



Operators Manual

**** M-1500D ****

USE IN CONJUNCTION WITH OEM MANUALS (ENCLOSED)

Unit Serial No. _____

Engine

Yanmar Engine Serial No. _____

Gorman-Rupp Pump

GR-84B2 – Serial No. _____

Links relating to this Manual

www.stsmixers.com

www.grpumps.com

Dealer

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Limited Warranty

United States and Canada

Surface to Surface Inc. or its subsidiary which last sold the product, warrants new products sold by it for use in the United States and Canada to be, at the time of manufacture, free from defects in workmanship and materials. This warranty covers for a period of **Twelve (12) Months** of operation from the date of delivery for initial use, whichever comes first.

Exclusions and Additional Limitations

1. This warranty relates to the condition of the product at the time of manufacture and does not cover parts or service as a result of:
 - (a) Normal wear and tear or required maintenance including, without limitation, adjustments or replacement of components subject to wear and tear, such as belts, hoses, seals and/or packing, fuses, bulbs, switches and ignition parts.
 - (b) Abuse including, without limitation, neglect, improper operation, misapplication, overloading, accident or alterations not approved by Surface to Surface Inc.
 - (c) Lack of maintenance, including, without limitation, failure to inspect and maintain, improper repair, use of "unapproved parts", cracked engine heads and blocks unless caused by the failure of an internally lubricated part or repair of engine valves, rings or guides.
 2. The Company's warranty does not apply to purchased components manufactured by others where separate warranty is made by the manufacture of such components and will be applied as interpreted by the supplier.
 3. All claims under his warranty shall be submitted in writing by the distributor to the Company, which will be the sole judge in determining the merits of the claim.
 4. The company shall have the right to have all products or parts claimed to be defective returned to it and the cost of shipping such items shall be borne by the distributor.
-

Warranty Registration Card

In order to help us provide complete service for our product, please complete this card and return it.

If not returned, all requests for warranty will be denied.

Print Name:

Address:

City:State/Province.....Zip/PC.....

Model No. Serial No.

Date of Purchase Dealer

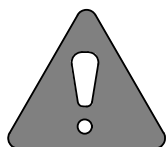
**Return to: Surface to Surface Inc.
5150 Forest Rd. RR#3
Watford, Ontario, Canada
N0M 2S0**

SAFETY STATEMENTS

Your personal safety and the safe operation of this unit are the concern of Surface to Surface Inc, and by reading and understanding this manual and understanding the safety statements, you will decrease the risk of personal and equipment damage.

Safety statements are listed here and throughout this manual to draw your attention to potential hazards that may be encountered while operating this piece of equipment. While reading this manual, you will notice that certain safety statements will relate directly to the operation, or maintenance of that particular part of the unit and should be followed carefully. Decals on the unit also follow the same format as the warnings in this manual, and therefore should be kept in good repair to alert the operator and others of the potential hazard.

The engine / motor manual also contains hazard warnings which pertain to the engine / motor and should also be followed.



This safety alert symbol appears with most safety statements.

It means attention, become alert, your safety is involved!

Please read and abide by the message that follows the safety alert symbol.

DANGER

Danger (the word "DANGER" is in white letters with a red rectangle behind it) indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury. Danger is limited to the most extreme situations.

CAUTION

Caution (the word "CAUTION" is in black letters with a yellow rectangle behind it) indicates an potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNING

Warning (the word "WARNING" is in black letters with an orange rectangle behind it) indicates an potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Caution "without the safety alert symbol" indicates an potentially hazardous situation that can cause damage to the, machine, personal property and / or the environment or cause the machine to operate improperly.

SAFETY STATEMENTS

The following caution statements have been drawn from the instructions in this manual. They have been assembled here for ready reference.

DANGER

IN AN EMERGENCY
rotate the key switch to
the STOP position
to halt engine, pump, and fluid flow

WARNING

**NEVER ATTEMPT TO REMOVE
OR CLEAN THE FILTER SHEAR**
while the unit is in operation.
Serious personal injury will result.

DANGER

**NEVER ATTEMPT REPAIRS
OR DISASSEMBLY**
without shutting off the engine / motor
and disconnecting the power source.
Serious personal injury will result.

CAUTION

**DO NOT POSITION
ANY PART OF YOUR BODY**
over the hopper, valve,
or mixing tee while cleaning.

WARNING

**NEVER USE BODY PARTS,
OR FOREIGN OBJECTS**
in an attempt to unplug or clean the
hopper valve or mixing tee.
Serious personal injury or
damage will result.

CAUTION

**WHEN THE UNIT
IS IN OPERATION,**
the fluid in the piping may reach
pressures up to 50 p.s.i.
When the engine is idling, the system is
still pumping fluid under pressure.

WARNING

**DO NOT REMOVE OR MODIFY
SAFETY COVERS OR GUARDS.**
Serious personal injury will result.

CAUTION

**NEVER OPERATE THE MIXING
unit with the tank lid open.**
If viewing is necessary, open
only the small inspection
vent cap in the center of the lid.

M-1500D

SAFETY STATEMENTS *continued*

The following caution statements have been drawn from the instructions in this manual. They have been assembled here for ready reference.

CAUTION

TRAPPED FLUID MAY BE PRESENT
and will spill out when piping, hoses,
pump or filter shear are removed.

CAUTION

NEVER LEAVE LIQUID IN THE
PUMP CASING, PIPING, OR HOSES
during freezing weather conditions,
as damage will result.
Follow instruction for winterizing.

CAUTION

AVOID ALLOWING FOREIGN MATERIAL
into the Venturi Mixing Tee thru the
Hopper, by keeping the valve closed
when not in use.

CAUTION

BEFORE STARTING THE ENGINE,
BE SURE THE PUMP IS PRIMED!
Check the pump by slowly & carefully
opening the plug located on the top
of the centrifugal pump discharge elbow.
A visual inspection can be made if the fluid
escapes around the plug as it is loosened.
Remove the plug to view inside fluid level.
The centrifugal pump seal WILL be
damaged if allowed to cavitate or run dry.

CAUTION

WHEN TRANSFERRING FLUID
to the drill rig, fluid pressure may
reach or exceed 50 p.s.i.
CHECK the drill rig manufacturers
specifications regarding maximum inlet
pressures allowed for their pump.

