

# LONDON FOGGERS

WORLDWIDE VECTOR CONTROL SINCE 1968

## MODEL 20-20

High Output ULV Aerosol Generator

## Machine Operators Manual



Aluminum  
Nozzle



Pistol Grip  
Cab Control



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**TOTAL SATISFACTION IS A TRADITION AT LONDON FOG, INC.  
EXCELLENT CUSTOMER SERVICE IS A RIGHT OF EVERY LONDON FOGGER OWNER.  
THANK YOU FOR YOUR PATRONAGE AND LOYALTY.**

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## SPECIFICATIONS

|                   |   |                                     |
|-------------------|---|-------------------------------------|
| TYPE:             | Vehicle or trailer mountable – non-thermal, U.L.V. (Ultra-Low Volume) Cold Fog aerosol generator.   |                                     |
| ENGINE:           | Twin cylinder Honda with overhead valves, 4-cycle, gasoline, 21hp, 12v. Fuel Consumption – regular or unleaded automotive 1 gal/hr. Electric start alternator, pressure lubrication and oil pressure sensing system.                |                                     |
| AIR PUMP:         | Positive displacement, rotary, cast iron. 3000rpm, 6psi   |                                     |
| FORMULATION PUMP: | Positive displacement piston pump with adjustable output from: 0 to 20 oz./min (0 to 491 ml/min)  |                                     |
| NOZZLE SYSTEM:    | High output, noise dampened with 360 degree horizontal and vertical adjustment.   |                                     |
| TANKS:            | All tanks are corrosion-resistant, high-density polyethylene.<br>Formulation: 15 US Gallons (56.7 liters)<br>Flushing: 1.5 US Quarts (1.42 liters)<br>Gasoline: 6.0 US Gallons (22.7 liters) with EPA Certified charcoal air filter |                                     |
| PARTICLE SIZE:    | 80% of droplets less than 20-micron diameter depending on flow rate and viscosity.  |                                     |
| DIMENSIONS:       | Weight Empty: 504 lbs. (228 kgs)<br>Length: 46 inches (117 cm)<br>Width: 33 inches (84 cm)<br>Height: 27 inches (69 cm)   |                                     |
| ENGINE:           | Power Rating at 3000rpm:  | 21 hp (15.66kw)                     |
|                   | Displacement:   | 688.0 cm <sup>3</sup> (41.97 cu-in) |
|                   | Bore:   | 78.0 x 72.0 mm                      |
|                   | Stroke:   | 3.07 x 2.83 in                      |
|                   | Compression Ratio:  | 8:5:1                               |
|                   | Oil Capacity (with filter)*:  | 1.6 US Qt. (1.5 L)                  |
|                   | Spark Plug Type:  | ZFR5F (NGK)                         |
| BLOWER:           | Frame Size:   | 45                                  |
|                   | Maximum RPM:  | 3000                                |
|                   | Maximum Pressure:   | 10psi                               |
|                   | Recommended Gear Oil:   | SAE 40 non-detergent                |
|                   | Gearbox Capacity:   | 12.7 Fl oz (0.37 L)                 |

\*For best results, fill to the “F” mark on dipstick as opposed to adding a given quantity of oil. Always check the level on dipstick before adding more oil. For engines equipped with oil filter – an additional ½ US pint (0.28 L) of oil is required when oil filter is replaced.

## **SAFETY PRECAUTIONS**

### **WARNING**

**READ AND UNDERSTAND THESE SAFETY PRECAUTIONS BEFORE OPERATING MACHINE**

**NOTE: When moving a London Fogger unit with a forklift, ensure the engine is on the side closest to the forklift. Lifting from the wrong side may result in damage to the unit.**

- 1. ENGINE AND FUEL:** This machine uses gasoline as the fuel for the internal combustion engine and all precautions commonly applying to this volatile fuel should be observed. Exercise extreme caution to avoid spilling gasoline. If spillage occurs, wipe off and allow evaporation time before starting the engine. DO NOT attempt to put fuel in the tank while the machine is still running. Avoid smoking or open flame in area when handling gasoline. Never run the unit indoors unless exhaust is vented to outside. These fumes contain carbon monoxide which is colorless and odorless and can be fatal.

### **CAUTION:**

**DO NOT OPERATE ENGINE WITHOUT MUFFLER**

**DO NOT TOUCH HOT MUFFLER, CYLINDERS OR FINS AS CONTACT MAY CAUSE BURNS**

**EXCEPT FOR ADJUSTMENT, DO NOT OPERATE THE ENGINE IF AIR CLEANER OR COVER DIRECTLY OVER THE CARBURETOR AIR INTAKE IS REMOVED.**

**DO NOT RUN THE UNIT IF THE BELT GUARD IS REMOVED – EVER!**

**DO NOT TAMPER WITH GOVERNOR SPRINTS, GOVERNOR SLINKS OR OTHER PARTS WHICH MAY INCREASE OR DECREASE THE GOVERNED ENGINE SPEED.**

- 2. ENGINE SPEED:** (RPM) should be checked periodically to ensure that it is operating correctly as engine speed affects the rate of air flow through the nozzle system which controls droplet particle size. The correct engine speed should be 15.5 kW (21.1 PS,20.8 bhp) @3000 rpm
- 3. BLOWER CASING:** Blower casing and associated piping or accessories may become hot enough to cause skin burns on contact.
  - a. DO NOT TOUCH WHEN HOT.**
  - b. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting.**
  - c. Disconnect power before doing any work and avoid bypassing or rendering inoperative any safety or protective devices.**
  - d. DO NOT operate blower with inlet filter removed.**

- e. DO NOT stand in the discharge air blast from the nozzle.
  - f. Avoid extended exposure in close proximity to machinery which exceeds safe noise levels.
4. **MACHINE DAMAGE:** Never operate a machine after it has been damaged. A damaged machine can be very hazardous.
5. **WIND:** Spraying during windy conditions is not usually practical because the formulation will drift out of the intended area.
6. **SAFETY EQUIPMENT:** In addition to any safety equipment that may be required by the type of formulation, which is being used, the following items should be with each vehicle which carries this machine during fogging operations:
- a. Fire Extinguisher, chemical type rated for fuel fires.
  - b. First Aid Kit.
  - c. Eye Wash Solution.
  - d. Safety Glasses.
  - e. Container of Oil Dry Compound.
  - f. Gloves rated for high temperature.
  - g. Respirator adequate for formulation being used.
7. **CHILDREN:** Many spraying operations are performed in residential areas commonly at dusk. This presents the operator with the problem of children who are attracted to the noise and/or the mist being created. The possible hazard lies in the toxic effect of some formulations, the severity of which depends upon the chemical used, mist density, and the length of time of direct exposure. IT IS THE OPERATOR'S RESPONSIBILITY TO DISCOURAGE ANYONE FROM PLAYING IN THE MIST OR BEING NEAR THE MOVING VEHICLE.
8. **FORMULATIONS:** Ensure that formulations are applied only in strict compliance with formulation label as well as local, state, and federal regulations.
- a. Always comply with any requirements for protective clothing, goggles, gloves, facial masks, or respirators required on the formulation label.
  - b. DO NOT exceed the dosage set forth on the registration label of the insecticide to be used.
  - c. Always store formulation in its original labeled container.

IN NO WAY IS IT TO BE COSTRUED THAT THE CHEMICALS AND/OR DOSAGES ARE THE RECOMMENDATION OF LONDON FOG, INC. ALWAYS ADHERE TO THE CHEMICAL MANUFACTURERS DIRECTIONS OR CONSULT WITH A CERTIFIED DISTRIBUTOR FOR EACH MANUFACTURER.

## ASSEMBLY/INSTALLATION

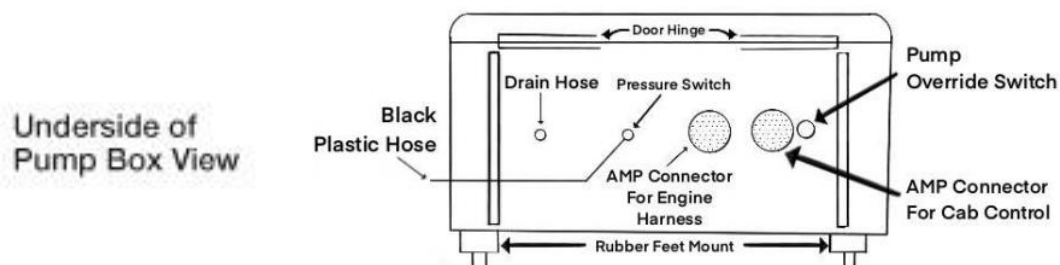
### 1. SHIPPING CONTAINER;

Remove the protective shipping container. Look for any hidden shipping damages and, if present, report it immediately to the carrier.

NOTE: It is a good idea to retain the original machine shipping carton as well as its inner packing and blocking materials for future storage and/or shipment which may be required.

