

OJK



Stepp OJK-Vertical Crack Sealers With
SMART TECHNOLOGY

STEPP MFG
ASPHALT MAINTENANCE EQUIPMENT
651-674-4491 / STEPPMFG.COM

Warranty

Stepp Manufacturing Company Inc. hereby warrants to the original purchaser that products manufactured by Stepp Mfg. will be free from defects in material and workmanship for a period of one (1) year from the date of purchase.

Stepp Mfg., at its discretion, will provide for the repair or replacement of any part found upon examination by Stepp Mfg. to be defective, except as noted below. Such repair or replacement will be free of charge to the original purchaser for a period of one (1) year from the date of purchase, except as noted below.

No warranty is extended to cover:

- Product pump wear or damage caused by foreign objects.
- Routine maintenance, cleaning, and adjustments.
- Parts/components that have been altered, misused, or improperly adjusted or maintained.
- Transportation to and from the place of warranty repair.
- Removal of material from equipment.

The following items are covered solely by their manufactures warranty:

- Engines
- Hydraulic components
- Burners
- Pumps
- Tires
- Other component parts

The following items are covered by a pro-rata warranty:

- Hoses that carry heated materials.
- Heating elements for hoses and wands.

Disclaimer of further warranty:

Stepp Mfg. makes no warranty, expressed or implied, other than this warranty. The implied warranties of merchantability and fitness for particular purpose are hereby disclaimed. Repair or replacement of products or parts proving to be defective in material or workmanship shall be the exclusive remedy for breach of this warranty.

Stepp Mfg. shall not be liable for incidental or consequential damages including but not limited to: damages for inconvenience, rental or purchase of replacement equipment, for loss of profits, loss of material, or other loss resulting from breach of this warranty.

Stepp Mfg. reserves the right to incorporate any changes in design into its products without obligation to make such changes on products previously manufactured.

Please see Warranty section for more details.

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INTRODUCTION

OJK Stepp Oil Jacketed Kettle

Thank you for selecting *Stepp* highway maintenance equipment. We are confident you will be satisfied with the *Stepp Oil Jacketed Kettle*. *Stepp Manufacturing* is backed by over 78 years of experience in the design and manufacture of highway maintenance equipment. This experience along with our innovative design and unique features make the *Stepp Oil Jacketed Kettle* the fastest and most efficient kettle available.

In order to assure safe operation of this equipment, the operator must read and understand all operating procedures and safety notices contained in this manual. In addition, the operator must receive instruction on how to safely operate the *Stepp Oil Jacketed Kettle*. Contact the manufacturer if any questions arise or if you desire training for additional staff members.

Operating instructions, adjustments and periodic maintenance procedures are given so you, the operator, can keep your unit working like new and expect many years of dependable service from it. Remember, any machine, regardless of design or type, will perform only in relation to the way it is operated and the maintenance it receives.

Read this manual carefully and observe all warnings and cautions. If you have any recommendations or comments regarding this manual, please send them attention to: Stepp Manufacturing Co., Inc., 12325 River Road, North Branch MN 55056-6225 or call 651-674-4491. All comments we receive are reviewed and may be incorporated into future manuals.

When ordering parts or making any inquiry about the *Stepp Oil Jacketed Kettle*, be sure to include the model number and serial number found on the data plate attached to the frame.

TABLE OF CONTENTS

Introduction	3
Contents	4
Warnings, Cautions, Notes	5
Specifications	6
Description	7
Operations	14
Maintenance	28
Troubleshooting	41
Replacement Parts	81
NHTSA Reporting Safety Defects	148
Proposition 65 Warning	149
Warranty Guide	150
Schematics	155
Heat Transfer Oil MSDS	162
Hydraulic Oil MSDS	172
Kubota Engine Manual	182
Kohler LPG Engine Manual	222

IMPORTANT NOTICE!

This manual contains cautions and warnings that alert you to potential safety issues.

WARNING is used to inform you of conditions or operations that could cause serious injury or death.

CAUTION is used to inform you of conditions or operations that could cause damage to the equipment

NOTE is used to provide you with additional information that may be helpful or useful for a particular situation.

This manual explains the basic operations, maintenance and use of the Stepp OJK Oil Jacketed Kettle. The main objective of this equipment is to melt rubberized crack sealing and water proofing compound and apply them to road surfaces.

Before Starting or Operating this Machine

Understand and observe all the following **Warnings**, **Cautions**, and **Notes**.

WARNINGS

- ◆ This equipment contains mechanical and heating components that may cause serious injury or death if not handled or maintained properly. All personnel must be properly trained in the operation and maintenance of this equipment.
- ◆ Before refueling, shut off the burners and allow all flames in the burner and pilot light to extinguish. Shut off the engine.
- ◆ Check fuel lines, fuel line connections, and all other components for leaks. If any leaks are found, they must be repaired before using the unit.
- ◆ Know the temperature required for the material being used, and do not exceed this temperature. Avoid over heating, as this may cause equipment damage, personal injury, and/or death.
- ◆ Never load a tank with heated oil when moisture is present in the tank. Depending on the temperature of the hot oil, the moisture may instantly boil causing hot oil to foam up and out of the tank causing severe burns.
- ◆ Do not operate the tack tank burner when the amount of material in the tank is less than 4" above the flues. Allow 10 minutes cool-down time after the burner has been shut off before exposing the flues. Exposed flues will over-heat and cause an explosion and/or fire.
- ◆ The tack tank cover must be unlatched when operating the tack tank burner. This is to provide for emergency venting, in the event of a flash, to prevent the tank from exploding.

CAUTIONS

- ◆ Know the materials being used and know the proper handling, heating, application, clean-up, and storage procedures. Not all materials are compatible with each other. Many materials have a very limited shelf life. Most materials require special handling procedures to prevent personal injury and/or equipment damage. Contact your material supplier and/or manufacturer for proper handling instructions. Equipment malfunction or damage due to improper handling or use of the materials is not covered by warranty.
- ◆ Do not exceed the maximum heating temperature or storage time as recommended by the material manufacturer. This may cause emulsion type materials to separate and become difficult or impossible to remove from the machine. Consult with the material manufacturer for recommendations.
- ◆ Over-agitation or circulation may cause emulsion type materials to separate and become difficult or impossible to remove from the machine. Consult with the material manufacturer for recommendations.
- ◆ Do not mix *Anionic* and *Cationic* materials together, as the materials attach to each other and will become difficult or impossible to remove from the machine. If you are not sure consult your material supplier.

NOTES

- ◆ Become familiar with the Material Safety Data Sheet (MSDS) for the material being used in the machine and take appropriate safety precautions. Wear the proper clothing and protective gear as recommended by the MSDS and your safety director.
- ◆ DO NOT use the equipment unless it is in good condition.
- ◆ In case of skin contact with hot materials, dip into **cool, clean water immediately**. Do not wipe the product, as this will spread the burn.
- ◆ Consult the MSDS and contact your safety director for proper extinguishing of petroleum based fires.
- ◆ Carry a fire extinguisher(s) as recommended by your safety director.
- ◆ Notify your supervisor or the manufacturer if any questions arise concerning the operation of this equipment.

	OJK 75	OJK 125
Shipping Weight	2100#	2700#
GVWR	6000#	6000#
Length x Width x Height	162"x78"x94"	162"x78"x108"
Material Capacity	75 Gallons	125 Gallons
Fuel Tank Capacity	23 Gallons	23 Gallons
Hyd Tank Capacity	10 Gallons	10 Gallons
Tank Construction	10ga Tank 7ga Oil Jacket 16ga	10ga Tank 7ga Oil Jacket 16ga
Tank Configuration	Vertical	Vertical
Loading Height	52"	52"
Heat Transfer Oil	Amsoil IHT 600°F	Amsoil IHT 600°F
HTO Capacity	23 Gallons	26 Gallons
Controls	AKC Advanced Kettle Control all	AKC Advanced Kettle Control
Burner Type and Output	Diesel 208,500 BTU	Diesel 208,500 BTU
Hose Style	Heated Ultra-Lite 3/4" Smooth	Heated Ultra-Lite 3/4" Smooth
Boom	24V Electric Heated	24V Electric Heated
Pump	Roper	Roper
Product Pump GPM	20 GPM with variable range 0-10 GPM	20 GPM with variable range 0-10
Wand	Ultra-Lite Aluminum Trigger Electrically Heated	Ultra-Lite Aluminum Trigger Electrically Heated
Engine	Kubota D602 16.5 HP	Kubota D602 16.5 HP
Engine Controls	Deep Sea Digital Engine Mgmt.	Deep Sea Digital Engine Mgmt.
Hydraulic Pump	.66 Gallon Gear Pump	.66 Gallon Gear Pump
Hitch Height	Adjustable 24"-32"	Adjustable 24"-32"
Frame Construction	2"x4"x3/16" Rectangular Steel	2"x4"x3/16" Rectangular Steel
Axles	Single 6,000#	Single 6,000#
Tires	(2) 225/75R15 LR-E	(2) 225/75R15 LR-E
Brakes	Electric (Hyd Optional)	Electric (Hyd Optional)
Hitch	3" Pintle or 2-5/16" Ball	3" Pintle or 2-5/16" Ball

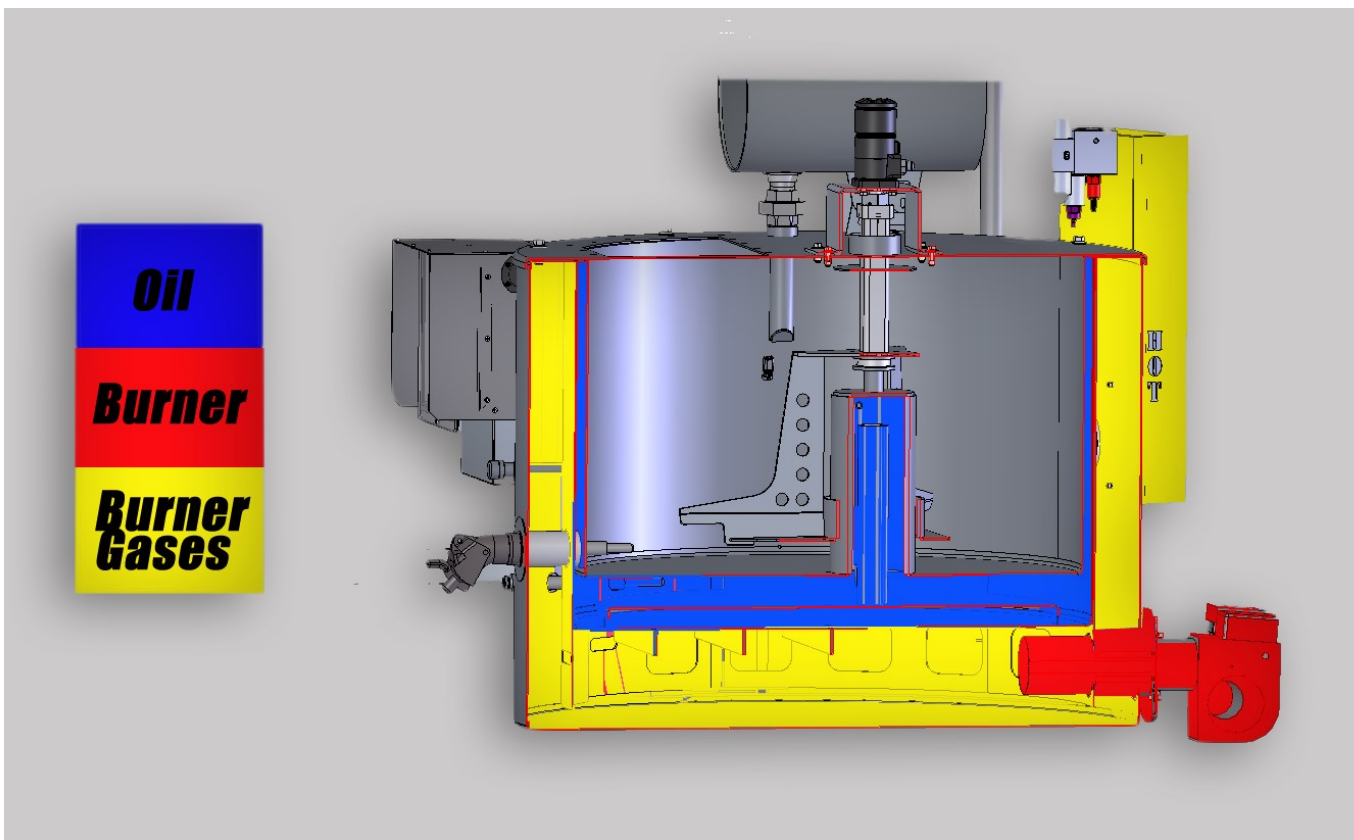
DESCRIPTION

DESCRIPTION

The OJK uses a tank surrounded by an oil jacket filled with heat transfer oil. The heat transfer oil is heated by a diesel fired burner. The temperature of the product and the heat transfer oil is automatically maintained by electronic temperature controls.

The heated asphalt is applied to the crack by an electrically heated hose and wand. The heating element in the hose and wand keep the product at working temperature thus eliminating wand "freeze up". No clean-up or flushing of the wand & hose is required.

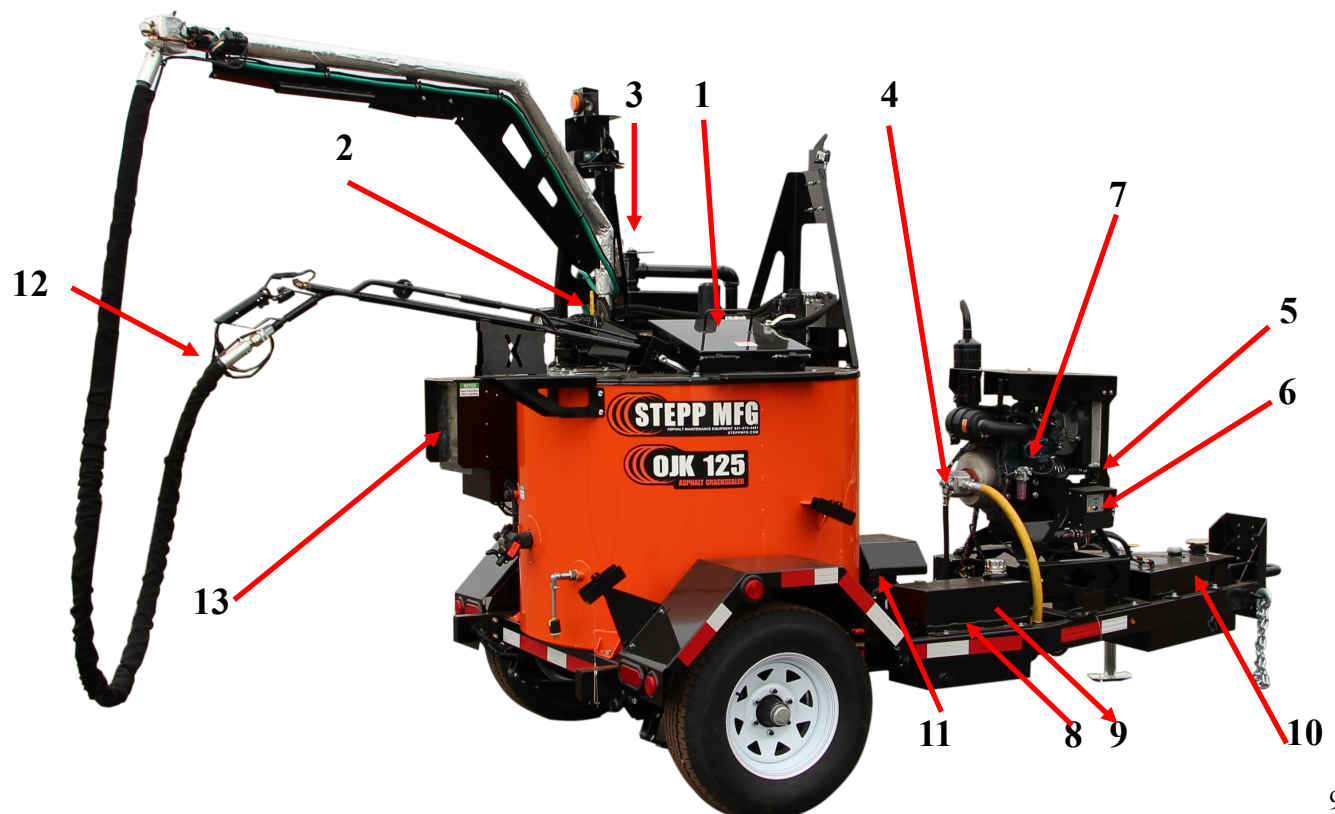
Power is supplied by a diesel engine. The engine drives a 24 volt alternator for the heated hose and wand. It also drives a hydraulic pump that powers product pump, and the agitator.



DESCRIPTION

Component Location

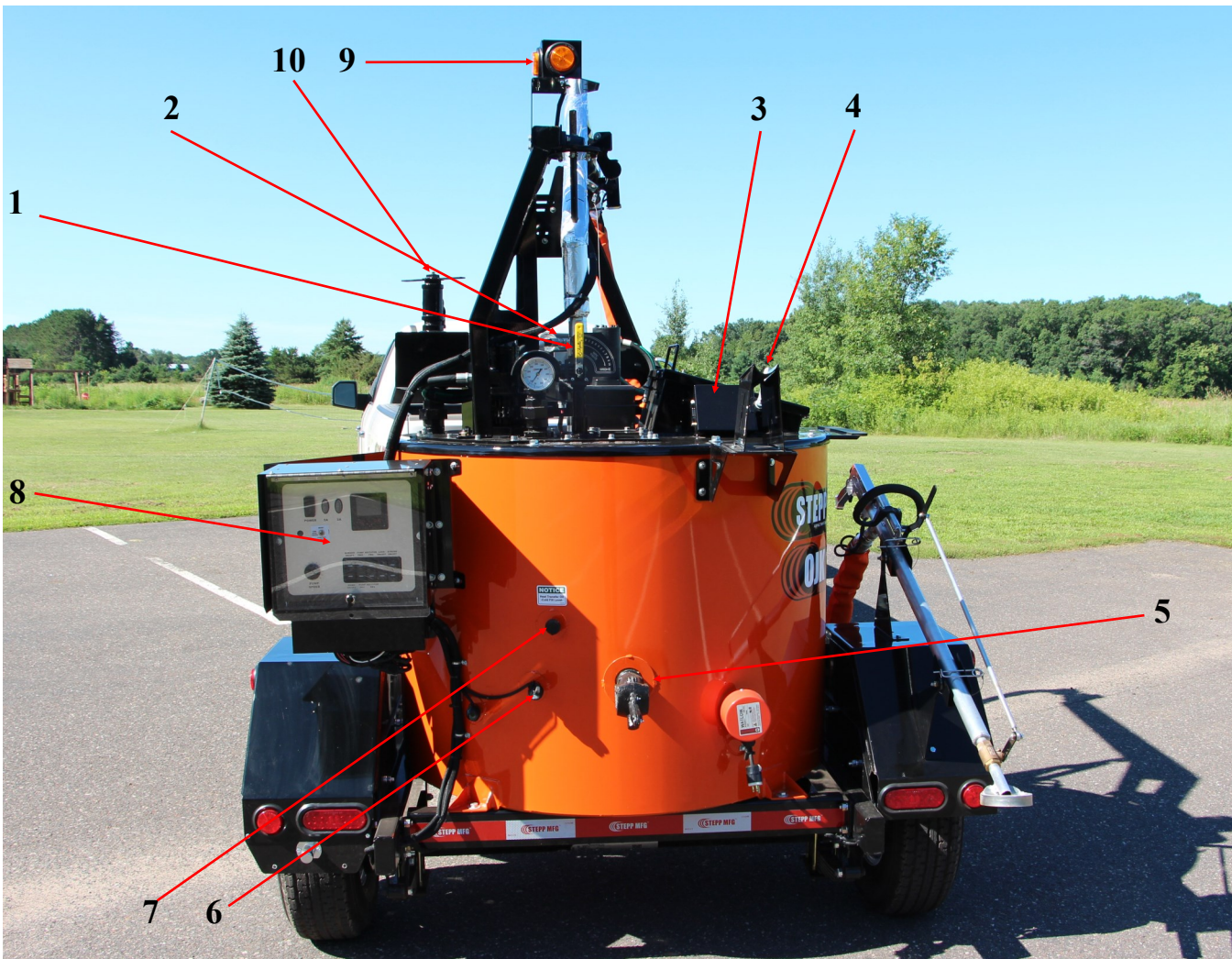
1. Safety loading chute — Provides a "splash free" way of loading product into a "hot" tank.
2. Product pump motor — Powers the pump that pumps the product from the tank to the wand.
3. Expansion tank — Provides room for the heat transfer oil to expand and allows the oil to cool. This creates a "cold seal" effect allowing safer operation at elevated oil temperatures.
4. Hydraulic pump — Provides hydraulic power to the agitator, and the product pump.
5. 24 volt alternator — Provides electrical power to the wand and hose heating elements.
6. Engine control panel — Provides a means of controlling engine functions.
7. Engine fuel filter — Provides clean fuel to engine.
8. Hydraulic filter — Removes contaminants from the hydraulic system.
9. Hydraulic reservoir — Provides a 15 gallon capacity for the hydraulic system.
10. Fuel tank — Stores 30 gallons of diesel fuel to operate the burner and the engine.
11. Burner— Provides heat to heat the heat transfer oil and melt the asphalt.
12. Wand & Hose — Provides a means of applying the product to the road surface.
13. Operators Control Box with AKC (advanced Kettle controls)



DESCRIPTION

Component Location

1. Wand Pressure Control (WPC) valve — Controls the amount of pressure being applied to the hose & wand when the Pump Saver System is not used. Also allows the operator to divert the flow of material back to tank for circulation, or to the wand for application to the road surface.
2. Drive Motor — Hydraulic drive motor powers the product pump.
3. Circulating Flange — The wand is placed into this port allowing circulation through the wand and back to tank.
4. Wand Rest — Holds the wand in position when circulating through the wand back to tank.
5. Draw off cock — Provides a means of draining tank or filling dispensing equipment.
6. Thermal Well — Contains temperature sensor for product temperature.
7. Heat Transfer Oil Level Plug — Allows easy check of oil level only when unit is cold.
8. Control Box— Houses the AKC Advanced Kettle Controls. Includes the thermostats for the Product temp, oil temp, hose temp, auger hydraulic control, pump fwd/rev, pump speed and optional equipment like the strobe light, auto loader and arrow board.
9. Attention Light — Gives operator warning if controls need attention such as product temp interlock, door open/ agitator off and burner malfunction.
10. Heat Transfer Fill and Dipstick— For checking and heating heat transfer levels.



Burner System:

The heating system is designed to burn diesel fuel and efficiently heat the transfer oil. The heating system is equipped with constant ignition (flame-out protection) and automatic controls to monitor the temperature of the heat transfer oil and the product temperature.

Stepp AKC Advanced Kettle Controls

The OJK-V series of crack sealing kettles now boasts an all-in-one PLC CAN bus control system. The AKC controller monitors and controls all burner functions, the heated hose, pumping and agitation controls, kettle interlock safety systems, autoloader controls and operations, auger safety shutdown, pump hours, and diagnostics for the burner control system. The AKC integrates all burner and hydraulic controls into a simple, easy-to-use control package.

Smart Control Burner Interlock

The AKC controller includes a burner interlock system. This will not let the operator activate the pumping system or agitator until the material has reached its interlock temperature. This prevents premature wear on the pumping system and unnecessary hydraulic load. The AKC controller also displays a warning message on the screen and a boom mounted warning light. The warning messages include burner interlock, RTD failure (temp sensor), door open/close, and agitator shutdown. You can also choose between US and Metric settings.

Temperature Control:

The Stepp OJK is equipped with automatic temperature controls. Two thermostats are used to monitor the temperature of the heat transfer oil and the asphalt product. Both thermostats have the capability of shutting off the burner when their respective settings are reached. Continuous observation of the temperature is recommended. If temperatures exceed the thermostat settings, a possible problem with the thermostatic controls may exist. Shut the burner OFF and contact qualified service personnel.

Full Sweep Agitator

The Ojk-V has a internal, vertical mixer with 3 opposing paddles that not only mix but also lift to add complete agitation within the kettle. The agitator is hydraulically driven and has forward/reverse control. Operating the agitator during the heating cycle will decrease the amount of time and energy necessary to bring the product up to working temperature. The agitator should be turned on as soon as the material melts sufficiently and the burner interlock minimum temp has been reached. This is factory preset to 275°F. The agitator may be run in either direction and left on while applying crack filler. This will give superior performance through even heating of the product.

Optional Variable Speed, On-demand, Removable, Submerged Pumping System

The OJK-V boasts a submerged 20GPM Roper gear pump for years of durable service. By submerging the pump, we can ensure that it is hot and ready to go as soon as the sealant is up to temperature. The variable speed control is located in the control box or, with the optional exact-flow wand control, on the wand. We have also designed the pump to be easily replaced with the top mounted flange and allows replacement without having to drain the kettle.

DESCRIPTION

Wand Pressure Control Valve

CAUTION: Operators must understand the proper operation of the WPC valve located on the top rear of the unit.

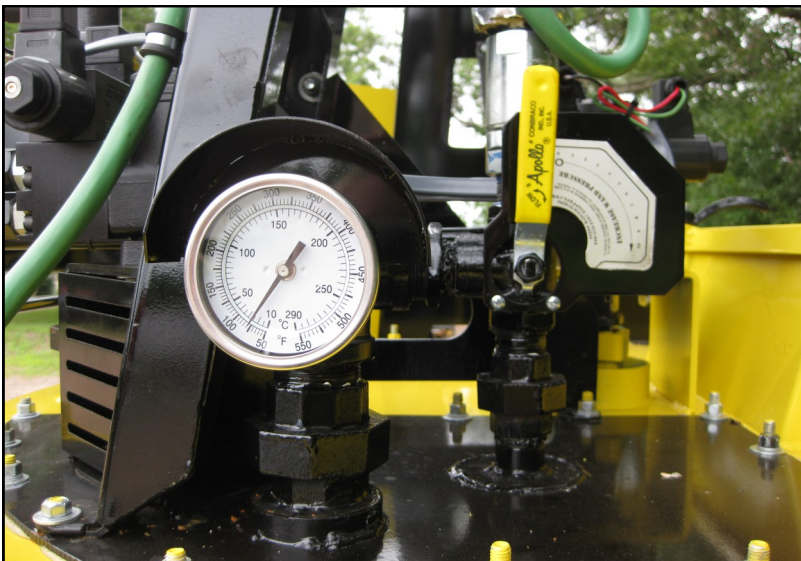
The purpose of this valve is to direct the flow of product either back to the tank (during start-up to assist melting) or to the wand (during crack filling operations).

During normal operation the WPC valve will be in the “Wand” position and the flow of crack sealant will be adjusted by the “Pump Speed” control located in the operators control box or on the wand if equipped with the Exact flow option.

NOTE: Positioning of the WPC valve towards “Recirculate” will cause less flow and less pressure to the wand. Positioning of the WPC valve towards “Wand” will cause more flow and more pressure to the wand.

CAUTION: Observing unusual flexing in the wand hose should alert the operator that excess pressure is being applied to the wand hose. Considering factors such as temperature of product, desired amount of flow and varied operating conditions will assist the operator in selecting the proper position of the WPC valve.

When finished for the day, the WPC valve will be returned to the “Recirculate” position and the pump reversed to evacuate the plumbing.



DESCRIPTION

Heated Hose & Wand:

The application wand and hose are equipped with an internal heating element. The element is powered by the 24 volt alternator run by the engine. This heating element prevents the product from "freezing" in the hose and wand.

The electric wand heat control should be turned on 20 to 40 minutes before trying to pump material through the hose and wand. This will allow time for the material to re liquefy in the hose.

NOTE: *It is recommended that you circulate the product back to the tank through the wand circulating flange provided in the hood. This is to assure proper flow and temperature of the material going through the wand.*

Depending upon the volume of the material going through the wand and the outside temperature, it may not be necessary to run the heated wand all the time. Once flow is established through the wand and circulating back to the tank. No cleanup is required with the electric wand, just shut the machine off as the product can be re melted by activating the wand heat control. No additional flushing is required.

Overnight Heater (optional):

This feature will maintain the product from 150° to 200° F., saving startup time. The system consists of two heating elements submerged in the heat transfer oil.

The heaters require 110V, 15 amp service each. The extension cords used must be the outdoor heavy duty type, grounded, and each rated for 1500 watt service.

Digital Engine Management Controls:

The engine controls consist of a starter / glow plug button, (the deep sea control will also stop the engine in case of low oil pressure or high coolant temperatures), and indicator lights for oil pressure, coolant temperature, hour meter and volt meter. Optional equipment includes engine gauges.

OPERATIONS

WARNING: *Before refueling, shut off the burners and the engine.*

CAUTION: *Be sure operators have been properly instructed in starting and operating all equipment before beginning.*

NOTE: *See following pages for specific instructions on operating burners and heating systems.*

Pre-Trip Inspection

1. Check engine fluid levels & grease machine.
2. Check tire pressure.
3. Inspect unit for any physical damage.
4. Check that discharge gate is operating properly.
5. Truck hook-up and lights .

Transporting

Trailer Hook-up

1. Connect trailer to towing vehicle
 - a. Assure hitch is engaged properly.
 - b. Attach safety chains to towing vehicle.
 - c. Connect electrical plug to towing vehicle.
 - d. Connect breakaway cable to towing vehicle.
 - e. Check operation of lights and brakes.
2. Secure trailer for transport
 - a. Shut OFF the engine and burners.
 - b. Shut OFF all fuel valves.
 - c. Be sure the product temperature is not above the recommended operating temperature.
 - d. Securely latch the loading cover.

WARNING: *Prior to transporting, the driver of the tow vehicle must assure the safety of the operation. The driver must also know, and assure, that the product temperature is within limits.*

Quick Start Operating Checklist

*Read and understand Operators Manual before operating equipment.
Failure to do so may cause Serious Injury or Death.
Below is a start-up check list.*

Start-Up

- 1. Check all fluid levels then start engine. (Refer to operators manual)*
- 2. Unlatch loading chute to provide emergency venting in case of a flash.*
- 3. Start the engine and turn control box power switch to "ON".*
- 4. Set the product temperature that is recommended by product manufacture.*
- 5. Set Heat Transfer Oil (HTO) temperature a minimum of 50° higher than product temperature. (NOT TO EXCEED HTO MAX TEMP refer to the operators manual.)*
- 6. Allow material to heat.*
- 7. Set wand heat thermostat for desired temperature and turn electric wand heat "ON" at least 30 minutes before starting pump.*
- 8. Engage agitator hydraulic control with switch in control box When product temperature reaches the preset temp the agitator will turn.*
- 9. Verify the Wand Pressure Control (WPC) valve is in the recirculate position.*
- 10. Engage pump switch forward and set pump speed at 50% to 75%. When product and wand temperature reach the preset temp, the pump will be enabled. Pull the trigger on the wand to activate the pump. Note: The trigger switch has a lock to be used in recirculation operations.*
- 11. Once the product is circulating, open valve on wand and turn the Wand Pressure Control (WPC) valve to establish flow through the wand.*
- 12. For units with the Exact Flow option, flow can be controlled by the knob on the wand by setting the selector switch to wand position.*

Shut Down

- 1. Turn wand heat OFF*
- 2. Set pump switch to OFF (center) position.*
- 3. Set WPC valve to recirculate position.*
- 4. Set product pump switch to reverse for 2 minutes.*
- 5. Set both thermostats to the lowest setting..*
- 6. Set agitator switch to neutral (center) position.*
- 7. Turn burner power switch OFF.*
- 8. Turn control box power switch OFF*
- 9. Close and latch all covers.*

Note: DO NOT attempt to operate the machine without using these and all other instructions.

Note: Refer to the manufacturer's instruction manual for more specifications on fuel requirements.

Preparing the Machine for Start Up

1. Fill the engine fuel tank with diesel fuel.
2. Check the oil level in the engine crankcase. Refer to the manufacturer's instruction manual for the engine.
3. Check the hydraulic fluid level while at a temperature of 70°F. Add fluid if necessary.
4. With the machine on level surface, check the heat transfer oil level while at a temperature of 70°F. The oil should be at the full mark on the dipstick. DO NOT overfill or spillage may occur when the oil is heated and expands.
5. Make sure discharge valve is in the closed position.
6. Make sure all toggle switches are turned "OFF" and all temperature control dials are set to their minimum settings.

WARNING: The safe operation of this machine is the operator's responsibility.

Use extreme care when operating this machine; safety is the result of being careful and paying attention to details. Remember the diesel flame is approximately 2,200°F. Some exposed parts of the machine reach 500°F, the material 400°F, and the hydraulic fluid 200°F.

Always put on protective clothing, gloves, hard-soled shoes, and safety glasses or a face shield. Be sure that all joints and fittings are tight and leak proof. Immediately replace any hose, which shows any signs of wear, fraying, or splitting. Tighten all bolts, nuts, and screws every 100 hours.

Loading:

It is very important that the operator know the operating temperature and flash point of the product being used. This information is available from the product manufacturer. Be sure the thermostat is set at the recommended temperature.

Prior to adding product to the tank, ensure that no water is present, also ensure the compatibility of the product in the tank to that being loaded. If products are not compatible the tank must be thoroughly drained and cleaned before switching products.

Loading When Hot:

1. Open the safety loading chute and place block of product on the cover of the chute, close loading chute cover and product will drop into tank. Open chute and repeat until product is at the desired level. Agitator will automatically shut off when cover is open. Make sure to close the cover to start the agitator and ensure that the material stays mixing.
2. Close loading chute but DO NOT latch, this will allow for emergency venting in case of a "flash".

Engine Starting:

NOTE: Be sure all pre-start checks are complete prior to starting engine.

1. Fill fuel tank.
2. Turn key switch to the ON (right) position.
3. Hold yellow glow plug button down for 30-60 seconds. This will heat up the glow plugs.
4. Press green start button to start engine.
5. If engine does not start on first try, turn key switch OFF and start the starting sequence over.
6. For units equipped with optional air compressor, an adjustable throttle is provided with in the control to start and run the engine at a lower idle while heating. Once you want to get the full air pressure you will need to press the idle up button on the control to raise the engine throttle to achieve full air pressure and full flow. For units without the compressor, the engine is governed at the optimum speed for operation of the kettle and no throttle cable is provided.



OPERATIONS

AKC Controller -Burner and Pump

AKC Controller Operations:

1. Start engine (see engine operations).
2. Unlatch loading chute, this will allow for emergency venting in case of a "flash".
3. Turn on the power switch
4. Set heating oil set point thermostat to 400-550° F. Not to exceed 600° Thermostat will display the set point (below) and the actual temperature of the product. To set the set point temperature press the button with the round circle under the corresponding temperature that you would like to change. This will highlight the selected thermostat that you will adjusting. You will then use the up and down button on the control to adjust to you desired setting. You will also see the set point temperature change as you press the up or down on the center circle. The top temperature reading is what the actual temp is and you will see that raise as the burner heats the unit up.
5. Set product set point thermostat to the product manufacturers recommended temperature. Thermostat will display the set point and the actual temperature of the product. To set the set point temperature press the button with the round circle under the corresponding temperature that you would like to change. This will highlight the selected thermostat that you will adjusting. You will then use the up and down button on the control to adjust to you desired setting. You will also see the set point temperature change as you press the up or down on the center circle. The top temperature reading is what the actual temp is and you will see that raise as the burner heats the unit up.



User Preferences Menu

By pressing the OK button you can get into the user preferences menu. Here you can change the units from Fahrenheit to Celsius, Gallons to liters. It also displays interlock temps, pounds per gallon, pulses per gallon for adjustment with optional autoloader. To change admin settings you must

press and hold the up arrow and the two round circle buttons on each side of the up arrow, down for 10-15 seconds. That will get you into the admin menu. We do not recommend any changes to the factory preset settings. Please consult with your Dealer or Stepp Mfg. Direct before making any changes.



OPERATIONS

AKC Controller -Burner and Pump

Wand

1. Set wand set point thermostat to the product manufacturers recommended temperature. Minimum of 385-400°F not to exceed 450°F Thermostat will display the set point and the actual temperature of the product. To set the set point temperature press the button with the round circle under the corresponding temperature that you would like to change. This will highlight the selected thermostat that you will adjusting. You will then use the up and down button on the control to adjust to you desired setting. You will also see the set point temperature change as you press the up or down on the center circle. The top temperature reading is what the actual temp is and you will see that raise as the alternator powers the hose.
2. Turn on the burner switch, The switch light will turn from red to green. You should see a small fire symbol if the thermostats are calling for heat. You should see heat coming out of the exhaust stack.
3. Turn on the wand switch, The switch light will turn from red to green. You should see a small fire symbol if the thermostats are calling for heat. You should hear the engine come under a small load as the alternator turns on. You will need 20-40 mins of heating time to completely thaw out hose and wand system. The pump will not operate until the hose temp reaches the burner lockout minimum factory preset of 275°F. We do however recommend that you get to full pouring temp to ensure longer pump life.



OPERATIONS

AKC Controller -Burner and Pump



Agitator

1. When product temperature reaches the minimum 275°F burner lockout temp. You can press the switch to turn on the agitator. Make sure that the agitator turns free. You can see the agitator shaft on the top center of the kettle. If it does not allow more time for the product to heat. The direction of the agitator does not matter but changing the direction every 10 mins during the initial heat up will speed up melting and ensure proper mixing.

Pump

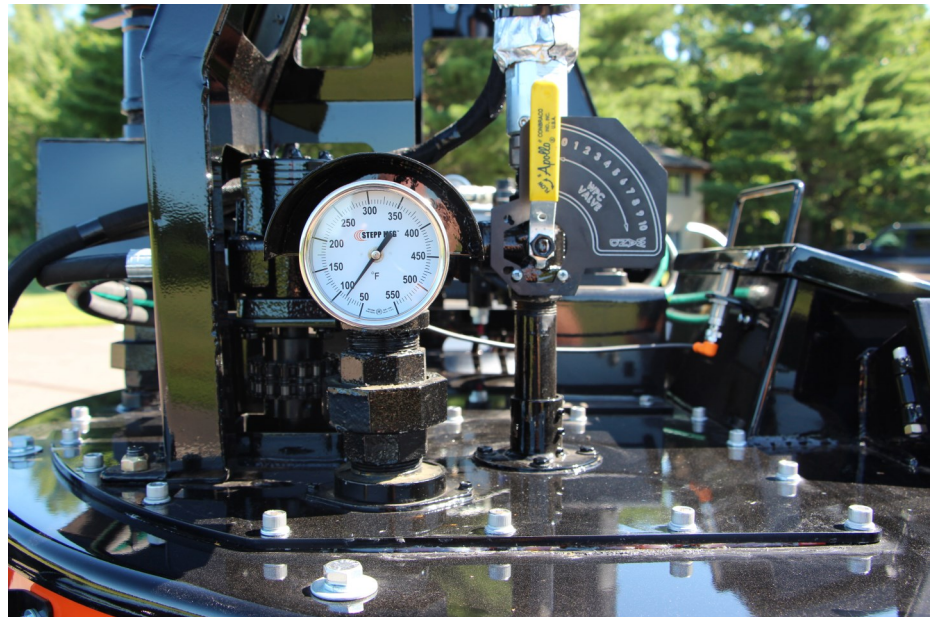
1. Once the Wand Temperature, and the Material Temperature are over the burner lockout temp (factory set to 275°) you can turn the pump on forward. The light on the switch will turn from red to green but the pump will not activate until the trigger on the wand is pulled. Make sure that the wand is in the recirculating flange before initially activating the switch. Also ensure that the manual valve is also in the open or forward position. NOTE that the trigger does have a lock and that the lock is not activated. To inactivate pull the trigger and release. To activate pull the trigger and push in the lock button.
2. Put pump speed control switch in to the control box position.
3. Adjust the pump speed via the pump speed control nob located in the control box. We suggest that you start at the lowest setting possible to just have the pump turning. Over pressuring the hose and pump will cause premature failure and can also create an unsafe situation.



OPERATIONS

AKC Controller -Burner and Pump

1. Before you operate the WPC valve to the wand position. Pull the trigger to recirculate the product in the plumbing back to tank. You can see that the pump is spinning at the rear pump motor.
2. Make sure that the wand shoe, disc or other nozzle are not plugged.
3. Place wand into the recirculating flange and fully open the wand flow control valve located on the wand handle (forward position)
4. Slowly move the WPC valve towards the "Wand" position to allow the product to flow through the wand and back to the tank. If no product flows out the wand, allow additional time for the electric heating elements to melt the product in the hose and wand. You are now ready to applicate material to the roadway surface.



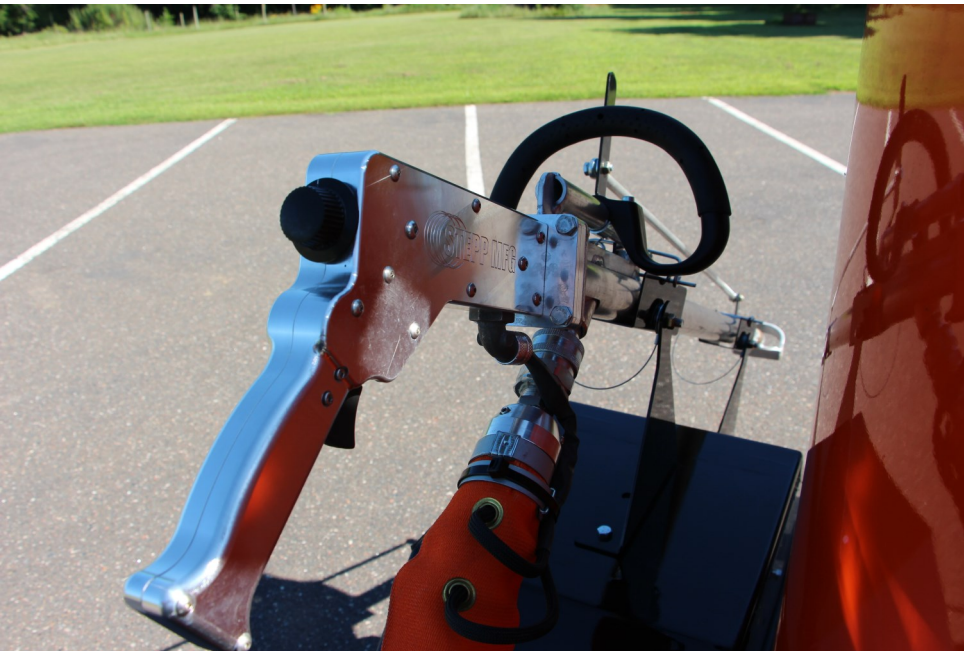
CAUTION: Initial wand purge could cause the material to spurt material. Make sure that the wand is the recirculate flange if it does spurt. Make sure that wand is pointed inside the kettle so that you and no other operators are potentially exposed to hot material.

NOTE: *The pump will not operate unless the trigger is pulled on the wand.*

Standard Application Operations:

Application Operations

1. Switch the pump speed control to wand to allow the rheostat knob on the wand to control the speed and pressure of the pump. Make sure that the rheostat is in the off or turned all the way counterclockwise until it stops.
2. Position the WPC valve fully to the "Wand" position.
3. De activate the trigger switch and ensure that the pump has stopped and remove wand from the recirculating flange. Make sure that trigger lock is unlocked.
4. Activate the trigger on the wand and adjust the rheostat knob to the desired flow allowing the product flow on to the road surface.
5. Adjust the pump speed as necessary for the desired flow.
6. If using a shoe maintain level in the shoe by changing the speed of the pump.
7. Monitor the level in the tank and add product as necessary.



CAUTION: Make sure that the trigger lock is unlocked

CAUTION: Positioning of the pump speed all the way to the "max flow" position may cause excess pressure in the wand which may cause damage to the wand hose or system. The pump speed should not be positioned fully to the "max flow" unless the wand flow control valve located on the wand is open and product is flowing freely, or the pump saver is in operation. Observing unusual flexing in the wand hose should signal to the operator that excess pressure is being applied to the wand hose and the pump speed should be adjusted accordingly.

Standard Shutdown Procedures:

1. Turn OFF the wand heat control switch. Switch should turn from green to red.
2. Move the WPC valve to the "Recirculate" position.
3. Press and hold the product pump switch to activate the pumping system in reverse. Allow the pump to stay in the "Reverse" position for 2 minutes then press the pump switch to turn OFF the pump. This will draw the product out of the pump, plumbing, and WPC valve. Leave sealant in the hose and wand.
4. Turn OFF the burner power switch.
5. Place the agitator switch to the OFF position.
6. Securely latch all covers.
7. Turn key to OFF position to shutdown the engine.

CAUTION: *The Stepp OJK requires special shutdown procedures that must be followed to maximize safety and equipment performance. These procedures will assure that the hose and wand always have product in them to avoid an overheated element. (DO NOT suck the product back out of the wand and hose assembly). No hose cleanup is necessary as the product in the hose is re melted at the next startup with the wand and hose heating element.*

CAUTION: *DO NOT reverse the pump with the WPC valve in the "Wand" position as this would suck the product out of the wand and hose assembly. The hose and wand must contain product to absorb the heat from the heating elements to avoid equipment damage. Only reverse the pump when the WPC valve is in the "Recirculate" position. No hose cleanup is necessary with this system.*

OPERATIONS

Helpful Hints

1. It is recommended that the product level be drawn down to 1/4 capacity or less prior to shutdown if the machine is not going to be used for two days or more. This will decrease the startup time next time the machine is used. However, if the equipment will be used the next day leave the unit 1/2 full or more, then plug in the optional overnight heaters (if available). This will help retain heat for a faster startup the following day.
2. Overnight heating elements normally should not be used for more than 48 hours at a time. Check your product manufacturers specifications for recommended "pot" life.
3. DO NOT heat or reheat any product for a length of time more than that recommended by the product manufacturer. The result of excessive heating time is the material hardening and possibly becoming difficult or impossible to remove from the machine.
4. The flow control valve at the end of the wand is not heated by the heating element. Although heat transfer from the wand will normally be enough, by inserting the wand into the recirculating flange, additional heat from the kettle will aid in heating the valve.
5. If the engine quits for any reason, move the WPC valve to the recirculate position then attempt to resolve the problem and restart the engine as soon as possible. The proper shutdown procedures must be followed before the product hardens in the plumbing between the WPC valve and the top of the kettle. If the product hardens between the WPC valve and the top of the kettle, use heat to re-liquefy the product to reestablish flow.

Optional Air Compressor:

100 CFM rotary screw compressor, direct coupled to the Kubota engine.

1. Start the engine (refer to engine start).
2. Set throttle to adjust the desired air flow using the supplied pressure gauge.
3. Connect the air hose to the quick connector and open the supply valve.

Optional Autoloader:

The optional autoloader will automatically add blocks of sealant to the kettle as you apply material from the wand. You can also operate the autoloader manually with the supplied tether.

1. Turn the load switch to the ON position.
2. Load blocks onto the loading conveyor.
3. Unlatch the loading chute hatch located on the front of the loading hatch.
4. Select between manual or auto-mode.
5. When finished turn the load switch to the OFF position.

NOTE: *The loader operates by calculating the amount of material that you have pumped. Operators still need to monitor the material height in the product tank. Autoloader also has a totalizing option to tell you how many gallons of sealant are pumped. This also includes any material pumped back into the tank.*

MAINTENANCE

OJK MAINTENANCE SCHEDULE

ITEM	OPERATION TO PERFORM	HOURS	AS NEEDED	DAILY	EVERY 3MO	EVERY 12 MO	EVERY 24MO
ENGINE	Refer to the engine manufacturers manual insert						
OIL	Check engine oil level, add oil as needed			X			
OIL	Change engine oil and filter. 50 Hours on initial oil changes.	100					
COOLANT	Check coolant level.			X			
COOLANT	Flush cooling system and replace coolant						X
RADIATOR	Clean radiator fins of dirt and dust with garden hose.		X				
AIR FILTER	Clean air filter		X				
AIR FILTER	Replace air filter	100				X	
FUEL FILTER	Replace fuel filter ENGINE AND PUMP	400				X	
FAN BELT	Check condition and tension			X			
HYDRAULICS							
HYD. OIL	Check hydraulic oil level, add oil as necessary			X			
HYD. OIL	Change hydraulic oil.	400					X
FILTER	Change hydraulic filter.	200				X	
STRAINER	Clean strainer screen					X	
DRIVE LINE							
ALT. BELTS	Check condition and tension of 24v alternator belts			X			
PRODUCT PUMP							
PACKING	Adjust shaft seal packing of pump.		X				
COUPLING	Check pump to hyd. Motor coupling for proper alignment and excess wear.					X	

OJK MAINTENANCE SCHEDULE

ITEM	OPERATION TO PERFORM	HOURS	AS NEEDED	DAILY	EVERY 3MO	EVERY 12 MO	EVERY 24MO
BURNER							
ELECTRODES	Check electrodes for wear and proper adjustment.					X	
NOZZLE	Replace fuel nozzle with same size and style					X	
FILTER	Replace burner fuel filter	400				X	
F-HEAD	Check condition of F-head on burner					X	
PHOTO EYE						X	
DRIVE COUPLER						X	
BURNER LINER		100	X		X		
HEAT TRANSFER OIL							
OIL	Check heat transfer oil level.			X			
OIL	Change heat transfer oil.	1000					X
CHASIS							
TIRES	Check tire condition and pressure			X			
BRAKES	Check brake operation.			X			
BRAKES	Inspect and adjust brake shoes, drums, and components.					X	
LUG NUTS	Check lug nuts for proper torque.				X		
BEARINGS	Inspect wheel bearings and repack with grease.					X	
SUSPENSION	Inspect all suspension components for wear, breaks, or damage				X		
LIGHTS	Check that all lights function properly.			X			
FRAME	Inspect frame for cracks or damage.					X	
HITCH	Inspect hitch for wear, damage, and proper adjustment.			X			

OJK MAINTENANCE SCHEDULE

[illegible]

OJK MAINTENANCE RECORD

[illegible]

All maintenance items must be performed according to the maintenance schedules and documented for warranty coverage to be effective.

OJK MAINTENANCE RECORD

[illegible]

All maintenance items must be performed according to the maintenance schedules and documented for warranty coverage to be effective.

OJK MAINTENANCE RECORD

[illegible]

All maintenance items must be performed according to the maintenance schedules and documented for warranty coverage to be effective.

Oil & Filter Change:

1. Run engine until operating temperature is reached, then shut OFF engine.
2. Place drain pan under oil drain hose.
3. Open oil drain valve and drain oil from the engine.
4. Close the oil drain valve.
5. Place drain pan under engine oil filter and remove filter.
6. Coat gasket of new oil filter with engine oil and install, hand tighten only.
7. Add 2.5L or 2.7 quarts SAE 10 W 40 oil.
8. Run engine and check for leaks.
9. Return used oil to a recycling center.

Air Cleaner Service:

1. Remove wing nut in center of air cleaner.
2. Remove filter.
3. Clean element following instructions on air cleaner housing. Element may be cleaned up to six times before replacement.
4. Reinstall element in housing and tighten wing nut.

Fuel Filter Change:

1. Position drain pan under fuel filter.
2. Remove fuel filter.
3. Fill new filter with clean diesel fuel.
4. Lubricate gasket with fuel and install filter, hand tighten.
5. Loosen the air vent plug on the injection pump where the fuel line is attached.
6. Pump the lever on the fuel pump until no air bubbles are present, tighten air vent plug.

Cooling System Service:

1. Allow engine to cool to ambient temperature.
2. Open radiator petcock and drain coolant into a suitable container.
3. Open petcock on left side of engine block and drain into a suitable container.
4. Open radiator cap and remove lower radiator hose.
5. Flush clean water through radiator until the water comes out clear.
6. Remove the thermostat then flush clean water through the engine block until the water comes out clear.
7. Install new thermostat and gasket.
8. Install radiator hose and close all petcocks.
9. Refill system with fresh anti-freeze in a 50/50 mix.
10. Run engine and check for leaks, then recheck coolant level after engine has cooled.

Filter Change:

1. Position drain pan under filter.
2. Remove oil filter.
3. Lubricate gasket of new filter with hydraulic oil.
4. Install new filter, hand tighten.
5. Start unit and check for leaks.
6. Shutdown unit then check hydraulic oil level.

Hydraulic Oil Change:

1. Position drain pan under the hydraulic reservoir (reservoir capacity exceeds 15 gallons, be sure drain pans have adequate capacity).
2. Remove drain plug from bottom of reservoir and drain oil.
3. Return used oil to a recycling center.
4. Replace drain plug using pipe sealer on threads.
5. Fill reservoir with hydraulic oil to about 3 to 4 inches from the top of the tank (approx. 15 gallons).

Strainer Screen Service:

1. Position drain pan under the hydraulic reservoir (reservoir capacity exceeds 15 gallons, be sure drain pans have adequate capacity).
2. Remove drain plug from bottom of reservoir to drain oil.
3. Replace drain plug using pipe sealer on threads.
4. Remove hose clamps and 1¼" suction hose from nipple on hydraulic reservoir tank.
5. Unscrew king nipple from street-el.
6. Unscrew strainer from tank and clean in solvent.
7. Apply pipe sealer to threads and reinstall strainer and king nipple.
8. Attach 1¼" suction hose to king nipple and tighten clamps.
9. Refill hydraulic reservoir with hydraulic oil.
10. Check for leaks.

Level Check:

1. Remove oil fill cap on top of expansion tank.
2. Cold oil level should be at the lower notch and the hot level at the upper notch in the dipstick.
3. Allow unit to cool, then add heat transfer oil as necessary. Use heat transfer oil with a minimum flash point of 600° F. C.O.C. in a closed loop heat transfer oil system. Amsoil INHT is the only recommended heat transfer oil to heat to 600°F C.O.C. in a closed loop system on the Stepp OJK line of equipment.
4. Replace oil fill cap.

Oil Change:

1. Allow unit to cool to ambient temperature.
2. Approximate oil capacities are 20 gal (OJK75), and 26 gal (OJK125). Have suitable containers ready to contain oil.
3. Remove the drain plug from lower rear of unit and drain oil into drain pan(s).

NOTE: *If optional overnight heater is installed, remove to allow the oil to drain.*

4. Replace drain plug and return oil to a recycling center.
5. Remove oil fill cap and add oil to the cold fill mark on the dipstick, or until oil flows from the cold oil level plug on the rear of the machine. Use heat transfer oil with a minimum flash point of 600° F. C.O.C.
6. Heat unit to normal operating temperature and verify oil is half full in the expansion tank.

