed; use the crankshaft jack R-953 to prevent damaging the crankshaft.
Important: ensure that the rotating part of the bearings do not come into contact with the seals.
23. Apply a small amount of multipurpose grease on both sides of the new crankcase gasket and carefully install on the crankcase pump side.
24. Apply a small amount of 15W40 engine oil on the crankcase seal seat and install the new oil seal R-342 on the magneto side (fan side). The oil seal must be installed from the inside to the outside with the closed side facing the exterior of the crankcase.
25. Grease the oil seal inside lip to facilitate insertion of the shaft. Use standard multipurpose grease.
26. Slide the crankcase magneto side on the crankshaft. Align the dowel tubes and verify that the connecting rod is not in the way during the installation. **Important:** the crankcase should slide right in without any resistance. Light pressing may be needed; use the crankshaft jack R-953.
27. Reassemble crankcase screws and lock washers. Apply Loctite 243 on the crankcase screws and tighten screws uniformly to 10 Nm [90 inch-lbs].
28. For stress relief, tap the crankshaft on both sides with a soft head hammer. Careful not to damage the threads. **Important:** the shaft should turn freely by hand.
29. Carefully cut off the crankcase gasket protruding from the cylinder base gasket surface with a sharp knife.
30. Oil the crankshaft needle bearing and bearing oil holes in the crankcase.
31. If piston was removed, reinstall it in proper position (arrow on top of piston pointing towards muffler side). Always use new circlips. Careful not to damage piston during circlip insertion. Replace needle bearing R-324 and gudgeon pin R-328 if necessary.
32. Install the cylinder base gasket R-235.

33. Oil inside of the cylinder, piston rings and piston skirt.
34. Ensure that the piston rings are correctly positioned (piston ring pins should be visible). Squeeze the piston rings and slide-in the cylinder. Ensure that the cylinder is correctly oriented.
35. Install cylinder head gasket R-238. **Important:** the cylinder head gasket must have the large band up.
36. When reassembling cylinder head, be sure the “filled” part inside the head is on the muffler side of the engine; therefore the “scooped-out” part will be on the carburetor side.

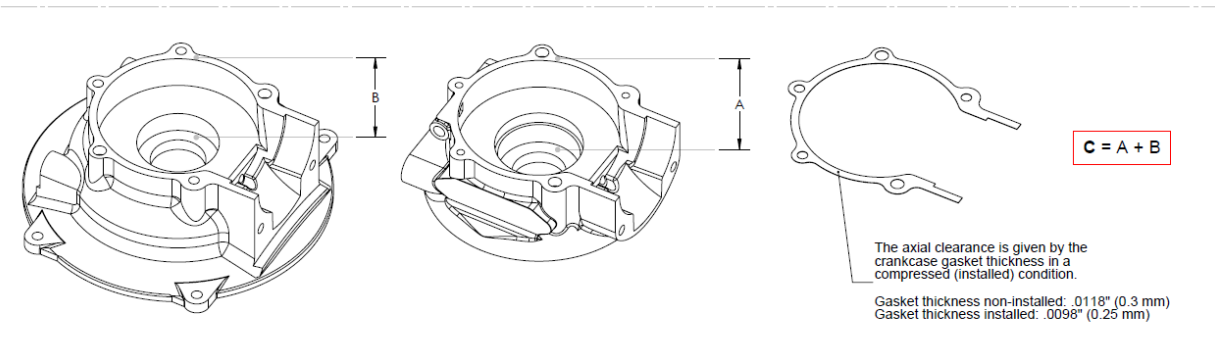
Important: Uniformly tighten cylinder head nuts to recommended torque of 20-22 Nm [177-195 in-lbs]. Preset torque: 10 Nm [89 in-lbs]. Nuts should be torqued after first 10 hours of operation and every 100 hours after.