CAUTION

IMPROPER INSTALLATION OF THE
MECHANICAL or GREASE SEAL
will result in leakage and possible
damage to the seal. All maintenance,
operating and repair of this unit, must be
done per the instructions in the operators
manual for safety and reliability.

CAUTION

CARE MUST BE TAKEN WHEN
INSTALLING THE COUPLER GASKETS.
If the gaskets are not properly lubricated
and installed, a leak may develop.

CAUTION

BEFORE STARTING OR RESTARTING
the engine and centrifugal pump, make
sure any valves installed on the pump
suction inlet line are open, and the
fluid level in the tank is above
the suction line.

SAFETY STATEMENTS *continued*

The following caution statements have been drawn from the instructions in this manual. They have been assembled here for ready reference.

CAUTION

LIFTING LUGS OR THE LIFTING POINT(S) identified and labelled on the skid structure must be used in order to safely lift and transport the unit.

CAUTION

BEFORE LIFTING OR MOVING THE UNIT, all fluid should be removed from the tank.

CAUTION

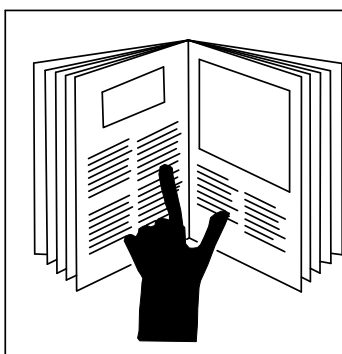
The manufacturer should be consulted when considering alternative uses for this piece of equipment. This unit was designed for the mixing and shearing of a dry additive, into a liquid stream. Other uses may create unforeseen safety issues and personal injury risk.

CAUTION

AVOID PLACING OBJECTS on top or against the tank as damage may result from the weight.

CAUTION

TO ENTER THE TANK is not recommended. Personal injury could result from the presents of hazardous fumes, remaining fluid or unit start-up.



⚠ WARNING

REFER TO THE SAFETY STATEMENTS IN THE ENGINE OEM MANUAL AND THIS MANUAL REGARDING THESE OPERATIONS.

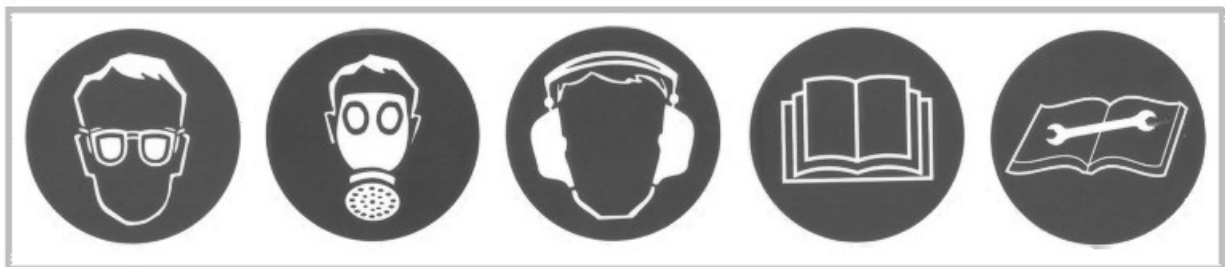
M-1500D

Safety Markings

Hazard and warning markings have been placed at appropriate points on the unit. International symbols have been used, in order to ensure universal understanding of the nature of the hazard. Please comply with all warnings and markings to ensure safe use of the equipment. These include but are not limited to:

- | | |
|---------------------------|--|
| a) Lifting points | b) Flammable Liquids |
| c) High temperature areas | d) Personal Protection recommendations |
| e) Personal dangers | f) Equipment dangers |
| g) Operating instructions | h) Fluid flow direction |

SOME EXAMPLES FOUND ON THE EQUIPMENT



Personal Protection, Read and understand Operator's manual and Maintenance manual



