

INSTRUCTION MANUAL AND PARTS LIST

COUGAR® ULV SPRAYER
WITH SMARTFLOW® II



COUGAR® ULV SPRAYER

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COUGAR® ULV SPRAYER

Clarke Cougar Specifications

THIS MANUAL IS FOR MY CLARKE COUGAR® ULTRA LOW VOLUME (ULV) SPRAYER

SERIAL NUMBER _____

MANUFACTURING DATE _____

The above information, which can be found on the CHASSIS, should be filled in.
Your prompt attention to this matter will make it convenient for you in the future,
as this information must be given when ordering parts.

CLARKE COUGAR® SPECIFICATIONS

Every effort has been made to make this manual as complete as possible so that it will provide maximum assistance in operating and maintaining your Clarke Cougar® ULV Sprayer.

Engine Blower	10 HP Briggs & Stratton OHV Engine Roots; 105 CFM @ 3600 RPM
Dispersal Head Fuel	Gasoline Min Octane
Tank Capacity Gasoline	2.84 Gal/10.7 L
Formulation Tank	15 Gal/56.7 L
Flush Tank	2 Qt/1.9 L
Size	90% less than 20 µm
Flow Rate	Up to 18 oz/min 532.26 mL/min*
Dimensions	42" x 38" x 43" 107cm x 97cm x 102cm (h x w x h)
Net Weight (Empty)	260 lbs/with skid 305 lbs 118 kg/with skid 138 kg
Shipping Weight	350 lbs 159 kg
Cube	43.85' 3.37 m

*With standard 1/4" Piston. Larger pump heads available with flow rates up to 77oz/min (2277 mL/min).

Warranty Information

Your Cougar® is warranted to the original purchaser by Clarke against defects in workmanship or materials for a period of one (1) year from the date of purchase from Clarke. If any warranted component fails within that period, return the component to Clarke, shipping prepaid, for repair or replacement. This warranty does not include incidental damages arising from machine failure, from incorrect use, or from improper or neglect of maintenance.

This warranty covers only the repair or replacement of warranted defective parts. It does not cover components which normally wear out or are used up during operation or through time. In the latter category are items such as tubing, fittings and rubber mountings.

Parts which prove to be defective will be repaired or replaced free of charge FOB factory, provided:

1. The component was properly installed, as per enclosed manual, given reasonable care, protected from wet weather conditions and freezing temperatures and used for its intended purpose.
2. No repairs have been attempted by other than factory personnel. No alterations or adjustments have been made to the electrical controls.
3. The component(s) have been returned properly packaged, insured, and with transportation charges prepaid.
4. Upon examination, Clarke personnel are satisfied that the defects were not caused by abuse, or subjection to conditions that violate the system specifications or neglect.
5. When the component is plugged into a vehicle electrical system, a Volt check confirms that the vehicle's alternator is meeting automotive standards 13.8 V to 14.8 V (15 V max) at the alternator. This is required for both the component and vehicle reliability.

All returns must have
an authorization number
issued by Clarke.

**Please call ahead to save
time and cost of having
items returned.**

1-800-323-5727

Thank you!

COUGAR® ULV SPRAYER

Important Notes to Help You Get the Most out of Your Sprayer and Maintain the Warranty

1. Read and understand this instruction booklet before operating your sprayer. If you have questions about operating the sprayer, proper applications, or insecticides, call Clarke and ask for technical support.
2. Use only insecticides that are specifically registered by the appropriate state and federal agencies for ultra-low-volume (ULV) adult mosquito and/or fly control.
3. Read and follow the insecticide label. It is a federal offense to use any pesticide in a manner not in accordance with its labeling. This includes directives on the use of protective clothing and safety equipment.
4. To obtain the best results with a ULV sprayer, the operator must be knowledgeable of space spraying concepts. Many insecticide labels list specific training and/or certification requirements for users. Consult Clarke or your nearest cooperative extension agent for information.
5. Operate the sprayer only when:
 - The vehicle is moving in a forward direction.
 - Winds are less than 8 m.p.h.
 - Insects are exposed to spray (evening or early morning is the best time for most species).
6. Before attempting to start your unit the first time, study the complete Operation Instructions carefully and identify all parts referred to. You will find that the operation of your Clarke Cougar® ULV Sprayer is a simple matter. However, like all mechanical equipment, your unit requires a certain amount of maintenance.
7. The Maintenance Instructions section will enable your Cougar® to give you continuous and trouble-free service. **It is highly recommended that some system be established to assure the performance of this maintenance as its importance cannot be overemphasized.**

Although, with proper maintenance, your unit should operate indefinitely without any trouble, there might come a time when trouble does develop. For such an occasion, a complete Trouble Shooting section has been prepared and included in this manual.

The Parts Book section of the manual is made up of photos and parts list. Assemblies and parts of the unit are shown and identified with a part number. **Always order parts by part number, description and the serial number of your unit.**

Safety

This Clarke Cougar® is manufactured and sold for use only with insecticides which have been duly registered and approved. **DO NOT EXCEED the dosage set forth on the registration label of the insecticide to be used.**

Only qualified personnel should operate the Cougar®.

All **SPRAY** switches must be in the OFF position before the **IGNITION SWITCH** is turned on.

Observe all safety precautions set forth on the registration label of the insecticide to be used.

Never operate the fog generator in an enclosed area unless the exhaust gases are piped to the outside. Exhaust gases contain carbon monoxide, which is colorless, odorless and poisonous gas.

Do not fill the fuel tank while the engine is in operation. Gasoline spilled on a hot engine may explode and cause serious injury to personnel.

Do not attempt repairs in the insecticide system without protection until the system has been thoroughly flushed with a flushing solution for the insecticide used.

CAUTION



HEARING PROTECTION REQUIRED

Note: Hearing protection must be worn when outside the vehicle in close proximity with the Clarke Cougar® ULV Sprayer when it is running.

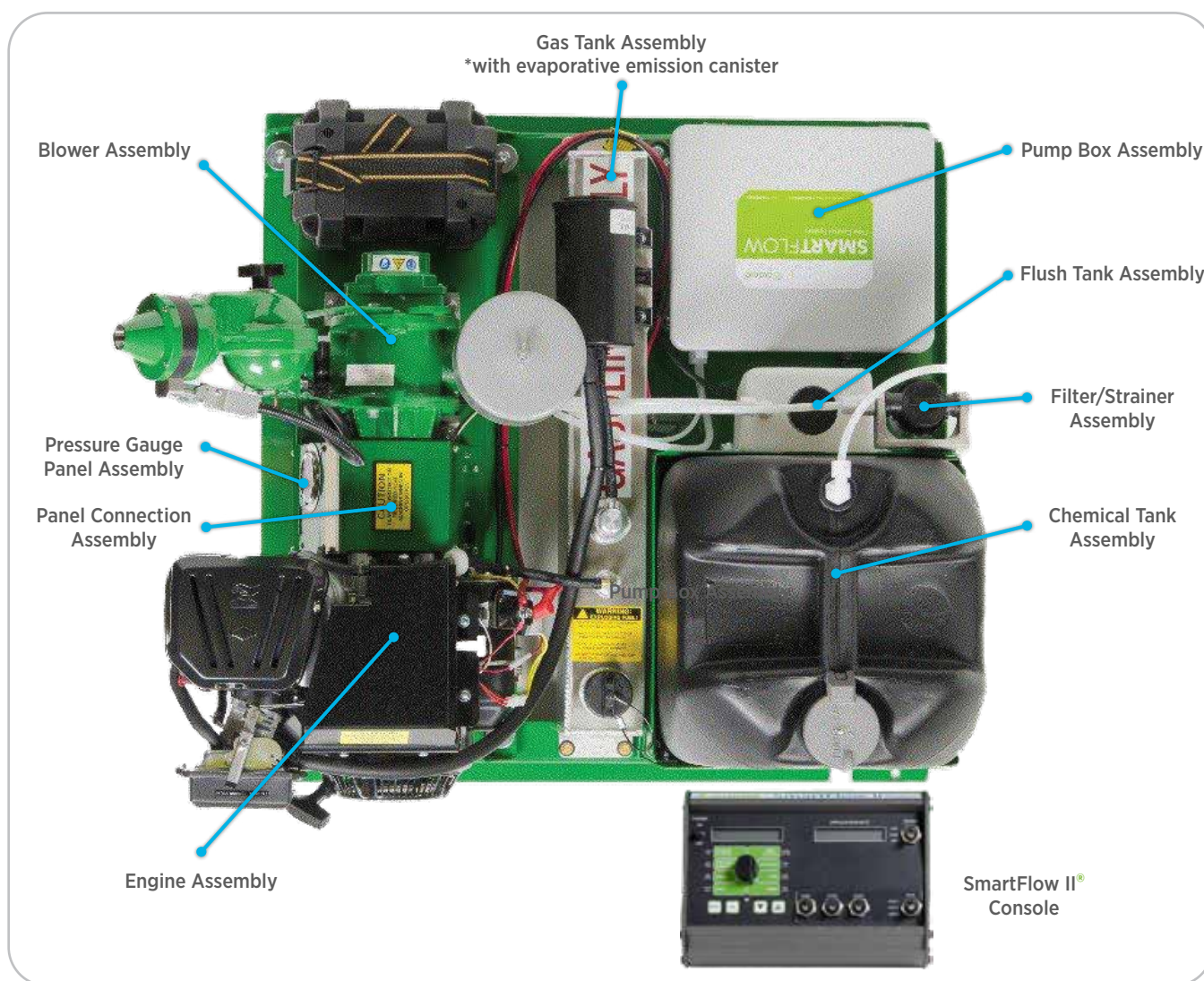
COUGAR® ULV SPRAYER

Description

This manual provides the description, theory of operation, assembling instructions, mounting instructions, operation instructions, calibration instructions, maintenance instructions and illustrated parts breakdown for the Clarke Cougar® Ultra Low Volume (ULV) Sprayer.

The Clarke Cougar® Ultra Low Volume (ULV) Sprayer consists of an engine, fuel tank, a rotary blower capable of developing 8 P.S.I. maximum pressure, an adjustable discharge nozzle head assembly, a flow control, an insecticide tank, a flush tank, a remote console a filter-silencer with a stainless steel element and insecticide filter.

FIGURE 1: COUGAR® ULV SPRAYER GAS TANK ASSEMBLY



Installation

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COUGAR® ULV SPRAYER

Installation Instructions

Uncrate. Remove from skid.



FIGURE 2: UNCRATE MACHINE

NOTE: You might want to save machine box for storage purposes.

FIGURE 3: COUGAR® ULV SPRAYER AND SMARTFLOW II



MACHINE OPTIONS



GPS

ORDER PART NO. 325490

The Cougar® ULV Sprayer can be sold with or without GPS. GPS can be ordered separately.



CLARKE INSTALL KIT

ORDER PART NO. 347741

If you wish to permanently install the sprayer into a vehicle, a Clarke Install Kit is available for easy installation to your vehicle's battery. This kit includes cables, vehicle circuit breaker and terminals. **Install Kit must be ordered separately.**

Installation Instructions (*continued*)

Mount to vehicle.

The Cougar® ULV Sprayer can be conveniently mounted on a variety of trucks and utility vehicles. To easily move and lift the machine, **we recommend using some type of lifting device, such as a forklift.**

The sprayer can be placed anywhere on the truck bed, but must be positioned with the nozzle aimed to the rear of the vehicle.



FIGURE 4: COUGAR® ULV SPRAYER (MOUNTING)



FIGURE 5: COUGAR® ULV SPRAYER (MOUNTED)

NOTE:
Sprayer can be left on skid and placed on truck bed or mounted directly to truck bed.
The nozzle and engine exhaust should be facing the rear of the vehicle, pointing away from the operator.

NOTE: The warranty is voided if the unit is damaged due to improper mounting.

COUGAR® ULV SPRAYER

Battery Install

A 12 Volt Lawn & Garden battery (size U1) can be installed using the mounted battery box on the Cougar® for stand-alone use.

NOTE: An Installation Kit can be purchased to connect to your vehicle's battery, and will eliminate the need for the additional battery.

See page 56 for Installation Kit purchasing information.

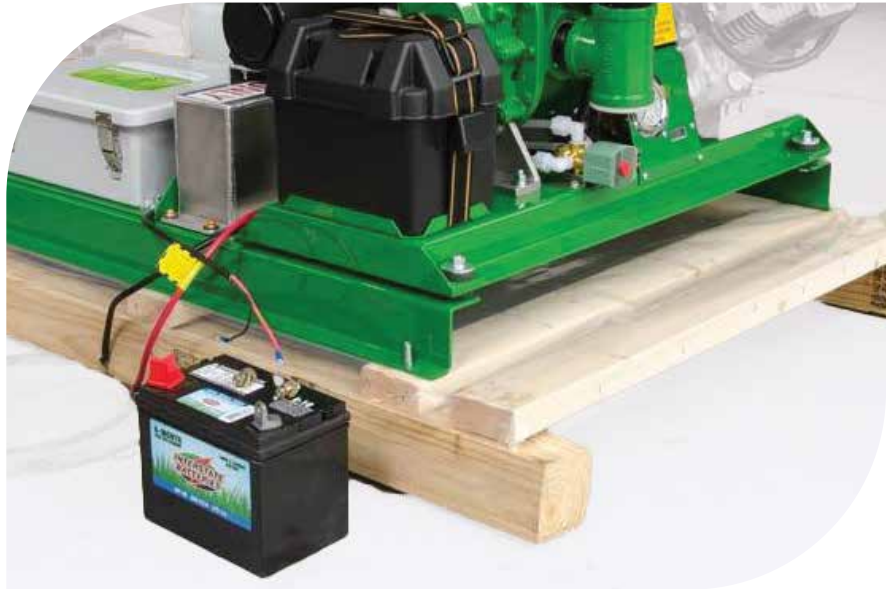


FIGURE 6: COUGAR® ULV SPRAYER AND SMARTFLOW II

FIGURE 7: COUGAR® ULV SPRAYER AND SMARTFLOW II



Battery Install (*continued*)

Next, connect the 10-pin control cable to the connection panel, located between the engine and blower assemblies.

Then, connect the 7-pin control cable to the pump box. This cable will be routed into the cab of the truck to hook up to the SmartFlow II control console.

These cables can be routed by drilling into the cab. It's important to protect the cables from sharp surfaces, similar to routing the power cables. Other methods include routing through the door or back window.



FIGURE 8: 10-PIN CONNECTION PANEL



FIGURE 9: 7-PIN CONTROL CABLE & PUMP BOX CONNECTION

COUGAR® ULV SPRAYER

Supplying Power with the Clarke Installation Kit

If using the Clarke Install Kit, you will not need an external battery.

First, remove existing red and black power cables from the sprayer. Note where you're removing them from so you can replace with the pre-made power whip in the Installation Kit.

Next, hook up the 32" power whip in the Installation Kit (the shortest in the box), along with the pump box power wires to the ground on the engine block, and the other to the starter solenoid.



FIGURE 10: COUGAR® ULV SPRAYER POWER SUPPLY

FIGURE 11: COUGAR® ULV SPRAYER POWER WHIP

POWER WHIP



GROUND



STARTER SOLENOID



Connecting the Cougar® to Your Vehicle's Electrical System

Step-by-step images on pages 16-18.

The Clarke Installation Kit contains vehicle circuit breaker and terminals.

If you intend to supply your own cabling and circuit protection components, **we recommend a minimum of 6 awg multi-stranded copper power cable with a 60 amp inline fuse located near the sprayers onboard battery as well as a 50 amp circuit breaker located near the vehicles power source.** This is extremely important to protect against electrical short and fire. It is critical that both ends of the power cable are protected.

NOTE: Vehicle Installation cables and breakers must meet Clarke systems vehicle installation specifications or Cougar Warranty will be voided.

Regardless of how you power your Cougar®, the SmartFlow® II console can be mounted in any convenient location within easy reach of the operator. Take care not to obstruct the driver's view forward or view of vehicles instruments. The control cable plugs into the back of the SmartFlow® II console in the vehicle at one end and into the pump box (Figure 12) and also in the socket located on the rear coupling control. (Figure 13)

Parts Required to complete Vehicle Installation

- Vehicle Installation Kit P/N 347741 (or comparable)
- 12 Volt garden battery (size U1)
- Tools required to complete vehicle installation
- Screw driver
- Wrench set up to 5/8"
- Crimping tool for insulated ring lugs wire size
- **AWG6 if using your own cabling**
- Electric hand drill and power source
- 3/16" drill bit (for mounting breaker bracket)
- 2" hole saw that fits your hand drill
- Sharp knife



FIGURE 12: PUMP BOX CONNECTION



FIGURE 13: REAR CONNECTION PANEL

NOTE: For proper plug insertion, the largest rib on the remote control socket should be at the 12:00 position.

Where to Install The Power Cable on the Vehicle

You may choose to run the power cable out through a hole in the front panel of the truck bed, in through the rear panel of the cab, under the seat, out through the fire wall into the engine compartment, and over to the vehicle battery.

Or you may choose to run the power cable out through a hole in the front panel of the truck bed, down under the cab, up into the engine compartment, and then over to the vehicle battery. With the first choice you could also bring the Cougar® Operator Control Unit Cable into the cab through the same holes as the power cable, providing the hole is large enough to accept both cables, which would be a 2-inch hole.

NOTE: Repeated bending or pinching of cable can cause cable failure.

COUGAR® ULV SPRAYER

Connecting the Cougar® to Your Vehicle's Electrical System (*continued*)

1. Disconnect the long lead from the 50 Amp breaker.
2. Mount the 50 Amp breaker very close to the positive battery terminal.
3. Take the long cable sections (now free from the breaker). Connect the plug end to the newly installed whip.
4. Drill a hole in the bed of the truck or find alternate path to run the cables to the vehicle battery. Use a heavy-duty rubber grommet around hole to protect cable.
5. Run both the black and red leads toward the front of the truck in the direction of the vehicle's battery and the mounted 50 amp breaker. Then, feed the cables through the hole.



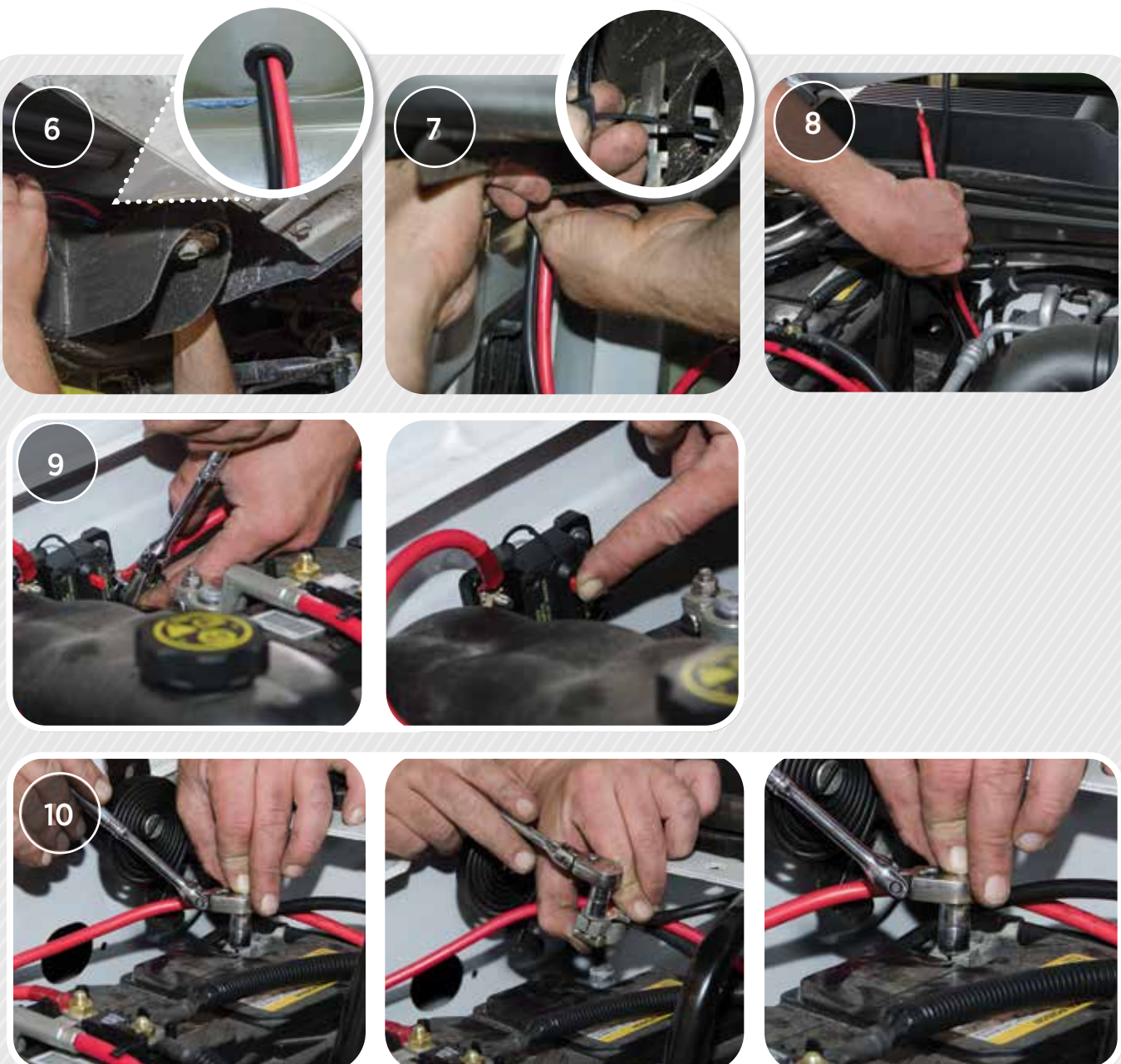
Connecting the Cougar® to Your Vehicle's Electrical System (*continued*)

6. From the underside of the truck, pull the cables through continuing towards the vehicle's battery and 50 Amp breaker.
7. Secure cable using ties and protect from sharp edges and surfaces.
8. Pull the cables into the engine compartment, to the mounted breaker.

9. Secure the ring terminal of the red cable to the breaker. The black cable will connect to the negative battery terminal in a future step of this instruction.
10. Connect the power leads to the vehicle battery terminals.

NOTE: The other end of these cables are connected to the SmartFlow II control console. Determine the best mounting location within the cab.

The included SmartFlow II mounting bracket can be used to secure the console within the cab. It is recommended to secure the console for safety purposes.



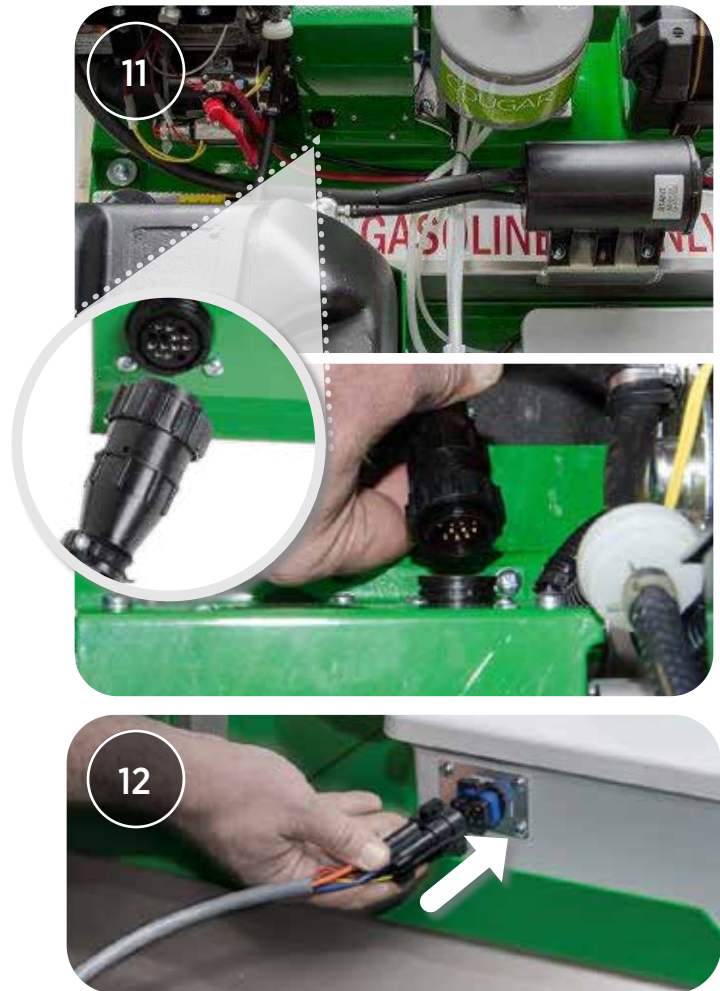
COUGAR® ULV SPRAYER

Connecting the Cougar® to Your Vehicle's Electrical System (*continued*)

11. Connect the 10 pin control cable to the connection panel located between the engine and blower assemblies.
12. Connect the 7 pin control cable to the pump box. This cable will be routed into the cab of the truck to hook up to the SmartFlow II control console.

These cables can be routed similar as the power cables by drilling into the cab and protecting the cables from sharp surfaces. Other methods include routing through the door or back window.

Verify all electrical connections are clean and secure. Reset breaker to allow vehicle charging system to deliver power to the machine.



NOTES

A large rectangular area filled with a uniform grid of small, light blue dots, intended for handwritten notes.

COUGAR® ULV SPRAYER

NOTES

Grid area for notes.

Operation

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COUGAR® ULV SPRAYER

Theory of Operations

The Clarke Cougar® ULV sprayer is designed for precision metering of concentrated insecticide through the discharge nozzle head. Any desired flow rate, within limits, can be easily set at a target rate. When fogging, the concentrated insecticide is drawn from the insecticide tank and pumped at the preset rate with constant, even flow to the discharge nozzle head where it is sheared into optimum size droplets by the air blast from the blower and dispersed into the atmosphere. After dispersal, the droplets stay suspended in the air and drift with prevailing winds to insect-infested areas.

The **optimum size** of a particular insecticide is defined on the registration label for that insecticide and can be controlled by varying either the nozzle air pressure, the insecticide flow rate, or both. Changing the speed of the engine will vary the nozzle air pressure. Slowing down the engine decreases the pressure which increases the droplet size, because of less shearing action and conversely, speeding the engine up increases the pressure which decreases the droplet size for a particular flow rate.

The **correct flow rate** will be defined on the registration label for that insecticide. As stated above, the flow rate also affects the droplet size. The droplet size tends to increase as the flow rate increases. Optimum size droplets must be maintained and should be checked periodically by an authorized person.

Particle Size

The air pressure at the nozzle and the volume of the chemical flow changes particle size. Particle size is specified on the label of the insecticide for that insecticide. This is a part of the label and a part of the legal use of that insecticide.

It is the responsibility of the user to determine the proper particle size produced by the Clarke Cougar ULV. This should be in accordance with the chemical label, as required by law.

[Your Clarke representative or distributor can work with you to be sure you are producing the correct particle size for the insecticide used.](#)

Insecticide labels discuss the determination of particle size and the suppliers of the insecticide should be equipped to measure, or help you measure, the particle size produced by your Clarke Cougar® ULV sprayer.

The Cougar® ULV sprayer should not be operated unless the required particle size is known and measured.

Clarke cannot tell you what air pressure to use with a particular insecticide to get the particle size required by the label. There are too many variables involved, such as chemical mixture, flow rate and the temperature of the insecticide.

Operation Instructions

When operating the Clarke Cougar® ULV Sprayer for the first time, move to an uncongested and well-ventilated work area in an open area away from flammable materials.

Pre-Start

1. Verify that the battery cable connections are correct and tight. This is a negative ground system.
2. Verify that no foreign objects or tools have been left in or about the Clarke Cougar® ULV Sprayer.

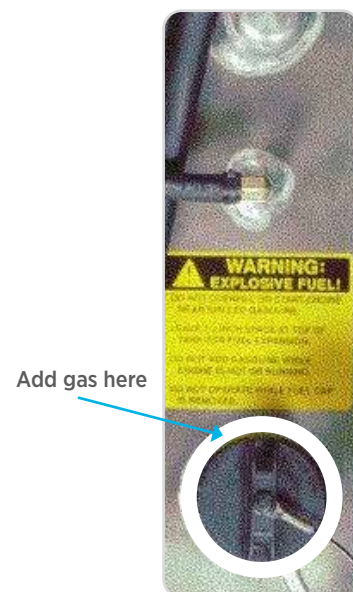
Check the oil in the engine. If necessary, add oil until the level reaches the mark on the dipstick. The engine manual supplied with the Clarke Cougar® ULV Sprayer will advise the correct oil to use. *Reference Figure 14.*

3. Check the oil and lubrication levels on the blower. See the Blower section (*page 36*).
4. Fill the gasoline tank. *Reference Figure 15.*

FIGURE 14: ENGINE OIL AND GASOLINE TANK



FIGURE 15: COUGAR® GAS CAP



COUGAR® ULV SPRAYER

5. Fill the insecticide tank with appropriate insecticide. Always use a funnel with a strainer when adding insecticide to the tank.
Reference Figure 16.
6. Place flushing solution in the flush tank.
Reference Figure 17.
7. Verify that the Console is within easy reach of the operator.
8. Verify that the nozzle is in the correct position for spraying. The nozzle is adjustable both horizontally and vertically. To rotate the nozzle, loosen the appropriate knob on the side of the mast or side of the nozzle head and rotate the nozzle. Retighten the knobs after adjustment.
Reference Figure 18.