37. Reassemble remaining parts in reverse procedure used in disassembly.

DETERMINE THE TOTAL THICKNESS OF SHIMS

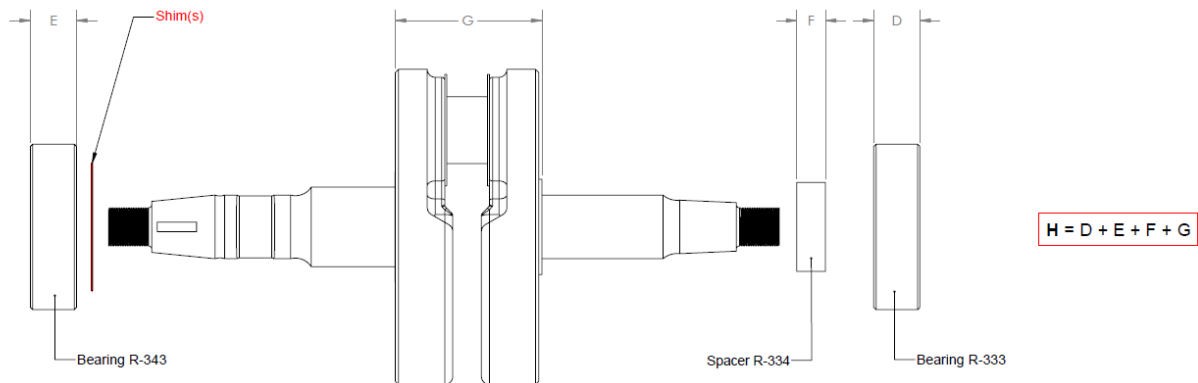
Total thickness of shims = I

$$I = C - H$$



Magneto side

Pump side



Pump End Overhaul Procedures

Pump Tool Kit

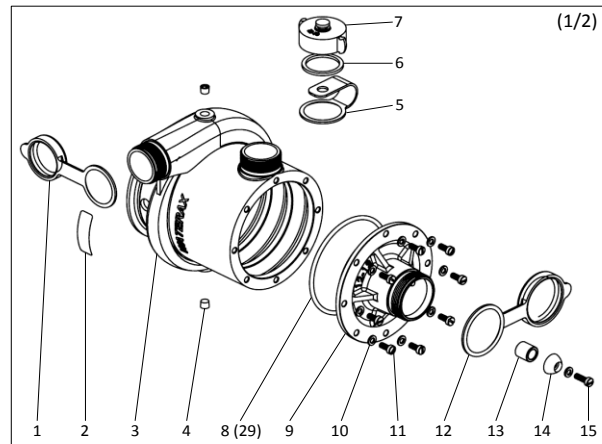


ID	ITEM NO	DESCRIPTION	QTY
-	250125	A-2356 TOOL KIT FOR PUMP END XX-16	-
1	700588	A-5297 SUPPORT TOOL	1
2	600078	A-1887 ALUMINUM GUIDE FOR SHAFT INSTALL	1
3	600157	R-938 PULLER, CRANKSHAFT BEARING 1-PIECE	1
4	600175*	R-904L SPARK PLUG WRENCH C/W ROD	1
5	600079	A-1888 PULLER FOR SUCTION COVER, ALU.	1
6	600052	B-4084 PUMP BEARING PRESSING SLEEVE	1
7	700531	A-4329 PRESSING SLEEVE ROTARY SEAL	1
8	700532	A-4097 PROTECTOR SHAFT	1
9	700642	A-7711 SEAL REMOVAL PRESS TOOL, 12-28N	1
10	700090	A-7644 SEAL PULLER FOR 12-28NS	1
11	700540	A-1884 PRESSING SLEEVE DISTRIBUTOR	1
12	701345	PRESS PIN REMOVAL TOOL PUMP PARTS DIA .686	1
13	600077	A-1886 PRESS PIN REMOVAL TOOL PUMP PARTS DIA .925"	1

* 600175 contains 800084 (R-904) and 800082 (R-905)