Lifting Point



Flammable Liquid



Hot Surface



Lifting Point



Fluid Flow Direction

CLEAN FILTER DAILY

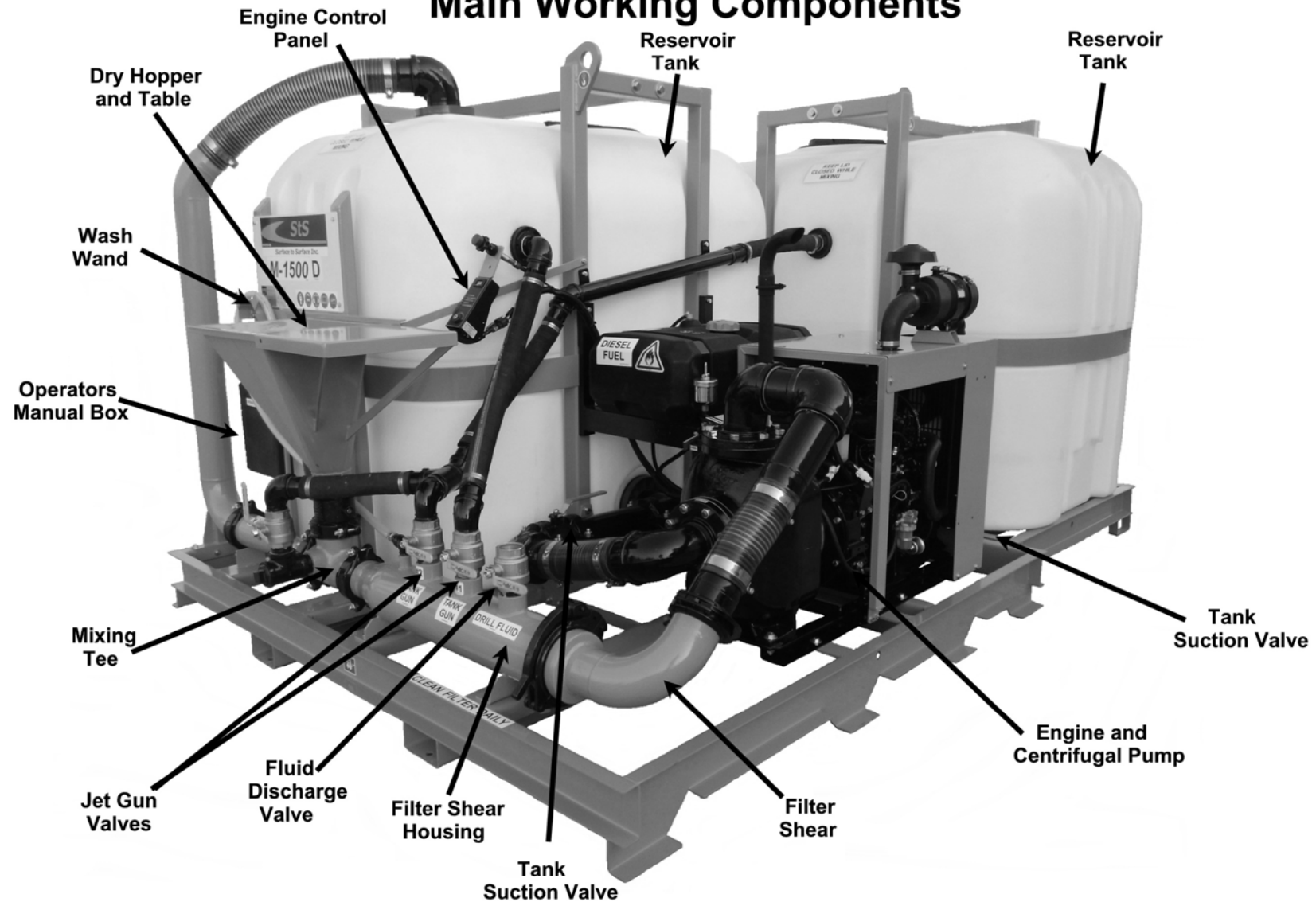
Maintenance Instructions

KEEP LID CLOSED
WHILE MIXING

Safety Instructions

M-1500D

Main Working Components





M-1500D

Operators Manual

Congratulations on your acquisition of the time proven M-1500 Mixing System. You have acquired the fastest and most efficient mixing system manufactured for mixing Bentonite drilling slurry (mud). As a manufacturer of HDD support equipment, we are well aware of the extreme conditions that HDD equipment is exposed to on a daily basis. Surface To Surface Inc. strives to overcome these conditions, with better design and manufacturing practices. Please feel free to call our toll free number (1-800-567-0978) if you have any questions or concerns about your M-1500.

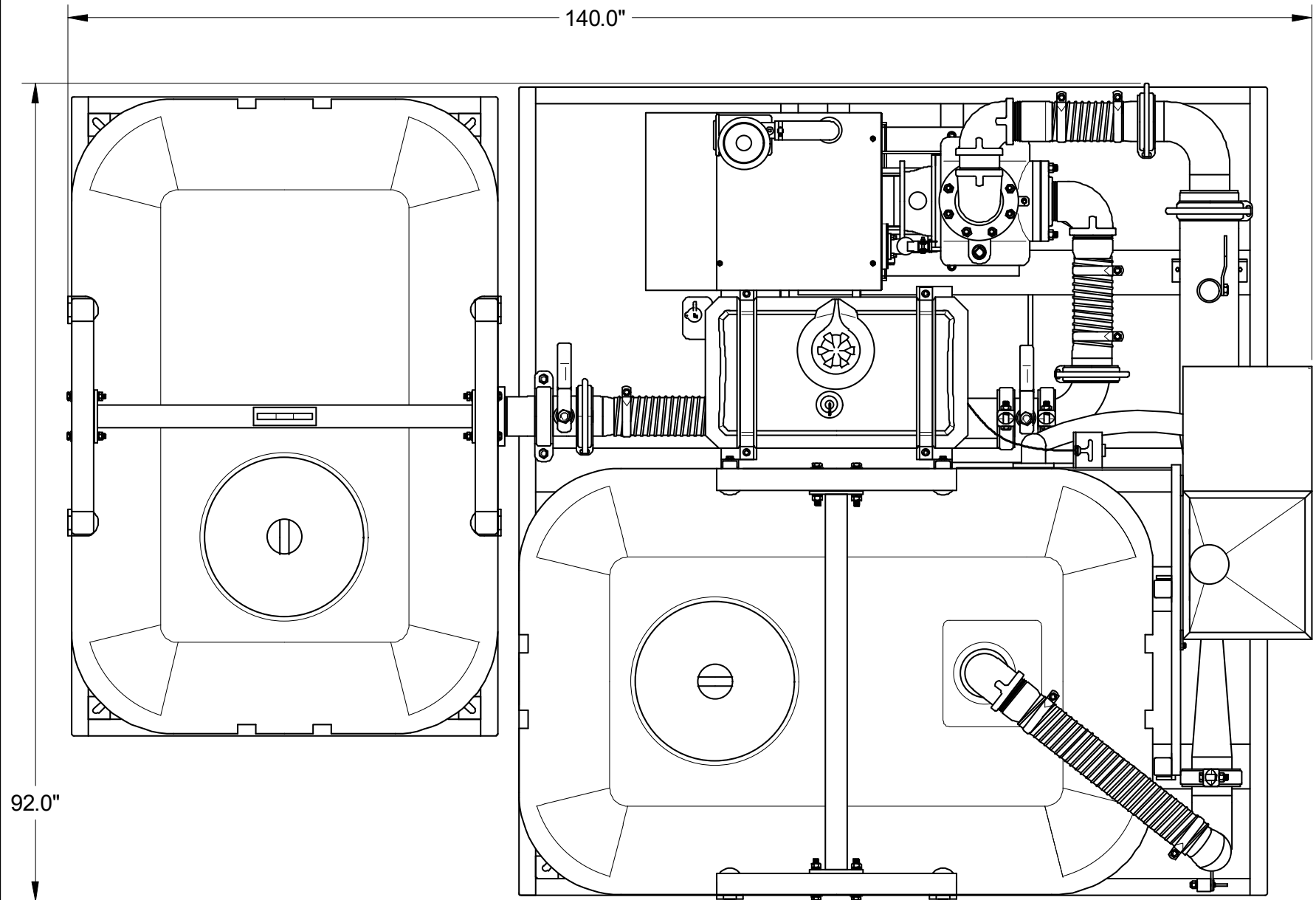
Thank you, for choosing the M-1500 series mixer.