WARNING: *The proper heat transfer oil level is critical to the safe operation of this equipment. The most accurate way to check the oil level is when the unit is at operating temperature, however, extreme caution must be used since the dipstick and the oil are very hot and will cause severe burns. Wear leather gloves, eye and face protection, and other appropriate safety gear when checking the oil level.*

WARNING: *It is important that the oil level (when hot) be approximately half full in the expansion tank. Allow the unit to cool before adding oil. DO NOT allow any water or moisture to be introduced into the system.*

NOTE: *The heat transfer oil will expand approximately 10 to 15% when heated from 60°F to 400°F. Make allowance for this when adding oil to a cold system.*

NOTE: *The unit is shipped with Amsoil INHT. Use this or an equivalent heat transfer oil.*

Fuel Filter Replacement:

1. Close fuel shutoff valve located at the fuel tank.
2. Remove the nut securing the canister to the fuel filter body.
3. Remove the canister and the filter element.
4. Replace the element with a new one.
5. Reinstall the canister and turn on the fuel valve.
6. Attach a clear hose to the fuel pump bleeder screw on the burner and direct the hose into a suitable container.
7. Start engine, set thermostats, then turn on the burner power switch. This will allow the fuel pump in the burner to run so the fuel system can be bled of air.
8. Loosen the bleeder screw and observe the flow of fuel through the clear hose, when all air is purged from the system close the bleeder screw.
9. Check entire fuel system for leaks.
10. Set the thermostats to the desired level and the burner will ignite.

MAINTENANCE

Combustion Chamber

Combustion Chamber Inspection:

1. Allow unit to cool to ambient temperature.
2. Remove four nuts and washers securing burner and burner liner.
3. Inspect the burner stainless steel liner for cracks, or deformation.
4. Inspect entire combustion chamber area for any other signs of leakage, damage or fatigue.
9. Reinstall burner and cover if no damage is found.

NOTE: *If any damage is found it must be repaired before returning the unit to service. Contact Stepp Mfg. (651) 674-4491 for replacement parts.*

MAINTENANCE

Hot Asphalt Hose Replacement

Hose Removal:

1. Disconnect all electrical connections from hose boom and at the wand connection.
2. Separate the hose from the wand at the quick coupling.
3. Remove the quick coupling from the hose and save for reuse on the new hose.

Hose Installation:

1. Screw the hose fitting into the cross fitting at the end of the boom assembly and tighten securely.
2. Screw the quick coupling to the other end of the hose and tighten securely.
3. Reconnect all electrical connections to hose.
7. Pump material through wand until flowing freely (refer to operating instructions).
8. Stop pump. The hose is now full of material and the unit can be returned to service.

TROUBLE SHOOTING

TROUBLESHOOTING

Hydraulic System

Problem	Possible Cause	Items To Check/ Service
LACK OF PERFORMANCE	Plugged Strainer Screen	Service strainer screen
	Hydraulic Filter Plugged	Replace hydraulic oil filter
	Collapsed Suction Hose	Replace suction hose and service strainer screen
	Air Leak in Suction Hose	Replace hose
	Low Fluid Level	Fill reservoir to proper level
	Engine RPM to low	Set to 2300 RPM
	Worn Pump or Hydraulic Motor	Adjust, rebuild, or replace as necessary
	Crushed Hydraulic Lines	Replace line
	Pressure relief out of adjustment	Adjust relief on valve to 1900 psi.
	Product in Tank not Melted	Allow for more time for product to melt
HYDRAULIC MOTORS DO NOT TURN OR TURN SLOWLY	Foreign Material Jamming Agitator	Remove foreign material from agitator
	Foreign Material Jamming Product Pump	Remove foreign material from product pump
	Also see "Lack of Performance"	
	Low Hydraulic Fluid	Fill reservoir to proper level. Bottom of Screen when cold
UNUSUAL NOISES	Air Leak in Suction Hose	Replace hose
	Damaged Pump or Hydraulic Motors	Repair or replace as necessary
	Chattering	Worn motor, or sucking air.
EXCESSIVE OIL LEAKS FROM PUMP OR HYDRAULIC MOTOR SHAFT	Bad Shaft or Shaft Seal	Replace as necessary

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Lock Out Message On	Fuel Delivery	Make sure that there is enough fuel in the tank.
		Ball valve on fuel tank is in the on position
		Bleed burner (see burner adjustment page)
		Check fuel filter for clogged or dirty filter
		If ambient temperature is below 30 degrees F is fuel gelled. * Bio Fuels with higher content of bio are more susceptible to gelling at lower temperatures * Stepp Recommends high quality winter blend fuels for cold weather operation. (winter blend fuels may require burner adjustment)
		Fuel is bad. * Fuel stored for long periods can attract moisture and even have algae growth in tank.
		Air leak in fuel line. Fuel pressure gauge may flutter excessively. * Check fuel line swivel connectors. * Make sure that fuel line connections are tight.
		Drive Coupler Between motor and fuel pump. * Could be stripped on the drive ends or melted.
		Fuel Coil failure. * See Fuel solenoid see Page 16
		Fuel Stem Failure. * Remove Fuel Stem and shake. If you can not hear valve move replace.
		Plugged or damaged fuel nozzle
		Bad Fuel Pump
	No flame or Flame Detection	Dirty Cad Cell (Eye)
		Faulty Cad Cell (eye)
		Faulty Primary Control See test page 24-27
		Flame Being Blown Out
	Ignition Source	Low Voltage
		Faulty Ignition Transformer See test page???
		Faulty Electrodes See Test page???
		Electrode out of adjustment
		Worn Electrodes

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Lock Out Message On	Ignition Source	Faulty Primary Control –No signal to fire
		* 10 Amp Fuse is blown on Primary Control (underside of primary)
		Bad Connection between electrode and transformer. (springs)
		* Rusty or corroded.
	Improper Air Fuel Mixture	Drive coupler failure (cracked, stripped, melted)
		Elevation Change
		Voltage to low or to high (12-14volts optimum)
		Cold weather adjustments
		Wrong air settings See Page 13-14 For burner setup
		Clogged nozzle
		Wrong size nozzle
		Bypass plug missing in fuel pump. (only on single fuel line sys)
		Wrong retention head –see page ??
		Collapsed or plugged flue or burner liner
		Obstruction in fire chamber
		Plugged or restricted air intake
		Clogged or restricted fuel filter
		Ignition transformer gasket bad allowing additional air
		Plug on side of burner missing or leaking air
		Squirrel cage fan faulty
		Air guide faulty
Won't Fire at All	Clogged/deformed Buner Firing Chamber or Tube	Carbon /Soot build up on firing chamber/tube
		* Check burner air settings
		* check for bad nozzle
		Worn out/burned out burner tube
		Insulation out of place/blocking air flow
		Debris buildup in fire tube/chamber
	No Fuel	Low Fuel in tank
		Shut of valve closed
		Fuel Filter Clogged
		Pick up tube clogged-debris in fuel tank
		Pinched or kinked fuel line
		Broken hose
		Bad Hose fittings
		Burner air locked not bled
		Gelled fuel (cold weather)
		Clogged strainer in fuel pump

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service	
Won't Fire at All	No Fuel	Clogged nozzle strainer	
		Fuel pump failure	
		Bad drive coupler (broken, stripped, or melted)	
		Fuel valve failure-Stem, coil, or cord failure	
		Water in fuel/bad fuel	
	No Power to Burner	Power switch is off	
		Engine is not running	
		Burner switch is not on	
		Thermostats not turned up (2 thermostats on oil jacketed units, both must be calling for heat)	
		Fuse in control box blown	
		Burner harness is faulty	
		Tilt switch not working (only on SPHD/dumping units)	
		Wash-down switch turned on (burner interlocked when on)	
		Bad or dead battery	
		Auto reset breaker in control box tripped	
		30 amp fuse on primary control blown	
		10 amp fuse on primary control blown	
		Not Enough Voltage	Low battery voltage
			Dead or bad battery
			12V alternator on engine faulty (on units equipped with an engine)
		Lack of voltage from towing vehicle to maintain battery	
		* Blown fuse on vehicle	
		* Bad connection	
		* No connection	
		* Wrong pin orientation on trailer plug	
		Lack of proper amperage from towing	
		* Supply wire too small (we recommend 10 ga)	
		Bad Connections	
		Bad Ground	
		Faulty Isolator (sphd units only)	
		Auto resetting breaker tripped or faulty	

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Won't Fire at All	No Call For Heat Signal	Control box not sending signal
		Wire harness is faulty
		Tilt switch is on the open position * Pendulum is stuck * Mount loose or out of adjustment (15 Degree setting) * Switch Is Faulty
		Wash down pump is on
Won't Stop Firing	Fuel Valve Not Closing	Fuel valve is energized after the call for heat light goes out * Check primary control functionality * Check burner wiring
		Fuel stem stuck in the on position
Fires but goes off after 15 seconds	Burner in lock out	Reference Lockout section
	Low or No Fuel	Reference low/no fuel section
Fires Intermittently	Bad Connections	Check connectors at control box and burner
	Bad Ground	
	Poor Flame Detection	See flame out detection section
	Low Fuel	Plugged Filter
		Plugged Strainer in fuel pump
		Plugged strainer in nozzle
		Bad Nozzle
	Unstable Voltage	See low voltage section
	Burner Out of Adjustment/dirty	See burner adjustment page
Burner Fires Until Call For Heat Light Goes Off But Will Not Relight	Unstable Voltage	Voltage to high or to low
	Burner Setting Different When Unit Reaches Temperature	To lean / air fuel mixture not set right
	No Call for Heat Light	See no call for heat signal section.
		Verify that both thermostats are calling for heat
Works Fine At The Shop But Wont Fire on the Road/ Job	Improper Voltage	No/ Low charge from tow vehicle.
		Low battery voltage
		Dead or bad battery

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Works Fine At The Shop But Wont Fire on the Road/ Job	Improper Voltage	Lack of voltage from towing vehicle to maintain battery
		* Blown fuse on vehicle
		* Bad connection
		* No connection
		* Wrong pin orientation on trailer plug
		Lack of proper amperage from towing
		* Supply wire to small (we recommend 10 ga)
		Bad Connections
		Bad Ground
		Faulty Isolator (sphd units only)
		Auto resetting breaker tripped or faulty
		No/ Low Charge from engine
		* RPM of engine to low (gasoline or LPG engine)
		* Belts loose or worn on alternator (diesel engine only)
		12V alternator on engine faulty (on units equipped with an engine)
	Improper Burner Setting	Cold weather settings– Adjust burner air fuel settings
		Bad or gelled fuel
	No call for heat	Tilt switch open/ stuck (sphd units only)
	Won't Fire	Backdraft while driving
Smokes To Much	Improper Air Fuel Mixture	Drive coupler failure (cracked, stripped, melted)
		Elevation Change
		Voltage to low or to high (12-14volts optimum)
		Cold weather adjustments
		Wrong air settings See Page 56-57For burner setup
		Clogged nozzle
		Wrong size nozzle
		Bypass plug missing in fuel pump. (only on single fuel line sys)
		Wrong retention head –see page ??
		Collapsed or plugged flue or burner liner
		Obstruction in fire chamber
		Plugged or restricted air intake
		Clogged or restricted fuel filter

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Smokes To Much	Improper Air Fuel Mixture	Ignition transformer gasket bad allowing additional air
		Plug on side of burner missing or leaking air
		Squirrel cage fan faulty
		Air guide faulty
	Improper Voltage	No/ Low charge from tow vehicle.
		Low battery voltage
		Dead or bad battery
		Lack of voltage from towing vehicle to maintain battery
		* Blown fuse on vehicle * Bad connection * No connection * Wrong pin orientation on trailer plug
		Lack of proper amperage from towing
		* Supply wire to small (we recommend 10 ga)
		Bad Connections
		Bad Ground
		Faulty Isolator (sphd units only)
		Auto resetting breaker tripped or faulty
		No/ Low Charge from engine
		* RPM of engine to low (gasoline or LPG engine) * Belts loose or worn on alternator (diesel engine only)
		12V alternator on engine faulty (on units equipped with an engine)
	Clogged/deformed Buner Firing Chamber or Tube	Carbon /Soot build up on firing chamber/tube
		* Check burner air settings * check for bad nozzle
		Worn out/burned out burner tube
		Insulation out of place/blocking air flow
		Debris buildup in fire tube/chamber

TROUBLESHOOTING

Diesel Burner

Problem	Possible Cause	Items To Check/ Service
Fuel Pump	No fuel supply	Verify proper supply of fuel, ball valve on fuel tank, filter plugged, hoses not kinked
		For units with dual fuel line (return line) installed verify that return port has a by pass plug.
		Verify that pump has been bleed on single fuel line systems. (See primary control section on Page67
		Verify fuel pressure (see burner adjustment chart page 57
		Verify that fittings are installed properly
		Fuel standby pressure is 40-60 PSI
		Infire pressure should be 100-120 PSI
		Check shaft seal (fuel is usually leaking in burner housing)
Photo eye/ Cad Cell (senses presence of flame or lack of flame and shuts system down if no flame is present)	Light but would shut off going into lockout	Verify eye is clean/ not covered in soot Open top at hinge Remove eye Clean with Q tip or soft rag
		Eye is faulty See Page 62 For instructions on testing
		Eye is not properly seated/ aligned and can not see flame. Bend eye mount and may need new gasket.
		Check weather pack connector for loose connection or broken pins.
		Check for pinched wire under lid.
Ignition Transformer	Caution HIGH VOLTAGE OUTPUT Disconnect Power Before testing	Check Ohms between springs. Should ohm out 480-580
		Check power connection from primary control is 12+volts
		Verify that blue and white wire from transformer are connected to blue wire from burner /primary control harness.
		Verify spring contacts are clean/free of rust and properly aligned with electrodes.
Electrode		Check alignment and spacing from nozzle –See data sheet page 60
		Check for broken electrodes.
		Check contact between electrode and ignition transformer springs.
		Check for excessive rust or soot prevent good contact.
		Check continuity between tip and stem of electrode.
		Check for cracked ceramic insulator.

TROUBLESHOOTING

Diesel Burner Fuel Pump

[illegible]

Start Up Burner & Set Combustion

WARNINGS Fire & Smoke Hazard

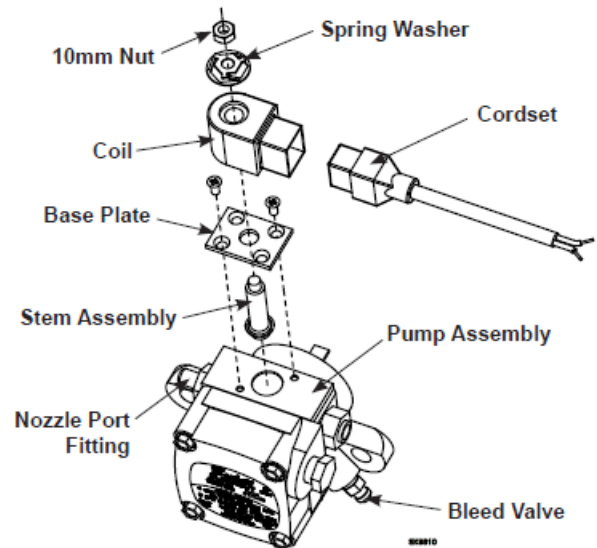
Basic Burner Operation

Typical Constant Duty Ignition Configuration - With this Beck-ett ADC oil burner configuration, the motor and igniter operate continuously while the valve that controls oil flow is cycled by the switches on the power washer. The motor is used to drive the blower and pump. The rotational speed of the motor is determined by the voltage supplied and the load placed on the motor. Pump pressure and air settings are the main factors affecting the motor load. The igniter converts battery DC voltage into a high voltage spark to ignite the oil. The igniter is capable of running continuously as long as the blower wheel is circulating air across the igniter base. The pump and solenoid valve are used to control the flow of oil from the reservoir to the nozzle.

Igniter with Interrupted Duty Ignition - This optional control circuit is available to reduce current draw on the charging system by turning the igniter off after a flame has been established. This option controls igniter operation based on a signal from a light sensing cad cell. When light hits the cell the control will sense a decrease in resistance across the sensor. A few seconds delay will occur prior to the igniter switching off. As long as sufficient light is reaching the cell eye, the igniter will remain off. If light is removed from the sensor, the igniter will turn on until light is again sensed by the cad cell.

Primary Safety Control - The 7556 control provides the same benefits as the ignition control board as described above as well as added safety, convenience, and performance features. It adds a valve on delay and motor-off delay to the burner's operation sequence that promote clean burner operation. It has a lock-out function that shuts the burner down if it is not operating properly. The control adds fusing at the burner to protect against component failures. The control also has redundant motor relays that are checked for proper operation every heat cycle. .

Figure 8. Pump and Valve Assemblies



Adequate Voltage Required

A low or erratic power supply could result in impaired burner operation, severe delayed ignition or an explosion inside the heat exchanger resulting in a burn and/or asphyxiation hazard.

- The Model ADC requires a continuous supply of 11V to 16V DC at 15A measured at the burner during operation.
- An automotive or small engine charging system that is capable of supplying the required continuous voltage/ amperage is recommended with certain road equipment, such as asphalt hot patchers and similar applications.
- This is especially true while maintaining nominal load temperatures during idle periods.



Adequate Combustion and Ventilation Air Supply Required

Failure to provide adequate air supply could seriously affect the burner performance and result in damage to the equipment, asphyxiation, explosion or fire hazards.

- The burner cannot properly burn the fuel if it is not supplied with a reliable combustion air source.
- Follow the guidelines in the latest editions of the NFPA 31 and CSA-B139 regarding providing adequate air for combustion and ventilation.

Start Up Burner & Set Combustion

All Stepp Mfg. Burners are set at the factory to operate between 50-90°F and at approximately 900ft elevation. Weather conditions/temperatures, elevation, fuel quality may dictate adjustments be made to operate the burner properly.

If your burner is not operating properly start by returning the burner to the factory settings and make minor adjustments as needed.

Combustion Set-up/Bleed Burner

As soon as burner motor starts rotating bleed all the air from the pump. (Required with single-pipe systems.) To bleed the pump, attach a clear plastic hose over the vent fitting. Loosen the fitting and catch the oil in an empty container. Tighten the fitting when all air has been purged from the supply system. Note: If the burner stops after a flame is established, the unit probably requires additional bleeding. Continue to bleed the system until the pump is primed and a flame is established when the bleed valve is closed.

Set Combustion without Instruments (Field adjustments)

Follow these steps to properly adjust the burner:

1. Determine factory burner setting by reviewing burner setup sheet for your specific unit.
2. Bleed burner to ensure you have no air in the fuel line. Not required on dual fuel line units.
3. Determine air band settings (large air) and shutter settings (small air) and adjust to factory recommended settings.
4. Determine fuel pressure and adjust to factory recommendations.
5. Allow the burner to run for approximately 5 to 10 minutes.

Once the combustion level is set, tighten the fasteners on the air band and air shutter.

Start and stop the burner several times to ensure satisfactory operation.

Test the equipment safety controls to verify they function according to the manufacturer's specifications

Recheck the smoke level. It should be zero.

General Guidelines:

If you have black smoke the burner is firing to rich.

Decrease fuel pressure or increase air settings

If it lights but goes out the burner is to lean

Increase fuel pressure or decrease air settings.

Check gaskets on burner ignition transformer as it may be sucking air.

If the burner lights but chugs or puffs repeatedly.

Decrease Air settings

Check gaskets on burner ignition transformer as it may be sucking air.

Set Combustion with Instruments

Allow the burner to run for approximately 5 to 10 minutes.

Follow these four steps to properly adjust the burner:

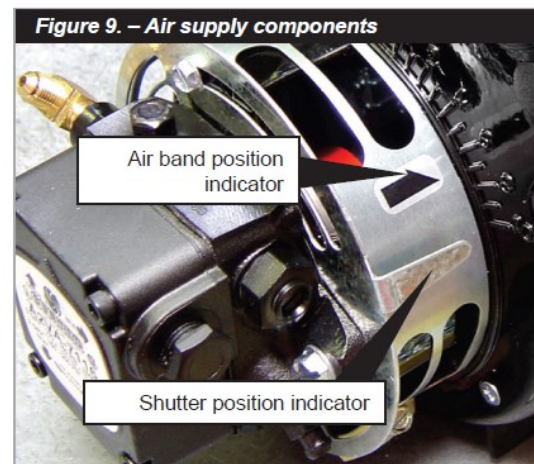
1. Adjust the air until a trace smoke level is achieved.
2. At the trace of smoke level, measure the CO₂ (or O₂). This is the vital reference point for further adjustments.
3. Increase the air to reduce CO₂ by 1 percentage point (O₂ will be increased by approximately 1.4 percentage points).
4. Recheck the smoke level. It should be zero.

This procedure provides a margin of reserve air to accommodate variable conditions.

Once the combustion level is set, tighten the fasteners on the air band and air shutter.

Start and stop the burner several times to ensure satisfactory operation.

Test the equipment safety controls to verify they function according to the manufacturer's specifications



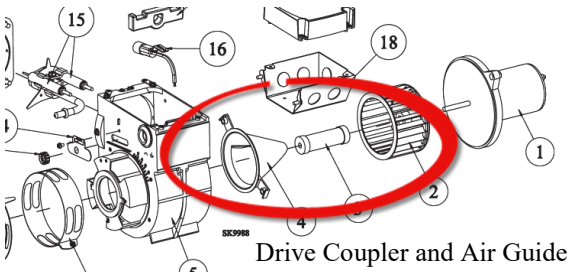
TROUBLE SHOOTING

Diesel Burner Factory Settings

Model	SRM 10x120	Model	OJK 75, Ojk-125	Models	SSPH-1.0
Stock Code	A10008105-001	Stock Number	A10008105-005	Stock Number	A10008105-012
Flange Length	2 1/2	Flange Length	4	Flange Length	2 1/2
Nozzle GPH	2.5	Nozzle GPM	1.5	Nozzle GPH	0.75
Spray Angle	80°	Spray Angle	80°	Spray Angle	80°
Head Size	F31	Head Size	F-12	Head Size	F3
Large Air Setting	3	Large Air Setting	0	Large Air Setting	0
Small Air Setting	10	Small Air Setting	5	Small Air Setting	3
Pressure	120	Pressure	115	Pressure	105
Oil Inlet Location	Back	Oil Inlet Location	Back	Oil Inlet Location	Back
Oil Return	SRM-NO	Oil Return	NO	Oil Return	YES
Model	SGS, STPH-6.0 STPH-7.0	Model	Ojk-185, Ojk-275, Ojk-400	Models	SPHD-2.0 SPHD-3.0, SSPH-2.0, SSPH-3.0
Stock Number	A10008105-002	Stock Number	A10008105-008	Stock Number	A10008105-013
Flange Length	2 1/2	Flange Length	2 1/2	Flange Length	2 1/2
Nozzle GPH	2.5	Nozzle GPH	2.5	Nozzle GPH	1.00
Spray Angle	80°	Spray Angle	80°	Spray Angle	80°
Head Size	F31	Head Size	F31	Head Size	F3
Large Air Setting	3	Large Air Setting	3	Large Air Setting	0
Small Air Setting	10	Small Air Setting	10	Small Air Setting	3
Pressure	120	Pressure	120	Pressure	105
Oil Inlet Location	Back	Oil Inlet Location	Back	Oil Inlet Location	Back
Oil Return	No	Oil Return	YES	Oil Return	YES
Model	SPH-OJ, STPH-4.0, STPH-5.0	Model	SSPH-4.0 SSPH-5.0	Model	SBF-300, SMMT
Stock Number	A10008105-003	Stock Number	A10008105-009	Stock Number	A10008105-014
Flange Length	2 1/2	Flange Length	2 1/2	Flange Length	2 1/2
Nozzle GPH	1.5	Nozzle GPH	0.75	Nozzle GPH	2
Spray Angle	80°	Spray Angle	80°	Spray Angle	80°
Head Size	F-12	Head Size	F3	Head Size	F-12
Large Air Setting	3	Large Air Setting	0	Large Air Setting	3
Small Air Setting	5	Small Air Setting	5	Small Air Setting	5
Pressure	115	Pressure	105	Pressure	115
Oil Inlet Location	Back	Oil Inlet Location	Back	Oil Inlet Location	Back
Oil Return	No	Oil Return	YES	Oil Return	No
Model	SMT-400-1200	Model	Sph-1.5 Sph-2.0, Sph-3.0, 40 Gallon Tack Tank, SRM-10x120 Tack oil tank,	Model	SMM-72
Stock Number	A10008105-004	Stock Number	A10008105-010	Stock Number	A10008105-015
Flange Length	2 1/2	Flange Length	2 1/2	Flange Length	2 1/2
Nozzle GPH	2	Nozzle GPH	0.75	Nozzle GPH	1.50
Spray Angle	80°	Spray Angle	80°	Spray Angle	80°
Head Size	F-12	Head Size	F3	Head Size	F12
Large Air Setting	3	Large Air Setting	0	Large Air Setting	3
Small Air Setting	5	Small Air Setting	3	Small Air Setting	5
Pressure	115	Pressure	105	Pressure	115
Oil Inlet Location	Back	Oil Inlet Location	Back	Oil Inlet Location	Back
Oil Return	No	Oil Return	No	Oil Return	NO

Driver Coupler and Air Guide

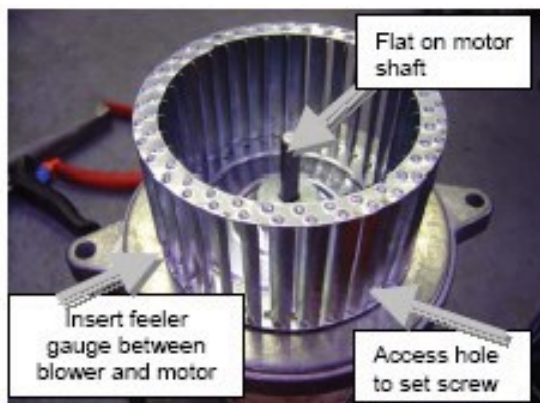
NOTE: Acts as a fusible link between fan motor and fuel pump, Will melt or soften if backdraft or fire is present to shut off flow of fuel.



Drive Component Maintenance

A. Motor, Blower Wheel, and Coupling Replacement

1. Inspect drive coupler for failure or deformation. Make sure to check drive lugs to make sure that they are not stripped on the ends or the tube side.
2. Inspect air guide. Often if the drive coupler melts that air guide will also be deformed.
3. Inspect blower wheel for damage. If couple melts it can also damage the blower wheel.
4. The motor will require replacement if the proper voltage is measured at the motor input, and the motor will either not run, or the current draw with a free running pump exceeds 10% of the rated current.
5. To replace the burner motor, coupling and/or blower wheel perform the following steps.
6. Before servicing, turn off and/or disconnect all power to the burner.
7. Disconnect the burner motor wires.
8. Remove the bolts securing the motor to the burner housing.
9. Remove the motor, coupling, and blower wheel.
10. Loosen the set screw on the blower wheel to slide the existing wheel off the shaft.
11. Slide the new blower wheel onto the old shaft (after thoroughly cleaning housing) and/or slide the old blower wheel onto the new motor shaft.
12. Place a .030" (1/32" $\pm$ 1/64") feeler gauge between the blower wheel and the motor housing.



13. Slide the blower wheel toward the motor until it contacts the feeler gauge.
14. Rotate the blower wheel until the setscrew is centered on the flat of the motor shaft. Tighten the
15. setscrew to secure the wheel.
16. Slide the motor coupling on the motor shaft then install the motor on the burner housing. Insure that
17. the motor coupling fits between the motor shaft and the pump shaft inside the housing. Tighten the
18. motor retaining screws. Reconnect the wires.
19. Restore power, start the burner and perform the combustion test described previously in this manual.

Fuel Solenoid Valve

NOTE: The Fuel Valve can be bench tested for proper operation using an automotive type 12 volt battery as a power source.

1. Disconnect the two leads and remove the fuel lines from the fuel valve.
2. The valve should be closed when no power is available.
3. Apply 12 volts to the two leads and the valve should open.

CAUTION: Replace the fuel valve if it does not respond in this way.

Valve Coil and Stem Replacement

To determine if the valve coil requires replacement perform the following steps.

1. Remove the cord set from the valve.
2. Place the leads from an ohm meter across the coil.
3. A 12 volt coil should measure between 15 and 25 ohms.
4. If the meter indicates an open circuit, replace the coil.

To check pump operation perform the following.

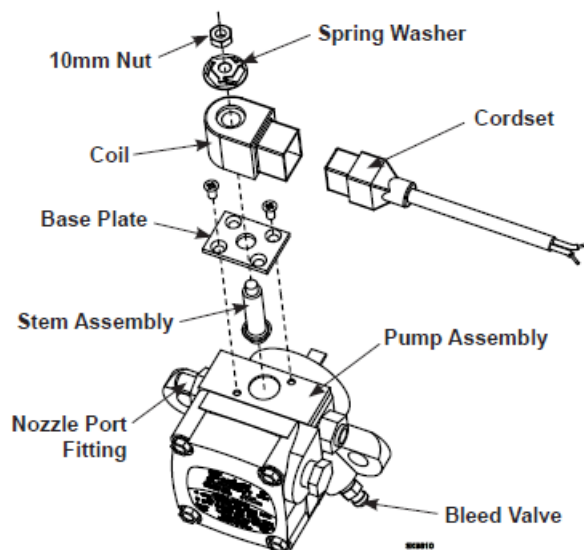
1. Check the operating pressure by removing the copper tubing from the nozzle line and installing a pressure gauge in the line. With the motor running and the coil energized, check the gauge. The pressure should read 100 psig unless otherwise stated. If the burner is not firing it should have a standby pressure between 40-60 PSI
2. To check the cutoff function, deadhead the pressure gauge onto the copper connector tube attached to the nozzle port. Run the burner for a short period of time. Shut the burner off; the pressure should drop and hold.

To replace the coil and/or pump assembly perform the following steps.

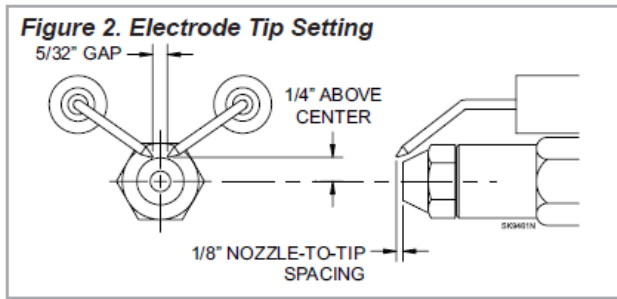
1. Before servicing, turn off and/or disconnect all power to the burner.
2. Remove the copper tube assembly when replacing the pump or when removing the coil and the tube blocks the coil.
3. Using a flat tip screwdriver, press the flat tip into the spring washer to prevent it from rotating. If nut is corroded you may need to use a hacksaw to cut a small straight groove into the top of the stem to be able to use a screw driver to remove the jam nut. This will not damage the stem.
4. Using a 10mm wrench or adjustable wrench, remove the nut and spring washer. Pay close attention not to damage spring washer as it not a replacement part.
5. Remove the coil by lifting it straight up. Remove the two base plate screws, (requires special **Philips bit part number P1000000**) then the base plate by lifting straight up.
6. Remove valve stem assembly by pulling straight up. Check for debris in stem seat
7. You can shake stem to listen for plunger movement inside of stem.
8. To install the new stem and coil assemblies, follow the above steps in reverse order, tightening each part as you go.
9. Restore power, start the burner and perform the combustion test described previously in this manual.

Cord Set

Replace cord set if you have no signal to coil. Check signal from primary controller to have power on purple/violet wire. If primary control has output then corset is bad. If no signal from primary control see primary control trouble shooting.



Electrodes



Check/Adjust Electrodes

Check the electrode tip settings. Adjust if necessary to comply with the dimensions shown in **Figure 2**. To adjust, loosen the electrode clamp screw and slide/rotate electrodes as necessary. Securely tighten the clamp screw when finished.

Igniter Maintenance

The igniter assembly does not require any adjustments beyond making sure the springs and the burner electrode rods make solid contact when the igniter is in the closed position. The sealing surfaces of the gaskets should be checked and replaced at the first signs of any damage or deterioration. Clean any dirt or residue from the porcelain bushings, springs, and baseplate.

The simplest way to check igniter operation is by supplying voltage to the input and checking to see whether an arc is produced. Check by either looking or listening to see if there is an arc across the electrodes while the burner is running and the igniter is energized.

The igniter must be grounded to the burner before checking the following. To check the igniter, ensure all power to the burner is off and use an ohmmeter to check the resistance between the two springs. The meter should read between 480 - 580 ohm.

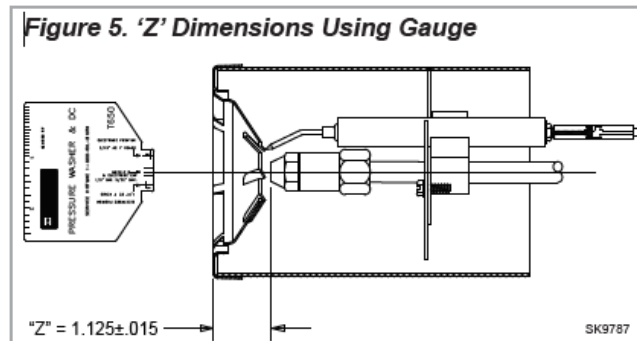
The igniter should be replaced if the meter indicates an open circuit, or the spring-to-spring resistance exceeds the 480 - 580 ohm range by more than 10%.

Check/Adjust “Z” Dimension

Refer to **Figure 5**. The critical “Z” dimension is the distance from the face of the nozzle to the flat face of the head. This distance for F heads is 1-1/8”. The “Z” dimension is factory set for burners shipped with the air tube installed but should always be verified during service and installation. If the “Z” dimension is out of adjustment, perform the following steps.

Before proceeding, turn off power to the burner.

1. Disconnect the oil connector tube from the nozzle line.
2. Referring to **Figure 4**, loosen the splined nut from the nozzle line. Loosen the hex head screw securing the escutcheon plate to the burner housing.
3. A Beckett T650 gauge should be used to set the Z dimension.
4. Place the end of a ruler at the face of the nozzle and, using a straight edge across the head, measure the distance to the face of the head.
5. Slide the nozzle line forward or back until this dimension for F heads is 1-1/8".
6. Tighten the hex head screw to secure the escutcheon plate to the burner chassis. Then tighten the splined nut and attach the oil connector tube.
7. Recheck the "Z" dimension periodically when servicing to ensure the escutcheon plate has not shifted. You will need to reset the "Z" dimension if you replace the air tube or nozzle line assembly.



Servicing Nozzle Line Assembly

Before proceeding, turn off power to the burner.

1. Disconnect the oil connector tube from the nozzle line.
2. Referring to **Figure 4**, loosen the two screws securing the igniter retaining clips (**a**) and rotate both clips to release the igniter baseplate. Then tilt the igniter back on its hinge.
3. Remove the splined nut (**b**).
4. Remove the nozzle line assembly from the burner, being careful not to damage the electrodes or insulators while handling. To ease removal of short assemblies, it may be necessary to loosen the escutcheon plate (**c**). Reset to the edge of the label.
5. To replace the nozzle line assembly, reverse the above steps.



Electronic Oil Igniter

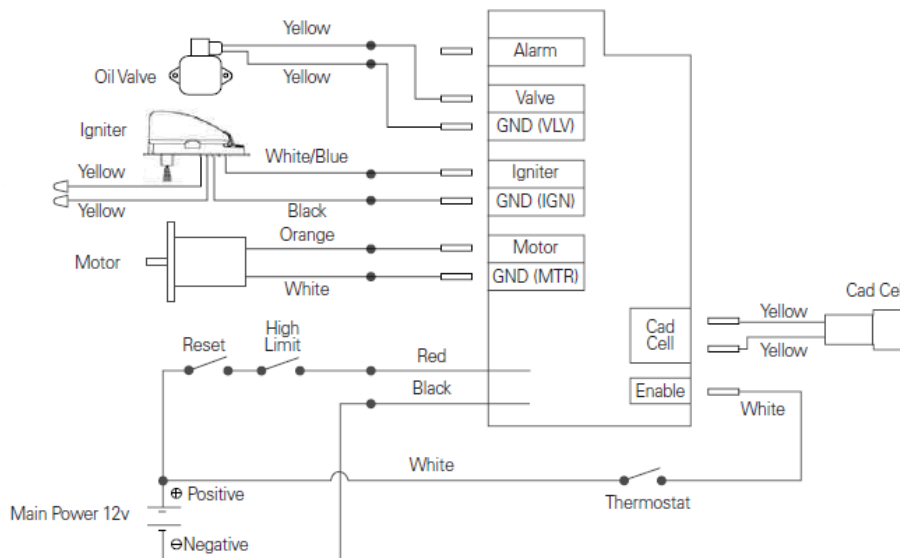
Installation Instructions:

1. Mount the assembled unit to the burner using the screws supplied.
2. Use "paint scraping" screws for all burners (2 at the hinge and 2 for non-hinged base plates). Tighten these screws securely to provide effective grounding to burner housing.
3. Verify the burner is properly connected to the negative battery terminal.
4. Install the cad cell. Carefully route the igniter input and cad cell leads to prevent them from being pinched during closing of the igniter at the hinge.
5. Wiring Igniter to GeniSys 12 Vdc Primary Control Carefully follow the control, or equipment manufacturer's wiring instructions and diagrams.
6. Fasten cad cell leads to control CAD CELL spade terminals.
7. Attach the Black lead with insulated flag terminal to the primary control GND (IGN) spade terminal Negative.
8. Combine the Blue-White striped to the insulated flag terminal to the primary control IGNITER spade terminal.
9. The Yellow leads from the igniter will NOT be used and shall be wire nuted INDIVIDUALLY and placed in the housing wiring compartment.
10. Verify the igniter secondary output/spring terminals are correctly arranged to make good electrical contact with the oil burner electrodes.
11. Close the igniter. Install and securely tighten the two front base plate retaining screws (4 screws, if no hinge).
12. Reconnect electric power to the burner circuit.
13. Verify with instruments that the burner is adjusted to the manufacturer's recommended settings.
14. Cycle the burner several times to verify prompt and smooth ignition. Verify proper operating and limit control operation before leaving



Electrical shock can cause severe personal injury or death.

- Disconnect all electrical power to the burner before servicing. More than one disconnect switch may be in the supply circuit.
- Installation and service must only be performed by a qualified service technician.
- Remove all jewelry, such as rings and watches before servicing.
- Provide ground wiring to the burner, metal control enclosures and accessories. (This may also be required to aid proper control system operation).



Wires are to be sized to prevent a voltage drop between the battery and the burner with the burner running at full load.

2. Fuse Sizes (inside control) 30 Amp. = Motor.
10 Amp = Igniter, Control, Valve, & Alarm.

3. Hard-wire burner ground to battery. Do NOT use chassis ground system.

4. Input power to the control's +12 Volt wire shall be provided from a fused service switch, rated at 50 amps or less.

5. Motor-off delay on a 7556P will be disabled if the safety and operating limits interrupt power to the control's red +12 Volt wire.

6. Do not wire power directly to the burner motor. Always wire the motor to the primary control "motor" terminals. If instant burner heat is required by the application, purchase or program

a control with a long motor-off delay time, which will ensure instant heat if a new call for heat is received within the motor-off delay time.

7. Igniter Yellow leads are capped and not used. Bundle with the other leads in the wiring box with a cable tie.

8. The igniter Blue-White striped attached to the primary control igniter spade terminal.

Photo Eye/ Cad Cell

The cadmium sulfide cell, or cad cell, is part of the primary control system and is used to sense the presence of the oil burner flame. The cad cell assembly consists of the actual cell, a holder, and cord to connect the cell to the primary control. This detector is mounted in the air tube of the burner in such a way as to sight the flame.

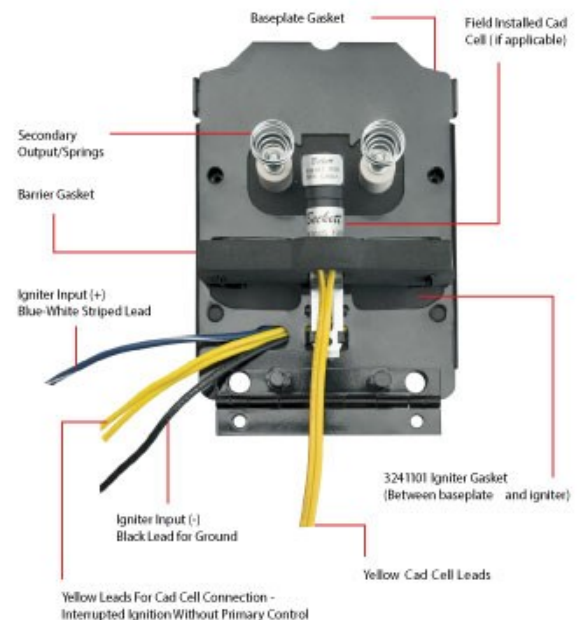
For a properly adjusted burner, during operation, the cad cell resistance should be approximately 300-1000 ohms, but not more than 1600 ohms. A resistance above 1600 ohms signals a problem that should be corrected.

NOTE: The Photo Electric Eye can be bench tested for proper operation using an ohm meter. Assure the lens of the Photo Electric Eye is clean prior to testing.

1. Block off all light to the Photo Electric Eye. Test across the yellow leads with your ohm meter; you should get an infinite resistance reading (a lot of resistance).
2. Point the Photo Electric Eye at a light source, the brighter the light, the less resistance your ohm meter will show. **CAUTION:** Replace the Photo Electric Eye if it does not respond in this way.

Troubleshooting

To understand how to troubleshoot the cad cell, it is important to first know how the control operates. Initially, the control must have a high resistance across its F-F terminals (cad cell does not sense visible light) before it will attempt to start the burner. If the cad cell senses light or is shorted, the relay in the primary control will not pull in to start the burner. Once the burner is running and the flame is established, the cad cell must have a low resistance (cad cell sensing flame) to keep the primary control from locking out on safety.

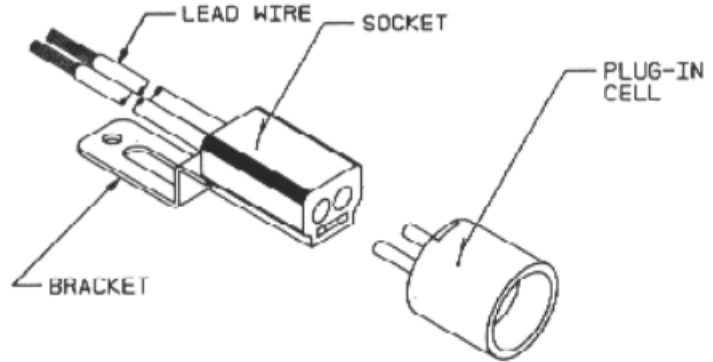


OHMMETER READING	CAUSE	ACTION
Less than 1600 ohms but not zero.	Cad cell operating properly.	None
Above 1600 ohms but not infinite	Defective or dirty cad cell, misaligned sighting of flame, or improper flame adjustment.	Clean cad cell and check for proper sighting of flame. Check for proper flame adjustment. If cell is defective then replace.
Infinite resistance. (0)	Open circuit.	Check for broken cell, holder, or wire. Loose cad cell in holder. If defective, replace necessary parts.

Photo Eye/ Cad Cell

Symptom #1

What if the burner will not start and the cad cell is suspected? The procedure for solving this problem would be first to make sure the thermostat is calling for heat and that there is line voltage to the control. Then remove one lead of the cad cell from the F-F terminals. If the burner starts, this suggests that the cad cell is either seeing external light inside the housing, cad cell wires are pinched, the assembly is shorted, or the cell is defective. You may need to shield the cell from external light, repair pinched wires, or put in a new cad cell.



Symptom #2

What if the burner starts but locks out and the cad cell is suspected? This symptom initially shows that the control did see the high resistance necessary to start the burner. However, during the lock-out timing period, it did not sense the low resistance on the cad cell necessary to keep the burner running. As stated earlier, the control must have no more than 1600 ohms of resistance to prevent random lock-out.

To troubleshoot this problem, start the burner and before the safety lock-out timing period ends, disconnect the cad cell wires from the F-F terminals on the control. Next, jumper the F-F terminals with a piece of wire or use a 1500 ohm resistor. This will allow the burner to continue running so that you will be able to check the cad cell resistance during the run cycle. If you did not get the F-F terminals on the control jumpered before the burner locked out, wait 3-5 minutes before attempting this again. With the burner running, connect the ohmmeter across the cad cell leads. Use the chart above and the resistance you measure on the cad cell to find the cause and the appropriate action recommended for solving the problem.

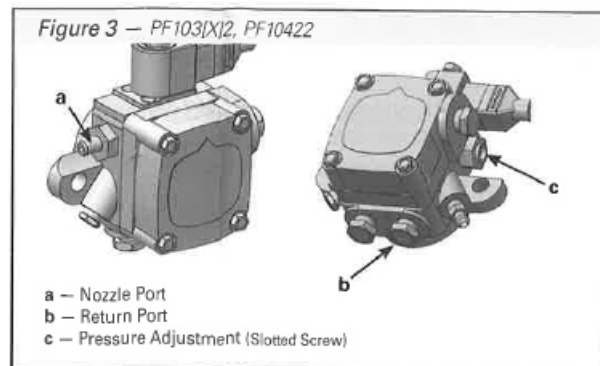
The cad cell control system has proven to be extremely reliable in our industry. This brief technical discussion should help you become more familiar with its operation and application. Remember, if it is installed so that it can sight the flame properly, is tightly secured, and is kept clean, you can expect to have years of uninterrupted service.

Fuel Pump

Configure Pump Before Installation

1. 1-pipe operation: Remove the hex plug from the desired inlet port with 5/8" or 1/4" allen and discard. Connect inlet piping to the 1/4" NPT fitting using the appropriate sealant. Do not use Teflon tape or compression fittings
2. 2-pipe Operation (return line) The return port is only used for 2 pipe operation. For 2 pipe operation a by-pass plug will need to be installed.

Clean-cut (figure 3) Remove the return port 5/8" hex plug and discard. Install bypass plug set screw with a 5/32" Allen wrench in the return port and tighten. Connect the return piping to the return port using appropriate sealant. Make sure no valves are placed in the return line. Do not use Teflon tape or compression fittings.\



MOUNTING PUMP (If the shutter screw interferes with the solenoid on the fuel unit)

To install a CleanCut fuel unit on chassis with existing shutter tab see Figure 2 and follow these steps: Remove existing fuel unit and solenoid valves, if applicable, and appropriately dispose of them. Note the air setting of the shutter, then remove the air shutter, set the shutter aside to be reinstalled.

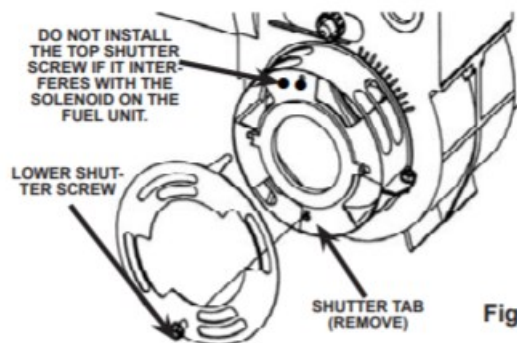


Figure 2

Bleeding the Pump

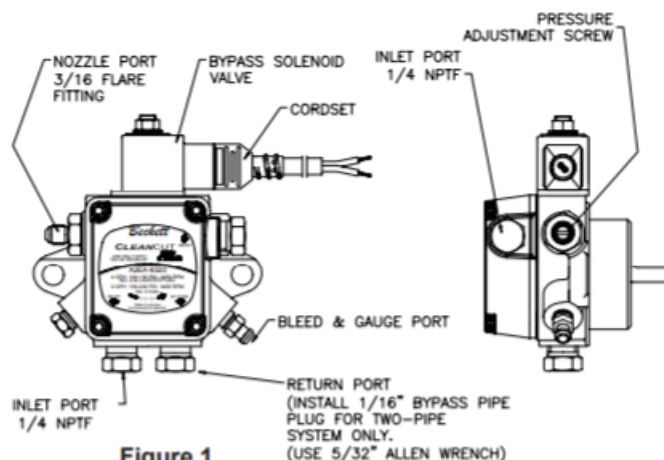
1. Open all fuel valve and inspect for line leaks.
2. One pipe systems require a manual bleeding process. Two pipe systems "bleed automatically but the bleeding process and be accelerated with the manual process.
3. All fuel line must be air tight with no leaks or the burner performance will be impacted. With poor combustion rumbles and pulsations may occur.
4. For Accelerated bleeding oil system.
 - a. Place hose on bleed port and position a catch can underneath.
 - b. Open 3/8" hex head on port and turn counter clockwise 1/2 –1 full turn and allow the oil to flow into the catch can.
 - c. Apply power to burner (turn on switch) the oil will start to flow.
 - d. Allow the oil to flow for 15 seconds in can until there is no sign of foam or air bubbles. If sign of air remain make sure all air is purged from fuel filter and repeat process until no air is present. You may have to turn the power switch off and then on to recycle the burner.
 - e. Tighten the 3/8" hex bleed port clock wise.

Fuel Pump

Adjusting the Pump Pressure

1. Install Pressure gauge in the gauge port. (most modern Stepp units come with gauge installed)
2. Set the pump pressure per the unit specific burner set up.
3. Turn the adjustment screw clock wise to increase and counter clockwise to decrease pressure.
4. Standby pressure (when burner is not firing) should be between 40-60 PSI.
5. Operating Pressure should be between 100-120 PSI *See Burner Set up page

Note: Minor adjustments to fuel pressure up or down may be required to get burner smoothly. See Start Up Burner & Set Combustion page for further details.



Fuel Nozzle Replacement

Remove burner from machine.

Remove Burner Tube assembly to expose electrode / nozzle assembly

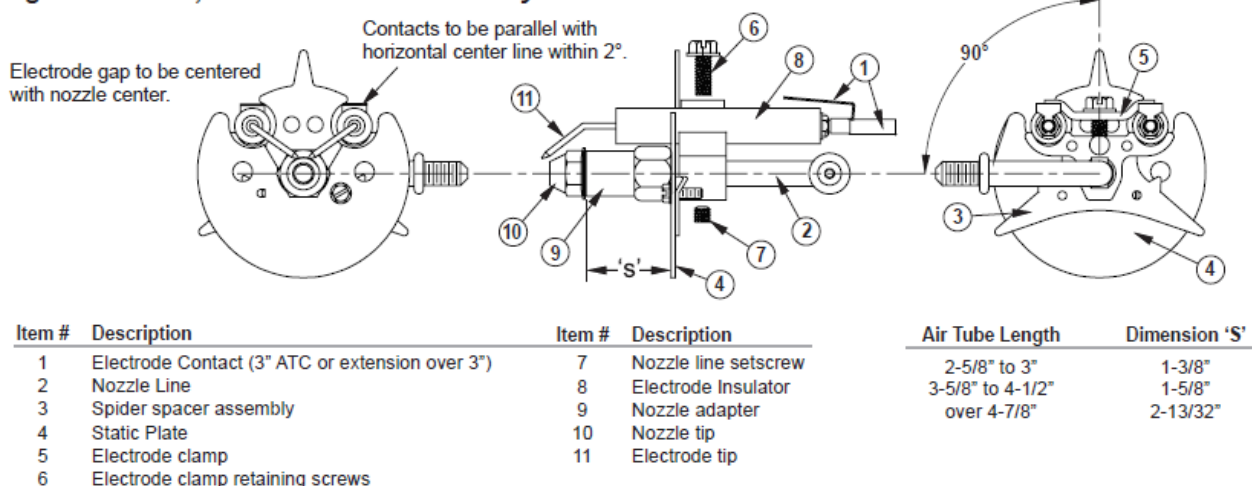
using a 5/8" inch wrench remove nozzle. Make sure not to damage electrodes or insulators.

Install new nozzle

Reinstall burner tube and install burner onto machine

You can also remove the nozzle electrode assembly through the top of the burner without removing it from the machine. See Servicing Nozzle Line Assembly on page previous page.

Figure 3. Nozzle, Line & Electrode Assembly



CAUTION

Use care when removing or installing an oil nozzle

A damaged nozzle could cause impaired combustion, sooting, puffback of hot gases, oil leakage and potential fire or asphyxiation hazards.

- Inspect the nozzle adapter to insure that the sealing surface is not grooved or scratched.
- To insure that the nozzle functions properly, check the orifice and strainer for dirt, scratches or other damage before installation.
- Do NOT attempt to install or remove a nozzle without securing the adapter to prevent seriously damaging the alignment.
- Use care when handling the nozzle line assembly to prevent changing the electrode tip settings or damaging the ceramic electrode insulators.
- Ensure that the electrode settings match the values shown in **Figure 2**.

WARNING

Correct Nozzle and Flow Rate Required



Incorrect nozzles and flow rates could result in impaired combustion, under-firing, over-firing, sooting, puff-back of hot gases, smoke and potential fire or asphyxiation hazards.

Use only nozzles having the brand, flow rate (gph), spray angle and pattern specified by the appliance manufacturer.

Follow the appliance manufacturer's specifications for the required pump outlet pressure for the nozzle, since this affects the flow rate.

- Nozzle manufacturers calibrate nozzle flow rates at 100 psig.
- When pump pressures are higher than 100 psig, the actual nozzle flow rate will be greater than the gph stamped on the nozzle body. (Example: A 1.00 gph nozzle at 140 psig = 1.18 gph)

Securely tighten the nozzle (torque: 90 in. lbs). For typical nozzle flow rates at various pressures refer to **Table 3**.

Primary Controller Burner

The Beckett GeniSys™ 12V Advanced Burner Control is a 12 Vdc primary safety control for oil burners used in special applications including, but not limited to, water heaters, pressure washers, crack sealers and portable heaters having firing rates less than 5.5 GPH. The GeniSys™ 12V is used with a suitable cad cell flame sensor to control the oil burner motor, igniter, and optional solenoid valve. It has 12 volt enable input compatible with mechanical and high limit switches. It can provide interrupted or intermittent duty ignition, and it has a 15 second lockout time on flame failure.

Maintain Specified Voltage

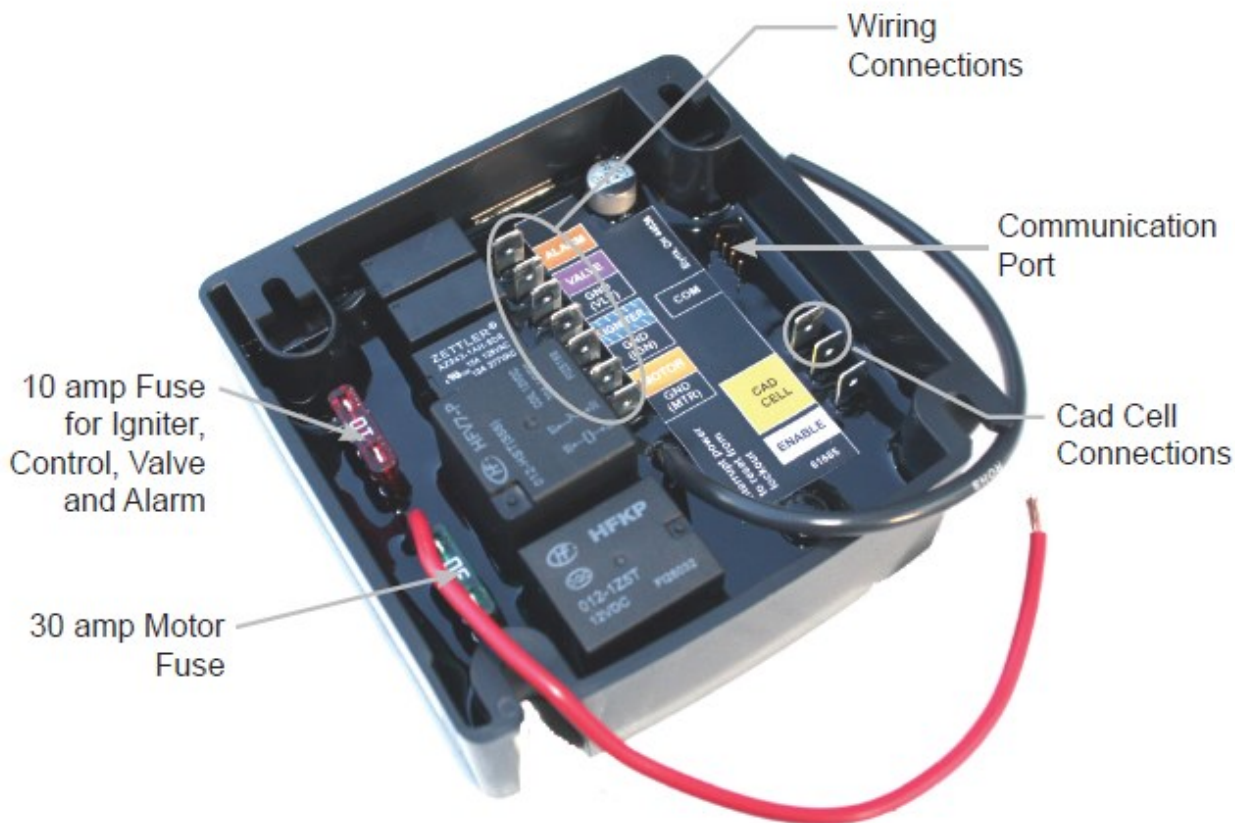
A low or erratic power supply could result in impaired burner operation, severe delayed ignition or an explosion inside the heat exchanger resulting in a burn and/or asphyxiation hazard.