Disassembly Procedure for Pump End 12-16S

ID	ITEM NO	DESCRIPTION	QTY
1	700023	A-5536 PROTECTIVE CAP FOR 1-1/2" DISCH.	1
2	700994	DECAL-35 NO GREASE DECAL	1
3	700068	12-8 PUMP BODY FOR 12-16	1
4	800366	12-73 PLUG, 1/8" BRASS	2
5	700024	A-5538 RETAINER FOR PRIMING CAP	1
6	700651	12-43 HOSE THREAD GASKET 38 MM NPSH	1
7	700048	12-10 CAP FOR PRIMING PORT, ALU	1
8	800363	12-27 O-RING	1
9	600380	12-12A SUCTION COVER - INCLUDES 12-40	1
10	800360	12-38 LOCKWASHER 1/4 SPLIT SS	9
11	800359	12-39 SCREW 1/4-28X9/16 SLOT FILLISTER	8
12	700022	A-5537 PROTECTIVE CAP FOR 2" SUCTION	1
13	700029	12-40 BUSHING BEARING, BRONZE	1
14	700069	12-13 NOSE FOR SHAFT, ALU.	1
15	800343	12-42 SCREW 1/4-28X3/4 SLOT FILLISTER NYLONLOCK SS	1



1. Remove shaft nose #14, by removing screw #15 and lockwasher.
2. Remove screws #11, and lockwashers #10.
3. With tool 600079, remove suction cover #9.
4. Bend down lockwasher #26 from lock nut #27. Secure the shaft #17 from rotating and remove lock nut using tool 600175 or a 19 mm (3/4") wrench. Discard lockwasher.
5. Remove screws #18.
6. Using an arbor press and tools 700532 and 700588, press out shaft assembly.
7. Using seal puller 700090, remove mechanical rotary seal.
8. Using an arbor press and tools 600077 and 700588, remove all impellers and distributors. This operation is done in jogging strokes of press ram.
9. To remove bearing from shaft, use an arbor press and tool 600157.

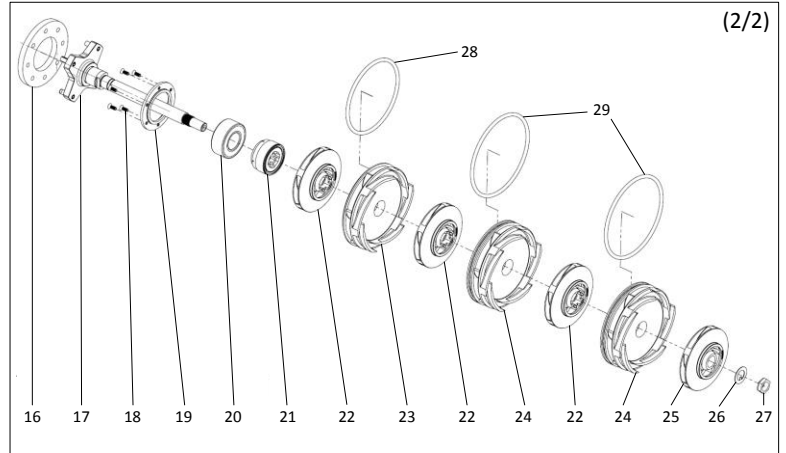
Note: If the threads on the 12-28NS mechanical rotary seal are damaged and tool 700090 cannot be used, tool 701345 can be used to press out the impellers and distributors. However, this procedure will likely damage the first impeller it comes in contact with due to the limited contact surface between the tool and the impeller hub.

Important: It is recommended to discard all O-rings, lockwashers and nylon lock screws. Kit containing replacements O-rings, lockwashers and nylon lock screws is available from WATERAX (item no 250228).

Assembly Procedure for Pump End 12-16S

ID	ITEM NO	DESCRIPTION	QTY
16	700006	12-17 COUPLING BUFFER	1
17	700037*	12-2C PUMP SHAFT FOR 12-16	1
18	800364	12-25 SCREW #8-32X7/16 PHILLIPS FLAT NYLON LOCK SS	6
19	700032*	12-3 RETAINING RING FOR BEARING, ALU.	1
20	700044*	12-48S DOUBLE ROW BALL BEARING WITH SEAL	1
21	700008	12-28NS MECHANICAL ROTARY SEAL	1
22	700036**	12-7 IMPELLER, ALU.	3
23	700014	12-6 DISTRIBUTOR, ALU.	1
24	700065	12-9 DISTRIBUTOR, ALU.	2
25	700074**	12-11 IMPELLER, ALU	1
26	600089**	12-49 LOCKWASHER SS	1
27	700012**	12-50 LOCK NUT SS	1
28	800450	12-26 O-RING	1
29	800363	12-27 O-RING	2
-	701169	GASKET BURASIL FOR 12-28NS SEAL	-
-	701170	O-RING FOR 12-28NS SEAL	-
-	600149	12-2DS PUMP SHAFT SUB-ASSY W/ IMPEL, SEALED BEARING (INCL. * & ** ITEMS)	-
-	600147	12-2ES PUMP SHAFT SUB-ASSY, SEALED BEARING (INCL. * ITEMS)	-

NOTE: The sealed bearing eliminates pump failure dangers related to improper greasing by completely removing the need to grease the pump end bearing.