### 2. REMOTE CONTROL UNIT ASSEMBLY:

- a. Remove Remote Cab Control Unit from the Battery Box.
- b. Place the Remote Cab Control Unit where it will not be damaged while the machine is being prepared.
- c. Lift machine onto the vehicle with the discharge end of the machine toward the rear of the vehicle.
- d. Pass the Remote Cab Control Unit through an open window and locate within reach of the person who will be operating the machine. If permanent vehicle installation is desired, the remote-control cable can be passed through a small hole in the vehicle cab and then reconnected. Make sure the small hole provides proper protection against wiring damage and is re-sealed to prevent exhaust gases from entering inside of the vehicle.



- e. Using the most convenient routing, run the cab control to the outermost electrical socket (blower end) on the flow control pump box. As the machine is shipped this will be the only unused socket. All the electrical connectors on the machine are polarized to prevent incorrect connections.
- f. Orient the electrical plug on the cab control so that the electrical pin locations match the mating pin receptacles in the socket and push the plug firmly into the socket. (Diagram is located on the pump box lid)

### 3. INSTALLATION:

- a. Securely bolt the machine to the vehicle.
- b. Loosen the nozzle swivel joints and orient the nozzle as required by the formulation label. The usual set up is towards the rear and 45 degrees up. Retighten joints.
- c. Correct battery type is 24/24m series 12V 36 Ah, 500cc minimum with marine style wing nut terminals preferred (not included with the fogger).

#### 4. BATTERY INSTALLATION

- a. When installing the battery, connect the negative (-) cable last to prevent sparking and shorting.
- b. When disconnecting is required, remove negative (-) connection first.
- c. Reversed polarity can cause damage to the starting and charging systems.

#### WARNING

**DO NOT JUMP START THE BATTERY WHILE  
CONNECTED TO THIS MACHINE.**

**ALWAYS DISCONNECT THE BATTERY AND  
CHARGE THE BATTERY SEPARATELY.**





## **SERVICE BEFORE START-UP**

### **1. ENGINE**

- a. Gasoline – Service the engine with gas and oil. For the best results, use only regular unleaded gasoline with an octane rating of 87 or higher. In countries using the research method, it should be 90 octane minimum. If leaded gasoline is used, combustion chamber, cylinder head and spark plug may require more frequent service (see SERVICE SCHEDULE, section VII).
- b. Oil – Use high quality oil of API service class SF. Multi-Viscosity SAE 10W-30 is recommended.

Make sure the machine is sitting level. Add the proper type of oil through the oil filter tube to bring the level up to, but not over, the “F” mark. The engine is oiled when the unit is shipped unless otherwise labeled.

### **CAUTION**

DO NOT operate the engine with oil level below the “L” mark or over the “F” mark.

### **2. BLOWER**

- a. Before starting the machine, be sure the gearbox on the blower is filled to the proper level with oil. The blower is shipped with oil. Check prior to start-up.
- b. To fill the gearbox, remove the combination breather/knob on the top side of the gearbox and also remove the lower ¼” pipe plug (called the overflow hole) which is on the air filter side of the gearbox.

### **USE SAE 40 NON-DETERGENT OIL**

Fill the gearbox up to the lower overflow hole. Replace the plug and the breather.

### **DO NOT OVERFILL**

### **3. FORMULATION**

Place formulation in the large black formulation tank. Always use a funnel and strainer to avoid getting dirt or other contaminants in the tank.

### **USE ONLY FORMULATION THAT IS LABELED FOR THE INTENDED USE**

### **4. FLUSHING FLUID**

Using a funnel with strainer or filter, place the appropriate flushing fluid (for the formulation being used) in the flushing tank.

## PRE-START CHECKLIST

|   |       | SEE SECTION # |
|---|-------|---------------|
| All safety equipment is in place        | _____ | I.            |
| Remote control panel is in place        | _____ | IV.           |
| Battery is secure in place              | _____ | IV.           |
| Sufficient gasoline in gas tank         | _____ | IV.           |
| Oil in engine at proper level           | _____ | IV.           |
| Oil in air pump at proper level         | _____ | IV.           |
| All hoses tight and connected           | _____ |               |
| Sufficient formulation in tank          | _____ | IV.           |
| Flushing fluid in flush tank            | _____ | IV.           |
| Flow rate is calibrated                 | _____ | VII.          |
| Nozzle is aimed correctly               | _____ | III.          |
| Spray switch is in OFF position         | _____ | VI.           |
| Selection switch is in SPRAY position   | _____ | VI.           |
| Ignition switch is in OFF position      | _____ | VI.           |
| Pump override switch is in OFF position | _____ | VII.          |

### CAUTION

Before proceeding with any spraying operation, the operator should be thoroughly familiar with starting and stopping the machine and with all the operating controls. If you are operating the machine for the first time, exercise the machine through its full operational sequences from a position of full visibility of the machine before operating the machine fully remote. This is also a good idea for experienced operators who may be operating a new machine or who may be reactivating a machine after repairs or a period of inactivity. Refer to the operation section for starting and stopping instructions.

## START-UP / SHUTDOWN

1. Be sure to complete the service before start-up: pre-start checklist and all safety precautions, before starting the machine.

2. **START**

Move the engine ignition switch (on the control panel, see figure 2 – section VII) to the “ON” position.

- a. On a cold engine, push both the start and the choke buttons at the same time. As soon as the engine starts to fire, release the choke button. Release the start button as soon as the engine can run on its own.

On cold engines, it may be necessary to intermittently push the choke button until the engine is running smoothly.

NOTE: The best starter life is provided by using short cranking cycles of several seconds; prolonged cranking can damage the starter motor if cranked more than 15 seconds per minute.

- b. On a warm engine, push the starter button until the engine starts.

If a very hot engine fails to start, some choking may be required.

### CAUTION

If the engine develops enough speed to disengage the starter but does not keep running (false start) the engine rotation must be allowed to come to a complete stop before pushing the starter button again. Failure to do so will damage the starter drive.

3. **SHUT OFF**

Control Panel

To turn off the engine, move the stop switch to the “OFF” position.

## **OPERATION**

Read this complete OPERATION section and the section on SAFETY PRECAUTIONS before starting the machine.

For first time operation, the sections on INSTALLATION, SERVICE BEFORE START-UP, and PRESTART CHECKLIST must be performed before proceeding with operation.

When operating this machine for the first time, move to an uncongested and well-ventilated work area in an open area away from flammable materials.

### **WARNING**

READ THE SECTION ON SAFETY PRECAUTIONS BEFORE PREPARING TO DISPENSE FORMULATION.

READ AND THOROUGHLY UNDERSTAND ALL THE INFORMATION, CAUTIONS AND WARNINGS ON THE FORMULATION LABEL WHICH MAY AFFECT PERSONAL SAFETY. KNOW ANY DANGERS OF THE SOLUTION USED AND KNOW WHAT TO DO IN CASE OF AN ACCIDENT INVOLVING THE SOLUTION.

ALWAYS USE THE APPROPRIATE SAFETY EQUIPMENT AND DRESS ACCORDING TO THE CHEMICAL FORMULATION WHICH IS BEING USED.

DO NOT USE ANY SUBSTANCES FROM UNMARKED CONTAINERS OR FROM CONTAINERS WITH OBVIOUSLY ALTERED LABELS.

READ AND FOLLOW THE INSTRUCTIONS ON THE CHEMICAL SOLUTION LABEL FOR ULV SPRAYING OF THE SOLUTION.

DO NOT SPRAY NEAR AN OPEN FLAME OR HOT MATERIALS.

DO NOT LEAVE THE MACHINE UNATTENDED.

#### **1. SPRAYING**

- a. With the engine running (it will only be at idle), move the selector switch on the control panel to the desired SPRAY or FLUSH position.
- b. Turn the spray switch on the control panel to the ON position (engine ignition switch must be on for spray pump to operate). The engine will automatically throttle up from the idle position.

### **CAUTION**

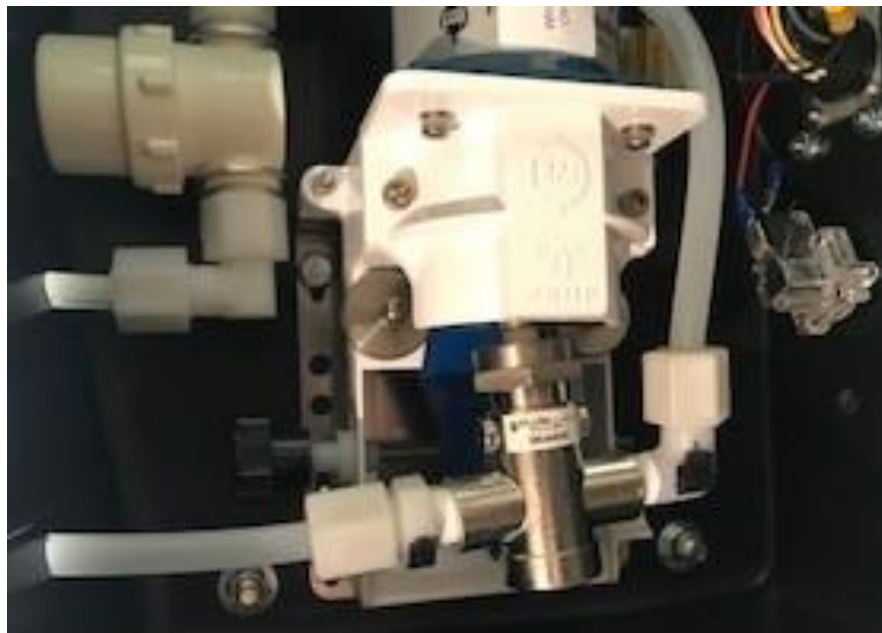
Before dispensing insecticide, be certain that no one is present in the area of the nozzle or aerosol dispersion area.