FIGURE 16: FILLING INSECTICIDE TANK



FIGURE 17: FILLING FLUSH TANK

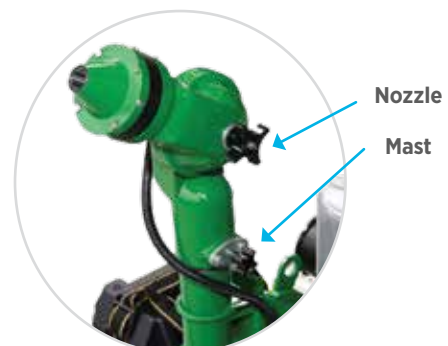


FIGURE 18: NOZZLE POSITION — ADJUSTMENT KNOBS

Start-Up

1. On the SmartFlow II Console (Console), turn the **MAIN POWER** switch to the ON position. *Reference Figure 19.*
2. On the Console, set the **SPRAY** switch to the OFF position. *Reference Figure 19.*
3. **For a cold engine**, on the Console, toggle the **CHOKE** switch and hold the choke ON. Then without releasing the choke, toggle the **STARTER** switch until the engine fires. **Don't hold more than 15 seconds at a time.** *Reference Figure 19.*
4. **For a hot engine**, on the Console, toggle the **STARTER** switch until the engine fires. *Reference Figure 19.*
5. When the engine fires, release both the **CHOKE** and **STARTER** switch.

NOTE: Pressing the **START** button on the engine will also start the engine. The Main Power switch on the Console must be in the ON position for the engine to be started. Manually lever actual choke if needed.

NOTE: Using short cranking cycles of several seconds provides the best starter life. **Prolonged cranking can damage the starter motor if cranked more than 15 seconds at a time.**

FIGURE 19: SMARTFLOW II CONSOLE FOR GAS ULV ONLY COUGAR AND/OR GRIZZLY



COUGAR® ULV SPRAYER

Pressure Gauge/Nozzle Air Pressure

The unit is equipped with a glycerin filled pressure gauge (*Figure 20B*) to read the nozzle air pressure and is mounted on the machine coupling guard between the engine and blower.

Nozzle air pressure is one of the main criteria for good particle size. Changing the speed of the engine adjusts this pressure. The nozzle air pressure can be adjusted by checking the pressure gauge as the engine speed is increased or decreased. The engine RPM can be adjusted by the throttle adjustment knob.

Reference Figure 20A.

Throttle Adjustment

The throttle setting which affects the RPM and in turn the PSI of the blower adjustment is accomplished by rotating a knob to select the desired RPM located on the rear of the engine.

Turn the knob counter clockwise to adjust to a lower RPM, and clockwise to adjust to a higher RPM (roughly 15 turns = total range) about 2,150 min - 4,000 max. A rise or drop in RPM effects the PSI in the same way.



FIGURE 20A: THROTTLE ADJUSTMENT KNOB

20B: PRESSURE GAUGE

Idle Adjustment

To adjust the **IDLE SCREW** to the best position to reduce pulsing and surging, perform these steps with the engine running and warmed up.
(Reference Figure 21.)

Push the **CARBURETOR LEVER** against the **IDLE SCREW** while engine is running. If the engine RPM drops below 1,700, release. Restart engine if it has stopped.

Turn the **IDLE SCREW** 2 turns. While engine is running again, push the throttle against this screw.

While holding the throttle against the **IDLE SCREW**, adjust screw to obtain an Idle of around 2,000 RPM. When releasing the **THROTTLE LEVER**, the idle should rise above this screws set point and float around 2,150 RPM.

To adjust this floating **NATURAL IDLE** to the preferred setting of 2150, follow the below steps.

First picture (Figure 22) is the top view of the engine with the Choke/Throttle Panel and Top Cover removed. The second picture (Figure 23) is with this panel and cover on.

The Spring shown is the Governor Spring. It is important to be aware of how this spring's tension effects the engine's Natural Idle. It can be accessed from below while the engine is running at Idle (Figure 23), without removing the cover.



FIGURE 21: IDLE SCREW ADJUSTMENT

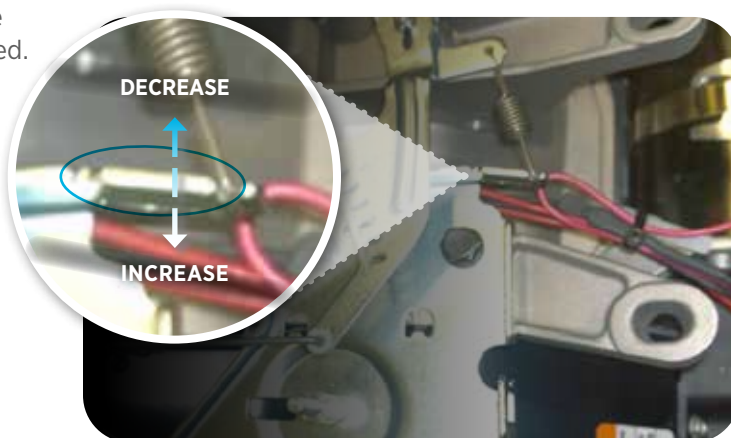


FIGURE 22: NATURAL IDLE ADJUSTMENT — NO COVER
TOP VIEW

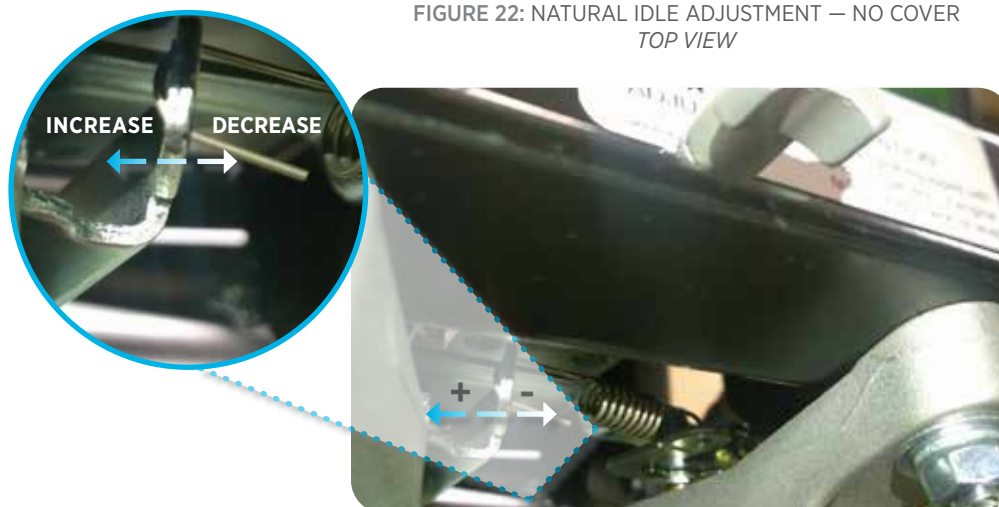


FIGURE 23: NATURAL IDLE ADJUSTMENT — COVER
VIEW FROM BELOW

COUGAR® ULV SPRAYER

Idle Adjustment (Cont.)

The **BENT TAB** on the engine bracket that this **GOVERNOR SPRING** is hooked to can have a dramatic effect on the Low and High Idle positions and the resulting RPMs achieved. It may be necessary to tweak this **TAB** to increase or decrease the tension of the **GOVERNOR SPRING**.

When increasing the **BENT TAB** and **GOVERNOR SPRING** tension (moving the **TAB** slightly left, *Figure 24*) the Low Idle will increase potentially above the **IDLE SCREW** setting. This is how to adjust the Natural Idle point. The engine must be warmed up before adjusting these points. When decreasing the **BENT TAB** and **GOVERNOR SPRING** tension (moving the **TAB** slightly right, *Figure 24*), the Low Idle will decrease until it is held up by the **IDLE SCREW** on the carburetor. The **IDLE SCREW** will not allow it to drop further. **(Set to 2,000 RPM in the previous steps).**

The preferred adjusted set point for this floating Natural Idle is to be 2150 RPM, and the **IDLE SCREW** setting will not allow a drop below 2000 or 2100 RPM. Take care that the **SPRING** above remains hooked properly when tweaking this **TAB**. Also avoid the exposed +12VDC at the starter solenoid.

Verifying that the **IDLE SCREW** will not allow a drop below approximately 2000 RPM, and more importantly that the **Natural Idle on a warmed up engine is running above this screw setting** (running actually closer to 2150 RPM), then the High throttle settings will be reached when Spray is turned on.

You can now test **SPRAY ON** and see where the current Throttle Adjustment **KNOB** (*Figure 25*) setting brings the RPMs. You should have solid adjustment from Idle to just above the recommended High limit of 4000 RPM.

If decent droplet size can be achieved below 4000 RPM, it is of course recommended running the engine below the high limit.

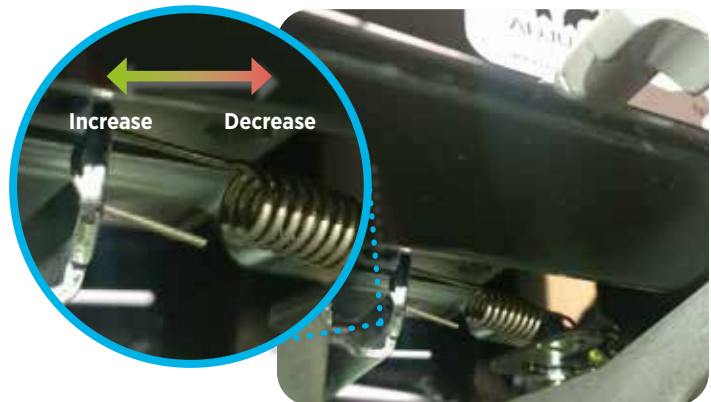


FIGURE 24: NATURAL IDLE ADJUSTMENT



FIGURE 25: THROTTLE ADJUSTMENT KNOB



FIGURE 26: PRESSURE GAUGE

Low-Pressure Cut-Off

The Clarke Cougar® ULV Sprayer is equipped with an air low-pressure cut-off switch. **If, for some reason, the nozzle air pressure drops below 1 P.S.I.**, the Flow Control will cut off. This prevents the blower from being filled with insecticide because of insufficient air blast. Because of this, the engine on the fog generator must be running when setting the flow rate.

The **AIR LOW-PRESSURE CUT-OFF** switch (*Figure 27*) is located inside the coupling guard and is mounted on the rear of the pressure gauge. If necessary, this switch can be adjusted in the field by removing the rubber plug from the tip of the switch and then using a 7/32" Allen wrench, turn the adjustment screw in about half turn increments. Turning clockwise increases the air pressure cut-off point. Turning counter-clockwise decreases the air pressure cut-off point.



FIGURE 27: AIR PRESSURE CUT-OFF SWITCH



FIGURE 28: PRESSURE GAUGE

Low Oil Sensor

The Briggs & Stratton 10 HP engine assembly includes a Low Oil Sensor that is tied into the **KILL SWITCH**. The Low Oil Sensor will prevent the engine from starting and will shut off the engine when low oil is detected. It is wired to a small Latching Circuit that holds the contact to the ground until the engine is fully shut down, preventing run-on or restart. This Low Oil Sensor connection and latching circuit is located on the top side of the engine and is connected to the **STOP** button with a black wire. The Latching Circuit (*see Figure 29*) must be mounted to the chassis ground of the engine to function properly.



FIGURE 29: LATCHING CIRCUIT

COUGAR® ULV SPRAYER

NOTES

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NOTES

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COUGAR® ULV SPRAYER

Maintenance

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General

Replace worn or damaged parts on the Clarke Cougar® ULV Sprayer.

Service the engine according to the Engine Maintenance Manual.

Service the blower according to the Blower Maintenance Manual, and the Blower section (*page 36*).

Daily

Visually check the ULV sprayer each day before use, and make any necessary adjustment and/or major repairs.

Start up and warm the engine, and check the nozzle air pressure as indicated on the pressure gauge on the machine. **If the pressure varies more than + or - 1/2 PSI from the preset pressure range**, readjust the nozzle air pressure. See *Adjusting Nozzle Air Pressure (page 26)*.

After use of the ULV sprayer, flush the insecticide system with a suitable flushing solution.

NOTE: It is highly recommended that a maintenance program be established to assure the performance of your machine.

COUGAR® ULV SPRAYER

Every 50 Hours

Check the flow rate calibration. See *Setting the Flow Cal Factor or Adjusting the Accuracy of the Flow Meter* (page 111) and *Calibration Factors* (pages 101-108).

Check all bolts and fasteners, and tighten if necessary.

Check all gasoline hoses, insecticide lines and fittings for cracks, leaks or wear. Replace if needed.

Check all nozzle parts for wear or physical damage. Replace damaged parts.

Remove and clean the element in the filter-silencer as follows.
See *Figure 30*:

1. Remove wing nut and washer.
2. Remove the cover and element.
3. Clean the inside of the housing and the element as required. If the element is damaged or bent, replace with a new one.
4. Replace the element, cover, washer and wing nut.



FIGURE 30: FILTER ELEMENT

Every 100 Hours

NOTE: 100 hours is an estimated amount of time. Depending upon formulation used, more frequent intervals might be necessary.

Clean the insecticide filter. If this filter becomes stopped up, the insecticide flow will be restricted or stopped. There is a fine mesh screen located in the cylindrical housing. This screen can be removed for inspection and/or cleaned by manually unscrewing the housing bowl. See Figure 31.

Check the battery voltage. Test the battery with a Volt-ohmmeter. Connect the positive (+) meter lead to the positive (+) battery terminal. Connect the negative (-) meter lead to the negative battery terminal. Set the meter on Volts. If the meter reads **11.5 - 12 or more Volts**, the battery voltage is okay. **If the meter reads less than 11.5 Volts**, the battery voltage is okay.

Replace the in-line gasoline filter. Using pliers, loosen the tension on the two hose clamps and slide them off of the filter barbs. Remove the old filter from the gasoline hose. Install a new filter and replace the hose clamps. New filters can be installed with the direction of flow going either way. Never reverse an old filter. See Figure 32.

Check the pulsation dampeners. The metering pump (located in the pump box) used on the ULV Sprayer tends to deliver a slightly pulsating flow of insecticide. For best aerosol particle size, a more even (non-pulsation) flow is desirable. A small air chamber pulsation dampener is located in the metering pump outlet line between the pump and the discharge nozzle. It is a nylon assembly with an air dome that can be unscrewed by hand for inspection. There is a gasket that seals the joint between the air dome and the lower housing. 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. When reassembling, be sure that the sealing gasket is properly positioned so as to avoid damage caused by pinching. Applying a light coat of oil or grease will prevent pinching the gasket. **Tighten the housing only by hand when reinstalling. Do not use tools.** See Figure 33.



FIGURE 31: INSECTICIDE FILTER

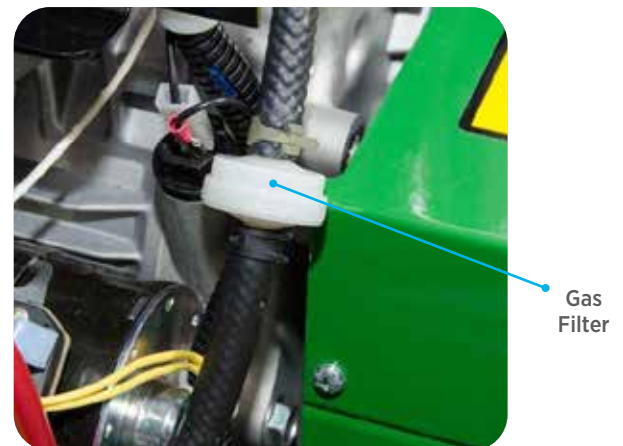


FIGURE 32: IN-LINE GASOLINE FILTER

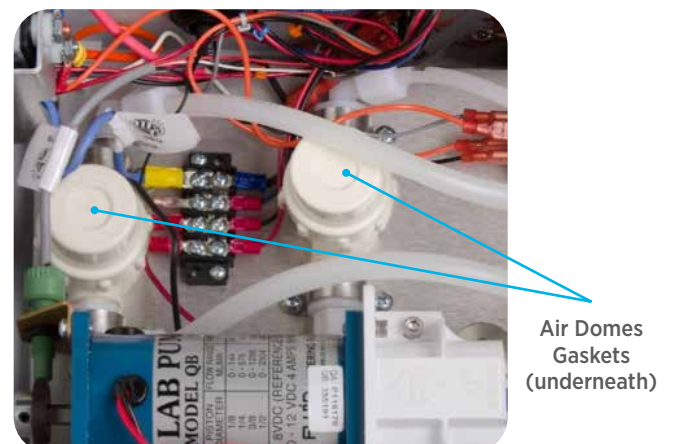


FIGURE 33: PULSATION DAMPENER

COUGAR® ULV SPRAYER

Engine

Lubricate and service the engine according to the engine manual. We recommend the use of high quality SAE 30-W detergent oil classified "for service SF, SG, SH" (such as Briggs & Stratton® 10005 or 100028) when operating at temperatures above 40°F. Below 40°F, SAE 10 W-30 or 5 W-30 oil is acceptable.

See Figure 34.

Recommended engine oil viscosity:

TEMPERATURE	OIL VISCOSITY.
above 40°F	SAE 30-W
below 40°F	SAE 10 W-30 SAE 5 W-30

Blower

A simple but very effective lubrication system is employed on the blower. At the drive shaft end, the bearings are grease lubricated using hydraulic pressure relief fittings. These relief fittings vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure, but permit venting excess lubricant under steadily rising pressures.

The blind end bearings and timing gears are enclosed by a gearhouse, located opposite the drive end of the blower. The lower timing gear functions as an oil slinger, carrying lubricant to the upper timing gear and providing splash lubricant for the bearings. Pressure within the gearbox is vented through the breather plug.

To fill the gearbox, remove the breather plug and the oil overflow plug. Fill the reservoir up to the overflow hole. Place the breather and the overflow plug into their respective holes. See Figure 35, Page 37.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit.

Under normal conditions, the oil level on the non-drive end of the blower should be checked **every 25 hours** of operation. Change the oil after the first 100 hours; then as per the intervals on the oil viscosity chart, on page 37. Under extremely hot or dusty operation conditions, the oil level should be checked more often and may require more frequent changes.



FIGURE 34: ENGINE FILTERS

Every six months, the oil breather plug should be removed, cleaned in solvent, and blown out with clean compressed air to provide unobstructed venting. Shaft bearings at the drive end of the blower are lubricated, and each bearing housing is equipped with pressure type grease fittings, and pressure type relief fittings. Using a pressure gun, force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fittings. Grease should be added using a hand-operated grease gun to the drive end bearings at varying times, in intervals depending on duty cycle. See Figure 35, Page 37.

Recommended greasing intervals:

1. With the blower operating 8 hours per day, grease should be added every two weeks.
2. With the blower operating 16 hours per day, grease should be added every week.

The oil used must be of the proper viscosity, and certified to meet M-S type specifications of heavy duty type. Use a National Lubricating Grease Institute Number 2 (NLGI-2) premium grade grease, such as Royal Purple 01312 High Performance Synthetic Grease. (Lithium-based greases are not compatible nor approved.) **Do not use multiple viscosity oils. Do not use automotive type lubricants**, as they are not formulated as non-detergent, rust inhibiting, anti-foaming and of correct viscosity.

Recommended Blower Oil Viscosity & Changing Intervals:

AMBIENT TEMPERATURE °F/°C	DISCHARGE TEMPERATURE °F/°C	EST. OIL TEMPERATURE (Splash Lube Design) °F/°C	ROOTS SYNTHETIC OIL Life Hours	ISO VISCOSITY Grade
0°-31° / 18°-0°	<270° / <132°	215° / 102°	1500	150*
32°-90° / 0°-32°	<245° / <118°	195° / 90°	3000	220
32°-90° / 0°-32°	<270° / <132°	215° / 102°	1500	220
32°-90° / 0°-32°	<295° / <146°	235° / 113°	750	220
Above 90° / Above 32°	<245° / <132°	195° / 90°	3000	320

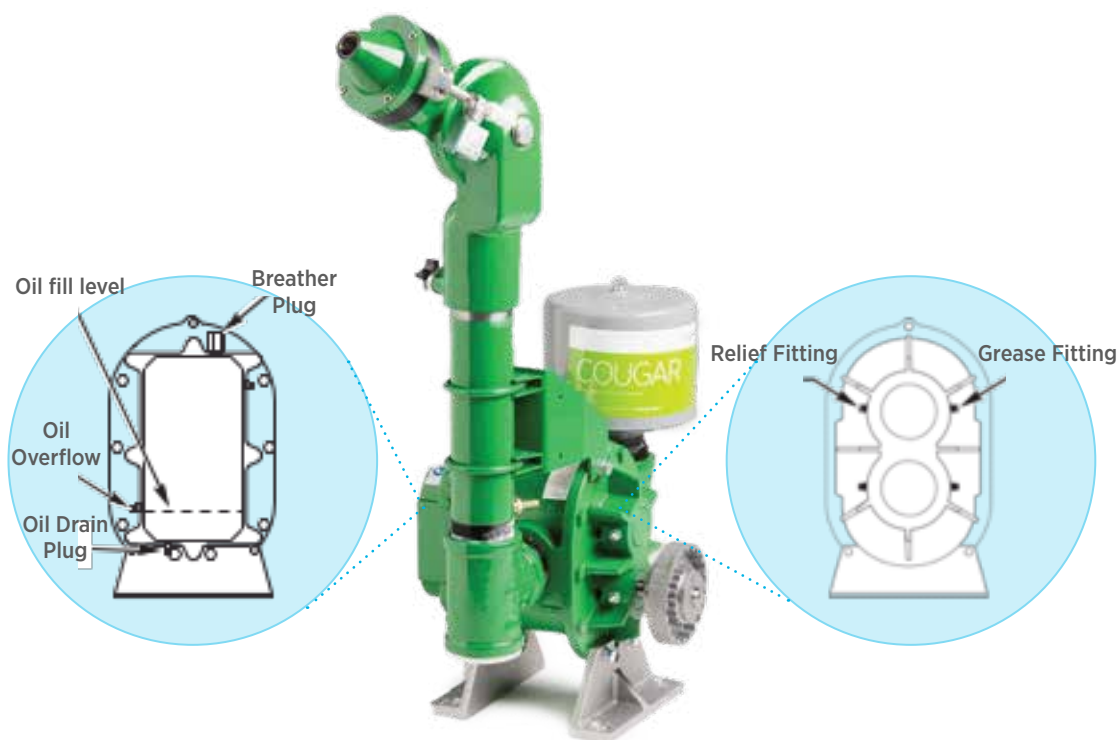


FIGURE 35: BLOWER

COUGAR® ULV SPRAYER

Couplings

To replace the engine or blower coupling or the coupling sleeve:

1. Disconnect the negative battery cable on the battery.
2. Remove the coupling guard cover.
3. Remove the blower from the chassis only if necessary.
4. Remove the set screws in the engine and blower couplings, and slide the couplings off of the shafts. If these couplings are difficult to move, the couplings are either rusted to the shafts, or there is a burr on the keys under the setscrews. If this is the case, use penetration oil to loosen the rust, and use a drill slightly smaller than the set screw holes to deburr the keys. This drill must have a flat point in order not to drill into the keys.
5. Carefully file and remove existing burrs or high spots caused by the setscrews on the engine and blower shafts and keys.
6. Slide the engine coupling and 1/4" key onto the engine drive shaft. Position the engine coupling 1-5/16" from the engine. *See Figure 37.*
7. Install the engine coupling setscrews and tighten them, which locates the engine coupling in its final position.
8. Slide the blower coupling and 3/16" key onto the blower drive shaft. Position the blower coupling 1-5/16" from the blower. *See Figure 37.*
9. Install the blower coupling setscrews and tighten them, which locates the blower coupling in its final position.
10. Install the rubber coupling sleeve. Mount the blower on the chassis, leaving the blower mounting bolts loose, and slide the blower towards the engine to engage the sleeve. The blower shaft may have to be rotated to engage the sleeve.

Continued on page 39.

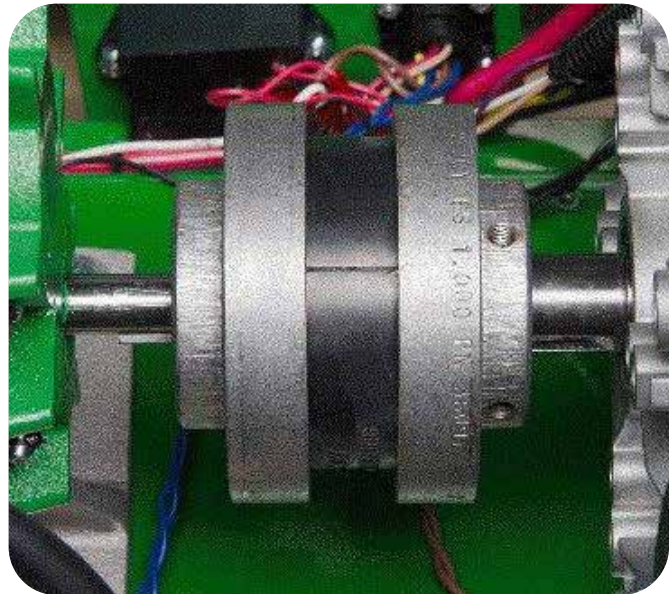


FIGURE 36: COUPLING ASSEMBLY

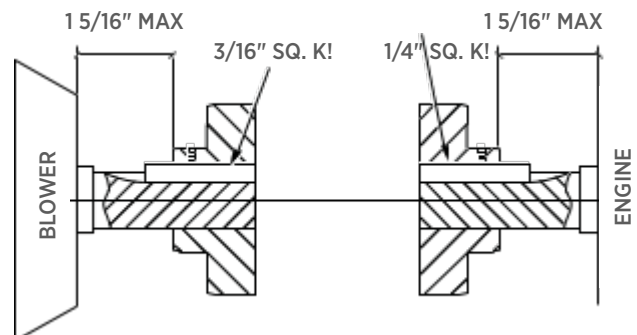


FIGURE 37: COUPLING ASSEMBLY SCHEMATIC

CAUTION: Coupling sleeve may be thrown from the coupling assembly with substantial force when the couplings are subjected to a severe shock load or abuse.

Couplings (continued)

11. If needed, using the shims under the blower, shim the blower to align the engine and blower shafts. Tighten the blower mounting bolts.
12. Check parallel alignment. Place a straight-edge across the two coupling flanges, and measure the maximum offset at various points around the edge of the coupling angles without rotating the coupling flanges. If the maximum offset exceeds 0.015 inches, realign the shafts. *See figure 38.*

Check angular alignment with a micrometer, vernier, or caliper. Measure from the outside of one flange to the outside of the other at intervals around the edge of the coupling flanges. Determine the maximum and minimum dimensions **without rotating the flange couplings**. These measurements must be within 0.070 inches *See Figure 39*. If correction is necessary be sure to recheck the parallel alignment. *See Figure 38.*

13. Install the coupling guard cover.
14. Connect the negative battery cable.

NOTE: Steps 12 and 13 must be performed to assure correct shaft alignment.

NOTE: The coupling sleeve and connected equipment will normally operate longer and more economically when the couplings are carefully aligned.

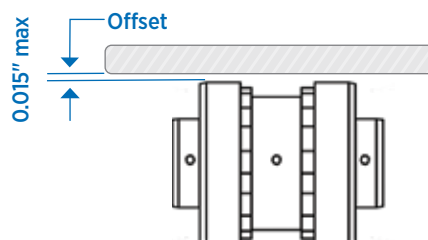


FIGURE 38: PARALLEL OFFSET

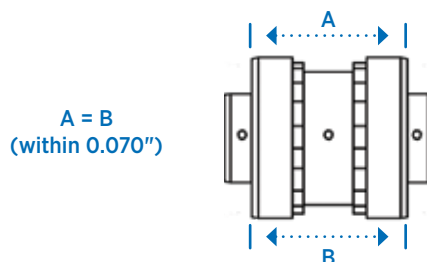


FIGURE 39: ANGULAR ALIGNMENT

CAUTION: Coupling sleeve may be thrown from the coupling assembly with substantial force when the couplings are subjected to a severe shock load or abuse.