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.

Mechanical Rotary Seal: The mechanical rotary seal requires careful inspection. The seal should be discarded if there are signs of leaks or if the internal drive bushing is excessively deformed. The drive bushing must be free to rotate without contact with the brass housing. If there is contact between the drive bushing and the housing, the seal must be discarded.



- Slide bearing retaining ring #19 on shaft #17. Ensure that retaining ring shoulder faces the bearing.
- Press bearing #20 on shaft using tool 600052.
- Carefully** press rotary seal #21 in pump body #3 using pressing sleeve tool 700531.
- Apply a small amount of dish soap on mechanical rotary seal O-ring to facilitate installation of pump shaft. Carefully pass end of shaft assembly through mechanical rotary seal bore. Make sure that flat sections of shaft line up with rotary seal drive bushing flat sections. Gently press down shaft until ball bearing rests firmly against shoulder in pump body. To verify that shaft has been properly installed, slowly rotate shaft by hand; rotary seal drive bushing should rotate with shaft.
- Attach retaining ring #19 to pump body with six screws #18 to a torque value of **22-25 in-lbs [2.5-2.8 Nm]**. Tighten evenly.
- A small amount of marine grease can be applied onto shaft to facilitate future disassembly.
- Slide impeller #22 onto shaft, and engage with mechanical rotary seal.
- Smear the O-rings with a suitable lubricant to facilitate assembly.
- Place O-ring #28 in groove of distributor #23.
- With open end of pump body in vertical position, carefully lower distributor #23 until it rests on bottom of body. Ensure that O-ring did not fall out of position during installation of distributor.
- Slide impeller #22 into position, aligning with previous impeller.

12. Place O-ring #29 in groove of distributor #24.
13. Using arbor press and assembly tool 700540, apply several light, downward strokes of press ram until distributor "drops" into body and rests on previous distributor.
14. Slide impeller #22 into position, aligning with previous impeller.
15. Repeat steps 12 and 13 for remaining distributor.
16. Slide impeller #25 into position, aligning with previous impeller.
17. Place lockwasher #26 on shaft with locating tab in milled groove. Slightly bend lockwasher tab downwards to facilitate insertion. Lockwasher tab should still prevent it from rotating on shaft.
18. Apply a small amount of Loctite 290 on lock nut #27 and screw onto shaft. Tighten to a torque value of **250-260 in-lbs [28-29 Nm]**. To secure lock nut and prevent from rotating, bend one side of lockwasher up onto one flat side of hexagon lock nut. Bend the lockwasher side that is at the opposite side of the milled slot in the shaft.
19. Place O-ring #8 in groove of suction cover. Press cover into pump body until it rests on distributor.
20. Install suction cover using screws #11 and lockwashers #10. Tighten screws evenly and firmly to a torque value of **32-36 in-lbs [3.6-4.1 Nm]**.
21. Attach shaft nose #14. Tighten screw firmly to a torque value of **32-36 in-lbs [3.6-4.1 Nm]**.
22. Reinstall remaining protective caps and adaptors.

Pump Test

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

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

Nozzle Size	1/2" [12.7 mm]	3/8" [9.5 mm]	1/4" [6.4 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

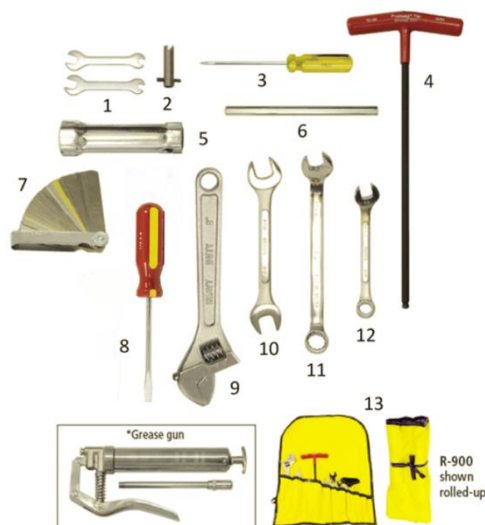
Note: Performance can vary depending on test conditions.