- c. To STOP spraying, turn the spray switch to the OFF position.
- d. When the spraying operation is complete, the unit must be flushed in accordance with the FLUSHING SYSTEM section of this manual.

## 2. SETTING THE FLOW RATE

NOTE: Since this machine may be used with various materials, the machines are shipped with the flow rate set at approximately 9.0 Fl oz/min.

- a. Loosen the two screws holding the flow control pump box shut and open the pump box cover.
- b. Loosen the pump pointer locking plate by loosening the two knurled rings, one on each side of the locking plate.



- c. Move the blue handle/pointer until the desired flow rate is obtained.

NOTE: All flow rates must be determined by calibration – see OPERATION, section VII-3.

- d. Lock the pointer handle at the desired flow rate setting by tightening the two knurled rings. DO NOT OVERTIGHTEN. Do not use any additional wrenches. Hand Tighten Only.
- e. Close the pump box and fasten latches.

### 3. CALIBRATION

NOTE: All calibrations must be made with the engine running and the fluid flowing through the nozzle.

- a. Loosen the two screws holding the flow control pump box shut and open the pump box cover.
- b. Run the engine and turn the spray switch to the “ON” position until the fluid lines are filled from the formulation tank to the stray nozzle and no air is trapped in the lines.
- c. Remove the fluid line from the formulation tank and insert it into a 1000ml. graduated cylinder filled with your formula.
- d. With the engine running, turn the spray switch “ON” for a measured amount of time using a stopwatch. Record the flow rate and pump setting for future reference.
- e. Loosen the pump pointer locking plate by loosening the two knurled nuts and adjusting pointer as needed. Tighten the two knurled nuts.
- f. Refill the graduated cylinder and repeat steps D and E until the desired flow rate is obtained.
- g. Replace the fluid line to the formulation tank.

The following are rough estimates of flow rates using very light mineral oil. Always calibrate to establish correct flow rates for the chemical or insecticide to be used.

| Flow Rate (ml/minute) | Flow Rate (oz/minute) | Scale Setting |
|-----------------------|-----------------------|---------------|
| 95                    | 3                     | 0.05          |
| 150                   | 5                     | 1.00          |
| 250                   | 8.40                  | 1.50          |
| 320                   | 9                     | 2.00          |
| 410                   | 14.20                 | 2.50          |
| 475                   | 16                    | 3.00          |

NOTE: When this machine leaves the factory, the pump is set at 2.

If after calibration, the flow rate you want results in a pump setting below 2, reduce engine RPM to approximately 2000 to achieve optimum droplet size.

#### CAUTION:

**Hand tighten nylon fittings. DO NOT use wrenches.**

#### 4. FLUSHING

- a. With most chemicals, it is desirable to flush the fluid system and nozzle after each operation. To flush the system, simply move the selector switch to the FLUSH position and turn the SPRAY switch to the ON position.
- b. With most flushing fluids, a distinct change in the look of the spray will occur once the flushing fluid has traveled through the whole system and is coming out of the nozzle. If the spray is not visible, flush for an adequate period of time to get the flushing fluid completely through the system.



## SERVICE SCHEDULE

| Items to be serviced                   | HOURS |    |    |     |     |
|--|-------|----|----|-----|-----|
|  | Daily | 25 | 50 | 100 | 500 |
| Check Air Pressure                     | X     |    |    |     |     |
| Clean Air Pump Air Filter              |       |    | X  |     |     |
| Check Air Pump Oil Level               |       | X  |    |     |     |
| Change Air Pump Oil                    |       |    |    |     | X   |
| Change Air Pump Breather               |       |    |    |     | X   |
| Grease Air Pump Bearings               |       |    |    | X   |     |
| Check Battery                          |       |    |    | X   |     |
| Check Engine Oil (Level)               | X     |    |    |     |     |
| Check Engine Oil (SAE-30)              |       |    |    | X*  |     |
| Change Engine Oil (Multi-Viscosity)    |       |    |    | X*  |     |
| Change Oil Filter                      |       |    |    | X*  |     |
| Check Engine Air Intake (Finger Guard) | X     |    |    |     |     |
| Clean Engine Cooling Fins              |       |    | X  |     |     |
| Change Engine Mesh Filter              |       |    |    |     | X   |
| Clean Engine Air Filter                |       |    | X  |     |     |
| Clean Engine Fuel Filter               |       |    |    |     | X   |
| Replace Engine Spark Plug              |       |    |    | X   |     |
| Engine, Decarbonize                    |       |    |    |     | X*  |
| Engine Timing                          |       |    |    |     | X*  |
| Engine Valve Clearance                 |       |    |    |     | X*  |
| Engine Governor                        |       |    |    |     | X*  |
| Calibration                            | A/R   |    |    |     |     |
| Check All Fittings                     | X     |    |    |     |     |
| Clean Formulation Filter               |       |    |    | X   |     |
| Fill Flush Tank                        | X     |    |    |     |     |
| Check Pulsation Dampener               |       |    | X  |     |     |
| Check Belt Tension                     |       |    | X  |     |     |

**\*Refer to engine service manual or authorized service dealer**



## MAINTENANCE

### 1. AIR PRESSURE

The nozzle air pressure can be checked at the gauge located under the flow control pump box. Pressure should be approximately 6psi.

Air pressure is controlled mainly by engine speed which should be 2700-3000rpm.

- a. Engine speed not correct – see Engine Trouble Shooting, Section X and Governor Maintenance, Section IV.
- b. Engine speed correct – see Air Pump Trouble Shooting, Section X.

### 2. AIR PUMP AIR FILTER

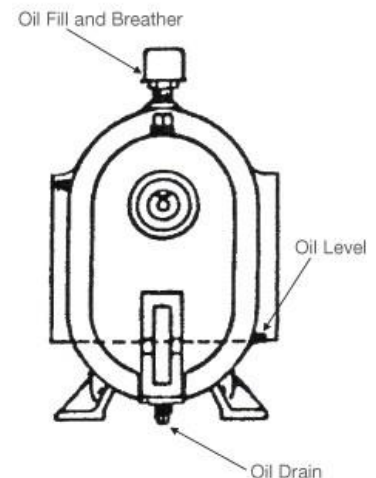
The air pump filter should be checked and cleaned every 50 hours.

- a. Loosen and remove the wing nut, rubber washer and filter outer housing.
- b. Clean the inner filter with a solvent, compressed air or other means as necessary.
- c. Replace the filter, cover, rubber washer and wing nut.

### 3. AIR PUMP OIL LEVEL

- a. Under normal conditions, the gearbox oil level should be checked every week or 25 hours, whichever comes first and changed every 120 days or 500 hours, whichever comes first. Use SAE 40 non-detergent oil.
- b. To fill the gearbox or add oil, remove the breather/plug and the oil level plug fill. Add oil through the breather plug hole until oil just starts to flow out of the oil level plug hole. Do not overfill. Replace the breather and oil level plug into their respective holes.

Proper lubrication is the most important single consideration in obtaining maximum air pump life. Check gearbox oil level and grease shaft bearing per the maintenance.



### 4. AIR PUMP BEARINGS

- a. The upper and lower shaft bearings at the drive end of the air pump are grease lubricated and each bearing housing is equipped with a pressure type (zerk) grease fitting. On the bearing housing – opposite side of the zerk fitting, is a pressure relief fitting that looks like a pipe plug with a hole drilled through it. It is normal for excess grease to flow out.
- b. When servicing drive bearings, use a premium grade, petroleum base grease with high temperature and moisture resistance and good mechanical stability. Using a pressure gun, force new lubricant into each drive end bearing housing until traces of grease come out of the relief fitting.

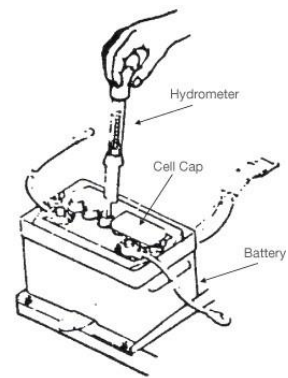
- c. After a long shutdown, it is recommended that the grease relief fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled.

## 5. AIR PUMP INTERNAL

In salt air or other corrosive type atmospheres, extended periods of non-use (i.e. off-season storage) the internal parts of the air pump may be protected by removing the air pump inlet filter and while holding the engine throttle at idle, spray a fine mist of lubricating oil (approximately 2oz. or 59cc) into the air intake. This will coat and protect the internal parts of the air pump.