The M-1500 mixing unit was designed to mix dry or liquid drilling products with clean water, into a slurry. The slurry is continually circulated through the mixing cycle until it reaches the desired consistency. The operator can then transfer the final product to a holding reservoir or directly to the drilling equipment.

The M-1500 mixing unit consists of two 750 u.s. gal. (2839 litre) polyethylene plastic tanks, diesel powered centrifugal pump, filter/shear unit, venturi mixing tee assembly, dry hopper with a table, tank internal jet guns and a discharge valve to pump the finished slurry to a holding tank or the drill rig. These components are all mounted on a frame type skid, built for lifting or solid mounting. For ease of interpretation, looking at the mixing unit hopper straight on will be considered looking at the front of the unit. Hence the other long side, will be the rear and the ends will be right or left end.

RECORD OF OWNERSHIP:

- Unit Serial No. _____
- Engine Serial No. _____
- Pump Serial No: _____
- Tank #1 Serial No: _____
- Tank #2 Serial No: _____
- Date Purchased/Leased: _____
- Dealer Purchased/Leased From: _____
- Special Custom Features: _____



M-1500D (Diesel)

**DRY WEIGHT
3025 lbs.**

** Due to our continuing product improvement, specifications are subject to change without notice. **

Surface to Surface Inc.	
DWR. NUM.	DATE. 04 / 18 / 23
M-1500D	REV.



Bentonite Mud Mixer Model M-1500D

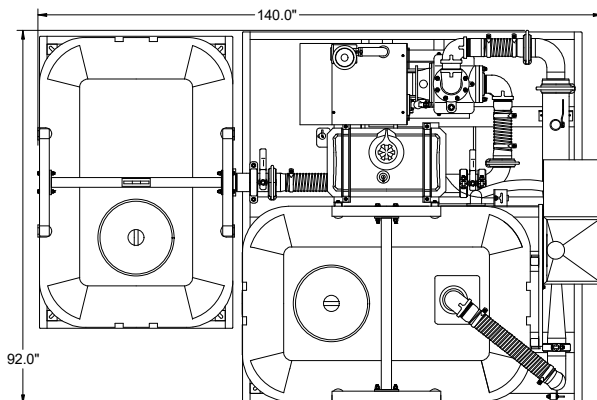


Surface to Surface Inc.

Features and Benefits

M-1500D Mixer

The M-1500D was designed and manufactured as a dual tank system that allows the HDD contractor two methods of mixing their bentonite mud requirements. This system allows the operator to mix 750 gallons of full yield mud in less than eight (8) minutes, while holding 750 gallons of water reserve in the second tank for the next mix, or mix 1500 gallons of full yield mud in less than sixteen (16) minutes, in one large batch. The operator controls the two methods of mixing by changing the direction of flows through the piping connections using the manual operated full flow valves. The vacuum port located in the mixing tee has the ability to draw water from the second tank when being used as a reservoir and the drill fluid can then be sent to your drilling rig with-out the use of a second pump. This model has been a popular choice of HDD Contractors due to its small space saving footprint relative to its capacity. Other power drives available.



Specifications

M-1500D Mixer

Dimensions	92"W x 140"L x 75"H
Approx. Weight	3275 lbs.
Hopper Height	41 inches high
Mixing System	4" Proprietary StS Mixing System
Mixing Tank (2)	750 gallon Roto-Mold Polyethylene
Skid frame (2)	5" Steel Channel, Welded
Diesel Engine	21.9 hp Water Cooled tier 4
Pump	4" Cast Iron Centrifugal Trash Pump
Pump Drive	Direct Coupled Engine to Pump
Fuel Tank	15 gal. Steel c/w Sight Gauge
Pipe Couplers	Bolt and Snap –Groove Type
Pressure Wand	Hopper Maintenance Wand
Tank Drain (2)	Bottom Tank Drains Supplied

Benefits

- Space saving design for its capacity.
- Excellent weight distribution
- Waist high hopper reduces back strain.
- Fast, efficient mixing time.
- Minimal maintenance required.
- Built for the rigors of the construction trade.
- Industrial rated for long service life.
- Rugged & Repairable for extended service life.
- No expensive couplers or inserts to replace.
- Provides a full day running on a fill up.
- Provide fast cold weather draining of system.
- Removal of blockages caused by additives.
- Provides fast cold weather tank drainage.

Also available in Gasoline (M-1500) - Hydraulic (M-1500H) – Electric (M-1500E) models.

*** All Specifications Subject to Change Without Notice ***

Check our website for the latest products and specifications

www.stsmixers.com

Surface to Surface Inc.

5150 Forest Road, R.R.#3, Watford, Ontario, N0M 2S0
Tel: 1-800-567-0978

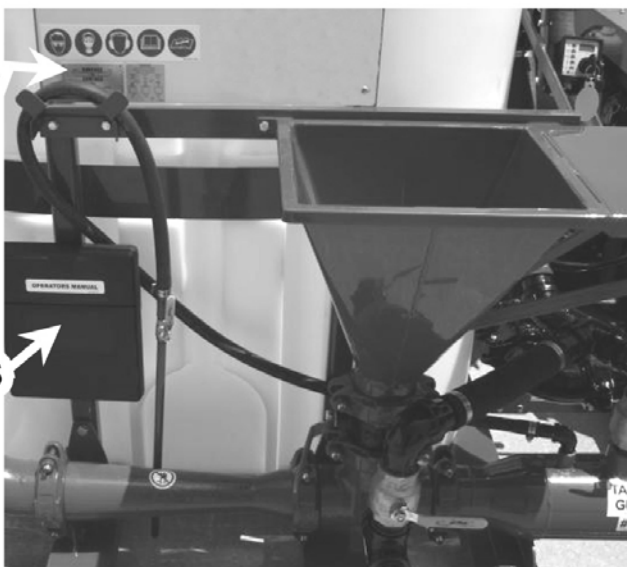
06/23/23

Identifying Your Machine & Components

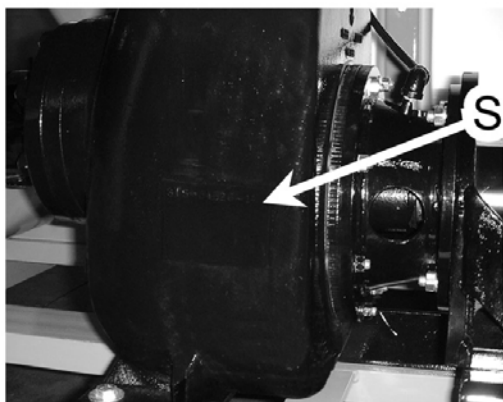
Location of Tags and PIN Plates

Unit
Serial Number

Operators
Manual



Pump
Serial Number



Engine
Serial Number



SECTION #II

Description, Care and Maintenance

Description, Care and Maintenance

Polyethylene Plastic Reservoir Tanks (750 us. gal)