Pump Tool Kit

ID	ITEM NO	DESCRIPTION	QTY
-	250158	R-900 TOOL KIT FOR MARK-3 PUMP	-
1	800081	R-908 WRENCH - OPEN END 5 & 8 MM	2
2	700541	A-3023 CARBURETTOR ADJUSTING TOOL	1
3	800492	R-902 SCREWDRIVER 1/8" BLADE	1
4	700539	271-928 6MM T-HANDLE HEX 10.5" LG	1
5	800084	R-904 WRENCH - SPARK PLUG	1
6	800082	R-905 HANDLE - ROD	1
7	700732	R-903 FEELER GAUGE 32 BLADES	1
8	800700	271-346 SCREWDRIVER FLAT 1/4" X 4"	1
9	700538	271-923 WRENCH - ADJUSTABLE 8"	1
10	700726	R-910 WRENCH - OPEN END 1/2" & 9/16"	1
11	600153	R-911M WRENCH, BOX & OPEN END 13MM	1
12	600160	R-906M WRENCH, BOX & OPEN END 10 MM	1
13	700537	271-488 TOOL ROLL BAG	1
-	700734*	PART-117 GREASE GUN U.S. STYLE	1

* Grease gun not included in tool kit. Can be ordered separately.



Technical Data

Pump End

Threads

Discharge port	1-1/2" [38 mm] NPSH male
Suction (intake) port	2" [51 mm] NPSH male
Priming port	1-1/2" [38 mm] NPSH male

Torque Values

Retaining ring screw	22-25 in-lbs	2.5-2.8 Nm
Shaft nose screw	32-36 in-lbs	3.6-4.1 Nm
Suction cover screw	32-36 in-lbs	3.6-4.1 Nm
Lock nut 12-50	250-260 in-lbs	28-29 Nm

Clearance Data and Limits

Impeller outside diameter	3.660-3.675 in	92.96-93.35 mm
Impeller hub outside diameter	2.105-2.113 in	53.47-53.67 mm
Impeller bore	0.669-0.671 in	16.99-17.04 mm
Impeller rear shroud diameter	0.908-0.918 in	23.06-23.32 mm
Impeller height (12-7)	1.525-1.532 in	38.74-38.91 mm
Impeller height (12-11)	1.334-1.343 in	33.88-34.11 mm
Distributor vane diameter	3.740-3.770 in	95.00-95.76 mm
Distributor bore	0.938-0.957 in	23.83-24.31 mm
Distributor rear hub diameter	2.127-2.140 in	54.03-54.36 mm
Pump body (volute) ball bearing housing bore	2.047-2.049 in	51.994-52.045 mm
Pump body (volute) mechanical rotary seal housing bore	1.810-1.812 in	45.974-46.025 mm
Suction cover hub diameter	2.127-2.140 in	54.03-54.36 mm
Suction cover bronze bearing bushing bore	0.7495-0.7505 in	19.037-19.063 mm
Suction cover rear face & bronze bushing perpendicularity	0.004 in	0.10 mm
Shaft ball bearing diameter	0.9844-0.9847 in	25.004-25.011 mm
Shaft bronze bushing bearing diameter	0.4980-0.5000 in	12.649-12.700 mm
Shaft maximum run-out	0.0035 in	0.089 mm
Bronze bushing bearing bore	0.501-0.503 in	12.725-12.776 mm