## 6. BATTERY

- a. Each week or 100 hours, remove the battery vent caps and check the electrolyte level. Add clean distilled water, if necessary to cover the battery plates. Replace the caps.
- b. Check the specific gravity. If the specific gravity is between 1.250 and 1.280, the battery cell being tested is OK. If the specific gravity is between 1.225 and 1.250, the battery cell being tested is still in FAIR condition. If the specific gravity is below 1.150 in any one cell, replace the battery. If the specific gravity in one cell is .050 more or less than the other cells and charging does not bring the charge to a 50% charge, replace the battery.



NOTE: Recommendation is for a fully sealed marine battery. See page 6 for recommended type.

### WARNING

DO NOT JUMP START THE BATTERY WHILE CONNECTED TO THIS MACHINE.  
ALWAYS DISCONNECT THE BATTERY AND CHARGE THE BATTERY SEPARATELY.

## 7. ENGINE OIL LEVEL

BEFORE EACH USE check the oil as follows:

- a. Make sure the engine is stopped and resting on a level surface. Also make sure the engine is cool and the oil has had time to drain into the sump.
- b. Clean the area around the dipstick and filler cap to keep dirt and debris out of the engine.
- c. Remove the dipstick and wipe the oil off. Reinsert the dipstick and push it all the way down into the tube. Remove the dipstick and check the level.
- d. Add the proper type of oil if the level is low. Bring the level up to, but not over, the "F" mark on the dipstick before adding more oil.

### CAUTION

**DO NOT** operate the engine with the oil level below the "L" mark or over the "F" mark.

## 8. ENGINE OIL CHANGE

- a. For a new engine, change the oil after the first 20 hours of operation, thereafter, change the oil after every 100 hours of operation.
- b. Make sure the engine is stopped and the oil has had time to drain into the sump. Drain oil while the engine is warm.
- c. Remove the oil drain plug and oil fill cap. Tilt the engine slightly towards the oil drain to obtain better drainage.
- d. Reinstall the drain plug. Make sure it is tightened securely.
- e. Fill with high quality, detergent SAE 10W-30, service class "SF" oil to the "F" mark on dipstick. Always check the level on the dipstick before adding more oil.

Reinstall the oil fill cap. Make sure it is tightened securely.

Make sure the engine is level when filling and checking the oil.

- f. If changing the oil filter, add oil to the "F" mark on the dipstick and then add ½ pint (76 cc) extra oil for the oil filter capacity.
- g. Start the engine and check for oil leaks.

## 9. ENGINE OIL FILTER

- a. Change the engine oil filter at "each" or "every other" oil change depending on operating conditions. A genuine Honda oil filter is recommended.
  - i. Drain crankcase oil, then remove the old filter.
  - ii. Before installing a replacement filter, apply a thin coating of oil on the surface of the rubber seal.
  - iii. Turn filter clockwise until rubber seal contacts the filter adapter, then tighten filter and additional ½ turn.
- b. Refill engine with oil – see Section IX- 8, above. Add an additional .5 pint (284.1 ml) of oil for the filter capacity.



## 10. ENGINE AIR INTAKE SCREEN

Make sure the air intake screen is clean and unobstructed. If debris builds up on screen during engine operation, STOP engine immediately and clean off. An obstructed screen can cause engine overheating.

## 11. ENGINE COOLING FINS

Every 50 operating hours (more often under extremely dusty or dirty conditions) remove cooling fins. Also, clean dust, dirt, and oil from external surfaces of engine which can cause improper cooling. Make sure cooling shrouds are reinstalled. Operating the engine without cooling shrouds will cause engine damage due to overheating.



## 12. ENGINE MESH AIR FILTER

This engine is equipped with a high-density wire mesh air cleaner at least once every 25 hours.

- a. Remove clipped, air cleaner cover, element cover seals, and element cover.
- b. Remove and wash in warm water with detergent.



### CAUTION

Damaged or loose components could allow unfiltered air into the engine causing premature wear and failure.

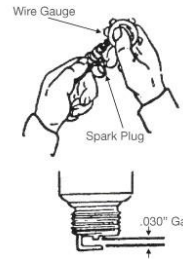
### 13. ENGINE FUEL FILTER

This filter is located on the gas line between the engine and the gas tank. Clean as needed.

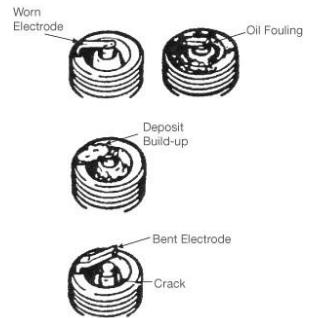
### 14. ENGINE SPARK PLUGS

Every 200 operating hours, remove the spark plugs, check condition and reset gaps, or replace with new plugs as follows:

- Before removing spark plugs, clean the area around base of plugs to keep dirt and debris out of engine.
- Remove plugs and check condition. Incorrect spark plugs, worn or fouled plugs, cracked porcelain, or improper spark gaps can cause hard starting or engine misfire.
- DO NOT clean the spark plugs in a machine using abrasive grit. Replace plugs when dirty or if reuse is questionable. See SPECIFICATIONS for plug type.
- Check gaps (0.7-.08) using a wire feeler gauge. Adjust the gaps as necessary by carefully bending the ground electrode. Install the plugs and torque to 18-22 ft. lb.



Replace if the following conditions exist:



### 15. DECARBONIZING ENGINE

See your local Honda Dealer.

### 16. CHECK/SET ENGINE TIMING

Refer to Engine Service Manual or Authorized Service Dealer.

### 17. CHECK VALVE TAPPET CLEARANCES

Refer to Engine Service Manual or Authorized Service Dealer.

### 18. CHECK/SET GOVERNOR

Check the engine operating speed with a handheld tachometer. A reflective type of tachometer with reflective tape on the flywheel screen or drive coupling is most desirable.

- Engine speed should be 3000 rpms.
- To adjust the engine speed, find the governor adjusting rod between the muffler and left cylinder of the engine. Turn the hex nut in or out as necessary to bring the engine to the correct speed.
- Some models may have a locking nut on the governor adjusting rod. Loosen and retighten as necessary.

## 19. PULSATION DAMPENER

The piston type metering pump tends to deliver a slightly pulsating flow of insecticide. For the best aerosol particle size, a more even (non-pulsating) flow is desirable. A small air chamber type pulsation dampener is located in the metering pump box assembly, between the pump and the aerosol discharge nozzle. It is a white, nylon assembly with an air dome that can be unscrewed by hand for inspection. It has a gasket which seals the joint between the air dome and the lower section.

The air dome should be checked periodically to make sure that it has not become filled with insecticide. If the dome has no air in it, it will not function as a pulsation dampener. Be careful to position the gasket ring carefully, so as to avoid pinching, when replacing the air dome.

## 20. FORMULATION FILTER

There is a fine mesh filter screen located in the large, cylindrical nylon housing. This screen can be removed for inspection and/or cleaning by manually unscrewing the cap. When reassembling, be sure that the sealing gasket is properly positioned so as to avoid damage caused by pinching. Tighten housing only hand tight during replacement; DO NOT use tools.



**If the screen should become clogged, maximum formulation flow rate will not be attained.**

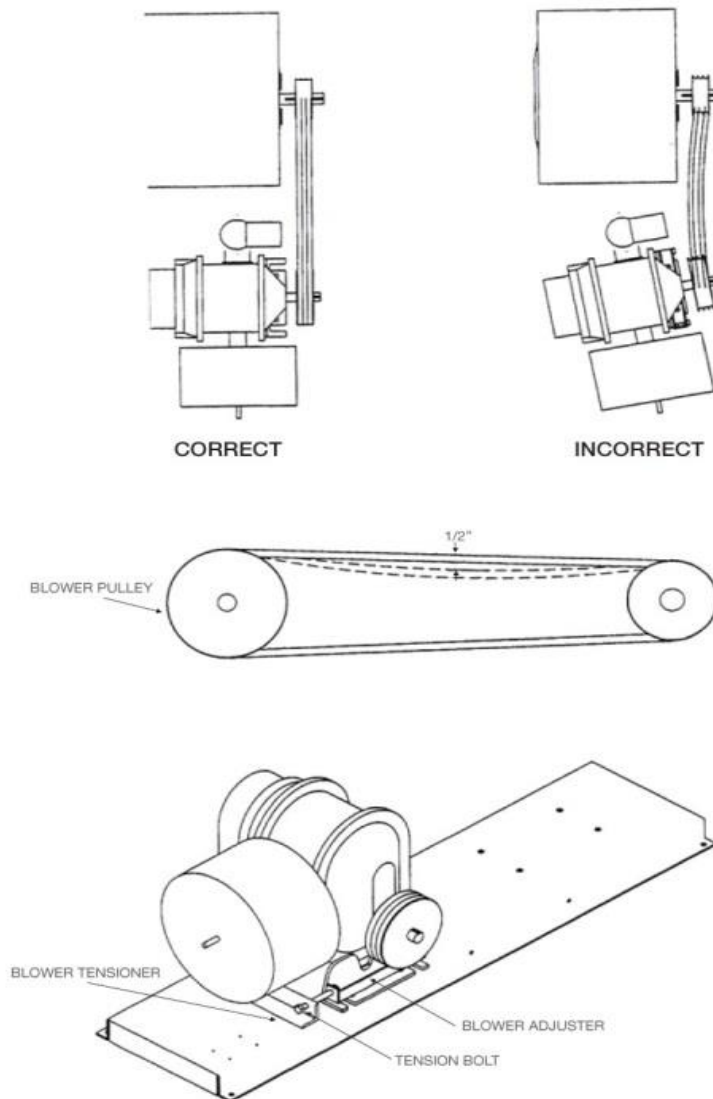
## 21. DRIVE BELT ALIGNMENT

Check drive belts regularly. They should be in alignment and neither excessively tight nor loose enough to slip.