Maintenance of the tanks is required, but is simple. The tanks should be cleaned on a regular basis by opening any drain caps on the tank tees (see Fig.1 for an example) and or open the customer installed bottom tank drain (see Fig.2) and rinse the tank with clear water. Residue such as leaves, stones, etc can be removed using a wet /dry vacuum.

All tank ports are of a threaded type bung (see Fig.1) with rubber gaskets. If a leak is noticed between the tank and gasket, the connection can be tightened up by tightening the large nut flange, located inside of the tank in the direction of the arrows (counter clock wise).

Fig.1



⚠ DANGER

NEVER ATTEMPT REPAIRS OR DISASSEMBLY

without shutting off the engine / motor and disconnecting the power source. Serious personal injury will result.

⚠ CAUTION

NEVER OPERATE THE MIXING unit with the tank lid open.

If viewing is necessary, open only the small inspection vent cap in the center of the lid.

CAUTION

BEFORE LIFTING OR MOVING THE UNIT, all fluid should be removed from the tank.

CAUTION

TO ENTER THE TANK is not recommended. Personal injury could result from the presents of hazardous fumes, remaining fluid or unit start-up.

Description, Care and Maintenance

Polyethylene Plastic Reservoir Tanks (750 us. gal)

INSTALLATION OF (CUSTOMER INSTALLED) TANK DRAIN

- Find a suitable location on the tank floor for the drain to be installed, taking into consideration the placement of the unit on a trailer. **LOOK** under the deck for obstructions (cross-members, wiring, and axles, ect.) Allow room for a shut off valve.
- Drill holes into floor of tank using the top (inside) portion of the drain as the template.
- Make sure the holes are free of burrs and both surfaces are clean.
- Install the drain bung as per FIG 1. Note the gaskets are on the inside and outside of the tank.
- Tighten nuts as to slightly squeeze the rubber gaskets.
- Cut a hole into the deck of the trailer or truck for the piping and valve to be installed.
- Install 2" pipe nipple and valve into tank bung with a sealant on the threads. **CAUTION: DO NOT OVER-TIGHTEN!**
- The nipple and valve should not extend to far from the tank without a support, as this will cause excess stress on the threads, drain bung and the tank floor.
- Fill with water and check for leaks.

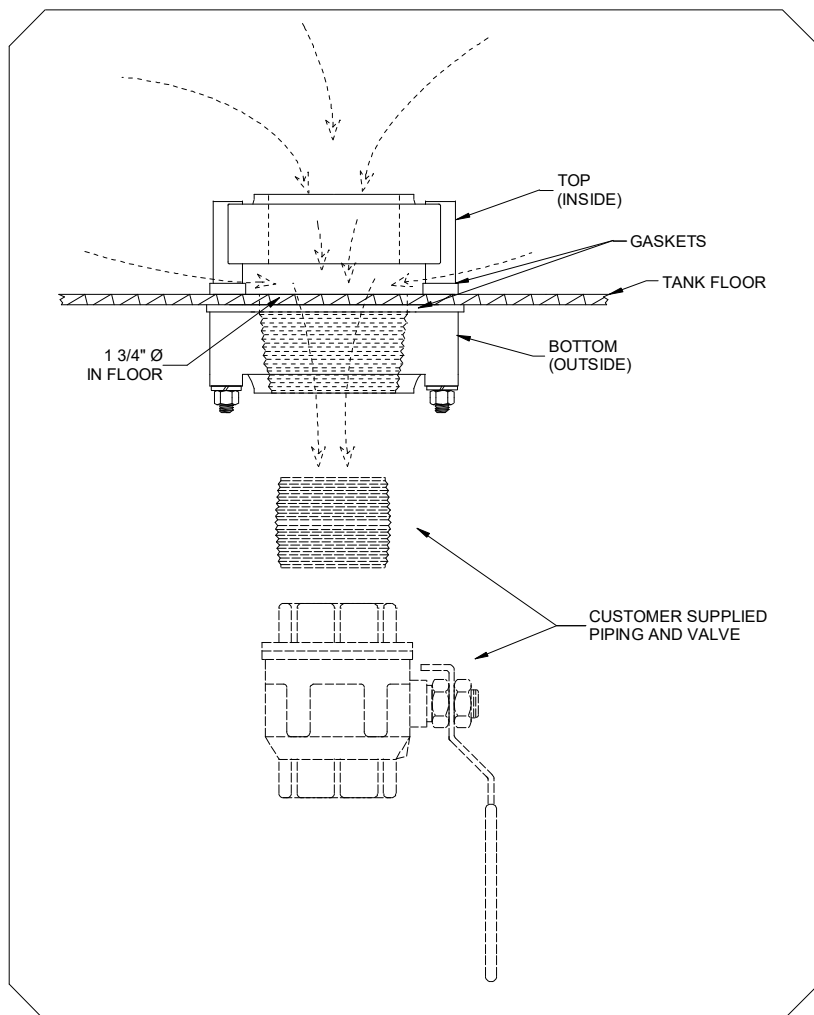


Fig.2



Description, Care and Maintenance

Diesel Powered Centrifugal Pump

Care and maintenance of the engine and pump is covered in this manual and/or the manufacturer operator's manuals supplied and should be read and understood. We suggest the following daily checks be carried out prior to using the system. Check the diesel fuel tank is full. Check oil level by removing the oil plug / dip stick, and viewing the oil level. Check the pump seal grease cup is full (see grease cup instructions Fig.5). Check the engine air filter (due to environmental conditions). Check that the suction valve (see Fig.3) is open and the reservoir tank has sufficient liquid to supply the centrifugal pump.