Engine

Specifications

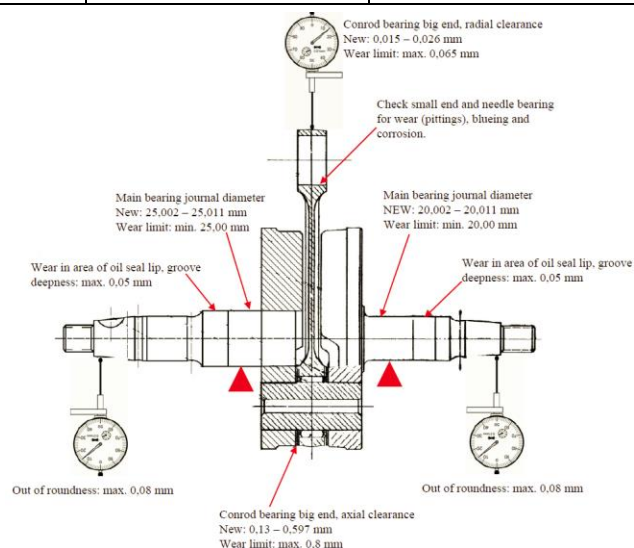
Bore	2.441 in	62 mm
Stroke	2.402 in	61 mm
Displacement	11.24 ci	184 cc
Direction of rotation	Counterclockwise (from output shaft)	
Spark plug type	Bosch M4AC 18 mm	

Torque Values

Spark plug	310-354 in-lbs	35-40 Nm
Cylinder head nuts	177-195 in-lbs	20-22 Nm
Cylinder head decompression switch	190-210 in-lbs	21-24 Nm
Starter pulley mounting nuts	71-89 in-lbs	8-10 Nm
Stator mounting screws	22-27 in-lbs	2.5-3 Nm
Labyrinth ring mounting screws	18-22 in-lbs	2-2.5 Nm
Fan mounting screws	35-44 in-lbs	4-5 Nm
Magneto mounting nuts	71-89 in-lbs	8-10 Nm
Crankshaft M12 nuts	399-443 in-lbs	45-50 Nm
Crankcase screws	71-89 in-lbs	8-10 Nm
Crankcase drain screw	89-133 in-lbs	10-15 Nm
M6 studs (except for carburetor studs)	27-35 in-lbs	3-4 Nm
M8 studs	53-71 in-lbs	6-8 Nm
M10 studs	89-106 in-lbs	10-12 Nm

Clearance Data and Limits

Spark plug gap	0.020-0.024 in	0.5-0.6 mm
Ignition timing – contact breaker (point)	0.147 - 0.020 in	3.75 - 0.5 mm
Ignition timing – CDI	0.147 +/- 0.020 in	3.75 +/- 0.5 mm
Magneto air gap	0.010-0.013 in	0.25-0.33 mm
Condenser capacity	0.15-0.19 mF	
Crankcase		
Crankcase main bearing diameter (new)	2.0453-2.0457 in	51.95-51.96 mm
Crankcase main bearing diameter wear limit	2.0469 in	51.99 mm
Cylinders		
Nikasil cylinder red grade (standard size)	2.4404-2.4406 in	61.985-61.990 mm
Nikasil cylinder green grade (standard size)	2.4406-2.4407 in	61.990-61.995 mm
Nikasil cylinder surface roughness	Rz 118-158 µin	Rz 3.0-4.0 µm
Nikasil cylinder honing cross hatch angle	35 degrees	--
Nikasil cylinder / piston clearance	0.0016-0.0024 in	0.04-0.06 mm
Nikasil cylinder / piston wear limit	0.005 in	0.127 mm
Nikasil cylinder / piston ring gap (new)	0.007-0.013 in	0.18-0.33 mm
Nikasil cylinder / piston ring gap wear limit	0.019 in	0.48 mm
Cast iron sleeve cylinder bore (standard size)	2.4390-2.4394 in	61.95-61.96 mm
Cast iron sleeve cylinder hone (standard size)	2.4409-2.4417 in	62.00-62.02 mm
Cast iron sleeve cylinder bore (oversize)	2.4587-2.4591 in	62.45-62.46 mm
Cast iron sleeve cylinder hone (oversize)	2.4606-2.4614 in	62.50-62.52 mm
Cast iron sleeve surface roughness	Ra 39-79 µin	Ra 1-2 µm
Cast iron sleeve honing cross hatch angle	45 degrees	--
Cast iron sleeve cylinder / piston clearance	0.0024-0.0031 in	0.06-0.08 mm
Cast iron sleeve cylinder / piston wear limit	0.0079 in	0.20 mm
Cast iron sleeve cylinder / piston ring gap (new)	0.008-0.014 in	0.20-0.35 mm
Cast iron sleeve cylinder / piston ring gap wear limit	0.039 in	1.00 mm
Pistons		
Piston red grade (standard size)	2.4384 +/- 0.0002 in	61.935 +/- 0.005 mm
Piston green grade (standard size)	2.4388 +/- 0.0002 in	61.945 +/- 0.005 mm
Piston red grade (oversize)	2.4581 +/- 0.0002 in	62.435 +/- 0.005 mm
Piston green grade (oversize)	2.4585 +/- 0.0002 in	62.445 +/- 0.005 mm
Rectangular ring / piston groove clearance (new)	0.003-0.004 in	0.07-0.102 mm
Rectangular ring / piston groove clearance wear limit	0.008 in	0.20 mm
Crankshaft		
Conrod bearing big end, radial clearance (new)	0.0006-0.0010 in	0.015-0.026 mm
Conrod bearing big end, radial clearance wear limit	0.0026 in	0.065 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