COUGAR® ULV SPRAYER

Prolonged Storage

To prepare for storage:

1. Flush the ULV sprayer for at least 10 minutes.
2. Drain the insecticide tank and thoroughly clean it.
3. Drain the flush tank and thoroughly clean it.
4. Pour one quart of light-weight oil into the flush tank. Engine oil can be used.
5. Pour enough light-weight oil into the insecticide tank to cover the bottom of the drop pipe.
6. Spray and flush the ULV sprayer until the oil in the insecticide and flush tanks is completely through the system and sprays out of the nozzle.

7. Engine

- a. All fuel should be removed from the tank. Run the engine until it stops from lack of fuel.
 - b. While the engine is still warm, drain the oil from the crankcase. Refill with fresh oil.
 - c. Remove the spark plugs and add a tablespoon of engine oil into the spark plug holes. Install the spark plugs, but do not connect the plug leads. Crank the engine slowly, 2-3 revolutions to distribute the oil. Replace the plug leads.
 - d. Clean dirt and chaff from the cylinders, cylinder head fins, engine blower housing, rotating screen and muffler areas.
 - e. Clean all other exterior surfaces of the engine.
 - f. Spread a light film of oil over any exposed metal surfaces of the engine to prevent rust.
8. Remove and clean the filter-silencer element and housing. See *Figure 31* on page 35, and *Figure 41* on page 41.

Continued on page 41.

Prolonged Storage (continued)

9. Blower

- a. Remove the oil breather plug, clean in solvent and blow out with clean, compressed air.
 - b. Drain the oil from the oil reservoir and refill with fresh oil. Grease the bearings on the drive end.
 - c. Remove the filter-silencer. If the filter-silencer is hard to unscrew from the blower inlet port, use penetrating oil to loosen the rusted threads.
 - d. Pour one pint of lubrication oil (SAE-40) in the blower intake. (Figure 41)
 - e. Use the recoil pull-start to turn the blower slowly, so that the entire inner surface of the blower is coated with oil. This will prevent a coat of rust from forming in the blower, and in all probability will save the cost of a new blower or an expensive repair bill.
 - f. Reinstall the filter-silencer.
10. Disconnect and charge the battery, and store as recommended by the manufacturer.
 11. Clean all insecticide residue and oil off the Clarke Cougar® ULV Sprayer, and repaint if necessary.
 12. Store Clarke Cougar ULV Sprayer in a clean, dry area under suitable cover, protected from the elements.



FIGURE 40: BREATHER PLUG 9A

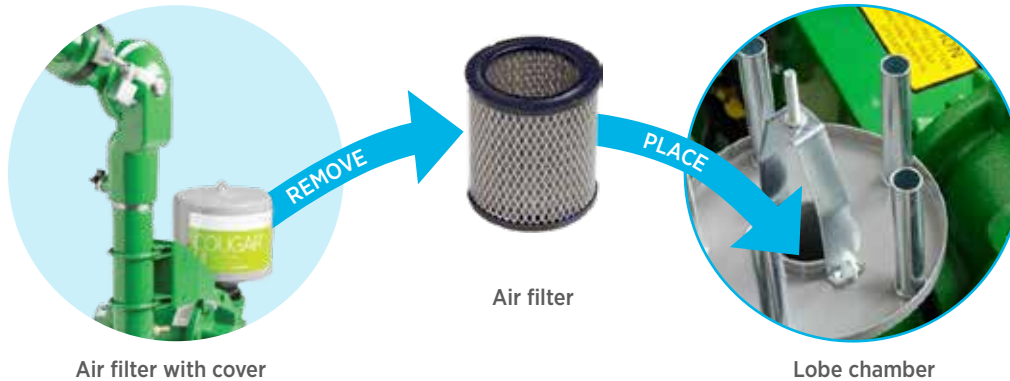


FIGURE 41: BLOWER AIR FILTER STORAGE

CAUTION: A major problem can be the blower rusting up over the winter. If moisture gets into the air chamber, the rotary lobes will rust together, preventing the blower from turning. When this happens, either the engine or blower shaft may be sheared when the engine is started. Following the storage recommendations of this manual can prevent this.

Remove the air filter cover, and pour light-weight penetration lubricant into the lobe chamber. This will usually loosen a rusted blower. The blower may need to sit for a day or two with the penetration oil in it before the engine is started. When trying to free the blower, don't turn the ignition switch on. Just momentarily activate the Start switch for less than 2 seconds until the blower turns. In extreme cases, the blower shaft may have to be turned by hand with the pipe wrench to loosen the lobes. Care must be taken not to damage the blower shaft with the pipe wrench. Once the blower turns, the engine can be started and the lobes should hone themselves free of rust.

COUGAR® ULV SPRAYER

NOTES

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PARTS BOOK AND COMPONENTS

COUGAR® ULV SPRAYER

Parts Book and Components

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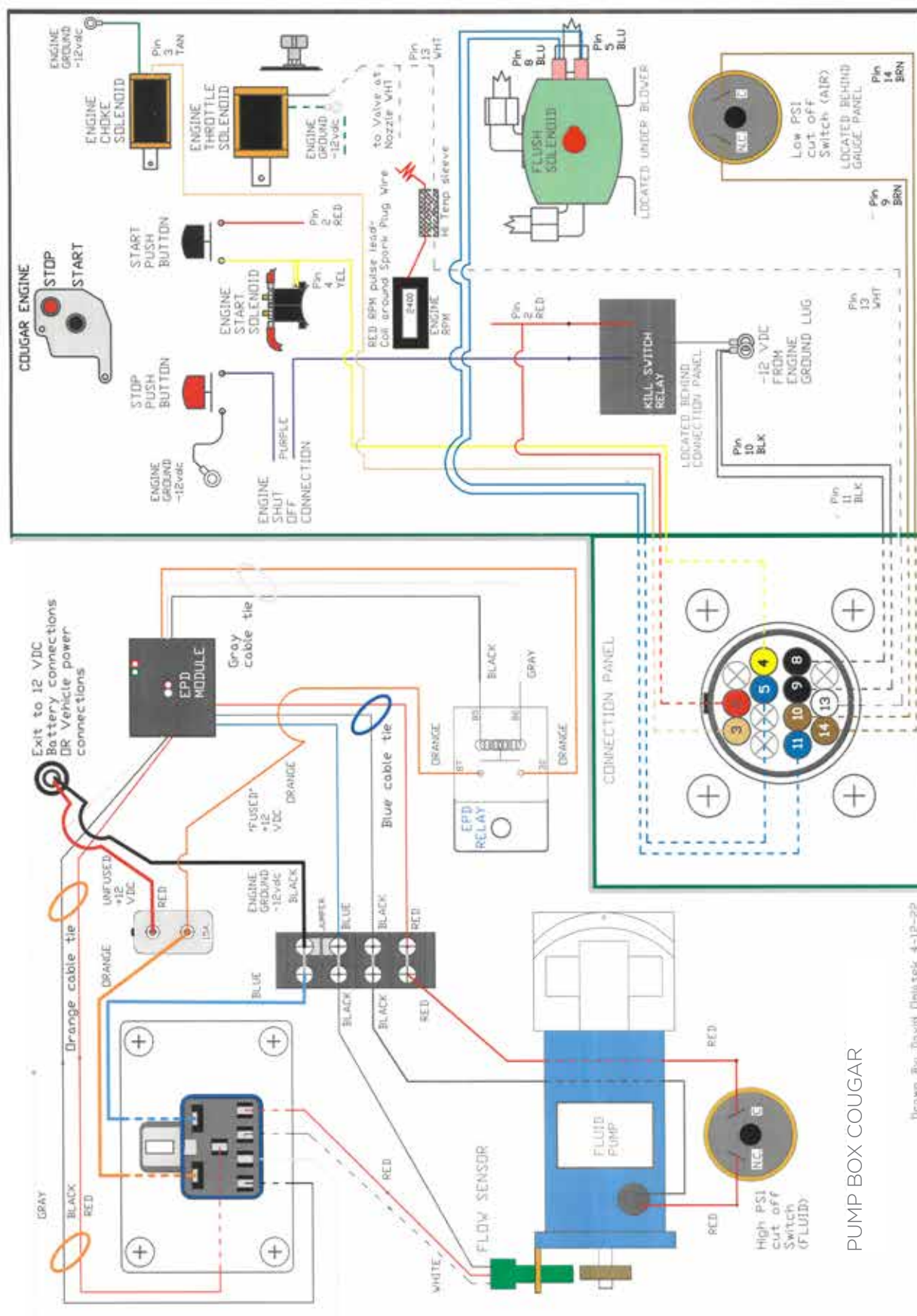
PARTS NUMBERS		DESCRIPTION	PAGE	PARTS NUMBERS		DESCRIPTION	PAGE
MANUAL	ORIGINAL			MANUAL	ORIGINAL		
		Main Assembly	49	319310	10042	Airline 1/4" ID 300 PSI Max Se	51
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324195	12847	Panel Gauge Assembly	49	342816	—	Engine Assembly	52-54
342816	—	Engine Assembly	49	324319	12975	Solenoid Assembly	54
324236	12817	Gas Tank Assembly	49	343731	—	Washer, Bearing, Rulon J, 0.625 x 0.25 x 0.010	54
324202	13287	Panel Connection Assembly	49	320648	11078	Screw 8-32 x 3 / 8 Ph Pan Hd	54
324278	12979	Pump Box Assembly	49	331299	—	LockWasher, #8, IntTooth, SS	54
323600	12891	Flush Tank Assembly	49	343731	—	Washer, Bearing, Rulon J, 0.625 x 0.25 x 0.010	54
323569	12829	Filter/Strainer Assembly	49	343757	—	Screw, 8-32 x 5/8 PhilPan	54
323890	10296	Chemical Tank Assembly	49	320664	11103	Washer #10 Hi Collar Lock	54
324179	13246	Flush Solenoid Assembly	49	324335	13070	Coil Sub-assembly	54
324393	12850	Blower Assembly	50	343781	—	Spring, Modified	54
324377	12010	Nozzle Assembly	50	342337	—	Spacer, 0.23OD x 3/8	54
323808	10312	Swivel Assembly	50	320408	10947	Engine Coupling Half 1 inch	54
319261	10037	Jaco 1/4 x 1/8 Male Fitting	50	320424	10949	Rubber Coupling Element (not part of Blower Assembly/purchase separately)	54
319394	10101	Solenoid Valve	50	324327	12852	Switch Panel Assembly	54
320466	10956	Filter Silencer	50	319659	10197	Engine Start Button	54
320416	10948	5/8 Coupling Half	50	319667	10198	Engine Stop Button	54
343202	—	Filter Element (Replacement)	50			Fuel System Components	55-56
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324195	12847	Panel Gauge Assembly	51	327545	—	Rollover Valve	55-56
320268	10550	Pressure Gauge (15-0 PSI)	51	324228	12837	Dip Tube Assembly	55-56
319245	10031.1	Brass Elbow, 1/4 NPT x 1/4 Hose x 90°	51	327470	—	Gas Cap w/Tether Assembly	55-56
321795	12894	Tach & Hour Meter	51	327347	—	Canister Assembly "Carbon"	55-56
321216	12328	1 PSI Pressure Switch	51	321422	12638	Gas Tank	55-56
319998	10329	1/4 NPT x 1/4 NPT x 1/4 NPT Tee Fitting	51	321779	12887	Grommet	55-56

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COUGAR® ULV SPRAYER

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327363	13317	Stop Engine Relay	57-58	319485	10155	Filter/Strainer	62
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321836	12931	15 AMP Circuit Breaker	59-60	323907	10298	Fitting, 1/4" NPT x 3/8" Tube, 90°	62
319469	10148	Pulsation Damper	59-60	320375	10838	Fitting, 3/8" NPT x 3/8" Tube, 90°	62
327305	12937	Speed Sensor	59-60	323890	10296	Chemical Tank Assembly	63
324020	12948	Magnetic Ring Assembly	59-60	319419	10118	Tank Cap Assembly	63
323626	10344	Electric Pump Assembly	59-60	323907	10298	Pickup Tube Assembly	63
319683	10204	Fitting, Elbow, 3/8" x 1/4", 90°	59-60	324179	13246	Flush Solenoid Assembly	64
323999	10439	Fluid Over Pressure	59-60	320036	10347	Flush Solenoid (with Mounting Bracket only)	64
319427	10127	Fitting, Elbow, 1/4", 90°, Fem.	59-60	319576	10181	1/4" NPT x 3/8" Tube, 90°, Male	64
327313	12988	EPD Module	59-60	326216	10580	Mount bracket	64
319550	10179	Bulkhead Union Jaco 1/4"	59-60	326282	10709	Valve, 3-way 12 VDC solenoid	64
319568	10180	Fitting, Bulkhead, 3/8" Tube	59-60	319295	10040A	1/4 inch tubing (by the foot) common throughout	
322347	13609	Relay, 12V SPST, 50A, 4-TermBrkt	59-60	319302	10041A	3/8 inch tubing (by the foot) common throughout	
319435	10128	1/4" x 1/4" Female Jaco	59-60			Accessories	65
319576	10181	Fitting, 90°, 3/8" Tube, 1/4" NPT, Male	59-60	325490	13589	GPS	65
319279	10038	1/4" x 1/4" x 90° Jaco Fitting	59-60	347741	—	Installation Kit	65
323600	12891	Flush Tank Assembly	61				
319683	10204	Fitting, Elbow, 3/8" x 1/4", 90°	61				
323593	10429	Pickup Tube Assembly	61				
320151	10416	Flush Tank	61				
323569	12829	Filter/Strainer Assembly	62				



COUGAR® ULV SPRAYER

SmartFlow II Console cable connections

SMARTFLOW II - (7 PIN HARNESS FROM CONSOLE TO PUMP BOX CONNECTOR)

CONNECTOR WIRES	DESTINATION/FUNCTION
BLUE wire	-12VDC from Pump Box Terminal Strip
ORANGE wire	Pump Box Breaker (Protected side of Breaker)
RED wire w/(Orange cable tie)	RED wire from EPD (Orange cable tied pair)
BLACK wire w/(Orange cable tie)	BLACK wire from EPD (Orange cable tied pair)
GRAY wire	GRAY wire from EPD
WHITE wire	WHITE wire from Speed Sensor
RED wire	RED wire from Speed Sensor
-12VDC from Pump Box Terminal Strip	BLACK wire from Speed Sensor

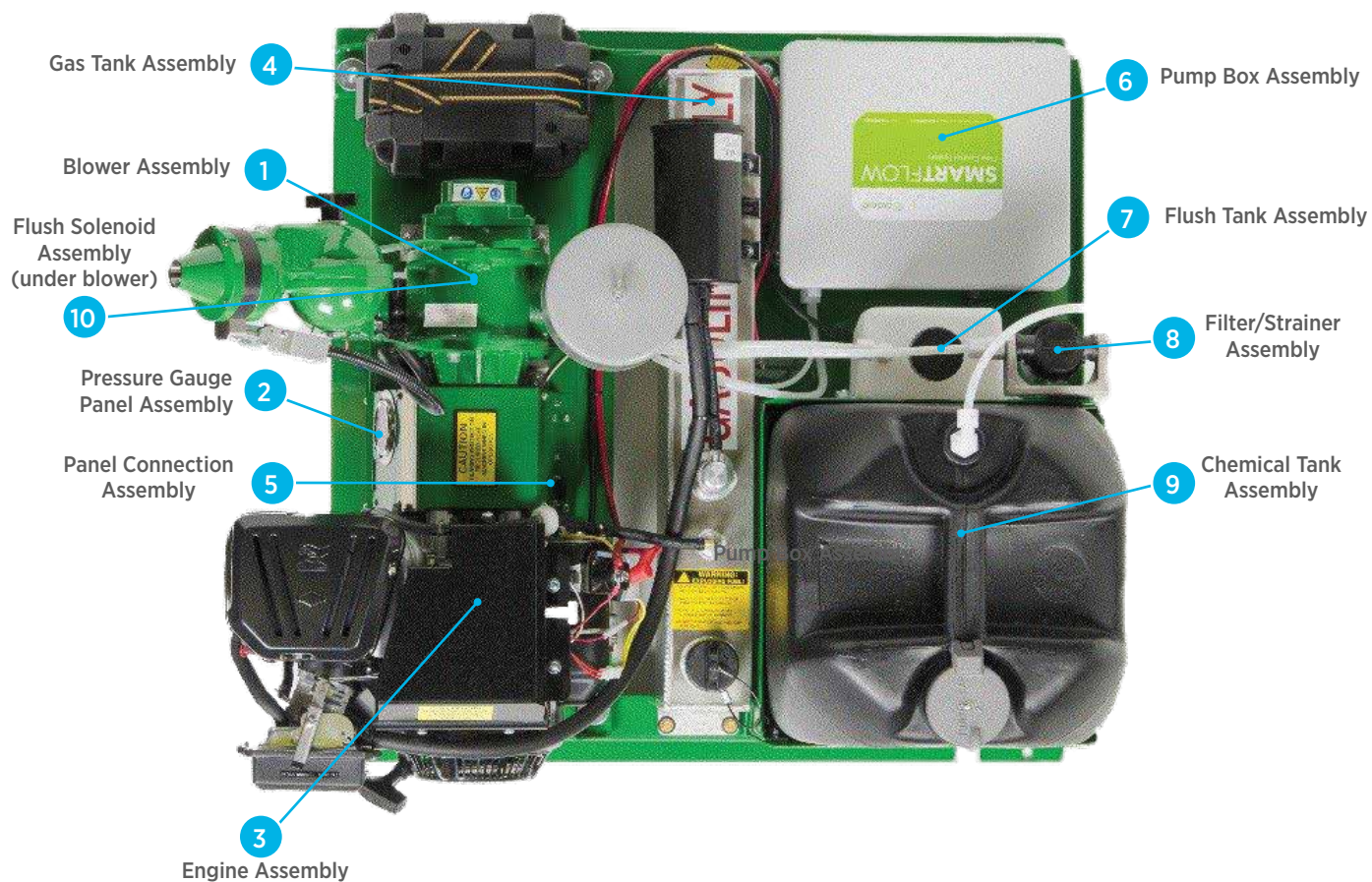
SmartFlow II - (10 Pin Harness from Console to Connection Panel's round Connector)

CONNECTION PANEL LEAD / PIN LOCATION	DESTINATION/FUNCTION
Pin 1 not used	N/A
Pin 2 RED +12VDC	RED lead on Engine Stop Relay
Pin 3 TAN	Engine Choke Solenoid
Pin 4 YELLOW	Engine Start relay and Start Push Button Contact
Pin 5 BLUE	Flush Solenoid Connection 1 of 2
Pin 6 not used	N/A
Pin 7 not used	N/A
Pin 8 BLUE	Flush Solenoid Connection 2 of 2
Pin 9 BROWN	Low Blower PSI (Pump Cut off switch) Connection 1 of 2
Pin 10 BLACK	-12VDC Engine Ground Lug
Pin 11 BLACK	-12VDC Engine Ground Lug
Pin 12 not used	N/A
Pin 13 WHITE	Engine Throttle Solenoid and Solenoid Valve at Nozzle
Pin 14 BROWN	Low Blower PSI (Pump Cut off switch) Connection 2 of 2
PURPLE lead from Engine Stop Relay	"Engine Stop connection on engine" Dual Spade Terminal
BLACK lead from Engine Stop Relay	-12VDC Engine Ground Lug
RED lead on Engine Stop Relay	see above, pin 2

Main Assembly

POS	QTY	DESCRIPTION	PART NO.
1	1	Blower Assembly	324393
2	1	Panel Gauge Assembly	324195
3	1	Engine Assembly	342816
4	1	Gas Tank Assembly	324236
5	1	Panel Connection Assembly	324202
6	1	Pump Box Assembly	324278
7	1	Flush Tank Assembly	323600
8	1	Filter/Strainer Assembly	323569
9	1	Chemical Tank Assembly	323890
10	1	Flush Solenoid Assembly	324179

COUGAR ULV® MAIN ASSEMBLY



PARTS BOOK AND COMPONENTS

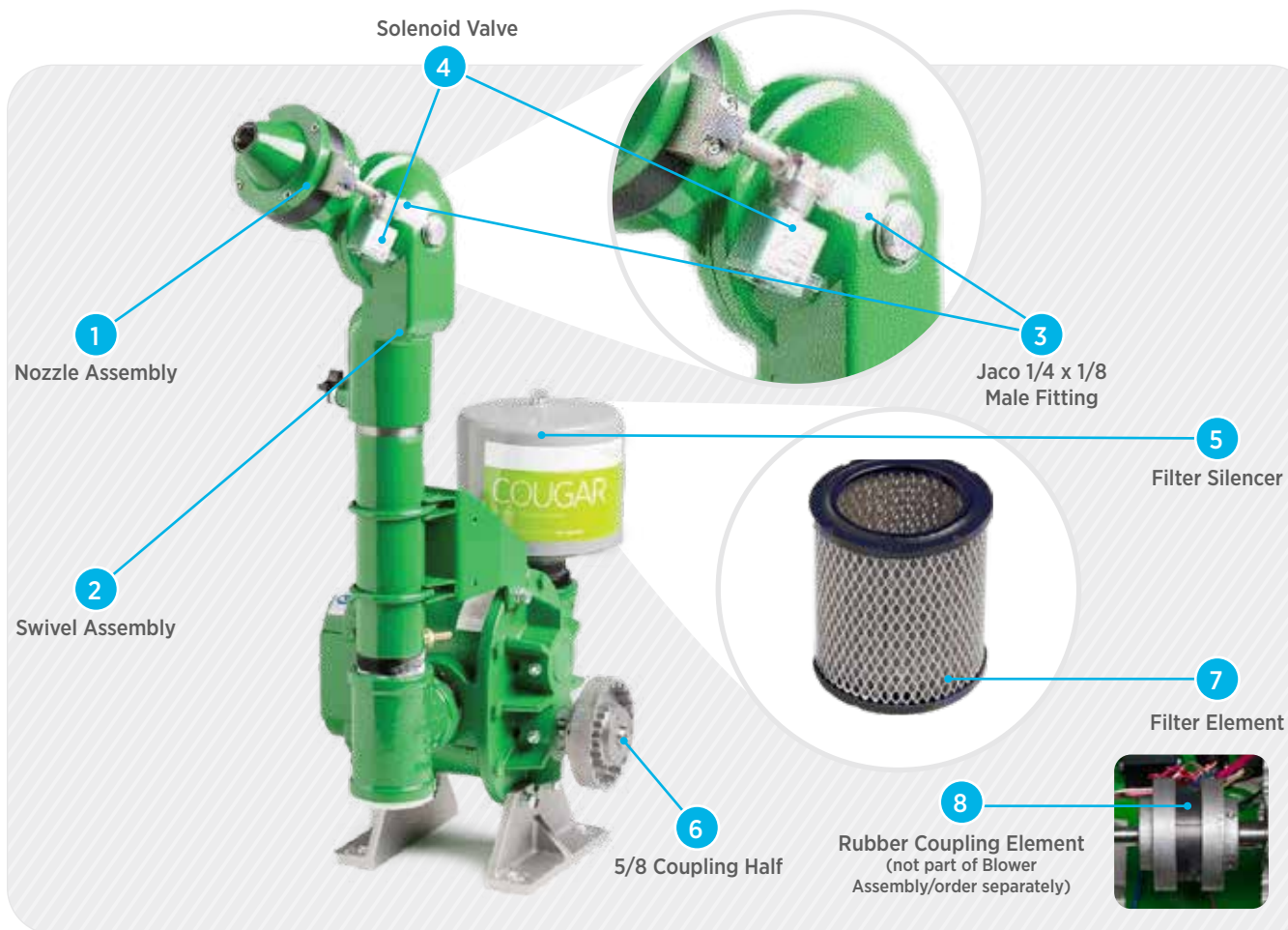
COUGAR® ULV SPRAYER

Blower Assembly (No. 324393)

Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Nozzle Assembly	324377
2	1	Swivel Assembly	323808
3	1	Jaco 1/4 x 1/8 Male Fitting	319261
4	1	Solenoid Valve	319394
5	1	Filter Silencer	320466
6	1	5/8 Coupling Half	320416
7	1	Filter Element (Replacement)	343202
8	1	Rubber Coupling Element (not part of Blower Assembly/order separately)	320424

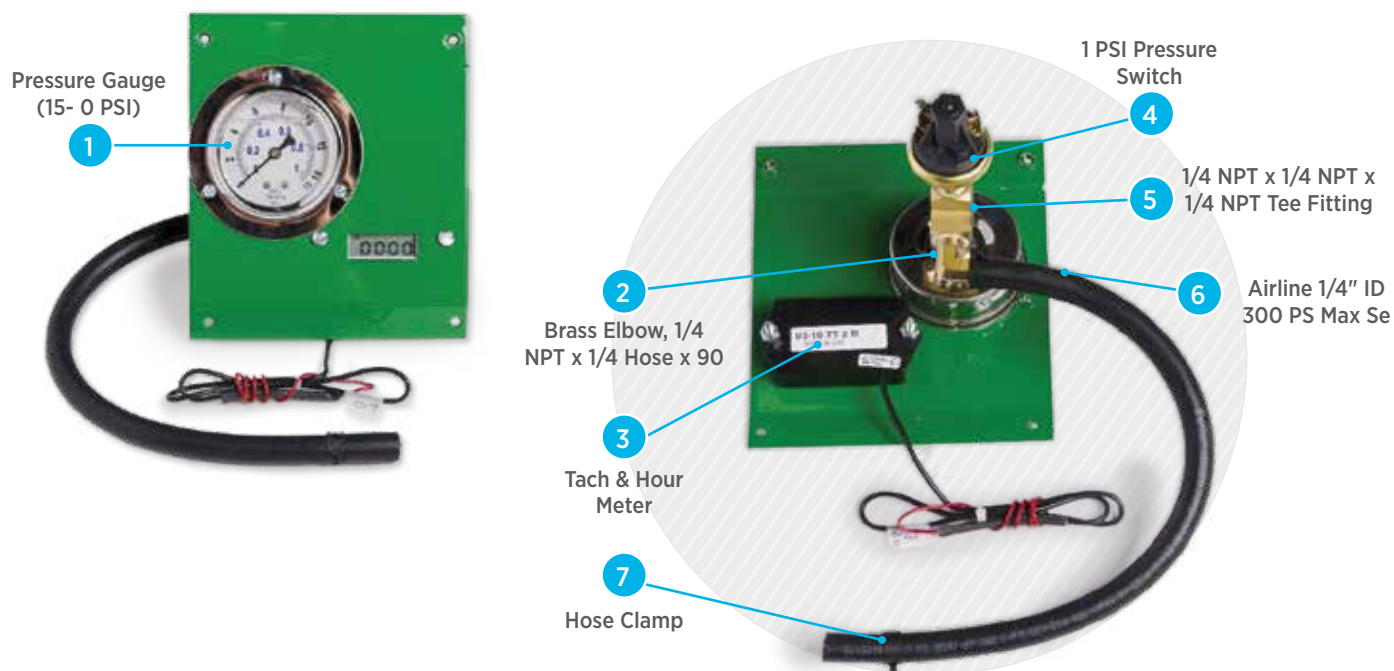
BLOWER ASSEMBLY



Panel Gauge Assembly (No. 324195)

Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Pressure Gauge (15 - 0 PSI)	320268
2	1	Brass Elbow, 1/4 NPT x 1/4 Hose x 90°	319245
3	1	Tach & Hour Meter	321795
4	1	1 PSI Pressure Switch	321216
5	1	1/4 NPT x 1/4 NPT x 1/4 NPT Tee Fitting	319998
6	1	Airline 1/4" ID 300 PSI Max Se	319310
7	1	Hose Clamp	319253



Engine Assembly (No. 342816)

Steps to Remove Cover

1. Remove both nut and stud with 10mm deep well socket.
2. Remove screw and nut with Philips and 7/16" wrench.
3. Remove screw and nut with Philips and 7/16" wrench.
4. Remove screw with Philips.
5. Remove screw with Philips.
6. Remove knob with 7/16 wrench and pliers, protect knob with cloth.
7. Remove jam nuts using two 7/16 wrenches.
8. Remove brass outer brass washer and save.