Beckett DC Burners require a continuous supply of 11 to 16 volts DC (at 15 amps for Model ADC), measured at the burner during operation.

Special Note: The 7556 Control shuts the burner down if the input voltage drops to a sustained level of 10 volts DC, or below.

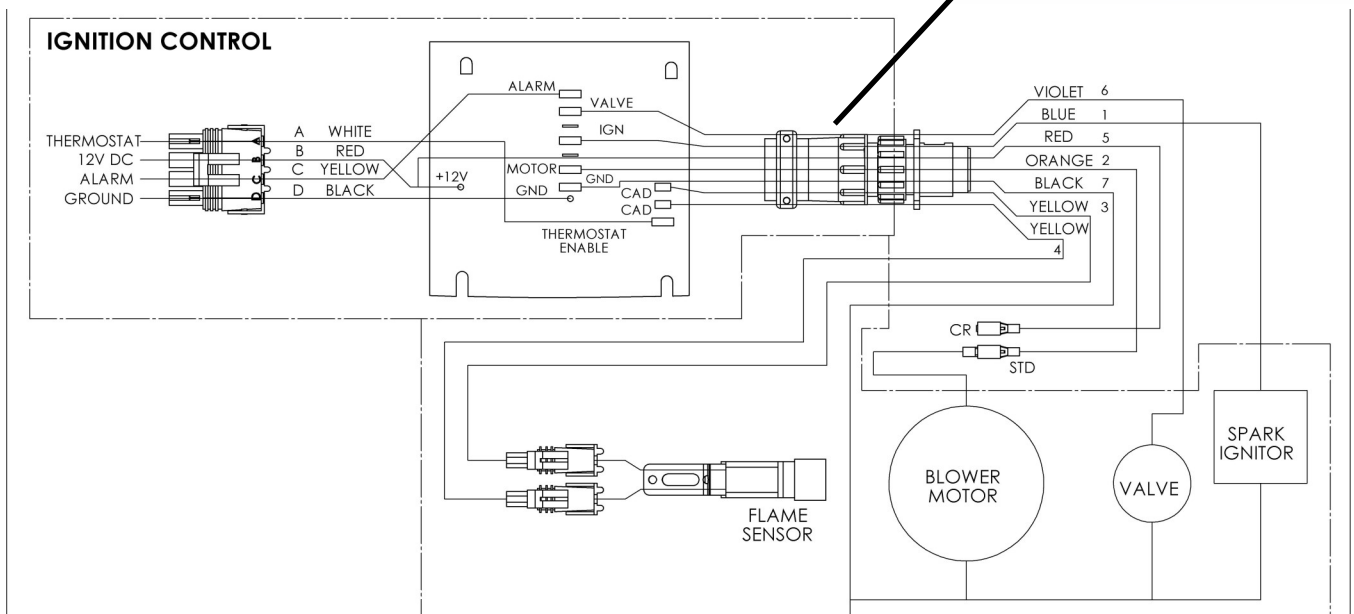
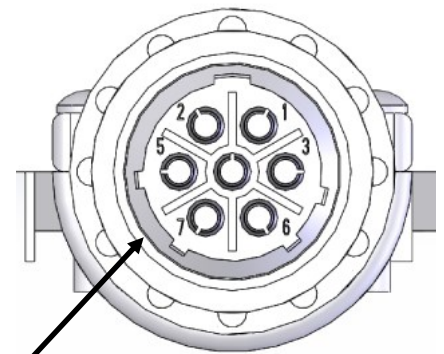
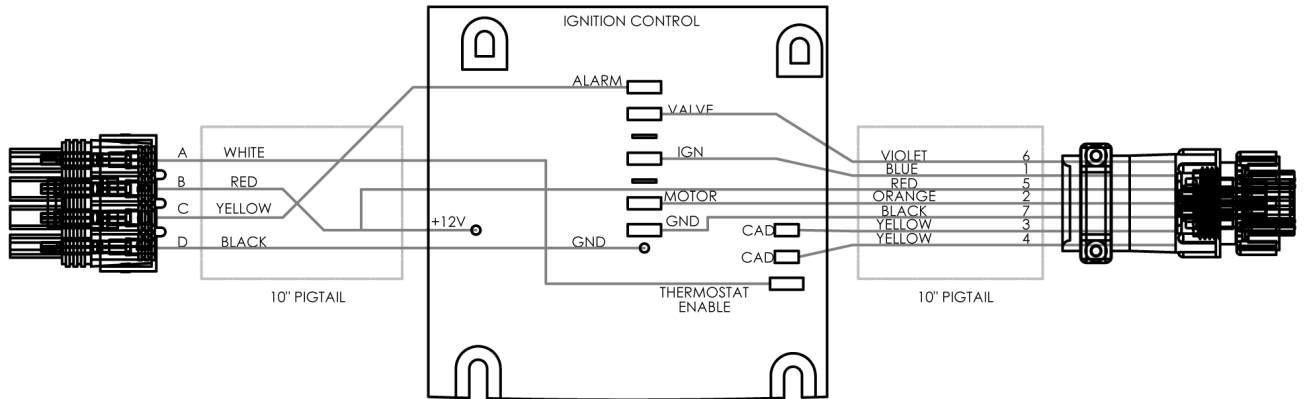
Operation resumes at a sustained input voltage of 11 volts DC, or above.

An automotive or small engine charging system that is capable of supplying the required continuous voltage/ampereage is recommended with certain road equipment, such as asphalt hot patchers and similar applications. This is especially true while maintaining nominal load temperatures during idle periods.



Primary Controller Burner

A10008216 REMOTE IGNITION CONTROLLER WITH LABEL
USED WITH OR WITHOUT CONTINUOUS RUN



Primary Controller Burner

WARNING: Fire Hazard

Reset and Service by Qualified Technician only

Startup / Checkout

If the burner or control fails any of the following tests, recheck control wiring. If the burner or control still fails any tests, replace the control.

Starting the System

1. Open the shut-off valve(s), if applicable, in the supply line from the fuel tank.
2. Adjust the thermostat to call for heat.
3. If the pump has not been primed, refer to "*Priming the Pump*" in this manual.
4. Monitor burner operation to insure that the burner ignites.
5. End the call for heat by turning the thermostat(s) to the lowest setting
6. Verify that the burner turns off before leaving .

Check Safety Features

Safe Start Check

1. Place a jumper across the cad cell terminals.
2. Refer to the steps for "*Starting the System*" and have the system call for heat.
3. Burner must not start. Verify that the control remains in Standby mode.
4. End the call for heat and remove the cad cell jumper.

Simulate Flame Failure and Ignition Failure

1. Refer to the steps for "*Starting the System*" and have the system call for heat.
2. After flame is established and the burner igniter turns off (if wired for interrupted ignition), simulate flame failure by pulling the cord set out of the solenoid valve.
3. At flame loss, the control will enter Relight mode. The control will immediately turn the igniter on.
4. After the 15 second lockout time, the control will lock out the burner. Verify that the burner motor and igniter are off and that the burner oil solenoid valve is not energized.
5. Push the cord set back in.

Sequence of Operation

Burner States

Standby: The burner is idle, waiting for a call for heat.

Valve-On Delay: The igniter and motor are on while the control delays turning on the oil solenoid valve for the programmed time. **15 Seconds**

Trial For Ignition: The oil solenoid valve is energized. A flame should be established within the factory set trial for ignition time ("lockout time"). **15 Seconds**

Lockout: The control has shut down for one of the following safety reasons:

- A. The trial for ignition (lockout) time expired without flame being established.
- B. The cad cell detected flame at the end of the Valve On Delay state.
- C. The pre-set time allotment for relighting is exceeded.
- D. Failed welded relay check.

If the control detects a welded motor contact, the motor only will cycle 5 seconds on, 5 seconds off, 3 times before locking out.

To reset the control from lockout turn off the power switch or turn off engine control switch for at least 2 seconds.

Primary Controller Burner

Ignition Carryover: Once flame is established, the igniter remains on for 10 additional seconds to ensure flame stability.

Run: The flame is sustained until the call for heat is satisfied. The control then switches to Motor-Off Delay, if applicable, or it shuts down and returns to Standby.

Relight: If the flame is lost while the burner is firing, the control immediately repeats the ignition sequence. The control will continue to relight each time the flame is lost, until it reaches a pre-set time allotment. The control will then go into Lockout instead of Relight. This feature prevents excessive accumulation of oil in the equipment's combustion chamber.

Motor-Off Delay: If applicable, the oil solenoid valve is turned off and the control delays turning the motor off for the set motor-off delay time before the control returns to standby. Note that to utilize the motor off delay, power must remain to the red wire after the call for heat ends.

Priming the Pump/ Bleeding the Burner

WARNINGS

Hot Gas Puff-Back & Heavy Smoke Hazard

Failure to bleed the pump properly could result in unstable combustion, hot gas puff-back and heavy smoke.

- Do not allow oil to spray into a hot combustion chamber while bleeding air from the pump.
 - Install a gauge in the nozzle discharge port tubing or fully open the pump bleed valve to prevent oil spray from accumulating in the combustion chamber during the air bleed procedure.
 - Insure that all bubbles and froth are purged from the oil supply system before tightening the pump bleed valve.
 - Insure that the equipment is free of oil and oil vapor before starting or resetting the burner
-
1. Prepare the burner for priming by attaching a clear plastic hose over the bleed port fitting and fully opening the pump bleed port.
 2. Use a suitable container to collect purged oil. Initiate a call for heat.
 3. Bleed the pump until all froth and bubbles are purged. You may have to cycle the power switch multiple time to clear all air in the system.
 4. If desired, terminate the call for heat to return to Standby. If prime is not established during the valve on delay and the trial for ignition times, repeat Step 3 until the pump is fully primed and the oil is free of bubbles.
 5. Terminate the call for heat, and the control will resume normal operation.

Primary Controller Burner

Resetting From Lockout

WARNINGS Fire & Smoke Hazard

Before starting or resetting the control from lockout state, troubleshoot the heating system for the root cause (s) of the lockout.

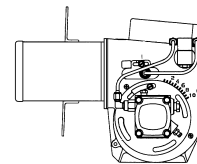
1. Make necessary repairs or adjustment to ensure a safe start condition.
2. Insure that the equipment is free of oil and oil vapors before starting or resetting the burner.
3. To reset, interrupt power for at least 2 seconds.
4. Always verify the control functions according to all specifications before leaving the installation site.
5. Replace the control if it does not operate as specified.

NOTES

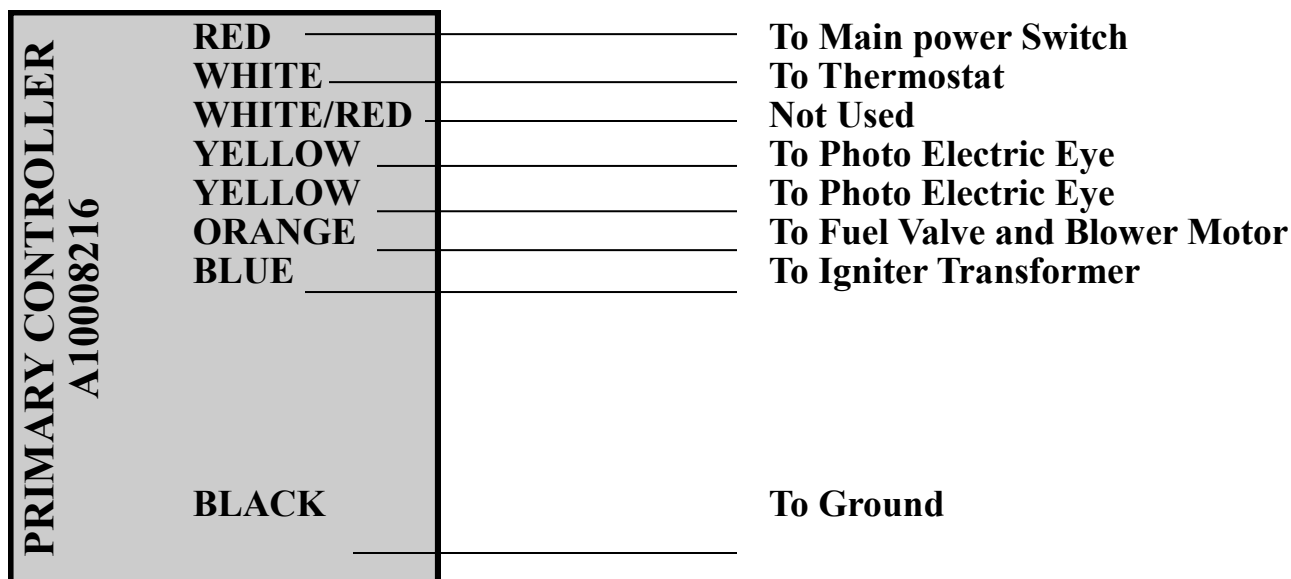
- Inspect the exterior of the control.
- Replace the control if there is any sign of impact damage.
- Use a multi meter to test the input voltage at the control.
- It should read 11 to 16 Vdc.
- Inspect all external wiring for secure connections and verify insulation integrity.
- Verify the control lockout and operation sequence, (Reference Startup/Checkout section).
- Observe a full operating cycle to prove the sequence and timings are correct.
- Replace any control that does not meet listed specifications.
- Always replace with the parts specified by the equipment manufacturer.
- Replace a blown fuse with an equivalent fast-acting automotive blade style fuse

Primary Controller Burner

NOTE: The primary controller can be bench tested for proper operation using an automotive type, 12 volt battery as a power source. Refer to the wiring schematics for wire identification.



1. Remove controller from burner.
2. Using two test lights, or volt meters, connect one to the blue wire, and one to the white/orange wire of the controller. Connect the black leads of your test instruments to the negative (-) terminal of the battery.
3. Connect the black wire from the controller to the negative (-) terminal of the battery.
4. Connect the red, white/red, and the white wires together, then connect these three wires to battery (+) terminal. Both test instruments should show voltage for approximately 15 seconds. After 15 seconds, the controller should "lock out" and no voltage will be present.
5. Repeat step #4, only this time connect the two yellow wires from the controller together three seconds after applying power to the three wires of the controller. (This simulates the controller receiving a "flame" signal from the photo electric eye). The white/orange wire should show voltage as long as the controller is hooked to the battery. The blue wire should only show voltage for about 15 seconds. Replace the controller if it fails any of these tests.



TROUBLESHOOTING

Trailer Lights

[illegible]

TROUBLESHOOTING

Diesel Engine

[illegible]

TROUBLESHOOTING

Control Box General

[illegible]

TROUBLESHOOTING

IFM Controller For models OJK, SRM, STRD, STPH,SSF

[illegible]

TROUBLESHOOTING

Product Pump

Problem	Possible Cause	Items To Check/ Service
No Pump Rotation	Pump Switch on forward	Green Light on switch
	Trigger on wand activated	
	Temperature interlocks	Minimum 275° for material and wand temperatures.
	Key way broken	Check pump shaft, motor shaft, and coupler
	Product Temperature too Cold	Heat product to manufacturers recommended temperature. If display show burner interlock you have not reached the minimum temperature.
	Product “Froze” in Wand & Hose	Allow additional time for heating element to melt product in hose
	Non-functioning Heat Element in Hose	Refer to “Electric Wand & Hose” troubleshooting
	WPC Valve not Positioned Correctly	Refer to operating instructions for WPC Valve position
	WPC Valve and External Plumbing “Froze”	Heat to re melt product. Proper shutdown procedures not followed.
	Worn Product Pump	Adjust or repair product pump as necessary
	Temperature interlocks	Minimum 275° for material and wand temperatures.
	Hyd valve not functioning	Bad coil, Check for corrosion. Check Ohms 4.2-4.8 Ω Stuck cartridge remove and clean. Consider hyd oil change with filter.
Pump will not pump but has rotation	Manual shut off valve on wand it in the off position	Could have stripped or broken valve stem if operated when cold.
	Wand shoe is plugged	Install wand in recirculating flange to heat up or melt out with hand torch
	Bad element in hose	Hose has 3 heating elements make sure that the entire hose is heating.
	WPC valve plumbing plugged	Operator did not follow shut down procedures. Heat with hand torch carefully to thaw out plumbing. DO NOT HEAT DIRECTLY ON WPC VALVE . The valve seal is only good to 600 degrees. Be careful not to melt wiring harness.
	Bad WPC valve	Check to see if the valve is bypassing when in the wand position. Replace WPC valve.
	Bad material	Overheated, separated, heated too many times. Clean out kettle.
	Boom Plugged/ Cold	Check heating element Ohms 1.4Ω
	Quick coupler plugged	Between hose and wand. Allow more time to heat or apply heat.
	Wand plugged	Check heating element Ohms. 3.3Ω
	Suction line plugged	Remove pump and clean suction line.

TROUBLESHOOTING

Product Pump

Problem	Possible Cause	Items To Check/ Service
Pump turning but poor or low flow	Pump packing leaking	Tighten packing. Replace packing
	Worn Pump	Replace pump
	Hyd motor key way broken	Replace key way.
	Bad material	Overheated, separated, heated too many times. Clean out kettle.
	Worn Hyd motor	May chatter, replace motor.
	Product Temperature too Cold	Heat product to manufacturers recommended temperature. If display show burner interlock you have not reached the minimum temperature.
	Bad WPC valve	Check to see if the valve is bypassing when in the wand position. Replace WPC valve.
Pump will not turn in reverse	Pump switch off	Push and hold for reverse.
	WPC valve plumbing plugged	Operator did not follow shut down procedures. Heat with hand torch carefully to thaw out plumbing. DO NOT HEAT DIRECTLY ON WPC VALVE. The valve seal is only good to 600 degrees. Be careful not to melt wiring harness.
Little or no change in RPM	Control box/wand switch not function	Check wiring for loose or broken wires.
	Rheostat not functioning	Check Ohms across two pins. Should have 0-5000Ω
	Worn hyd motor	See hyd troubleshooting
	Manual override out of adjustment	See adjustment for rheostat adjustment on hyd valve.

TROUBLESHOOTING

Heated Hose and Wand

Problem	Possible Cause	Items To Check/ Service
No Heat	Hose switch on	Green light on Red light off.
	Thermostat calling for heat.	Will have flame symbol next to temp display. Make sure that you have your set temp set to 400°F
	Connections on wire harness pulled apart	Make sure that connectors are plugged in. Connector under control box, boom to hose, and hose to wand. Check for broken pins in connectors. Turn hose switch off before unplugging. Check to make sure that wand to hose connections are not twisted and pulled apart. Very common problem.
	24 volt alternator (large alternator in front of engine)	Verify 24-28 volts out of alternator when switch is on.
	Bad Ground	Check Ground Wire
		Check resistor (brown ceramic cylinder behind Deep Sea controller.) If broken replace. Check for corrosion. Check ohms should be 10Ω. Resistor excites the 24 volt alt from the 12 v battery. Should have 1.5 volts when switch is off. If it does than the wiring harness has a dead short, bad element. If it has no voltage when switch is off it is a bad alternator. Boom element Ohms 1.4Ω Hose element Ohms 3.7Ω Wand element Ohms 3.3Ω 0Ω would indicate a broken element or shorted, cut wire harness.
	Belts	Check for belt tightness. Replace worn belts. Loose belts could produce less voltage making the hose heat much slower. Check alternator brackets for damage.
		Check Relay behind Deep sea controller.
Low Voltage	Low Engine RPM	Set to 2300 RPM
	Belts	Check for belt tightness. Replace worn belts. Loose belts could produce less voltage making the hose heat much slower. Check alternator brackets for damage.

Problem	Possible Cause	Items To Check/ Service
Controller Won't Power Up		Check battery voltage.
		Check 20A fuse on engine harness and 2A fuse on controller harness.
		Check for backed out terminals in 12-pin Deutsch connectors. Look closely at pin #1 (ground) and pin #3 (battery +).
		Check continuity of battery wire (pin #3) from engine to on/off switch.
Controller Powers Up, Engine Won't Crank		Check for backed out terminals in 12-pin Deutsch connectors. Look closely at pin #2 (crank) terminal.
		Check for bad relays at the engine and in the control box.
		Check functionality of starter solenoid.
Engine Cranks, But Won't Start		Check 15A fuse on controller harness.
		Check for backed out terminals in 12-pin Deutsch connectors.
		Make sure fuel system is primed.
		Check functionality of glow plugs.
		Check fuel solenoid. (D1105 & V1505)
		Check for clogged fuel filter.
		Check quality of fuel.
Engine Shutdown, Oil Lamp Displayed		Check oil level.
		Check fuel level/fuel supply. An engine that runs out of fuel due to fuel starvation will display a low oil pressure fault.
		Check the function of the oil pressure switch. Switch will ground to case when oil pressure is less than 7 psi
Engine Shutdown, Temp Lamp Displayed		Check radiator for blockage.
		Once engine has cooled down, check coolant level.
		Check functionality of thermostat.
Engine Doesn't Shutdown (Z602)		Check shutdown solenoid.
		Check 15A fuse on controller harness.
		Check for backed out terminals in 12-pin Deutsch connectors.
		Check energize-to-stop timer for proper function.
Engine Runs Rough		Check for air bubbles in fuel supply and white exhaust.
		Check quality of fuel.

TROUBLESHOOTING

Deep Sea Engine Controller

Problem	Possible Cause	Items To Check/ Service
Deutsch 12 Pin Connector Terminal Functions		1. Ground 2. Crank 3. Battery Power (protected by 20A fuse) 4. Charge Fail Lamp 5. Run Signal (provides power to the following: a. Fuel solenoid (D1105 & V1505) b. Shutdown solenoid (Z602) c. Fuel Pump (All Engines) d. Alternator Ignition Terminal (All Engines) 6. Tachometer (Not Used) 7. Glow 8. Fuel Level Sender (Not Used) 9. Oil Pressure Switch (Grounds On Fault) 10. Oil Gauge Sender Signal 11. Temp Switch (Grounds On Fault) 12. Temp Gauge Sender Signal

TROUBLESHOOTING

LP SPARK IGNITION BURNER SYSTEM

Problem	Possible Cause	Items To Check/ Service
Pilot won't ignite		Turn power switch ON and check for sparks at electrodes at pilot light.
	Sparks Present	Switch OFF then ON again to purge air from gas lines.
		Check fuel supply and fuel valve, check for 10 to 20 lbs on regulator, repair or replace regulator if necessary.
	Correct Pressure	Check that the pilot valve is open 4 to 6 turns
	Pilot wont light	Check for plugged pre-orifice (located at the pilot valve) Clean orifice with compressed air or a .013" orifice cleaner.
		Check pilot solenoid valve for 12 volts when power switch is first turned ON. (check voltage within 5 sec.)
		Listen to, and feel pilot solenoid for activation when power switch is first turned ON. If no activation is observed replace solenoid
		Check for a low battery.
	Low Voltage	Check for 12-14 volts at red wire at Ignition Control.
		Check for faulty wiring or a poor ground connection
		Check for low battery, bad fuse in control panel, or faulty wiring between solenoid and ignition control.
Pilot ignites & then goes out. (flame not sensed causing control to lock out)		Check for sufficient flame to be sensed. Check fuel pressure, 10-20 lbs nominal. Open pilot valve 4-6 turns. Check for plugged pre-orifice (located at the pilot valve) Clean orifice with compressed air or a .013" orifice cleaner. Clean pilot orifice
		Clean electrodes with a fine grade of emery cloth
		Check for proper electrode gap of .125"± .031 Replace electrodes if out of spec
		Check for faulty wiring between sensing electrode and ignition control. Check for poor ground connections. Replace Ignition Control.

Fuel Valve Solenoid

The fuel solenoid valve needs to be removed to perform this test. 12 volts applied to the fuel solenoid valve activates an electromagnet that pulls the valve open. With no power applied, a spring pushes the valve closed. Blow through the valve to verify proper operation. Replace valve if not functioning properly.

Fenwal Ignition Control

The Fenwal Ignition Control creates sparks at the electrodes for igniting the pilot light, and supplies power to the fuel valve at the appropriate times. The controller receives voltage from either the thermostat or main power switch (depending on the system) to begin operation. A flame sensing circuit is incorporated for control of the fuel valve if the flame goes out.

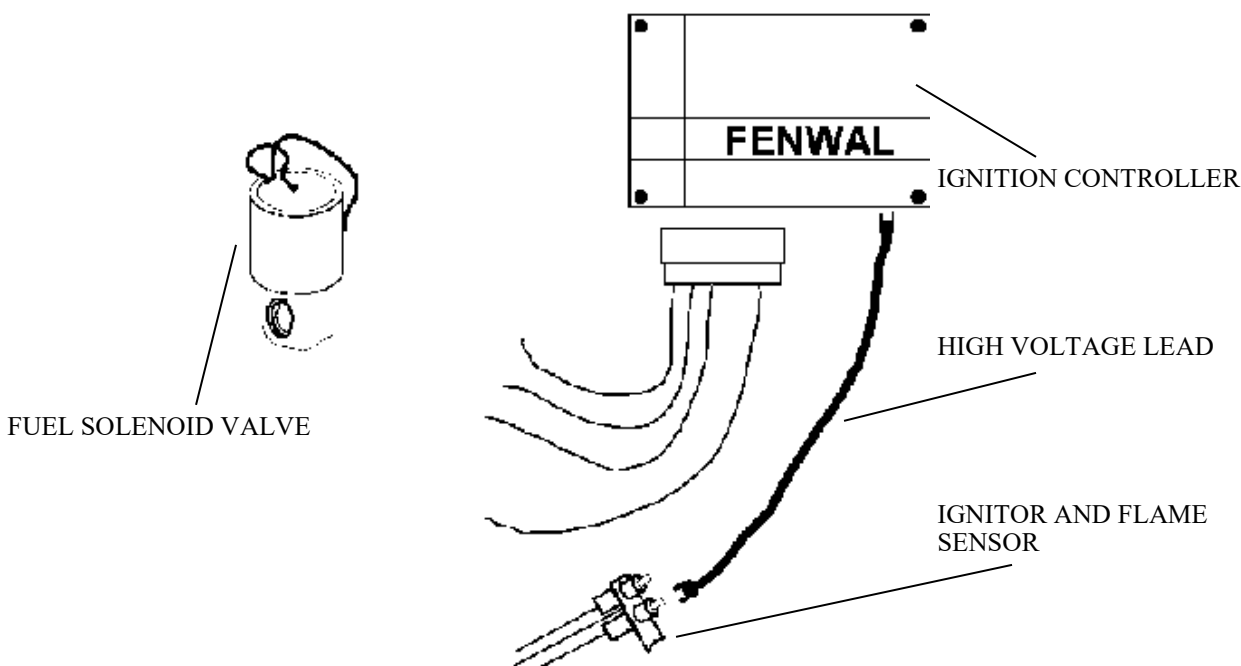
When the power switch is turned on, or when the thermostat calls for heat, a 12 volt signal is sent to the controller. The controller will then create sparks at the electrodes. At the same time, the controller also sends a 12 volt signal to the fuel valve causing it to open. This allows fuel into the pilot light and it is ignited by the sparks at the electrodes.

The flame sensing circuit will signal the controller that ignition was successful. The controller will then shut off the sparks. The fuel valve will remain open to keep the flame burning.

If the controller does not sense a flame within approximately six to seven seconds, it will shut off the fuel supply and the sparks. The controller will then "lock out".

If the flame should go out for any reason, the controller will try for re-ignition, if re-ignition is not successful in six to seven seconds, the controller will "lock out".

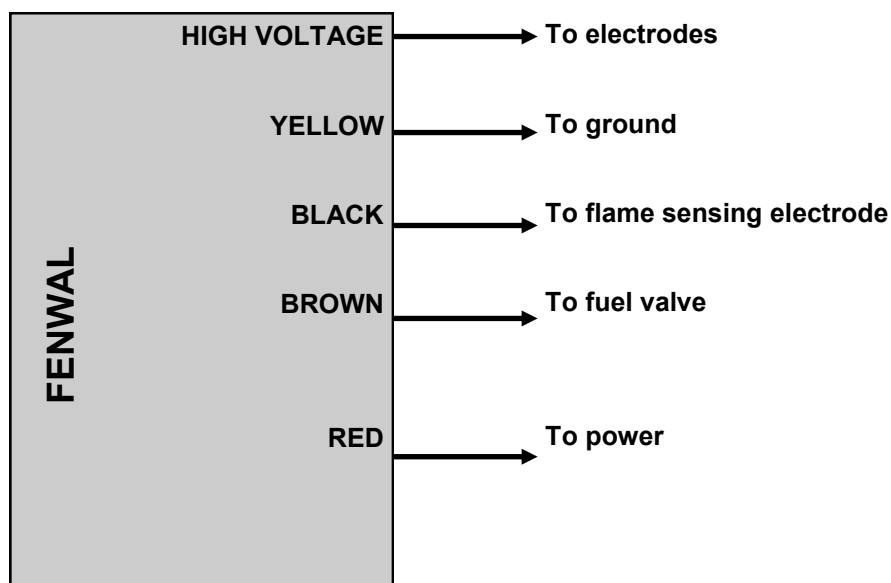
If a lock out situation occurs, the main power switch must be shut off, then on again, to reset the system. (continued on next page)



Fenwal Ignition Control

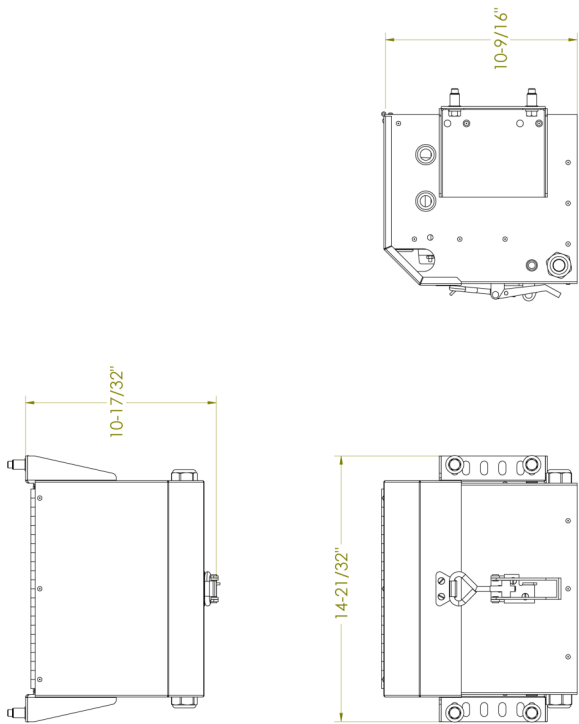
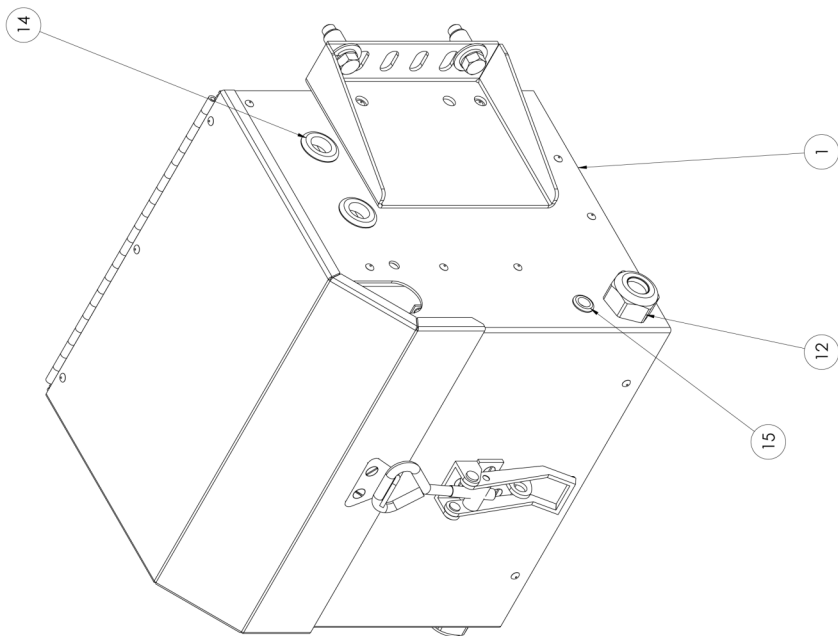
The Ignition Controller can be tested for proper operation using an automotive type 12 volt battery as a power source. A propane torch, and a 12 volt test light will also be needed. Do not use a digital volt/ohm meter, as it may give false readings for these tests.

1. Disconnect wires as necessary to perform these tests. Mark all wires for proper reassembly.
2. Connect one lead of your test light to the brown wire from the fuel valve. Connect the other lead to neg. (-) terminal of battery.
3. Be sure the yellow wire from the controller is connected to ground. (neg. terminal of battery).
4. While observing your test light, apply power to the red wire on the controller by turning on the main power switch and thermostat (if equipped). The test light should light up and sparks will be present at the electrodes for approximately six seconds, then the controller should "lock out." The sparks will stop and the test light will go out.
5. Repeat step #4, only this time direct flame from a propane torch across the sensing and ground electrodes two seconds after applying power to the controller.
6. The sparks should stop and the brown wire (fuel valve) should show voltage as long as the flame is directed across the electrodes.
7. Remove the flame and the sparks should reappear for six seconds; this is the trial for re-ignition. If the flame is not re-established, the system "locks out".
8. Be certain all wiring is correct and undamaged, then replace the controller if it fails any of these tests.



REPLACEMENT PARTS

REVISIONS		
REV	DESCRIPTION	DATE
C03	ADDED WIRE HARNESS	8/1/2016
C04	REMOVED BATTERY FROM PAN	11/10/2017
C05	ECR19572 ADDED 2X SLOTS TO M19741	9/13/2019

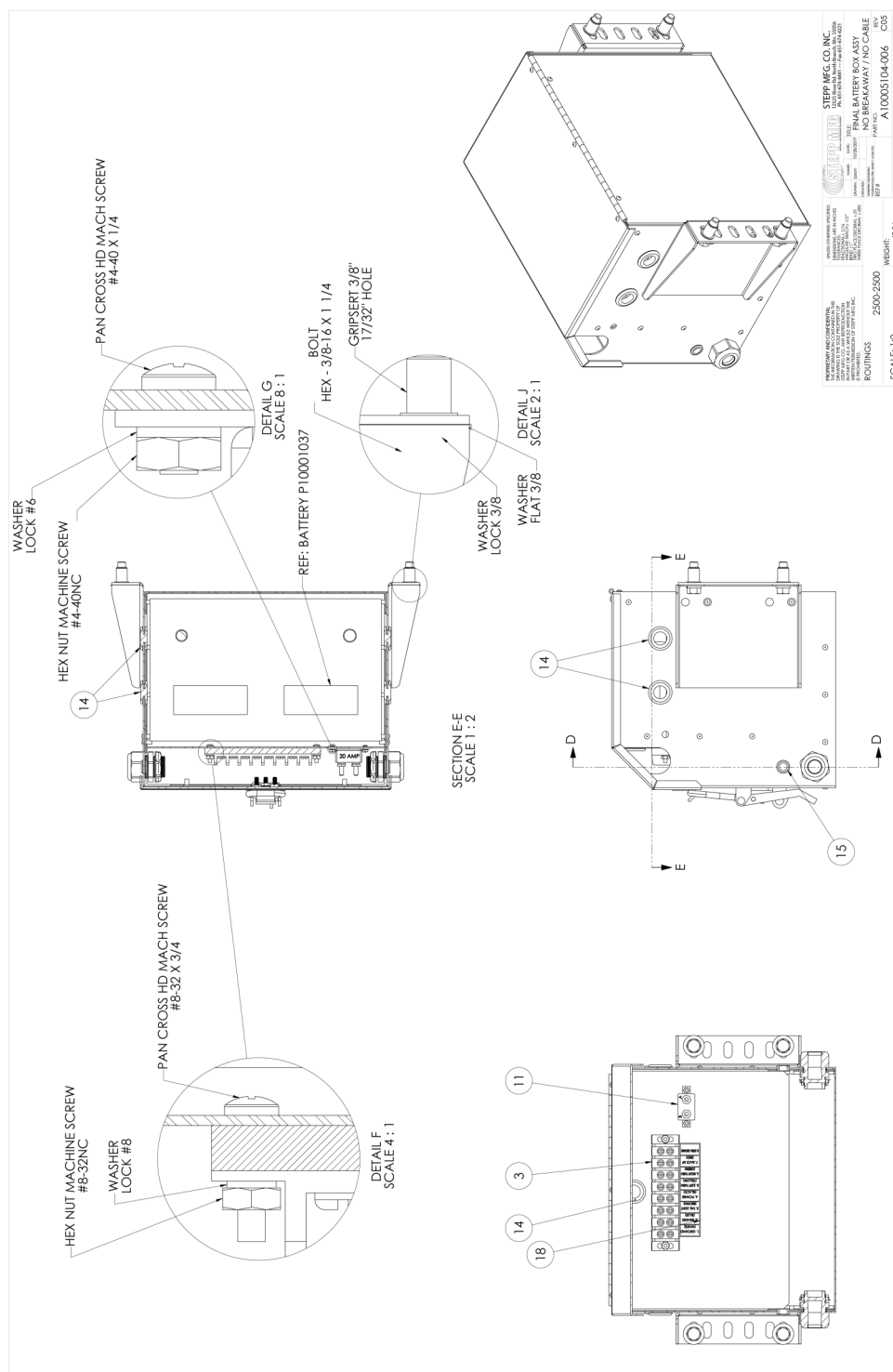


ITEM NO.	QTY.	PartNo	Description-1	Description-2
19	2	P10001619-096	PAN CROSS HD MACH SCREW	#4-40 X 1/4
18	1	P10019269	BATTERY TERMINAL ID	BOLT ON BATTERY BOX
17	2	P10001619-015	PAN CROSS HD MACH SCREW	#8-32 X 3/4
16	4	P10005045	GRIPSERT 3/8"	17/32" HOLE
15	2	P10004461	GROMMET	5/16" I.D. 5/8" O.D.
14	5	P10002730	RUBBER GROMMET	5/8 ID X 1/16 X 1-1/8 OD
13	2	P10002606	LOCKING NUT 3/4	STEEL
12	2	P10002558	CONNECTOR STRAIN RELIEF 3/4	WITH LOCKING NUT
11	1	P10002031	BREAKER	20 AMP AUTO RESET
10	2	P10001625-003	HEX NUT MACHINE SCREW	#8-32NC
9	2	P10001625-001	HEX NUT MACHINE SCREW	#4-40NC
8	4	P10001609-006	WASHER	FLAT 3/8
7	4	P10001608-006	WASHER	LOCK 3/8
6	2	P10001608-002	WASHER	LOCK #8
5	2	P10001608-001	WASHER	LOCK #6
4	4	P10001603-002	BOLT	HEX - 3/8-16 X 1 1/4
3	1	P10000187	TERMINAL STRIP	8 X 30 AMP
2	1	A10005156	WH - BAT BOX	BATTERY BOX
1	1	A10003290	BATTERY BOX ASSY	POP RIVET STYLE
ITEM NO.	-006/QTY.	PartNo	Description-1	Description-2

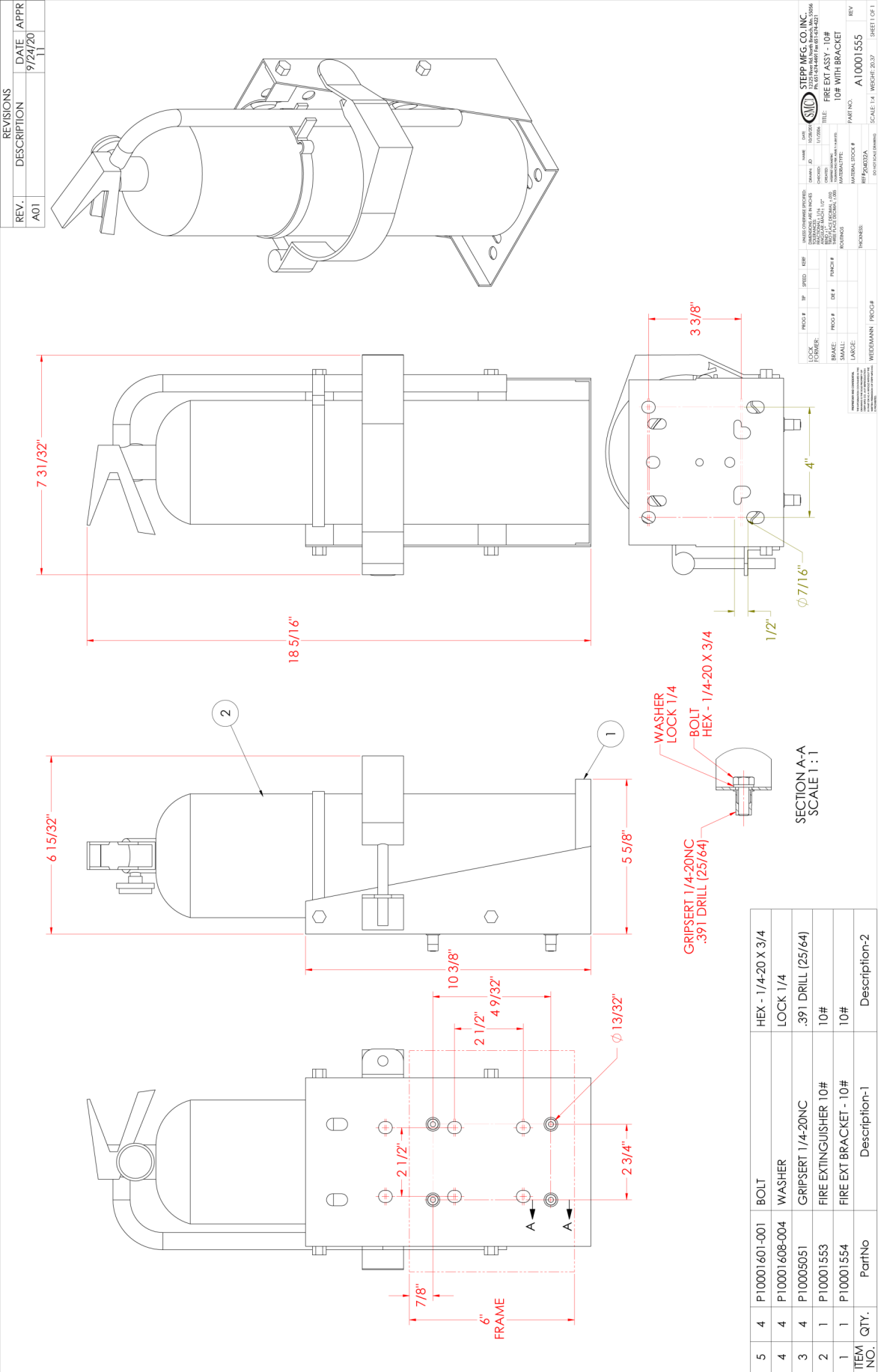
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ROUTINGS		FINAL BATTERY BOX ASSY	
NO BREAKAWAY / NO CABLE		NO BREAKAWAY / NO CABLE	
PART NO.		A10005104-006	
REV		C05	
DO NOT SCALE DRAWING		SHEET 1 OF 2	

REPLACEMENT PARTS

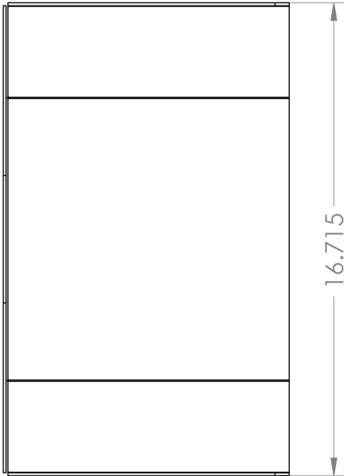
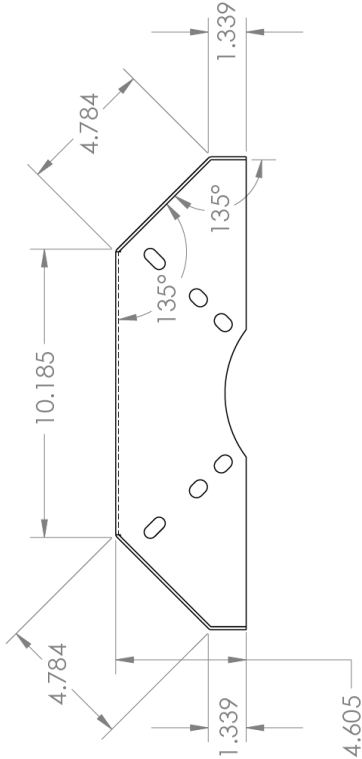
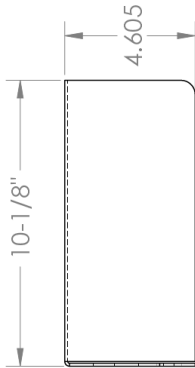
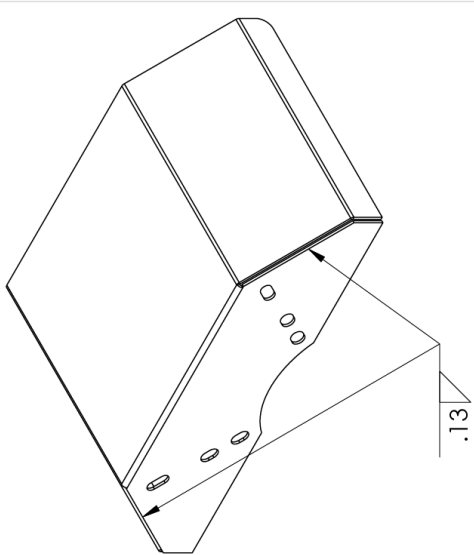
Battery Box



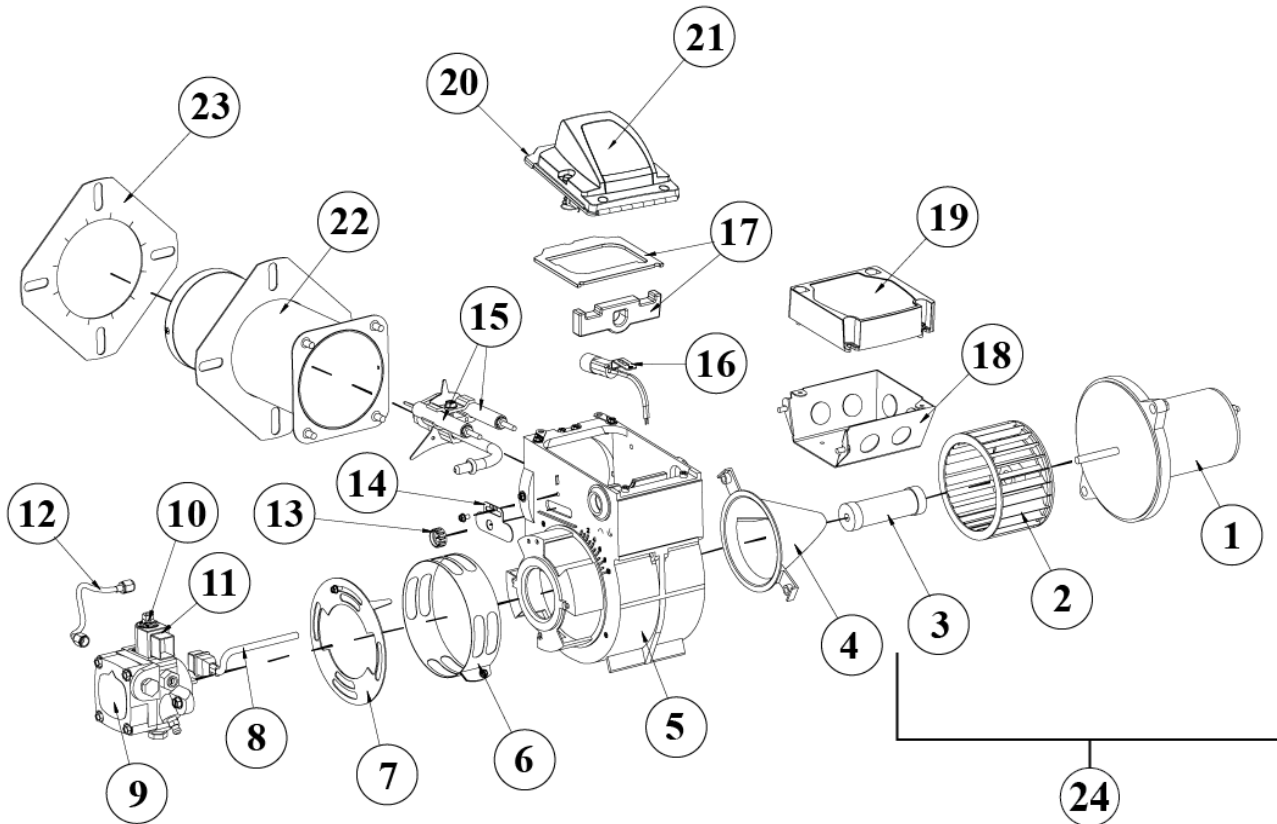
SECTION D-D
SCALE 1:2



REVISIONS		
REV.	DESCRIPTION	DATE
C02	CHANGE TO FIT PRIMARY	10/3/2009
C03	ADDED TWO SLOTS	9/5/2014
C04	ECR17136 ADDED 2 MORE SLOTS	9/22/2017

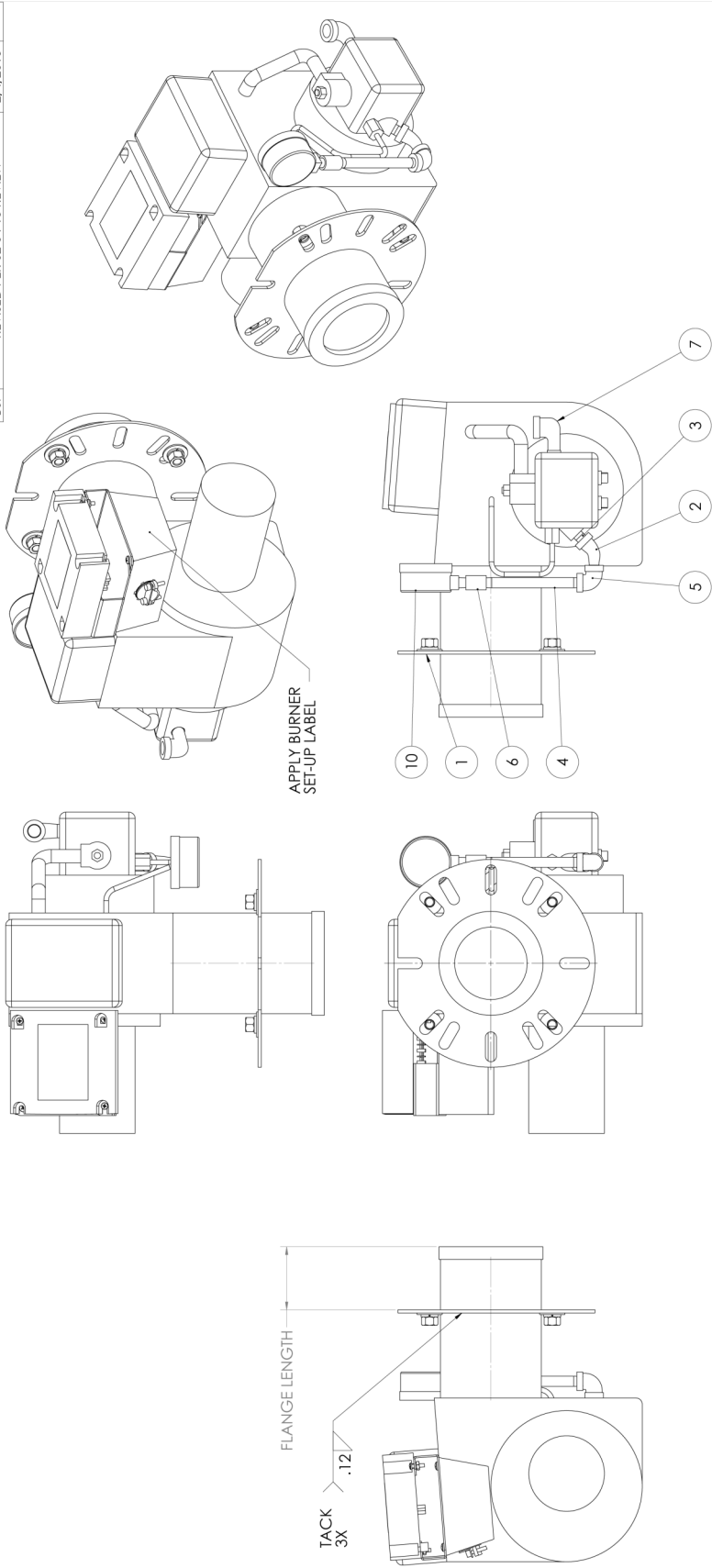


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	DRAWN: jason	DATE: 10/28/2019	TITLE: BURNER RAIN COVER	
	CREATED:	MATERIAL TYPE: HR	BOLT ON COVER SSPH-4.0	
	MATERIAL STOCK # P10000255	REF# M10002402	DO NOT SCALE DRAWING	
ROUTINGS		THICKNESS: 0.1046	PART NO. M10004131	
			REV C04+	
			SCALE: 1:4 WEIGHT: 7.35	
			SHEET 1 OF 2	