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301326	R-1037 LOCK WASHER 1/4 OD X .15 ID	15	600540	R-1113N GASKET CARBURATOR	15,31
301327	R-1039 STEEL THROTTLE SHAFT RETURN SPRING	15	600590	185CC GASKET KIT TOP END	31
301330	R-1046N-L LONG NEEDLE, SEAT AND GASKET	15	700004	A-4453 EYE BOLT, PLATED STEEL	22
301331	R-1047 BRONZE INLET SEAT GASKET	15	700006	12-17 COUPLING BUFFER	41
301333	R-1026 INLET CONTROL LEVER PINION SCREW	15	700008	12-28NS MECHANICAL ROTARY SEAL	41
301334	R-1003 PLATED SPRING FOR CHOKE FRICTION	15	700011	A-4027 INDEX PIN, BRASS	20
301335	R-1021 SS STEEL FLAT WASHER 1/4"OD X 3/16"ID	15	700012	12-50 LOCK NUT SS	41
400022	HOSE SPEC 187 1.5 NPSH X 10" CPLG AL	42	700014	12-6 DISTRIBUTOR, ALU.	41
600037	A-6149P MARK-3 MOUNTING LEG, PLATED	26,32	700017	12-65 COUPLING SWIVEL	20,21
600052	B-4084 PUMP BEARING PRESSING SLEEVE	40	700021	A-6179 RING, RUBBER	26
600061	A-2390 PRESSURE GAUGE ADAPTOR 1-1/2" NPSH	42	700022	A-5537 PROTECTIVE CAP FOR 2" SUCTION	40
600077	A-1886 PRESSING PIN FOR DISTRIBUTOR, STEEL	40	700023	A-5536 PROTECTIVE CAP FOR 1-1/2" DISCHARGE	40
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600079	A-1888 PULLER SUCTION COVER, ALU. & PLATED	40	700029	12-40 BUSHING BEARING, BRONZE	40
600081	C-5200-7R SPACER-RUBBER	20,21,26	700032	12-3 RETAINING RING FOR BEARING, ALU.	41
600082	C-5200N-15 HARDWARE KIT FOR C-5200N FRAME	26	700033	B-4024 QUADRANT FOR THROTTLE LEVER	20
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600089	12-49 LOCKWASHER SS	41	700036	12-7 IMPELLER, ALU.	41
600095	C-5200N MOUNTING FRAME WITH HARDWARE	26	700037	12-2C PUMP SHAFT FOR 12-16	41
600108	A-4005 MOUNTING PAD, PLATED	26	700044	12-48S DOUBLE ROW BALL BEARING WITH SEAL	41
600110	B-4461 PUMP CLAMP TOP HALF	22	700048	12-10 CAP FOR PRIMING PORT, ALU	40
600122	A-4452 SIDE LINK FOR LEVER, ZINC PLATED	22	700065	12-9 DISTRIBUTOR, ALU.	41
600125	B-7592 ELECTRONIC IGNITION BOX ASSY	28	700068	12-8 PUMP BODY FOR 12-16	40
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600147	12-2ES PUMP SHAFT SUB-ASSY, SEALED BEARING	41	700071	C-5370-11 WASHER 7/8"OD X 11/32"ID X 1/16"TH	26,32
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Notes

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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).

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, 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; (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 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



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