The pump is mounted directly to the engine, so there is no "drive coupler" to check or maintain. The pump is the primary component that will see the most wear due to the nature of the material it is handling therefore it will require regular checks, adjustments and maintenance.

There is a section of this manual dedicated to the pump itself and should be read and understood which will help should any problems or concerns arise in the field.

The pump should never be allowed to start or run dry, as this **WILL** damage the internal pump seal (grease seal) and render the unit inoperable until the seal is fixed.

To prime the pump or check to visually see if the pump is primed, slowly undo the plug on top of the pump beside the discharge elbow (see Fig.4) and stop after about 3 turns. If the pump is primed, fluid & air will escape from around the plug threads. This indicates that the pump housing is full, and the plug can be tightened back up. If no fluid is escaping from around the threads, completely remove the plug. Fluid or water can be poured into this opening to fill the pump cavity, and a visual of the fluid level inside the pump can be made. The level should be approximately to the top of the pump housing.

Another way to prime the pump is to have the tank **FULL** of fluid, and standing off to the side of the hopper, rotate the hopper valve **SLOWLY** to the open position. As the valve is opened, you will hear air escaping followed by fluid, into the hopper itself. Close the valve as the fluid enters the hopper. This means the fluid in the tank has filled the pump cavity of the pump and flowed from the outlet of the pump to the remaining piping on the unit.

Fig.3

⚠ DANGER

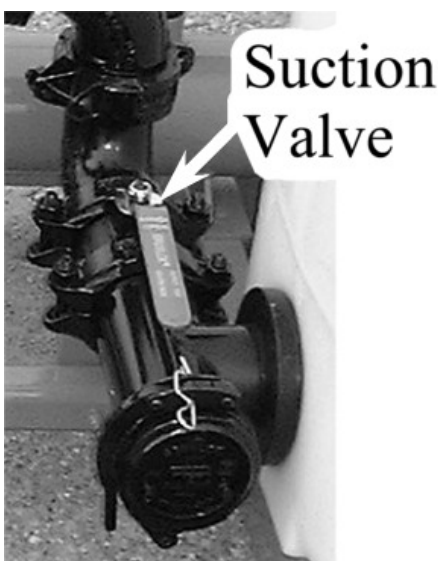
IN AN EMERGENCY

rotate the key switch to
the STOP position
to halt engine, pump, and fluid flow

⚠ DANGER

**NEVER ATTEMPT REPAIRS
OR DISASSEMBLY**

without shutting off the engine / motor
and disconnecting the power source.
Serious personal injury will result.



CAUTION

**BEFORE STARTING THE ENGINE,
BE SURE THE PUMP IS PRIMED!**

Check the pump by slowly & carefully
opening the plug located on the top
of the centrifugal pump discharge elbow.
A visual inspection can be made if the fluid
escapes around the plug as it is loosened.
Remove the plug to view inside fluid level.
The centrifugal pump seal **WILL** be
damaged if allowed to cavitate or run dry.

CAUTION

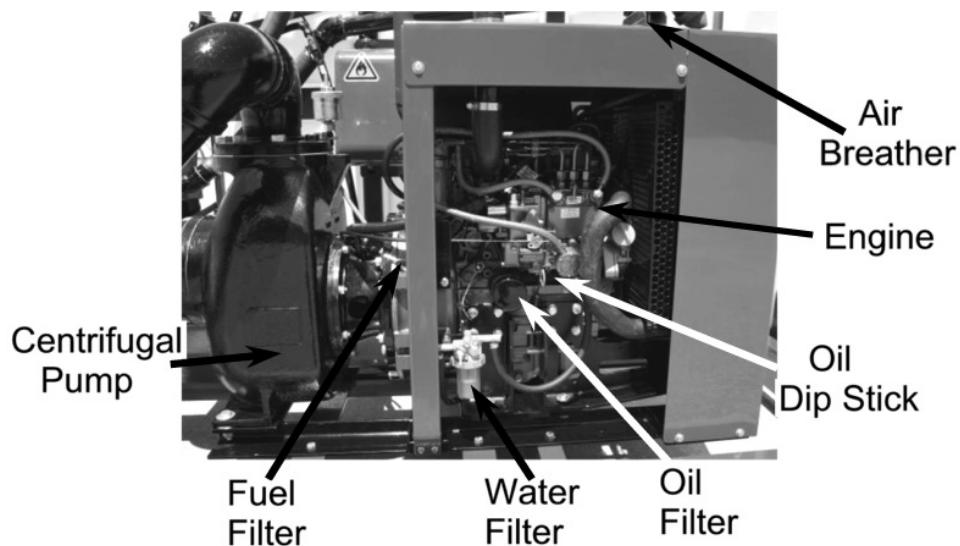
**IMPROPER INSTALLATION OF THE
MECHANICAL or GREASE SEAL**
will result in leakage and possible
damage to the seal. All maintenance,
operating and repair of this unit, must be
done per the instructions in the operators
manual for safety and reliability.

M-1500D

Description, Care and Maintenance

Diesel Powered Centrifugal Pump

Fig.4

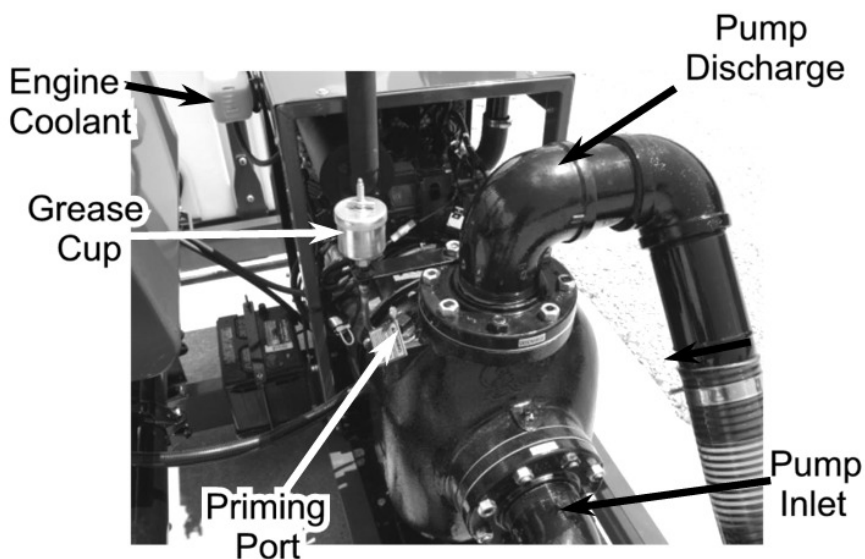


CAUTION

TRAPPED FLUID MAY BE PRESENT and will spill out when piping, hoses, pump or filter shear are removed.