ITEM	QTY	DESCRIPTION	PART#
1	1	Motor, blower	509092
2	1	Blower Fan Wheel	509069
3	1	Coupling, pump to motor.....	509086
4	1	Air Tube	509066
5	1	Burner Housing	P10015946
6	1	Air Band	Call
7	1	Air Shutter	Call
8	1	Cord Set.....	P10015940
9	1	Pump.....	509109
10	1	Valve Stem	P10015922
11	1	12 Volt Coil	P10015920
12	1	8" Copper Tubing	P10015921
13	1	Escutcheon Plate Spline Nut.....	Call
14	1	Escutcheon Plate.....	Call
15	1	Electrode and Fuel Line assembly	509112
	1	Electrode only.....	509089
16	1	Cad Cell	A10008216
17	1	Igniter Gasket Kit	P10015548
18	1	4x4 Wiring Box kit.....	Call
19	1	Primary Control	A10008216
20	1	Igniter Assembly With Base Plate	509087
21	1	Igniter Only	N/A
22	1	Air Tube Assembly	509070
23	1	Flange Mounting Gasket	509111
	1	Flange with Gasket.....	509071
24	1	Motor Kit with Blower Wheel and Coupling	509092
25	1	Complete Burner Assembly of OJK 75 and 125	A10008105-005

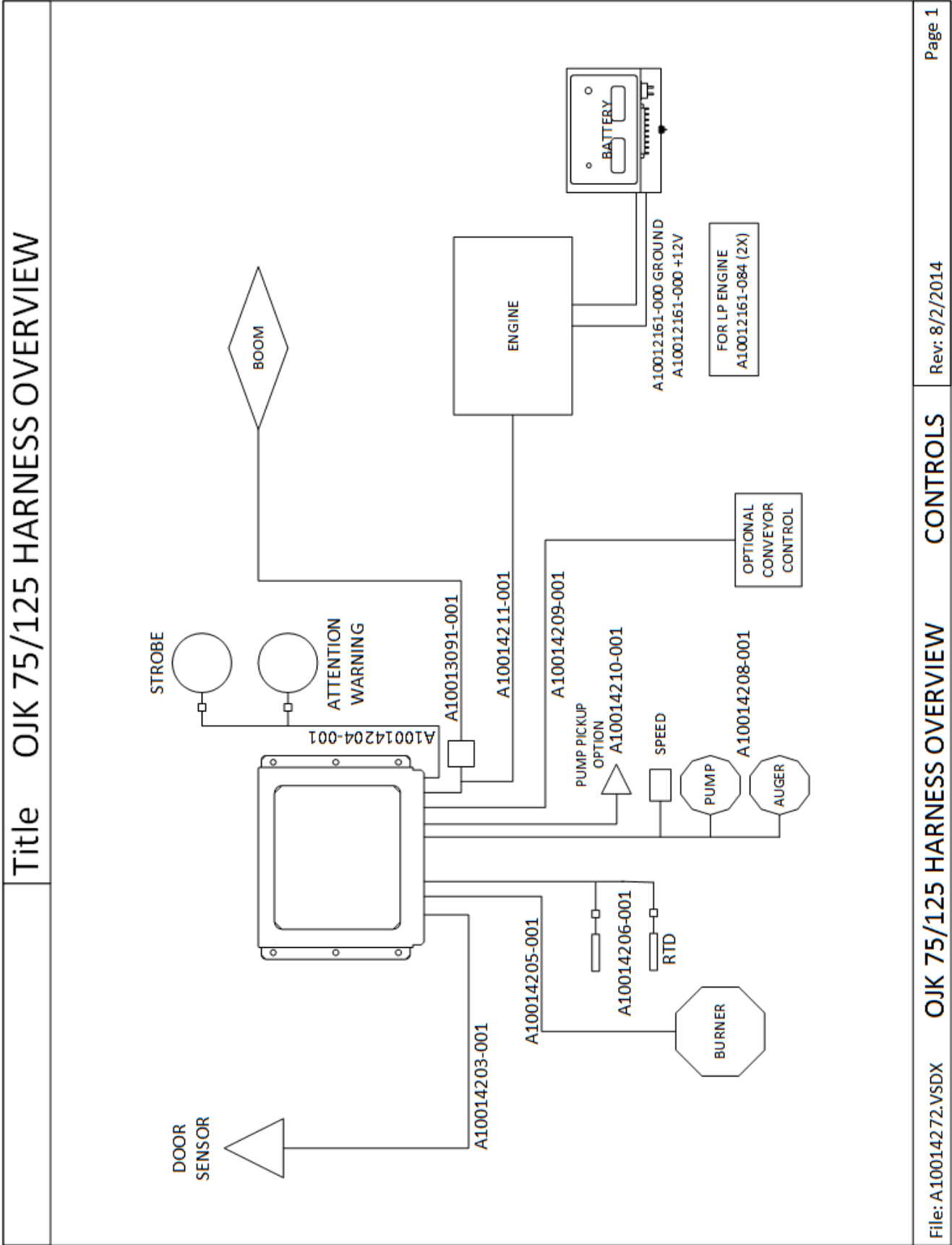
REV.	DESCRIPTION	DATE	APPR.
B03	CHANGED GAUGE FITTINGS	9/25/2013	
B04	REVISED AND REDRAWN	1/9/2015	
B07	REVISED PER 02-04-15 REVIEW	2/4/2015	



NOTE: USE BURNER SET-UP SHEET A10008105-005
TEST AFTER ASSEMBLY

ITEM NO.	QTY.	PartNo	Description-1	Description-2
10	1	P10012560	PRESSURE GAUGE	0-200 PSI
9	1	P10005132	F - 1/2 FUEL RETURN HEAD	BECKETT MODEL ADC DIESEL BURNER
8	1	P10005125	1.50 GPH BURNER NOZZLE	DIESEL BECKETT MODEL ADC BURNER
7	1	P10001539-002	ELL - ST - 90°	1/4 NPT
6	1	P10001520-001	COUPLING - FULL STANDARD	1/8"
5	1	P10001465-001	ELBOW - BLK 90°	1/8"
4	1	P10001298-007	PIPE NIPPLE - SCH.40	1/8 x 4
3	1	P10001298-001	PIPE NIPPLE - SCH.40	1/8 x CLOSE
2	1	P10001048-001	ELBOW - ST - 45°	1/8 NPT
1	1	A 10008215	BURNER BASE UNIT ASSY CPC	BURNER BASE UNIT ASSY
ITEM NO.	-005/QTY.	PartNo	Description-1	Description-2

STEP 1: PREPARE THE BURNER BASE UNIT ASSY CPC FOR THE DIESEL BURNER. SEE THE DIESEL BURNER SET-UP SHEET A10008105-005 FOR THE DIESEL BURNER SET-UP PROCEDURE.		STEP 2: INSTALL THE DIESEL BURNER. SEE THE DIESEL BURNER SET-UP SHEET A10008105-005 FOR THE DIESEL BURNER SET-UP PROCEDURE.	
ROUTINGS		BURNER ASSY	
ASSEMBLY, QC		CJL 7/5 & 1/25	
WEIGHT: 23.54		A 10008105-005	
SCALE: 1:2		B07	
DO NOT SCALE DRAWING		SHEET 1 OF 2	



REPLACEMENT PARTS

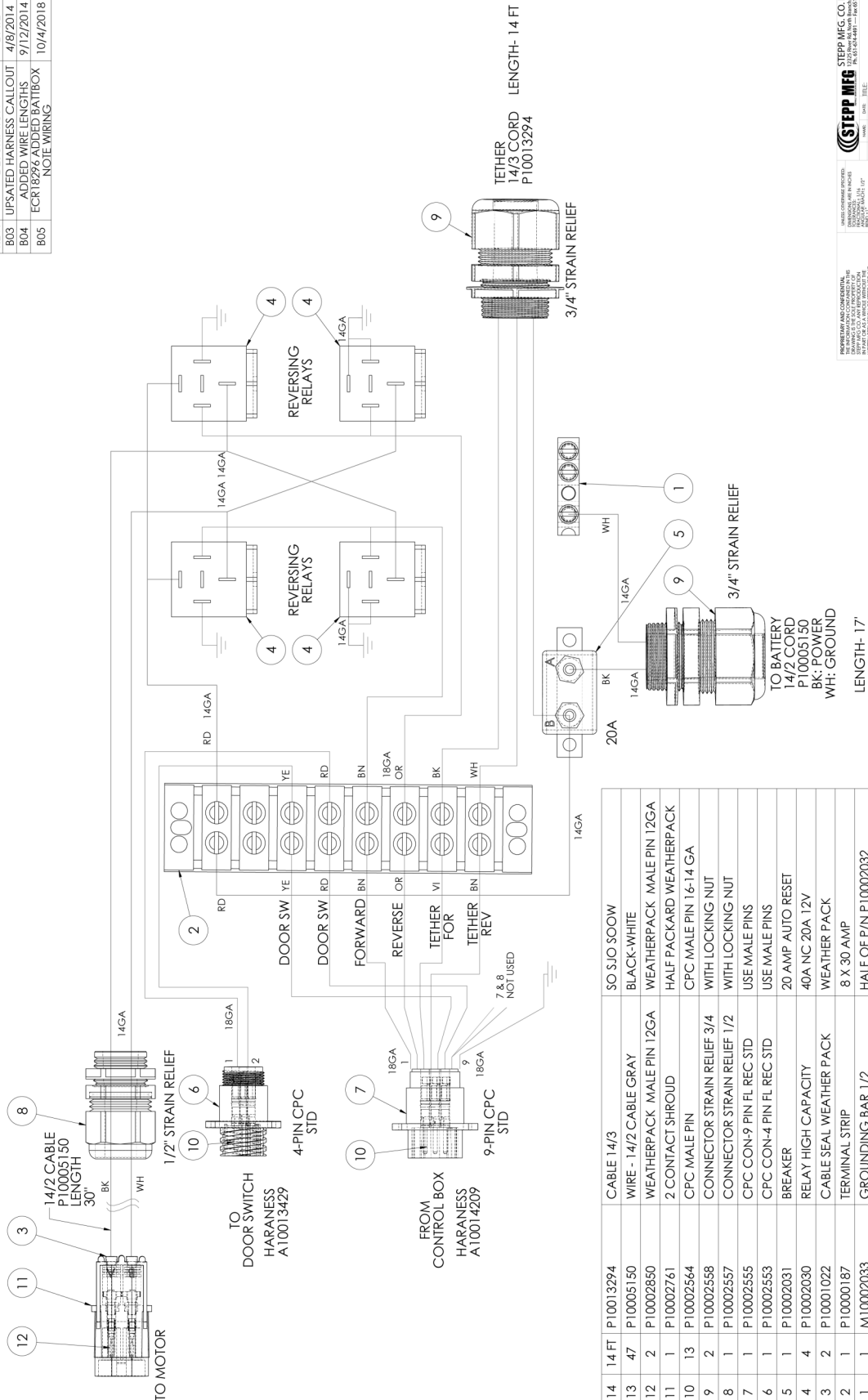
Lights

[illegible]

REPLACEMENT PARTS

Conveyor Wire Harness

REVISIONS			
REV.	DESCRIPTION	DATE	APPR
B03	UPDATED HARNESS CALLOUT	4/8/2014	
B04	ADDED WIRE LENGTHS	9/12/2014	
B05	ECR18296 ADDED BATTBOX NOTE WIRING	10/4/2018	



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ROUTINGS	ELEM	REV
SCALE: 3:2	WEIGHT: 1.20	PART NO. K10013428
DO NOT SCALE DRAWING	SHEET OF 1	OJK CONVEYOR BOX WIRING
DATE: 11/20/2007	DRAWN: COWLEY	300700707
CHECKED:	DESIGNED:	11/20/2007
100% PLACE SPECIAL	100% PLACE SPECIAL	100% PLACE SPECIAL

REPLACEMENT PARTS

24 V Wiring Box

SCREW-THRD ROLLING
#8-32UNF X 1/2
P10001666-003

ITEM NO.	QTY.	PartNo	Description-1	Description-2
7	1	P10009211	RELAY - 12VDC SPST 100A	
6	1	P10002674	WIREWOUND RESISTOR	10 OHM, 25 WATT
5	1	P10002030	RELAY HIGH CAPACITY	40A NC 20A 12V
4	9	P10001666-003	SCREW-THRD ROLLING	#8-32UNF X 1/2
3	1	M10018720	COVER	24V WIRING BOX ASSY
2	1	M10018719	BASE	24V WIRING BOX ASSY
1	1	M10003698	MOUNT, RESISTOR 100HM, 25W	TO MOUNT RESISTOR P10002674

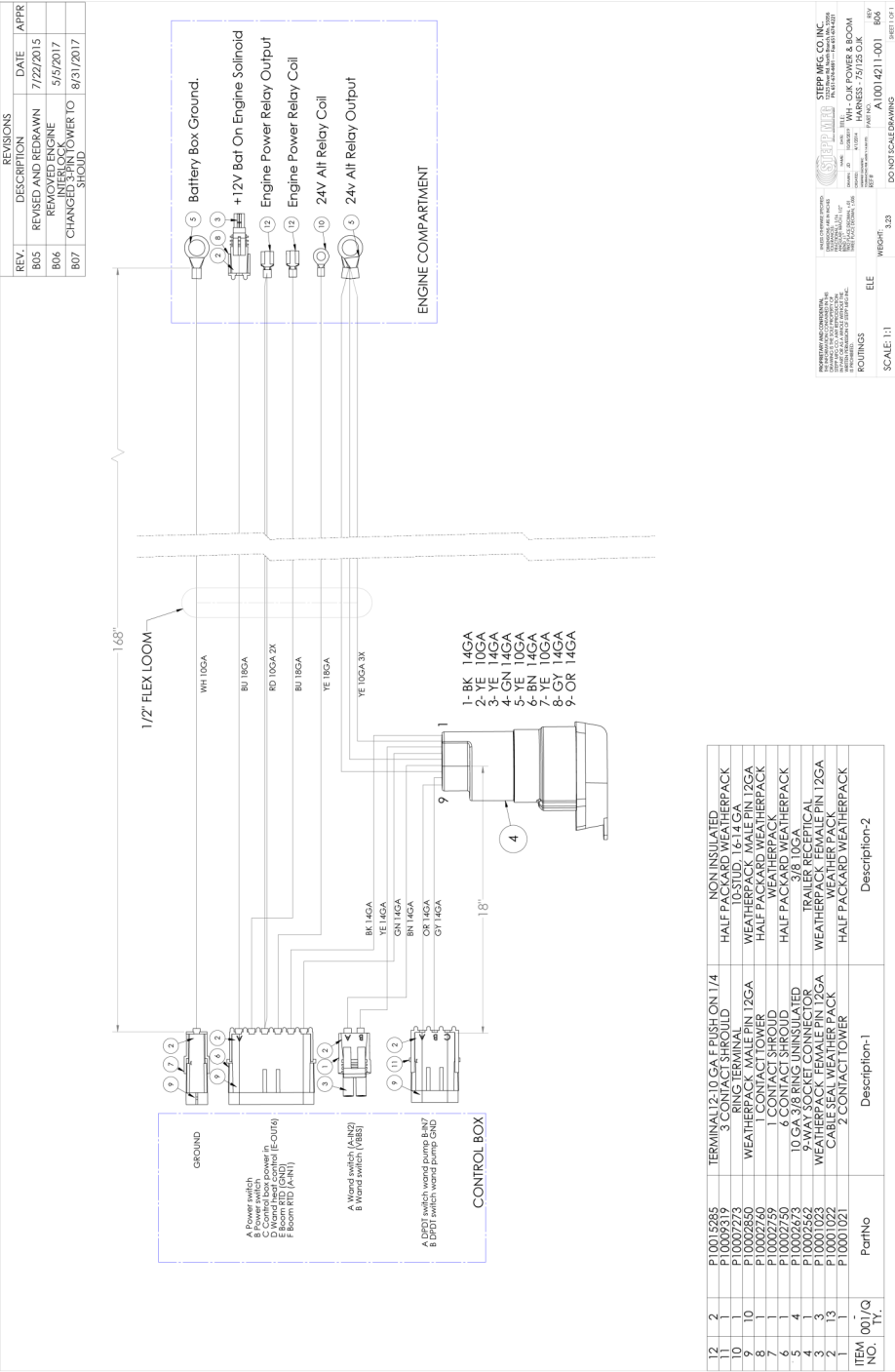
REVISIONS		DATE
REV.	DESCRIPTION	
B01	RELEASED FOR PROTOTYPE	10/31/2017

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ROUTINGS ASSEMBLY SCALE: 3:2 WEIGHT: 2.37		PART NO.: A10018721 REV: B01+ DO NOT SCALE DRAWING

REPLACEMENT PARTS

Lights and Brakes Harness

[illegible]



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STEPP MFG CO. INC.
1000 STEPP DRIVE
MILWAUKEE, WI 53211
TEL: 414-224-1100
FAX: 414-224-1101
WWW.STEPPMFG.COM

WHOLESALE POWER & BOOM
1000 STEPP DRIVE
MILWAUKEE, WI 53211
TEL: 414-224-1100
FAX: 414-224-1101
WWW.STEPPMFG.COM

ROUTINGS
ELE
SCALE: 1:1
INCHES
3/32
DO NOT SCALE DRAWING
A10014211-001
REV
806
PAGE 1 OF 1

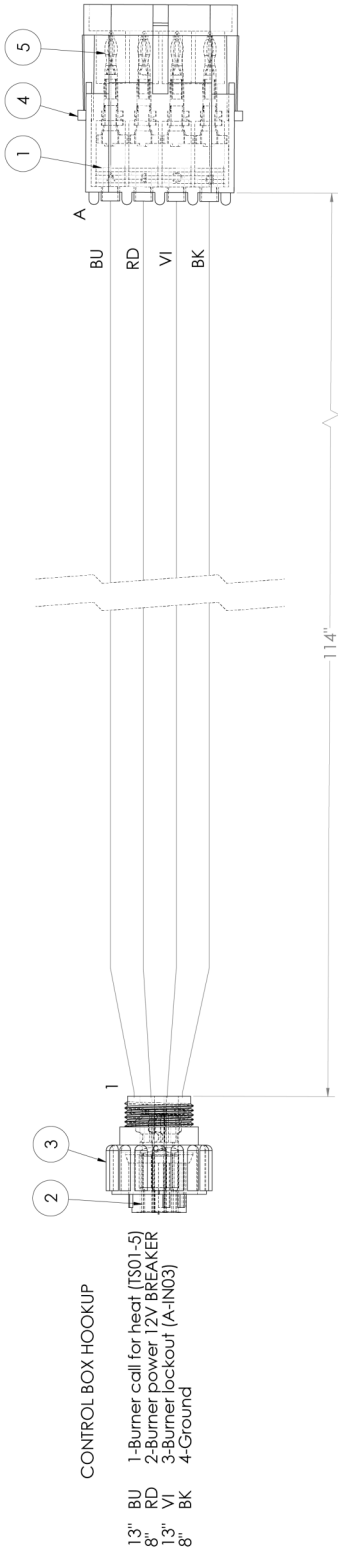
Power and Boom Harness



Pump and Auger Motor Harness



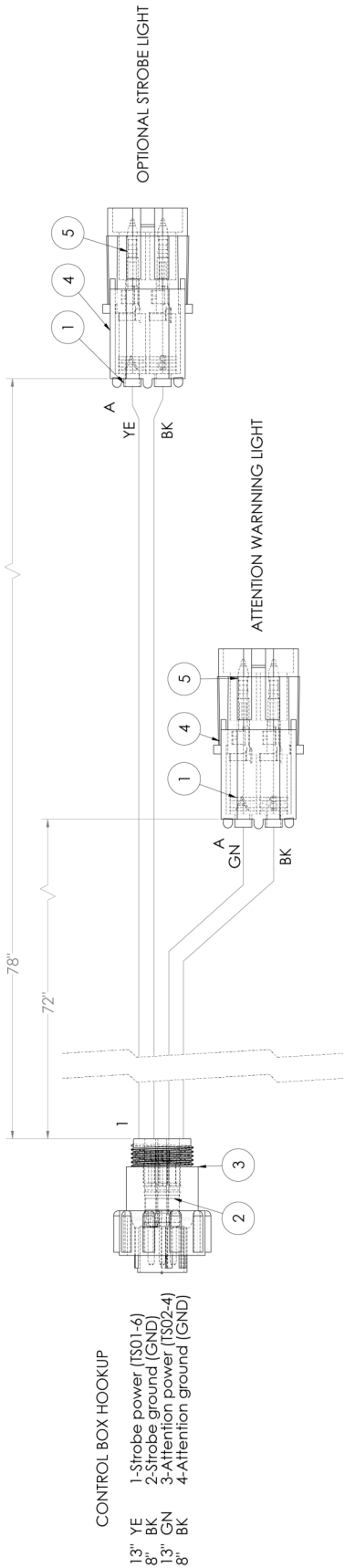
REVISIONS			
REV.	DESCRIPTION	DATE	APPR.
B02	ADDED LENGTH	7/10/2014	
B03	CHANGED LENGTH	7/31/2014	
B04	114" WAS 108"	11/2/2017	



10	12	P10005744	LOOM FLEX 1/2	BLACK
9	12	P10005241	WIRE - 14 GA - VIOLET	WAYTEK WIRE
8	12	P10005224	WIRE - 14 GA - BLUE	WAYTEK WIRE
7	12	P10005220	WIRE - 14 GA - RED	WAYTEK WIRE
6	12	P10005165	WIRE - 14 GAUGE BLACK	
5	4	P10002850	WEATHERPACK MALE PIN 12GA	WEATHERPACK MALE PIN 12GA
4	1	P10002749	4 CONTACT SHROUD	HALF PACKARD WEATHERPACK
3	1	P10002681	CPC CON-4 PIN PLUG STD	USE FEMALE PINS
2	4	P10002566	CPC FEMALE PIN 16-14 GA	CPC FEMALE PIN 16-14 GA
1	4	P10001022	CABLE SEAL WEATHER PACK	WEATHER PACK
ITEM NO.	Defau	PartNo	Description-1	Description-2

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STEPP MFG. CO. INC.			
1000 STEPP DRIVE MILWAUKEE, WI 53219-1422			
DATE	DESIGN	DATE	REV
3/26/2014	3/26/2014	3/26/2014	1
ROUTINGS		HARNESSES	
EIE		A10014205-001	
SCALE: 2:1		DO NOT SCALE DRAWING	
WEIGHT: 0.27		REV B03+	
		SHEET 1 OF 1	

REVISIONS		
REV.	DESCRIPTION	DATE
B01	RELEASED FOR PROTOTYPE	5/9/2014
B02	CHANGED TOWER TO SHROUD	6/26/2014
B03	ADDED LENGTH	7/10/2014



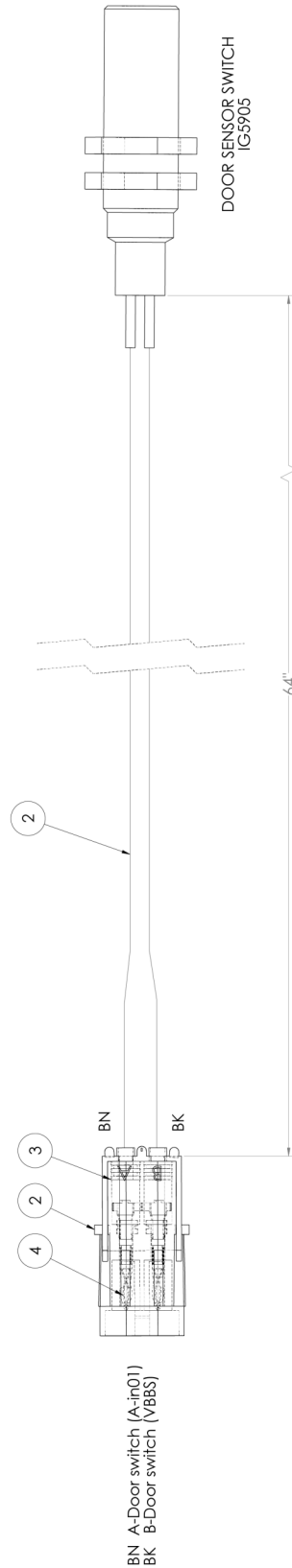
ITEM NO.	PartNo	Description-1	Description-2
9	P10005744	LOOM FLEX 1/2	BLACK
8	P10005211	WIRE - 18 GAUGE - GREEN	WAYTEK WIRE
7	P10005210	WIRE - 18 GAUGE - YELLOW	WAYTEK WIRE
6	P10005206	WIRE - 18 GAUGE - BLACK	WAYTEK WIRE
5	P10002850	WEATHERPACK MALE PIN 12GA	WEATHERPACK MALE PIN 12GA
4	P10002761	2 CONTACT SHROUD	HALF PACKARD WEATHERPACK
3	P10002643	CPC CON-4 PIN PLUG REV	USE MALE PINS
2	P10002564	CPC MALE PIN	CPC MALE PIN 16-14 GA
1	P10001022	CABLE SEAL WEATHER PACK	WEATHER PACK
ITEM NO. / QTY.			

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NAME: TITLE: DATE: 10/06/2014		HARNESS - 75/125 OJK	
ROUTINGS		PART NO. A10014204-001	
ELE		REV B02+	
SCALE: 2:1		DO NOT SCALE DRAWING	
WEIGHT: 0.15		SHEET 1 OF 1	

REPLACEMENT PARTS

Door Sensor Harness

REVISIONS			
REV.	DESCRIPTION	DATE	APPR
B02	ADDED LENGTH	7/10/2014	
B03	REMOVED SENSOR	1/20/2015	
B04	WAS 84" LONG	11/2/2017	



4	2	P10002850	WEATHERPACK	MALE PIN 12GA	WEATHERPACK	MALE PIN 12GA
3	2	P10001022	CABLE SEAL	WEATHER PACK	WEATHER PACK	
2	1	P10002761	2 CONTACT	SHROUD	HALF PACKARD	WEATHERPACK
1	1	P10011284	PROX SENSOR	CABLE 5M	EVC005	FEMALE SOCKET M12 90°
ITEM NO.	Default	PartNo	Description-1		Description-2	

PREPARE AND CONFIDENTIAL DRAWING FOR THE USE OF THE STEPP MFG. CO. AND STEPP MFG. CO. OF THE UNITED STATES OF AMERICA UNITED STATES OF AMERICA STEPP MFG. CO. OF THE UNITED STATES OF AMERICA		STEPP MFG. CO. OF THE UNITED STATES OF AMERICA P.O. BOX 10400 • FORT WORTH, TEXAS 76110-0400 TEL. (817) 451-4000 • FAX (817) 451-4221	
		WH - OAK DOWNS JUNKYARD HARNESS - 75/125 OZ SKR	
ROLLINGS	ELEM	WEIGHT: 0.36	REV A 10014203-001 SHEET 03 OF 1
DO NOT SCALE DRAWING		PART NO.	
DATE: 10/20/01 DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN APPROVED BY: J. L. BROWN UNIT PLACE (FORM) : 100		DATE: 10/20/01 DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN APPROVED BY: J. L. BROWN UNIT PLACE (FORM) : 100	

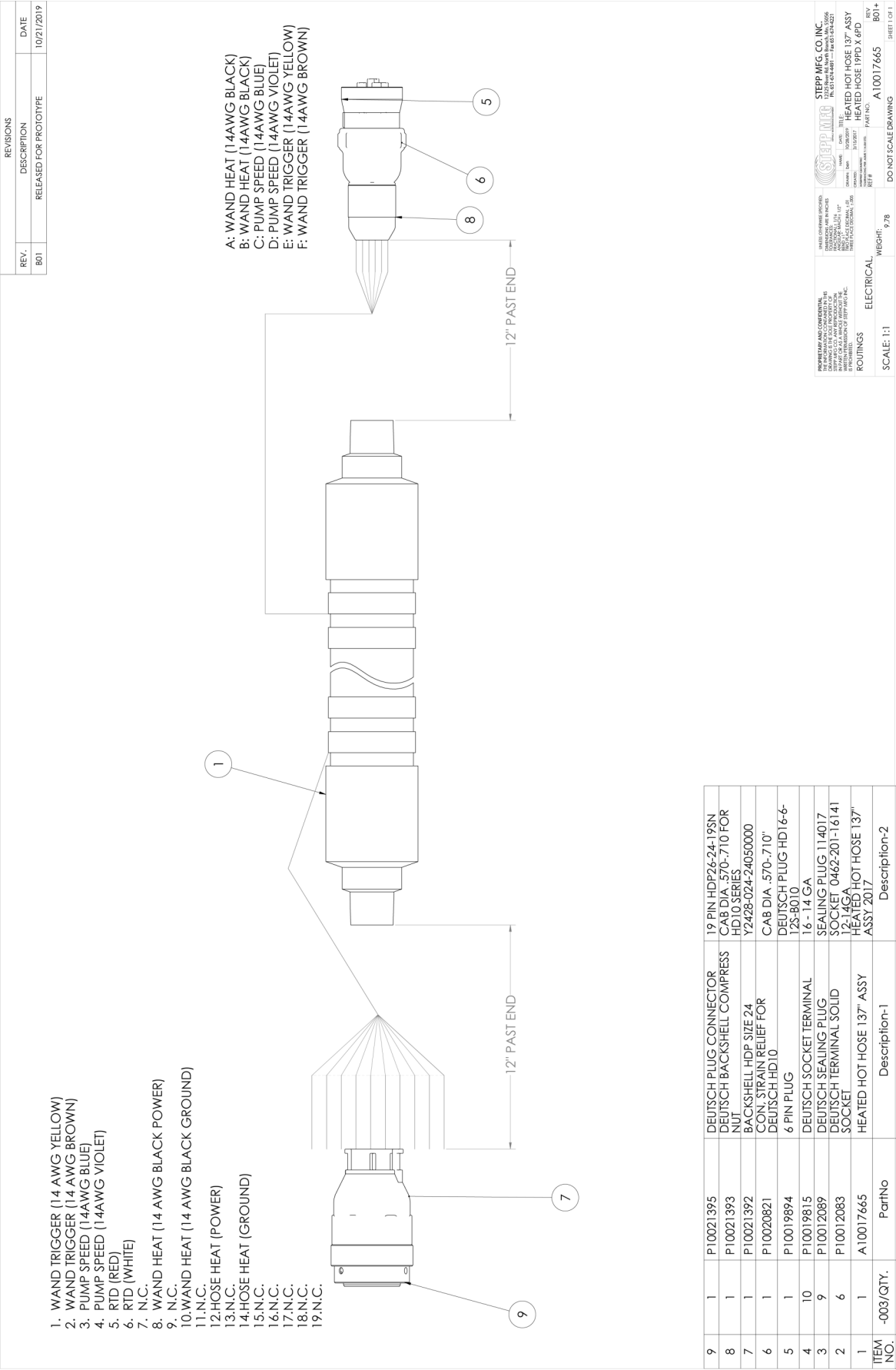
REVISIONS		
REV.	DESCRIPTION	DATE
B03	REVISED AND REDRAWN	3/4/2014
B04	ADDED -137 CONFIGURATION	2/26/2016
B05	ADDED CONFIG -090	7/3/2018

NOTE: -000 REQUIRES FEEDBACK TO ENGINEERING
OF WHERE USED AND LENGTH REQUIRED.



3	1	P10008627	CABLE-BATTERY	BLACK 4GA
2	1	P10002833	BATTERY LUG-BRASS 4 GA	STRAIGHT IN UNIVERSAL
1	1	P10002832	4 GA COPPER EYELET	3/8" STUD SIZE
ITEM NO.		Defau	PartNo	Description-1
NO. 11/QT.				Description-2

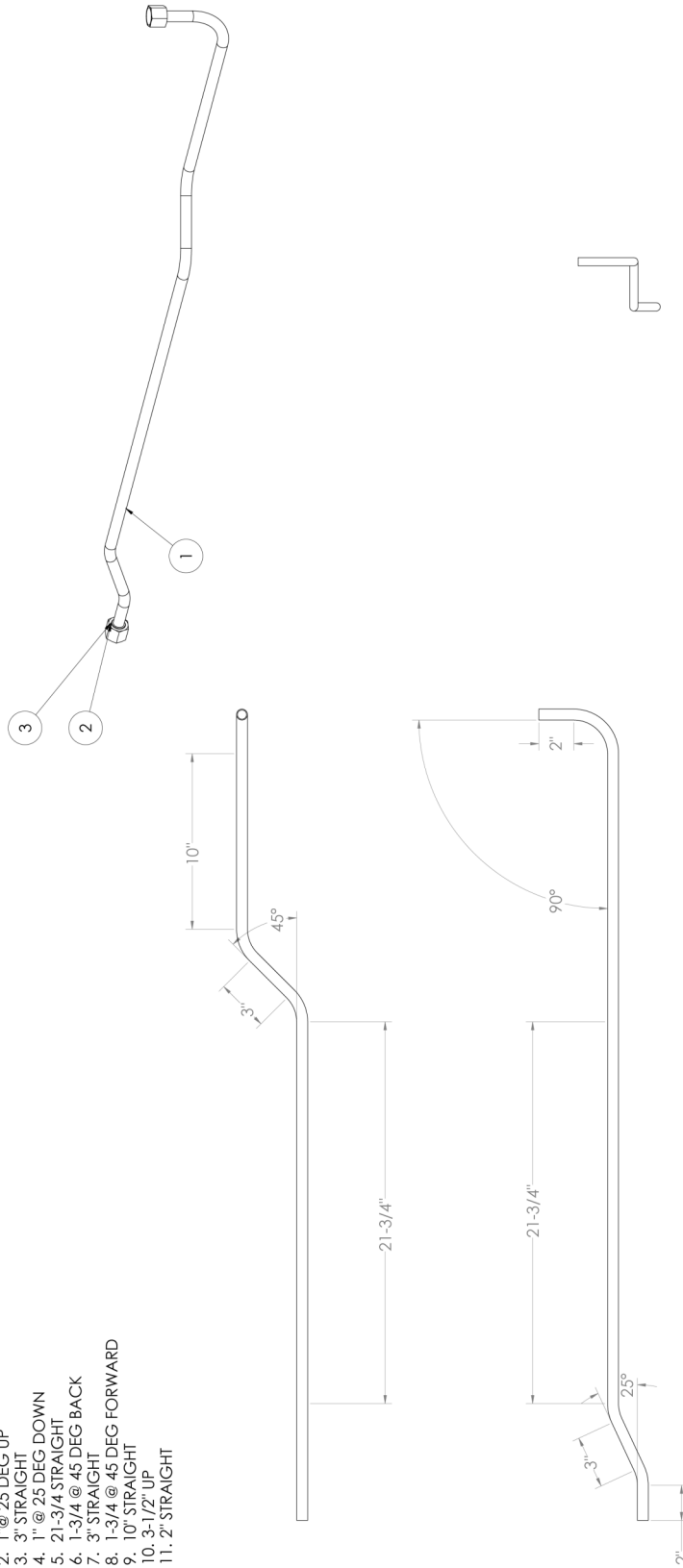
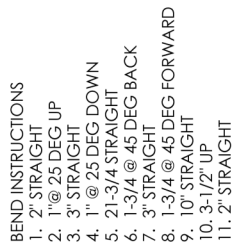
PROPERTY AND COMMENTARY		STEP 1000	
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ROUTINGS		ELECTRICAL	
SCALE: 2:1		WEIGHT: 0.16	
PART NO.		A1 0012161-000	
REV		B05+	
DO NOT SCALE DRAWING		SHEET 1 OF 1	



Steel Hydraulic Lines

[illegible]

REVISIONS		
REV.	DESCRIPTION	DATE
B01	RELEASED FOR PROTOTYPE	8/28/2018



TUBE CUT LENGTH: 50.75"

3	2	P10007852-001	HYD-TUBE FACE SEAL NUT #10	5/8" HYD TUBE - (.049 WALL)
2	2	P10007851-001	HYD. TUBE SLEEVE #10	5/8 HYD TUBE - (.049 WALL)
1	4.22917	P10000451	5/8 DIA HYD TUBING	.049 WALL
ITEM NO.		PartNo	Description-1	Description-2

[illegible]

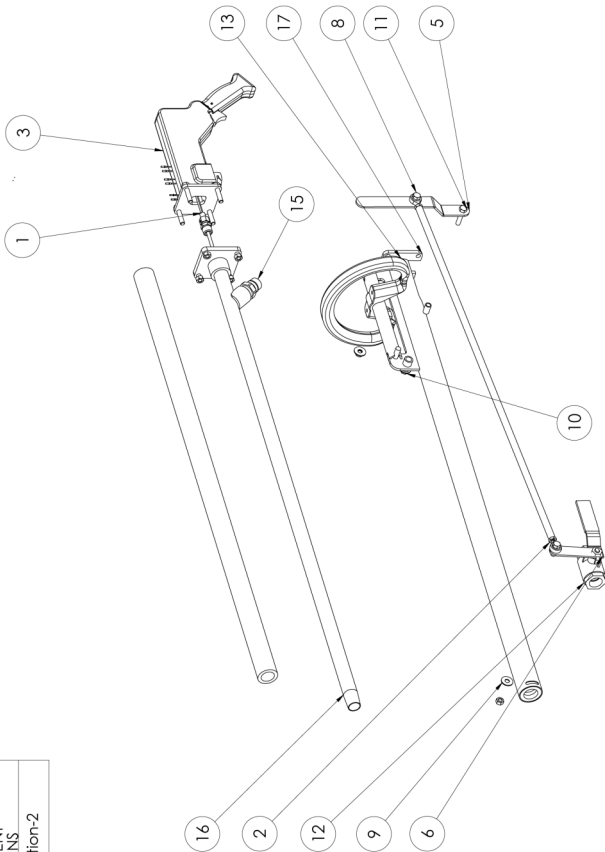
REPLACEMENT PARTS

Hydraulic Valve Assembly

REPLACEMENT PARTSAluminum Trigger Style Crack Sealing Wand

ITEM NO.	-001/QTY.	PartNo	Description-1	Description-2
17	1	W10017592	INSULATION COVER	A10017592
16	1	W10017409	WAND W/DT	WAND ASSEMBLY
15	1	P10019281	3/4" QUICK CONNECT PLUG	#12MNP X M QUICK CONNECT
14	1	P10017596	SLEEVE	A10017595
13	1	P10017460	PLASTIC HANDLE	ADJUSTABLE
12	1	P10001772	BALL VALVE	3/4 NPT
11	5	P10001641-004	LOCK NUT	HEX - 5/16 X 1 1/2
10	7	P10001624-009	LOCK NUT	HEX 5/16-18 NC
9	3	P10001609-005	WASHER	FLAT 5/16
8	2	P10001602-002	BOLT	HEX - 5/16 X 1
7	1	M10017566	SILICONE INSULATION	A10017423
6	1	M10017563	VALVE LEVER	A10017423
5	1	M10017416	LEVER	A10017423
4	1	M10009910	MODIFIED 3/8" COMP. FITTING	06MCOMPx06MNP
3	1	A10019901	HANDLE ASSEMBLY	A10017595
2	1	A10017565	PUSH ROD	A10017524
1	1	A10009938-002	44" WAND HEAT ELEMENT ASSY	44" HEAT ELEMENT W/DEUTSCH PINS

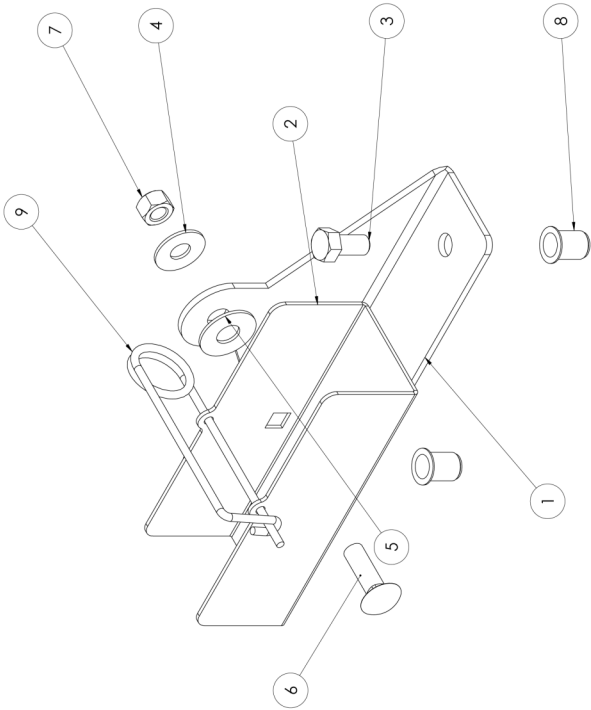
REV.	DESCRIPTION	DATE
B01	RELEASED FOR PROTOTYPE	5/23/2018
B02	ADD P10019281 COUPLE	4/15/2019
B03	ECH19324, 19325 UPDATED ELEC COMPONENTS	5/20/2019



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ASSEMBLY	WEIGHT: 32.21	DO NOT SCALE DRAWING	SCALE: 1:8		SHEET 1 OF 1

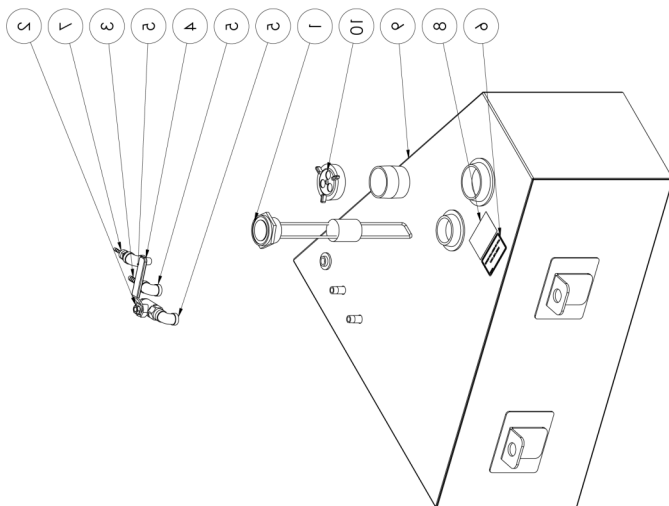
REVISIONS		
REV.	DESCRIPTION	DATE
A01	RELEASED FOR PROTOTYPE	4/12/2017
B02	UPDATED & REDRAWN	5/4/2017
B03	ECR18063 ADDED CARRIAGE BOLT	2/26/2018

9	1	P10005520	SAFETY PIN 5/32 X 3 W/LANYARD
8	2	P10005045	GRIPSERT 3/8"
7	1	P10001624-010	LOCK NUT
6	1	P10001618-041	RND HD SQ NECK BOLT
5	1	P10001609-007	WASHER
4	1	P10001609-006	WASHER
3	2	P10001603-000	BOLT
2	1	M10017477	WAND HOLDER
1	1	M10011884-001	WAND HOSE SUPPORT SHORT
ITEM NO.	-001/QTY.	PartNo	Description-1
			Description-2

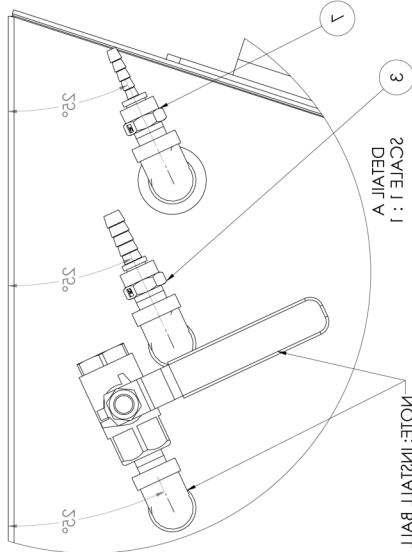


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DATE	FILE	DATE	FILE
10/08/2017	10/08/2017	10/08/2017	10/08/2017
NAME	NAME	NAME	NAME
DESIGNED BY	DESIGNED BY	DESIGNED BY	DESIGNED BY
DRAWN BY	DRAWN BY	DRAWN BY	DRAWN BY
CHECKED BY	CHECKED BY	CHECKED BY	CHECKED BY
APPROVED BY	APPROVED BY	APPROVED BY	APPROVED BY
ROUTINGS	ASSEMBLY	WAND HOLDER ASSY	WAND HOLDER ASSY
SCALE: 1:2	WEIGHT: 1.57	REV	REV
		A10017479-001	B03
		PART NO.	PART NO.
		DO NOT SCALE DRAWING	SHEET 1 OF 1

REPLACEMENT PARTS

[illegible]

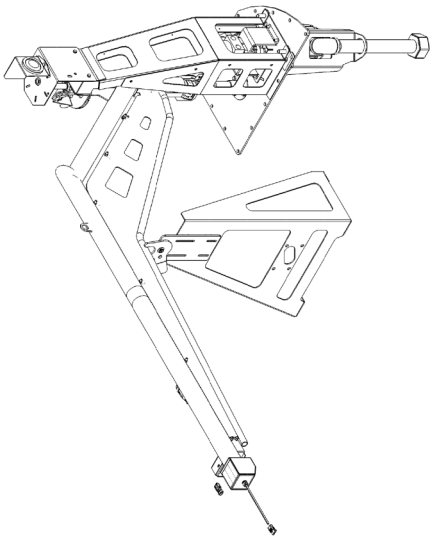
—NOTE: INSTALL BALL VALVE TOWARD ELBO WHEN OPEN SO HANDLE SWINGS



B06	ECR18338 CHANGED FUEL CAP	9/13/2018
B02	ECR11029 ADDED HOSE HITCHES	2/15/2013
B04	ECR11190 COMPONENT ORIENTATIONS CHANGED	2/13/2013
BFA	DESCRIPTION	DATE
	REVISIONS	

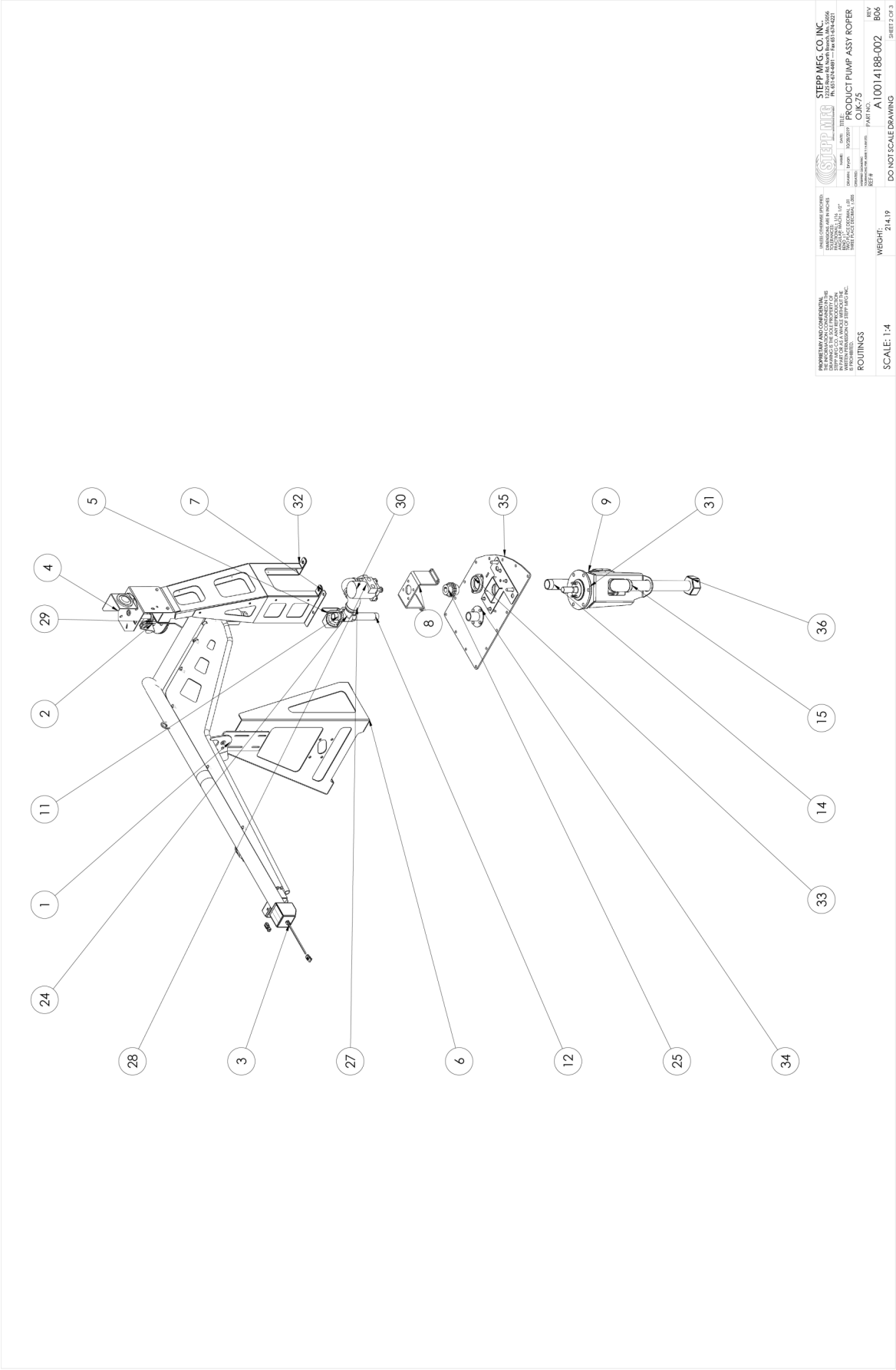
REV.	REVISIONS	DATE
B04	ADDED 1" X 2 NIPPLE	5/26/2017
B05	REMOVE THERMOWELL AND THERMOMETER ADD ELBOW	12/10/2018
B06	ECR 18465 UPDATES	12/11/2018

NOTE: PACK PUMP WITH GREASE
SEE SHEET 2 FOR EXPLODED VIEW WITH BALLOONS



36	1	W10017546	PICKUP WILDM ROPER OJK 125	VERTICAL OJK PUMP ASSY
35	1	W10014191-001	PUMP COVER WILDM ROPER	PRODUCT PUMP ASSY
34	1	W10011629	ADJUSTABLE PIPE CLAMP WILDM	ADJUSTABLE PIPE CLAMP
33	1	W10009976	SOFT POCKET 1 1/2" PIPE	SOFT POCKET WELDMENT
32	1	W10009420	BOOM TOWER WILDM	BOOM ASSY
31	1	P10017459	ROPER PRODUCT PUMP	20 GPM
30	1	P10014168	HYD MOTOR	2.8 CU. IN. MOTOR
29	1	P10009290	3/4" PILLOW BLOCK	UCP-204
28	1	P10005676-008	UNION	1-1/2-UNION
27	1	P10004952-021	BUSHING - 1 1/2 X 1	1 1/2 X 1
26	1	P10004556	ROLLER CHAIN ONLY	4016
25	2	P10004555-004	4016 CHAIN COUPLING	4016 1 BORE
24	1	P10004391	1" 3 PORT BALL VALVE	1" 3 PORT BALL VALVE
23	2	P10001666-007	SCREW-THRD ROLLING	#10-32UNF X 1/2
22	2	P10001619-012	PAN CROSS HD MACH SCREW	#8-32X0.375X0.375-N
21	4	P10001609-006	WASHER	FLAT 3/8
20	4	P10001609-005	WASHER	FLAT 5/16
19	2	P10001609-003	WASHER	FLAT #10
18	4	P10001603-000	BOLT	HEX - 3/8-16 X 3/4
17	4	P10001602-001	BOLT	HEX - 5/16 X 3/4
16	4	P10001600-002	NUT HEX	5/16-18NC
15	4	P10001465-008	ELBOW - BLK 90°	1 1/2"
14	1	P10001305-011	PIPE NIPPLE - SCH.40	1 1/2 x 7
13	4	P10001305-001	PIPE NIPPLE - SCH.40	1 1/2 x CLOSE
12	1	P10001303-010	PIPE NIPPLE - SCH.40	1 x 6
11	1	P10001303-002	PIPE NIPPLE - SCH.40	1 x 2
10	1	P10001303-001	PIPE NIPPLE - SCH.40	1 x CLOSE
9	1	M10017681	PICKUP BRACE	PRODUCT PUMP ASSY
8	1	M10014190-001	MOTOR MT - PRODUCT PUMP	ROPER
7	1	M10014189	BOOM SUPPORT	OJK-125
6	1	M10014162	BOOM TOWER	PRODUCT PUMP ASSY
5	1	M10008185	VALVE LABEL	OJK-125
4	1	A100011423	ATTENTION SERVICE LIGHT ASSY	OJK-125/75
3	1	A10009394-003	BOOM ASSY	RECIRC-WAND
2	1	A10009289	BEARING MOUNT ASSY	SRM 10 PLC
1	1	A10009284	SLAM LATCH ASSY	HOSE BOOM KIT OJK-75-125
ITEM NO.	-002/QTY.	PartNo	Description-1	Description-2

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ROUTINGS	DATE: 12/11/2018 DRAWN BY: J. STEPP CHECKED BY: J. STEPP APPROVED BY: J. STEPP
REVISIONS	DATE: 12/11/2018 REV: B06 DESCRIPTION: ECR 18465 UPDATES
SCALE: 1:4	WEIGHT: 214.19
DO NOT SCALE DRAWING	PART NO. A10014188-002
	SHEET 1 OF 3



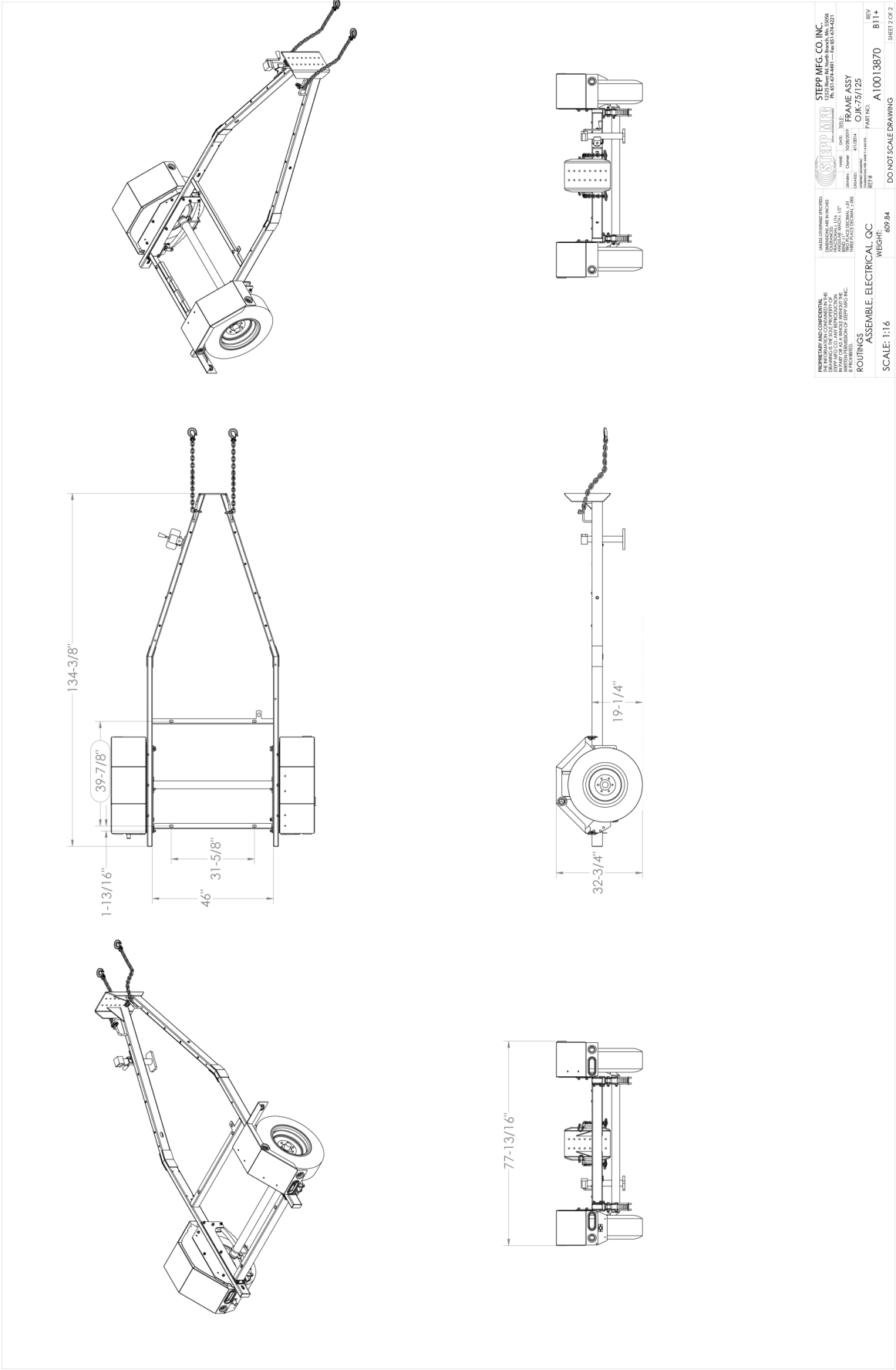
PROPERTY AND CONFIDENTIALITY NOTICE: THIS DRAWING IS THE PROPERTY OF STEPP MFG. CO. INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF STEPP MFG. CO. INC.		UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.		STEPP MFG. CO. INC. 1000 STEPP DRIVE MILWAUKEE, WI 53211 TEL: 414-488-0002 FAX: 414-488-0001	
ROUTINGS		NAME: J. DAVIS DATE: 10/1/2011 DRAWN BY: J. DAVIS CHECKED BY: J. DAVIS APPROVED BY: J. DAVIS		STEPP MFG. CO. INC. 1000 STEPP DRIVE MILWAUKEE, WI 53211 TEL: 414-488-0002 FAX: 414-488-0001	
SCALE: 1:4		WEIGHT: 214.19		PART NO.: A10014188-002	
DO NOT SCALE DRAWING		REV: B06		SHEET 2 OF 3	

Tank Assembly

Technical drawings of the OJK-V Hopper Assembly. The drawings include a top view, a side view, and a detailed view of the agitator offset. The top view shows a circular hopper with a diameter of 39-7/8 inches and an agitator offset of 3-1/2 inches. The side view shows the hopper with a height of 53-15/16 inches. The detailed view shows the agitator offset with a diameter of 31-5/8 inches and a height of 3-1/2 inches. The drawings are labeled with dimensions and part numbers.