Both the engine and blower pulley bushings should be located  $\frac{1}{2}$ " from the vertical belt guard mount.

Since both pulleys are of the same thickness, a 2' carpenter's square can be used as an alignment tool.

Two belt tensioning bolts, one to push and one to pull, are located at the bottom of the Howden Roots blower. When properly tensioned, the belt should have approximately  $\frac{1}{2}$ " deflection at 20 lbs. of force.



## TROUBLE SHOOTING

| SYMPTOMS                              | POSSIBLE CAUSE   | CORRECTIVE ACTION  |
|---------------------------------------|--|--|
| 1. Starter fails to crank engine      | <ul style="list-style-type: none"> <li>a. Battery cable connection is loose, dirty or damaged.</li> <li>b. Dead battery.</li> <li>c. Starter solenoid is defective or has a loose connection.</li> <li>d. Defective starter switch.</li> <li>e. The starter is defective.</li> <li>f. The air pump is locked up.</li> <li>g. Fuse is blown.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Clean &amp; tighten cable connections or replace damaged cables.</li> <li>b. Replace or charge battery. NEVER JUMP!</li> <li>c. Replace solenoid &amp; tighten connections.</li> <li>d. Check the starter button on the engine and/or starter switch on remote control box.</li> <li>e. Replace starter.</li> <li>f. Inspect air pump for rotation.</li> <li>g. Replace the fuse</li> </ul>                                |
| 2. Engine hard to start or fails.     | <ul style="list-style-type: none"> <li>a. Start/Stop switch on engine is in stop position or is faulty.</li> <li>b. Machine ON/OFF switch located on remote control box is in OFF position or is faulty.</li> <li>c. No fuel or contaminated fuel.</li> <li>d. Clogged fuel filter.</li> <li>e. Spark plugs faulty.</li> <li>f. Fuel pump or carburetor defective.</li> <li>g. Terminals loose or wiring defective.</li> <li>h. Spark plug wire disconnected.</li> </ul> | <ul style="list-style-type: none"> <li>a. Place switch in start position, replace faulty switch.</li> <li>b. Place switch in ON position or replace faulty switch.</li> <li>c. Add fuel or clean tank and refuel.</li> <li>d. Clean or replace fuel filter.</li> <li>e. Clean or replace plugs.</li> <li>f. Consult the nearest engine service center.</li> <li>g. Tighten loose terminals, replace defective wires.</li> <li>h. Connect spark plug wire.</li> </ul> |
| 3. Engine misses or runs erratically. | <ul style="list-style-type: none"> <li>a. Spark plugs faulty.</li> <li>b. Spark plug wire disconnected.</li> <li>c. Contaminated fuel.</li> <li>d. Clogged fuel filter.</li> <li>e. Carburetor mounting gasket leaks.</li> <li>f. Cylinder head gasket leaks.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Clean or replace spark plug.</li> <li>b. Connect spark plug wire.</li> <li>c. Replace fuel.</li> <li>d. Clean or replace fuel filter.</li> <li>e. Tighten bolts, replace gasket, if necessary.</li> <li>f. Tighten cylinder head bolts.</li> </ul>   |



| <b>SYMPTOMS</b>                       | <b>POSSIBLE CAUSE</b>  | <b>CORRECTIVE ACTION</b>   |
|---------------------------------------|--|--|
| 4. Engine knocks or develops a noise. | <ul style="list-style-type: none"> <li>a. Crankcase oil low.</li> <li>b. Mufflers clogged.</li> <li>c. Flywheel loose.</li> <li>d. Contaminated fuel.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Fill oil to proper level, after oil fill if noise continues, consult nearest engine service center.</li> <li>b. Clean or replace muffler.</li> <li>c. Consult the nearest engine service center.</li> <li>d. Clean tank and refuel.</li> </ul>   |
| 5. Engine will not run smoothly.      | <ul style="list-style-type: none"> <li>a. The carburetor is dirty or out of adjustment.</li> <li>b. Contaminated fuel.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Clean or adjust carburetor.</li> <li>b. Clean tank and refuel.</li> </ul>  |
| 6. Engine overheats                   | <ul style="list-style-type: none"> <li>a. Crankcase oil low.</li> <li>b. Air shroud clogged.</li> <li>c. Exhaust restricted.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Add oil to proper level.</li> <li>b. Clean or replace air shroud.</li> <li>c. Replace muffler.</li> </ul>  |
| 7. Engine backfires                   | <ul style="list-style-type: none"> <li>a. Gasoline mixture too lean.</li> <li>b. Defective spark plugs.</li> <li>c. Inlet valves sticking.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Adjust carburetor.</li> <li>b. Clean, adjust and/or replace spark plugs.</li> <li>c. Free, clean and adjust valves.</li> </ul>   |
| 8. Engine Compression low.            | <ul style="list-style-type: none"> <li>a. Valve clearance improper.</li> <li>b. Defective cylinder head.</li> <li>c. Defective valve or piston rings.</li> <li>d. Cylinder head gaskets leak.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Adjust valve.</li> <li>b. Consult the nearest engine service center.</li> <li>c. Consult the nearest engine service center.</li> <li>d. Replace gasket and tighten head bolts.</li> </ul>  |
| 9. Engine doesn't deliver full power. | <ul style="list-style-type: none"> <li>a. The carburetor choke valve partly closed.</li> <li>b. Air cleaner dirty.</li> <li>c. Carburetor defective.</li> <li>d. Exhaust restricted.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Adjust choke.</li> <li>b. Service air cleaner.</li> <li>c. Clean, adjust or replace carburetor.</li> <li>d. Replace muffler.</li> </ul>  |
| 10. Engine stops suddenly.            | <ul style="list-style-type: none"> <li>a. Ignition switch faulty.</li> <li>b. Fuel system has dirt, water or gum.</li> <li>c. Defective choke.</li> <li>d. Carburetor defective.</li> <li>e. Air pump locked up.</li> <li>f. Fuel pump defective.</li> <li>g. Faulty wiring.</li> <li>h. Remote control unplugged.</li> <li>i. Low oil level.</li> <li>j. Fuse blown.</li> </ul> | <ul style="list-style-type: none"> <li>a. Replace ignition switch.</li> <li>b. Clean fuel tank and check fuel filter.</li> <li>c. Inspect choke.</li> <li>d. Clean or replace.</li> <li>e. Inspect air pump for rotation.</li> <li>f. Clean or replace the pump.</li> <li>g. Tighten loose terminal, replace wiring.</li> <li>h. Connect remote.</li> <li>i. Fill oil to full mark.</li> <li>j. Replace fuse.</li> </ul> |

| <b>SYMPTOMS</b>  | <b>POSSIBLE CAUSE</b>  | <b>CORRECTIVE ACTION</b>  |
|--|--|---|
| 11. Power light is not it when power switch is in ON position. | <ul style="list-style-type: none"> <li>a. Machine not turned on.</li> <li>b. Defective switch.</li> <li>c. Lamp defective.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Turn on ignition switch.</li> <li>b. Replace switch. Switch may be temporarily shorted across terminals for test.</li> <li>c. Replace bulb.</li> </ul>  |
| 12. Formulation pump runs but no output.                       | <ul style="list-style-type: none"> <li>a. Leak in suction line.</li> <li>b. Out of formulation.</li> <li>c. Output solenoid not opening.</li> <li>d. Filter gasket pinched.</li> <li>e. Filter plugged.</li> <li>f. Pump defective.</li> </ul> | <ul style="list-style-type: none"> <li>a. Check lines and tighten.</li> <li>b. Check that both formulation tank and flush tank have solution in them.</li> <li>c. Check voltage at solenoid connector and control panel. With flush "ON", both should be 12v.</li> <li>d. Replace gasket.</li> <li>e. Clean or replace filter.</li> <li>f. Visually check pump for rotation and piston movement, replace as necessary.</li> </ul> |
| 13. Formulation pump runs all the time.                        | <ul style="list-style-type: none"> <li>a. Override switch in ON position.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Turn override switch to OFF position.</li> </ul>  |
| 14. Air pump will not operate while engine is running.         | <ul style="list-style-type: none"> <li>a. Shaft belt broken.</li> <li>b. Gears in blower damaged.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Replace belt.</li> <li>b. Consult factory.</li> </ul>   |
| 15. Air pump makes excessive noise.                            | <ul style="list-style-type: none"> <li>a. Oil level low.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Ensure proper oil level before consulting factory.</li> </ul>   |
| 16. No air flow.   | <ul style="list-style-type: none"> <li>a. Speed too low.</li> <li>b. Obstruction in piping.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Check engine RPM with tachometer.</li> <li>b. Check piping, screen valves, silencer to assure an open flow path.</li> </ul>   |
| 17. Low capacity.  | <ul style="list-style-type: none"> <li>a. Speed too low.</li> <li>b. Excessive pressure.</li> <li>c. Obstruction in piping.</li> <li>d. Excessive slip on belt.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Check engine RPM.</li> <li>b. Outlet obstructed. Check piping, screen valves, silencer to assure an open flow path.</li> <li>c. Check piping, screen valves, silencer to assure an open flow path.</li> <li>d. Consult factory.</li> </ul>  |