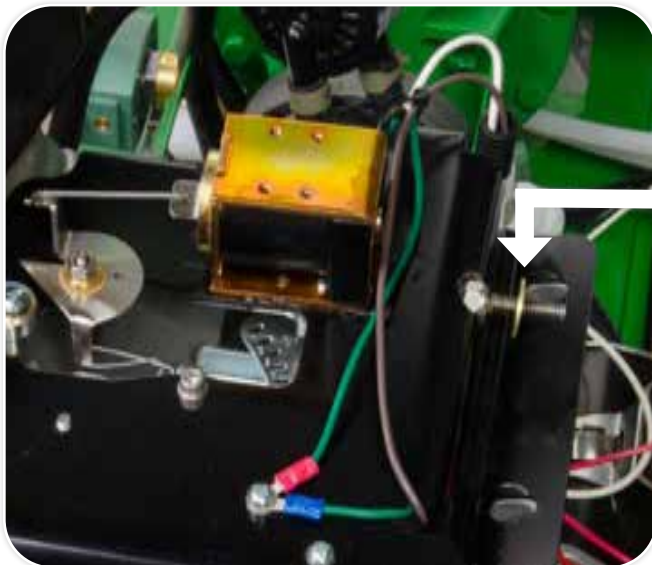
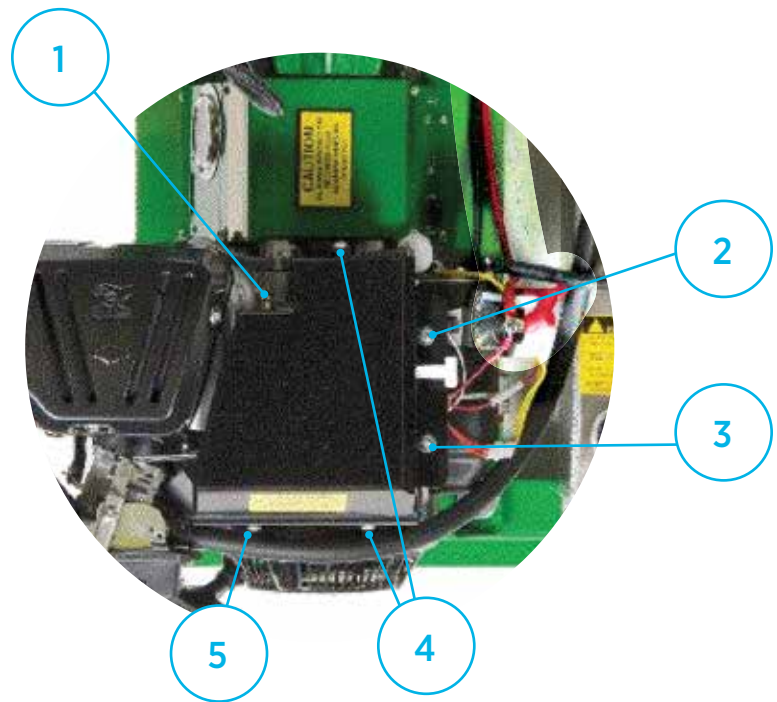


FIGURE 42: ENGINE ASSEMBLY (TOP COVER REMOVED)

Remove and save inner brass washer.



Engine Assembly (No. 342816)**Parts Numbers**

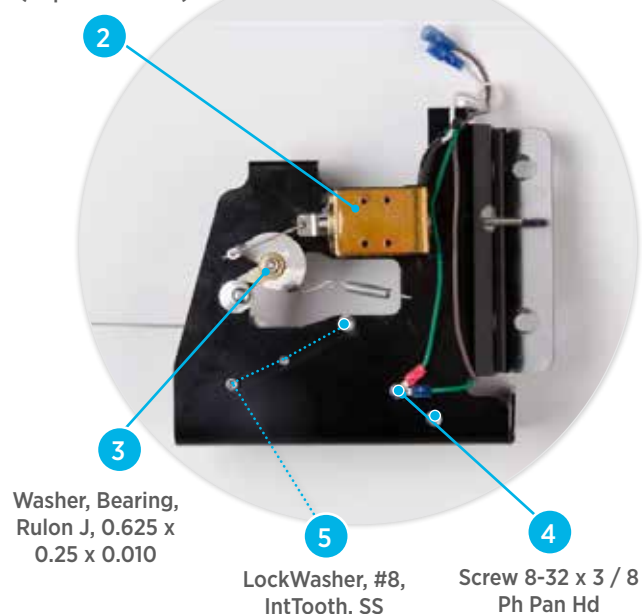
POS*	QTY	DESCRIPTION	PART NO.
1	1	Engine Assembly	342816
2	1	Solenoid Assembly (Replaces 12890)	324319
3	1	Washer, Bearing, Rulon J, 0.625 x 0.25 x 0.010	343731
4	2	Screw 8-32 x 3 / 8 Ph Pan Hd	320648
5	3	LockWasher, #8, IntTooth, SS	331299
6	1	Washer, Bearing, Rulon J, 0.625 x 0.25 x 0.010	343731
7	3	Screw, 8-32 x 5/8 PhilPan	343757
8	3	Washer #10 Hi Collar Lock	320664
9	1	Coil Sub-assembly	324335
10	1	Spring, Modified	343781
11	3	Spacer, 0.23OD x 3/8	342337
12	1	Switch Panel Assembly	324327
13	1	Engine Start Button	319659
14	1	Engine Stop Button	319667
15	1	Coupler Half 1 Inch On Engine Side	320408
16	1	Rubber Coupling Element (not part of Engine Assembly/order separately)	320424

*Parts 1-5 are for TOP; parts 6-11 are for BOTTOM.

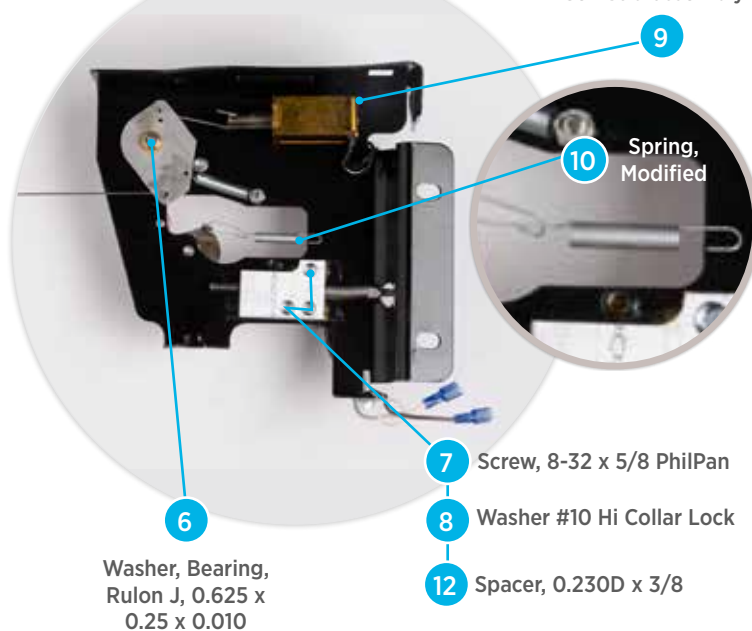
PARTS BOOK AND COMPONENTS

COUGAR® ULV SPRAYER

Solenoid Assembly
(Replaces 12890)



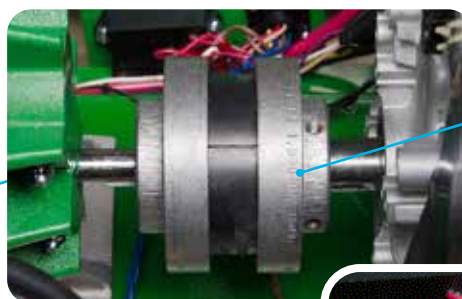
Coil Sub-assembly



12 Engine Switch Panel Assembly (Complete of parts 13 and 14)

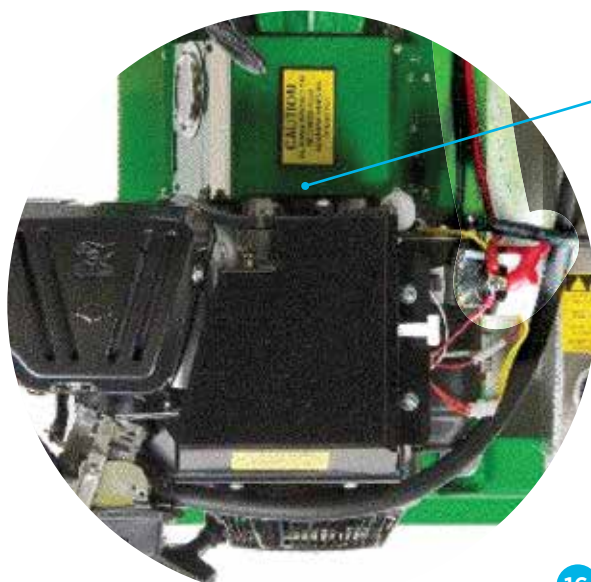
14 Engine Stop Button

13 Engine Start Button



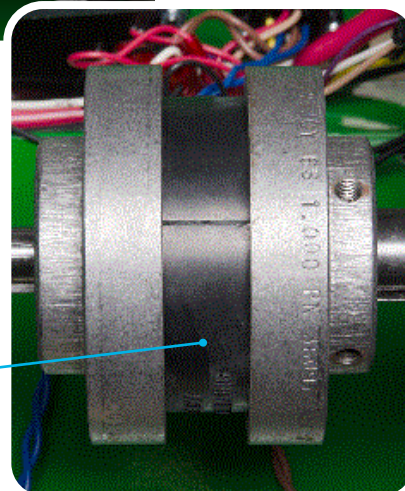
Engine Coupling Half 1 inch

15



16

Rubber Coupling Element
(not part of Engine Assembly/order separately)



Fuel System Components

Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Gas Tank Assembly Complete	324236
2	1	Rollover Valve	327545
3	1	Dip Tube Assembly	324228
4	1	Gas Cap with Tether Assembly	327470
5	1	Canister Assembly "Carbon"	327347
6	1	Gas Tank	321422
7	4	Grommet	321779
8	1	Fuel Filter	349581

COUGAR® ULV SPRAYER

Fuel System Components
Parts NumbersGas Tank Assembly
(Complete of parts 2 - 7)

1



Rollover Valve

2

Dip Tube Assembly

3

Gas Cap with Tether
Assembly

4

5

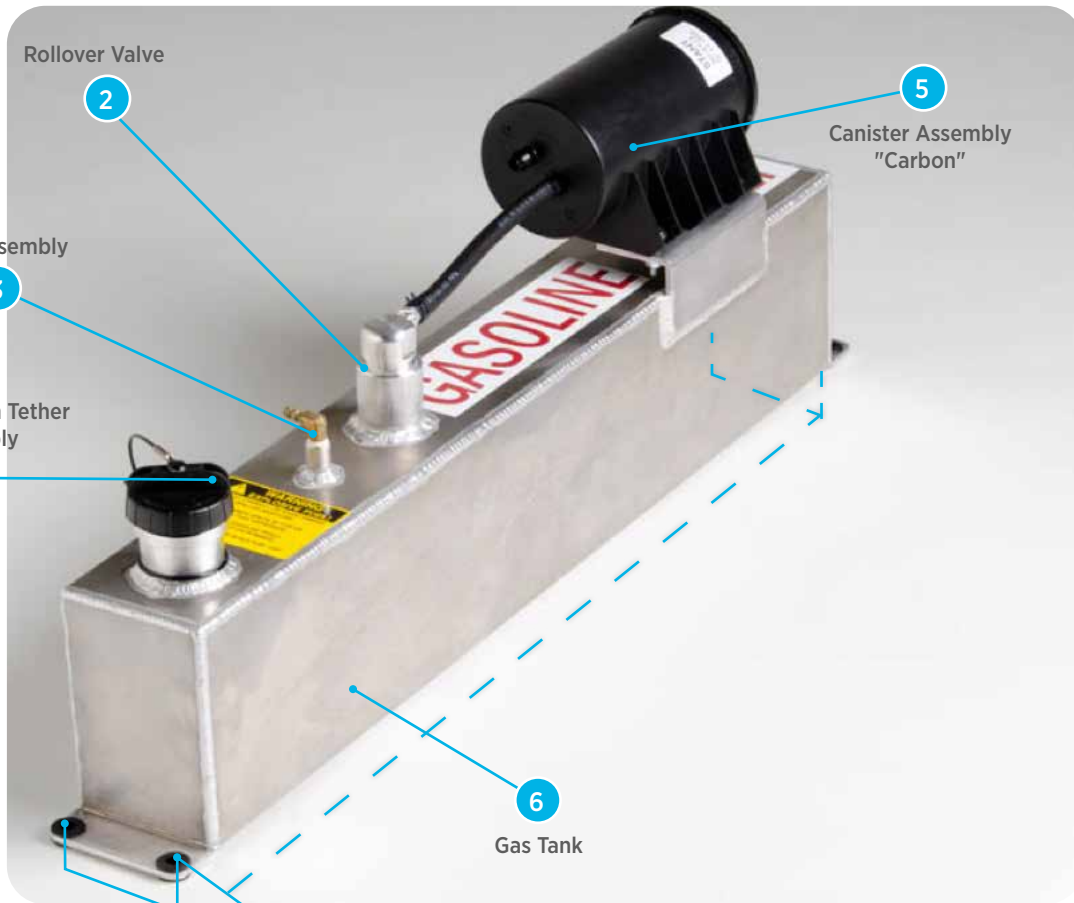
Canister Assembly
"Carbon"

6

Gas Tank

7

Grommet(s)



8

Fuel
Filter

Connection Panel Assembly (No. 324202)

FRONT VIEW CONNECTION PANEL WITH KEYED SMII 10 PIN CONNECTOR



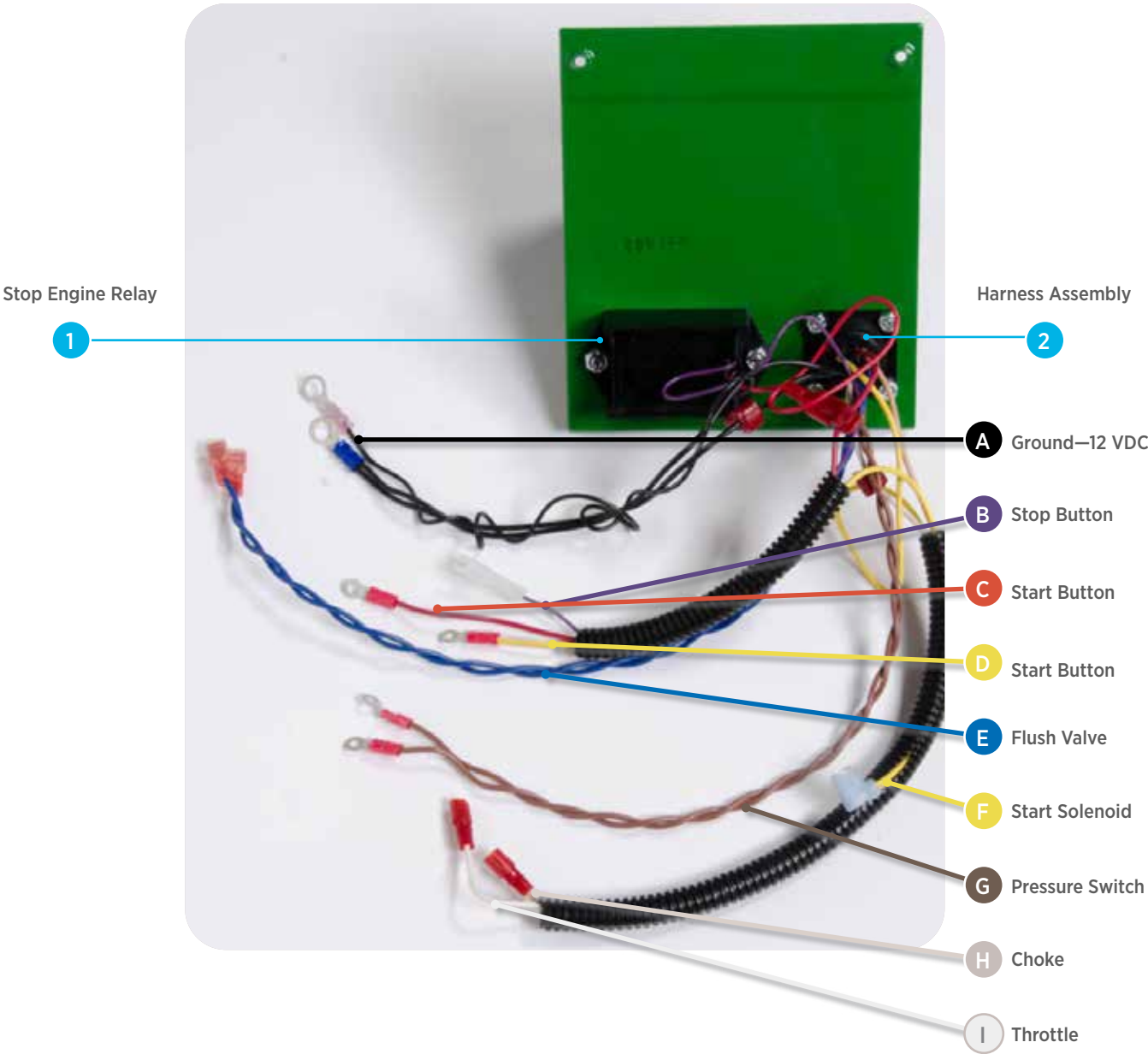
NOTE: Make sure connections are aligned.

COUGAR® ULV SPRAYER

Connection Panel Assembly (No. 324202)
Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Stop Engine Relay	327363
2	1	Harness Assembly	322123

CONNECTION PANEL—REAR VIEW



Pump Box Assembly (No. 324278)

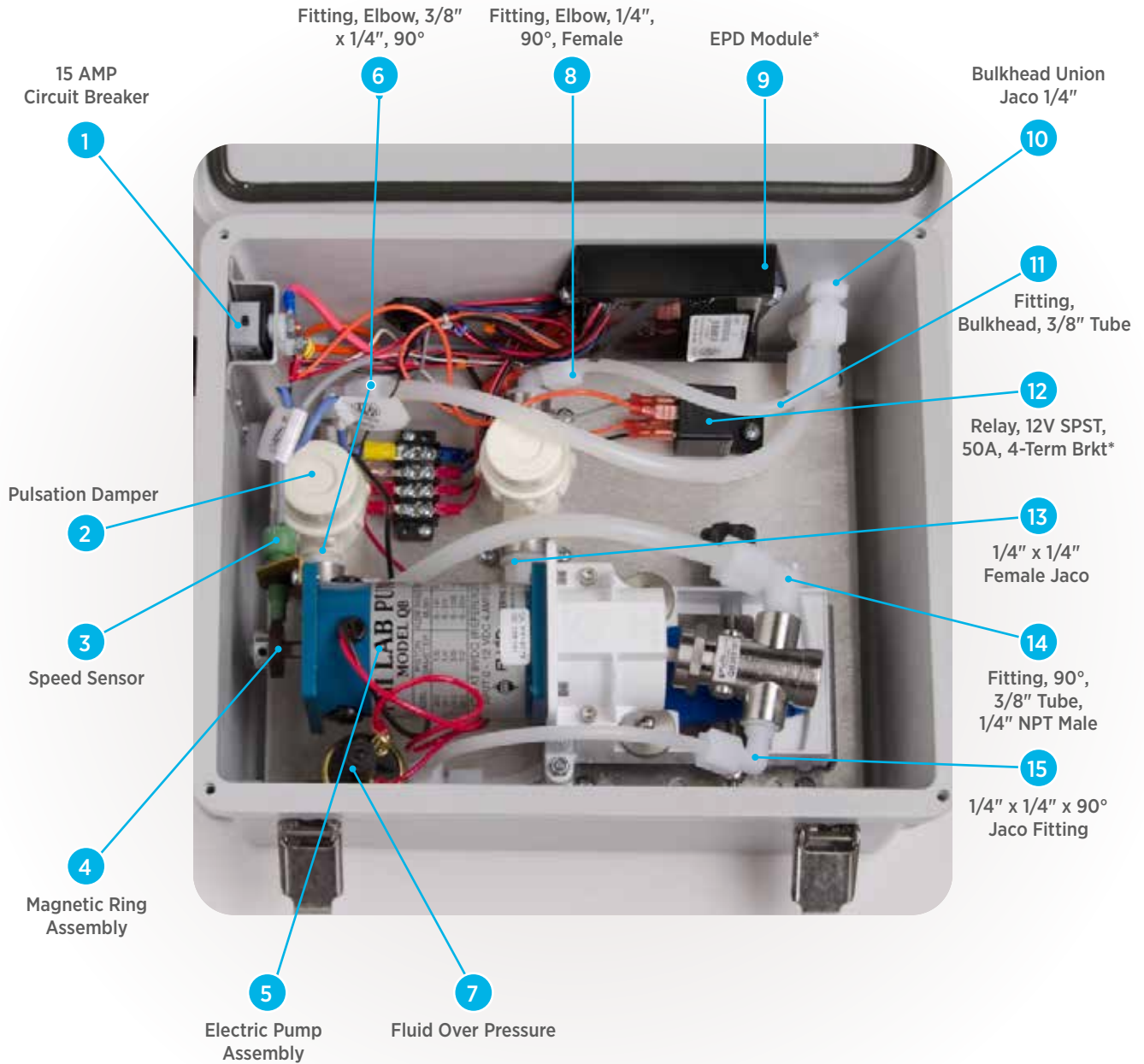
Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	15 AMP Circuit Breaker	321836
2	1	Pulsation Damper	319469
3	1	Speed Sensor	327305
4	1	Magnetic Ring Assembly	324020
5	1	Electric Pump Assembly	323626
6	1	Fitting, Elbow, 3/8" x 1/4", 90°	319683
7	1	Fluid Over Pressure	323999
8	1	Fitting, Elbow, 1/4", 90°, Female	319427
9	1	EPD Module*	327313
10	1	Bulkhead Union Jaco 1/4"	319550
11	1	Fitting, Bulkhead, 3/8" Tube	319568
12	1	Relay, 12V SPST, 50A, 4-Term Brkt*	322347
13	1	1/4" x 1/4" Female Jaco	319435
14	1	Fitting, 90°, 3/8" Tube, 1/4" NPT Male	319576
15	1	1/4" x 1/4" x 90° Jaco Fitting	319279

COUGAR® ULV SPRAYER

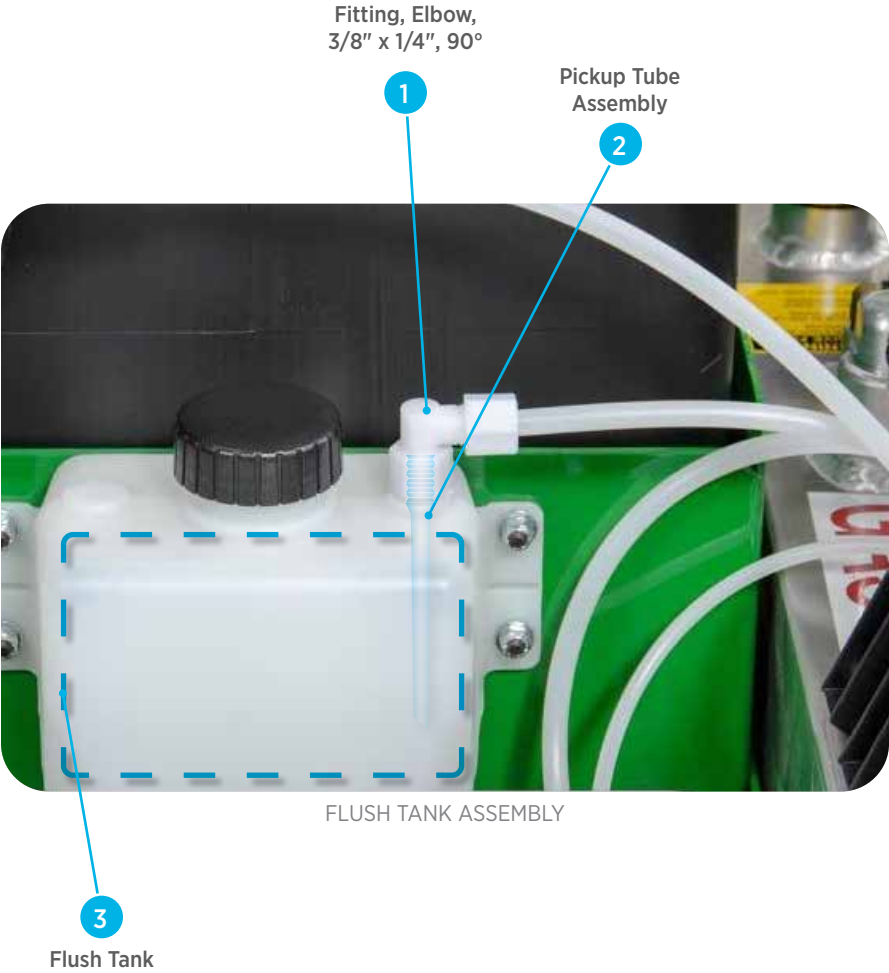
Pump Box Assembly (No. 324278)

PUMP BOX ASSEMBLY



Flush Tank Assembly (No. 323600)
Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Fitting, Elbow, 3/8" x 1/4", 90°	319683
2	1	Pickup Tube Assembly	323593
3	1	Flush Tank	320151



COUGAR® ULV SPRAYER

Filter/Strainer Assembly (No. 323569)

Parts Numbers

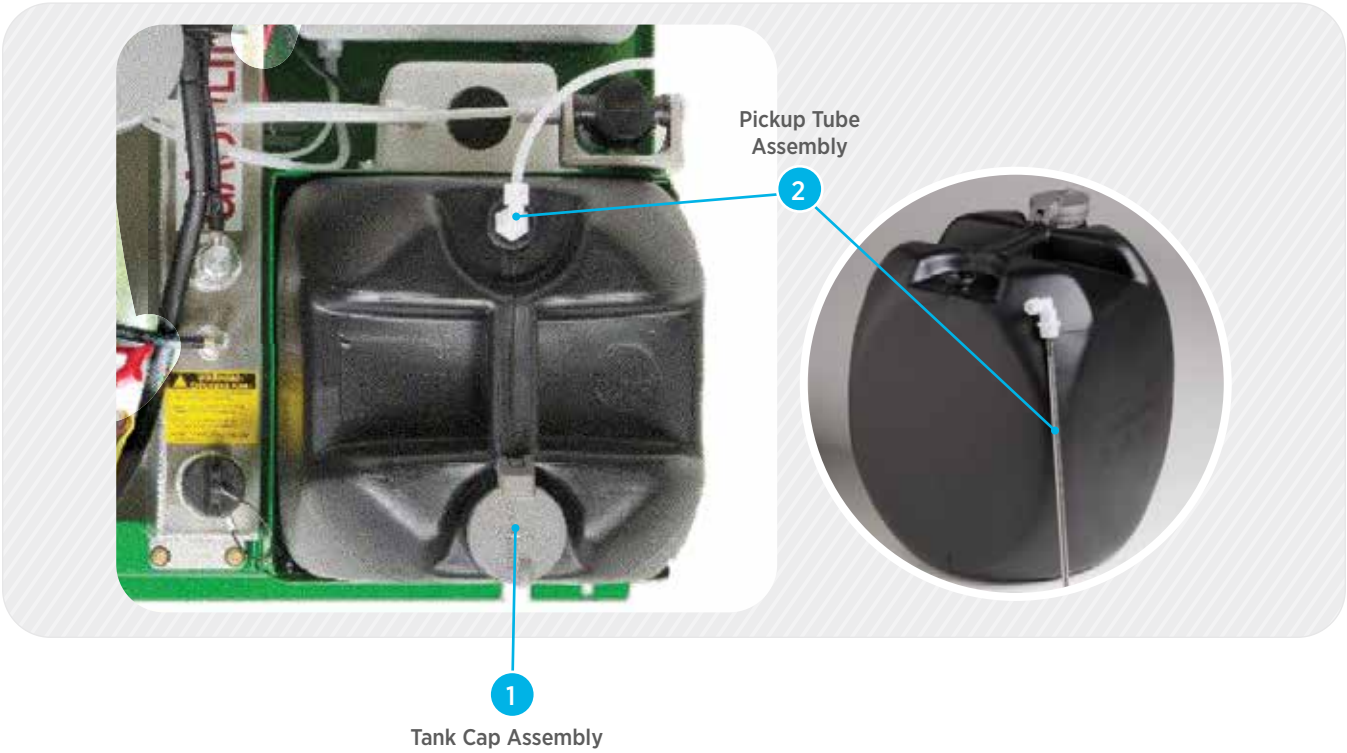
POS	QTY	DESCRIPTION	PART NO.
1	1	Fitting, 3/8" NPT x 3/8" Tube	320367
2	2	Fitting, Nipple, 3/8", NPT, Short, SS	321662
3	1	Filter/Strainer	319485
4	1	Filter Element for Strainer, "Replacement"	326654
5	1	Strainer Seal, "Replacement"	328262
6	1	Fitting, 1/4" NPT x 3/8" Tube, 90°, Part of Pickup Tube Assembly	323907
7	1	Fitting, 3/8" NPT x 3/8" Tube, 90°	320375



Chemical Tank Assembly (No. 323890)
Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Tank Cap Assembly	319419
2	1	Pickup Tube Assembly	323907

CHEMICAL TANK ASSEMBLY



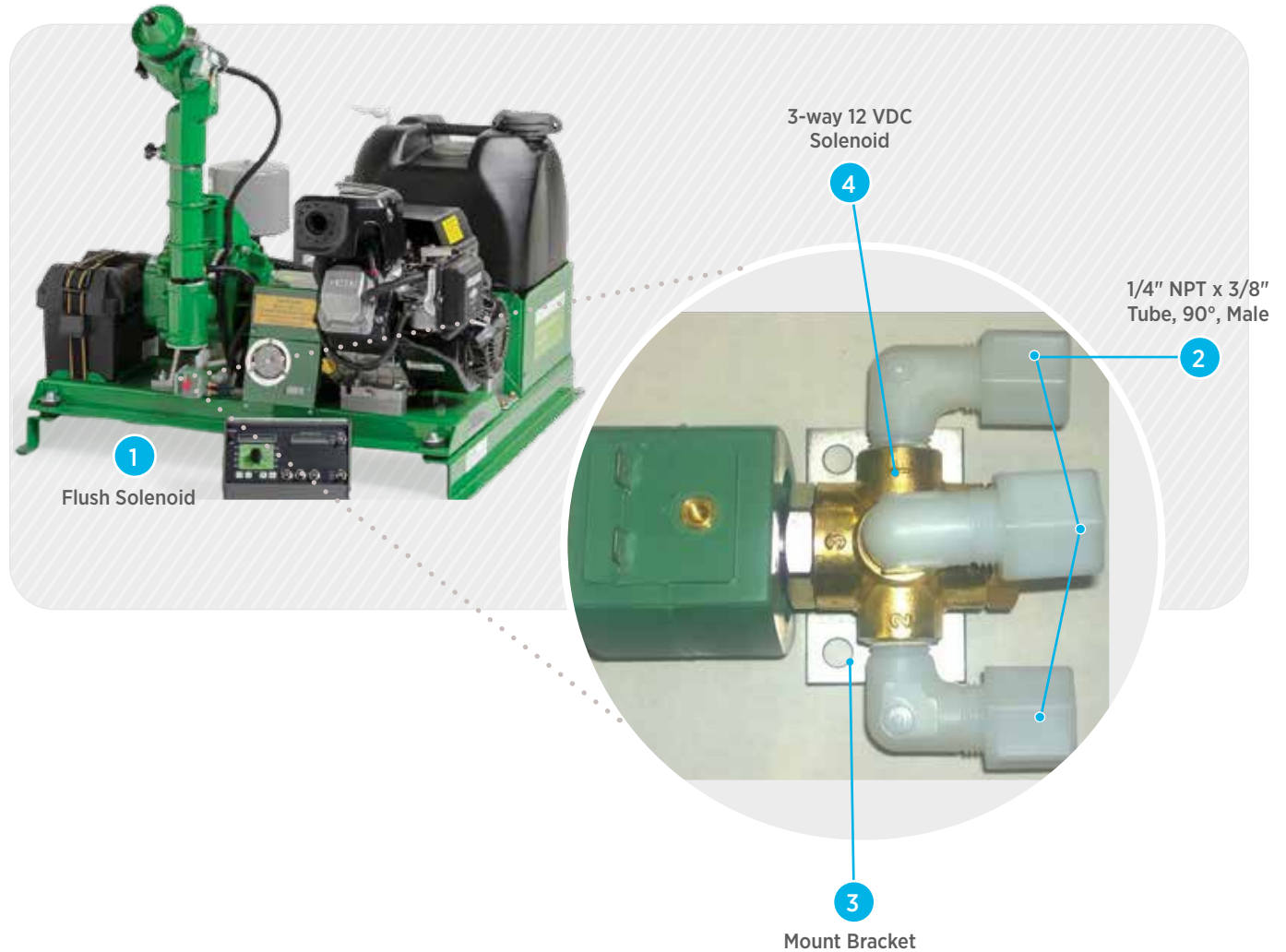
COUGAR® ULV SPRAYER

Flush Solenoid Assembly (No. 324179)

Parts Numbers

POS	QTY	DESCRIPTION	PART NO.
1	1	Flush solenoid	320036
2	1	1/4" NPT x 3/8" Tube, 90°, Male	319576
3	1	Mount bracket	326216
4	1	Valve, 3-way 12 VDC solenoid	326282

FLUSH SOLENOID ASSEMBLY



Available Accessories



DESCRIPTION	PART NO.
GPS	325490



DESCRIPTION	PART NO.
Installation Kit	347741

This kit includes cables, vehicle circuit breaker and terminals. The quick connect plugs enable you to easily remove the sprayer from a truck. Will work with extended cab long bed trucks too.