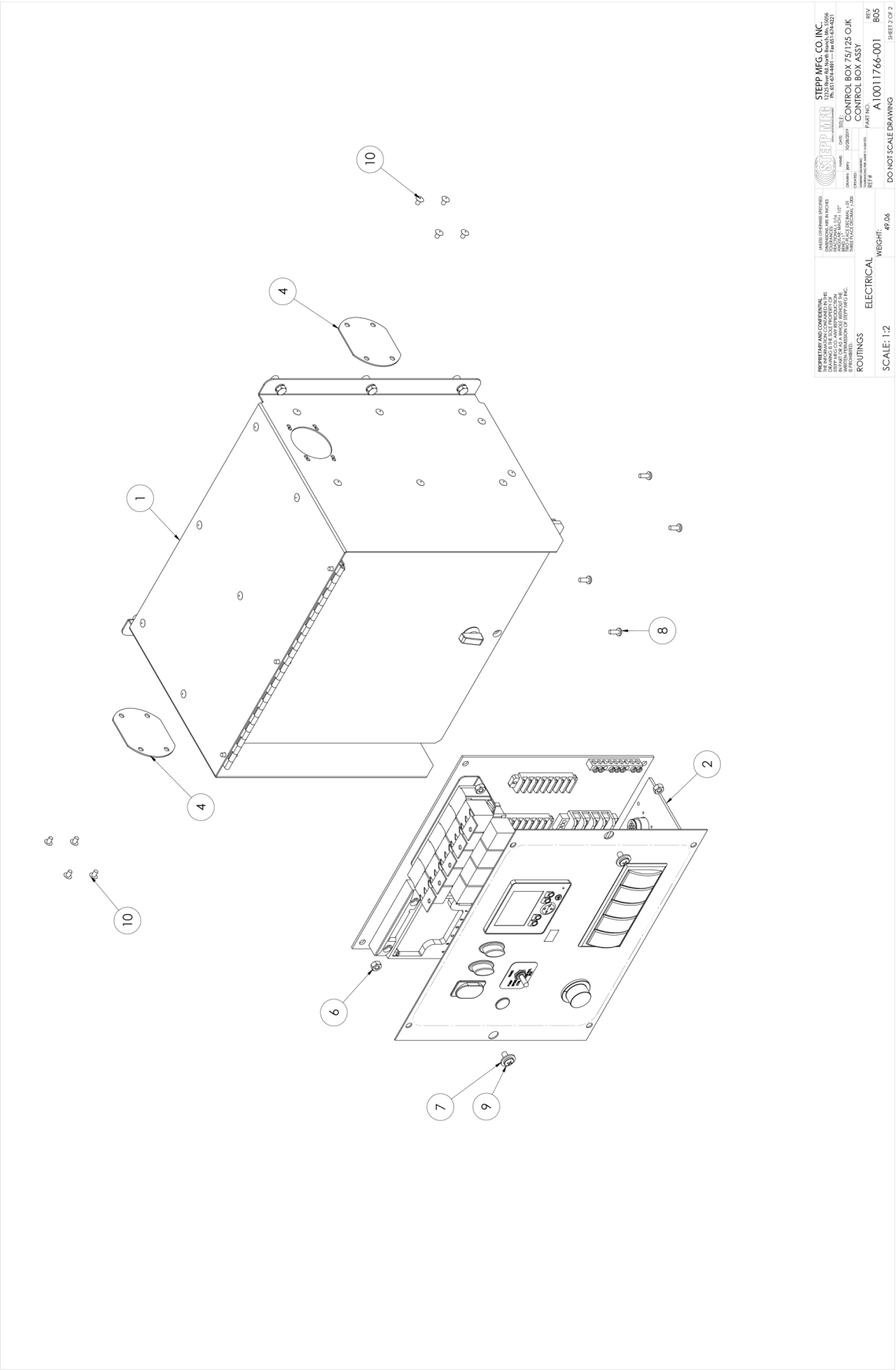
Tank Assembly





Control Box Enclosure

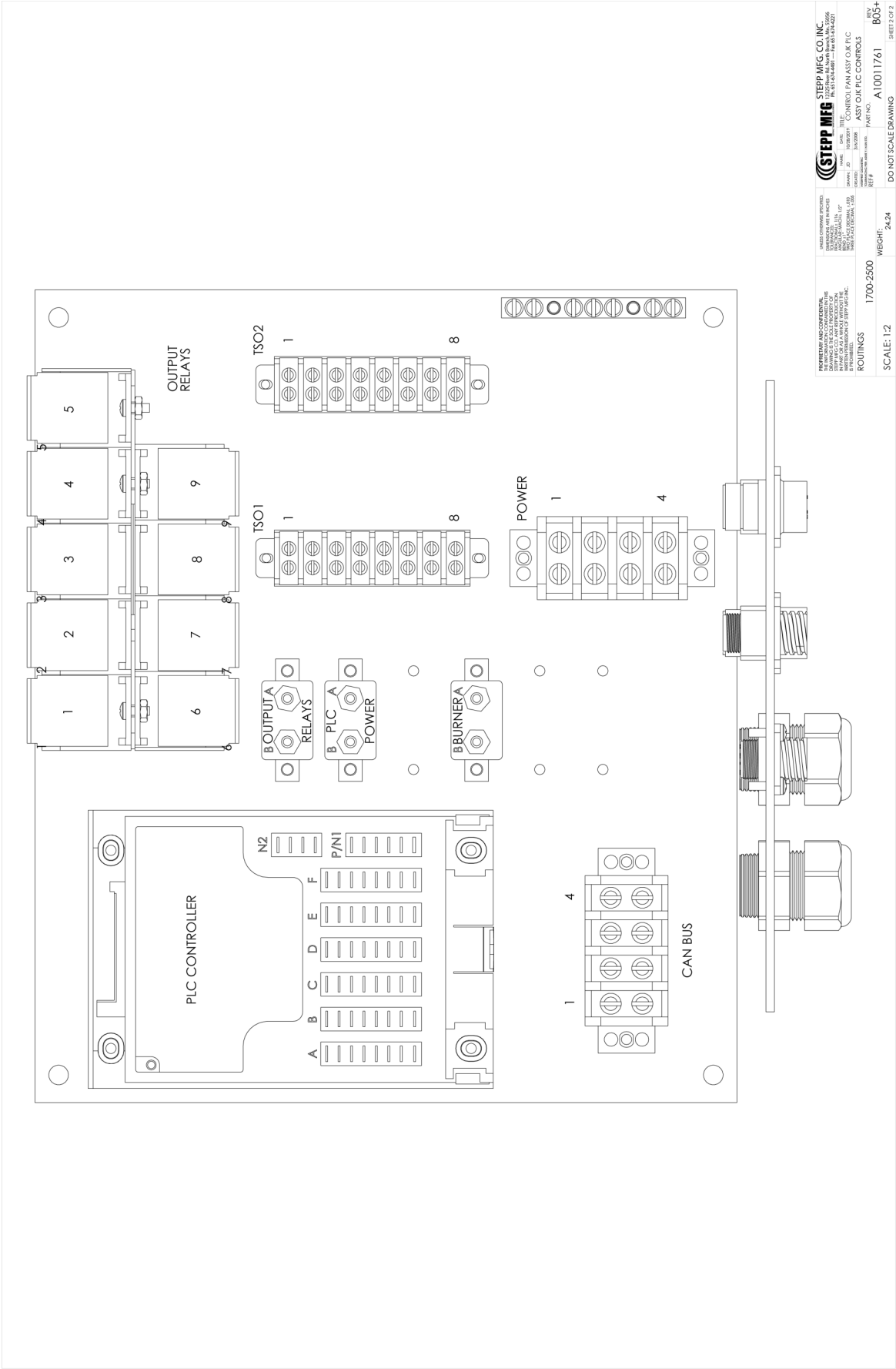
	STEPP MFG. CO. INC. 15556 W. 10th Avenue Tulsa, OK 74107-4211 Tel: 918-432-4401 Fax: 918-432-4211	REV. 00000000 CONTROL BOX ASSY	REV. 00000000 A 10011766-001	REV. 00000000 SHEET 01 OF 2
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES FRACTIONS ARE TO BE USED TOLERANCES ARE AS SHOWN UNLESS OTHERWISE SPECIFIED	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	DATE: 03/07/07 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM
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ROUTINGS	ELECTRICAL	WEIGHT	47.04	DO NOT SCALE DRAWING
SCALE: 1:2				

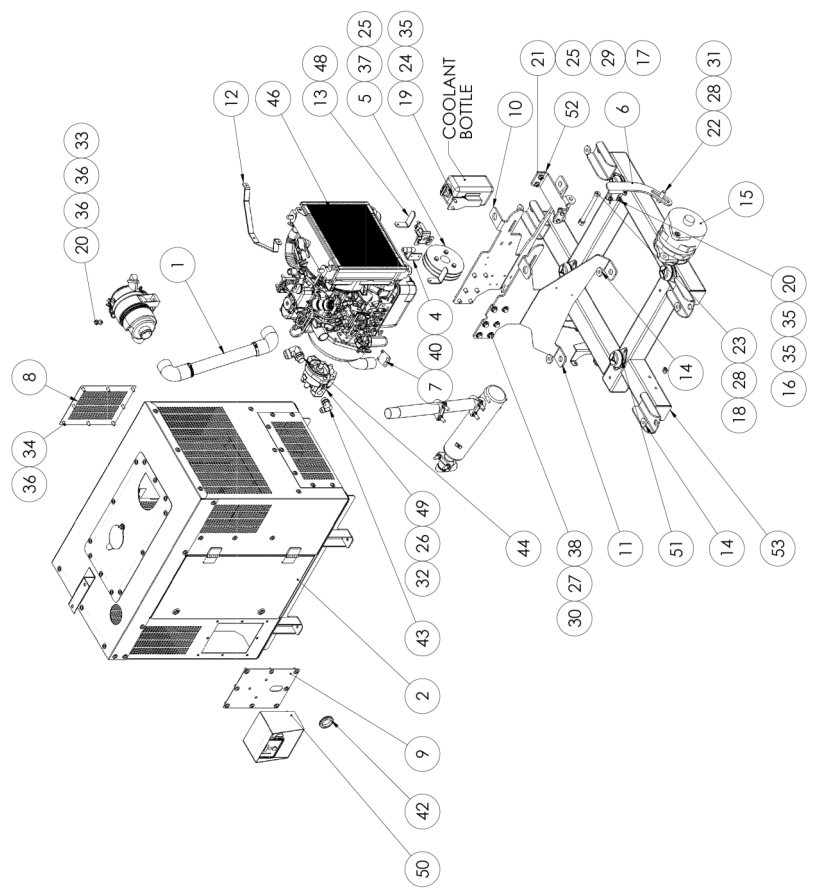
Control Box

125



PROPRIETARY AND CONFIDENTIAL THIS DRAWING IS THE PROPERTY OF STEPP MFG. CO. INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.	STEPP MFG. STEPP MFG. CO. INC. 1700-2500 1700-2500 1700-2500	NAME: TITC CONTROL PAN ASSY O.B.E PLC		PART NO. A10011761	REV. 805+
		DATE: 11/1/2008	DATE: 11/1/2008		
DRAWN BY: J. J. JONES		APPROVED BY: J. J. JONES			
CHECKED BY: J. J. JONES		DATE: 11/1/2008			
ROUTINGS		DO NOT SCALE DRAWING		SHEET 2 OF 2	
SCALE: 1:2		SHEET 2 OF 2		SHEET 2 OF 2	

VERTICAL OJK WITH ENCLOSURE



REV.	DESCRIPTION	DATE
B07	ADDED RELAYS FOR OJK UNITS	5/13/2017
B08	ADDED 24V WIRING	11/17/2017
B09	UPDATED EXHAUST MUFFLER	8/28/2019

ITEM NO.	QTY	PartNo	Description-1	Description-2
53	1	W10016365	WLDT. MOTOR MNT	A10016388
52	1	P10003763	ALT MT W/SPACER WDMT	Z482 ALT ENG PKG
51	4	P10016356	ISOLATOR	A10008526-013
50	1	P10009927-004	DEEP SEA CONTROL STD W/ENCLOSURE	DEEP SEA ENGINE CONTROL
49	1	P10009691	.66 CUBIC INCH EATON	HYDRAULIC PUMP
48	1	P10009211	RELAY - 12VDC SPST 100A	
47	2	P10008528	BELT 4L290	FOR Z602 ALTERNATOR
46	1	P10008345	Z602 ENGINE W/RAD	NORTHERN POWER PRINT
45	1	P10008295	15W40 ENGINE OIL	0.1 LITERS
44	1	P10007830-024	ADAPTER ELBOW	ADPT-L16MJICx12MORB
43	1	P10007830-010	ADAPTER ELBOW	ADPT-L08MJIC X 10MORB
42	1	P10005143	RUBBER GROMMET	1-1/2" I.D. X 1 1/8" X 2-1/8
41	2	P10005051	GRIPSERT 1/4-20NC	.391" DRILL (25/64)
40	1	P10002674	WIREWOUND RESISTOR	10 OHM, 25 WATT
39	1	P10002030	RELAY HIGH CAPACITY	40A NC 20A 12V
38	12	P10001664-020	HEX HEAD CAP SCREW	M10-1.5x25
37	3	P10001664-015	HEX HEAD CAP SCREW	M8-1.25x50
36	20	P10001633-004	WASHER SS	FLAT 1/4
35	6	P10001633-004	WASHER	FLAT 1/4
34	16	P10001630-016	SOCK. BUT. HD CAP SCREW SS	1/4-20 X .750
33	2	P10001624-008	LOCK NUT	HEX 1/4-20 NC
32	1	P10001620-115	SHCS	3/8-16UNC X 1.25
31	1	P10001609-008	WASHER	FLAT 1/2
30	12	P10001609-006	WASHER	FLAT 3/8
29	4	P10001609-005	WASHER	FLAT 5/16
28	2	P10001608-008	WASHER	LOCK 1/2
27	12	P10001608-007	WASHER	LOCK 7/16
26	2	P10001608-006	WASHER	LOCK 3/8
25	7	P10001608-005	WASHER	LOCK 5/16
24	4	P10001608-004	WASHER	LOCK 1/4
23	1	P10001605-012	BOLT	HEX - 1/2-13 X 6
22	1	P10001605-003	BOLT	HEX - 1/2-13 X 1 1/2
21	4	P10001602-002	BOLT	HEX - 5/16 X 1
20	4	P10001601-002	BOLT	HEX - 1/4-20 X 1
19	2	P10001601-001	BOLT	HEX - 1/4-20 X 3/4
18	1	P10001600-005	NUT HEX	1/2-13NC
17	4	P10001600-002	NUT HEX	5/16-18NC
16	2	P10001600-001	NUT HEX	1/4-20NC
15	1	P10001147	ALTERNATOR ASSY	24 VOLT WITH 2 GROOVE PULLEY
14	8	M10017017	SPACER	A10008526-013
13	2	M10012839	L-BRACKET	Z602 ENGINE ASSY
12	1	M10009797	Z602 TOP RAD. BRACKET	Z602 ENGINE - PREMAD
11	1	M10008344	ENGINE MOUNT - CURB SIDE	Z602 STRD ENG PKG
10	1	M10008343	ENGINE MOUNT - STREET SIDE	Z602 STRD ENG PKG
9	1	M10008262-004	EXTERNAL CONTROL PANEL	KUBOTA CABINET ASSY
8	1	M10008262-003	BLANK - REMOTE CTRLS	KUBOTA CABINET ASSY
7	1	M10003795	Z482 THROTTLE LOCK	Z482 STRD ENG PKG
6	1	M10003762	ALT. ADJUST BRACKET	Z482 ALT ENG PKG
5	1	M10003761	2-GROOVE CRKSHFT PULLEY	Z482 ALT
4	1	M10003698	MOUNT, RESISTOR 100HM, 25W	TO MOUNT RESISTOR P10002674
3	1	A10021475	MUFFLER ASSEMBLY	A10008526-013
2	1	A10009891	Z602 EXT. ENGINE CABINET	Z602 CABINET PKG
1	1	A10003832	PIPE AND HOSE ASSY	Z482 ENGINE CABINET
ITEM NO.	QTY	PartNo	Description-1	Description-2

STEPP MFG. CO. INC.

11400 CABINET PKG

EXTERNAL CTRLS-CURB W/ALT

REV. 809

DATE 11/17/2017

BY 11400

DESIGNED BY 11400

ENGINEER 11400

MANUFACTURED BY 11400

REVISIONS

REV. 809

DATE 11/17/2017

BY 11400

DESCRIPTION

ADDED RELAYS FOR OJK UNITS

ADDED 24V WIRING

UPDATED EXHAUST MUFFLER

ROUTINGS

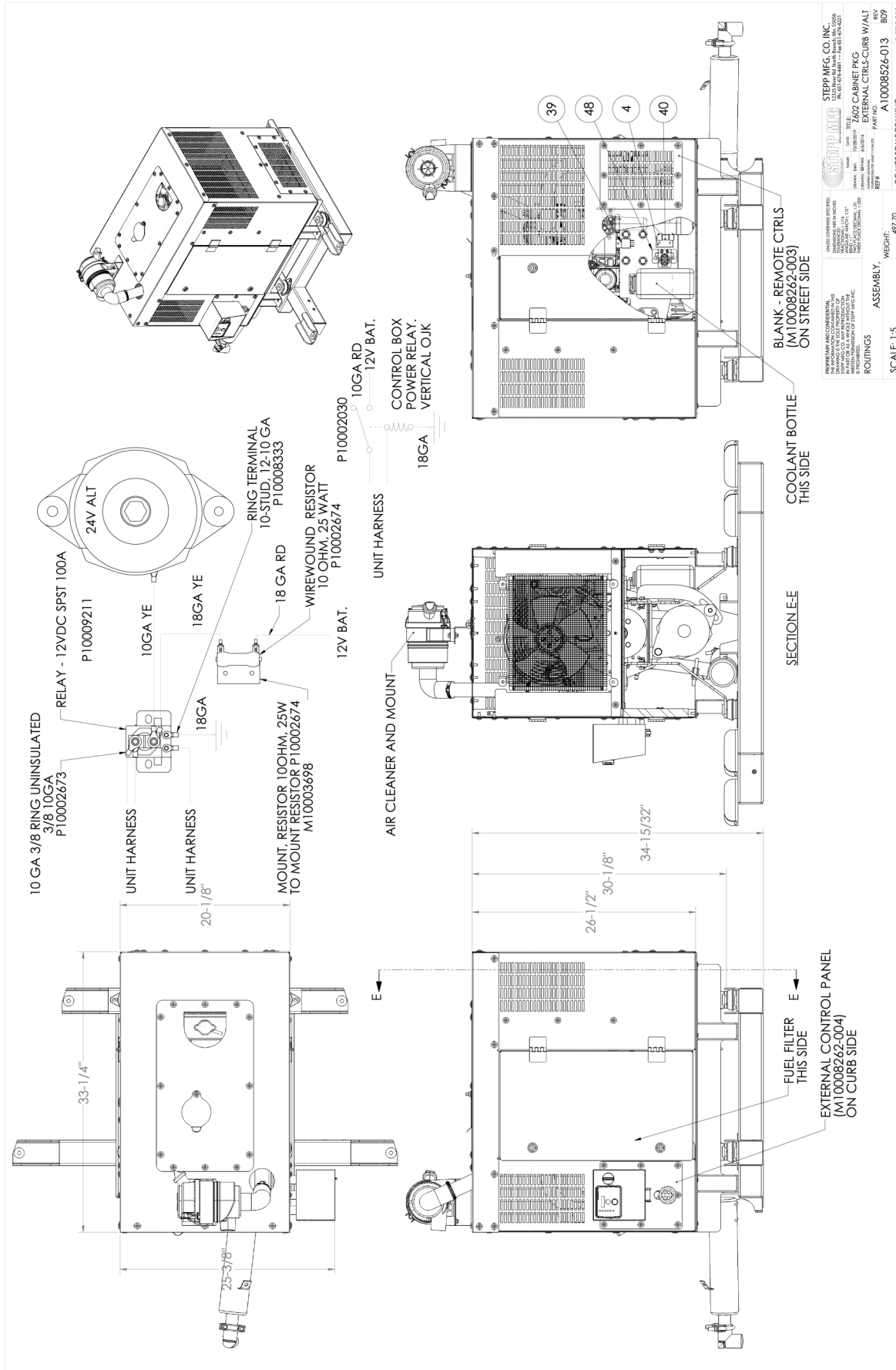
ASSEMBLY

WEIGHT: 497.70

SCALE: 1:6

DO NOT SCALE DRAWING

SHEET 1 OF 2



STEPP MFG CO. INC. 1000 STEPP DRIVE STEPP, MISSOURI 65081 PHONE: (636) 421-4400 FAX: (636) 421-4401		STEPP MFG CO. INC. 1000 STEPP DRIVE STEPP, MISSOURI 65081 PHONE: (636) 421-4400 FAX: (636) 421-4401	
DATE:	10/08/01	DATE:	10/08/01
DESIGNED BY:	WALT	DESIGNED BY:	WALT
DRAWN BY:	WALT	DRAWN BY:	WALT
CHECKED BY:	WALT	CHECKED BY:	WALT
ROUTINGS:		ROUTINGS:	
ASSEMBLY:		ASSEMBLY:	
WEIGHT:	47.70	WEIGHT:	47.70
SCALE:	1:5	SCALE:	1:5
DO NOT SCALE DRAWING		DO NOT SCALE DRAWING	
PART NO. A10008526-013		PART NO. A10008526-013	
REV. 001		REV. 001	
EXTERNAL CTRLS-CURB W/ALT		EXTERNAL CTRLS-CURB W/ALT	
Z602 CABINET PKG		Z602 CABINET PKG	
SHEET 2 OF 2		SHEET 2 OF 2	

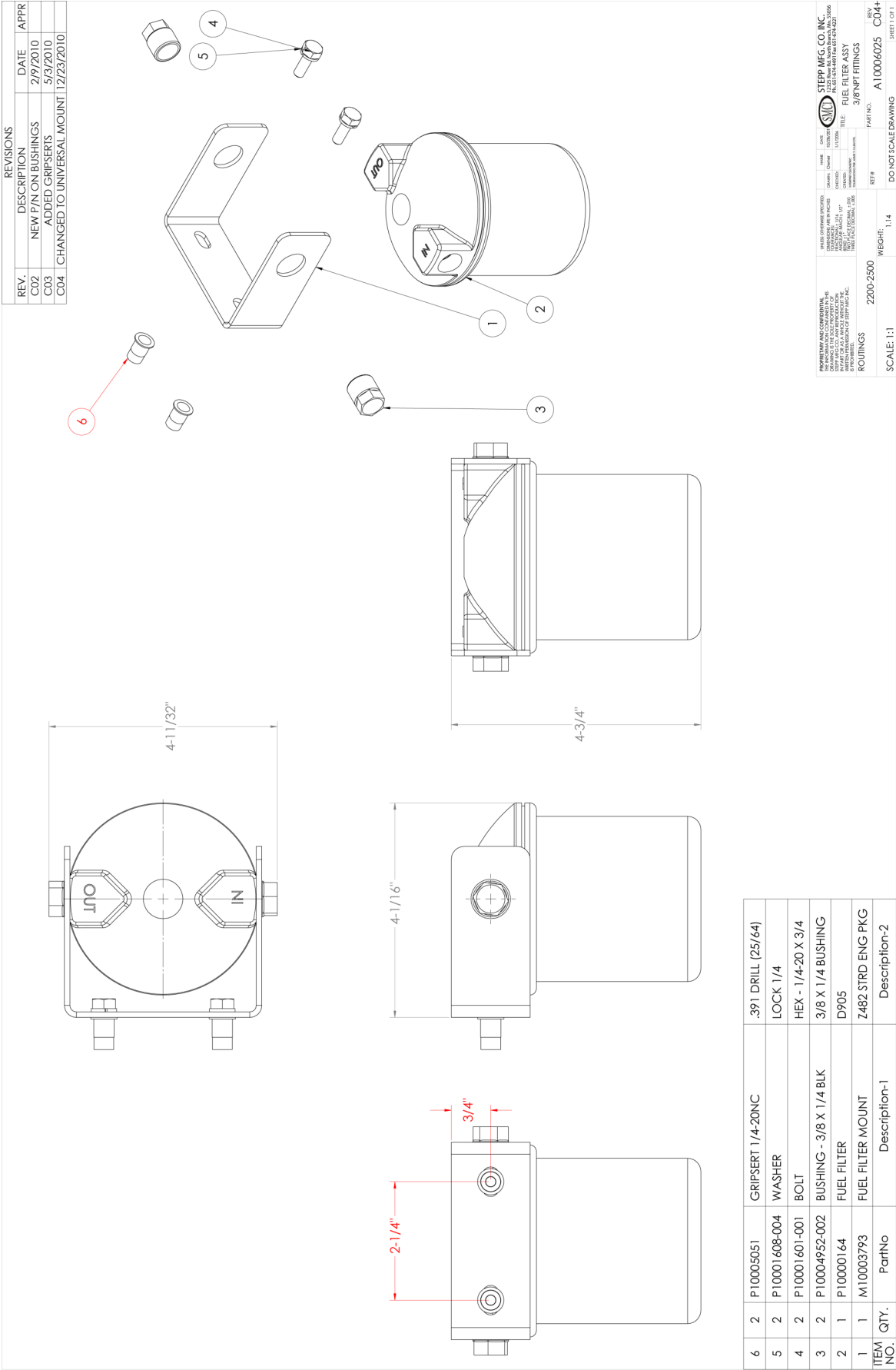
Hydraulic Tank

129

[illegible]

REPLACEMENT PARTS

Diesel Fuel Filter

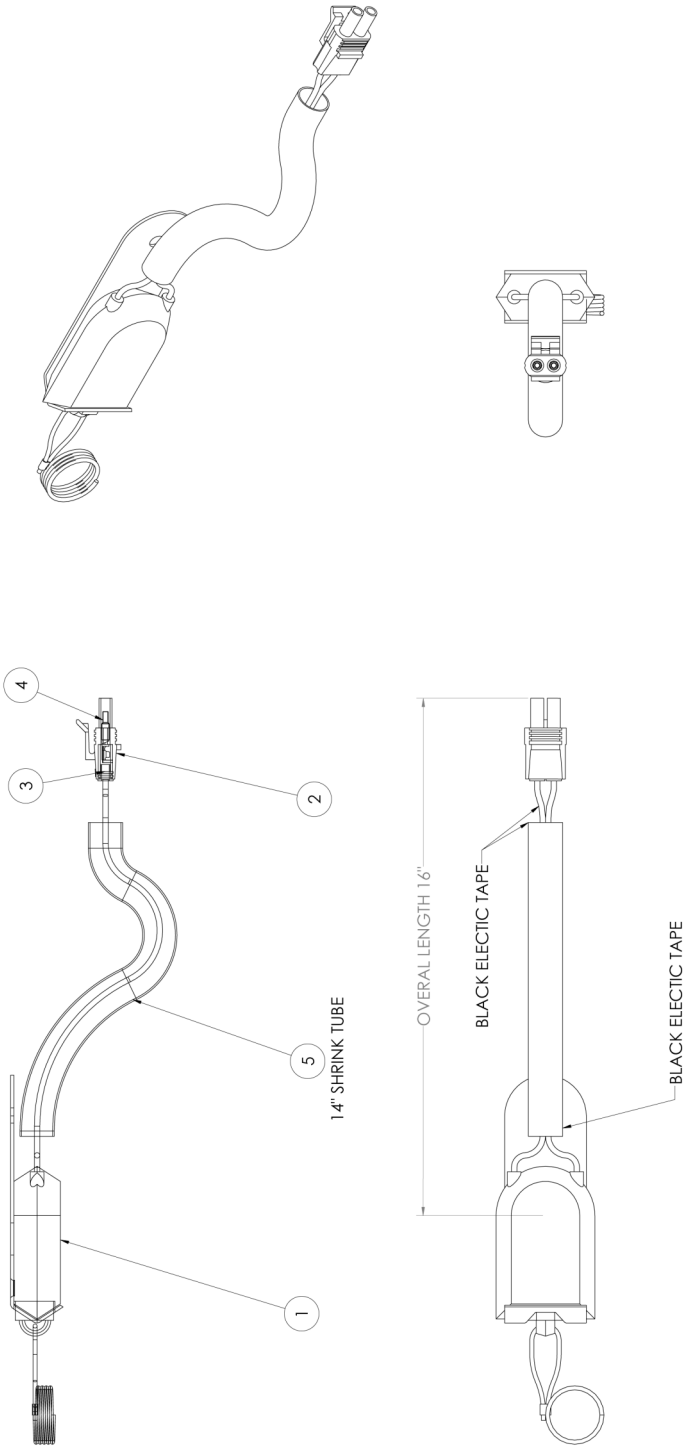


REPLACEMENT PARTS

Strobe Light

[illegible]

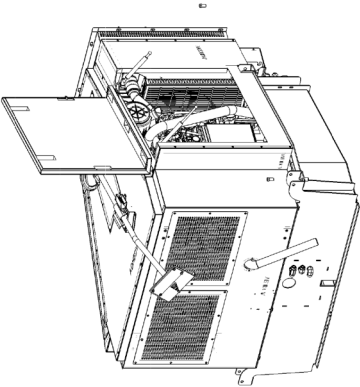
REVISIONS			
REV.	DESCRIPTION	DATE	APPR
C01	RELEASED FOR PRODUCTION	12/27/2010	
C03	ADDED LENGTH TO SHRINK TUBE	1/16/2014	
C04	ADDED OAL DIM	5/12/2014	



ITEM NO.	QTY.	PartNo	Description-1	Description-2
6	1	P10005164	ELECTRICAL TAPE	BLACK
5	14 IN	P10005155	TUBE - SHRINK 1/2" BLACK	TUBE - SHRINK 1/2" BLACK
4	2	P10001023	WEATHERPACK FEMALE PIN 12GA	WEATHERPACK FEMALE PIN 12GA
3	2	P10001022	CABLE SEAL WEATHER PACK	WEATHER PACK
2	1	P10001021	CONNECTOR 2 PIN TOWER	HALF PACKARD WEATHERPACK
1	1	P10003207	BREAKAWAY SWITCH	PIONEER 2010S

STEP P MFG 1222 River Rd. South, MA, 01070 Tel: 413-239-1111 Fax: 413-239-1112 E-Mail: sales@stepmfg.com Web: www.stepmfg.com			
REVISIONS			
REV.	DESCRIPTION	DATE	APPR
C01	RELEASED FOR PRODUCTION	12/27/2010	
C03	ADDED LENGTH TO SHRINK TUBE	1/16/2014	
C04	ADDED OAL DIM	5/12/2014	

REVISIONS		
REV.	DESCRIPTION	DATE
B03	UPDATED FOR NEW TANK DESIGN	8/10/2018
B04	UPDATED BOM FROM FIRST BUILD	8/30/2018
B05	ADDED FUEL FILTER MNT	3/12/2019



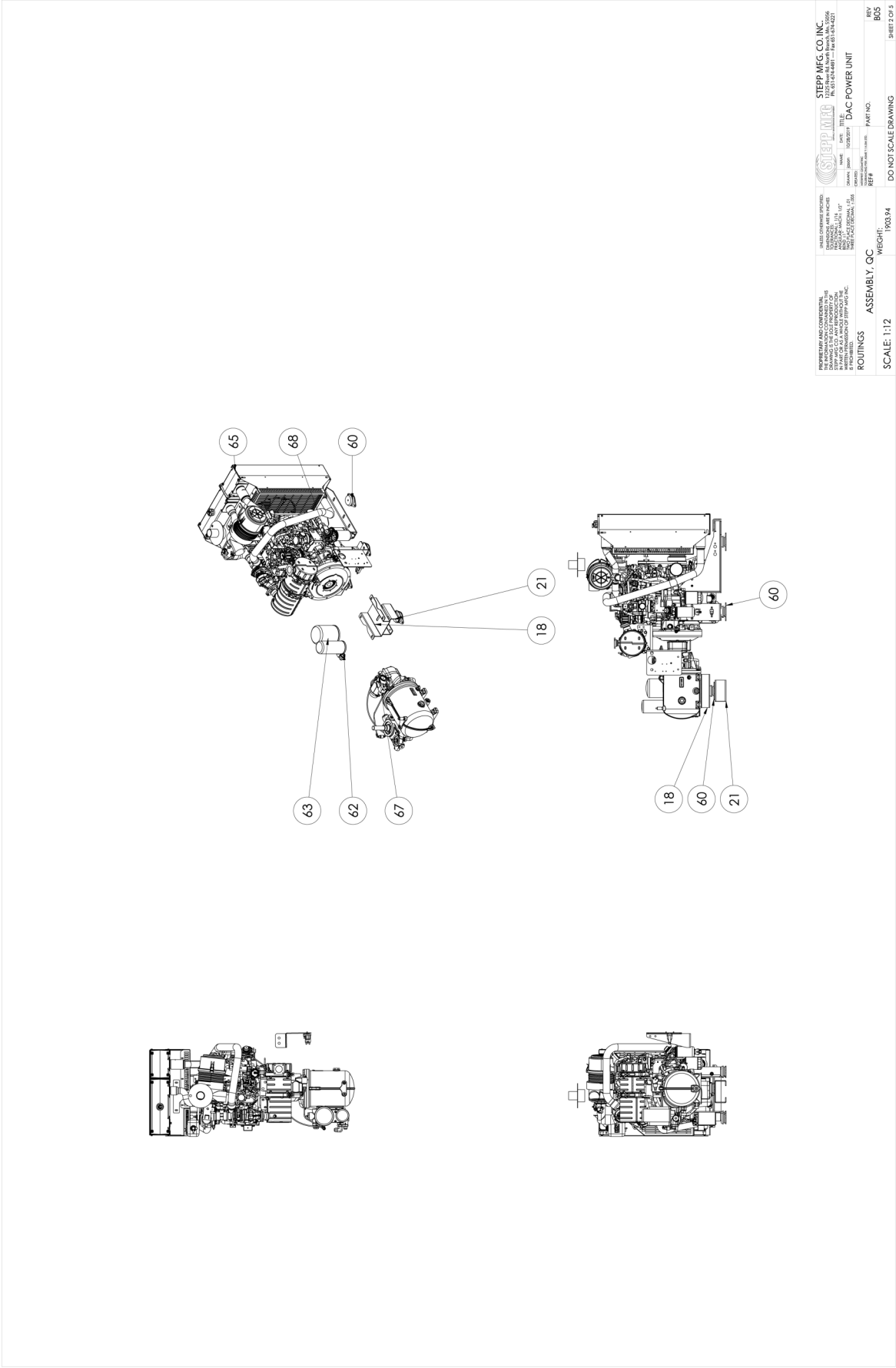
ITEM NO.	DEFAULT QTY.	PartNo	Description-1	Description-2
78	1	P10001068-007	PIPE PLUG - BLACK	1 1/4"
77	1	W10020245	DAC TANK W/DM	DAC ASSY
76	1	W10020076	INLET PIPE W/DM	DAC AIR INLET
75	1	W10019782	WAND HOLDER W/DM	OJK DAC CABINET
74	1	W10017756-001	ACCESS PANEL W/DM	DAC AIR WAND
73	1	P10020290-003	ADPT-3-12M/JIC X 12 MBSPP	DAC OJK CABINET ACCESS PANEL
72	1	P10020290-001	ADPT-5-12M/JIC X 12 MBSPP	
70	2	P10020289	BELL 3/8" V BELT	
68	1	P10019858	DAC DRIVE COUPLING ASSY	
67	1	P10019794	AIR COMPRESSOR W/GEARBOX 2.42	PACKSMARTV90C GR2.42
66	1	P10019792	CONTROLS MURPHY PV-380	
65	1	P10019791	ENGINE DIESEL T4 FINAL 49.6 HP	
64	1	P10019284	FUEL CAP W/CHAIN	2" NPT
63	1	P10017714	OIL SEPARATOR	PRACTIKO
62	1	P10017703	PUMP HYD. 49 CI 2 BOLT A MOUNT	9" FUEL LINE
60	5	P10013033	MOTOR MOUNT ISOLATOR OJK	DS-80-30-M12
59	1	P10009211	RELAY - 12VDC SPST 100A	
58	1	P10008295	1.5W40 ENGINE OIL	0.1 LITERS
57	1	P10007855-002	ADAPTER - BULKHEAD TEE	ADPT-1-8H-10MOFSx10MOFSx10MOFS
56	2	P10007835-002	ADAPTER ELBOW	ADPT-B-L-10MOFSx10MOFS
55	1	P10007827-030	ADAPTER STRAIGHT	ADPT-S-20M/JICx12MORB
54	1	P10007825-018	ADPT-S-12M/JICx12MNPT	2404-12-12
53	1	P10006278-002	PIPE CAP SCH. 40	1/4" NPT
52	1	P10005843	GRIPSERT 1/2-13UNC	.687 HOLE
51	2	P10005041	EDGE TRIM	1 1/16 X 1
49	1	P10003952-016	SHOVEL OLDER	1 1/4 X 1
48	2	P10001666-007	SCREW-THRD ROLLING	BUYERS #SH475SS
47	1	P10001609-008	WASHER	#10-32UNF X 1/2
46	14	P10001609-005	WASHER	FLAT 1/2
45	8	P10001608-008	WASHER	LOCK 5/16
44	14	P10001608-005	WASHER	LOCK 5/16
43	1	P10001605-011	BOLT	HEX - 1/2-13 X 5 1/2
42	1	P10001605-002	BOLT	HEX - 1/2-13 X 1 1/4
41	2	P10001605-001	BOLT	HEX - 1/2-13 X 1
40	4	P10001602-006	BOLT	HEX - 5/16 X 2 1/2
38	6	P10001602-002	BOLT	HEX - 3/16 X 1
37	14	P10001600-002	NUT HEX	5/16-18UNC
36	1	P10001539-006	ELL - ST - 90°	1/4 NPT
35	1	P10001539-002	ELL - ST - 90°	3/4"
34	1	P10001465-005	ELBOW - BLK 90°	1/4"
33	2	P10001465-002	ELBOW - BLK 90°	2 X CLOSE
32	1	P10001306-001	PIPE NIPPLE - SCH.40	24 VOLT WITH 2 GROOVE PULLEY
31	1	P10001292	HYDRAULIC OIL	2" X 1-1/4 NPT
30	1	P10001147	ALTERNATOR ASSY	CABINET FRAME ASSY
29	1	P10001124	HYDRAULIC SUCTION STRAINER	2" NPT
28	1	P10001114	HYD CAP AND SCREEN	FUEL TANK ASSY
27	1	P10001150	FUEL GAUGE	D1803 FUEL & HYD FILTER MOUNT
26	1	M10002804	FILTER MOUNT	D1803 ENGINE
25	1	M10002023	FAN SPACER	D1803 ALTERNATOR MNT
24	1	M10002021	ADJUSTABLE ALTERNATOR MNT	D1803 ENGINE
23	1	M10002026	ENGINE CONTROL MOUNT	DAC ENGINE ASSY
22	1	M10002058	COMPRESSOR TO TANK MOUNT	FOR ALTERNATOR PKG
21	1	M10002056	COMPRESSOR TO TANK MOUNT	DAC TANK ASSY
20	1	M10002052	ALTERNATOR MOUNT	DAC ENGINE CABINET
19	1	M10002050	COMPRESSOR MOUNT	TOOL HOLDER BRACKET
18	1	M10019782	TOOL HOLDER STANDOFF 1 1/2"	ENGINE CONTROL MOUNT DAC
17	1	M10017753	ENGINE CONTROL MOUNT DAC	1/2" X 1/2" X 1/2" X 1/2"
16	1	A100020275-085	HOSE - HYD. HIGH - 3/4" X 89"	1/2" X 1/2" X 1/2" X 1/2"
15	1	A100020275-087	HOSE - HYD. HIGH - 3/4" X 89"	1/2" X 1/2" X 1/2" X 1/2"
14	1	A100020275-030	HOSE - HYD. HIGH - 3/4" X 30"	1/2" X 1/2" X 1/2" X 1/2"
13	1	A10019775	AIR TANK ASSY	DAC ENGINE CABINET
12	1	A10019769	AC COOLER ASSY	DAC ENGINE CABINET
11	1	A10019719	ENGINE CABINET OJK DAC	ENGINE CABINET OJK DAC ASSY
10	1	A10017750	ALUMINUM AIR WAND ASSY	DAC PACKAGES
9	1	A10017596-100	HOSE - HYD. HIGH - 1/2" X 100	8FSJIC X 8FJIC 90
8	1	A10017596-089	HOSE - HYD. HIGH - 1/2" X 89	8FSJIC X 8FJIC 90
7	1	A10007896-010	HOSE - SUCTION - 1-1/4"	5-1/4 MNPT - #20FSJIC - FER
6	1	A10007882-022	HOSE - FUEL 1/4 X 30"	5-1/6 MNPT - #20FSJIC - FER
5	1	A10007884-050	HOSE - 1/2 HYD HIGH ASSY	8FSJIC X 10FOFS
4	1	A10007846-038	HOSE 1/2 HYD HIGH ASSY	8FSJIC X 10FOFS
3	1	A10007846-038	FUEL FILTER ASSY	3/8" NPT FITTINGS
2	1	A100060025		

STEP 90 MFG CO. INC.
1225 E. 4th Ave. Suite 100
P.O. Box 100
P.O. Box 100
P.O. Box 100

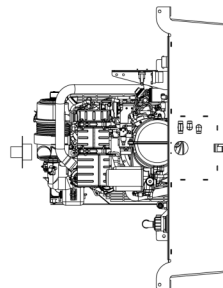
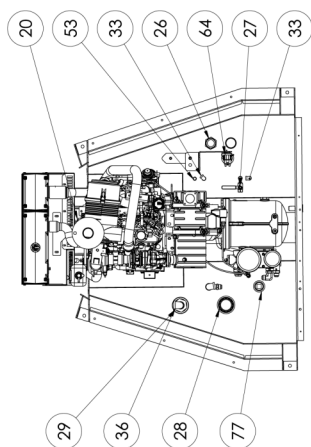
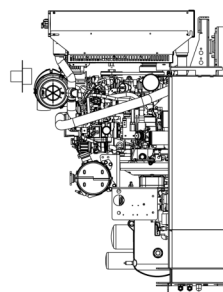
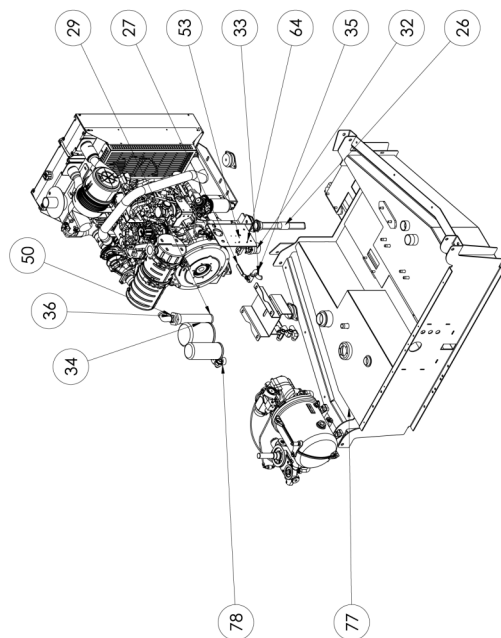
DATE: 10/09/17
DESIGN: DAC POWER UNIT
REV: 805

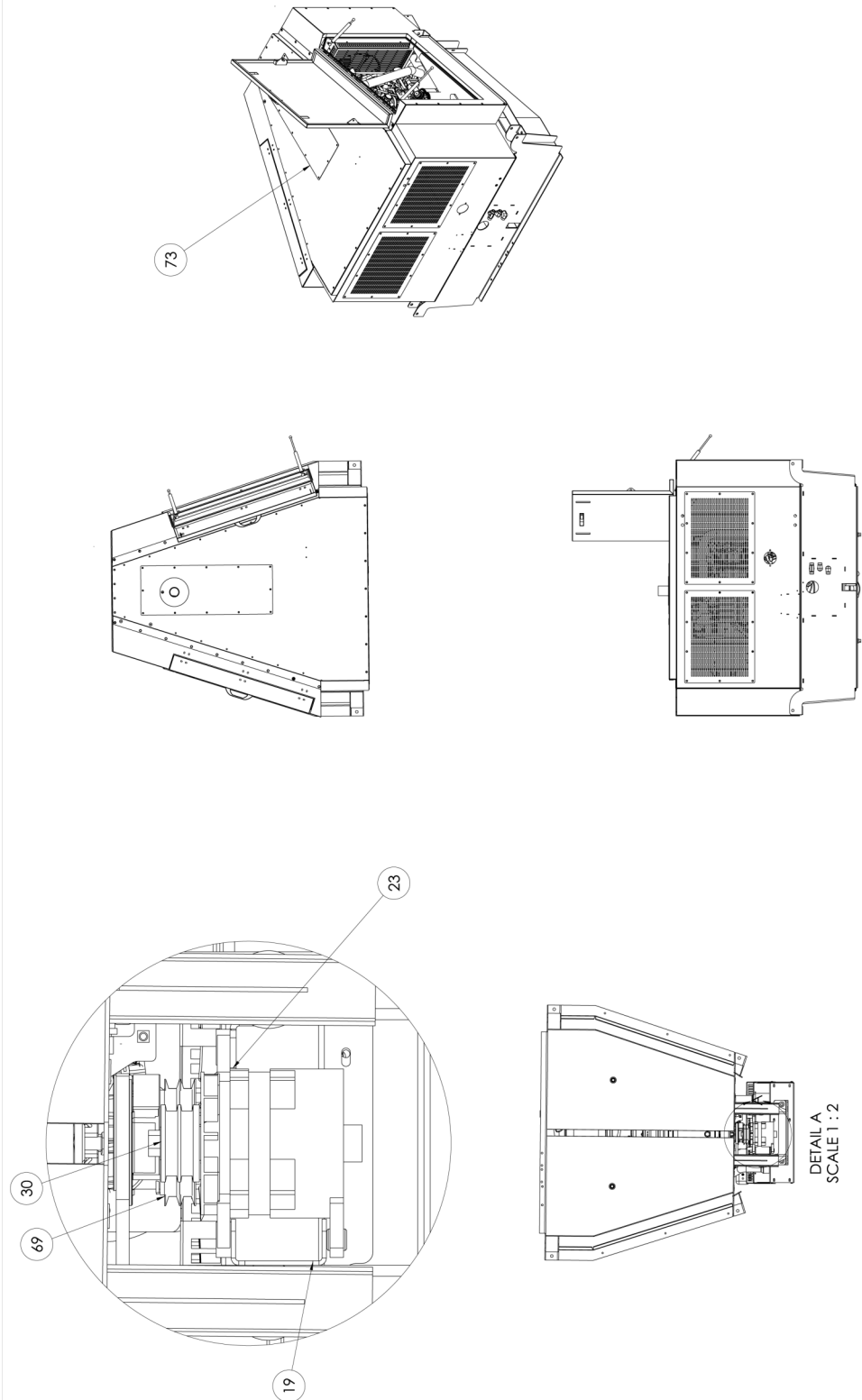
ASSEMBLY, OC
WEIGHT: 1903.94
SCALE: 1:12

ROUTINGS
DO NOT SCALE DRAWING
SHEET 05.5

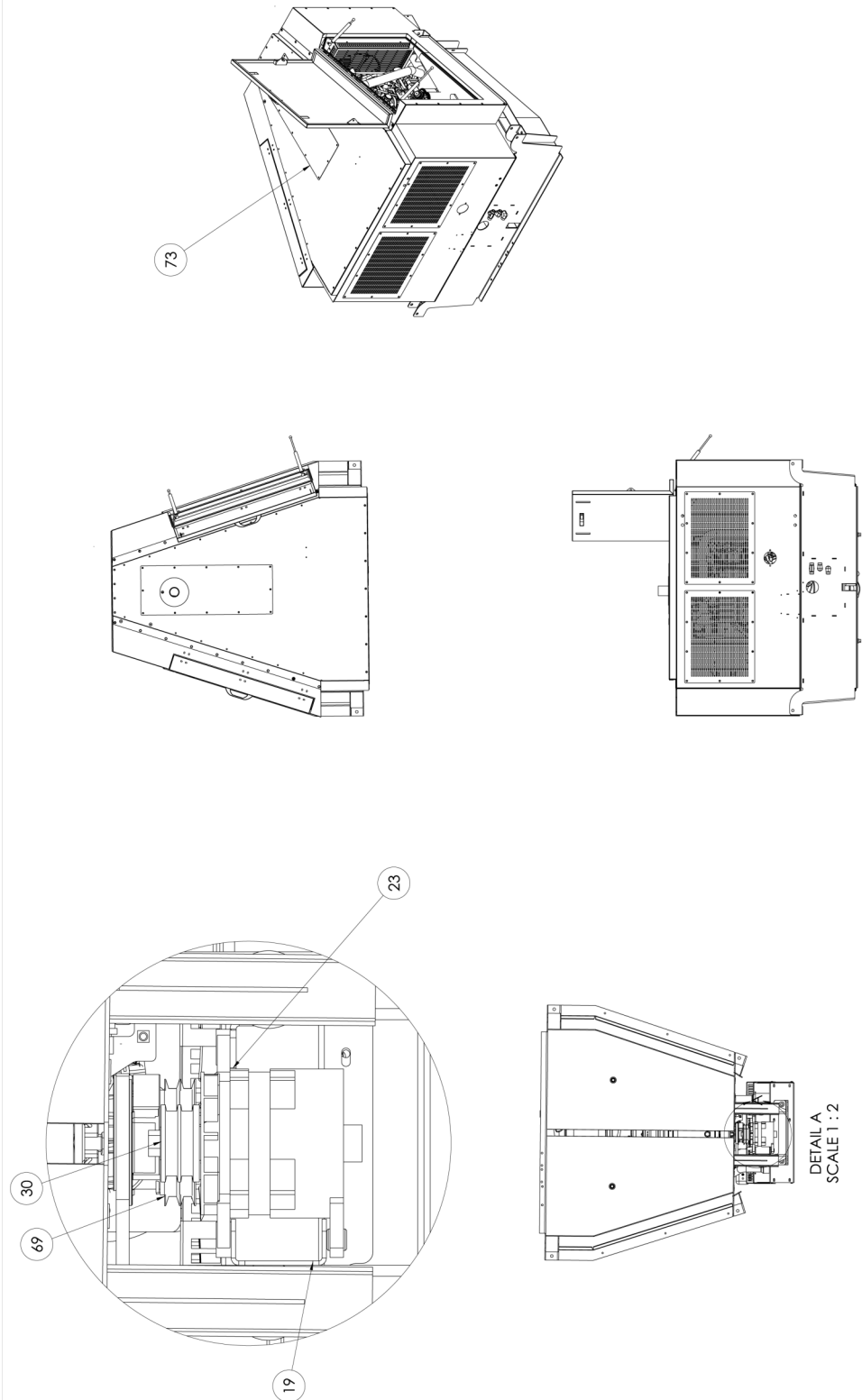


PROPRIETARY AND CONFIDENTIAL THIS DRAWING IS THE PROPERTY OF STEPP MFG. CO., INC. IT IS TO BE USED FOR THE MANUFACTURE OF THE PRODUCT DESCRIBED HEREIN AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF STEPP MFG. CO., INC.	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS FINISHES: F = FREE, B = BLACK, U = UNFINISHED SURFACES: S = SPOT, P = POLISH, G = GRIND, T = TURN TOLERANCES: FRACTIONS: 1/16" = .0625", 1/32" = .03125", 1/64" = .015625" DECIMALS: .1 = .001, .2 = .002, .3 = .003, .4 = .004, .5 = .005, .6 = .006, .7 = .007, .8 = .008, .9 = .009 ANGLES: 1/2" = .001, 1/4" = .0005, 1/8" = .00025, 1/16" = .000125, 1/32" = .0000625, 1/64" = .00003125	STEPP MFG. CO., INC. 1000 STEPP DRIVE FARMINGTON, CT 06030 TEL: 860.634.4444 FAX: 860.634.4444 WWW.STEPPMFG.COM	DATE: 10/15/2019 TITLE: DAC POWER UNIT DRAWN BY: J. STEPP CHECKED BY: J. STEPP PART NO.: REV:
ROUTINGS	ASSEMBLY, QC	WEIGHT: 1903.94	DO NOT SCALE DRAWING
SCALE: 1:12			REV: B05
			SHEET 2 OF 3

[illegible]



PROPERTY AND CONFIDENTIALITY THIS DRAWING IS THE PROPERTY OF STEPP MFG. CO. INC. AND IS NOT TO BE REPRODUCED OR USED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF STEPP MFG. CO. INC.	STEPP MFG. CO. INC. 12345 Main Rd. Springfield, MA 01106 (413) 555-1234 FAX: (413) 555-5678 WWW.STEPPMFG.COM	DATE: 10/20/2019 DRAWN BY: JMM CHECKED BY: JMM APPROVED BY: JMM	TITLE: DAC POWER UNIT PART NO.: REV: B05	DO NOT SCALE DRAWING SCALE: 1:12 WEIGHT: 1903.94 SHEET 4 OF 5



PROPERTY AND CONFIDENTIALITY THIS DRAWING IS THE PROPERTY OF STEPP MFG. CO. INC. IT IS TO BE USED FOR THE MANUFACTURE OF THE PRODUCT ONLY. IT IS NOT TO BE REPRODUCED, COPIED, OR DISTRIBUTED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF STEPP MFG. CO. INC.	PART NUMBER 1903.94	WEIGHT 1903.94	DO NOT SCALE DRAWING	REV B05	SHEET 4 OF 5
ROUTINGS	ASSEMBLY, QC				
STEPP MFG. CO. INC. 12345 Main Rd. Suite 100 Anytown, MA 01006 Tel: 555-555-5555 Fax: 555-555-5555 Email: info@steppmfg.com Website: www.steppmfg.com					
DATE 10/20/2019	TITLE DAC POWER UNIT	PART NO. 1903.94			

Trailer Frame Air Compressor Unit

139

Trailer Frame Air Compressor Unit



WANDS SHOES FOR CRACK SEALING

Wand Shoes for Aluminum Trigger Wand



Part # 204095 5/16 flat steel 1/4 straight
5/16" wide flat nozzle typically used for
applying sealer into sawed cuts in concrete
or asphalt. Steel construction with 3/4" NPT
Threads.