| SYMPTOMS                             | POSSIBLE CAUSE   | CORRECTIVE ACTION  |
|--------------------------------------|--|--|
| 18. Excessive power required.        | <ul style="list-style-type: none"> <li>a. Speed too high.</li> <li>b. Pressure too high.</li> <li>c. Impellers rubbing.</li> </ul>   | <ul style="list-style-type: none"> <li>a. Check RPM.</li> <li>b. Check piping, screen valves, silencer to assure an open flow path.</li> <li>c. Consult factory.</li> </ul>  |
| 19. Overheating of bearing or gears. | <ul style="list-style-type: none"> <li>a. Inadequate lubrication.</li> <li>b. Excessive lubrication.</li> <li>c. Excessive pressure rise.</li> <li>d. Belt misalignment.</li> <li>e. Speed too low.</li> </ul>           | <ul style="list-style-type: none"> <li>a. Restore correct oil levels in gearbox and lubricate.</li> <li>b. Check gear oil level. If correct, drain and refill with lean oil of recommended grade.</li> <li>c. Check piping, screen valves, silencer to assure an open flow path.</li> <li>d. Check carefully. Realign if questionable.</li> <li>e. Speeds lower than the minimum recommended will overheat the entire blower.</li> </ul> |
| 20. Vibration                        | <ul style="list-style-type: none"> <li>a. Belt misalignment.</li> <li>b. Impellers rubbing.</li> <li>c. Worn bearings/gears.</li> <li>d. Unbalanced or rubbing impellers.</li> <li>e. Driver or blower loose.</li> </ul> | <ul style="list-style-type: none"> <li>a. Check carefully. Realign if questionable.</li> <li>b. Consult factory.</li> <li>c. Check gear backlash and condition of bearings.</li> <li>d. Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance.</li> <li>e. Tighten mounting bolts securely.</li> </ul>                                |

## PREPARATION FOR STORAGE

### 1. GENERAL

If the unit is to be out of service for two or more months, clean the entire machine with soapy water. Rinse and dry thoroughly.

### 2. BLOWER

When a blower is taken out of service, it may require internal protection against rusting or corrosion. The need for such protection must be a matter of judgement based on existing conditions as well as length of downtime. Under favorable conditions, protection will probably not be needed if shutdown is no longer than a month.

Under atmospheric conditions producing rapid corrosion or for storage periods longer than one month:

- a. Remove the cover and screen on the air intake silencer. Start the engine and pour 6oz. of lubricating oil (SAE 40) in the blower intake. Shut the engine down immediately. Replace the cover and screen. The oil will coat the entire inner surface of the blower. This will prevent a coat of rust from forming in the blower.
- b. Service drive end bearings annually using a NLGI #2 premium grade, petroleum base grease with high temperature (300 degrees service temperature) and moisture resistance and good mechanical stability. Using a pressure gun, force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.
- c. Change gearbox oil annually.

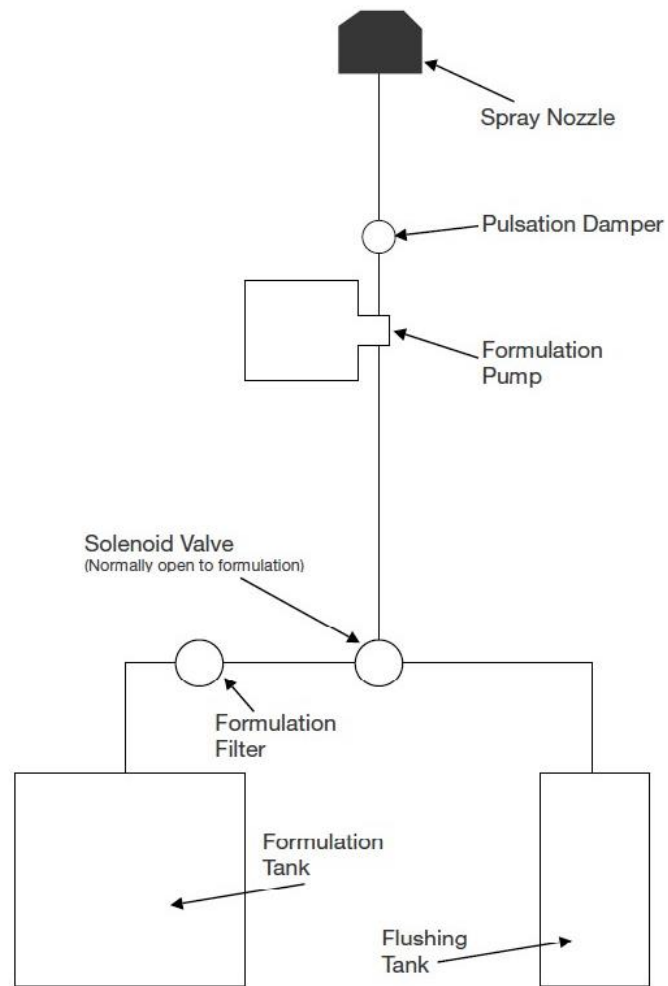
### 3. ENGINE

- a. Drain oil from crankcase while engine is still warm from operation. Refill engine to "F" mark on dipstick with proper viscosity oil.
- b. Add a fuel stabilizer to the fuel tank and run the engine for 20 minutes and run gas out of carburetor.
- c. Remove spark plug and add a tablespoon of engine oil into the spark plug hole. Install plug, but DO NOT connect plug lead. Crank engine slowly 2 to 3 revolutions.
- d. Spread a light film of oil over any exposed metal surfaces of engine to prevent rust.

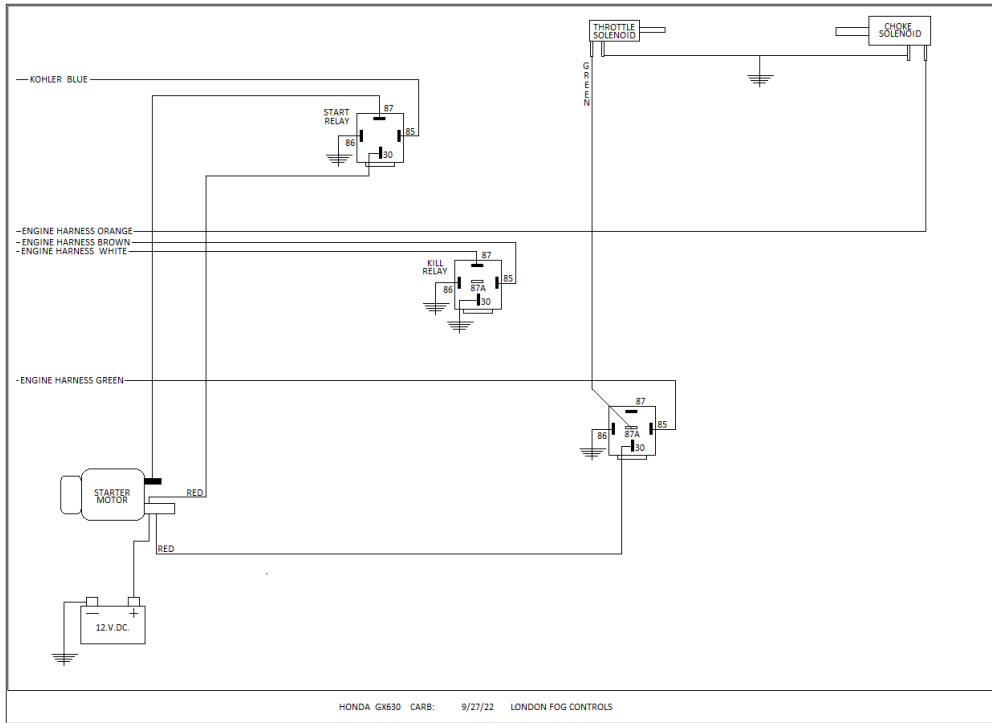
### 4. STORAGE

Store the unit in a clean, dry place.