COUGAR® ULV SPRAYER

NOTES

NOTES

Grid area for notes.

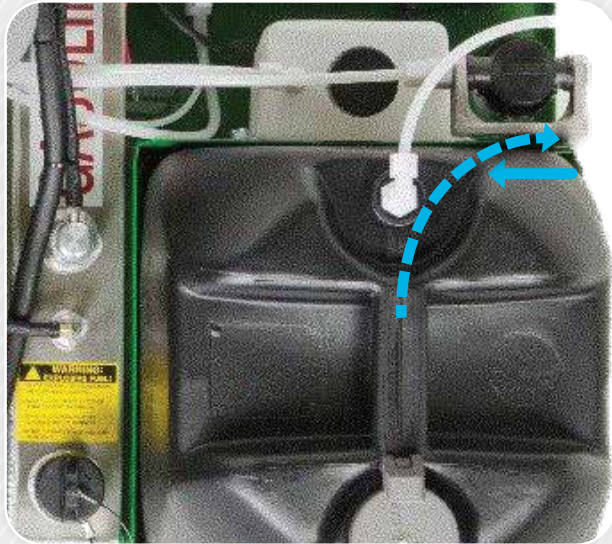
COUGAR® ULV SPRAYER

Plumbing and Fluid Path

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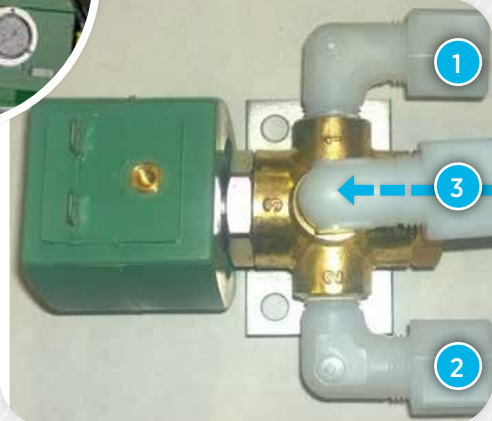
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Plumbing and Fluid Path Chemical Tank



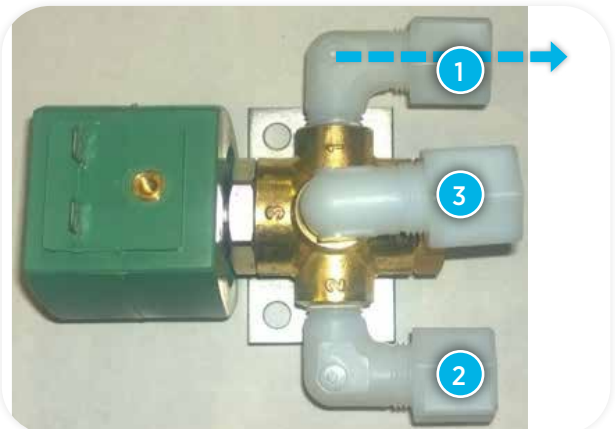
1

Insecticide leaving formulation tank and enters filter/strainer.



2

Travels to the flush solenoid valve and into **port 3**.

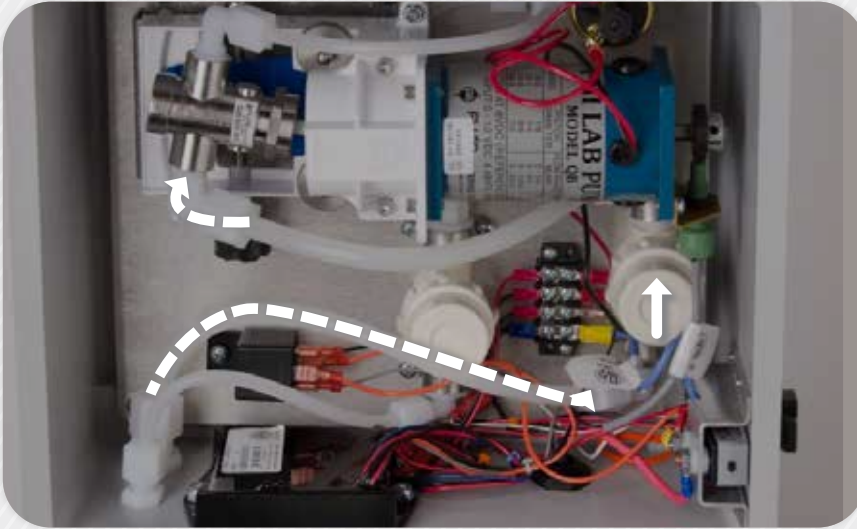


3

Flows out of port 1 towards the pump box.

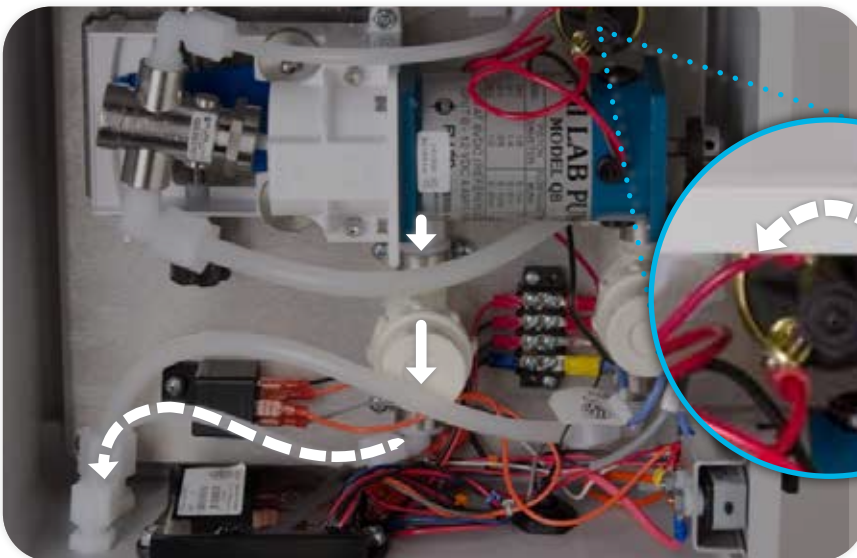
COUGAR® ULV SPRAYER

Plumbing and Fluid Path Chemical Tank (*continued*)



4

Enters into the pump box traveling through the pulsation dampener into the pump.



5

Then leaves the pump box through a 1/4" fitting to a high-pressure switch, into a second pulsation dampener then out of the pump box.



6

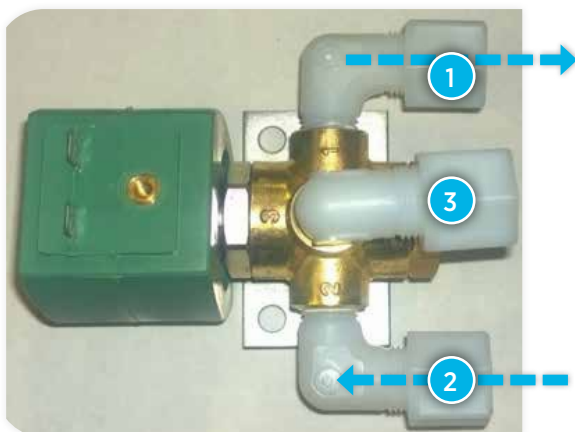
From pump box the insecticide follows tubing to the solenoid valve at the nozzle and then into the nozzle where it's mixed with air to make droplets.

Plumbing and Fluid Path Flush Tank



1

Flushing solution travels from flush tank.

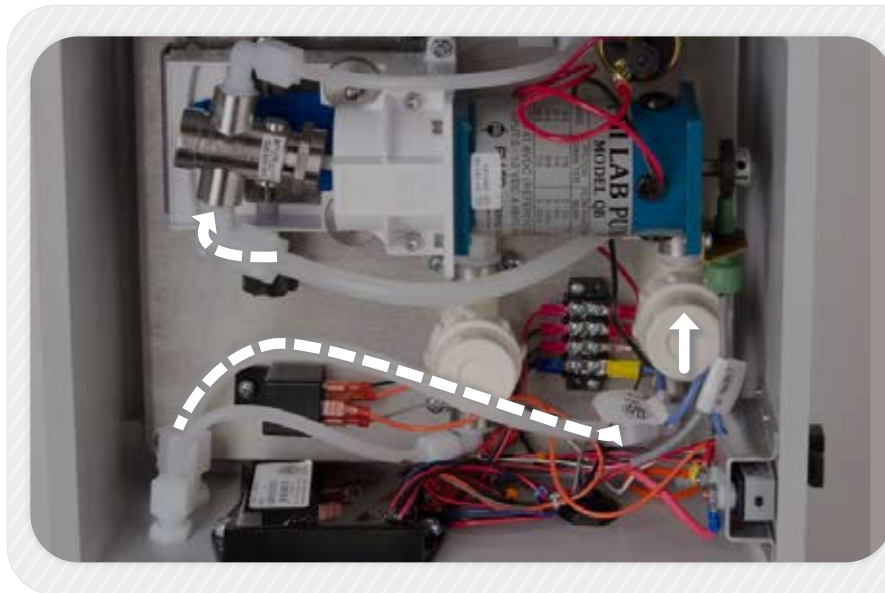


2

Travels to the flush solenoid valve and enters into port 2 and out of port 1.

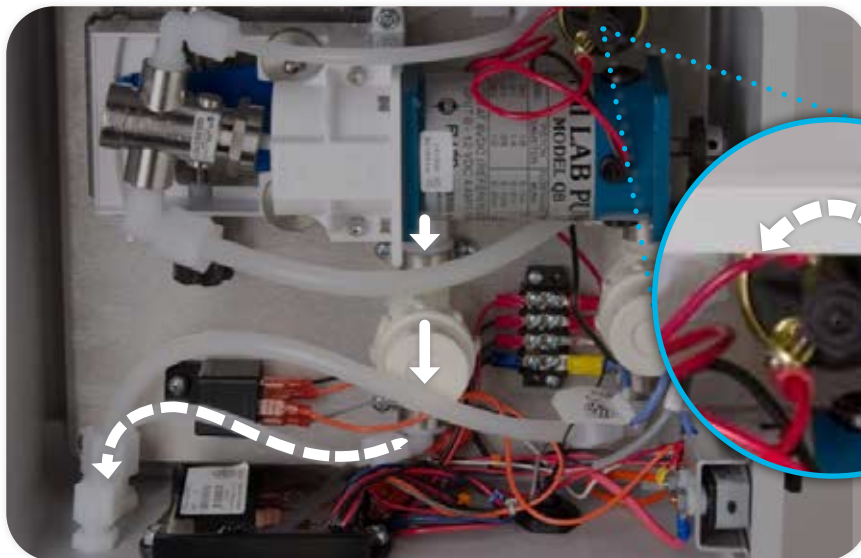
COUGAR® ULV SPRAYER

Plumbing and Fluid Path Flush Tank (continued)



3

Enters into the pump box traveling through the pulsation dampener into the pump.



4

Then, leaves the pump box through a 1/4" fitting to a high-pressure switch, into a second pulsation dampener, then out of the pump box.



5

From pump box, the insecticide follows tubing to the solenoid valve at the nozzle, and then into the nozzle where it's mixed with air to make droplets.

NOTES

A large grid of small blue dots, arranged in approximately 30 rows and 40 columns, covering the majority of the page below the header and to the left of the 'NOTES' label. This grid is intended for handwritten notes.

SMARTFLOW II® INSTRUCTION MANUAL

FOR COUGAR® ULV SPRAYER



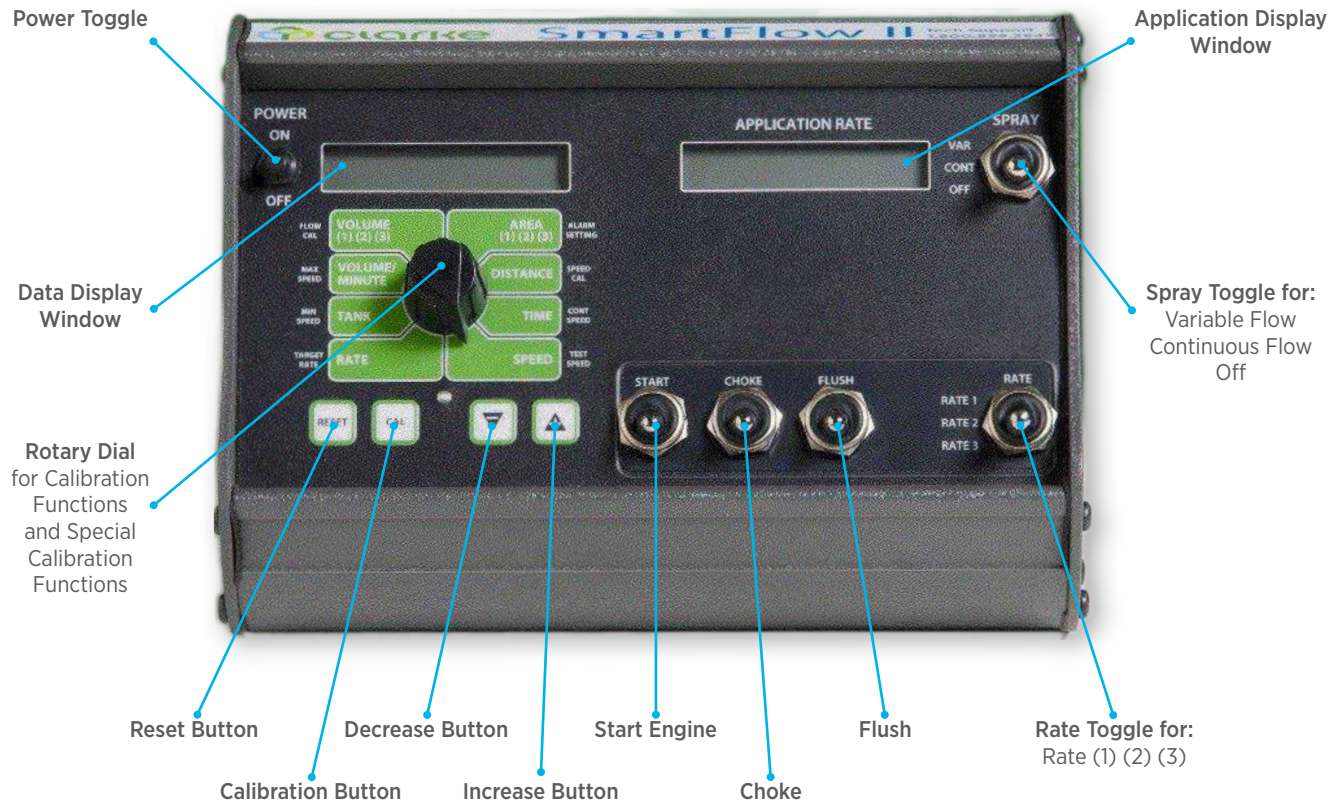
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FIGURE 1: SMARTFLOW II® CONSOLE FOR GAS ULV ONLY
COUGAR AND/OR GRIZZLY



COUGAR® ULV SPRAYER

Description

The SmartFlow II® control provides programmable microcomputer control for Clarke spraying systems.

The SmartFlow II® control offers the following features:

- The SmartFlow II® control uses data from Speed and Flow sensor to vary the speed of the electric pump on the spraying system. This automatically maintains the target application rate.
- The SmartFlow II control can operate alone, or for GPS-controlled Variable Rate Applications (VRA's), it can use an RS232 Serial Link to send data to and receive commands from an external computer.
- Three different application rates can be preprogrammed into the SmartFlow II control, allowing quick operator selection by the touch of a switch.
- The SmartFlow II control is available for both gas and electric spraying systems.
- The SmartFlow II accumulates several totals (Volume, Area, Distance, Time and Hours) to help verify spraying applications.

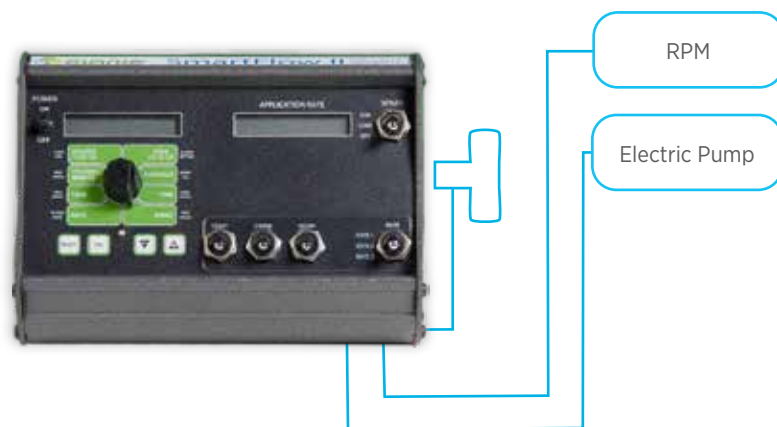


FIGURE 2: SMARTFLOW II® CONSOLE

Total Counters

The SmartFlow II® has five Total Counters:

Total Counters	79-81
Description	80
Volume Counters	80
Area Counters	81
Distance	81
Time	81
Hours	81

COUGAR® ULV SPRAYER

Total Counters

Description

The SmartFlow II® accumulates the following totals to document spraying applications:

COUNTER	DESCRIPTION	UNITS
Volume	The amount of liquid applied since the counter was last reset.	Tenths of gallon or tenths of a liter
Area	The total application area since the counter was last reset.	Acres or hectares
Distance	The distance the vehicle has traveled while spraying since the counter was last reset.	Miles or kilometers
Time	The spray time since the counter was last reset.	Hours
Hours	The cumulative spray time. This counter cannot be reset.	Hours

Volume Counters

Three volume counters are provided. When in the **VOLUME** position the selected counter is indicated by the number icon (1, 2, 3) in the data display and a different counter can be selected by using **INC** key. Cycling power or brown-outs will not change the selection. The user cannot change the counter selection while in **CALIBRATE** or **SPECIAL CALIBRATE** but it can be changed while in **TEST SPEED** mode.

If a flow signal is present, then volume continues to accumulate while in the **VARIABLE**, **CONTINUOUS** or **OFF** mode. **All three volume counters are always active and will accumulate volume** (not just the selected or displayed counter).

NOTE: the **DEC** key is not used since that is used to clear the counter in some models.

Area and volume counters are coupled together (as pairs) so selecting **Volume Counter 1** also selects **Area Counter 1**. This was done so user can easily see how much volume was applied to a particular area (**Volume 1** is always applied to **Area 1**, and **Volume 2** to **Area 2** etc.).

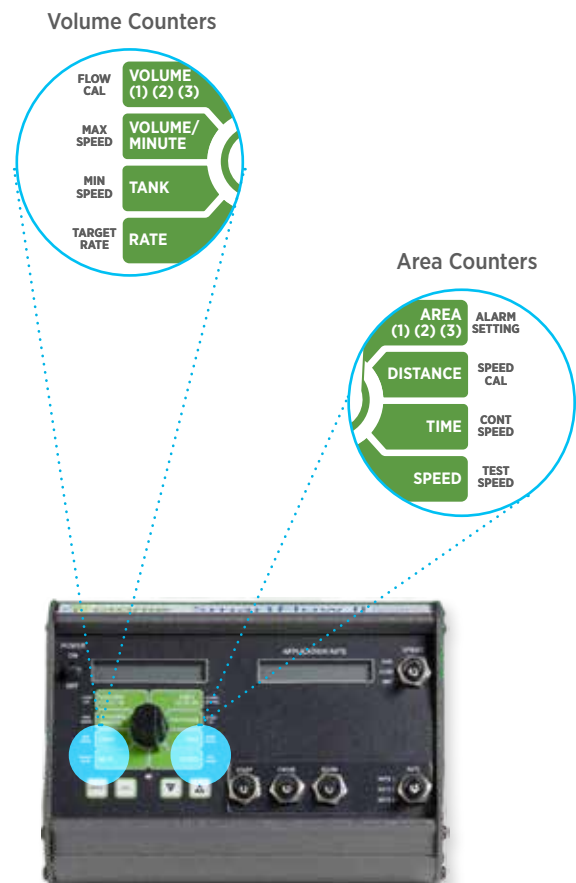


FIGURE 3: SMARTFLOW® II VOLUME/AREA COUNTERS

Area Counters

Three area counters are provided. When in the AREA position the selected counter is indicated by the number icon (1, 2, 3) shown in the data display. A different counter can be selected by using the **INC** key.

NOTE: the **DEC** key is **not** used, since that is used to clear the counter in some models: 'Lite' and 'D'.

Cycling power or brown-outs will not change the selection. The user can not change the counter selection while in **CALIBRATE** or **SPECIAL CALIBRATE** but it can be changed while in **TEST SPEED** mode.

Area is only accumulated while in the **VARIABLE** mode (not "Lo Speed" or "Hi Speed") and all three counters are active and will accumulate area (not just the selected or displayed counter). When in the **CONTINUOUS** or **OFF** mode all three area counters stop accumulating area.

Area and volume counters are coupled together (as pairs) so selecting **Area Counter 1** also selects **Volume Counter 1**. This was done so the user can easily see how much volume was applied to a particular area (**Volume 1** is always applied to **Area 1**, and **Volume 2** to **Area 2** etc.).

The **SPEED CAL** factor can be changed at any time (before or after a field is completed) and the correct area will be re-computed.

Distance

The **DISTANCE** position shows the distance traveled in 0.1 increments from 0 to 9,999.9 miles, or km. Distance is accumulated in feet or meters.

The distance counter will only accumulate when in **VARIABLE** mode (not "Lo Speed" or "Hi Speed"). If in **CONTINUOUS** or **OFF** mode, it will display the last accumulated distance.

Distance is saved to **EEPROM** during brown-outs or when power is turned **OFF**.

Time

The **TIME** position displays the "spray time" since the counter was last reset. It displays from 0.1 to 9999.9 hours.

The Time Counter accumulates spray time when in **VARIABLE** (and not "Lo Speed" or "Hi Speed") or **CONTINUOUS** mode.

Hours

When the SmartFlow II is turned on, it will display the number of hours it has operated in 0.1 hour increments up to a maximum of 9999.9 hours (then it displays OFL).

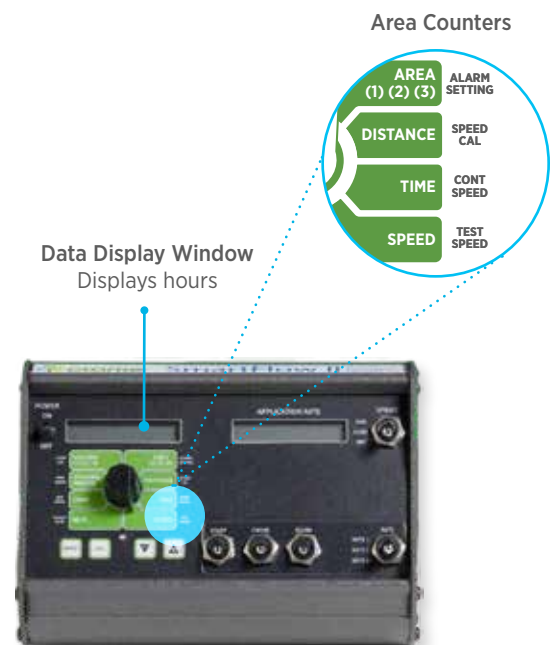


FIGURE 4: SMARTFLOW II® DATA DISPLAY AND AREA COUNTERS

COUGAR® ULV SPRAYER

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CAL	96

FIGURE 5: SMARTFLOW II® CONSOLE FOR GAS ULV ONLY
COUGAR AND/OR GRIZZLY



LCD Display Driver

The Clarke control box has two LCD displays (Data Display Window and Application Display window) each of which is capable of displaying any combination of digits, decimal points, and icons as shown in the illustration above.

Alarm On/Off Toggle Switch

An audible alarm (beeper) sounds when there is an error. A rear-mounted toggle switch (on the back of the SmartFlow II console) is used to turn off (disable) the Audible Alarm.

The Warning LED and "ERROR" indicator in the Data display window will also be lit.

Warning LED & Alarm

While in **VARIABLE** or **CONTINUOUS** mode, the Warning LED, and the Audible Alarm will turn on (steady) whenever there is more than 10% error in the application rate. **However, the Audible Alarm (only) can be delayed if the "Alarm Setting" is used.**

POWER Switch

The **POWER** switch turns the SmartFlow II® control ON and OFF. In the OFF position, this switch also grounds the magneto on a gas spraying system, or trips the main breaker on an electric spraying system.

COUGAR® ULV SPRAYER

Rotary Dial Functions

The rotary switch is used to select the parameters to display and to set calibration values. The SmartFlow II has eight display functions and are selected by the rotary knob positions as described in this section.

1. Rotary Dial Position: Distance Function: Distance Traveled

The **DISTANCE** positions shows the distance traveled in 0.1 increments from 0 – 9,999.9 miles or kilometers and then increments from 10,000 – 99,999 miles or kilometers.* This is shown in the Data Display window.