Part # 204047 (2 1/2" steel disc 1/4 x 45°)
Part # 204094 (4" steel disc 1/4 x 45°)
2 1/2" or 4" diameter concave disc with
turned up edge. Steel construction with 3/4"
NPT Threads.



Part # 204053 (4" steel "O" 1/4)
"O" shaped shoe 4" wide gives you a
narrow over-band and eliminates the need
for a second squeegee operation. Steel
construction with vertical swivel with 3/4"
NPT Threads.



Part # W10018004 (4" steel "U" 1/4 x 53°)
"U" shaped shoe 4" wide gives you a
medium width over-band and eliminates
the need for a second squeegee operation.
Steel construction with 3/4" NPT Threads.



Part # W10018000 (4" alum. "U" 1/4 x 53°)
Lightweight aluminum for less operator
fatigue. Aluminum construction with 3/4"
NPT Threads.



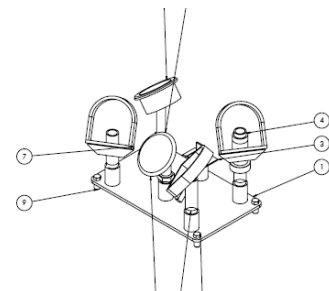
Part # A10020453(4" alum "U" swivel 1/4 x 53°)
Part # A10020458(4" steel "U" swivel 1/4 x 53°)
"U" shaped shoe 4" wide with built-in swivel
constructed of lightweight aluminum for less
operator fatigue and ease of operation. Grease
fitting on swivel for long life. All aluminum
construction with 3/4" NPT



Part # P10017454 (3" stainless steel Disk 3/4"
Adjustable)
Adjustable approach angle for customized
operator comfort. 4" circular disk with
turned up edge gives you a medium width
over-band and eliminates the need for a
second squeegee operation. Steel construc-
tion with 3/4" NPT threads.



Part # P10017455(4" stainless steel Disk 3/4"
Adjustable)
Adjustable approach angle for customized
operator comfort. 4" circular disk with
turned up edge gives you a medium width
over-band and eliminates the need for a
second squeegee operation. Steel construc-
tion with 3/4" NPT threads.



Part # K10020643 Wand Shoe Kit
Includes a Mounting Bracket and 6 of the
most popular shoes.
1-W10018004 Steel 4" U
1-W10018000 Aluminum 4" U
1-P10017455 4" SS Swivel Disk
1-A100203053 Aluminum 4 Swivel U
1-204095 Saw cut
1-204053 Adjustable 4"O

ITEM NO.	Default Qty	PartNo	Description-1	Description-2
1	1	A10018721	24V WIRING BOX ASSY	24V WIRING BOX ASSY
2	1	M10004309	GAS ENGINE BASE	ENGINE MOUNT
3	1	M10011888	LOVEJOY L100 1 7/16	LOVEJOY
4	2	M10013917	NUT PLATE	LP ENGINE ASSY OJK-75/125
5	1	M10014194	ALT MOUNTING BRACKET	LP ENGINE ASSY OJK-75/125
6	1	M10014195	PUMP MOUNT	LP ENGINE ASSY OJK-75/125
7	1	M10014196	BELT GUARD	LP ENGINE ASSY OJK-75/125
8	1	M10014198	HYDRAULIC PUMP MOUNT	LP ENGINE ASSY OJK-75/125
9	1	P10001147	ALTERNATOR ASSY	24 VOLT WITH 2 GROOVE PULLEY
10	2	P10001600-003	NUT HEX	3/8-16NC
11	1	P10001600-005	NUT HEX	1/2-13NC
12	8	P10001603-002	BOLT	HEX - 3/8-16 X 1 1/4
13	4	P10001603-004	BOLT	HEX - 3/8-16 X 2
14	1	P10001605-002	BOLT	HEX - 1/2-13 X 1 1/4
15	1	P10001605-004	BOLT	HEX - 1/2-13 X 2
16	3	P10001608-003	WASHER	LOCK #10
17	10	P10001608-006	WASHER	LOCK 3/8
18	2	P10001608-008	WASHER	LOCK 1/2
19	8	P10001609-006	WASHER	FLAT 3/8
20	1	P10001609-008	WASHER	FLAT 1/2
21	3	P10001619-033	PAN CROSS HD MACH SCREW	#10-32 X 5/8
22	2	P10001620-118	SOCKET HEAD CAP SCREW	3/8-16 X 1-1/2
23	4	P10001624-010	LOCK NUT	HEX 3/8-16 NC
24	3	P10001625-005	HEX NUT MACHINE SCREW	#10-32NF
25	8	P10001666-011	SCREW-THRD ROLLING	1/4-20UNC X 1/2
26	1	P10002757	KOHLER 25HP LP	HYDRAULIC PUMP
27	1	P10009491	.66 CUBIC INCH EATON	L100
28	1	P10011987	SPIDER	FOR OJK VERT LP OPTION
29	2	P10013879	BELT 4L400	SDS STYLE BUSHING QUICK DISCONNECT
30	1	P10013889	BUSHING - H X 1-7/16 BMCO	REF# 514022
31	1	P10014199	PULLEY - SHEAVE 2BK 67H	LOVEJOY
32	1	P10014355	LOVEJOY HUB L100 5/8"	
33	2	P10001622-032	SOCKET SET SCREW	3/8-16 x 1/2

REV.	DESCRIPTION	DATE	APPR
B04	ADDED 24V RELAY BOX	11/6/2017	
B05	ECR18071 ADDED LOCATION FOR ALT	3/1/2018	
B06	ECR 18044 ADD 1 EA P10013879 FOR QNTY 2 EA	4/6/2018	

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STEPP MFG CO. INC.
1000 STEPP DRIVE
MILWAUKEE, WI 53211
TEL: 414.381.1000
FAX: 414.381.1001
WWW.STEPPMFG.COM

DATE: 11/6/2017
DRAWN BY: J. L. STEPP
CHECKED BY: J. L. STEPP
APPROVED BY: J. L. STEPP

ITEM NO. 10014197
REV. B06
PART NO. A10014197
DO NOT SCALE DRAWING

SCALE: 1:4
WEIGHT: 676.60
ROUTINGS: ASSY

Kohler LPG Engine



REV.

DESCRIPTION

DATE

APPR.

B01

RELEASED FOR PROTOTYPE

7/18/2014

B02

ECK1086018668 ADDED
SOLENOID HARNESS

3/6/2018

REVISIONS

9

8

4

3

6

7

2

8

ITEM NO.

QTY.

PartNo

Description-1

Description-2

9

1

P10005657

POL FITTING LIQUID LP

FEMALE

8

1

P10001520-002

COUPLING - FULL STANDARD

1/4"

7

1

M10005777

OP CHART LP BURNER

SPARK IGN SYSTEM

6

1

A10013915

OJK VERT GAS TRIN ASSY

LP BURNER KIT

5

1

A10012199

SPARK BOX TO BURNER WH

SPARK BOX TO BURNER

4

1

A10007881-085

HOSE - FUEL 1/4 X 85"

WH

3

1

A10007881-060

HOSE - FUEL 1/4 X 60"

1/4 MNPT-KNS-FER

2

1

A10005742

SPARK BOX ELEC ASSY

1/4 MNPT-KNS-FER

1

1

A10005713-001

SPARK IGN BURNER ASSY

STEPP MFG PARTS

ITEM NO.

QTY.

PartNo

Description-1

Description-2

1

1

A10005713-001

SPARK IGN BURNER ASSY

MLT-250-FT LH-PILOT

STEPP MFG CO. INC.

12225 Main Rd. Dept. 400, MA 01906

TEL: 508-548-4227 FAX: 508-548-4227

STEPP MFG

DATE: 10/20/07

ISSUE: 1

REV: 1

DESCRIPTION: LP BURNER KIT

REP: OJK VERT LP

WEIGHT: 25.52

SCALE: 1:2

DO NOT SCALE DRAWING

REV: B02

SHEET 1 OF 1

145

REPLACEMENT PARTS

LP Burner

FRONT VIEW
 Dimensions: 9-11/32" (width), 9-5/16" (height).
 Callouts: 1 (Washer Flat 3/8), 2 (Washer Lock 3/8), 3 (Nut Hex 3/8-16NC), 14 (Detail A: Hex Nut Machine Screw #8-32NC, Washer Lock #8, Pan Cross HD Mach Screw #8-32x0.375x0.375-N, Scale 2:1).
 Detail A Scale 2:1

SIDE VIEW
 Dimensions: 8-3/16" (width).
 Callouts: 15 (Bolt Hex - 1/4-20 x 1/2), 16 (Washer Lock 1/4), 17 (Detail B: Scale 2:1).
 Detail B Scale 2:1

DETAIL C
 Scale 2:1

REVISIONS

REV.	DESCRIPTION	DATE	APPR.
C01	RELEASED FOR PRODUCTION	6/23/2010	
C02	ADDED MOUNTING FASTENERS	7/27/2010	
C03	1500S - ADDED COMPS FROM A10004318	7/27/2010	

LP Burner Spark Ignition

[illegible]



NHTSA Reporting Safety Defects

If you believe that your vehicle has a defect in which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying STEPP MANUFACTURING CO., INC..

If NHTSA receives similar complaints, it may open an investigation and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or STEPP MANUFACTURING CO., INC..

To Contact NHTSA, you may either call the Auto Safety Hotline toll-free at 1-888-327-4236 (TTY: 1-800-424-9153); go to <http://www.safercar.gov>; or Write to: NHTSA, US Department of Transportation, 1200 New Jersey Ave., S.E., Washington DC 20590. You can also obtain information about your motor vehicle safety from <http://www.safercar.gov>.

California Proposition 65

California Proposition 65

The state of California currently maintains a list of chemicals that can cause cancer, birth defects or other reproductive harm.

Your Stepp Mfg. Co Inc equipment comes with the following warnings:

 **WARNING:** Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel.



Consumer Warranty Guide



Introduction

Congratulations on your purchase of equipment built by Stepp Manufacturing for your asphalt maintenance needs. Your equipment has been designed and constructed to give you the most in performance, ease of use, and reliability. It is our desire that you will find operating the equipment both productive and profitable.

Warranty Procedures Through A Dealer

If your equipment requires repair, or needs parts for repair, please contact your area dealer. For repairs, the unit must be brought to the dealer for warranty. The dealer will require purchase date information, where the machine was purchased, and the Vehicle Identification Number (VIN) of the equipment. This information is needed so the dealer can submit a warranty claim. The dealer will repair your equipment, once warranty is approved, at no charge to you under the provisions of the warranty policy.

Warranty Procedures Direct Through The Factory *(when no servicing dealer is available in your area)*

Contact Stepp Manufacturing's Customer Service Department at (651) 674-4491.

In this situation, it may be advantageous for you to repair the machine and be reimbursed direct from the factory for warranty repairs. If you do not have the facilities, or the technicians, to perform the repair, the unit can be brought to a local repair facility. In either case, Stepp Manufacturing **MUST** be contacted and authorize the warranty repair **PRI-OR** to any work being performed. If work is done prior to authorization, the warranty will not be honored.

If parts are required for the warranty repair, contact Customer Service at Stepp Manufacturing for replacements. When warranty replacement parts are shipped to you, a Warranty Authorization Number will be issued. If asked to return the defective parts, "tag" the defective parts with the Warranty Authorization Number, then package them in the same box the new parts were shipped in. Ten (10) business days will be allowed for return of the defective parts. If the defective part is not received back at the factory within this allotted time, the warranty will not be honored.

You will be billed for all parts shipped that require returning of defective parts. However, when the defective parts are returned and evaluated, you will receive credit for the cost of the part only. Thus, it is important that all defective parts are turned to Stepp Manufacturing in the allotted ten (10) day period.

Engine Warranty Claims

When a warranty issue develops with the engine, bring the unit to the engine manufacturer nearest authorized service center for repair. Be prepared to supply them with proof of purchase information with purchase dates.

Stepp Manufacturing cannot process engine warranty claims. However, we will be happy to offer assistance in locating the nearest service center.

Equipment Owner Responsibilities

As the equipment owner, you are responsible for:

- Using the equipment in accordance with the correct operating procedures as shown in the operators manual.
- Assuring all maintenance items are completed in accordance with the operators/maintenance manuals.
- Transporting the equipment to the place where warranty repairs can be completed.
- Supplying purchase date and VIN information to establish warranty coverage.



General Warranty Statement
Stepp Manufacturing's One (1) Year Limited Warranty

Stepp Manufacturing Co., Inc. hereby warrants, to the original purchaser of new equipment, that products manufactured by Stepp Manufacturing will be free from defects in material and workmanship for a period of one (1) year from the date of purchase from Stepp Manufacturing.

Stepp Manufacturing, at its discretion, will provide for the repair or replacement of any part found, upon examination by Stepp Manufacturing, to be defective, except as noted below. Such repair or replacement shall be free of charge to the original purchaser of new equipment for a period of one (1) year from the date of purchase, except as noted below.

No warranty is extended to cover:

- Product pump wear or damage caused by foreign objects.
- Routine maintenance, cleaning, and adjustments.
- Parts or components that have been altered, misused, improperly adjusted, or improperly maintained.
- Transportation to and from the place of warranty repair.
- Removal of materials from equipment.

The following items are covered solely by their manufacturer's warranty:

- Engines
- Hydraulic components
- Burners
- Pumps
- Axles
- Tires
- Other component parts not solely manufactured by Stepp Manufacturing

The following items are covered by a pro-rata warranty:

- Hoses that carry heated materials
- Heating elements for material hoses and wands

Disclaimer of further warranty:

Stepp Manufacturing makes no warranty, expressed or implied, other than this warranty. The implied warranties of merchantability and fitness for a particular purpose are hereby disclaimed. Repair or replacement of products or parts proving to be defective in material or workmanship shall be the exclusive remedy for breach of this warranty.

Stepp Manufacturing shall not be liable for incidental or consequential damages. Including, but not limited to, damages for inconvenience, rental or purchase of replacement equipment, loss of profits, or other loss resulting from breach of this warranty.

Stepp Manufacturing reserves the right to incorporate any changes in design into its products without obligation to make such changes on products previously manufactured.



Twelve (12) Month Pro-Rata Limited Warranty
Heated Asphalt Hose and Heating Elements
Effective for Equipment Delivered After 5/1/2012

Stepp Manufacturing Co., Inc. hereby warrants to the original purchaser, on a pro-rated basis, that the heated asphalt hose and heating elements installed on NEW Stepp Manufacturing's equipment shall be free from defects in material and workmanship for period of twelve (12) months for the heated asphalt hose and six (6) months for the heating element.

In the event that a heated asphalt material hose or a heating element fails under normal use during the warranty period, Stepp Manufacturing will supply a replacement heated asphalt hose or heating element, along with one-half (0.5) hour for installation labor on a pro-rated adjustment basis.

- If the failure occurs under normal use within the first three (3) months from date of purchase, Stepp Manufacturing will supply a replacement, and provide for one-half (0.5) hour installation labor at no charge to the customer.
- If the failure occurs under normal use within the fourth (4th) through twelfth (12th) months, Stepp Manufacturing will supply a replacement, and provide for one-half (0.5) hour installation labor on a pro-rata basis.

The pro-rated adjustment is based on the total number of months elapsed since the purchase date of the new equipment from Stepp Manufacturing. This rate is then applied to the one-half (0.5) hour labor rate and the current suggested retail price of the proper replacement heated asphalt hose or heating element supplied by Stepp Manufacturing. This is the amount the customer will have to pay. Freight will not be included in the reimbursement. If a new heated asphalt hose or heating element is needed prior to warranty inspection, you will be billed for all parts shipped that require returning of defective parts. However, when the defective parts are returned and evaluated, you will receive credit for the cost of the part only. **Thus, it is important that all defective parts are turned in to Stepp Manufacturing in the allotted ten (10) day period, or warranty will be denied.**

In no case will the warranty coverage extend beyond the six (6) month period for the heating element or the twelve (12) month period for the heated asphalt hose, from the original purchase date of the new equipment from Stepp Manufacturing. *Physical damage is not covered by this warranty.* Physical damage may include, but is not limited to:

- Broken heating element (typically caused by repeated bending to less than a one (1) foot radius).
- Heated asphalt hoses burnt from the inside (typically caused by operating the heating element in an empty hose).
- External cuts or abrasions on the heated asphalt hose (typically caused by dragging on the ground).

The chart below shows the pro-rated amount, by percentage, that will be allowed by warranty, pending examination of the heated asphalt hose or heating element.

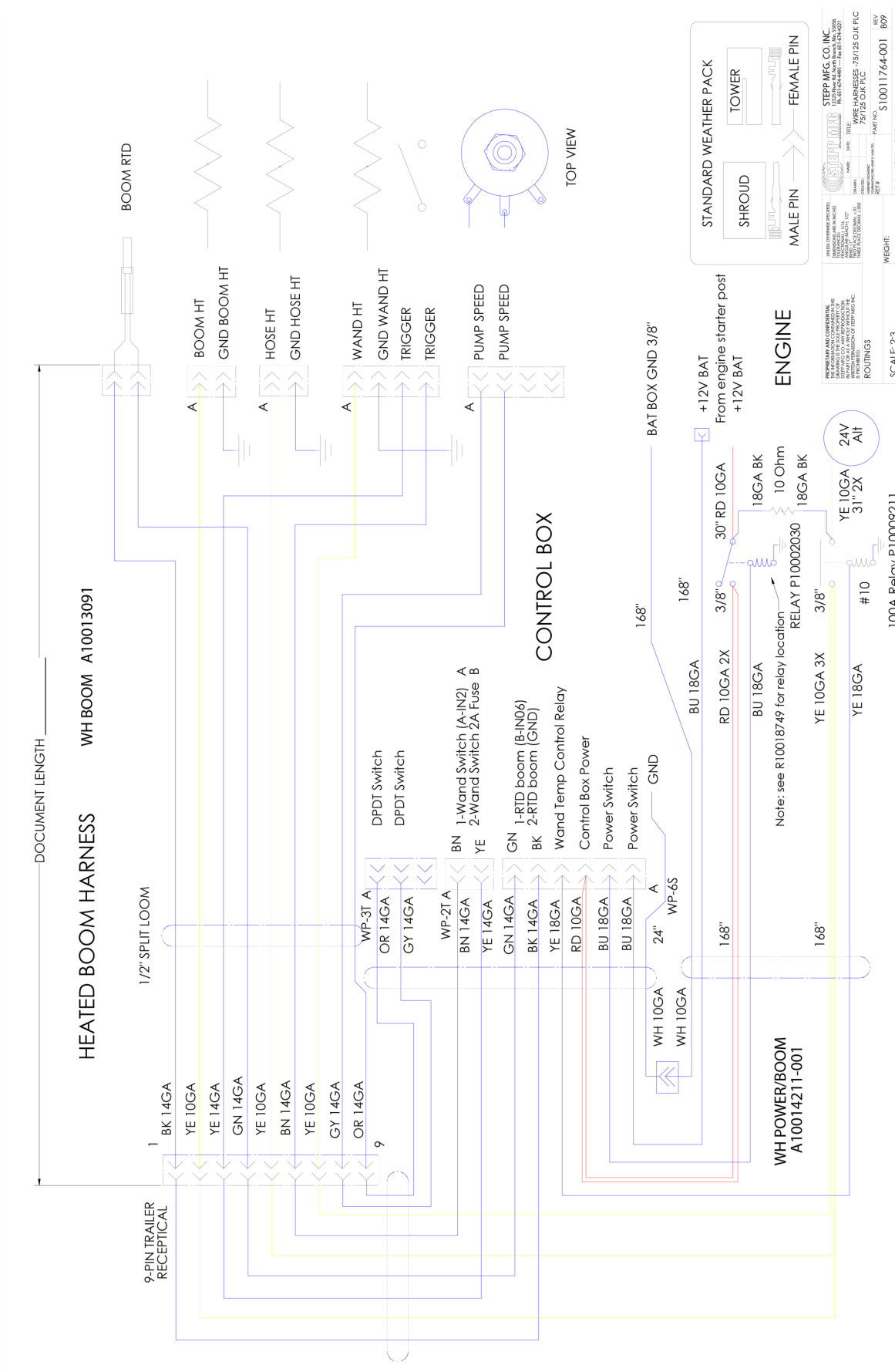
Heated Asphalt Hose		
Failure Date	Warranty's Responsibility	Customer's Responsibility
0-3 Months 0-90 Days	100%	0%
3-6 Months 91-180 Days	70%	30%
6-7 Months 181-211 Days	60%	40%
7-8 Months 212-242 Days	50%	50%
8-9 Months 243-273 Days	40%	60%
9-10 Months 274-304 Days	30%	70%
10-11 Months 305-335 Days	20%	80%
11-12 Months 336-365 Days	10%	90%
After 12 Months	0%	100%

Heating Element		
Failure Date	Warranty's Responsibility	Customer's Responsibility
0-3 Months 0-90 Days	100%	0%
3-4 Months 91-121 Days	60%	40%
4-5 Months 122-152 Days	40%	60%
5-6 Months 153-180 Days	20%	80%
After 6 Months	0%	100%



Warranty Claim Authorization Number: _____
 Call Customer Service at 651-674-4491 to obtain prior approval or warranty will be denied.
 Date of Authorization Request _____

Equipment Owner		Warranty to be Performed by	
Customer Name		Company Name	
Street Address		Address	
City/State/Zip		City/State/Zip	
Equipment Model #		Contact Name	
Equipment VIN		Contact Phone #	
Hour Meter Read			
Purchase Date		Date of Malfunction	
Dealer Purchased Form		Date of Repair	
Warranty Authorization		Signature for Authorization	
Date of Malfunction		X	
Date of Repair			
Symptoms / Diagnostics / Action			
Symptoms	Diagnostics	Action	
<i>Describe the symptoms in detail, be as specific as possible. Ex: Burner ignites and runs for 35 seconds, then goes out.</i>	<i>Describe issues found, be as specific as possible. Ex: Part failed due to loose connection, resulting in misalignment and premature wear.</i>	<i>Describe action taken, be as specific as possible. Ex: Removed damaged section of wire harness, soldered new leads in place, and insulated splices w/ heat shrink tubing.</i>	
Parts and Labor			
Labor Time to Correct Problem (reimbursed at \$55/hour)		Parts Used to Correct Problem	
Labor Time (in hours)	Repair Made	Part Number	Description Qty
Parts Return			
All parts returned must be tagged with the warranty authorization number and a copy of this claim. Retain all parts until credit is received from the factory. When requested, return the parts, along with this claim, to: Stepp Manufacturing Co., Inc. Attn: Warranty Department 12325 River Road North Branch MN 55056 *Note: If defective parts are not returned within 10 days, or this warranty claim does not accompany the returned parts, the claim will be denied.			
Office Use Only			
Date Claim/Parts Received?		Is this a warrantable claim?	Yes No
Claim Reviewed By:		Original Invoice # for Parts	
Date of Review:			
Warranty Totals			



REV.	DESCRIPTION	DATE	APPR.
B07	UPDATED HARNESS	7/27/2015	
B08	REMOVED ENGINE INTERLOCK	5/5/2017	
B09	ECR 18038 ADDED JUMPER WIRE LENGTH	2/28/2018	

BN 1-Door switch (A-IN01)

BK 2-Door switch (VBBS)

BN 84"

BN CABLE EVC005 P10011284

BK WP-2S BK

DOOR SW

SENSOR (G5905)

A10014203-001

OPTIONAL STROBE

A10014204-001

ATTENTION WARNING LIGHT

BURNER

A10014205-001

RTD PRODUCT

A10014206-001

RTD HOT OIL

PUMP & AUGER

A10014208-001

OPTIONAL PUMP PICKUP

A10014210-001

OPTIONAL CONVEYOR

A10014209-001

YE 1-Strobe power (TS01-4)

BK 2-Strobe ground (GND)

GN 3-Attention power (TS02-4)

BK 4-Attention ground (GND)

BU 1-Burner call for heat (TS01-5)

RD 2-Burner power 12V BREAKER

VI 3-Burner lockout (A-IN03)

BK 4-Ground

VI A-RTD product (B-IN5)

OR B-RTD product (GND)

OR C-RTD hot oil (B-IN4)

OR D-RTD hot oil (GND)

GY 1-Pump forward (TS01-1)

OR 2-Pump reverse (TS01-2)

VI 3-Pump speed (TS02-2)

BN 4-Auger forward (TS01-3)

RD 5-Auger reverse (TS01-4)

BK 7-Ground

BK A-Sensor signal (C-IN08)

BN B-Sensor power (VBBS)

BU D-Sensor ground (GND)

GY 1-Conveyor forward (TS01-8)

OR 2-Conveyor reverse (TS02-1)

PK 3-Tether forward (C-IN10)

VI 4-Tether reverse (C-IN11)

BN 5-Door switch (C-IN09)

RD 6-Door switch (VBBS)

BK 9-Ground

OPTIONAL STROBE

A10014204-001

ATTENTION WARNING LIGHT

BURNER

A10014205-001

RTD PRODUCT

A10014206-001

RTD HOT OIL

PUMP & AUGER

A10014208-001

OPTIONAL PUMP PICKUP

A10014210-001

OPTIONAL CONVEYOR

A10014209-001

STANDARD WEATHER PACK

SHROUD

TOWER

MALE PIN

FEMALE PIN

BN 84"

BN CABLE EVC005 P10011284

BK WP-2S BK

DOOR SW

SENSOR (G5905)

A10014203-001

OPTIONAL STROBE

A10014204-001

ATTENTION WARNING LIGHT

BURNER

A10014205-001

RTD PRODUCT

A10014206-001

RTD HOT OIL

PUMP & AUGER

A10014208-001

OPTIONAL PUMP PICKUP

A10014210-001

OPTIONAL CONVEYOR

A10014209-001

YE 1-Strobe power (TS01-4)

BK 2-Strobe ground (GND)

GN 3-Attention power (TS02-4)

BK 4-Attention ground (GND)

BU 1-Burner call for heat (TS01-5)

RD 2-Burner power 12V BREAKER

VI 3-Burner lockout (A-IN03)

BK 4-Ground

VI A-RTD product (B-IN5)

OR B-RTD product (GND)

OR C-RTD hot oil (B-IN4)

OR D-RTD hot oil (GND)

GY 1-Pump forward (TS01-1)

OR 2-Pump reverse (TS01-2)

VI 3-Pump speed (TS02-2)

BN 4-Auger forward (TS01-3)

RD 5-Auger reverse (TS01-4)

BK 7-Ground

BK A-Sensor signal (C-IN08)

BN B-Sensor power (VBBS)

BU D-Sensor ground (GND)

GY 1-Conveyor forward (TS01-8)

OR 2-Conveyor reverse (TS02-1)

PK 3-Tether forward (C-IN10)

VI 4-Tether reverse (C-IN11)

BN 5-Door switch (C-IN09)

RD 6-Door switch (VBBS)

BK 9-Ground

OPTIONAL STROBE

A10014204-001

ATTENTION WARNING LIGHT

BURNER

A10014205-001

RTD PRODUCT

A10014206-001

RTD HOT OIL

PUMP & AUGER

A10014208-001

OPTIONAL PUMP PICKUP

A10014210-001

OPTIONAL CONVEYOR

A10014209-001

STANDARD WEATHER PACK

SHROUD

TOWER

MALE PIN

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OPTIONAL STROBE

A10014204-001

ATTENTION WARNING LIGHT

BURNER

A10014205-001

RTD PRODUCT

A10014206-001

RTD HOT OIL

PUMP & AUGER

A10014208-001

OPTIONAL PUMP PICKUP

A10014210-001

OPTIONAL CONVEYOR

A10014209-001

YE 1-Strobe power (TS01-4)

BK 2-Strobe ground (GND)

GN 3-Attention power (TS02-4)

BK 4-Attention ground (GND)

BU 1-Burner call for heat (TS01-5)

RD 2-Burner power 12V BREAKER

VI 3-Burner lockout (A-IN03)

BK 4-Ground

VI A-RTD product (B-IN5)

OR B-RTD product (GND)

OR C-RTD hot oil (B-IN4)

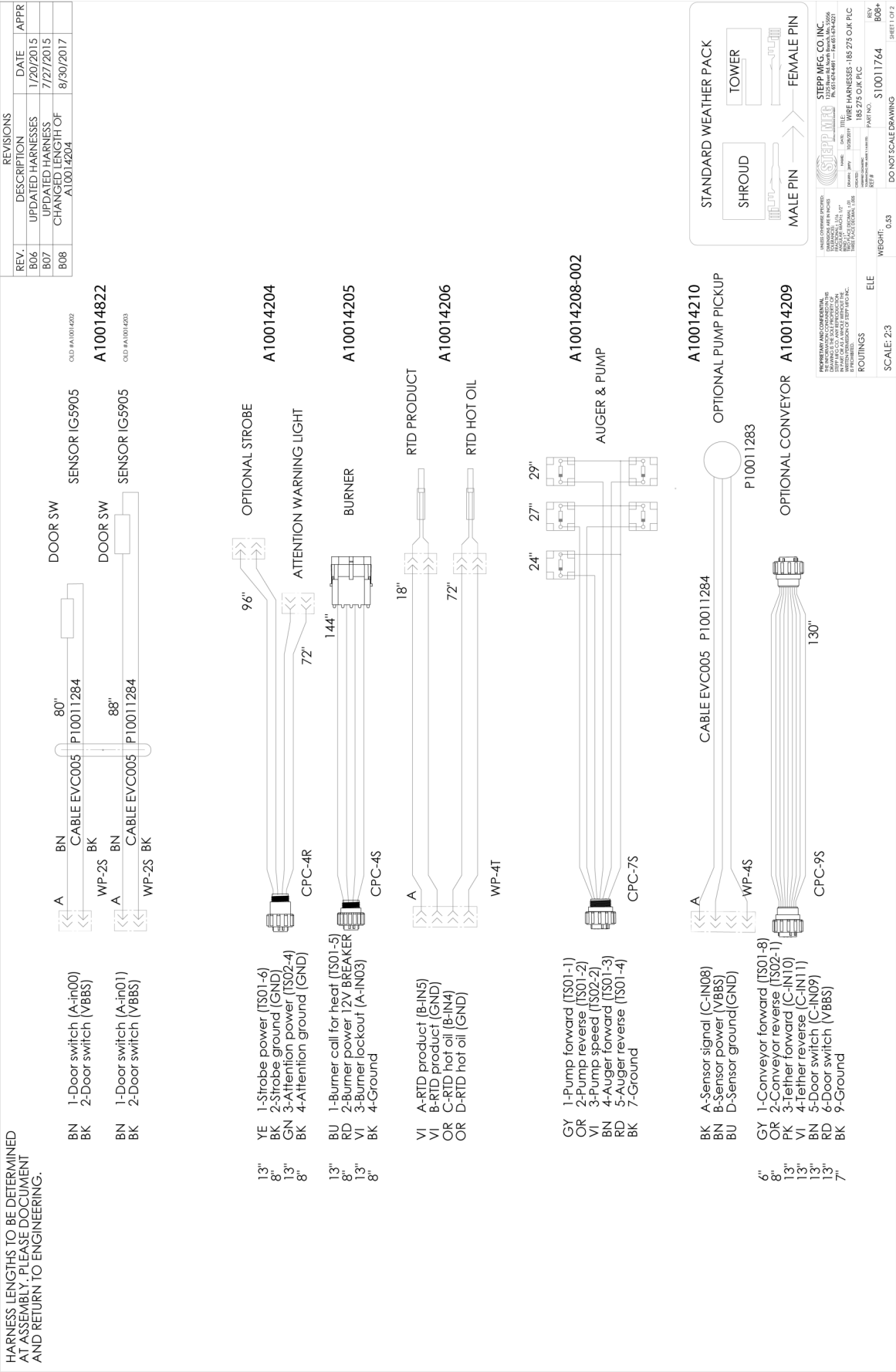
OR D-RTD hot oil (GND)

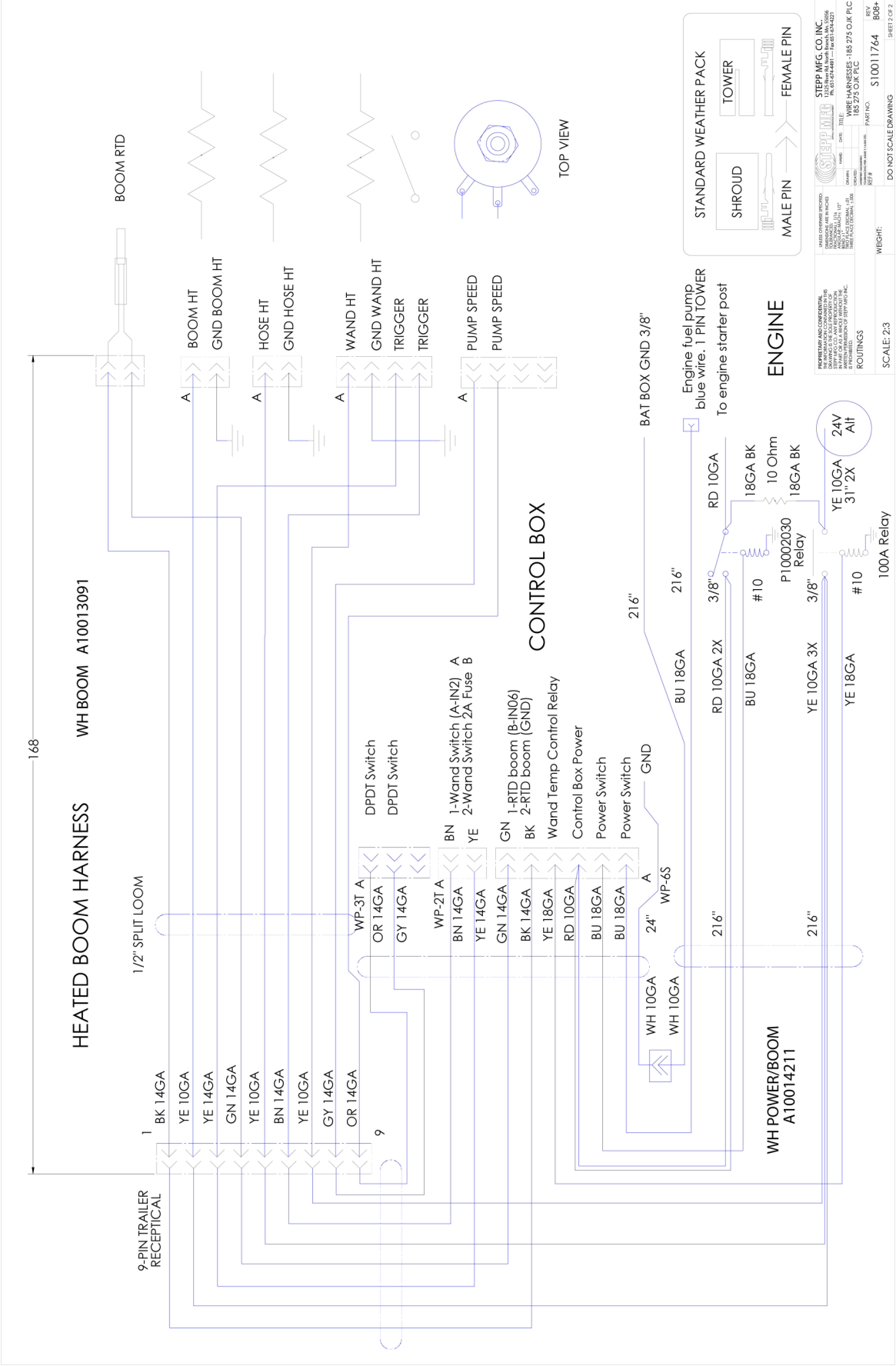
GY 1-Pump forward (TS01-1)

OR 2-Pump reverse (TS01-2)

VI 3-Pump speed (TS02-2)

BN





HEAT TRANSFER OIL MSDS



SAFETY DATA SHEET

Heat Transfer Oil

According to Appendix D, OSHA Hazard Communication Standard 29 CFR §1910.1200 and WHMIS 2015, in compliance with the Hazardous Product Act (HPA, as amended) and the requirements of the Hazardous Product Regulations (HPR).

1. Identification

Product identifier

Product name Heat Transfer Oil

Product number INHT

Recommended use of the chemical and restrictions on use

Application Lubricant.

Uses advised against Avoid the formation of mists.

Details of the supplier of the safety data sheet

Supplier AMOIL INC.
Bordner, Ladner, Gervais
Scotia Plaza, 40 King St W
Toronto, ON, Canada M5H 3Y4
+1 416.367.6547

Manufacturer SEVERUS INC.
1101 Susquehanna Ave.
Superior, WI 54880, USA.
T: +1-7 15-395-0946

Emergency telephone number

Emergency telephone CHEMTREC: Within USA and Canada: 1-800-424-9300
Outside the USA and Canada: +1 703-741-5970
(collect calls accepted) 24/7

2. Hazard(s) identification

Classification of the substance or mixture

OSHA/WHMIS Regulatory Status This Product is not Hazardous under the OSHA Hazard Communication Standard and according to the hazard criteria of the Hazardous Product Regulations.

Physical hazards Not Classified

Health hazards Not Classified

Environmental hazards Not Classified

Label elements

Hazard statements NC Not Classified

Other hazards

This product does not contain any substances classified as PBT or vPvB.

3. Composition/information on ingredients

Heat Transfer Oil

Composition comments No classified ingredients, or those having occupational exposure limits, present above the levels of disclosure.

4. First-aid measures

Description of first aid measures

General information	Get medical attention if any discomfort continues. Show this Safety Data Sheet to the medical personnel.
Inhalation	Move affected person to fresh air and keep warm and at rest in a position comfortable for breathing. Maintain an open airway. Loosen tight clothing such as collar, tie or belt.
Ingestion	Rinse mouth thoroughly with water. Give a few small glasses of water or milk to drink. Stop if the affected person feels sick as vomiting may be dangerous. Do not induce vomiting unless under the direction of medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. Maintain an open airway. Loosen tight clothing such as collar, tie or belt.
Skin Contact	Wash skin thoroughly with soap and water.
Eye contact	Rinse immediately with plenty of water. Remove any contact lenses and open eyelids wide apart. Continue to rinse for at least 10 minutes.
Protection of first aiders	First aid personnel should wear appropriate protective equipment during any rescue.

Most important symptoms and effects, both acute and delayed

General information	See Section 11 for additional information on health hazards. The severity of the symptoms described will vary dependent on the concentration and the length of exposure.
Inhalation	Prolonged inhalation of high concentrations may damage respiratory system.
Ingestion	Gastrointestinal symptoms, including upset stomach. Fumes from the stomach contents may be inhaled, resulting in the same symptoms as inhalation.
Skin contact	Prolonged contact may cause dryness of the skin.
Eye contact	May cause temporary eye irritation.

Indication of immediate medical attention and special treatment needed

Notes for the doctor	Treat symptomatically.
Specific treatments	No special treatment required.

5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	Extinguish with alcohol-resistant foam, carbon dioxide, dry powder or water fog. Use fire-extinguishing media suitable for the surrounding fire.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.

Special hazards arising from the substance or mixture

Specific hazards	Containers can burst violently or explode when heated, due to excessive pressure build-up. Contains Hydrocarbons. The product is immiscible with water and will spread on the water surface.
Hazardous combustion products	Thermal decomposition or combustion products may include the following substances: Harmful gases or vapors.

Advice for firefighters

Heat Transfer Oil

Protective actions during firefighting	Avoid breathing fire gases or vapors. Evacuate area. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. If a leak or spill has not ignited, use water spray to disperse vapors and protect men stopping the leak.
Special protective equipment for firefighters	Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing. Standard Firefighter's clothing including helmets, protective boots and gloves, that provides a basic level of protection during chemical incidents is defined by the Canada Occupational Health and Safety Regulations, by provincial guidelines on occupational health and safety or by NFPA standards if applicable.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions	No action shall be taken without appropriate training or involving any personal risk. Keep unnecessary and unprotected personnel away from the spillage. Wear protective clothing as described in Section 8 of this safety data sheet. Follow precautions for safe handling described in this safety data sheet. Wash thoroughly after dealing with a spillage. Use protective equipment appropriate for surrounding materials.
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Environmental precautions

Environmental precautions	Avoid discharge to the aquatic environment.
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Methods and material for containment and cleaning up

Methods for cleaning up	Wear protective clothing as described in Section 8 of this safety data sheet. Clear up spills immediately and dispose of waste safely. Reuse or recycle products wherever possible. Absorb the spillage with an inert, dry material and place it in a suitable waste disposal container. Flush contaminated area with plenty of water. Wash thoroughly after dealing with a spillage. Dispose of contents/container in accordance with national regulations.
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Reference to other sections	For personal protection, see Section 8. For waste disposal, see Section 13.
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7. Handling and storage

Precautions for safe handling

Usage precautions	Read and follow manufacturer's recommendations. Wear protective clothing as described in Section 8 of this safety data sheet. Keep away from food, drink and animal feeding stuffs. Handle all packages and containers carefully to minimize spills. Keep container tightly sealed when not in use. Avoid the formation of mists. Avoid contact with used product. Do not reuse empty containers.
Advice on general occupational hygiene	Wash promptly if skin becomes contaminated. Take off contaminated clothing and wash before reuse. Wash contaminated clothing before reuse. Do not eat, drink or smoke when using this product. Wash at the end of each work shift and before eating, smoking and using the toilet. Change work clothing daily before leaving workplace.

Conditions for safe storage, including any incompatibilities

Storage precautions	Store away from incompatible materials (see Section 10). Keep container tightly closed, in a cool, well ventilated place. Protect containers from damage.
Storage class	Chemical storage.
Specific end uses(s)	
Specific end use(s)	The identified uses for this product are detailed in Section 1.

8. Exposure controls/Personal protection

Heat Transfer Oil

Occupational exposure limits

Comments The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

Under conditions which may generate mists, the following exposure limits are recommended:

Long-term exposure limit (8-hour TWA): 5 mg/m³

Short-term exposure limit (15-minute): 10 mg/m³

Exposure controls

Appropriate engineering controls Provide adequate ventilation. Good general ventilation should be adequate to control worker exposure to airborne contaminants.

Eye/face protection Eyewear complying with an approved standard should be worn if a risk assessment indicates eye contact is possible. Personal protective equipment for eye and face protection should comply with OSHA 1910.133 and/or the Canadian regulation on health and safety at work, SOR/86-304, Part XII (12.6), and any relevant provincial regulation relating to health and safety at work. The following protection should be worn: Chemical splash goggles.

Hand protection Chemical-resistant, impervious gloves complying with an approved standard should be worn if a risk assessment indicates skin contact is possible. The most suitable glove should be chosen in consultation with the glove supplier/manufacturer, who can provide information about the breakthrough time of the glove material. To protect hands from chemicals, gloves should comply with OSHA 1910.138 and/or the Canadian regulation on health and safety at work, SOR/86-304, Part XII (12.9), and be demonstrated to be impervious to the chemical and resist degradation. Considering the data specified by the glove manufacturer, check during use that the gloves are retaining their protective properties and change them as soon as any deterioration is detected. Frequent changes are recommended.

Other skin and body protection Appropriate footwear and additional protective clothing complying with an approved standard should be worn if a risk assessment indicates skin contamination is possible.

Hygiene measures Provide eyewash station and safety shower. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before reuse. Clean equipment and the work area every day. Good personal hygiene procedures should be implemented. Wash at the end of each work shift and before eating, smoking and using the toilet. When using do not eat, drink or smoke.

Respiratory protection Respiratory protection complying with an approved standard should be worn if a risk assessment indicates inhalation of contaminants is possible. Provide adequate ventilation. Large Spillages: If ventilation is inadequate, suitable respiratory protection must be worn.

Environmental exposure controls Not regarded as dangerous for the environment.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Liquid.
Color	Amber.
Odor	Mild petroleum.
Odor threshold	Not available.
pH	Not available.
Melting point	Not available.
Initial boiling point and range	Not available.

Heat Transfer Oil

Flash point	212°C Cleveland open cup. [ASTM D 92]
Evaporation rate	Not available.
Upper/lower flammability or explosive limits	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	0.8639
Solubility(ies)	Not known.
Partition coefficient	Not available.
Auto-ignition temperature	Not available.
Decomposition Temperature	Not available.
Viscosity	36.2 cSt @ 40°C 6.1 cSt @ 100°C [ASTM D 445]
Explosive properties	Not considered to be explosive.
Oxidizing properties	Does not meet the criteria for classification as oxidizing.
Fire point	238°C Cleveland open cup. [ASTM D 92]
Pour point	-21°C [ASTM D 97]

10. Stability and reactivity

Reactivity	See the other subsections of this section for further details.
Stability	Stable at normal ambient temperatures and when used as recommended. Stable under the prescribed storage conditions.
Possibility of hazardous reactions	No potentially hazardous reactions known.
Conditions to avoid	There are no known conditions that are likely to result in a hazardous situation.
Materials to avoid	No specific material or group of materials is likely to react with the product to produce a hazardous situation.
Hazardous decomposition products	Does not decompose when used and stored as recommended. Thermal decomposition or combustion products may include the following substances: Harmful gases or vapors.

11. Toxicological information

Information on toxicological effects

Toxicological effects	Not regarded as a health hazard under current legislation.
<u>Acute toxicity - oral</u>	
Notes (oral LD ₅₀)	Based on available data the classification criteria are not met.
<u>Acute toxicity - dermal</u>	
Notes (dermal LD ₅₀)	Based on available data the classification criteria are not met.

Heat Transfer Oil

Acute toxicity - inhalation

Notes (inhalation LC₅₀) Based on available data the classification criteria are not met.

Skin corrosion/irritation

Animal data Based on available data the classification criteria are not met.

Serious eye damage/irritation

Serious eye damage/irritation Based on available data the classification criteria are not met.

Respiratory sensitization

Respiratory sensitization Based on available data the classification criteria are not met.

Skin sensitization

Skin sensitization Based on available data the classification criteria are not met.

Germ cell mutagenicity

Genotoxicity - in vitro Based on available data the classification criteria are not met.

Carcinogenicity

Carcinogenicity Based on available data the classification criteria are not met.

IARC carcinogenicity None of the ingredients are listed or exempt.

Reproductive toxicity

Reproductive toxicity - fertility Based on available data the classification criteria are not met.

Reproductive toxicity - development Based on available data the classification criteria are not met.

Specific target organ toxicity - single exposure

STOT - single exposure Not classified as a specific target organ toxicant after a single exposure.

Specific target organ toxicity - repeated exposure

STOT - repeated exposure Not classified as a specific target organ toxicant after repeated exposure.

Aspiration hazard

Aspiration hazard Based on available data the classification criteria are not met.

General information

No specific health hazards known. The severity of the symptoms described will vary dependent on the concentration and the length of exposure.

Inhalation

Prolonged inhalation of high concentrations may damage respiratory system.

Ingestion

Gastrointestinal symptoms, including upset stomach. Fumes from the stomach contents may be inhaled, resulting in the same symptoms as inhalation.

Skin Contact

Prolonged contact may cause dryness of the skin.

Eye contact

May cause temporary eye irritation.

Route of exposure

Ingestion Inhalation Skin and/or eye contact

Target Organs

No specific target organs known.

Medical considerations

Skin disorders and allergies.

12. Ecological information

Ecotoxicity

Not regarded as dangerous for the environment. However, large or frequent spills may have

Heat Transfer Oil

Toxicity Based on available data the classification criteria are not met.

Persistence and degradability

Persistence and degradability The degradability of the product is not known.

Bioaccumulative potential

Bio-Accumulative Potential No data available on bioaccumulation.

Partition coefficient Not available.

Mobility in soil

Mobility No data available.

Other adverse effects

Other adverse effects None known.

13. Disposal considerations

Waste treatment methods

General information The generation of waste should be minimized or avoided wherever possible. Reuse or recycle products wherever possible. This material and its container must be disposed of in a safe way. Disposal of this product, process solutions, residues and by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any local authority requirements.

Disposal methods Dispose of surplus products and those that cannot be recycled via a licensed waste disposal contractor. Waste packaging should be collected for reuse or recycling. Incineration or landfill should only be considered when recycling is not feasible. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of the local water authority.

14. Transport information

General The product is not covered by international regulations on the transport of dangerous goods (IMDG, IATA, DOT, TDG).

UN Number

UN No. (International) Not applicable.

UN proper shipping name

Proper shipping name (International) Not applicable.

Transport hazard class(es)

Transport labels

No transport warning sign required.

Packing group

Packing group (International) Not applicable.

Environmental hazards

Environmentally Hazardous Substance

No.

Special precautions for user

Not applicable.

Heat Transfer Oil

DOT TIH Zone Not applicable.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

15. Regulatory information

Regulatory References OSHA Hazard Communication Standard 29 CFR §1910.1200 Hazardous Products Regulation (SOR/2015-17) Transportation of Dangerous Goods Regulations -SOR/2015-100.

US Federal Regulations

SARA Section 302 Extremely Hazardous Substances Tier II Threshold Planning Quantities

None of the ingredients are listed or exempt.

CERCLA/Superfund, Hazardous Substances/Reportable Quantities (EPA)

None of the ingredients are listed or exempt.

SARA Extremely Hazardous Substances EPCRA Reportable Quantities

None of the ingredients are listed or exempt.

SARA 313 Emission Reporting

None of the ingredients are listed or exempt.

CAA Accidental Release Prevention

None of the ingredients are listed or exempt.

SARA (311/312) Hazard Categories

None of the ingredients are listed or exempt.

OSHA Highly Hazardous Chemicals

None of the ingredients are listed or exempt.

US State Regulations

California Proposition 65 Carcinogens and Reproductive Toxins

None of the ingredients are listed or exempt.

California Air Toxics "Hot Spots" (A-I)

None of the ingredients are listed or exempt.

California Air Toxics "Hot Spots" (A-II)

None of the ingredients are listed or exempt.

California Directors List of Hazardous Substances

None of the ingredients are listed or exempt.

Massachusetts "Right To Know" List

None of the ingredients are listed or exempt.

Rhode Island "Right To Know" List

None of the ingredients are listed or exempt.

Minnesota "Right To Know" List

None of the ingredients are listed or exempt.

New Jersey "Right To Know" List

None of the ingredients are listed or exempt.

Heat Transfer Oil

Pennsylvania "Right To Know" List

None of the ingredients are listed or exempt.

Inventories

Canada - DSL/NDSL

All the ingredients are listed or exempt.

US - TSCA

All the ingredients are listed or exempt.

US - TSCA 12(b) Export Notification

None of the ingredients are listed or exempt.

16. Other information

Abbreviations and acronyms used in the safety data sheet	C.A.S. = Chemical Abstracts Service; E.C. No = European Commission number; GHS = Globally Harmonised System; OSHA = Occupational Safety and Health Administration; WHMIS = Workplace Hazardous Materials Information System; DOT = Department of Transport; TDG = Transport of Dangerous Goods Regulations; IMDG = International Maritime Dangerous Goods; IATA = International Air Transport Association; SARA = Superfund Amendments and Reauthorization Act; CERCLA = Comprehensive Environmental; EPCRA = Emergency Planning and Community Right-to-Know Act; TSCA = Toxic Substances Control Act; LD/LC/EC = Lethal Dose, Lethal Concentration/Effect Concentration for 50% of population; NOEC = No Overall Effect Concentration; NOEL = No Overall Effect Level; REACH = Registration, Evaluation, Authorisation & Restriction of Chemicals; STOT-RE = Single Target Organ Toxicity - Repeat Exposure; STOT-SE = Specific Target Organ Toxicity - Single Exposure; PBT = Persistent, Bioaccumulative, Toxic; vPvB = Very Persistent, Very Bioaccumulative.
Key literature references and sources for data	Source: European Chemicals Agency, http://echa.europa.eu/
Training advice	Read and follow manufacturer's recommendations. Only trained personnel should use this material.
Revision comments	This is the first issue.
Revision date	4/14/2019
SDS No.	8602

This information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is, to the best of the company's knowledge and belief, accurate and reliable as of the date indicated. However, no warranty, guarantee or representation is made to its accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability of such information for his own particular use.

HYDRAULIC OIL MSDS

MATERIAL SAFETY DATA SHEET

SECTION 1	PRODUCT AND COMPANY IDENTIFICATION
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PRODUCT

Product Name: UNIVIS N 32
Product Description: Base Oil and Additives
Product Code: 8259
Intended Use: Hydraulic fluid

COMPANY IDENTIFICATION

Supplier: Canada Imperial Oil Limited, An Affiliate of Exxon Mobil Corporation
P.O. Box 4029, Station A
Calgary, ALBERTA. T2P 3M9 Canada

24 Hour Health Emergency 519-339-2145

Transportation Emergency Phone 519-339-2145

Supplier General Contact 1-800-567-3776

SECTION 2	COMPOSITION / INFORMATION ON INGREDIENTS
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Reportable Hazardous Substance(s) or Complex Substance(s)

Name	CAS#	Concentration*
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	64742-53-6	20 - 30%

* All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

SECTION 3	HAZARDS IDENTIFICATION
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This material is not considered to be hazardous according to regulatory guidelines (see (M)SDS Section 15).

POTENTIAL HEALTH EFFECTS

Low order of toxicity. Excessive exposure may result in eye, skin, or respiratory irritation. High-pressure injection under skin may cause serious damage.

NFPA Hazard ID: Health: 0 Flammability: 1 Reactivity: 0

HMIS Hazard ID: Health: 0 Flammability: 1 Reactivity: 0

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 4	FIRST AID MEASURES
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INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5	FIRE FIGHTING MEASURES
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EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight Streams of Water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Unusual Fire Hazards: Pressurized mists may form a flammable mixture.