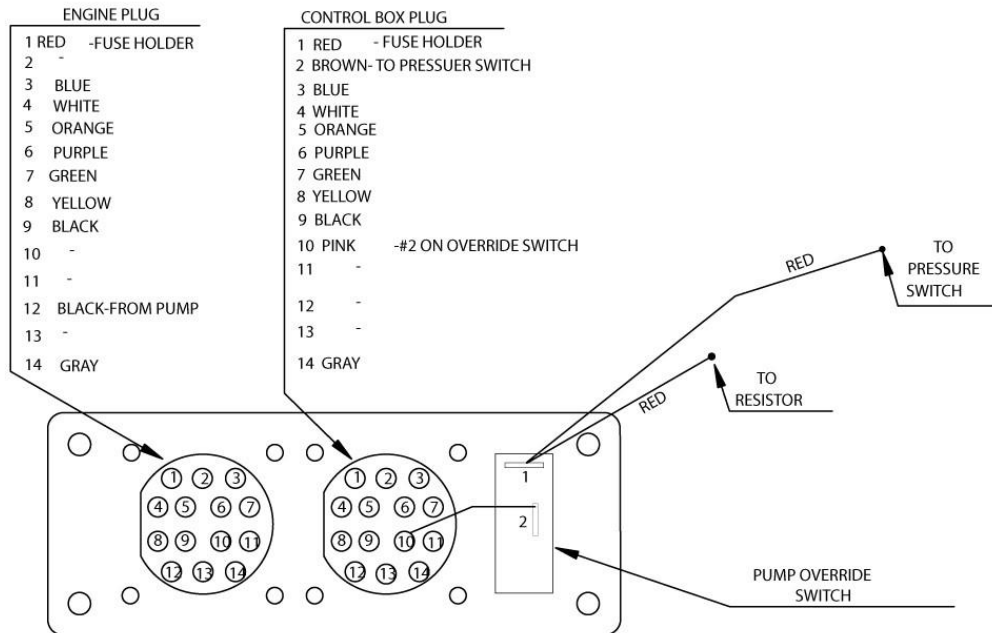
# FLUID SYSTEMS DIAGRAM



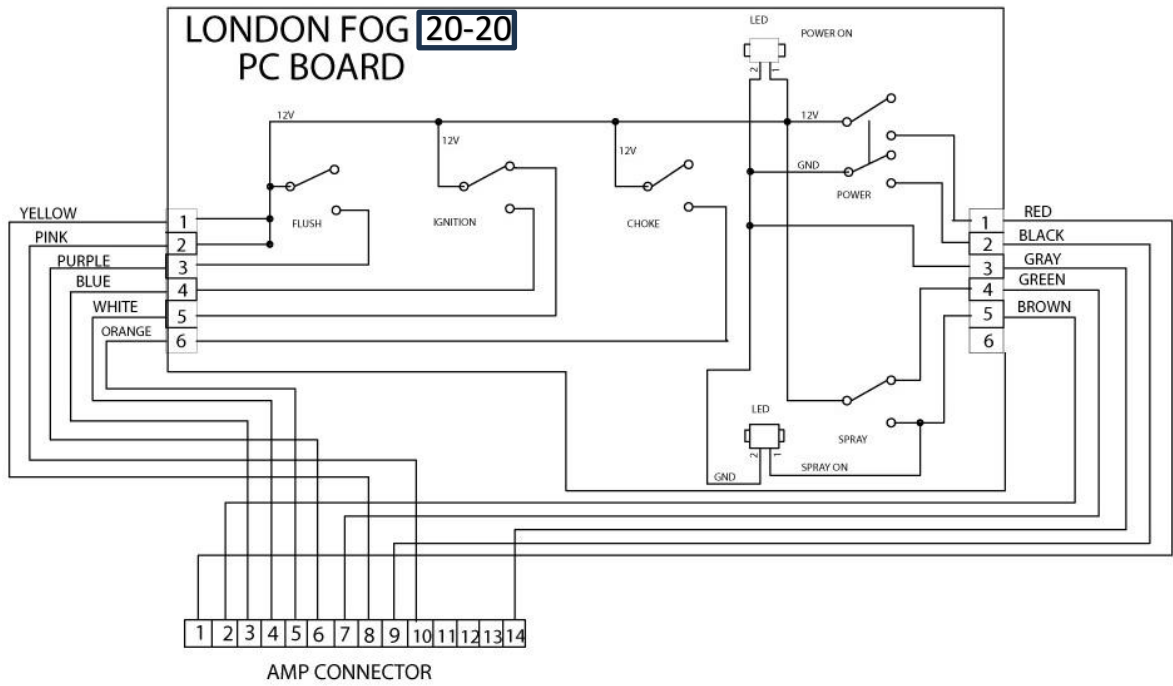
## 20-20 ENGINE WIRE DIAGRAM



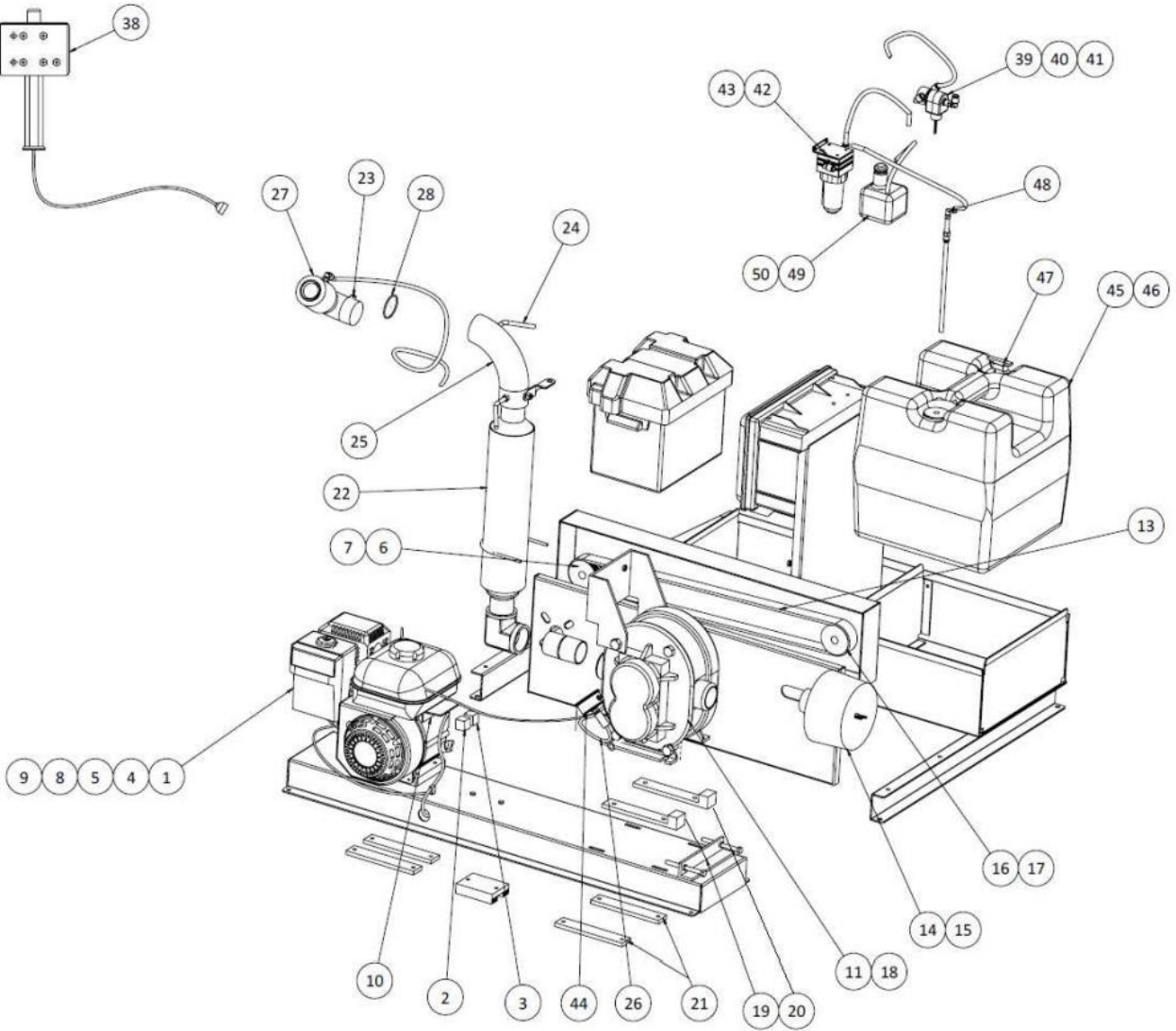
## PUMP BOX WIRING DIAGRAM



# YELLOW CAB CONTROL WITH PC BOARD

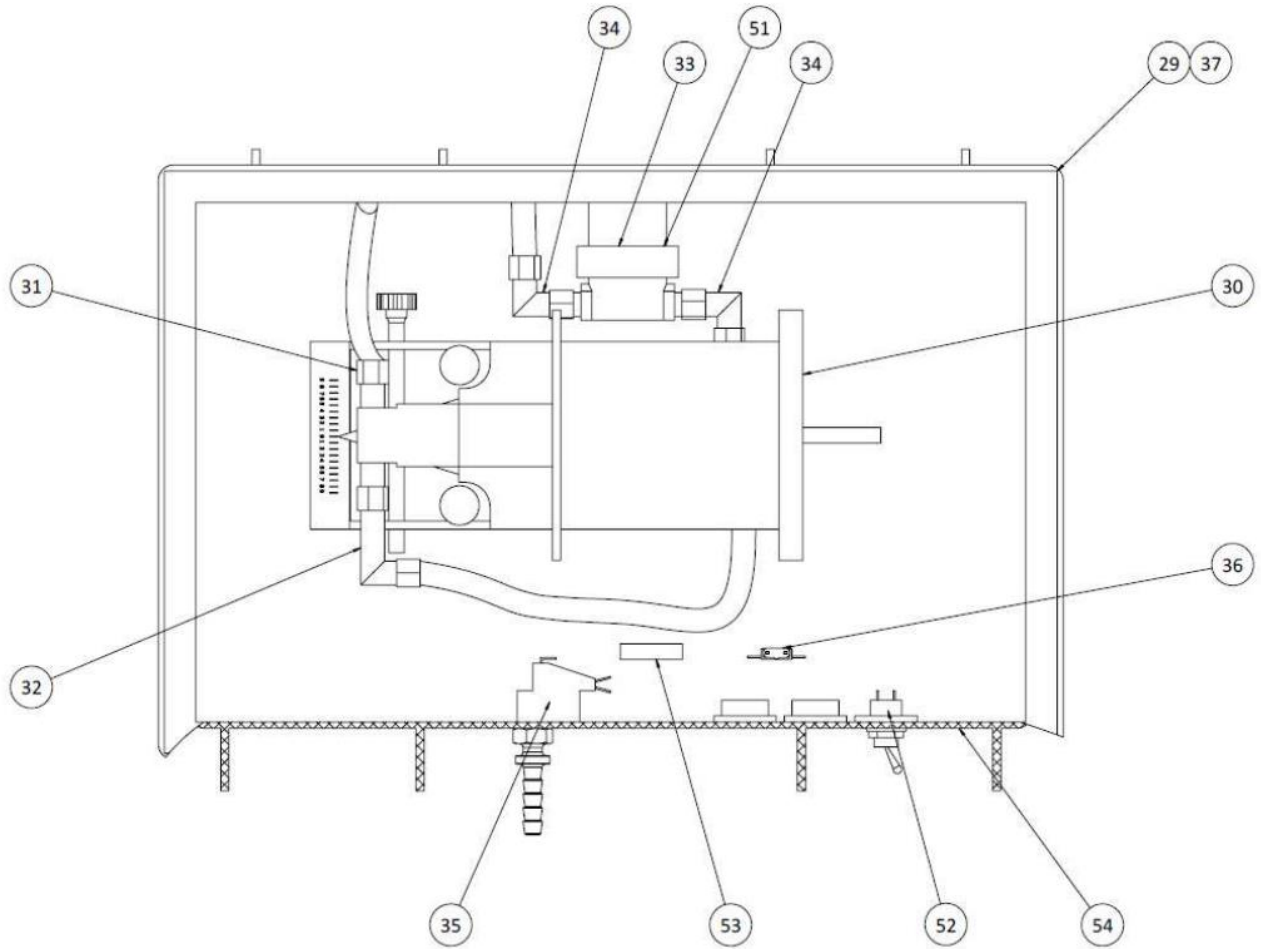


# PARTS BREAKDOWN – 20-20





# PARTS BREAKDOWN – PUMP BOX



## PARTS BREAKDOWN – KEY

Model H-1000/1010

| Item # | Part #   | Description   | Qty. |
|--------|----------|---|------|
| 1      | H-101A   | Engine Assembly Complete Wired                            | 1    |
| 2      | 1-102    | Relay 5 Pin Kill Relay                                    | 2    |
| 3      | 1-103    | Relay 4 Pin Start Relay                                   | 1    |
| 4      | 1-105A   | Engine Wire Harness Complete (AMP)                        | 1    |
| 5      | H-134SP  | Engine Oil Filter   | 1    |
| 6      | 1-105    | Blower/Engine Pulley (does not include bushing)           | 1    |
| 7      | 1-124    | Taper Bushing (does not include pulley)                   | 1    |
| 8      | H-137SP  | Engine Air Filter Element                                 | 1    |
| 9      | H-138SP  | Engine Spark Plugs  | 1    |
| 10     | 1-141    | Fuse 30 AMP   | 1    |
| 11     | 1-200A   | Blower Assembly Complete with Pulley                      | 1    |
| 12     | H-139SP  | Fuel Filter   | 1    |
| 13     | 1-202    | Triple V-Belt   | 1    |
| 14     | 1-203    | Engine Air Filter Complete Assembly                       | 1    |
| 15     | 1-204    | Blower Air Filter Element Only                            | 1    |
| 16     | 1-205    | Blower Pulley (does not include bushing)                  | 1    |
| 17     | 1-206    | Blower Pulley Bushing (does not include pulley)           | 1    |
| 18     | 1-207    | Mobil DTE Oil 13 Oz.                                      | 1    |
| 19     | 1-209    | Belt Tensioner with Nut                                   | 1    |
| 20     | 1-210    | Belt Tensioner Without Nut                                | 1    |
| 21     | 1-211    | Blower Nut Plate  | 2    |
| 22     | 1-215A   | Silencer Tube Assembly                                    | 1    |
| 23     | 1-224    | Safety Set Screw (to secure rotating nozzle)              | 2    |
| 24     | 1-225    | Locking Handle (to lock rotating nozzle & elbow)          | 2    |
| 25     | 1-227A   | Swivel Elbow Assembly                                     | 1    |
| 26     | 1-230A   | Blower Pressure Hose Assembly                             | 1    |