CAUTION

NEVER LEAVE LIQUID IN THE PUMP CASING, PIPING, OR HOSES during freezing weather conditions, as damage will result. Follow instruction for winterizing.



CAUTION

BEFORE STARTING OR RESTARTING the engine and centrifugal pump, make sure any valves installed on the pump suction inlet line are open, and the fluid level in the tank is above the suction line.

Description, Care and Maintenance

Diesel Powered Centrifugal Pump

Grease cup instructions (Fig.5)

Fill the grease cup through the grease fitting with No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal.

NOTE:

Some smoking and leakage may occur after installing a new seal assembly. This should stop after the pump has run a while and the lapped seal faces have seated in.

Fig.5

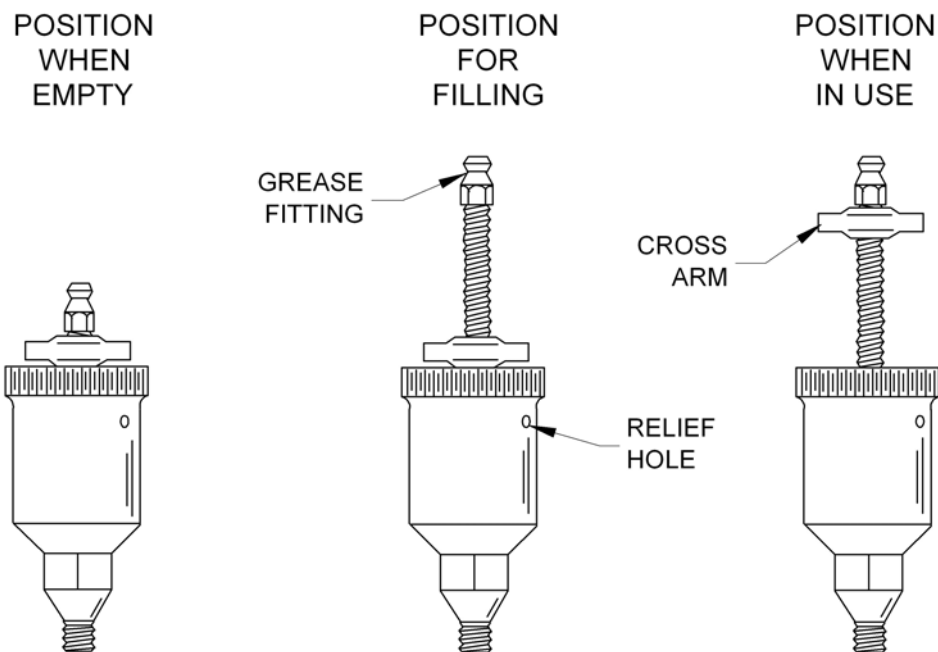


Figure 4. Automatic Lubricating Grease Cup

Description, Care and Maintenance

Diesel Powered Centrifugal Pump

Grease cup instructions (Fig.5a)

GREASE CUP NEEDS TO BE CLEANED REGULARLY

The grease cup may not perform its function properly (lubricating the seal) if it is not routinely cleaned of old hard grease build-up.

If the grease cup is always “topped up” instead of allowed to run to the full stroke of the plunger, the grease may dry out and build up inside of the cup and not allow the plunger to push to the full stroke. This in turn will stop the supply of grease to the seal causing premature seal failure.

As a precaution it is strongly recommended that every 30 days, the grease cup (or the top of the grease cup) be removed and the inside of the cup and the plunger be cleaned of all old grease.

Reassemble the plunger into the cup and check that the plunger slides to the bottom of the now clean cup.

Fill with fresh grease.

FIG #5a Shows clean grease cup & plunger and old, dried grease taken out of the cup, that was causing the plunger to “hang-up”.

Fig. 5a



M-1500D

Description, Care and Maintenance

Filter / Shear System

The filter / shear (Fig.6a) system on the M-1500 is an integral part of the mixing system and to operate efficiently requires daily cleaning of the stainless steel internal filter /shear. The filter / shear system is a two-piece unit (Fig.6b) consisting of an outside housing and an internal filter / shear. The filter / shear will trap any debris, such as parts of bags, stones, leaves grass etc. The proper procedure for cleaning the filter / shear is to close the suction valve from the reservoir tank to the pump, Rotate the “Tank Gun” & “Drill Fluid” valves to the closed position, remove the 6 inch Snap Loc coupler at the right end of the filter housing, remove the 4 inch Snap Loc coupler at the discharge port of the centrifugal pump. You will now be able to remove the internal filter / shear from the housing, after the internal filter / shear has been removed, you will see on the end of the filter / shear an end cap (Fig.6b). Remove the end cap and wash out the filter / shear with clear water. Reinstall the end cap on the filter / shear, reinstall the filter / shear in the housing (*Note the small block on the bottom of the screen, this is placed on the bottom of the filter housing to aid lining up the 6 inch Snap Loc coupler and gasket*) do-not clamp the 6 inch coupler until the 4 inch coupler and gasket are properly lined up. After all pieces are correctly lined up, clamp the 6 inch coupler 1st and 4 inch coupler 2nd and reinstall the safety pins. Open all of the valves that were close prior to removing the filter / shear.