Hazardous Combustion Products: Smoke, Fume, Sulfur oxides, Aldehydes, Oxides of carbon, Incomplete combustion products

FLAMMABILITY PROPERTIES

Flash Point [Method]: 165C (329F) [ASTM D-93]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6	ACCIDENTAL RELEASE MEASURES
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NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. U.S. regulations require reporting releases of this material to the environment which exceed the reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do it without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dike far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7	HANDLING AND STORAGE
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HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8	EXPOSURE CONTROLS / PERSONAL PROTECTION
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Exposure limits/standards for materials that can be formed when handling this product: When mists / aerosols can occur, the following are recommended: 5 mg/m³ - ACGIH TLV, 10 mg/m³ - ACGIH STEL, 5 mg/m³ - OSHA PEL.

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Work conditions can greatly effect glove durability; inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS

See Sections 6, 7, 12, 13.

SECTION 9	PHYSICAL AND CHEMICAL PROPERTIES
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Typical physical and chemical properties are given below. Consult the Supplier in Section 1 for additional data.

GENERAL INFORMATION

Physical State: Liquid
Color: Yellow
Odor: Characteristic
Odor Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 C): 0.87
Flash Point [Method]: 165C (329F) [ASTM D-93]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D
Boiling Point / Range: 229C (444F) - 512C (954F)
Vapor Density (Air = 1): N/D
Vapor Pressure: [N/D at 40 °C] | < 1 kPa (7.5 mm Hg) at 38C
Evaporation Rate (n-butyl acetate = 1): < 0.1
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): > 3.5
Solubility in Water: Negligible
Viscosity: 32 cSt (32 mm²/sec) at 40 C
Oxidizing Properties: See Sections 3, 15, 16.

OTHER INFORMATION**Freezing Point:** N/D**Melting Point:** N/A**Pour Point:** -48°C (-54°F)**DMSO Extract (mineral oil only), IP-346:** < 3 %wt

SECTION 10	STABILITY AND REACTIVITY
-------------------	---------------------------------

STABILITY: Material is stable under normal conditions.**CONDITIONS TO AVOID:** Excessive heat. High energy sources of ignition.**MATERIALS TO AVOID:** Strong oxidizers**HAZARDOUS DECOMPOSITION PRODUCTS:** Material does not decompose at ambient temperatures.**HAZARDOUS POLYMERIZATION:** Will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION
-------------------	----------------------------------

ACUTE TOXICITY

<u>Route of Exposure</u>	<u>Conclusion / Remarks</u>
Inhalation	
Toxicity (Rat): LC50 > 5000 mg/m ³	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data.	Negligible hazard at ambient/normal handling temperatures. Based on assessment of the components.
Ingestion	
Toxicity (Rat): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Skin	
Toxicity (Rabbit): LD50 > 2000 mg/kg	Minimally Toxic. Based on test data for structurally similar materials.
Irritation (Rabbit): Data available.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Irritation (Rabbit): Data available.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.

CHRONIC/OTHER EFFECTS**Contains:**

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test animals.

Additional information is available by request.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC

3 = IARC 1

5 = IARC 2B

2 = NTP SUS

4 = IARC 2A

6 = OSHA CARC

SECTION 12	ECOLOGICAL INFORMATION
-------------------	-------------------------------

The information given is based on data available for the material, the components of the material, and similar materials.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13	DISPOSAL CONSIDERATIONS
-------------------	--------------------------------

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrositivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

Empty Container Warning PRECAUTIONARY LABEL TEXT: Empty containers may retain residue and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

SECTION 14	TRANSPORT INFORMATION
-------------------	------------------------------

LAND (DOT) : Not Regulated for Land Transport

LAND (TDG) : Not Regulated for Land Transport

SEA (IMDG) : Not Regulated for Sea Transport according to IMDG-Code

AIR (IATA) : Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION
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OSHA HAZARD COMMUNICATION STANDARD: When used for its intended purposes, this material is not classified as hazardous in accordance with OSHA 29 CFR 1910.1200.

NATIONAL CHEMICAL INVENTORY LISTING: DSL, TSCA

EPCRA: This material contains no extremely hazardous substances.

SARA (311/312) REPORTABLE HAZARD CATEGORIES: Delayed Health.

SARA (313) TOXIC RELEASE INVENTORY: This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The Following Ingredients are Cited on the Lists Below:*

Chemical Name	CAS Number	List Citations
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE (PETROLEUM)	64742-53-6	13, 17, 18
PHOSPHORODITHOIC ACID, O,O-DI C1-14-ALKYL ESTERS, ZINC SALTS (2:1) (ZDDP)	68649-42-3	15

--REGULATORY LISTS SEARCHED--

1 = ACGIH ALL	6 = TSCA 5a2	11 = CA P65 REPRO	16 = MN RTK
2 = ACGIH A1	7 = TSCA 5e	12 = CA RTK	17 = NJ RTK
3 = ACGIH A2	8 = TSCA 6	13 = IL RTK	18 = PA RTK
4 = OSHA Z	9 = TSCA 12b	14 = LA RTK	19 = RI RTK
5 = TSCA 4	10 = CA P65 CARC	15 = MI 293	

Code key: CARC=Carcinogen; REPRO=Reproductive

* EPA recently added new chemical substances to its TSCA Section 4 test rules. Please contact the supplier to confirm whether the ingredients in this product currently appear on a TSCA 4 or TSCA 12b list.

SECTION 16**OTHER INFORMATION**

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

No revision information is available.

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Internal Use Only

MHC: 0, 0, 0, 0, 0, 0

PPEC: A

DGN: 5007202 (1012936)

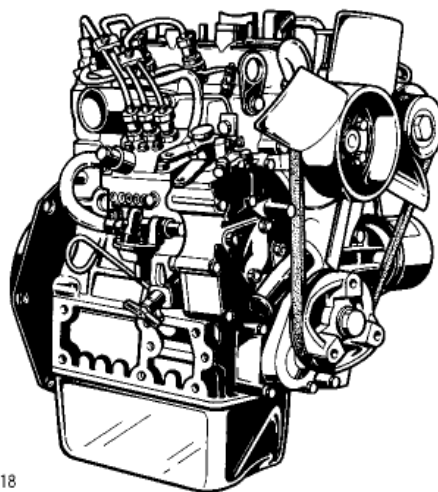
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OPERATOR'S MANUAL

ENGLISH

KUBOTA DIESEL ENGINE

**MODELS Z482-E·Z602-E
D662-E·D722-E
D782-E·D902-E**



B-1418

16676-8917-1

READ AND SAVE THIS BOOK

Kubota



SAFE OPERATION

Careful operation is your best assurance against an accident. Read and understand this section carefully before operating the engine. All operators, no matter how much experience they may have, should read this and other related manuals before operating the engine or any equipment attached to it. It is the owner's obligation to provide all operators with this information and instruct them on safe operation.

Be sure to observe the following for safe operation.

1. OBSERVE SAFETY INSTRUCTIONS

- A Read and understand carefully this "OPERATOR'S MANUAL" and "LABELS ON THE ENGINE" before attempting to start and operate the engine.
- A Learn how to operate and work safely. Know your equipment and its limitations. Always keep the engine in good condition.
- A Before allowing other people to use your engine, explain how to operate and have them read this manual before operation.
- A DO NOT modify the engine. UNAUTHORIZED MODIFICATIONS to the engine may impair the function and/or safety and affect engine life. If the engine does not perform properly, consult your local Kubota Engine Distributor first.



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2. WEAR SAFE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

- A DO NOT wear loose, torn or bulky clothing around the machine that may catch on working controls and projections or into fans, pulleys and other moving parts causing personal injury.
- A Use additional safety items- PPE, e.g. hard hat, safety protection, safety goggles, gloves, etc., as appropriate or required.
- A DO NOT operate the machine or any equipment attached to it while under the influence of alcohol, medication, or other drugs, or while fatigued.
- A DO NOT wear radio or music headphones while operating the engine.



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CONTENTS

▲SAFE OPERATION	1
SERVICING OF THE ENGINE	1
NAMES OF PARTS	2
PRE-OPERATION CHECK.....	3
BREAK-IN.....	3
DAILY CHECK.....	3
OPERATING THE ENGINE	4
STARTING THE ENGINE (NORMAL).....	4
COLD WEATHER STARTING	5
STOPPING THE ENGINE	6
CHECKS DURING OPERATION	6
Radiator Cooling water (Coolant)	6
Oil pressure lamp	6
Fuel	7
Color of exhaust	7
Immediately stop the engine if,.....	7
REVERSED ENGINE REVOLUTION AND REMEDIES	7
How to tell when the engine starts running backwards	7
Remedies	7
MAINTENANCE	8
SERVICE INTERVALS	9
PERIODIC SERVICE	11
FUEL	11
Fuel level check and refueling.....	11
Air bleeding the fuel system	12
Checking the fuel pipes	12
Cleaning the fuel filter pot.....	13
ENGINE OIL	13
Checking level and adding engine oil	13
Changing engine oil.....	14
Replacing the oil filter cartridge	15
RADIATOR	15
Checking coolant level, adding coolant	15
Changing coolant	16
Checking radiator hoses and clamp bands	17
Precaution at overheating	17
Cleaning radiator core (outside)	17
Cleaning the radiator (inside)	17
Anti-freeze	.. 17
AIR CLEANER.....	18
ELECTRIC WIRING	19
FAN BELT	19
Adjusting Fan Belt Tension	19
CARRIAGE AND STORAGE	20
CARRIAGE	20
STORAGE	20

TROUBLESHOOTING	21
SPECIFICATIONS	23
WIRING DIAGRAMS.....	25



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1AAACAAAP008B

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- A DO NOT wear radio or music headphones while operating the engine.



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3. CHECK BEFORE STARTING & OPERATING THE ENGINE

- A Be sure to inspect the engine before operation. Do not operate the engine if there is something wrong with it. Repair it immediately.
- A Ensure all guards and shields are in place before operating the engine. Replace any that are damaged or missing.
- A Check to see that you and others are a safe distance from the engine before starting.
- A Always keep the engine at least 3 feet (1 meter) away from buildings and other facilities.
- A DO NOT allow children or livestock to approach the machine while the engine is running.
- A DO NOT start the engine by shorting across starter terminals. The machine may start in gear and move. Do not bypass or defeat any safety devices.



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4. KEEP THE ENGINE AND SURROUNDINGS CLEAN

- A Be sure to stop the engine before cleaning.
- A Keep the engine clean and free of accumulated dirt, grease and trash to avoid a fire. Store flammable fluids in proper containers and cabinets away from sparks and heat.
- A Check for and repair leaks immediately.
- A DO NOT stop the engine without idling; Allow the engine to cool down, first. Keep the engine idling for about 5 minutes before stopping unless there is a safety problem that requires immediate shut down.



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5. SAFE HANDLING OF FUEL AND LUBRICANTS -KEEP AWAY FROM FIRE

- A Always stop the engine before refueling and/or lubricating.
- A DO NOT smoke or allow flames or sparks in your work area. Fuel is extremely flammable and explosive under certain conditions.
- A Refuel at a well ventilated and open place. When fuel and/or lubricants are spilled, refuel after letting the engine cool down.
- A DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause a fire or severe engine damage.
- A Do not use unapproved containers e.g. buckets, bottles, jars. Use approved fuel storage containers and dispensers.



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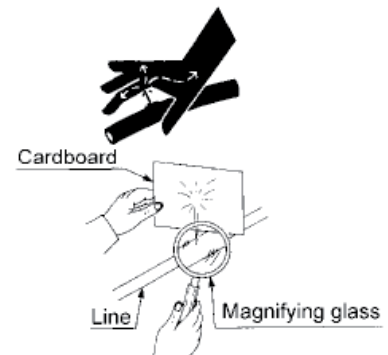
6. EXHAUST GASES & FIRE PREVENTION

- A Engine exhaust fumes can be very harmful if allowed to accumulate. Be sure to run the engine in a well ventilated location and where there are no people or livestock near the engine.
- A The exhaust gas from the muffler is very hot. To prevent a fire, do not expose dry grass, mowed grass, oil or any other combustible materials to exhaust gas. Keep the engine and muffler clean at all times.
- A To avoid a fire, be alert for leaks of flammable substances from hoses and lines. Be sure to check for leaks from hoses or pipes, such as fuel and hydraulic fluid by following the maintenance check list.
- A To avoid a fire, do not short across power cables and wires. Check to see that all power cables and wirings are in good condition. Keep all electrical connections clean. Bare wire or frayed insulation can cause a dangerous electrical shock and personal injury.



7. ESCAPING FLUID

- A Relieve all pressure in the air, the oil and the cooling systems before disconnecting any lines, fittings or related items.
- A Be cautious of possible pressure relief when disconnecting any device from a pressurized system that utilizes pressure. DO NOT check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- A Escaping fluid under pressure has sufficient force to penetrate skin causing serious personal injury.
- A Fluid escaping from pinholes may be invisible. Use a piece of cardboard or wood to search for suspected leaks: do not use hands and body. Use safety goggles or other eye protection when checking for leaks.
- A If injured by escaping fluid, see a medical doctor immediately. This fluid can produce gangrene or severe allergic reaction.



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8. CAUTIONS AGAINST BURNS & BATTERY EXPLOSION

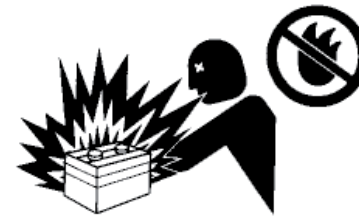
- A To avoid burns, be cautious of hot components, e.g. muffler, muffler cover, radiator, hoses, engine body, coolants, engine oil, etc. during operation and after the engine has been shut off.
- A DO NOT remove the radiator cap while the engine is running or immediately after stopping. Otherwise hot water will spout out from the radiator. Wait until the radiator is completely cool to the touch before removing the cap. Wear safety goggles.
- A Be sure to close the coolant drain valve, secure the pressure cap, and fasten the pipe band before operating. If these parts are taken off, or loosened, it will result in serious personal injury.
- A The battery presents an explosive hazard. When the battery is being charged, hydrogen and oxygen gases are extremely explosive.
- A DO NOT use or charge the battery if its fluid level is below the LOWER mark.
Otherwise, the component parts may deteriorate earlier than expected, which may shorten the service life or cause an explosion. Immediately, add distilled water until the fluid level is between the UPPER and LOWER marks.
- A Keep sparks and open flames away from the battery, especially during charging. DO NOT strike a match near the battery.
- A DO NOT check the battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer.
- A DO NOT charge a frozen battery. There is a risk of explosion. When frozen, warm the battery up to at least 16°C (61°F).



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9. KEEP HANDS AND BODY AWAY FROM ROTATING PARTS

- A Be sure to stop the engine before checking or adjusting the belt tension and cooling fan.
- A Keep your hands and body away from rotating parts, such as the cooling fan, V-belt, fan drive pulley or flywheel. Contact with rotating parts can cause severe personal injury.
- A DO NOT run the engine without safety guards. Install safety guards securely before operation.



1ABAAAAAP1470

10. ANTI-FREEZE & DISPOSAL OF FLUIDS

- A Anti-freeze contains poison. Wear rubber gloves to avoid personal injury. In case of contact with skin, wash it off immediately.
- A DO NOT mix different types of Anti-freeze. The mixture can produce a chemical reaction causing harmful substances. Use approved or genuine KUBOTA Anti-freeze.
- A Be mindful of the environment and the ecology. Before draining any fluids, determine the correct way to dispose of them. Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.
- A When draining fluids from the engine, place a suitable container underneath the engine body.
- A DO NOT pour waste onto the ground, down a drain, or into any water source. Dispose of waste fluids according to environmental regulations.



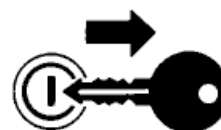
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11. CONDUCTING SAFETY CHECKS & MAINTENANCE

- A When inspecting the engine or servicing, place the engine on a large flat surface. DO NOT work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or the correct stands to support the engine before servicing.
- A Disconnect the battery from the engine before conducting service. Put a "DO NOT OPERATE!" tag on the key switch to avoid accidental starting.
- A To avoid sparks from an accidental short circuit always disconnect the battery's ground cable (-) first and reconnect it last.
- A Be sure to stop the engine and remove the key when conducting daily and periodic maintenance, service and cleaning.
- A Check or conduct maintenance after the engine, coolant, muffler, or muffler cover have cooled off completely.
- A Always use the appropriate tools and fixtures. Verify that they are in good condition before performing any service work. Make sure you understand how to use them before service.
- A Use ONLY correct engine barring techniques for manually rotating the engine. DO NOT attempt to rotate the engine by pulling or prying on the cooling fan and V-belt. This practice can cause serious personal injury or premature damage to the cooling fan and belt.



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- A Replace fuel pipes and lubricant pipes with their hose clamps every 2 years or earlier whether they are damaged or not. They are made of rubber and age gradually.
- A When servicing is performed together by two or more persons, take care to perform all work safely.
- A Keep a first aid kit and fire extinguisher handy at all times.

12. WARNING AND CAUTION LABELS



13. CARE OF WARNING AND CAUTION LABELS

1. Keep warning and caution labels clean and free from obstructing material.
2. Clean warning and caution labels with soap and water, dry with a soft cloth.
3. Replace damaged or missing warning and caution labels with new labels from your local KUBOTA dealer.
4. If a component with warning and caution label(s) affixed is replaced with a new part, make sure the new label(s) is (are) attached in the same location(s) as the replaced component.
5. Mount new warning and caution labels by applying to a clean dry surface and pressing any bubbles to the outside edge.

SERVICING OF THE ENGINE

Your dealer is interested in your new engine and has the desire to help you get the most value from it. After reading this manual thoroughly, you will find that you can do some of the regular maintenance yourself.

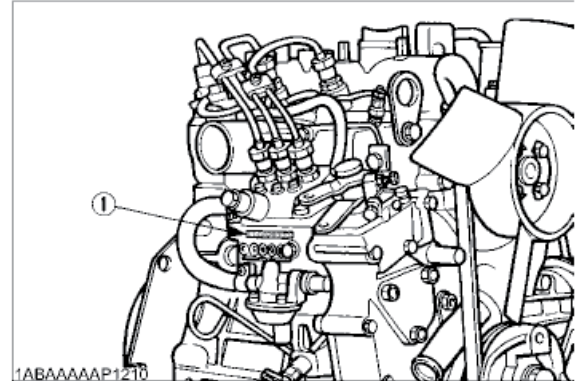
However, when in need of parts or major service, be sure to see your KUBOTA dealer.

For service, contact the KUBOTA Dealership from which you purchased your engine or your local KUBOTA dealer.

When in need of parts, be prepared to give your dealer the engine serial number.

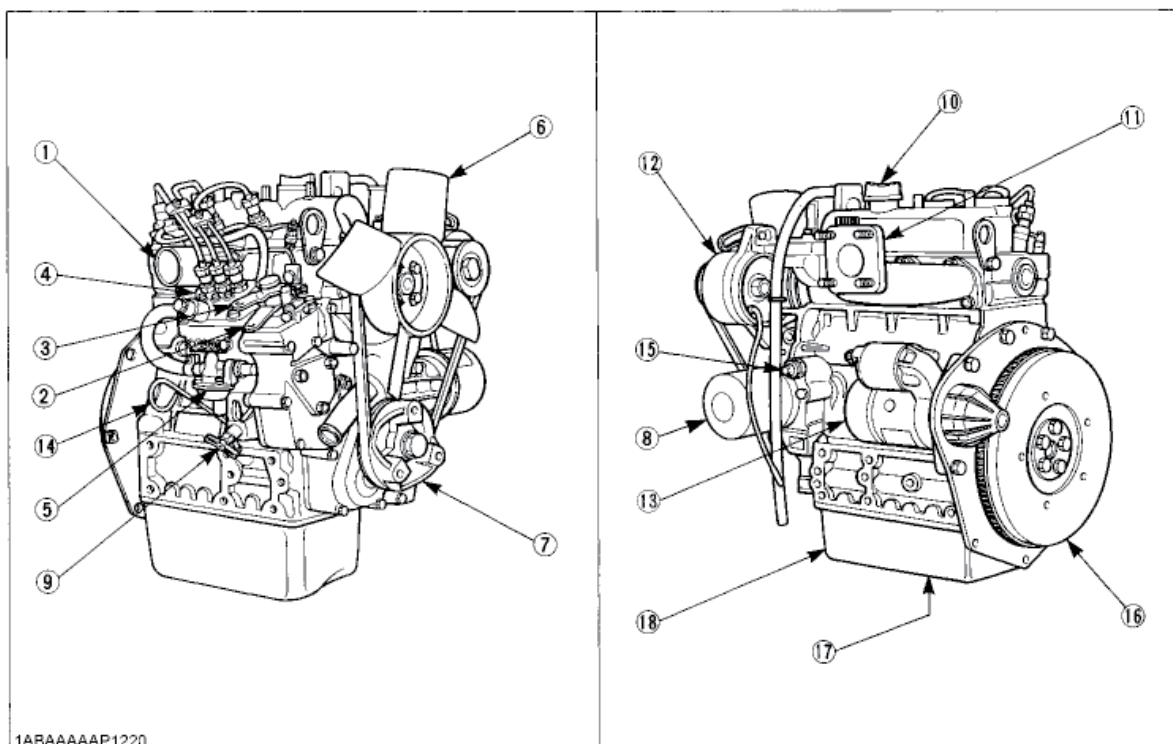
Locate the serial number now and record them in the space provided.

	Type	Serial No.
Engine		
Date of Purchase		
Name of Dealer		
(To be filled in by purchaser)		



(1) Engine serial number

NAMES OF PARTS



1ABAAAAAP1220

- (1) Intake manifold
- (2) Speed control lever
- (3) Engine stop lever
- (4) Injection pump
- (5) Fuel feed pump
- (6) Cooling fan
- (7) Fan drive pulley
- (8) Oil filter cartridge
- (9) Water drain cock

- (10) Oil filler plug
- (11) Exhaust manifold
- (12) Alternator
- (13) Starter
- (14) Oil level gauge
- (15) Oil pressure switch
- (16) Flywheel
- (17) Oil drain plug
- (18) Oil pan

PRE-OPERATION CHECK

BREAK-IN

During the engine break-in period, observe the following by all means:

1. Change engine oil and oil filter cartridge after the first 50 hours of operation. (See "ENGINE OIL" in "PERIODIC SERVICE" section.)
2. When ambient temperature is low, operate the machine after the engine has been completely warmed up.

DAILY CHECK

To prevent trouble from occurring, it is important to know the conditions of the engine well. Check it before starting.



CAUTION

To avoid personal injury:

- A Be sure to install shields and safeguards attached to the engine when operating.
- A Stop the engine at a flat and wide space when checking.
- A Keep dust or fuel away from the battery, wiring, muffler and engine to prevent a fire. Check and clear them before operating everyday. Pay attention to the heat of the exhaust pipe or exhaust gas so that it can not ignite trash.

Item		Ref. page
1. Parts which had trouble in previous operation		-
2. By walking around the machine	(1) Oil or water leaks	13 to 15
	(2) Engine oil level and contamination	13
	(3) Amount of fuel	11
	(4) Amount of coolant	15
	(5) Dust in air cleaner dust cup	18
	(6) Damaged parts and loosened bolts and nuts	-
3. By inserting the key into the starter switch	(1) Proper functions of meters and pilot lamps; no stains on these parts	-
	(2) Proper function of glow lamp timer	-
4. By starting the engine	(1) Color of exhaust fumes	7
	(2) Unusual engine noise	7

OPERATING THE ENGINE

STARTING THE ENGINE (NORMAL)



CAUTION

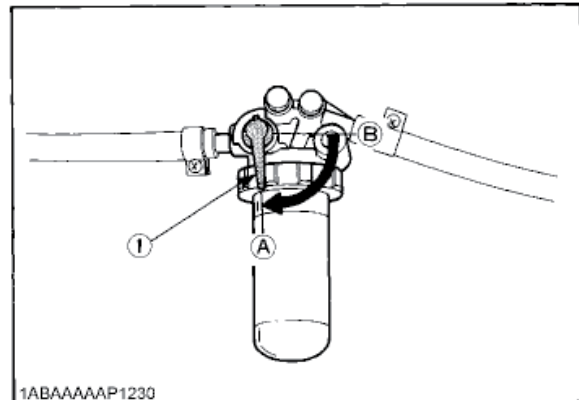
To avoid personal injury:

- A Do not allow children to approach the machine while the engine is running.
- A Be sure to install the machine on which the engine is installed, on a flat place.
- A Do not run the engine on gradients.
- A Do not run the engine in an enclosed area. Exhaust gas can cause air pollution and exhaust gas poisoning.
- A Keep your hands away from rotating parts (such as fan, pulley, belt, flywheel etc.) during operation.
- A Do not operate the machine while under the influence of alcohol or drugs.
- A Do not wear loose, torn or bulky clothing around the machine. It may catch on moving parts or controls, leading to the risk of accident. Use additional safety items, e.g. hard hat, safety boots or shoes, eye and hearing protection, gloves, etc., as appropriate or required.
- A Do not wear radio or music headphones while operating engine.
- A Check to see if it is safe around the engine before starting.
- A Reinstall safeguards and shields securely and clear all maintenance tools when starting the engine after maintenance.

IMPORTANT :

- A Do not use ether or any starting fluid for starting the engine, or a severe damage will occur.
- A When starting the engine after a long storage (of more than 3 months), first set the stop lever to the "STOP" position and then activate the starter for about 10 seconds to allow oil to reach every engine part.

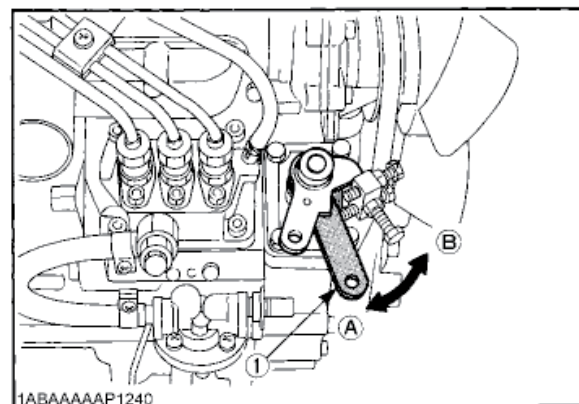
1. Set the fuel lever to "ON" position.



(1) Fuel lever

(A) "ON"
(B) "OFF"

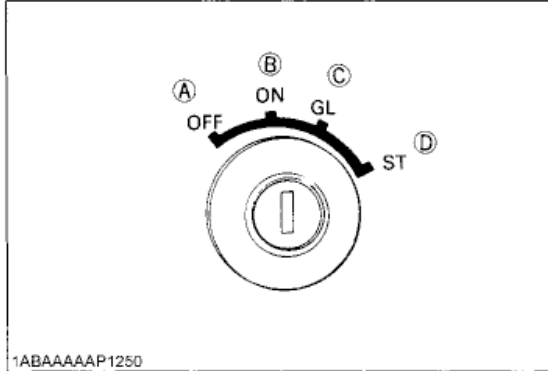
2. Place the engine stop lever in the "START" position.
3. Place the speed control lever at more than half "OPERATION"



(1) Speed Control lever

(A) "OPERATION"
(B) "IDLING"

4. Insert the key into the key switch and turn it to the "OPERATION" position.



(A) "OFF" SWITCHED OFF
(B) "ON" OPERATION
(C) "GL" PREHEATING
(D) "ST" STARTING

5. Turn the starter switch to the "PREHEATING" position to allow the glow lamp to redden.
6. Turn the key to the "STARTING" position and the engine should start. Release the key immediately when the engine starts.
7. Check to see that the oil pressure lamp and charge lamp are off. If the lamps are still on, immediately stop the engine, and determine the cause.
(See "CHECKS DURING OPERATION" in "OPERATING THE ENGINE" section.)

NOTE :

- A If the oil pressure lamp should be still on, immediately stop the engine and check;
- if there is enough engine oil.
 - if the engine oil has dirt in it.
 - if the wiring is faulty.

8. Warm up the engine at medium speed without load.

IMPORTANT :

- A If the glow lamp should redden too quickly or too slowly, immediately ask your KUBOTA dealer to check and repair it.
- A If the engine does not catch or start at 10 seconds after the starter switch is set at "STARTING" position, wait for another 30 seconds and then begin the engine starting sequence again. Do not allow the starter motor to run continuously for more than 20 seconds.

COLD WEATHER STARTING

If the ambient temperature is below* -5 °C (23 °F) and the engine is very cold, start it in the following manner: Take steps (1) through (4) left.

5. Turn the key to the "PREHEATING" position and keep it there for a certain period mentioned below.

IMPORTANT :

- A Shown below are the standard preheating times for various temperatures. This operation, however, is not required, when the engine is warmed up.

Ambient temperature	Preheating time	
	Ordinary heat type	With glow lamp timer
Above 10 °C (50 °F)	NO NEED	See NOTE:
10 °C (50 °F) to -5 °C (23 °F)	Approx. 5 seconds	
*Below -5 °C (23 °F)	Approx. 10 seconds	
Limit of continuous use	20 seconds	

NOTE :

- A In case of installing standard glow lamp, glow lamp goes off after about 6 seconds, when the starter switch key is turned to the "PREHEATING" position. However if necessary, keep the starter switch key at the "PREHEATING" position for longer time, according to the left recommendation.

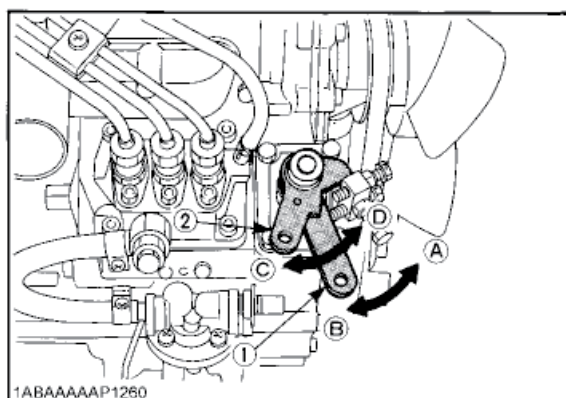
6. Turn the key to the "STARTING" position and the engine should start.
(If the engine fails to start after 10 seconds, turn off the key for 5 to 30 seconds. Then repeat steps (5) and (6).)

IMPORTANT :

- A Do not allow the starter motor to run continuously for more than 20 seconds.
- A Be sure to warm up the engine, not only in winter, but also in warmer seasons. An insufficiently warmed-up engine can shorten its service life.
- A When there is fear of temperature dropping below -15 °C (5 °F) detach the battery from the machine, and keep it indoors in a safe area, to be reinstalled just before the next operation.

STOPPING THE ENGINE

1. Return the speed control lever to low idle, and run the engine under idling conditions.
2. Set the engine stop lever to the "STOP" position.
3. With the starter switch placed to the "SWITCHED OFF" position, remove the key. (Be sure to return the engine stop lever to the "START" position to be ready for the next start.)



(1) Speed control lever
(2) Engine stop lever

(A) "IDLING"
(B) "OPERATION"
(C) "START"
(D) "STOP"

CHECKS DURING OPERATION

While running, make the following checks to see that all parts are work correctly.

B Radiator Cooling water (Coolant)



WARNING

To avoid personal injury:

- A Do not remove radiator cap until coolant temperature is well below its boiling point. Then loosen cap slightly to the stop position, to relieve any pressure, before removing cap completely.

If the coolant temperature warning lamp lights up or if steam or coolant does not stop squirting from the radiator overflow pipe, turn off the load and keep the engine idling (COOLING-DOWN) for at least 5 minutes to let it cool down gradually. Then stop the engine and take the following inspection and servicing.

1. Check to see if the coolant runs short or if there is any coolant leak;
2. Check to see if there is any obstacle around the cooling air inlet or outlet;
3. Check to see if there is any dirt or dust between radiator fin and tube;
4. Check to see if the fan belt is too loose; and
5. Check to see if radiator water pipe is clogged.

B Oil pressure lamp

The lamp lights up to warn the operator that the engine oil pressure has dropped below the prescribed level. If this should happen during operation or should not go off even after the engine is accelerated more than 1000rpm, immediately stop the engine and check the following:

1. Engine oil level (See "ENGINE OIL" in "PERIODIC SERVICE" section.)

B Fuel**CAUTION**

To avoid personal injury:

A Fluid escaping from pinholes may be invisible. Do not use hands to search for suspected leaks; Use a piece of cardboard or wood, instead. If injured by escaping fluid, see a medical doctor at once. This fluid can produce gangrene or a severe allergic reaction.

A Check any leaks from fuel pipes or fuel injection pipes. Use eye protection when checking for leaks.

Be careful not to empty the fuel tank. Otherwise air may enter the fuel system, requiring fuel system bleeding. (See "FUEL" in "PERIODIC SERVICE" section.)

B Color of exhaust

While the engine is run within the rated output range:

A The color of exhaust remains colorless.

A If the output slightly exceeds the rated level, exhaust may become a little colored with the output level kept constant.

A If the engine is run continuously with dark exhaust emission, it may lead to trouble with the engine.

B Immediately stop the engine if;

A The engine suddenly slows down or accelerates.

A Unusual noises are suddenly heard.

A Exhaust fumes suddenly become very dark.

A The oil pressure lamp or the water temperature alarm lamp lights up.

REVERSED ENGINE REVOLUTION AND REMEDIES**CAUTION**

To avoid personal injury:

A Reversed engine operation can make the machine reverse and run it backwards. It may lead to serious trouble.

A Reversed engine operation may make exhaust gas gush out into the intake side and ignite the air cleaner; It could catch fire.

Reversed engine revolution must be stopped immediately since engine oil circulation is cut quickly, leading to serious trouble.

B How to tell when the engine starts running backwards

1. Lubricating oil pressure drops sharply. Oil pressure warning light, if used, will light.
2. Since the intake and exhaust sides are reversed, the sound of the engine changes, and exhaust gas will come out of the air cleaner.
3. A louder knocking sound will be heard when the engine starts running backwards.

B Remedies

1. Immediately set the engine stop lever to "STOP" position to stop the engine.
2. After stopping the engine, check the air cleaner, intake rubber tube and other parts, and then replace parts as needed.

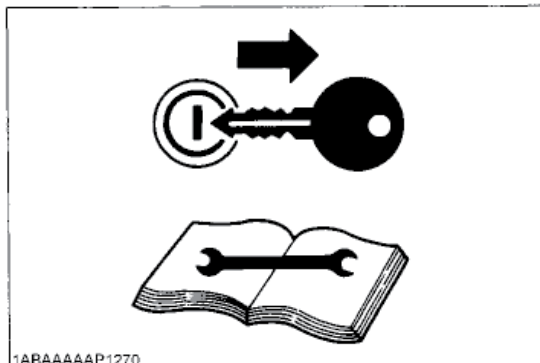
MAINTENANCE



CAUTION

To avoid personal injury:

- A Be sure to conduct daily checks, periodic maintenance, refueling or cleaning on a level surface with the engine shut off and remove the key.
- A Before allowing other people to use your engine, explain how to operate, and have them read this manual before operation.
- A When cleaning any parts, do not use gasoline but use regular cleanser.
- A Always use proper tools, that are in good condition. Make sure you understand how to use them, before performing any service work.
- A When installing, be sure to tighten all bolts lest they should be loose. Tighten the bolts by the specified torque.
- A Do not put any tools on the battery, or battery terminals may short out. Severe burns or fire could result. Detach the battery from the engine before maintenance.
- A Do not touch muffler or exhaust pipes while they are hot; Severe burns could result.



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1ABAAAAAP1280

SERVICE INTERVALS

Observe the following for service and maintenance.

Interval	Item	Ref. page		
Every 50 hours	Check of fuel pipes and clamp bands	12		@
See NOTE	Change of engine oil (depending on the oil pan)	13,14	Ⓒ	
Every 100 hours	Cleaning of air cleaner element	18	*1	@
	Cleaning of fuel filter	13		
	Check of fan belt tightness	19		
Every 200 hours	Replacement of oil filter cartridge (depending on the oil pan)	15	Ⓒ	
	Check of intake air line	-		@
Every 200 hours of operation or six months	Check of radiator hoses and clamp bands	17		
Every 400 hours	Replacement of fuel filter element	13		@
Every 500 hours	Removal of sediment in fuel tank	-		
	Cleaning of water jacket (radiator interior)	-		
	Replacement of fan belt	19		
Every year or every 6 cleanings of air cleaner element	Replacement of air cleaner element	18	*2	@
Every 800 hours	Check of valve clearance	-	*3	
Every 1500 hours	Check of fuel injection nozzle injection pressure	-	*3	@
Every 3000 hours	Check of injection pump	-	*3	@
Every two years	Replacement of radiator hoses and clamp bands	17		
	Replacement of fuel pipes and clamps	12	*3	@
	Change of radiator coolant (L.L.C.)	15		
	Replacement of intake air line	-	*4	@

IMPORTANT :

A The jobs indicated by ☐ must be done after the first 50 hours of operation.

*1 Air cleaner should be cleaned more often in dusty conditions than in normal conditions.

*2 After 6 times of cleaning.

*3 Consult your local KUBOTA Dealer for this service.

*4 Replace only if necessary.

A The items listed above (@ marked) are registered as emission related critical parts by KUBOTA in the U.S. EPA nonroad emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instruction.

Please see the Warranty Statement in detail.

NOTE :

A Changing interval of Engine oil and oil filter cartridge.

		*Oil pan depth	
		*101 mm (3.98 in.)	121 mm (4.76 in.)
Z602-E D902-E	Engine oil	50 Hrs (Initial)	-
		100 Hrs	
	Oil filter cartridge	200 Hrs	
Z482-E D662-E D722-E	Engine oil	50 Hrs (Initial)	
		75 Hrs	100 Hrs
	Oil filter cartridge	150 Hrs	200 Hrs
D782-E	Engine oil	-	50 Hrs (Initial)
			100 Hrs
	Oil filter cartridge		200 Hrs

* 101 mm (3.98 in.) oil pan depth is optional for Z482-E, D662-E, D722-E.
(Standard replacement interval)

A API service classification: above CD grade

A Ambient temperature: below 35 °C (95 °F)

A Lubricating oil

With the emission control now in effect, the CF-4 and CG-4 lubricating oils have been developed for use of a low-sulfur fuel on on-road vehicle engines. When an off-road vehicle engine runs on a high-sulfur fuel, it is advisable to employ the CF, CD or CE lubricating oil with a high total base number. If the CF-4 or CG-4 lubricating oil is used with a high-sulfur fuel, change the lubricating oil at shorter intervals.

A Lubricating oil recommended when a low-sulfur or high-sulfur fuel is employed.

☐ recommendable X : Not recommendable

Lubricating oil class	Fuel		Remarks
	Low-sulfur	High-sulfur	
CF	☐	☐	TBN ≥10
CF-4	☐	X	
CG-4	☐	X	

PERIODIC SERVICE

FUEL

Fuel is flammable and can be dangerous. You should handle fuel with care.



CAUTION

To avoid personal injury:

- A Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.
- A Be careful not to spill fuel during refueling. If fuel should spill, wipe it off at once, or it may cause a fire.
- A Do not fail to stop the engine before refueling. Keep the engine away from the fire.
- A Be sure to stop the engine while refueling or bleeding and when cleaning or changing fuel filter or fuel pipes. Do not smoke when working around the battery or when refueling.
- A Check the fuel systems at a well ventilated and wide place.
- A When fuel and lubricant are spilled, refuel after letting the engine cool off.
- A Always keep spilled fuel and lubricant away from engine.

B Fuel level check and refueling

1. Check to see that the fuel level is above the lower limit of the fuel level gauge.
2. If the fuel is too low, add fuel to the upper limit. Do not overfill.

No.2-D is a distillate fuel oil of lower volatility for engines in industrial and heavy mobile service.

(SAE J313 JUN87)

Grade of Diesel Fuel Oil According to ASTM D975

Flash Point, °C (°F)	Water and Sediment, volume %	Carbon Residue on, 10 percent Residuum, %	Ash, weight %
Min	Max	Max	Max
52 (125)	0.05	0.35	0.01

Distillation Temperatures, °C (°F) 90% Point		Viscosity Kinematic cSt or mm ² /s at 40°C		Viscosity Saybolt, SUS at 37.8 °C (100 °F)	
Min	Max	Min	Max	Min	Max
282 (540)	338 (640)	1.9	4.1	32.6	40.1

Sulfur, weight %	Copper Strip Corrosion	Cetane Number
Max	Max	Min
0.50	No. 3	40

The cetane number is required not less than 45.

IMPORTANT :

- A Be sure to use a strainer when filling the fuel tank, or dirt or sand in the fuel may cause trouble in the fuel injection pump.
- A For fuel, always use diesel fuel. You are required not to use alternative fuel, because its quality is unknown or it may be inferior in quality. Kerosene, which is very low in cetane rating, adversely affects the engine. Diesel fuel differs in grades depending on the temperature.
- A Be careful not to let the fuel tank become empty, or air can enter the fuel system, necessitating bleeding before next engine start.

B Air bleeding the fuel system



CAUTION

To avoid personal injury;

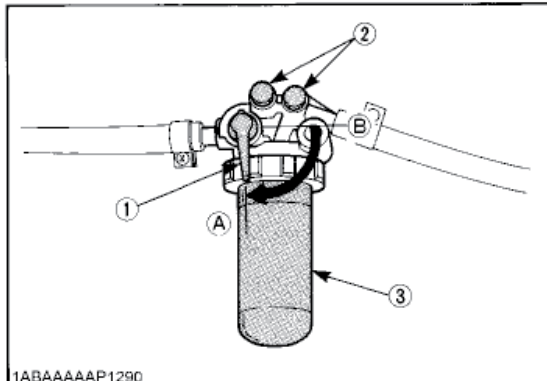
- A Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.

Air bleeding of the fuel system is required if;

- A after the fuel filter and pipes have been detached and refitted;
- A after the fuel tank has become empty; or
- A before the engine is to be used after a long storage.

[PROCEDURE]

1. Fill the fuel tank to the fullest extent. Open the fuel filter lever.
2. Loosen air vent plug of the fuel filter a few turns.
3. Screw back the plug when bubbles do not come up any more.
4. Open the air vent plug on top of the fuel injection pump.
5. Retighten the plug when bubbles do not come up any more.



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- (1) Fuel filter lever
- (2) Air vent plug
- (3) Fuel filter pot

- (A) "ON"
- (B) "OFF"

B Checking the fuel pipes



CAUTION

To avoid personal injury;

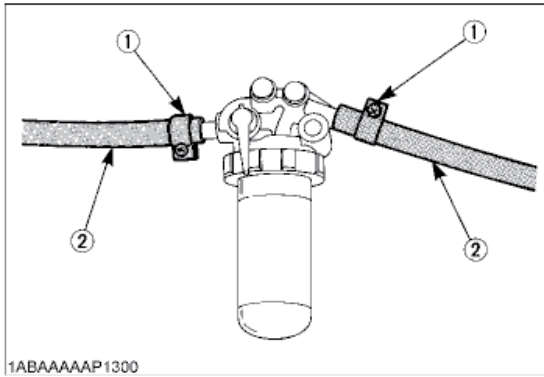
- A Check or replace the fuel pipes after stopping the engine. Broken fuel pipes can cause fires.

Check the fuel pipes every 50 hours of operation. When if;

1. If the clamp band is loose, apply oil to the screw of the band, and tighten the band securely.
2. If the fuel pipes, made of rubber, become worn out, replace them and clamp bands every 2 years.
3. If the fuel pipes and clamp bands are found worn or damaged before 2 years' pass, replace or repair them at once.
4. After replacement of the pipes and bands, air-bleed the fuel system.

IMPORTANT :

- A When the fuel pipes are not installed, plug them at both ends with clean cloth or paper to prevent dirt from entering. Dirt in the pipes can cause fuel injection pump malfunction.



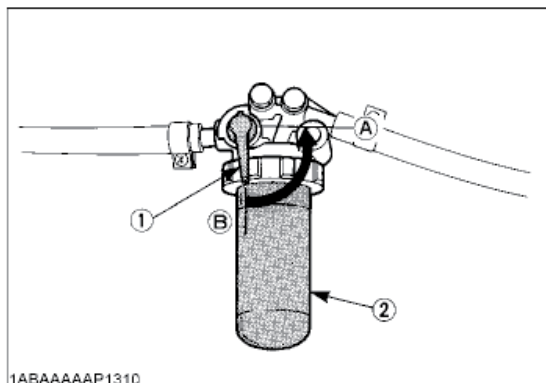
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- (1) Clamp band
- (2) Fuel pipe

B Cleaning the fuel filter pot

Every 100 hours of operation, clean the fuel filter in a clean place to prevent dust intrusion.

1. Close the fuel filter lever.



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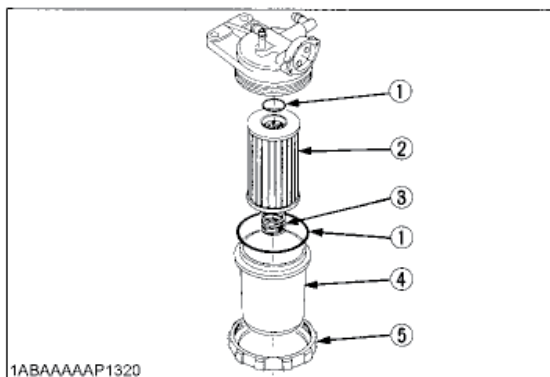
- (1) Fuel filter lever
(2) Fuel filter pot

(A) "OFF"
(B) "ON"

2. Remove the top cap, and rinse the inside with diesel fuel.
3. Take out the element, and rinse it with diesel fuel.
4. After cleaning, reinstall the fuel filter, keeping out of dust and dirt.
5. Air-bleed the injection pump.

IMPORTANT :

- A Entrance of dust and dirt can cause a malfunction of the fuel injection pump and the injection nozzle. Wash the fuel filter cup periodically.



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- (1) O ring
(2) Filter element
(3) Spring
(4) Filter bowl
(5) Screw ring

ENGINE OIL



CAUTION

To avoid personal injury:

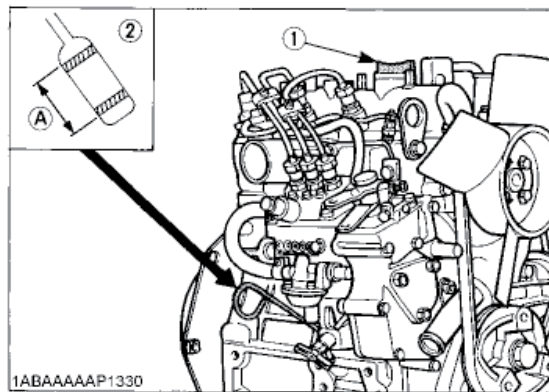
- A Be sure to stop the engine before checking and changing the engine oil and the oil filter cartridge.
- A Do not touch muffler or exhaust pipes while they are hot; Severe burns could result. Always stop the engine and allow it to cool before conducting inspections, maintenance, or for a cleaning procedure.
- A Contact with engine oil can damage your skin. Put on gloves when using engine oil. If you come in contact with engine oil, wash it off immediately.

NOTE :

- A Be sure to inspect the engine, locating it on a horizontal place. If placed on gradients accurately, oil quantity may not be measured.
- A Be sure to keep the oil level between upper and lower limits of the oil gauge. Too much oil may cause a drop in output or excessive blow-by gas. On the closed breather type engine in which mist is sucked through port, too much oil may cause oil hammer. While too little oil, may seize the engine's rotating and sliding parts. (The closed breather is an option.)

B Checking level and adding engine oil

1. Check the engine oil level before starting or more than 5 minutes after stopping the engine.
2. Remove the oil level gauge, wipe it clean and reinstall it.
3. Take the oil level gauge out again, and check the oil level.



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- (1) Oil filler plug
(2) Oil level gauge

[Lower end of oil level gauge]
(A): Engine oil level within this range is proper.

4. If the oil level is too low, remove the oil filler plug, and add new oil to the prescribed level.
5. After adding oil, wait more than 5 minutes and check the oil level again. It takes same time for the oil to come down to the oil pan.

Engine oil quantity

Models	*Oil pan depth	
	*101 mm (3.98 in.)	121 mm (4.76 in.)
Z482-E	2.1 L (0.55 U.S.gals.)	2.5 L (0.66 U.S.gals.)
D662-E D722-E	3.2 L (0.84 U.S.gals.)	3.8 L (1.0 U.S.gals.)
D782-E	-	3.6 L (0.95 U.S.gals.)
Z602-E	2.5 L (0.66 U.S.gals.)	-
D902-E	3.7 L (0.98 U.S.gals.)	-

*101 mm (3.98 in.) oil pan depth is optional.

Oil quantities shown are for standard oil pans.

IMPORTANT :

- A Engine oil should be MIL-L-2104C or have properties of API classification CD grades or higher.
Change the type of engine oil according to the ambient temperature.

above 25 °C (77 °F)	SAE30 or SAE10W-30 SAE15W-40
0° C to 25 °C (32 °F to 77 °F)	SAE20 or SAE10W-30 SAE15W-40
below 0° C (32 °F)	SAE10W or SAE10W-30 SAE15W-40

- A When using oil different from the previous one, be sure to drain all the previous oil before adding the new engine oil.

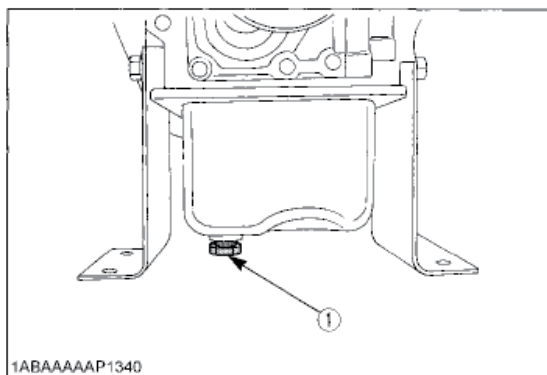
B Changing engine oil



CAUTION

To avoid personal injury:

- A Be sure to stop the engine before draining engine oil.
- A When draining engine oil, place some container underneath the engine and dispose it according to local regulations.
- A Do not drain oil after running the engine. Allow engine to cool down sufficiently.
1. Change oil after the initial 50 hours of operation and every 100 hours thereafter.
 2. Remove the drain plug at the bottom of the engine, and drain all the old oil. Drain oil easier and completely while the engine is hot.



(1) Oil drain plug

3. Add new engine oil up to the upper limit of the oil level gauge.

B Replacing the oil filter cartridge

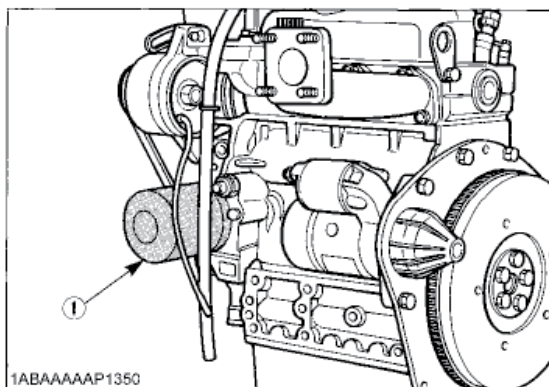


CAUTION

To avoid personal injury:

- A Be sure to stop the engine before changing the oil filter cartridge.
- A Allow engine to cool down sufficiently, oil can be hot and cause burns.

1. Replace the oil filter cartridge after the initial 50 hours of operation and every 200 hours thereafter.
2. Remove the old oil filter cartridge with a filter wrench.
3. Apply a film of oil to the gasket for the new cartridge.
4. Screw in the cartridge by hand. When the gasket contacts the seal surface, tighten the cartridge enough by hand. Because, if you tighten the cartridge with wrench, it will be tightened too much.



- (1) Oil filter cartridge
Remove with a filter wrench
(Tighten with your hand)

5. After the new cartridge has been replaced, the engine oil level normally decreases a little. Thus, run the engine for a while and check oil leaks through the seal before checking the engine oil level. Add oil if necessary.

NOTE :

- A Wipe off any oil sticking to the machine completely.

RADIATOR

Coolant will last for one day's work if filled all the way up before operation start. Make it a rule to check the coolant level before every operation.



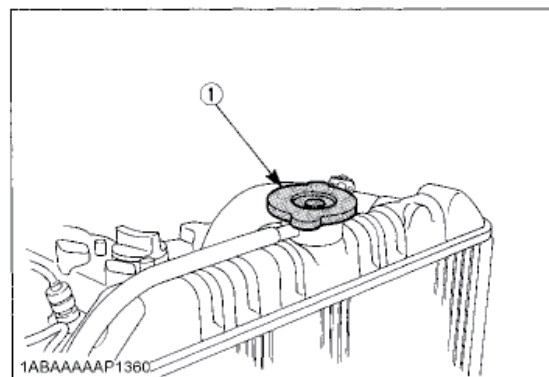
WARNING

To avoid personal injury:

- A Do not stop the engine suddenly, stop it after about 5 minutes of unloaded idling.
- A Work only after letting the engine and radiator cool off completely (more than 30 minutes after it has been stopped).
- A Do not remove the radiator cap while coolant is hot. When cool to the touch, rotate cap to the first stop to allow excess pressure to escape. Then remove cap completely. If overheats should occur, steam may gush out from the radiator or recovery tank; Severe burns could result.

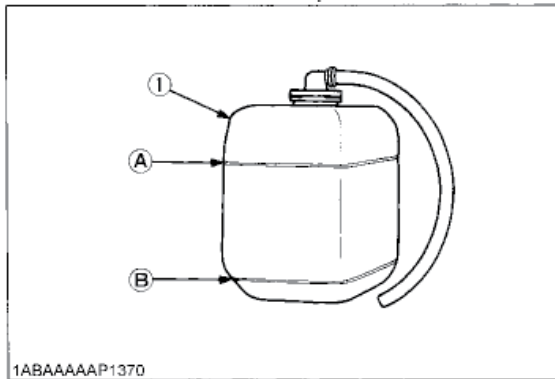
B Checking coolant level, adding coolant

1. Remove the radiator cap after the engine has completely cooled, and check to see that coolant reaches the supply port.



- (1) Radiator pressure cap

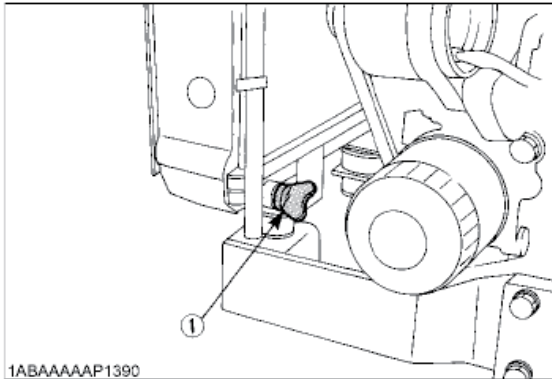
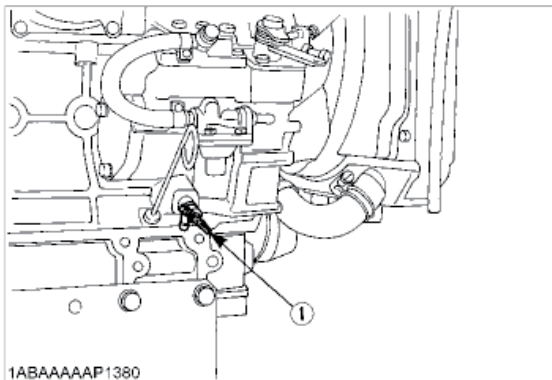
2. If the radiator is provided with a recovery tank, check the coolant level of the recovery tank. When it is between the "FULL" and "LOW" marks, the coolant will last for one day's work.