| 27     | 1-300A   | Hoot Nozzle Assembly (with housing & fitting)             | 1    |
| 28     | 1-315    | O-Ring x3 (nozzle with 2, silencer tube with 1)           | 2    |
| 29     | 1-501    | Black Pump Box Only                                       | 1    |
| 30     | 1-550    | F.M.I. Pump 3/8" Ceramic Piston with Fittings             | 1    |
| 31     | 1-502    | Pump Fitting, Jaco 1/4 x 3/8 male                         | 1    |
| 32     | 1-503    | Pump Fitting, Jaco 1/4 x 3/8 90 deg. male                 | 1    |
| 33     | 1-504A   | Pulse Dampener with Bracket & Hose Fittings Assembly      | 1    |
| 34     | 1-507    | Jaco, 1/4 x 3/8 90 deg. female                            | 2    |
| 35     | 1-509    | Pressure Switch   | 1    |
| 36     | 1-513    | Gold Resistor with Heat Sink Complete with Connectors     | 1    |
| 37     | N/A      |   |      |
| 38     | 1-575A   | Yellow Cab Control Complete Assembly                      | 1    |
| 39     | 1-600A   | Spray Flush Solenoid Complete Assembly                    | 1    |
| 40     | 1-503    | Flush Solenoid Jaco 90 Deg. Male Fitting 1/4 x 3/8        | 2    |
| 41     | 1-502    | Flush Solenoid Jaco Straight Fitting 1/4 x 3/8            | 1    |
| 42     | 1-650A   | Filter Assembly Complete with Fittings                    | 1    |
| 43     | 1-656    | 90 Deg. Male Jaco Formulation Filter                      | 2    |
| 44     | 1-675A   | Pressure Gauge Complete Assembly                          | 1    |
| 45     | 1-700A   | 15-Gal Black Formulation Tank with Pickup Tube & Fittings | 1    |
| 46     | 1-701    | 15 Gallon Formulation Tank Only                           | 1    |
| 47     | 1-702A   | Formulation Tank Cap with Handle (non-locking)            | 1    |
| 48     | 1-712A   | Stainless Steel Pickup Tube Complete with Fittings        | 1    |
| 49     | 1-725A   | Flush Tank Assembly with Cap                              | 1    |
| 50     | 1-727    | Flush Tank Cap  | 1    |
| 51     | 1-527SP  | Pulsation Dampener Green Gasket                           | 1    |
| 52     | 1-512    | Toggle Switch   | 1    |
| 53     | 1-515    | 5 Amp Fuse  | 1    |
| 54     | 1-508    | Pump Box Electrical Wiring                                | 1    |
| 55     | 1-517    | Clear Poly Tubing (per foot)                              | 1    |
| 56     | 1-1005SP | Nylon Fitting Kit (including all 12 Jaco fittings)        | 1    |
| 57     | 1-1003SP | Hose & Fitting Kit (everything included)                  | 1    |