The Distance counter will only accumulate when in **VARIABLE** mode (and not “Lo Speed” or “Hi Speed”). If in the **CONTINUOUS** or **OFF** mode it will display the last accumulated distance.

Use the **RESET** button for clearing Distance.

Distance is saved to **EEPROM** during brown-outs or when power is turned off.

NOTE: Once 99,999 is reached, Data Display will show OFL (Overflow) and stop counting. The user must clear Distance to resume counting.



FIGURE 6: SMARTFLOW II® CONSOLE

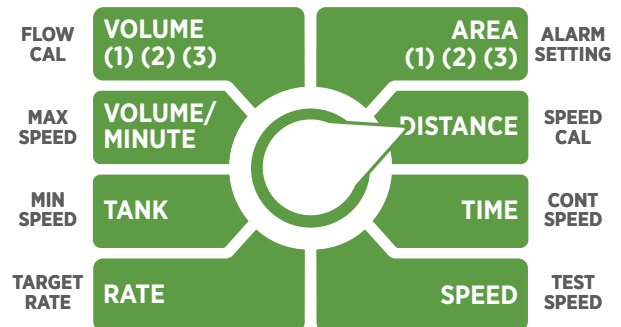


FIGURE 7: ROTARY DIAL—DISTANCE

Rotary Dial Functions (*continued*)

2. Rotary Dial Position: Speed

Function: mph or kph

The **SPEED** position shows ground speed in 0.1 increments from 0.0 – 655.4 mph or kph if in **VARIABLE** or **OFF** mode and is shown in the Data Display window. If in **CONTINUOUS** mode then the Continuous Speed Cal factor value is flashed instead of the actual speed.

If using external GPS, then the GPS Speed input is used and the Speed input is ignored. (If using the Clarke GPS part number 325490, then the **SPEED CAL** setting should remain at the factory setting with the yellow loop intact, which is .189). SmartFlow II can accept GPS speed from an external device (typically a PC with GPS) via the “G” Command. To use GPS Speed from an external source, the user must program the **SPEED CAL** to zero, (with the **DECREASE** button) which will disable the normal Speed input.

NOTE: The SmartFlow II will convert mph to kph depending on the Units selected and use it for all control and measurement functions (Speed, Area, Distance).

It is assumed the GPS speed received is “Speed over ground” and is always in mph x 10.

When using GPS the distance is no longer measured directly, instead it is calculated by the GPS receiver. Thus the SmartFlow II Distance and Area accuracy will be determined by the GPS receiver. Control accuracy will also depend on the GPS receiver.

NOTE: If GPS receiver only sends data once every second, then at 10 mph the vehicle will travel 14.7 ft. in 1 second. Therefore in the **VARIABLE** mode automatic control can only be made once every second, making it respond much more slowly to speed changes.

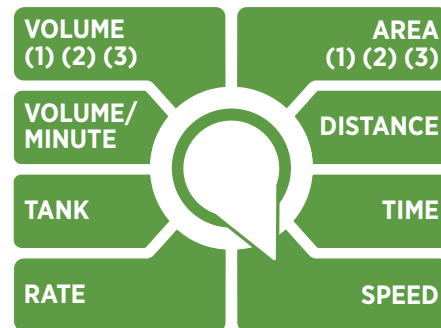


FIGURE 8: ROTARY DIAL—SPEED

COUGAR® ULV SPRAYER

Rotary Dial Functions (*continued*)

3. Rotary Dial Position: Area 1, 2, 3

Function: Acres Sprayed

Three Area counters are provided. When in the **AREA** position the selected counter is indicated by the Number icon (1, 2, 3) shown in the Data display and a different counter can be selected by using the **INC** key. (Note the **DEC** key is not used since that is used to clear the counter in some models). Cycling power or brown outs will not change the selection. The user cannot change the Counter selection while in **CALIBRATE** or **SPECIAL CALIBRATE** but it can be changed while in Test Speed mode.

Area is only accumulated while in the **VARIABLE** mode (and not “Lo Speed” or “Hi Speed”) and all three counters are active and will accumulate area (not just the selected or displayed counter). When in the **CONTINUOUS** or **OFF** mode all three Area counters stop accumulating area.

In English units, it counts from 0.1 – 9,999.9 acres, then drops the decimal point to count up to 99,999 acres. Metric counts from 0.01 – 999.99 hectares then shifts the decimal to count up to 9,999.9 hectares, then drops the decimal point to count up to 99,999 hectares.

NOTE: Once the display reaches 99,999 it will display **OFL (Overflow)** in the Data display window and stop counting. The user must clear the Area to resume counting. Use the **RESET** button for clearing Area.

Area and Volume counters are coupled together (as pairs) so selecting **Area counter 1** also selects **Volume Counter 1**. This was done so the user can easily see how much Volume was applied to a particular area. (Volume 1 is always applied to Area 1, and Volume 2 to Area 2 etc.).

The **SPEED CAL** factor can be changed at any time (before or after a field is completed) and the correct area will be re-computed.

All three Area counters are saved to **EEPROM** during brown-outs or when power is turned off.

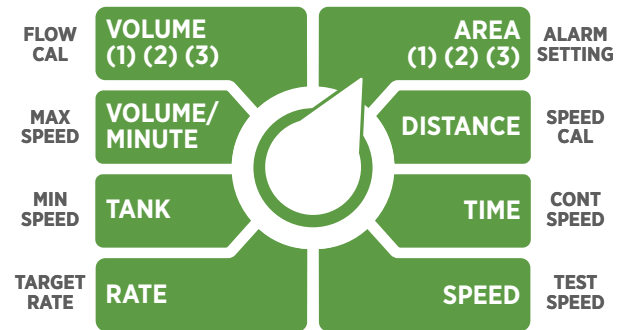


FIGURE 9: ROTARY DIAL—AREA

Rotary Dial Functions (*continued*)

4. Rotary Dial Position: **VOLUME/MINUTE**

Function: Ounces or Milliliters per Minute

The **VOLUME/MINUTE** position shows a range from 0.001 – 16,777 oz/min or from 0.1 – 99,999 ml/min. A typical application is 1 oz/acre at a width of 300 ft at 10 mph which generates a typical volume/minute of 6.060 oz/min or 179.2 ml/min.

English volume/minute is displayed with one or more decimal places that range from 0.001 – 99,999 gallons/minute. Metric volume/minute is displayed with zero or one decimal place that ranges from 0.1 – 99,999 ml/min. For English and Metric automatic decimal shift and hysteresis is the same as described in the Rate section (*pages 91-92*).

Volume/Minute operates while in **VARIABLE**, **CONTINUOUS** or **OFF** mode, as long as a flow signal is present, control can only be made once every second, making it respond much more slowly to speed changes.

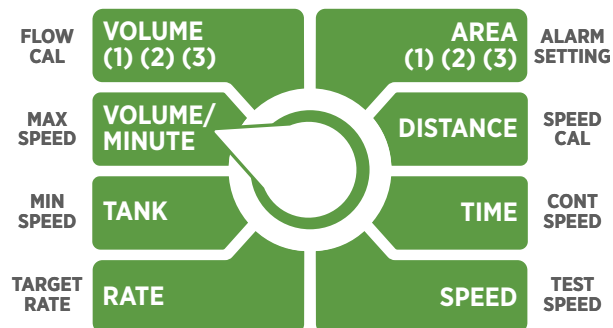


FIGURE 10: ROTARY DIAL—VOLUME/MINUTE

COUGAR® ULV SPRAYER

Rotary Dial Functions (*continued*)

5. Rotary Dial Position: **VOLUME (1)(2)(3)**

Function: Volume Pumped in Gallons or Liters

Three Volume counters are provided. When in the **VOLUME** position the selected counter is indicated by the Number icon (1, 2, 3) in the Data display window and a different counter can be selected by using **INC** key. (Note the **DEC** key is not used since that is used to clear the counter in some models). Cycling power or brown outs will not change the selection. The user cannot change the Counter selection while in **CALIBRATE** or **SPECIAL CALIBRATE** but it can be changed while in Test Speed mode.

If a flow signal is present then Volume continues to accumulate while in the **VARIABLE, CONTINUOUS** or **OFF** mode. All three Volume counters are always active and will accumulate volume (not just the selected or displayed counter).

The Volume mode displays the volume pumped from .01 – 999.99 gallons or liters and then from 1,000.0 – 9,999.9 gallons or liters and then from 10,000 – 99,999 gallons or liters. Once it reaches 99,999 it will display “OFL” (Overflow) and stop counting. The user must clear Volume to resume counting. Use the **RESET** button for clearing Volume.

Area and Volume counters are coupled together (as pairs) so selecting Volume counter 1 also selects Area Counter 1. This was done so user can easily see how much Volume was applied to a particular area (Volume 1 is always applied to Area 1, and Volume 2 to Area 2, etc.).

The Flowmeter Calibrate factor can be changed at any time (before or after an application is completed) and the correct Volume will be re-computed.

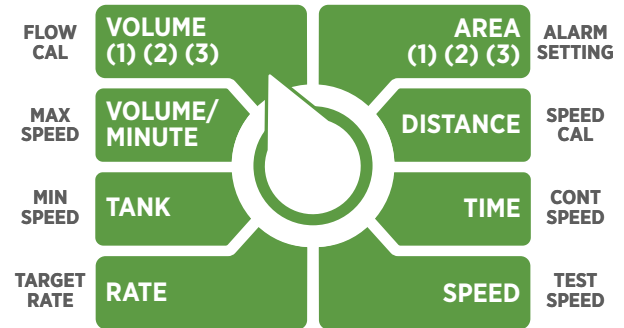


FIGURE 11: ROTARY DIAL—VOLUME (1)(2)(3)

Rotary Dial Functions (*continued*)

6. Rotary Dial Position: **TANK**

Function: Amount of Liquid in the Tank

The **TANK** position shows the amount of liquid remaining in the tank, to the nearest tenth of a gallon or liter.

NOTE: This is not an automatic function. The user must manually set the level of the tank. As the spray volume accumulates, the tank volume decreases.

An alarm (see below) will be given when the Tank level equals or drops below the Set Point cal factor (default 2.0 gallons or 7.5 liters) while in **VARIABLE**, **CONTINUOUS** or **OFF** mode. This alerts the user that the Tank is low whether he is spraying or stopped. The user can stop the audible and visual Tank alarm by momentarily pressing the **RESET** button (while in any position).

If a flow signal is present then Tank continues decrementing while in the **VARIABLE**, **CONTINUOUS** or **OFF** mode.

The Tank volume can be adjusted by setting the Spray switch to **OFF** and then using the **INC** or **DEC** buttons to adjust it from 0.0 – 6553.5 gallons or liters. For safety this can only be done while the spray switch is in **OFF**.

Adjusting the Tank volume to any value greater than zero will always activate the Tank Alarm function. To disable this function, the user must decrease the Tank Volume to 0.0 and press Reset. This will disable the function until the tank volume is increased. Once activated, the alarm will beep On and Off slowly, the Warn LED will turn on and the Application Rate display will alternate between FILL and OFF until the user adjusts the Tank value above the TANK ALARM SET POINT (alarm will stop) or back to 0.0 and pressing reset to disable it.

The Tank value cannot be changed while in **CAL** mode or **SPECIAL CAL** mode, but it can be changed while in **TEST SPEED** mode.

The **FILL** message will not flash while in **CAL** mode or **SPECIAL CAL** mode.

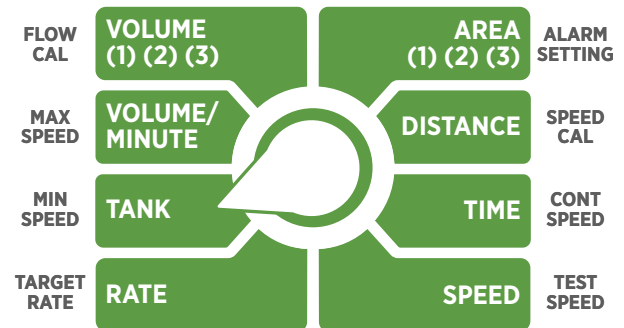


FIGURE 12: ROTARY DIAL—TANK

NOTE: Setting the Spray switch to OFF will stop the 10% Rate Error alarm (steady tone) but will not stop the Tank Alarm. If the user clears the Tank alarm by pressing the RESET button it will stay cleared even if the SmartFlow II power is turned on and off.

CONTROL PANEL FUNCTIONS

COUGAR® ULV SPRAYER

Rotary Dial Functions (*continued*)

7. Rotary Dial Position: Time

Function: Time Spraying Since Counter

Was Last Reset

The **TIME** position displays the spray time since the counter was last reset. It displays from 0.1 – 9999.9 hours and then from 10,000 – 99,999 hours. **Once it reaches 99,999 it will display OFL (overflow).**

The Time counter accumulates spray time when in Variable (and not “Lo Speed” or “Hi Speed”) or **CONTINUOUS** mode, and the “PRESSURE OK” or “RPM OK” input is active.

Use the **RESET** button for clearing Time.

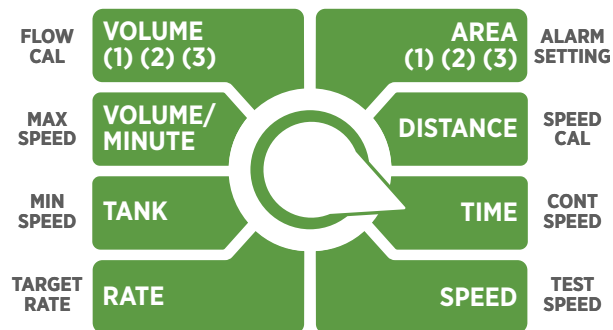


FIGURE 13: ROTARY DIAL—TIME

Rotary Dial Functions (*continued*)**8. Rotary Dial Position: Rate**

Function: Displays Actual Rate in OZ/Acre
or Milliliters/Hectare

The **RATE** position displays in the Data Display Window, and also will show the same value shown in the Application Rate Display Window.

The **RATE** position displays .001 – 99,999 oz/acre or 0.1 – 99,999 Milliliters/Hectare.

Rate operates while in **VARIABLE** and **CONTINUOUS** mode but will go to zero in the **OFF** mode even if a flow signal is present. It also goes to zero if in **VARIABLE** mode and “Lo speed” or “Hi Speed” in the Application Rate display window.

Rate is displayed with one or more decimal places depending on the rate, as shown below. In general the decimal point is automatically shifted to eliminate redundant digits that add “jitter” while maintaining a 1% resolution for high accuracy.

English Units:

When slowly increasing from 0 to maximum, the decimal point will automatically shift at the following values:

3 decimal places	0.000 – 1.999
2 decimal places	2.00 – 9.99
1 decimal place	10.0 – 99.9
No decimal place	100 – 16,777 (displays OFL)

When slowly decreasing from maximum to 0, the decimal point will automatically shift at the following values:

No decimal place	16,777 – 90
1 decimal place	89.9 – 9.0
2 decimal places	8.99 – 1.00
3 decimal places	0.999 – 0.000

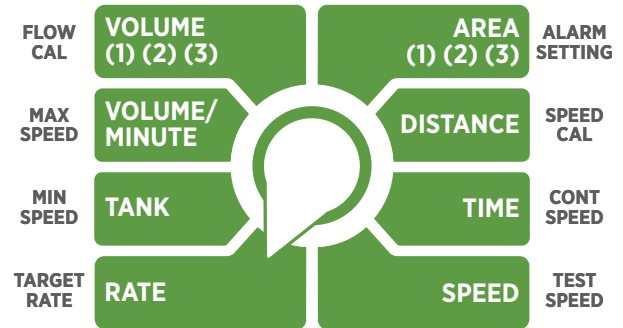


FIGURE 14: ROTARY DIAL—RATE

Between each of the previous chart's 4 decimal ranges, a hysteresis window as shown below will prevent rapid switching back and forth between decimal points.

2 or 3 decimal places	1.000 – 1.990
1 or 2 decimal places	9.00 – 9.90
0 or 1 decimal places	90.0 – 99.9

Metric Units:

When slowly increasing from 0 – maximum the decimal will shift at the following values:

1 decimal place	0.1 – 99.9
No decimal place	100 – 99,999 (then goes to OFL)

When slowly decreasing from maximum to 0 the decimal will shift at the following values:

No decimal place	99,999 – 90
1 decimal place	89.9 – 0.1

If an error between the Actual Rate and the Target Rate is $\geq 5\%$, then the display will simply show the Target Rate. If the error ever exceeds 10%, then the Warn LED and the audible alarm will turn on (steady). However, the audible alarm (only) can be delayed by adjusting the “Alarm Setting” calibration value.

CONTROL PANEL FUNCTIONS

COUGAR® ULV SPRAYER

Rotary Dial Functions (*continued*)

NOTE: The Application Rate display window should always match the Rate displayed in the Data display window except for the following:

- Displays Target Rate for 3 seconds when the Rate Toggle switch is changed and the “FILL” message does not alternate with it.
- Alternate between “Lo” and “SPEED” when in VARIABLE mode (and not PCOFF) if the speed is below “min Speed”, and it will alternate between “hi” and “SPEED” if the speed is above “Max Speed”: cal factor. This will take precedence over the 3 second display of Target Rate.
- Displays “OFF” when in OFF mode or displays “PCOFF” if PC issued an Off command by sending target+0. “OFF” takes precedence over “PCOFF” and both take precedence over the “Lo/Hi Speed” and “OFL” messages.

If some error occurs “Err 1” – “Err 4” will display and take precedence over the above messages (OFF, PCOFF, OFL, FLUSH and Hi/Lo SPEED). (See Error Codes section for details).

- It will alternate “FILL” when the Tank level is low and these messages: OFF, PCOFF, OFL, ErrX. (FILL is not displayed when it’s alternating between “Lo/Hi and SPEED”.)
- The MAN icon is on when in CONTINUOUS mode and the AUTO icon is on when in VARIABLE mode.
- A number icon 1,2,3 will turn on, based on the rate selected with the Rate Toggle switch. When in PCCC mode, these numbers will be off. This will remind the user the SmartFlow II is under PC control and it’s using a Target received from the PC rather than Target Rate 1, 2 or 3.

The Application Rate display is blank during power up when the SmartFlow II Hours and REV level are displayed.

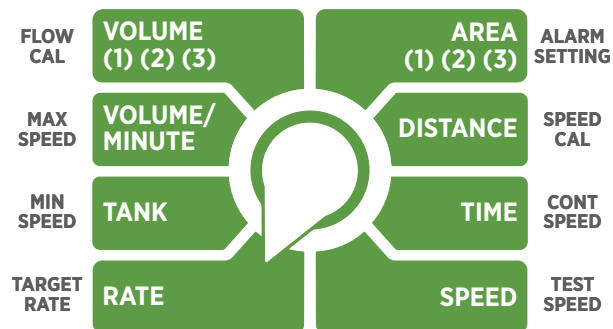


FIGURE 15: ROTARY DIAL—RATE

Toggle Switches

The SmartFlow II has six toggle switches:

1. Power On/Off Switch

The Power toggle is an On/Off switch.

The Power switch turns the SmartFlow control on and off.

2. Start

A momentary toggle switch drives Starter Solenoid, **24 Watt at 12 Volts**.

3. Choke

A momentary toggle switch drives Choke Solenoid, **16 Watt at 12 Volts**.

4. Flush

If the Spray Switch is in the **OFF** position and the user engages the momentary Flush toggle Switch for one second, then the Controller will automatically flush the Sprayer for one minute. It will display Flush in the Application Rate display and run the engine to full throttle. Running to full throttle will generate blower pressure, which will activate the "Pressure OK" switch when it reaches 1 PSI and will then turn on the Spray Pump.

If the "Pressure OK" switch does not activate within three seconds, then it will display Error 5 (too low pressure). If this occurs, the user needs to start the gas engine, or complete whatever is required to get the blower pressure up. When "pressure OK" becomes active, "Error 5" will clear, and the Flush operation will then continue its normal process.

Once Flush is started, it will continue for one minute, and the only way to abort the Flush operation is to power down, or if pressure becomes low, it will abort, and stop the pump, and the user will have to press the Flush Switch to start over.

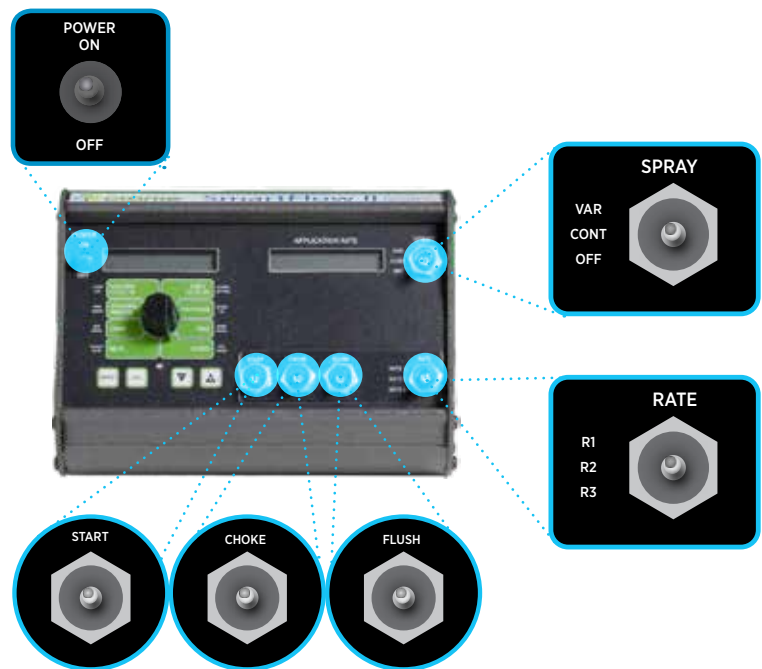


FIGURE 16: SMARTFLOW II® TOGGLE SWITCHES

5. Rate Toggle Switch

This toggle switch is used to select from 1 to 3 pre-programmed application rates for **VARIABLE** or **CONTINUOUS** spray rate control. A number icon 1, 2, 3 will turn on in the Application Rate display window to reflect which rate is selected.

When the Rate switch is changed, the Application Rate display window will show the selected Target Rate for 3 seconds if in **VARIABLE** or **CONTINUOUS** mode. It is not displayed while in the **OFF** mode because "OFF" is being displayed, but the new rate is still selected.

6. Spray Toggle Switch

The Spray toggle switch has three positions **VAR** (Variable), **CONT** (Continuous), **OFF** (OFF mode, not Power Off).

CONTROL PANEL FUNCTIONS

COUGAR® ULV SPRAYER

CALIBRATION FACTOR	DESCRIPTION
VAR Position	<p>VARIABLE MODE The SmartFlow control varies the pump speed to automatically maintain the selected application rate. This is based on the flow and speed information received from a signal from an external device e.g. GPS, tablet, computer, etc.</p> <p>Total Flow, Distance, Time, Hours, and Area counters accumulate in this mode.</p>
CONT Position	<p>CONTINUOUS MODE The SmartFlow control varies the pump speed to automatically maintain the selected application rate based on flow only. This mode uses the speed value set in the Cont Speed selection of settings. In addition, this mode can be used to spray while the vehicle is stopped.</p> <p>Total Flow, Time, and Hours counters accumulate in this mode.</p>
OFF Position	<p>OFF MODE The sprayer is stopped, and the Application Rate, Flow Per Minute, and Active Swath values go to zero.</p> <p>Total Flow and Tank counters accumulate in this mode in case flow does not stop immediately.</p>

Toggle Switches (*continued*)6. Spray Toggle Switch (*continued*)**VAR:**

In the **VARIABLE** position the **AUTO** icon turns on in the Application Rate display window. As the Speed of the vehicle can “vary”, the SmartFlow II will “vary” the drive to the electric pump to automatically maintain the selected Target Rate (1, 2, or 3). Both Speed and Flow are measured to compute and control the application rate (Oz/Acre).

*The Target Rate cannot be adjusted by using the **INC** and **DEC** buttons.

NOTE: If the pressure from the blower is sufficient, (“Pressure OK” or “RPM OK”) then the SmartFlow II will turn on the spray pump by turning on the “EPD Enable” output. The “EPD Enable” is turned back off if the “Pressure OK” or “RPM OK” inputs ever indicate low pressure or low RPM.

The Target Rate cannot be adjusted by using the **INC** and **DEC** buttons.

CONT:

The **CONTINUOUS** mode can be used to spray while stationary or parked. In this position the **MAN** icon turns on in the Application Rate display window. The Speed is assumed to be “continuous” or a constant speed. The SmartFlow II will measure the flow (but not the speed) and automatically adjust the sprayer to maintain the selected Target Rate* (1, 2, or 3) on a “continuous” speed even though the actual **CONTINUOUS** ground speed may vary or is stopped. Only the Flow is measured to compute and control the application rate (Oz/Acre) independent of actual ground speed.

When switched from **OFF** to the **CONTINUOUS** mode, the SmartFlow II will turn on and off as described in **VARIABLE** mode.

The “Continuous” speed Calibration value can be set from 2.0 – 45.0 mph (or kph) and the same speed is used for all 3 Rates. If the “speed” position is selected on the rotary switch, it will flash the “Continuous Speed” Calibration factor rather than show the actual speed.

NOTE: The Target Rate cannot be adjusted by using the **INC** and **DEC** buttons.

OFF:

In the **OFF** mode the Application Rate display will show “OFF” and the **AUTO** and **MAN** icons will turn off. The SmartFlow II will stop the sprayer.



FIGURE 17: SMARTFLOW II®—SPRAY SWITCH

CONTROL PANEL FUNCTIONS

COUGAR® ULV SPRAYER

Push Buttons

The SmartFlow II has four push buttons. Their functions are described below:

1. Reset Button

When Area and Volume 1 (only) are selected then the **RESET** button will clear 4 counters (Area 1, volume 1, Distance and Time) at the same time. When in the **OFF** mode, and in the Distance, Area, Volume or Time rotary position then pressing the **RESET** button for 1 second will clear Time, Distance, Area 1 and Volume 1 (4 counters). While in the Distance or Time position it will not display “CLEAR” or clear any counters unless the counter pair 1 is selected in **AREA** or **VOLUME**.

The Area-Volume pairs 2 or 3 are cleared independently. While in **AREA** or **VOLUME** mode, select the desired pair to clear (2 or 3) and with the Spray toggle in **OFF** mode press the **RESET** button for 1 second. Since the **AREA** and **VOLUME** counters are paired, clearing a selected **AREA** counter will also clear the corresponding **VOLUME** counter (and vice versa).

When the **RESET** button is pressed it will immediately display “CLEAR” in the Data display window as a warning that it is about to clear counters. If the **RESET** button is released while displaying “CLEAR” then the counters remain unchanged. If the **RESET** button is pressed for 1 second or more then the “CLEAR” message disappears and is replaced with “0” to indicate the counters were cleared.

When fine tuning Flow Cal, the **RESET** button is pressed to immediately clear a separate (independent) Volume counter only used for fine tuning Flow Cal (“CLEAR” is not displayed).

Pressing **RESET** while in the PcOff will have no effect and will not clear any counters. Instead the SmartFlow II must be in **OFF** mode using the console’s Spray toggle switch. (See Maintenance Alert section for additional use of **RESET** button.)



FIGURE 18: SMARTFLOW II®—PUSH BUTTONS

2. INC (+) and 3. DEC (-)

The **INC/DEC** buttons are used to enter or adjust values in the display.

If in Volume or Area mode the **INC/DEC** buttons will select 1 of 3 counters.

If in the Tank mode then the **INC** or **DEC** buttons are used to change the Tank level. This also works while in the **PCCC** (PC Command/Control) mode.

If in Speed position and Test Speed mode, then the **INC** and **DEC** buttons will adjust the Test Speed.

In the Calibrate or special Calibrate Mode, the **INC** or **DEC** buttons are pressed to increase or decrease each Calibrate value and the longer the key is pressed the faster the value will change. (See Maintenance Alert section for additional use of the **DEC** button).

4. CAL Button

Used to start and stop the Calibrate modes.
*See Calibrate Modes beginning on page 101, and
Special Calibrate Modes beginning on page 112.*

Calibration

This section covers these calibration topics:

Calibration	97-111
Calibration Factors—Description	98
How to Enter Calibration Mode	99-100
Calibration Factors	101-108
Alarm Setting	101
Speed Cal	102
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Max Speed	106
Flow Cal	107
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To Calibrate	110
Adjusting the Accuracy of the Flow Meter or Setting the Flow Cal Factor	111

CALIBRATION

COUGAR® ULV SPRAYER

Calibration Factors—Description

The SmartFlow II control has eight calibration factors:

CALIBRATION FACTOR	ROTARY SWITCH POSITION	DESCRIPTION
Alarm Setting	Area (1) (2) (3)	Sets the delay time for triggering the audible alarm.
Speed Cal	Distance	Specifies the distance the vehicle travels between speed sensor pulses. This enables the SmartFlow II control to accurately measure speed, distance, area and application rate.
Continuous Speed	Time	The speed that is used in Continuous mode.
Test Speed	Speed	Not a true calibrate factor, but a method of testing the sprayer.
Target Rate	Rate	Sets the three preset Target Application Rates.
Minimum Speed	Minimum Speed	The minimum speed allowed in Variable mode. If the vehicle goes below this speed, the control goes into Off mode until the speed exceeds this number again..
Maximum Speed	Volume/Minute	The maximum speed allowed in Variable mode. If the vehicle exceeds this speed the control goes into OFF mode until the speed goes below this number again.
Flow Cal	Flow Cal	Specifies the number of flow sensor pulses per gallon applied. This enables the SmartFlow II control to accurately measure total flow per minute, and application rate.