(1) Recovery tank

(A) "FULL"
(B) "LOW"

3. When the coolant level drops due to evaporation, add water only up to the full level.
4. Check to see that two drain cocks; one is at the crankcase side and the other is at the lower part of the radiator as figures below.



(1) Coolant drain cock

IMPORTANT :

- A If the radiator cap has to be removed, follow the caution and securely retighten the cap.
- A If coolant should be leak, consult your local KUBOTA dealer.
- A Make sure that muddy or sea water does not enter the radiator.
- A Use clean, fresh water and 50% anti-freeze to fill the recovery tank.
- A Do not refill recovery tank with coolant over the "FULL" level mark.
- A Be sure to close the radiator cap securely. If the cap is loose or improperly closed, coolant may leak out and decrease quickly.

B Changing coolant

1. To drain coolant, always open both drain cocks and simultaneously open the radiator cap as well. With the radiator cap kept closed, a complete drain of water is impossible.
2. Remove the overflow pipe of the radiator pressure cap to drain the recovery tank.
3. Prescribed coolant volume (U.S.gallons)

Models	Quantity
Z482-E, Z602-E	2.8L (0.74 U.S.gals.)
D662-E, D722-E D782-E, D902-E	3.1L (0.82 U.S.gals.)

NOTE :

- A Coolant quantities shown are for standard radiators.
- 4. An improperly tightened radiator cap or a gap between the cap and the seat quickens loss of coolant.
- 5. Coolant (Radiator cleaner and anti-freeze)

Season	Coolant
All seasons	Pure water and anti-freeze (See "Anti-freeze" in "RADIATOR" section.)

B Checking radiator hoses and clamp bands



CAUTION

To avoid personal injury:

- A Be sure to check radiator hoses and clamp bands periodically. If radiator hose is damaged or coolant leaks, overheats or severe burns could occur.

Check to see if radiator hoses are properly fixed every 200 hours of operation or 6 months, whichever comes first.

1. If hose clamps are loose or water leaks, tighten hose clamp securely.
 2. Replace hoses and tighten hose clamps securely, if radiator hoses are swollen, hardened or cracked.
- Replace hoses and hose clamps every 2 years or earlier, if checked and found that hoses are swollen, hardened or cracked.

B Precaution at overheating

The event that the coolant temperature is nearly or more than the boiling point is called "OVERHEATING". While running, make the following checks to see that all parts are working correctly. If anything is unusual, inspect it, referring to the relevant description in "MAINTENANCE" and "PERIODIC SERVICE" section.

C Coolant

If the coolant temperature warning lamp lights up or if steam or coolant does not stop squirting from the radiator overflow pipe, turn off the load and keep the engine idling (COOLING-DOWN) for at least 5 minutes to let it cool down gradually. Then stop the engine and take the following inspection and servicing.

1. Check to see if the coolant runs short or if there is any coolant leak;
2. Check to see if there is any obstacle around the cooling air inlet or outlet;
3. Check to see if there is any dirt or dust between radiator fins and tube;
4. Check to see if the fan belt is too loose; and
5. Check to see if radiator water pipe is clogged.

B Cleaning radiator core (outside)

If dust is between the fin and tube, wash it away with running water.

IMPORTANT :

- A Do not clean radiator with firm tools such as spatulas or screwdrivers. They may damage specified fin or tube. It can cause coolant leaks or decrease cooling performance.

B Cleaning the radiator (inside)

1. Clean up the coolant line inside in the following cases.
 - A As per the SERVICE INTERVALS list.
 - A When changing the coolant.
2. Use a radiator cleaning agent. This helps wash away scale deposits.

B Anti-freeze



CAUTION

To avoid personal injury:

- A When using anti-freeze, put on some protection such as rubber gloves (Anti-freeze contains poison.).
- A If should drink anti-freeze, throw up at once and take medical attention.
- A When anti-freeze comes in contact with the skin or clothing, wash it off immediately.
- A Do not mix different types of anti-freeze. The mixture can produce chemical reaction causing harmful substances.
- A Anti-freeze is extremely flammable and explosive under certain conditions. Keep fire and children away from anti-freeze.
- A When draining fluids from the engine, place some container underneath the engine body.
- A Do not pour waste onto the grounds, down a drain, or into any water source.
- A Also, observe the relevant environmental protection regulations when disposing of anti-freeze.

Always use a 50/50 mix of long-life coolant and clean soft water in KUBOTA engines.

Contact KUBOTA concerning coolant for extreme conditions.

1. Long-life coolant (hereafter LLC) comes in several types. Use ethylene glycol (EG) type for this engine.
2. Before employing LLC-mixed cooling water, flush the radiator with fresh water. Repeat this procedure 2 or 3 times to clean up the radiator and engine block from inside.
3. Mixing the LLC
 - Premix 50% LLC with 50% clean soft water. When mixing, stir it up well, and then fill into the radiator.
4. The procedure for the mixing of water and anti-freeze differs according to the make of the anti-freeze. Refer to SAE J1034 standard, more specifically also to SAE J814c.

Vol % Anti-freeze	Freezing Point		Boiling Point *	
	°C	°F	°C	°F
50	-37	-34	108	226

*At 1.013 x 10⁵ Pa (760 mmHg) pressure (atmospheric). A higher boiling point is obtained by using a radiator pressure cap which permits the development of pressure within the cooling system.

5. Adding the LLC

- (1) Add only water if the coolant level reduces in the cooling system by evaporation.
- (2) If there is a coolant leak, add the LLC of the same manufacturer and type in the same coolant percentage.

*Never add any long-life coolant of different manufacturer. (Different brands may have different additive components, and the engine may fail to perform as specified.)

6. When the LLC is mixed, do not employ any radiator cleaning agent. The LLC contains anti-corrosive agent. If mixed with the cleaning agent, sludge may build up, adversely affecting the engine parts.
7. Kubota's genuine long-life coolant has a service life of 2 years. Be sure to change the coolant every 2 years.

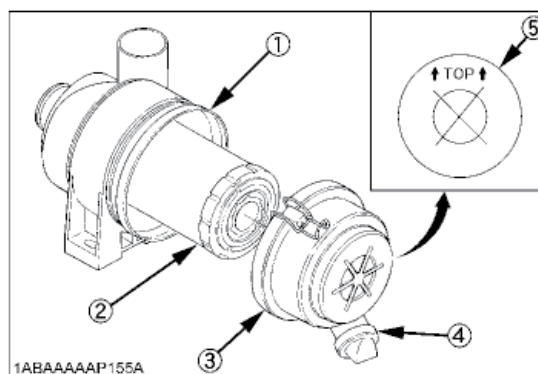
NOTE :

- A The above data represents industry standards that necessitate minimum glycol content in the concentrated anti-freeze.

AIR CLEANER

As the element of the air cleaner employed on this engine is a dry type, never apply oil to it.

1. Open the evacuator valve once a week under ordinary conditions-or daily when used in a dusty place-to get rid of large particles of dust and dirt.
2. Wipe the inside air cleaner clean with cloth or the like if it is dirty or wet.
3. Avoid touching the element except when cleaning.
4. When dry dust adheres to the element, blow compressed air from the inside turning the element. Pressure of compressed air must be under 205 kPa (2.1 kgf/cm² 30 psi).
5. Replace the element every year or every six cleanings.



- (1) Air cleaner body
- (2) Element
- (3) Cover
- (4) Evacuator valve
- (5) "TOP" mark

IMPORTANT :

- A Make sure the hooking clip for cover for the element is tight enough. If it is loose, dust and dirt may be sucked, wearing down the cylinder liner and piston ring earlier and thereby resulting in poor power output.

ELECTRIC WIRING

**CAUTION**

To avoid personal injury:

- C Shorting of electric cable or wiring may cause a fire.
- A Check to see if electric cables and wiring are swollen, hardened or cracked.
- A Keep dust and water away from all power connections.
Loose wiring terminal parts, make bad connections. Be sure to repair them before starting the engine.

Damaged wiring reduces the capacity of electrical parts.
Change or repair damaged wiring immediately.

1. Use automobile low voltage wiring cables for this wiring harness.
2. Use fuse and slow blow fuse as wiring protection.
3. Generally, available current of each fuse and size of wire in this drawing are recommendable value showed by Kubota, use suitable size fuses and wires for each machine to consideration to wiring setting and connection with another lines.
4. Install slow blow fuse near by battery, and install fuse box near by key switch.
5. Do not connect any parts which may cause induction current like motors to AC line.
6. Use heatproof cables, if room temperature around wire harness become over 75 °C 67 °F
7. Remove painting at connecting position before installation of each cable to any parts.

FAN BELT

B Adjusting Fan Belt Tension

**CAUTION**

To avoid personal injury:

- A Be sure to stop the engine and remove the key before checking the belt tension.
- A Be sure to reinstall the detached safety shield after maintenance or checking.

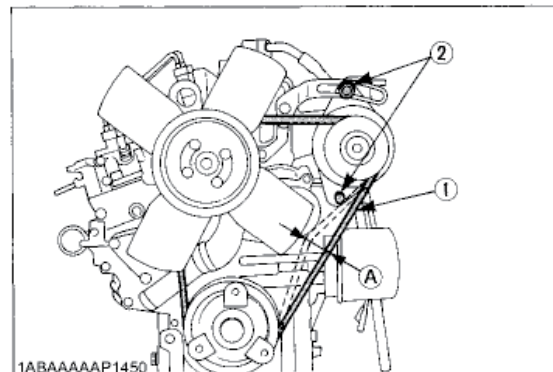
Proper fan belt tension

A deflection of between 7 to 9 mm (0.28 to 0.35 in.) when the belt is pressed in the middle of the span.

1. Stop the engine and remove the key.
2. Apply moderate thumb pressure to belt between the pulleys.
3. If tension is incorrect, loosen the alternator mounting bolts and, using a lever placed between the alternator and the engine block, pull the alternator out until the deflection of the belt falls within acceptable limits.
4. Replace fan belt if it is damaged.

IMPORTANT :

- A If belt is loosen or damaged and the fan is damaged, it could result in overheats or insufficient charging. Correct or replace belt.



(1) Fan belt

(2) Bolt and nut

(A) 7 to 9 mm (0.28 to 0.35 in.)

(under load of 10 kgf (22.1 lbs))

CARRIAGE AND STORAGE

CARRIAGE



CAUTION

To avoid personal injury:

- A Fix the engine securely not to fall during operation.
 - A Do not stand near or under the engine while carrying it.
 - A The engine is heavy. In handling it, be very alert not to get your hands and body caught in.
1. Use carrier such as crane when carrying the engine, or hurt your waist and yourself. Support the engine securely with rope not to fall while carrying it.
 2. When lifting the engine, put the hook securely to metal fittings attached to the engine. Use strong hook and fittings enough to hang the engine.

STORAGE



CAUTION

To avoid personal injury:

- A Do not clean the machine with engine running.
- A To avoid the danger of exhaust fume poisoning, do not operate the engine in a closed building without proper ventilation.
- A When storing the engine just after running, let the engine cool off.

Before storing the engine for more than a few months, remove any dirt on the machine, and:

1. Drain the coolant in the radiator. Open the cock at the bottom of the radiator, and remove the pressure cap to drain water completely. Leave the cock open. Hang a note written "No water" on the pressure cap. Since water may freeze when the temperature drops below 0° C (32 °F), it is very important that no water is left in the machine.
2. Remove dirty engine oil, fill with new oil and run the engine for about 5 minutes to let the oil penetrate to all the parts.
3. Check all the bolts and nuts, and tighten if necessary.
4. Remove the battery from the engine, adjust the electrolyte level, and recharge it. Store the battery in a dry and dark place.
5. When the engine is not used for a long period of time, run it for about 5 minutes under no load every 2 to 3 months to keep it free from rust. If the engine is stored without any running, moisture in the air may condense into dew over the sliding parts of the engine, resulting in rust there.
6. If you forget to run the engine for longer than 5 to 6 months, apply enough engine oil to the valve guide and valve stem seal and make sure the valve works smoothly before starting the engine.
7. Store the engine in a flat place and remove the key from engine.
8. Do not store the engine in a place where has flammable materials such as dry grass or straw.
9. When covering the engine for storage, let engine and muffler cool off completely.
10. Operate the engine after checking and repairing damaged wirings or pipes, and clearing flammable materials carried by mouse.

TROUBLESHOOTING

If the engine does not function properly, use the following chart to identify and correct the cause.

B When it is difficult to start the engine

Cause	Countermeasures
Fuel is thick and doesn't flow.	* Check the fuel tank and fuel filter. * Remove water, dirt and other impurities. * As all fuel will be filtered by the filter, if there should be water or other foreign matters on the filter, clean the filter with kerosene.
Air or water mixed in fuel system	* If air is in the fuel filter or injection lines, the fuel pump will not work properly. To attain proper fuel injection pressure, check carefully for loosened fuel line coupling, loose cap nut, etc. * Loosen air vent screws stop fuel filter and fuel injection pump to eliminate all the air in the fuel system.
Thick carbon deposits on orifice of injection nozzle.	* This is caused when water or dirt is mixed in the fuel. Clean the nozzle injection piece, being careful not to damage the orifice. * Check to see if nozzle is working properly or not. If not, install a new nozzle.
Engine oil becomes thick in cold weather and engine cranks slow.	* Change grade of oil according to the weather (temperature.)
Battery is discharged and the engine will not crank.	* Charge battery. * In winter, always remove battery from machine, charge fully and keep indoors. Install in machine at time of use.

B When output is insufficient

Cause	Countermeasures
Carbon stuck around orifice of nozzle piece	* Clean orifice and needle valve, being very careful not to damage the nozzle orifice. * Check nozzle to see if good. If not, replace with new parts.
Fuel is insufficient.	* Check fuel system.
Overheating of moving parts	* Check lubricating oil system. * Check to see if lubricating oil filter is working properly. * Filter element deposited with impurities would cause poor lubrication. Change element.
Air cleaner is dirty	* Clean the element every 100 hours of operation.
Injection pump wear	* Do not use poor quality fuel for it will cause wear of the pump. Only use No. 2-D diesel fuel.

NOTE :

A If the cause of trouble can not be found, contact your KUBOTA dealer.

B When engine suddenly stops

Cause	Countermeasures
Lack of fuel	* Check the fuel tank and refill the fuel, if necessary. * Also check the fuel system for air or leaks.
Bad nozzle	* If necessary, replace with a new nozzle.
Moving parts are overheated due to shortage of lubrication oil or improper lubrication.	* Check amount of engine oil with oil level gauge. * Check lubricating oil system. * At every 2 times of oil change, oil filter cartridge should be replaced.

NOTE :

A When the engine has suddenly stopped, decompress the engine by the decomp and turn the engine lightly by pulling on the fan belt. If the engine turns easily without abnormalities, the cause of the trouble is usually lack of fuel or bad nozzle.

B When color of exhaust is especially bad

Cause	Countermeasures
Fuel is of extremely poor quality.	* Select good quality fuel. - Use No. 2-D diesel fuel only.
Nozzle is bad.	* If necessary, replace with new nozzle.

B When engine must be stopped immediately

Cause	Countermeasures
Color of exhaust suddenly turns dark.	* Check the fuel injection system, especially the fuel injection nozzle.
Bearing parts are overheated.	* Check the lubricating system.
Oil lamp lights up during operation.	* Check the lubricating system. * Check the function of the relieve valve in the lubricating system. * Check pressure switch. * Check filter base gasket.

B When engine overheats

Cause	Countermeasures
Engine oil insufficient	* Check oil level. Replenish oil as required.
Fan belt broken or elongated	* Change belt or adjust belt tension.
Coolant insufficient	* Replenish coolant.
Excessive concentration of antifreeze	* Add water only or change to coolant with the specified mixing ratio.
Radiator net or radiator fin clogged with dust	* Clean net or fin carefully.
Inside of radiator or coolant flow route corroded	* Clean or replace radiator and parts.
Fan or radiator or radiator cap defective	* Replace defective parts.
Thermostat defective	* Check thermostat and replace if necessary.
Temperature gauge or sensor defective	* Check temperature with thermometer and replace if necessary.
Overload running	* Reduce load.
Head gasket defective or water leakage	* Replace parts.
Unsuitable fuel used	* Use the specified fuel.

SPECIFICATIONS

Model	Z482-E	Z602-E	D662-E
Type	Vertical, water-cooled, 4-cycle diesel engine		
Number of cylinders	2		3
Bore and stroke mm (in.)	67 x 68 (2.64 x 2.68)	72 x 73.6 (2.83 x 2.90)	64 x 68 (2.52 x 2.68)
Total displacement L (cu.in.)	0.479 (29.23)	0.599 (36.55)	0.656 (40.03)
Combustion chamber	Spherical Type (ETVCS)		
SAE NET Intermittent kW / rpm H.P. (SAEJ1349) (HP / rpm)	9.32 / 3600 (12.5 / 3600)	11.6 / 3600 (15.6 / 3600)	12.9 / 3600 (17.3 / 3600)
SAE NET Continuous kW / rpm H.P. (SAEJ1349) (HP / rpm)	8.05 / 3600 (10.8 / 3600)	10.1 / 3600 (13.5 / 3600)	11.18 / 3600 (15.0 / 3600)
Maximum bare speed rpm	3800	3850	3800
Minimum bare idling speed rpm	800 to 900	900 to 1000	800 to 900
Order of firing	1-2		1-2-3
Direction of rotation	Counter-clockwise (viewed from flywheel side)		
Injection pump	Bosch MD Type mini pump		
Injection pressure	13.73 MPa, 1991 psi (140 kgf/cm ²)		
Injection timing (Before T.D.C.)	0.366 rad (20°)	0.35 rad (20°)	0.366 rad (20°)
Compression ratio	23.5 : 1	24 : 1	23.5 : 1
Fuel	Diesel Fuel No.2-D		
Lubricant (API classification)	above CD grade		
Dimension mm (in.) (length x width x height)	351 x 389 x 520 (13.82 x 15.31 x 20.47)	385 x 421 x 544 (15.16 x 16.57 x 21.42)	426 x 389 x 520 (16.77 x 15.31 x 20.47)
Dry weight (BB Spec.) kg (lbs.)	53.1 (117.1)	57.0 (125.7)	63.7 (140.4)
Starting system	Cell starter (with glow plug)		
Starting motor	12 V, 0.8 kW	12 V, 1.0 kW	12 V, 0.8 kW
Charging generator	12 V, 150 W	12 V, 480 W	12 V, 150 W
Recommended battery capacity (5Hr capacity)	12 V, 28 AH, equivalent	12 V, 36 AH, equivalent	

NOTE :

A Specifications are subject to change without notice.

A The battery capacity is indicated in 5-hour ratio.

Model	D722-E	D782-E	D902-E
Type	Vertical, water-cooled, 4-cycle diesel engine		
Number of cylinders	3		
Bore and stroke mm (in.)	67 x 68 (2.64 x 2.68)	67 x 73.6 (2.64 x 2.90)	72 x 73.6 (2.83 x 2.90)
Total displacement L (cu.in.)	0.719 (43.88)	0.778 (47.46)	0.898 (54.80)
Combustion chamber	Spherical Type (ETVCS)		
SAE NET Intermittent kW / rpm H.P. (SAEJ1349) (HP / rpm)	14.0 / 3600 (18.8 / 3600)	13.5 / 3200 (18.1 / 3200)	17.5 / 3600 (23.5 / 3600)
SAE NET Continuous kW / rpm H.P. (SAEJ1349) (HP / rpm)	12.15 / 3600 (16.3 / 3600)	11.7 / 3200 (15.7 / 3200)	15.2 / 3600 (20.4 / 3600)
Maximum bare speed rpm	3800	3450	3850
Minimum bare idling speed rpm	800 to 900		900 to 1000
Order of firing	1-2-3		
Direction of rotation	Counter-clo ckwise (viewed from flywheel side)		
Injection pump	Bosch MD Type mini pump		
Injection pressure	13.73 MPa, 1991 psi (140 kgf/cm) ²		
Injection timing (Before T.D. C.)	0.366 rad (20) ^o		0.35 rad (20) ^o
Compression ratio	23.5 : 1	24 : 1	
Fuel	Diesel Fuel No.2-D		
Lubricant (API classification)	above CD grade		
Dimension mm (in.) (length x width x height)	426 x 389 x 520 (16.77 x 15.31 x 20.47)		467 x 421 x 544 (18.39 x 16.57 x 21.42)
Dry weight (BB Spec.) kg (lbs.)	63.1 (139.1)	63.5 (140.0)	72.0 (158.7)
Starting system	Cell star ter (with glow plug)		
Starting motor	12 V, 0.8 kW		12 V, 1.2 kW
Charging generator	12 V, 150 W		12 V, 480 W
Recommended battery capacity (5Hr capacity)	12 V, 36 AH, equivalent		12 V, 52 AH, equivalent

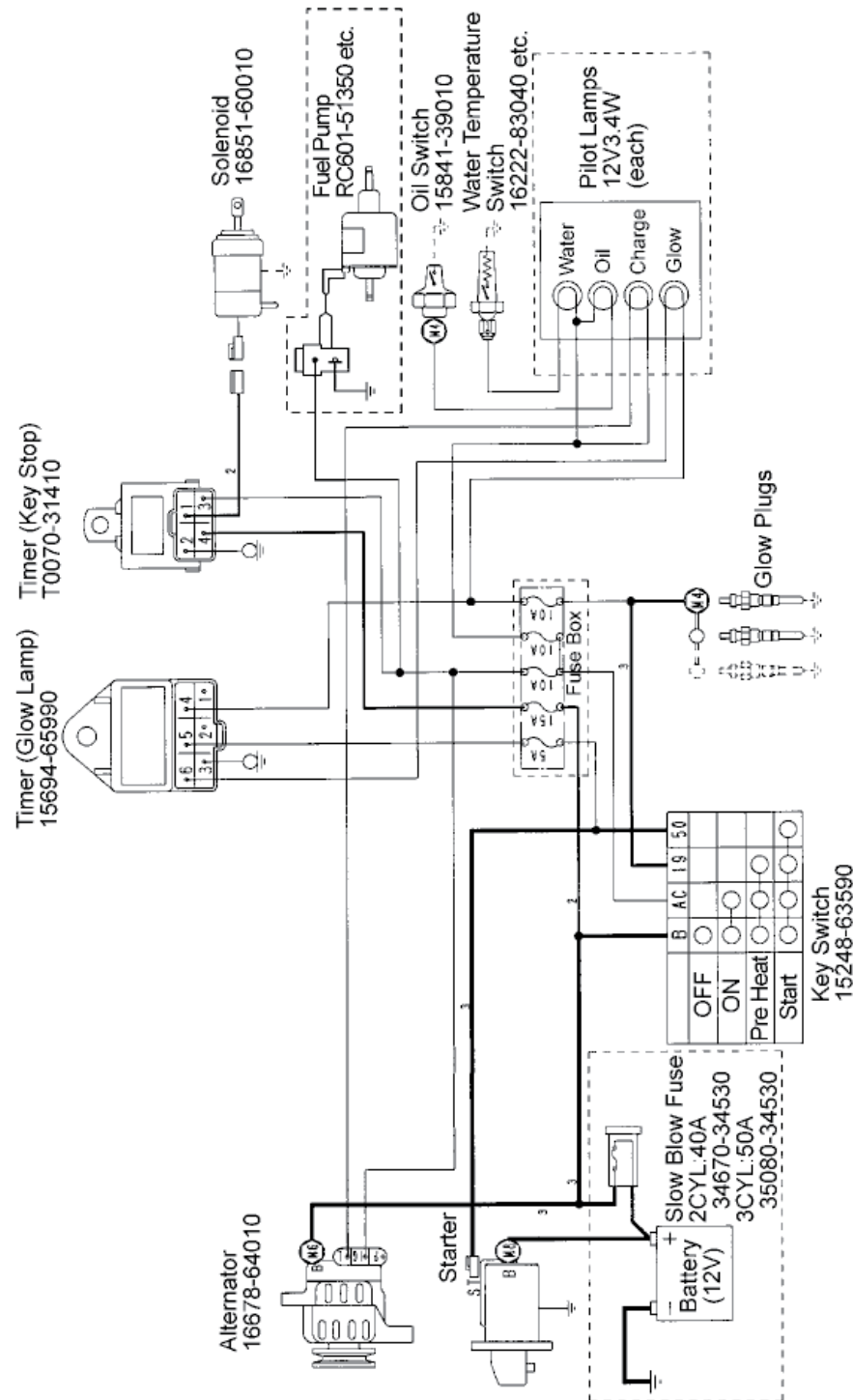
NOTE :

A Specifications are subject to change without notice.

A The battery capacity is indicated in 5-hour ratio.

WIRING DIAGRAMS

EU standard for Alternator (Energize to stop)

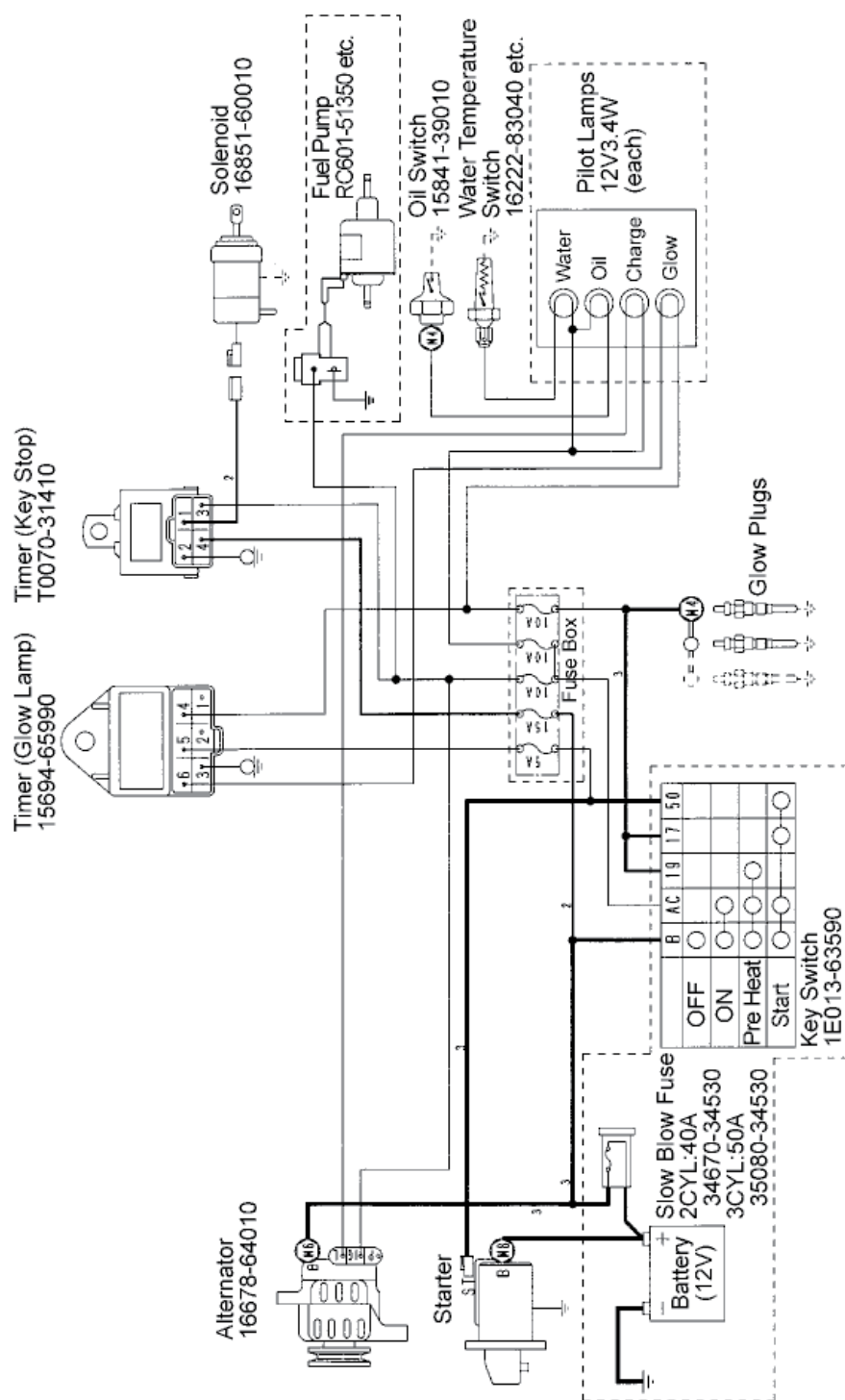


*The parts boxed in [] are reference, NOT equipped for standard engine spec.

*Use wire size 0.5 ~ 0.85 mm² with no mark.

1ABAAAAP151F

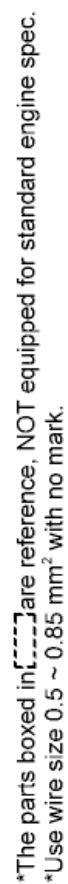
KEA standard for Alternator (Energize to stop)



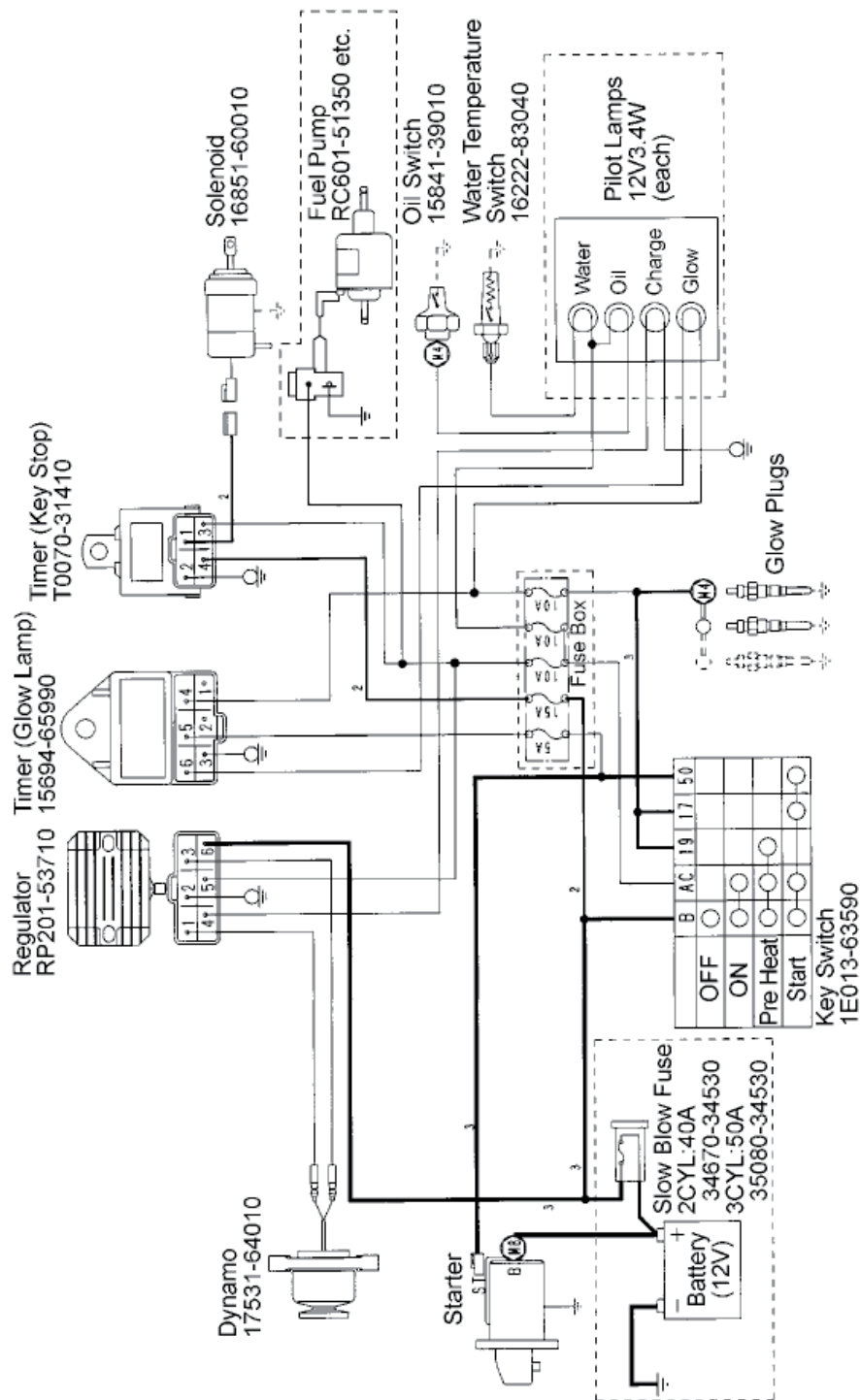
*The parts boxed in [] are reference. NOT equipped for standard engine spec.
 *Use wire size 0.5 ~ 0.85 mm² with no mark.

1ABAAAAAP152F

219



KEA standard for Dynamo (Energize to stop)



*The parts boxed in [] are reference, NOT equipped for standard engine spec.
 *Use wire size 0.5 ~ 0.85 mm² with no mark.

1ABAAAAAP154F

LP ENGINE

KOHLER® Command PRO

EN

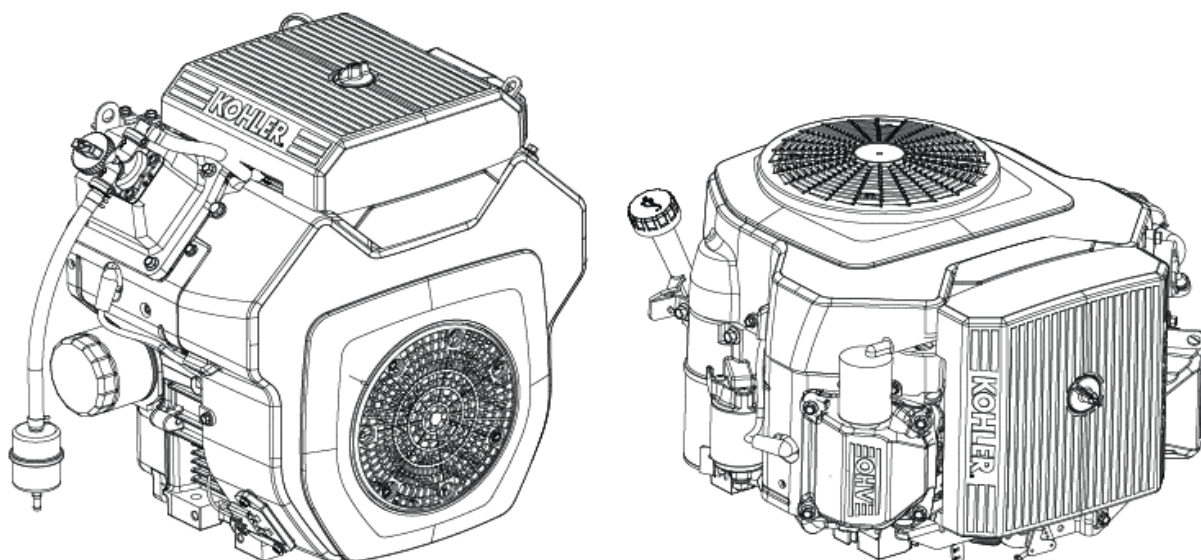
ESS

FRC

CH23, CH620-CH740, CH750

CV23, CV620-CV740, CV750

Owner's Manual



IMPORTANT:

Read all safety precautions and instructions carefully before operating equipment. Refer to operating instruction of equipment that this engine powers.

Ensure engine is stopped and level before performing any maintenance or service.

Warranty coverage as outlined in the warranty card and on KohlerEngines.com. Please review carefully as it provides your specific rights and obligations.

To maintain compliance with applicable emission regulations, exhaust system backpressure may not exceed limits which can be found on KohlerEngines.com. Search by Model No., then select Specs tab.

Kohler Engines has published CO2 values on KohlerEngines.com website.

Record engine information to reference when ordering parts or obtaining warranty coverage.

Engine Model _____
Specification _____
Serial Number _____
Purchase Date _____

Safety Precautions

⚠ WARNING: A hazard that could result in death, serious injury, or substantial property damage.

⚠ CAUTION: A hazard that could result in minor personal injury or property damage.

NOTE: is used to notify people of important installation, operation, or maintenance information.

	⚠ WARNING Explosive Fuel can cause fires and severe burns. Do not fill fuel tank while engine is hot or running.
Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent.	

	⚠ WARNING Carbon Monoxide can cause severe nausea, fainting or death. Avoid inhaling exhaust fumes. Never run engine indoors or in enclosed spaces.
Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled.	

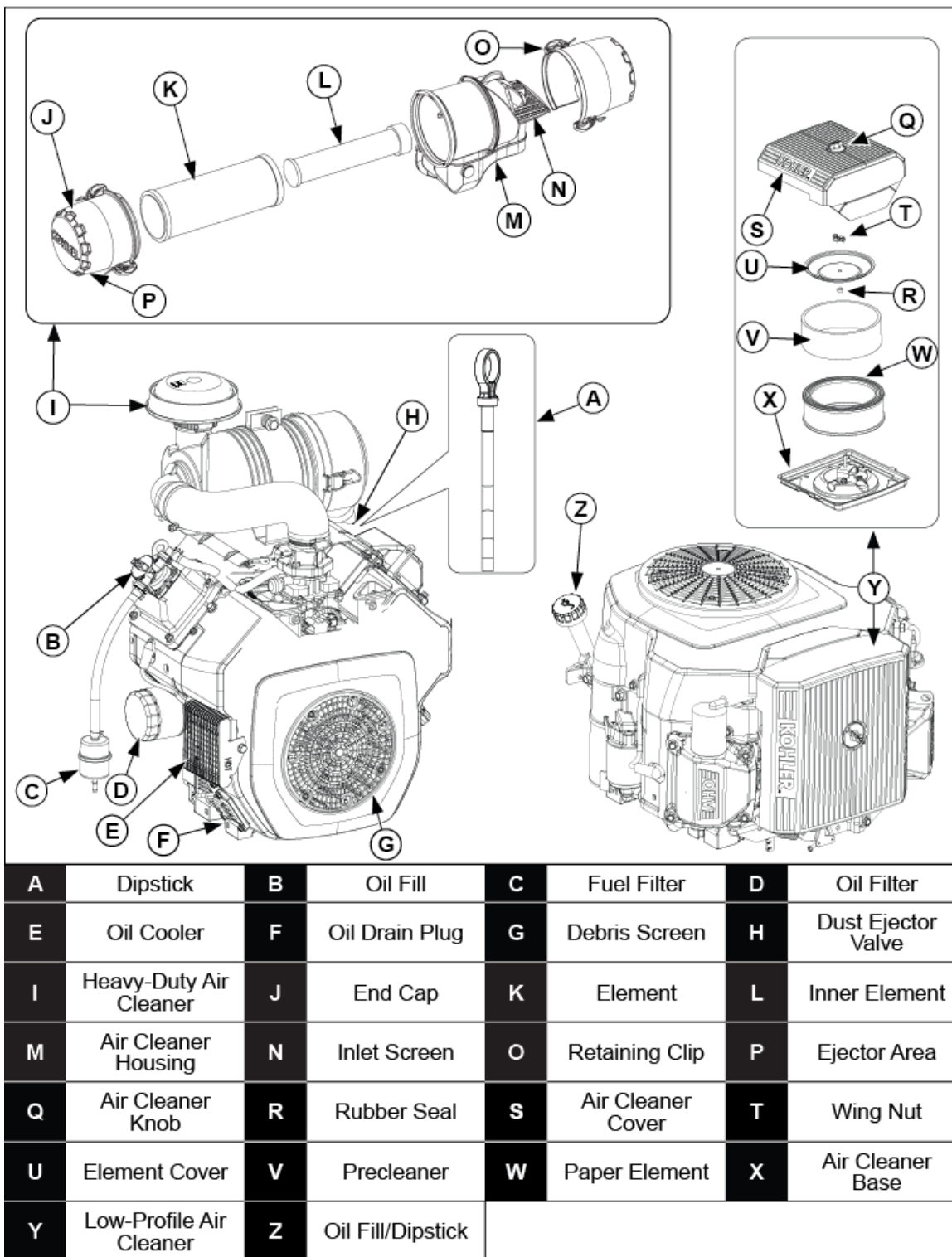
	⚠ WARNING Accidental Starts can cause severe injury or death. Disconnect and ground spark plug lead(s) before servicing.
Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.	

	⚠ WARNING Rotating Parts can cause severe injury. Stay away while engine is in operation.
Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate engine with covers, shrouds, or guards removed.	

	⚠ CAUTION Electrical Shock can cause injury. Do not touch wires while engine is running.
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	⚠ WARNING Hot Parts can cause severe burns. Do not touch engine while operating or just after stopping.
Never operate engine with heat shields or guards removed.	

⚠ WARNING: This product can expose you to chemicals including carbon monoxide and benzene, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.



Visit KohlerEngines.com for service parts information and purchasing options.

Pre-Start Checklist

1. Check oil level. Add oil if low. Do not overfill.
2. Check fuel level. Add fuel if low. Check fuel system components and lines for leaks.
3. Check and clean cooling areas, air intake areas and external surfaces of engine (particularly after storage).
4. Check that air cleaner components and all shrouds, equipment covers, and guards are in place and securely fastened.
5. Check spark arrestor (if equipped).

Starting

	⚠ WARNING Carbon Monoxide can cause severe nausea, fainting or death. Avoid inhaling exhaust fumes. Never run engine indoors or in enclosed spaces.
Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled.	

	⚠ WARNING Rotating Parts can cause severe injury. Stay away while engine is in operation.
Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate engine with covers, shrouds, or guards removed.	

NOTE: Do not crank engine continuously for more than 10 seconds. Allow a 60 second cool down period between starting attempts. Failure to follow these guidelines can burn out starter motor.

NOTE: Upon start-up, a metallic ticking may occur. Run engine for 5 minutes. If noise continues, run engine at mid throttle for 20 minutes. If noise persists, take engine to your local Kohler authorized dealer.

Standard Choke System

1. Place throttle control midway between slow and fast positions. Place choke control into ON position.
2. Turn key switch to START position. Release switch as soon as engine starts. If starter does not turn engine over, shut off key switch immediately. Do not make further attempts to start engine until condition is corrected. Do not jump start. See your Kohler authorized dealer for trouble analysis.
3. Cold engine: Gradually return choke control to OFF position after engine starts and warms up. Engine/equipment may be operated during warm-up period, but it may be necessary to leave choke partially on until engine warms up.

Warm engine: return choke to OFF position as soon as engine starts.

eChoke™

• Above 32°F (0°C)

1. This feature will automatically make system adjustments to engine on start up with throttle in any position.

2. If engine does not start on first attempt, wait 3-5 seconds and try again (if no start after fourth attempt, wait 1 minute).
3. If engine does not start consistently by fifth attempt, turn key to OFF, pause briefly, and make another attempt. If engine does not start, consult Kohler authorized dealer for assistance.

• 32°F (0°C) and Below

1. This feature will automatically make system adjustments to engine on start up with throttle in any position (winter blend fuel is recommended).
2. If engine does not start on first attempt, wait 3-5 seconds and try again (if no start after fourth attempt wait 1 minute).
3. If engine does not start consistently by fifth attempt, turn key to OFF, pause briefly, and make another attempt. If engine does not start, consult Kohler authorized dealer for assistance.

Cold Weather Starting Hints

1. Use proper oil for temperature expected.
2. Disengage all possible external loads.
3. Use fresh winter grade fuel. Winter grade fuel is formulated to improve starting.
4. Make sure battery has a full charge.

Stopping

1. If possible, remove load by disengaging all PTO driven attachments.
2. Position throttle control between half and full throttle; stop engine.

Angle of Operation

Refer to operating instructions of equipment this engine powers. Do not operate this engine exceeding maximum angle of operation; see specification table. Engine damage could result from insufficient lubrication.

Engine Speed

NOTE: Do not tamper with governor setting to increase maximum engine speed. Overspeed is hazardous and will void warranty.

Cold Weather Operation

Anti-icing kits can be installed to improve cold weather operation and are available through your local Kohler authorized dealer.

High Altitude Operation

EN

If this engine is operated at an altitude of 4000 ft. (1219 meters) or above, a high altitude carburetor kit is required. To obtain high altitude carburetor kit information or to find a Kohler authorized dealer, visit KohlerEngines.com or call 1-800-544-2444 (U.S. and Canada).

This engine should be operated in its original configuration below 4000 ft. (1219 meters).

Operating this engine with the wrong engine configuration at a given altitude may increase its emissions, decrease fuel efficiency and performance, and result in damage to the engine.

Maintenance Instructions

	WARNING Accidental Starts can cause severe injury or death. Disconnect and ground spark plug lead(s) before servicing.	Before working on engine or equipment, disable engine as follows: 1) Disconnect spark plug lead(s). 2) Disconnect negative (–) battery cable from battery.
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Normal maintenance, replacement or repair of emission control devices and systems may be performed by any repair establishment or individual; however, warranty repairs must be performed by a Kohler authorized dealer found at KohlerEngines.com or 1-800-544-2444 (U.S. and Canada).

Maintenance Schedule

Weekly

- Check heavy-duty air cleaner element.

Every 25 Hours or Annually¹

- Service/replace low-profile precleaner.

Every 100 Hours or Annually¹

- Replace low-profile air cleaner element.
- Change oil.
- Remove cooling shrouds and clean cooling areas.
- Check oil cooler fins, clean as necessary (if equipped).

Every 200 Hours

- Change oil filter.
- Replace fuel filter.

Every 250 Hours¹

- Replace heavy-duty air cleaner element and check inner element.

Every 500 Hours¹

- Replace heavy-duty air cleaner inner element.
- Replace spark plugs and set gap.

Every 500 Hours²

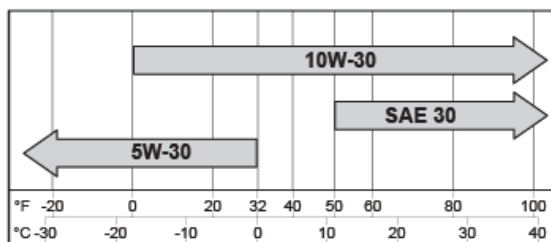
- Have crankshaft spline lubricated.

¹ Perform these procedures more frequently under severe, dusty, dirty conditions.

² Have a Kohler authorized dealer perform this service.

Oil Recommendations

We recommend use of Kohler oils for best performance. Other high-quality detergent oils (including synthetic) of API (American Petroleum Institute) service class SJ or higher are acceptable. Select viscosity based on air temperature at time of operation as shown in table below.



Check Oil Level

NOTE: To prevent extensive engine wear or damage, never run engine with oil level below or above operating range indicator on dipstick.

Ensure engine is cool. Clean oil fill/dipstick areas of any debris.

1. Remove dipstick; wipe oil off.
 - a. Press-in cap: reinsert dipstick into tube; press completely down.
 - or
 - b. Thread-on cap: reinsert dipstick into tube; rest cap on tube, do not thread cap onto tube.
2. Remove dipstick; check oil level. Level should be at top of indicator on dipstick.
3. If oil is low on indicator, add oil up to top of indicator mark.
4. Reinstall dipstick and tighten securely.

Change Oil and Filter

Change oil while engine is warm.

1. Clean area around oil fill cap/dipstick, drain plug/oil drain valve.
 - a. Remove drain plug and oil fill cap/dipstick. Allow oil to drain completely.
 - or
 - b. Open oil drain valve cap; if needed, attach a length of 1/2 in. I.D. hose to direct oil into appropriate container; twist valve drain body counterclockwise and pull. Remove dipstick. Allow oil to drain completely.
2. Clean area around oil filter. Place a container under filter to catch any oil and remove filter. Wipe off mounting surface.
 - a. Reinstall drain plug. Torque to 10 ft. lb. (13.6 N·m).
 - or
 - b. Close oil drain valve body, remove hose (if used), and replace cap.
3. Place new filter in shallow pan with open end up. Fill with new oil until oil reaches bottom of threads. Allow 2 minutes for oil to be absorbed by filter material.
4. Apply a thin film of clean oil to rubber gasket on new filter.
5. Refer to instructions on oil filter for proper installation.
6. Fill crankcase with new oil. Level should be at top of indicator on dipstick.
7. Reinstall oil fill cap/dipstick and tighten securely.

8. Start engine; check for oil leaks. Stop engine; correct leaks. Recheck oil level.

9. Dispose of used oil and filter in accordance with local ordinances.

Oil Sentry™ (if equipped)

This switch is designed to prevent engine from starting in a low oil or no oil condition. Oil Sentry™ may not shut down a running engine before damage occurs. In some applications this switch may activate a warning signal. Read your equipment manuals for more information.

Fuel Recommendations

	WARNING Explosive Fuel can cause fires and severe burns. Do not fill fuel tank while engine is hot or running.
Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Never use gasoline as a cleaning agent.	

NOTE: E15, E20 and E85 are NOT approved and should NOT be used; effects of old, stale or contaminated fuel are not warrantable.

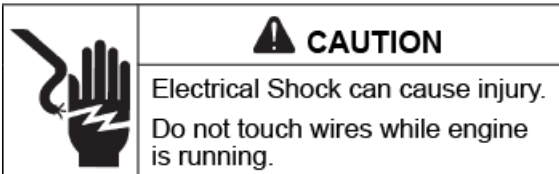
Fuel must meet these requirements:

- Clean, fresh, unleaded gasoline.
- Octane rating of 87 (R+M)/2 or higher.
- Research Octane Number (RON) 90 octane minimum.
- Gasoline up to 10% ethyl alcohol, 90% unleaded is acceptable.
- Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blend (max 15% MTBE by volume) are approved.
- Do not add oil to gasoline.
- Do not overfill fuel tank.
- Do not use gasoline older than 30 days.

Fuel Line

Low permeation fuel line must be installed on carbureted Kohler Co. engines to maintain EPA and CARB regulatory compliance.

Spark Plugs



Clean out spark plug recess. Remove plug and replace.

1. Check gap using wire feeler gauge. Adjust gap, see specification table for adjustment.
2. Install plug into cylinder head.
3. Torque plug to 20 ft. lb. (27 N-m).

Air Cleaner

NOTE: Operating engine with loose or damaged air cleaner components could cause premature wear and failure. Replace all bent or damaged components.

NOTE: Paper element cannot be blown out with compressed air.

Low-Profile/Commercial Mower

Loosen knob and remove air cleaner cover.

Precleaner:

1. Remove precleaner from paper element.
2. Replace or wash precleaner in warm water with detergent. Rinse and allow to air dry.
3. Saturate precleaner with new engine oil; squeeze out excess oil.
4. Reinstall precleaner over paper element.

Paper Element:

1. Clean area around element. Remove wing nut, element cover, and paper element with precleaner.
2. Separate precleaner from element; service precleaner and replace paper element.
3. Check condition of rubber seal and replace if necessary.
4. Install new paper element on base; install precleaner over paper element; reinstall element cover and secure with wing nut.

Reinstall air cleaner cover and secure with knob.

Heavy-Duty

1. Unhook retaining clips and remove end cap(s).
2. Check and clean inlet screen (if equipped).
3. Pull air cleaner element out of housing and replace. Check condition of inner element; replace when dirty.
4. Check all parts for wear, cracks, or damage, and that ejector area is clean.

5. Install new element(s).

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6. Reinstall end cap(s) with dust ejector valve/screen down; secure with retaining clips.

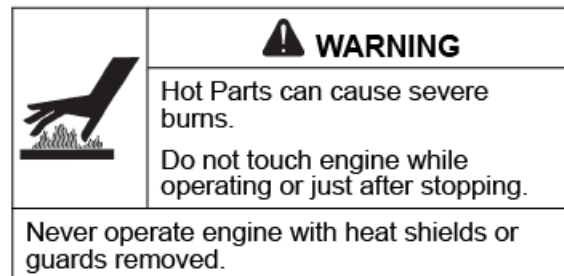
Breather Tube

Ensure both ends of breather tube are properly connected.

Oil Cooler (if equipped)

1. Clean fins with a brush or compressed air.
2. Remove two screws securing oil cooler, and tilt to clean back side.
3. Reinstall oil cooler.

Air Cooling



Proper cooling is essential. To prevent over heating, clean screens, cooling fins, and other external surfaces of engine. Avoid spraying water at wiring harness or any electrical components. See Maintenance Schedule.

Repairs/Service Parts

We recommend that you use a Kohler authorized dealer for all maintenance, service, and replacement parts for engine. To find a Kohler authorized dealer visit KohlerEngines.com or call 1-800-544-2444 (U.S. and Canada).

Storage

If engine will be out of service for 2 months or more follow procedure below.

1. Add Kohler PRO Series fuel treatment or equivalent to fuel tank. Run engine 2-3 minutes to get stabilized fuel into fuel system (failures due to untreated fuel are not warrantable).
2. Change oil while engine is still warm from operation. Remove spark plug(s) and pour about 1 oz. of engine oil into cylinder(s). Replace spark plug(s) and crank engine slowly to distribute oil.
3. Disconnect negative (-) battery cable.
4. Store engine in a clean, dry place.

Troubleshooting

Do not attempt to service or replace major engine components, or any items that require special timing or adjustment procedures. This work should be performed by a Kohler authorized dealer.

Problem	Possible Cause							
	No Fuel	Improper Fuel	Dirt In Fuel Line	Dirty Debris Screen	Incorrect Oil Level	Engine Overloaded	Dirty Air Cleaner	Faulty Spark Plug
Will Not Start	•	•	•		•	•	•	•
Hard Starting		•	•		•	•	•	•
Stops Suddenly	•		•	•	•	•	•	•
Lacks Power		•	•	•	•	•	•	•
Operates Erratically		•	•	•		•	•	•
Knocks or Pings		•		•		•		•
Skips or Misfires		•	•	•			•	•
Backfires		•	•			•	•	•
Overheats		•	•	•	•	•	•	
High Fuel Consumption						•	•	•

Engine Specifications

Model	Bore	Stroke	Displacement	Oil Capacity (Refill)	Spark Plug Gap	Maximum Angle of Operation (@ full oil level)*
CH621	3.03 in. (77 mm)	2.6 in. (67 mm)	38.1 cu. in. (624 cc)	1.7-1.9 U.S. qt. (1.6-1.8 L)	0.030 in. (0.76 mm)	25°
CV621						
CH641						
CV641						
CH620	3.2 in. (80 mm)		41 cu. in. (674 cc)			
CV620						
CH640						
CV640						
CH23/CH680						
CH670						
CV23/CV680						
CV670						
CH730	3.27 in. (83 mm)		44.2 cu. in. (725 cc)			
CV730						
CH740						
CV740						
CH750		2.72 in. (69 mm)	45.6 cu. in. (747 cc)			
CV750						

*Exceeding maximum angle of operation may cause engine damage from insufficient lubrication.

Additional specification information can be found in service manual at KohlerEngines.com.

Any and all horsepower (hp) references by Kohler are Certified Power Ratings and per SAE J1940 & J1995 hp standards. Details on Certified Power Ratings can be found at KohlerEngines.com.

Emission Control System

Exhaust Emission Control System for models CH23, CV23, CH620-CH740, CV620-CV740, CH750, and CV750 is EM for U.S. EPA, California, and Europe.

NOTE: Tampering with the engine and its emission control system voids the EPA Certificate of Conformity, ARB Executive Order, and EU type-approval.