How to Enter Calibration Mode

Two methods can be used to enter Calibration Mode:

1. Only allows user to view the CAL factors.

To enter “View” Calibration Mode:

- Toggle the **SPRAY** switch to **OFF**.
- Press and hold the **CAL** button for 1 second. The word “CAL” will be displayed in the Application Rate display window and the Data display window will show the Calibration Factors. The red Warning LED will remain off as a reminder the user cannot change the Calibration Factors.

NOTE: Make sure that machine and battery connections are properly made, and the power switch on the SmartFlow II console is ON..

NOTE: The audible alarm remains off while in either Calibration Mode, except when fine-tuning.

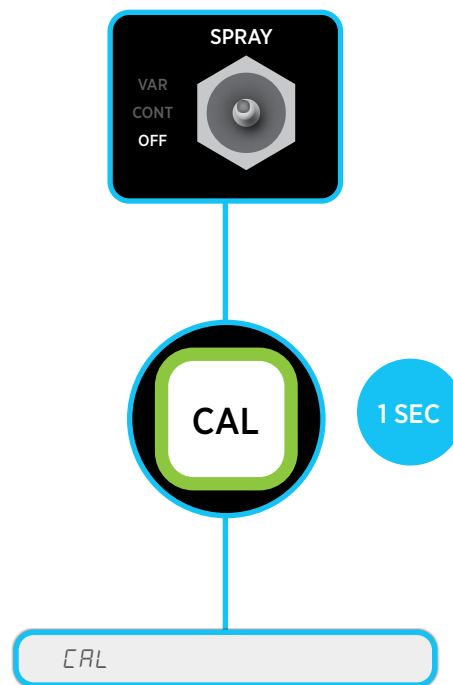


FIGURE 19: ENTER CALIBRATION MODE

How to Enter Calibration Mode (*continued*)

2. Allows user to view and change the Calibration Factors.

To enter “View and Change” Calibration Mode:

- Toggle the **SPRAY** switch to **OFF**.
- Turn rotary switch to **TARGET RATE** position. Press and hold both the **CAL** and **INC** button for 1 second. The word “**SET**” will be displayed in the Data display window and the word “**CAL**” will be displayed in the Application Rate display window. The red Warning **LED** will flash on/off as a warning that the Calibration Factors can be set (changed). A Calibration Factor is selected with the rotary switch. The word “**SET**” remains in the Data display window until the user releases both the **CAL** and **INC** buttons to prevent accidental increments to a Calibration Factor. The **INC** or **DEC** buttons are used to adjust the Calibration Factor. The longer the key is pressed, the faster the value will change.

To exit “View and Change” Calibration Mode:

- Press the **CAL** button for 1 second with the rotary switch in any position. The **SPRAY** switch can be in **VARIABLE**, **CONTINUOUS** or **OFF**. If a calibration change was made, the SmartFlow II will store the Calibration Factors in **EEPROM** thus saving the changes.
- To exit Calibration Mode without saving any changes, simply turn the Power **OFF**.

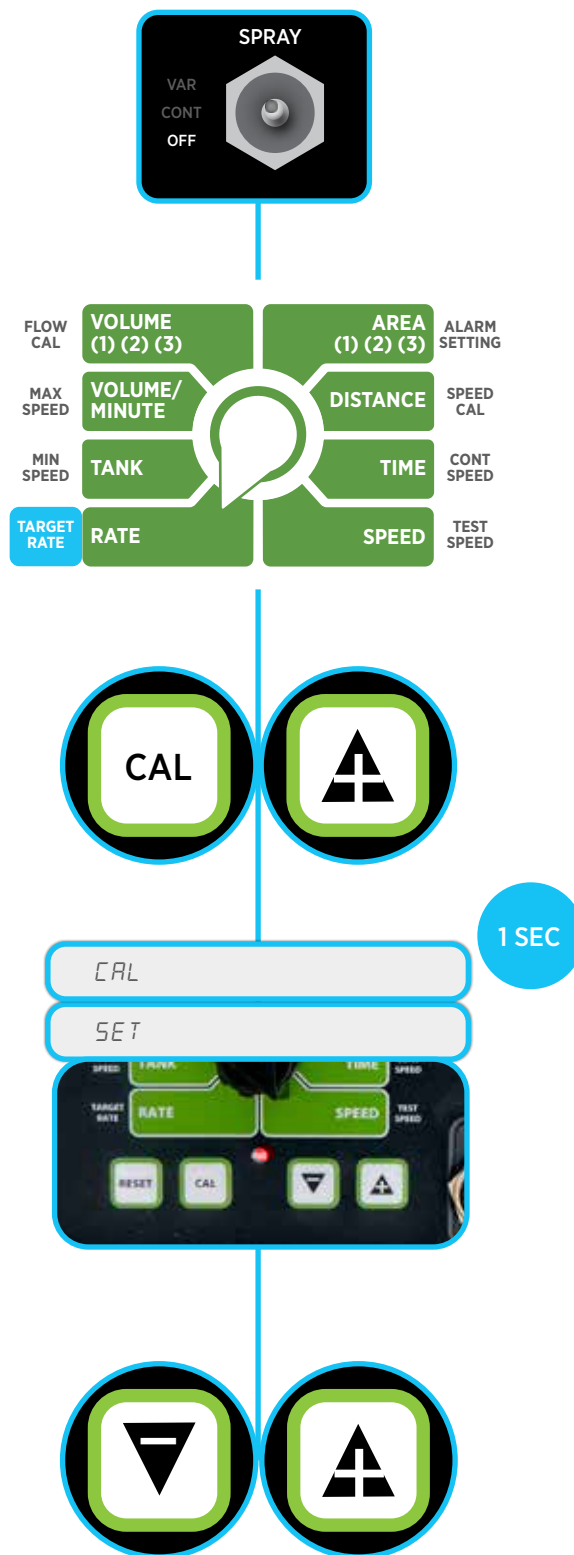


FIGURE 20 — ENTER CALIBRATION MODE

Calibration Factors

1. Alarm Setting

The **ALARM SETTING** calibration factor is used to set the delay time for triggering the audible alarm*. This delay can be changed from 0 – 6 seconds.

1. To set the **ALARM SETTING** Cal factor: Place the SmartFlow II in Calibration mode by placing the rotary dial to **TARGET RATE** and hold the **CAL** and **INC** buttons together until the console reads **SET** and the red Warning **LED** light is flashing.
2. Move the rotary dial to **ALARM SETTING** position. In the Data Display window, the **DELAY SECONDS** are displayed. In the Application Rate Window, **CAL** is displayed.
3. Use the **INC/DEC** buttons to increase or decrease the time.
4. Rotate the rotary dial to **TARGET RATE**, press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.

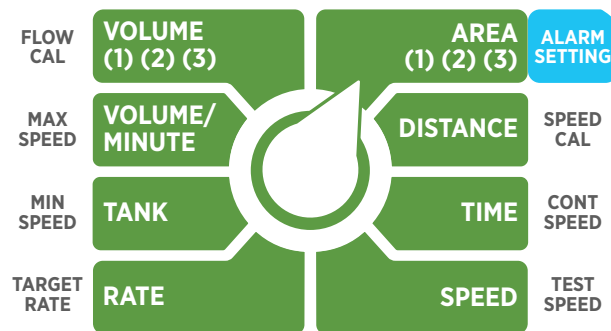


FIGURE 21: ROTARY DIAL—AREA (1)(2)(3)

***NOTE:** This delay setting only affects the audible alarm, it does not affect any visual alarm (warning LED). It also does not affect the Tank alarm (slow beeping) of the Min/Max speed alarm (fast beeping).

Example: Whenever there is more than 10% error in the application rate, the Warning LED will turn on (not affected by this setting), but the audible alarm will not turn on for another (delay value) seconds. Therefore, if the SmartFlow II has settled on target within (delay value) seconds, the audible alarm will not turn on. This temporary delay in sounding the Audible Alarm helps to prevent it from becoming a nuisance alarm (where user may be tempted to shut it off).

CALIBRATION

COUGAR® ULV SPRAYER

Calibration Factors (*continued*)

2. Speed Cal

SPEED CAL displays the Distance Sensor Cal factor in distance traveled between speed sensor pulses. It can be changed from 0.001 – 655.36 cm per Edge (rise and fall from pulse to pulse).

To use external GPS input speed sensor, the user must set Speed Cal to zero (no calibration is required).

1. To set the **SPEED CAL** factor: Place the SmartFlow II in Calibration mode by placing the rotary dial to **TARGET RATE** and hold the **CAL** and **INC** buttons together until the console reads **SET** and the red Warning LED light is flashing.
2. Move the rotary dial to **SPEED CAL** position. The Data Display window will show speed sensor pulses. In the Application Rate Window, **CAL** is displayed. (If using the Clarke GPS part number 325490, then the SPEED CAL setting should remain at the factory setting with the yellow loop intact, which is .189.)
3. Use the **INC/DEC** buttons to set to zero.
4. Rotate the rotary dial to **TARGET RATE**, press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.

3. CONT Speed

CONT SPEED displays the Continuous Speed value, which can be adjusted from 2.0 – 45.0 mph or kph. This Speed is used for all Application Rates when in the Continuous mode.

1. To set the **CONT SPEED** factor: Place the SmartFlow II in Calibration mode by placing the rotary dial to Target Rate and hold the **CAL** and **INC** buttons together until the console reads **SET** and the red Warning LED light is flashing.
2. Move the rotary dial to **CONT SPEED** position. 'SPEED' is displayed in the in the Data display window, and the current Continuous Speed is displayed in the Application Rate display window.
3. Use the **INC/DEC** buttons to increase or decrease the speed.
4. Rotate the rotary dial to **TARGET RATE**, press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.

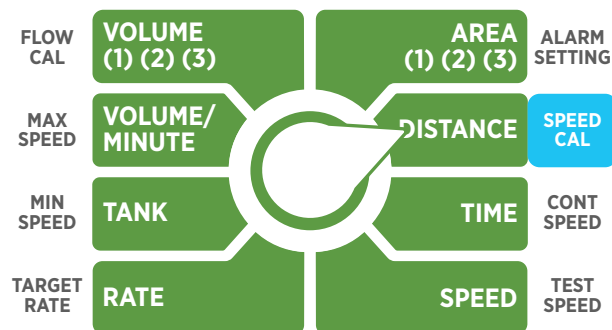


FIGURE 22: ROTARY DIAL—SPEED CAL

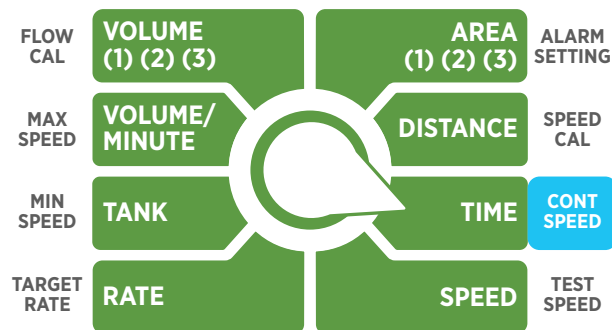


FIGURE 23: ROTARY DIAL—CONTINUOUS SPEED

Calibration Factors (*continued*)

4. Test Speed

TEST SPEED is not a true “calibrate factor” but rather a method of testing the sprayer. Typically it is used to confirm that Auto Control can be maintained across a range of expected ground speeds. The **VARIABLE** mode (on **SPRAY** toggle switch) must be selected because the **CONTINUOUS** mode will always use the “Continuous Speed” calibration factor (instead of Test Speed). It will display “GoVar” (Go to **VARIABLE**) if the user tries to adjust the **TEST SPEED** while in the **CONTINUOUS** mode.

Each time the Calibrate Mode is selected, (either “View” or “View and Change” cal mode) the Test Speed will be reset to 0 mph (turned off) so it does not interfere with any other calibration procedures.

To use Test Speed, Enter Calibration Mode:

- Turn the rotary dial to the Speed position and use the **INC** button to adjust it above 0 mph. (Any non-zero Test Speed will make the **CAL** icon flash and the Warn LED light will turn on to remind the user that a “Test Speed” is running, and the Calibrate Mode is no longer fully operating, and therefore cannot change any Calibrate factors).
- Normal operating modes will now use the Test Speed instead of the actual speed input.
- Speed will operate using the Test Speed and Volume, Tank, Rate and Volume/Minute will also operate.
- The Area and Distance will not change while in the Test Speed Mode. The Application Rate window will show normal data instead of “**CAL**”.
- The audible alarm will operate as normal.
- In the **VARIABLE** mode, the SmartFlow II will automatically adjust the flow to reach the Target Rate (GPA) based on the Test Speed.
- In the **CONTINUOUS** mode, SmartFlow II will adjust the flow to reach the Target Rate (GPA) based on the Continuous speed cal factor (instead of Test Speed).

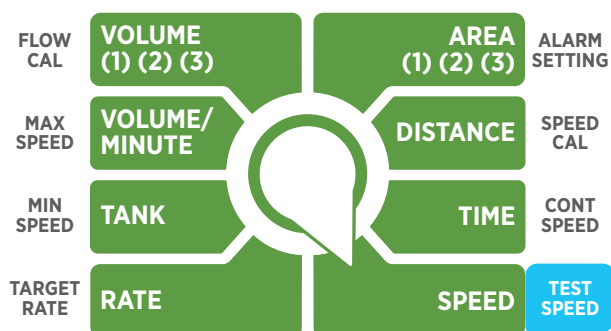


FIGURE 24: ROTARY DIAL—TEST SPEED

To exit Test Speed:

Hold the **CAL** button for 1 second (or turn the SmartFlow II off) and the **CAL** icon will stop flashing, the red Warning LED will turn off, and Test Speed will be exited. (The Test Speed cannot be turned off by reducing it to 0 because the minimum Test Speed is 0.1 mph.)

While in the Speed position holding the **CAL** and **INC** buttons will not start the Test Speed Mode. This could happen by accident when the user is trying to start the “View and Change” Cal mode but, is accidentally in the Speed position instead of the Rate position.

NOTE: If the user changes some Cal Factors and then instead of exiting CAL mode he starts the Test Speed mode, then all Cal Factors will be stored in EE when he stops Test Speed mode by exiting the CAL Mode. But if the user cycles power to stop the test speed mode then the Cal Factors will NOT be stored.

CALIBRATION

COUGAR® ULV SPRAYER

Calibration Factors (*continued*)

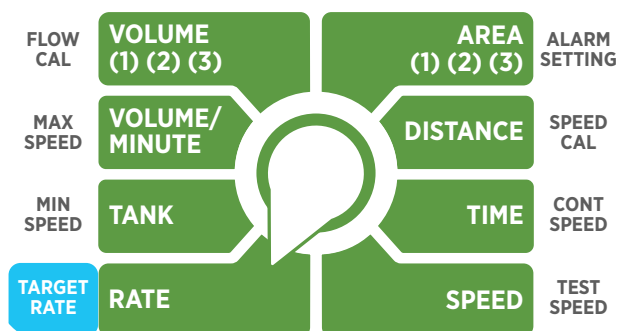


FIGURE 25: ROTARY DIAL—TARGET RATE

5. Target Rate

TARGET RATE displays the Target Application rate for **VARIABLE** and **CONTINUOUS** mode (automatic control). Up to three different Target Rates can be programmed in **oz/acre** or **from mL/Hectare**. The factory setting is at 1.00 oz/acre (73.1 mL/Hectare).

The Rate toggle switch (Rate 1, 2 or 3) will determine which target Rate is selected and the number icon (1, 2 or 3) will be displayed in the Application Rate display window.

Target Rate is displayed with one or more decimal places depending on the flow rate as shown below. It can range from 0.01 – 99,999.

Setting Target Application Rate

1. To set the **TARGET RATE** factor: Place the SmartFlow II in Calibration mode by placing the rotary dial to **TARGET RATE** and hold the **CAL** and **INC** buttons together until the console reads "SET" and the red Warning LED light is flashing.
2. Move the rotary dial to **TARGET RATE** position.
3. Move the Rate (1)(2)(3) toggle switch to select the Target Rate to be changed.
4. The selected rate and current units are displayed in the in the Data display window and the current target application rate is displayed in the Application Rate display window.
5. Use the INC/DEC buttons to increase or decrease the rate.
6. Rotate the rotary dial to **TARGET RATE**, press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.

English Units:

When slowly increasing from 0 to maximum, the decimal point will automatically shift at the following values:

VALUE	DECIMAL PLACES	RANGE
5	3	0.000 - 1.999
6	2	2.000 - 9.90
7	1	10.0 - 99.0
8	None	100 - 16,777 then stops

When slowly decreasing from maximum to 0, the decimal point will automatically shift at the following values:

VALUE	DECIMAL PLACES	RANGE
5	None	16,777 - 90
3	1	89.9 - 10.0
2	2	9.90 - 1.00
1	3	0.999 - 0.000

Between each of the above 4 decimal ranges, a hysteresis window as shown below will prevent rapid switching back and forth between decimal points.

DECIMAL PLACES	RANGE
2 or 3	1.000-1.990
0 or 1	90.0-99.0

Metric Units:

When slowly increasing from 0 to the maximum, the decimal will shift at the following values:

DECIMAL PLACES	RANGE
1	0.1 - 99.9
None	100 - 99,999 (then goes to OFL)

When slowly decreasing from maximum to 0, the decimal will shift at the following values:

DECIMAL PLACES	RANGE
None	99,999 - 99
1	98.9 - 0.1

Calibration Factors (*continued*)

6. Min Speed

MIN SPEED displays the “Minimum Speed” which can be adjusted from “Off” to 0.1-45.0 mph or kph. If used, the user must ensure that Min Speed is less than Max Speed (if used) or else the sprayer will never turn on.

MIN SPEED is used to stop the sprayer (and Distance, Area and Time counting) when the ground speed drops below this limit (in the **VARIABLE** mode only).

1. To set the MIN SPEED factor:

Place the SmartFlow II in Calibration mode by placing the rotary dial to **TARGET RATE**, and hold the **CAL** and **INC** buttons together until the console reads “SET” and the red Warning LED light is flashing.

2. Move the rotary dial to **MIN SPEED** position.

‘Lo’ is displayed in the in the Data display window, and the current Minimum Speed is displayed in the Application Rate display window.

3. Use the **INC/DEC** buttons to increase or decrease the speed.

4. Rotate the rotary dial to **TARGET RATE**. Press and hold the **CAL** button for 3 seconds to save the change, and exit Calibration mode.

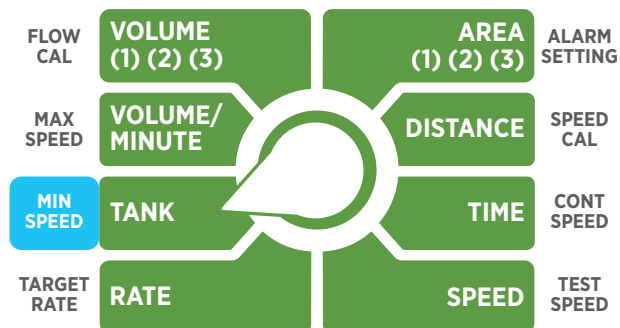


FIGURE 27: ROTARY DIAL—MIN SPEED

COUGAR® ULV SPRAYER

Calibration Factors (*continued*)

7. Max Speed

MAX SPEED displays the “Maximum Speed” which can be adjusted from “Off” to 0.1 to 45.0 mph or kph. If used, the user must ensure that **MAX SPEED** is greater than **MIN SPEED** (if used) or else the sprayer will never turn on.

MAX SPEED is used to stop the sprayer (and Distance, Area and Time counting) when the ground speed exceeds this limit (in the **VARIABLE** mode only).

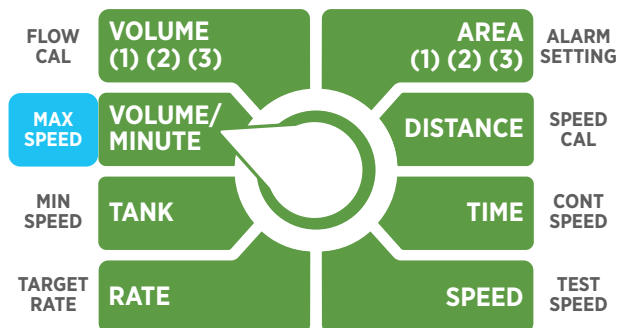


FIGURE 28: ROTARY DIAL—MAX SPEED

1. To set the **MAX SPEED** factor: Place the SmartFlow II in Calibration mode by placing the rotary dial to **TARGET RATE** and hold the **CAL** and **INC** buttons together until the console reads "SET" and the red Warning LED light is flashing.
2. Move the rotary dial to **MAX SPEED** position. "Hi" is displayed in the in the Data display window, and the current Minimum Speed is displayed in the Application Rate display window.
3. Use the **INC/DEC** buttons to increase or decrease the speed.
4. Rotate the rotary dial to **TARGET RATE**. Press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.

Calibration Factors *(continued)*

8. Flow Cal

In the **FLOW CAL** position, the current Flowmeter Calibrate factor value will be displayed. This specifies the number of flow sensor pulses per gallon applied. This enables the SmartFlow II control to accurately measure total flow, flow per minute and application rate. The Flowmeter calibrate factor is in English or Metric.

To set the **FLOW CAL** factor reference page 111.

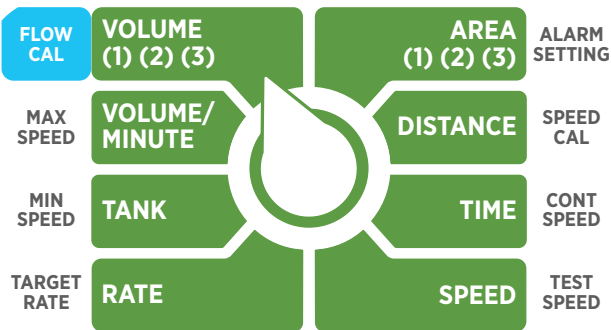


FIGURE 29: ROTARY DIAL—FLOW CAL

***HINT:** Choose your fluid oz./min. per product label, then divide by 6 to give you the correct target rate for a continuous spray mode for a speed of 10 mph.

COUGAR® ULV SPRAYER

Reloading Calibration Defaults

To confirm that defaults were actually loaded, the SmartFlow II will display *LOAd* for at least 1.5 seconds or as long as the **CAL** or **DEC** buttons are held, up to 3 seconds. If the **CAL** and **DEC** buttons are held for 3 seconds, the display will change to *StorE* and the defaults will be saved to EEPROM. If the **CAL** and **DEC** keys are held less than 3 seconds, then *StorE* is never displayed, and defaults are loaded but not stored in EEPROM.

NOTE: When loading defaults the Tank value is loaded with the default 'Tank Size' to prevent a Tank Alarm after loading defaults.

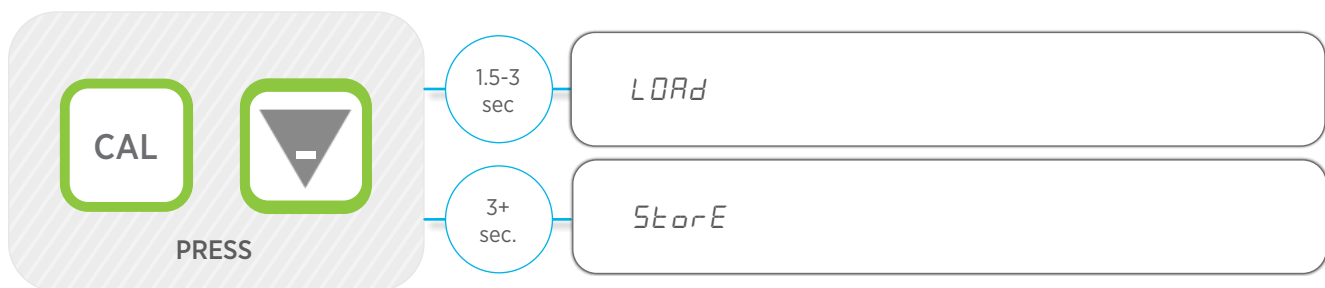


FIGURE 30: RELOADING CALIBRATION DEFAULTS

Reloading Calibration Defaults (*continued*)

Default Calibration Factors are loaded, and all Counters are cleared, if the **CAL** and **DEC** buttons are held while turning the SmartFlow II on. If the rotary switch is in the **AREA** position, it will select the Metric Units and load Metric defaults. Any other rotary position will select English units and load English defaults.

CAL FACTOR	ENGLISH	METRIC
Distance	0	0
Area 1	0	0
Area 2	0	0
Area 3	0	0
Gallons 1	0	0
Gallons 2	0	0
Gallons 3	0	0
Tank Size	15.0 Gal.	56.8 Liter
Time	0	0
Audible Alarm Delay "Alarm Setting"	3 sec	3 sec
Speed Cal	.189 (inch/edge)	0.48 (cm/edge)
Flow Cal (Edges/Oz)	2660.0	2660.0
Target Rate 1	1.00 Oz/A	73.0 mL PH
Target Rate 2	1.00 Oz/A	73.0 mL PH
Target Rate 3	1.00 Oz/A	73. mL PH
Continuous Speed	10.0 mph	16.0 kph
Min Speed	2.0 mph	3.2 kph
Max Speed	22.0 mph	35.4 kph
Units	0 (Eng)	1 (Metric)
Vehicle ID	1	1
Width	300.0 feet	91.44 m
Control Speed	-1	-1
Tank Set Point	2.0 Gal.	7.5 Liter

COUGAR® ULV SPRAYER

To Calibrate

All ULV equipment has been factory calibrated to 6 fl oz/min OR 1 fl oz/acre at 10 mph.

Connect

1. Plug the SmartFlow® II control box into your ULV unit, and the pump box on the ULV unit.
2. If you have a GPS/Radar unit, connect that as well.

Calibrate for different rates or to verify rate for accuracy.

3. Fill your formulation tank.
4. Power. Move the SmartFlow II Power Toggle to **ON**.
5. Check to make sure the Spray toggle on the right side of the SmartFlow II control box to **OFF**.
6. At a minimum, you need to set these two Calibration Factors:
 - a. **TARGET RATE**. Always refer to chemical label for target rates. Target Rate is **oz/acre**.
 - b. **CONTINUOUS SPEED, (CONT SPEED)**

To set these Calibration Factors, enter Calibration Mode by:

7. Turn rotary switch to **RATE/TARGET RATE**.
8. Press **CAL** and **INC/+** simultaneously. **EDL** will appear in the application rate window, and the red LED warning light will be flashing.
9. **SET** will appear. Release the buttons. **EDL** will display, and the red warning LED will be blinking.

To set the Target Rate:

10. Move the Rate (1), (2), (3), toggle switch to select the Target Rate to be changed.
11. The selected rate and current units are displayed in the Data display window and the current target application rate is displayed in the Application Rate display window.
12. Use the **INC/DEC** buttons to increase or decrease the rate.

To set the Cont Speed factor

13. Rotate the rotary dial to **CONT SPEED** position. "Distance" is displayed in the Data display window, and the current Continuous Speed is displayed in the Application Rate display window.

14. Use the **INC/DEC** buttons to increase or decrease the speed.

To save and exit Calibration Mode

15. Rotate the rotary dial to **TARGET RATE**, press and hold the **CAL** button for 3 seconds to save the change and exit Calibration mode.
16. For more details, consult calibration section of your machine's manual.

NOTE: The FLOW CAL value is always displayed when the rotary switch is turned to the FLOW CAL position.

For example, if a user displays the FLOW CAL value and then presses the CAL button to toggle to the Volume 1 value, leaving it to display Volume 1, then rotates the switch to some other CAL factor, when returning to the Flow CAL position, the console will automatically switch back to displaying the FLOW CAL value rather than staying "stuck" in the Volume 1 display (with the CAL icon flashing).

If a user displays the FLOW CAL value and then presses the CAL button to toggle to the Volume 1 value, leaves it displaying the Volume 1 and then rotates the switch to some other CAL factor, when he returns to the Flow CAL position it will automatically switch back to displaying the FLOW CAL value rather than staying "stuck" in the Volume 1 display (with the CAL icon flashing).

Calibration Factors

Setting the Flow Cal Factor Or Adjusting the Accuracy of the Flow Meter

To adjust the accuracy of the Flow Meter, enter Calibration Mode by:

1. Turn rotary switch to **RATE/TARGET RATE**.
2. Press **CAL** and **INC/+** simultaneously. *SET* will appear in the application rate window, and the red LED warning light will be flashing.
3. Disconnect the product/formulation line from the nozzle solenoid valve on the gas machine. Have someone hold the formulation line in a container with ounce markings. Should hold at least 10 oz (or 1.25 cups) or .296 liters.

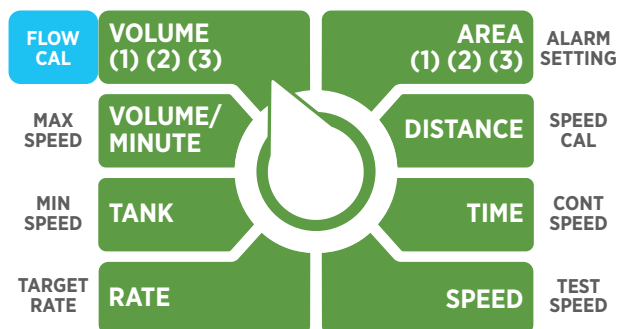


FIGURE 29: ROTARY DIAL—FLOW CAL

4. Turn rotary switch to **Volume/Flow Cal**.
5. Move the **SPRAY** toggle on the SmartFlow® II box from **OFF** to **CONT**.
6. Fill the container to 10 oz or .296 liters. (Volume counter will begin to increment and display from 0.0 to 1000.0 Ounces or from 0.000 to 30.000 Liters.)
7. Move the **SPRAY** toggle to **OFF** when container reaches the desired mark.
8. **Check.** Press **CAL** momentarily, and the display above the rotary knob will change to show the amount in ounces (1 decimal point) or liters (3 decimal places) The Flowmeter calibrate factor is in English or Metric and can be adjusted from 0.1 to 6553.5 Edges/oz.
9. **Adjust Volume.** If the number in the display does not equal the number of ounces or liters pumped into

your container, press the **INC/+** or **DEC/-** buttons until the display equals the amount in the container. Hold for 10 seconds or so before adjustment begins. **Repeat if necessary to verify accuracy.** Press the **RESET** key to clear the Volume counter and make sure to empty the measuring container.

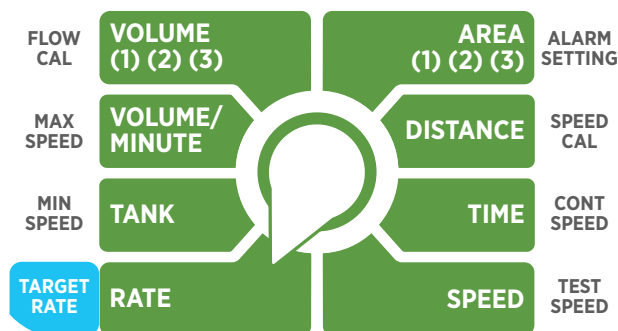


FIGURE 26: ROTARY DIAL—TARGET RATE

10. **Save.** Turn dial to **RATE**. Press and hold **CAL** to save.
11. **Reattach** the product line.
12. **Start** your machine.
13. **Ready.** If you have a GPS or radar, set your **SPRAY** toggle in the upper right of the SmartFlow® II unit to **VAR**. This will let you maintain a constant rate, regardless of whether you are driving 5 mph or 15 mph.

NOTE: Engine does not need to be running to perform this check.

NOTE: The unit will shut off <2 mph and >15 mph. If you do not have GPS or radar, set the Spray toggle to Cont, and drive as close to 10 mph at all times when you have spray on.

SPECIAL CALIBRATION MODES

COUGAR® ULV SPRAYER

Special Calibration Modes

This section covers these special calibration modes and procedures:

Special Calibration Modes	112-114
Operation	113
Units	114
Vehicle ID	114
Width	114
Control Speed	114
Tank Alarm Set Point	114
Fill Tank Size	114

Special Calibration Modes

Operation

When in Special Calibrate mode various words will be displayed in the Application Rate display window to help identify which Special Cal Factor you have selected.

To enter **SPECIAL CALIBRATE** mode the user must turn the machine's Power Switch to **ON** while holding the **CAL** and the **RESET** button at the same time. The Data display will show "SPEC" for 1.5 seconds and then the value of the selected **SPECIAL CALIBRATE** factor.

The **CAL** icon will also be visible in the Data display window and the red Warn LED will flash to indicate that these factors can be adjusted.

Various words will be displayed in the Application Rate display to help identify which Special Cal Factor is selected. The **INC** or **DEC** buttons are used to adjust each **SPECIAL CALIBRATE** factor and the longer the button is pressed the faster the value will change.

All **SPECIAL CALIBRATE** factors will be stored in Electrically Erasable Programmable Read-Only Memory (**EEPROM**) when exiting **SPECIAL CALIBRATE** mode (press **CAL** button for 1 sec). They will not be saved when power is turned off, so if a user accidentally makes a change, he can turn the power off to abort any **SPECIAL CALIBRATE** changes.

The following positions have a Special Cal factor. The Data display will show dashes and the Application Rate display will go blank when in an unused **SPECIAL CAL** position.

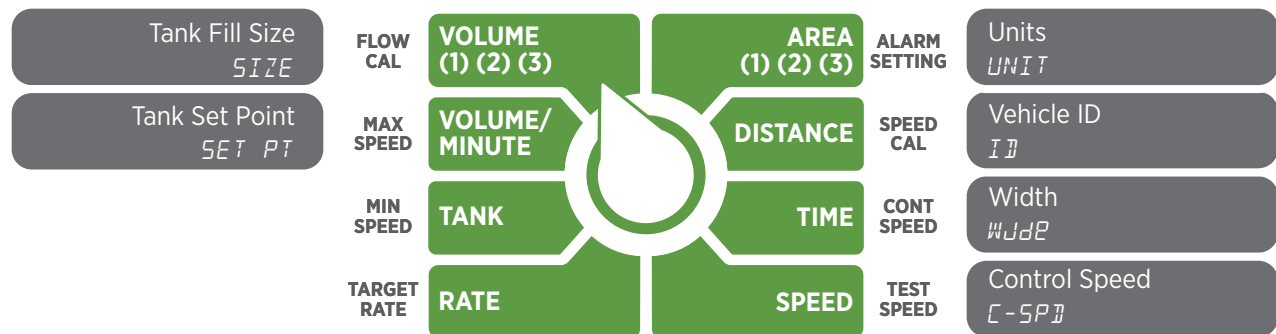


FIGURE 31: SPECIAL CALIBRATION FACTORS

OPERATION

COUGAR® ULV SPRAYER

Special Calibration Modes (*continued*)

1. Units

Selecting Area position displays Unit in the Application Rate display and allows the user to change the Units. Pressing the **INC** or **DEC** button will toggle between English and Metric and the Data display will show *ENG* or *MET*.

It is recommended that Units be changed by loading English or Metric defaults because changing the Units cal factor does not automatically convert other **CAL** factors. Therefore if the Units are changed the user must review and change all other cal factors (like Width) to the correct value for those units. Display will go blank when in an unused **SPECIAL CAL** position.

2. Vehicle ID

Selecting Distance position displays *ID* in the Application Rate display and allows the user to change the Vehicle ID from 0 to 255.

3. Width

Selecting Time position displays *WIDTH* in the Application Rate display and allows user to change the Width from 0.1 to 6,553.5 feet or 0.01 to 655.35 meters if Metric.

4. Control Speed

Selecting Speed position displays *C-SPD* in the Application Rate display and allows the user to change the Control Speed for the control algorithm. Pressing the **INC** or **DEC** key will adjust the Control Speed from -4 to 3. It is normally set in the middle (-1) but if needed, it allows the user to decrease or increase the Control Speed for his particular system.

5. Tank Alarm Set Point

Selecting the Volume/Minute position displays *SEETP* in the Application Rate display and allows the user to change the **TANK ALARM SETPOINT** which can be toggled to **OFF** or set from 0.1 to 6,553.5 Gallons or Liters.

When **OFF** no alarm will be given as the Tank is emptied otherwise a visual and audible alarm is given. See Tank function for details.

6. Fill Tank Size

Selecting Volume position displays *"SIZE"* in the Application Rate display allows the user to enter a **Fill Tank Size** which can be toggled to **OFF** for 0.1 to 6,553.5 Gallons or Liters.

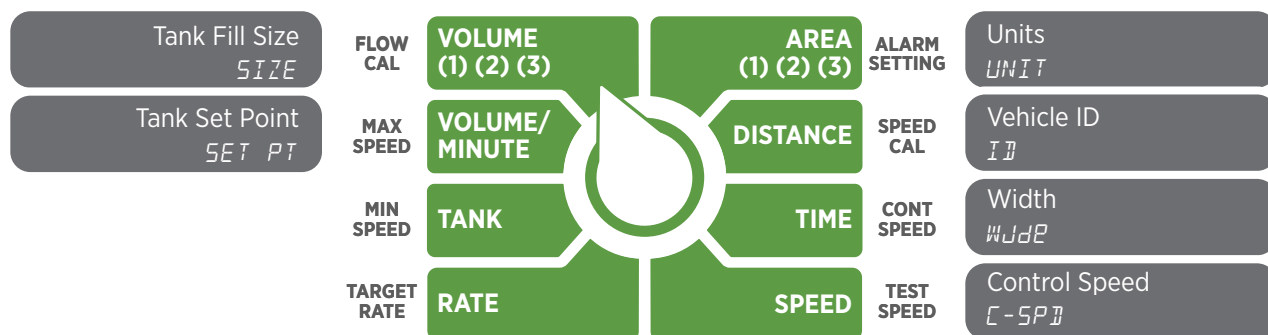


FIGURE 32: SPECIAL CALIBRATION FACTORS

SmartFlow II Operation

This section covers these operating procedures:

Operation	115-120
Startup/Shutdown	116
Power-Up Messages	117-118
Selecting the Application Rate	119
Clearing Counters	120
Adjusting Tank Volume	120

OPERATION

COUGAR® ULV SPRAYER

Startup/Shutdown

Step by Step SmartFlow II Operation

1. Make sure **SPRAY** is **OFF**.
2. Check **RATE** switch in position.
3. Switch **POWER** switch to **ON**.
4. Hold **CHOKE** switch up.
5. Hold **START** switch up until engine starts.
6. When ready to start spraying move **SPRAY** switch to **VAR** or **CONT**.
7. When done spraying flip **SPRAY** switch to **OFF**.
8. If desired, hold **FLUSH** switch for 2 seconds.
9. After one-minute flush cycle, engine will throttle down.
10. Move Power switch to **OFF** position.

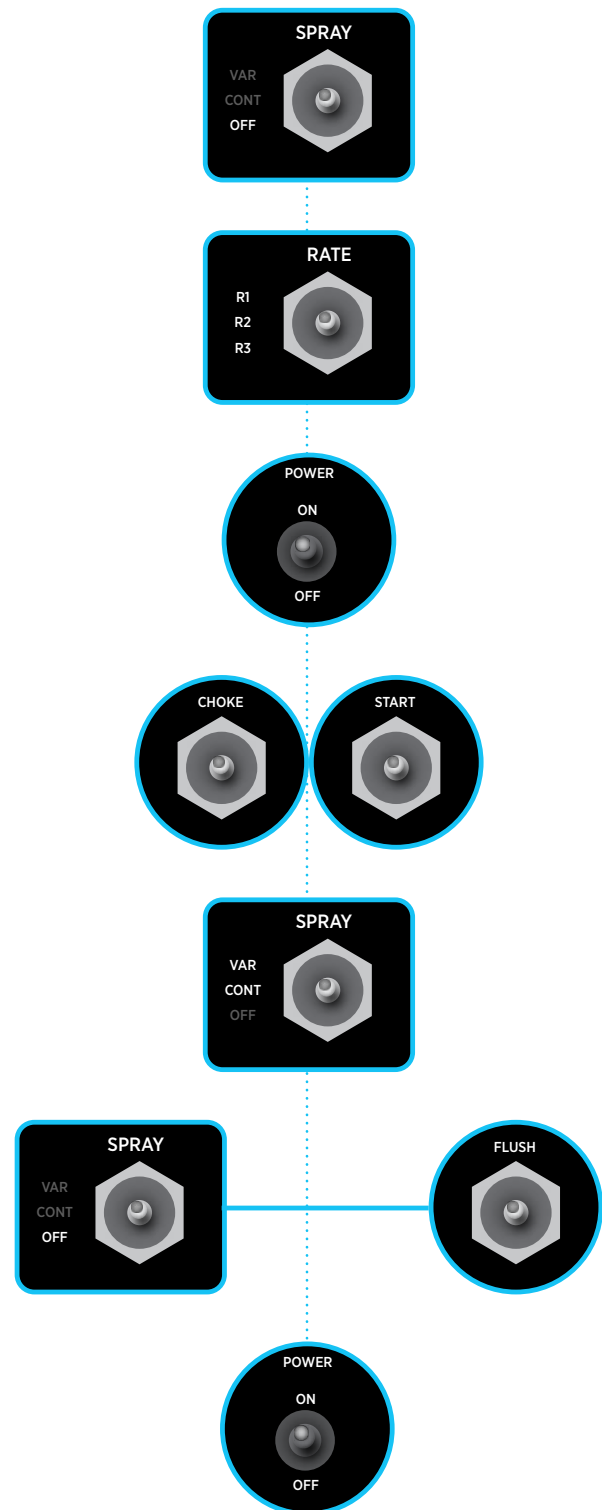


FIGURE 33: STARTUP STEPS

Power Up Messages

When the SmartFlow II is turned on it will give a very short beep and flash the Warning LED to ensure they are working.

It will then display the number of hours it has operated in 0.1 hour increments up to a maximum of 9999.9 hours (then it will display OFL).

9 9 9 9. 9

After one second it will display the Software Part Number for 1.5 seconds and then will display the Software Revision for 1.5 seconds.



FIGURE 34: POWER UP MESSAGES

OPERATION

COUGAR® ULV SPRAYER

Power Up Messages (*continued*)

Bad Cal

At power the SmartFlow II performs a verification of its stored memory (EEPROM). If it detects a problem it will display “bAd CAL” and wait for the user to press the **CAL** button.

It will then enter “view only” **CALIBRATE**, and the user should check all the calibration values and the **SPECIAL CALIBRATE** factors. The console will remember Bad Cal until the user selects the ‘View’ Calibrate Mode.

Cycling power, etc. will not clear it.

FIGURE 35: POWER UP MESSAGES



Selecting the Application Rate

To select a preset Application Rate, flip the toggle switch to the desired Rate (1, 2, or 3) and this will be displayed in the Application Rate window.

If the **SPRAY** switch is in the **VAR** or **CONT** position, the selected Rate is displayed.

If the **SPRAY** switch is in the **OFF** position, the upper window will still display **OFF**, but the new application rate will be selected.

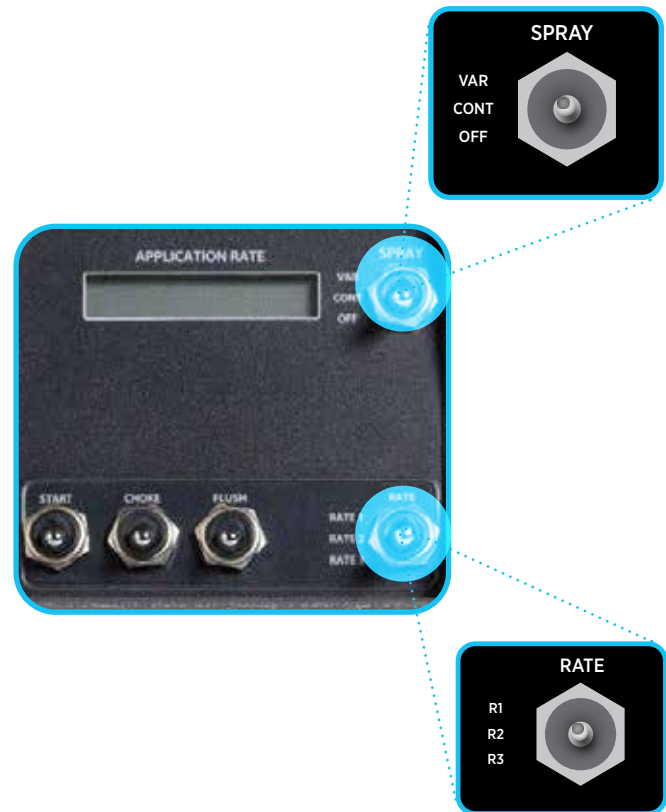


FIGURE 36: SELECTING THE APPLICATION RATE

OPERATION

COUGAR® ULV SPRAYER

Clearing Counters

When **AREA** and **VOLUME 1** (only) are selected, the **RESET** key will clear four counters (Area 1, Volume 1, Distance and Time) at the same time.

When in **OFF** mode, and in the **DISTANCE**, **AREA**, **VOLUME**, or **TIME** rotary position, pressing the **RESET** key for 1 second will clear Time, Distance, Area 1 and Volume 1 (four counters).

While in **DISTANCE** or **TIME** mode, it will not display or clear any counters unless the counter pair 1 is selected in **AREA** or **VOLUME**. The Area-Volume pairs 2 or 3 are cleared independently.

While in **AREA** or **VOLUME** mode, select the desired pair to clear (2 or 3), and with the **SPRAY** toggle in **OFF** mode press the **RESET** key for 1 second. Since the Area and Volume Counters are paired, clearing a selected Area Counter will also clear the corresponding Volume Counter (and vice versa).

When the **RESET** key is pressed it will immediately display in the Data display as a warning that it is about to clear counters. If the **RESET** key is released while displaying, then the counters remain unchanged. If the **RESET** key is pressed for 1 second or more, then the message disappears and is replaced with "0" to indicate the counters were cleared.

Adjusting Tank Volume

You should adjust the Tank Volume to match the actual volume of pesticide liquid in your tank each time you fill the tank.

To adjust the tank volume:

1. Make sure that the SmartFlow II control is **not** in **Calibration Mode**.
2. The tank volume can be adjusted by setting the **SPRAY** switch **OFF** and then using the **INC** or **DEC** keys to adjust it from 0.0 to gallons or liters. For safety this can only be done while the **SPRAY** switch is in **OFF**.

Troubleshooting

This section covers these operating procedures:

Troubleshooting	121-127
Error Codes	122-123
Messages and Warnings	124-125
EPD Status Codes	125
Console Display Conditions	126-127
No Console Power	126
Warning LED & Audible Alarm	127
Low Voltage Detection	127
Notes	128-130

Error Codes

General

If an Error occurs for more than 1.5 seconds, then the Application Rate display will display *Err 1*, *Err 2*, *Err 3*, *Err 4*, or *Err 5*. Error codes are not shown while in the **CALIBRATE** or **SPECIAL CAL** modes. Error codes take precedence and will override **OFF**, **PCOFF**, **OFL**, or **FLUSH** messages.

Error Codes—Err 1

Error Code 1

No Air Pressure detected. This code relates to whether the engine is running or not. Located behind the PSI gauge is a Low-Pressure Cut Off Switch that detects air pressure coming from the blower. Typical reasons this error would come up are;

- The engine is not running.
- The blower is not turning (check the coupler from the engine to the blower).
- The hose from the blower to the gauge is damaged, missing, disconnected or clogged.
- The wires to the pressure switch have been damaged.
- The pressure switch is bad.

Error Codes—Err 2

Error Code 2

In CONTINUOUS mode there is no flow signal.

- The pump is not turning.
 - The High fluid pressure switch is bad. Located next to the pump is a 50 psi switch that disconnects power to the pump when excess fluid pressure is detected on the chemical line.
 - The nozzle solenoid valve is malfunctioning causing a high fluid pressure issue when the pump attempts to run. Check all wires leading to the nozzle solenoid, there should be 12 volts going to the solenoid when the spray switch is on.
 - The pump is bad or has a high current draw. If the pump spins briefly, stops, spins briefly again and then completely stops working until the spray switch is cycled, the pump motor may need to be replaced.
 - The EPD module is malfunctioning. If the pump does not turn at all, the system has power and all the wires look good the EPD module may be damaged. If the module has the center System Status LED, it can be used to troubleshoot. *See chart on page 125.*
- The magnetic wheel is damaged.
- The green flow sensor is malfunctioning. If the pump runs it does not accumulate volume on the SmartFlow II display.
- There is a problem in the wiring.

Error Codes (*continued*)

Error Code 3

In **VARIABLE** mode there is no flow signal.

- a. Same as Error 2, just in **VARIABLE** rather than **CONTINUOUS**.

Error Code 4

Flow detected when the spray switch is OFF.

- a. There are shorted wires.
- b. EPD module is malfunctioning.

NOTE: This error can show up if the pump runs on briefly after the switch has been shut off. As long as the error does not last more than 2 seconds, this should not be a concern.

Error Code 5

Flicked Flush switch and the pump is not running.

- a. Same as Error 2 just in **FLUSH** rather than **VAR** or **CONT**.

NOTE: Any of these errors can also be caused by a malfunctioning SmartFlow II console. Trouble shoot the basics first, if another console is available try using that different one to see if the error is resolved.

TROUBLESHOOTING

COUGAR® ULV SPRAYER

Messages and Warnings

The Consoles will display the following messages
(in alphabetical order) for the conditions indicated:

DISPLAY	CONDITION
<i>bAd CAL</i>	if EEPROM Check Sum equals zero or fails at power up.
<i>CAL</i>	Shown in App Rate display to help indicate Cal mode is selected.
<i>CLER</i>	Warning that user is about to Clear a counter.
<i>C-SPd</i>	In App Rate display to indicate the control algorithms 'Control Speed' in Special CalMode is selected.
<i>Err 0</i>	Error code in App Rate display where n = 1 to 5.
<i>FAIL</i>	Failed to reprogram the Flash.
<i>FILL</i>	Flashed in App Rate display to indicate the Tank level is equal or less than Tank Set Point.
<i>FLASH</i>	Console is ready to have the Flash reprogrammed.
<i>FLUSH</i>	In App Rate display when performing Flush operation.
<i>bOUR</i>	User is trying to adjust Test Speed while in Continuous mode and needs to go to Variable mode.
<i>HI SPEED</i>	In the App Rate display indicates the ground speed exceeds the Max Speed cal factor while in Variable mode.
<i>Id</i>	In App Rate display to indicate Special Cal 'Vehicle ID' is selected.
<i>LOAD</i>	User has loaded Default Cal Factors. (Metric if in Area mode).
<i>Lo P</i>	Low Power. Pump is stopped.
<i>Lo SPEED</i>	In the App Rate display indicates the ground speed has dropped below the Min Speed cal factor while in Variable mode.
<i>OFF</i>	In App Rate display when Spray toggle switch is in OFF mode.
<i>OFL</i>	Overflow in any display (greater than 99999).
<i>PASS</i>	Correctly finished reprogramming the software.
<i>PCOFF</i>	In App Rate display when VRA Controller selects PC OFF mode by sending Target = 0.
<i>SEE</i>	User has started 'View and Change' Cal mode.

DISPLAY	CONDITION
SEEP E	In App Rate display to indicate Special Cal TANK 'SET POINT' is selected.
SPEC	In App Rate display to indicate SPECIAL CAL mode is selected.
SIZE	In App Rate display to indicate Special Cal TANK 'Size' is selected.
Store	Has stored Default Cal Factors to non-volatile memory.
Units	In App Rate display to indicate Special Cal UNITS is selected.
WIDTH	In App Rate display to indicate Special Cal WIDTH is selected.

Messages/Warnings: EPD Status Codes*

*revised 7/23/20

Control Signal LEDs:

GREEN LED lights when control signal is present and increasing

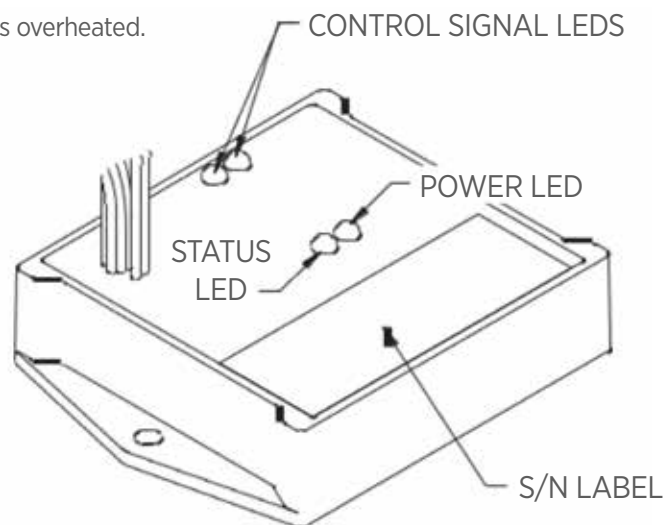
RED LED lights when control signal is present and decreasing

Power LED (**GREEN**):

- Steady ON when spray switch is in CONT or VAR position.
- 1 Flash/pause when spray switch is in OFF position.
- After 5 consecutive minutes in OFF position, the Power LED will automatically turn off and stay off until spray switch is moved to CONT or VAR position again.

Status LED (**RED**): flashing code repeats every 4 sec

- | | |
|-------------------|---|
| • 2 Flashes/pause | Output short circuit detected. Check motor connections. |
| • 3 Flashes/pause | Over-current condition. Check total load. |
| • 4 Flashes/pause | Input power fault. Check input voltage and/or power wiring. |
| • 6 Flashes/pause | Internal processor fault. |
| • 7 Flashes/pause | Thermal shutdown fault. Unit is overheated. |



TROUBLESHOOTING

COUGAR® ULV SPRAYER

Messages/Warnings: No Console Power

Condition

No display or luminance.

Check 1

Make sure that the main breaker and power on switch are engaged. Make sure battery is connected and fully charged.

Check 2

Disconnect 7 pin cable from console; measure for voltage between the two larger terminals in the connector (thick Blue and Orange wires).

Repair

If voltage is present, reconnect to console.

If voltage not present, see Check 3.

Check 3

Disconnect 7 wire cable from pump box; measure for voltage between the two large terminals of the 7 pin connector (thick Blue and Orange wires).

Repair

If voltage is present and it was not present for check 2, replace defective cable.

If voltage is not present, see Check 4.

Check 4

Check the EPD circuit breaker in pump box. Is the circuit breaker tripped? (i.e. black button extended)

Repair

Push in circuit breaker button. **If circuit breaker stays closed**, reconnect cable and console, and retest.

If circuit breaker does not stay reset, go to Check 5.

Check 5

Disconnect the small orange wire from the circuit breaker and reset, if the breaker stays reset and there is power to the SmartFlow II then the EPD module may be faulty.

Repair

Tighten and/or replace EPD module.

Messages/Warnings: Warning LED & Audible Alarm

While in VARIABLE or CONTINUOUS mode, the Warning LED, and the Audible Alarm will turn on (steady) whenever there is more than 10% error in the application rate. However the audible alarm (only) can be delayed if the “Alarm Setting” is used.

While in VARIABLE, CONTINUOUS, or OFF mode, the Audible Alarm will beep (on and off) the Warn LED will turn on, and the Application display will alternate with the “FILL” message, whenever the **TANK** value is less than the **TANK ALARM SET POINT**.

When in the “View Calibration” mode the Warning LED does not turn on but when in the “View and Change” Calibration mode then the Warning LED will flash (warning) that the INC and DEC keys will change the calibrate factors.

The Warning LED will flash (warning) when in the Special Calibrate mode and the INC and DEC keys will change the special calibrate factors.

The Warning LED will turn on (steady) when in Test Speed mode.

There are three types of Audible alarms.

1. A steady tone indicates a 10% Rate Alarm.
2. A fast beeping (On/Off) indicates the Maximum or Minimum Speed has been exceeded.
3. A slow beeping (On/Off) indicates a Tank Alarm.

When all three alarms occur at the same time, the priority is shown above and the Rate Error alarm will take precedence and the alarm will stay on steady, and the Min/Max Speed Alarm will take precedence over the Tank alarm.

The audible alarm (only) can be turned off (disabled) using the “Alarm On/Off” toggle switch on the back of the console.

Messages/Warnings: Low Voltage Detection

When the supply voltage drops below the minimum required operating range, the Data display will display “Lo P” (Low Power) and:

- Stop Sprayer (clear Enable EPD output to ‘0’).
- Stop Blower (clear Enable Throttle/Nozzle output to ‘0’)
- Store all counters in EEPROM

If supply voltage returns (brown out recovery) to normal operation then it will turn the blower back on (enable Throttle/Nozzle output) and then wait for either “Pressure OK” or “RPM OK” and then turn the sprayer back on (enable EPD output) to return to normal operation.

NOTES

A large grid of small blue dots, arranged in approximately 30 rows and 60 columns, covering the majority of the page below the 'NOTES' header. This grid is intended for users to write or draw notes on.

NOTES

NOTES

A large grid of light blue dots covering the majority of the page, intended for taking notes.



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