Fig.6a

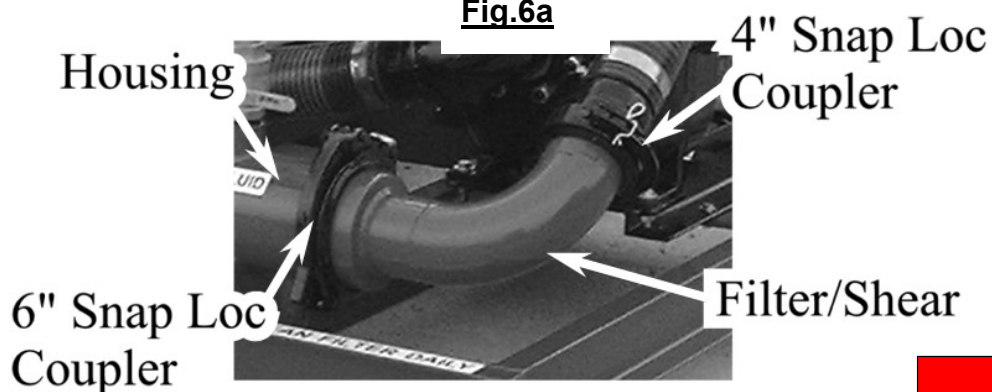
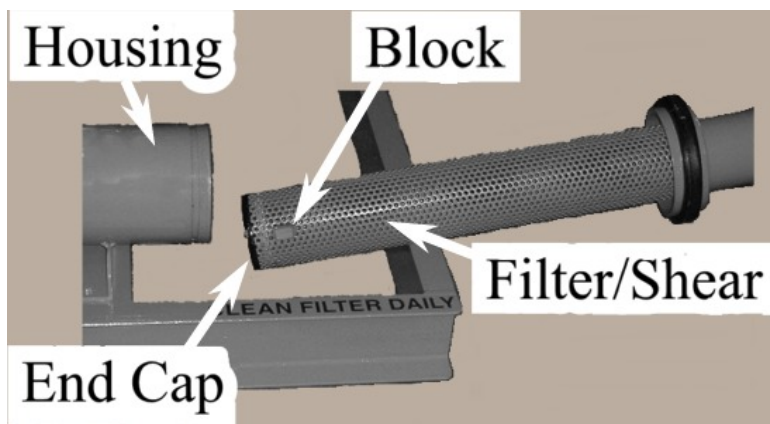


Fig.6b



⚠ DANGER

NEVER ATTEMPT REPAIRS OR DISASSEMBLY

without shutting off the engine / motor
and disconnecting the power source.
Serious personal injury will result.

⚠ WARNING

NEVER ATTEMPT TO REMOVE OR CLEAN THE FILTER SHEAR

while the unit is in operation.
Serious personal injury will result.

CAUTION

CARE MUST BE TAKEN WHEN
INSTALLING THE COUPLER GASKETS.
If the gaskets are not properly lubricated
and installed, a leak may develop.

Description, Care and Maintenance

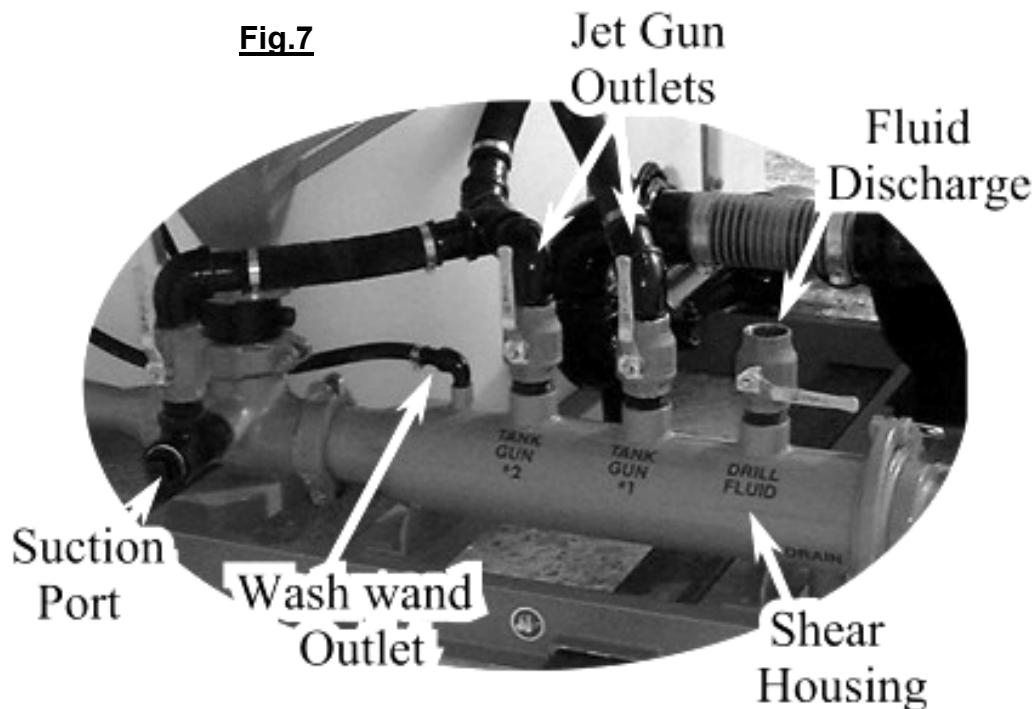
Filter / Shear System *continued*

On top of the filter / shear housing (Fig.7) are three outlets that have 2" NPT ball valves connected to them. The outlets are labeled for their functions. An outlet will be labeled and connected to the internal jet gun (explained further on in this manual) mounted inside of the 1st reservoir tank. Another outlet will be labeled and have a "T" connection. One run of the "T" connection will be connected to the internal jet gun mounted inside of the 2nd reservoir tank, the other run of the "T" connection will be routed to a valve on the suction port of the venturi mixing tee.

The final outlet will be labeled and is to be used as a discharge for the fluid after it is mixed. The discharge can be connected to another reservoir tank or directly to the drill rig. To control the flow of discharge, the ball valve can be used to regulate the flow. The speed of the engine can also be used to control the flow and pressure of the discharge. It is up to the customer to decide the piping arrangement and how they would use the discharge options. The discharge flow can have high pressure and high volume flows associated with it, and should be treated as such. If you are unsure of the installation and routing of this flow, contact Surface to Surface Inc. for more details.

Also on top of the housing is the outlet for the wash wand. The wash wand is explained in more detail further on in this manual.

Fig.7



CAUTION

WHEN TRANSFERRING FLUID to the drill rig, fluid pressure may reach or exceed 50 p.s.i.
CHECK the drill rig manufacturers specifications regarding maximum inlet pressures allowed for their pump.

CAUTION

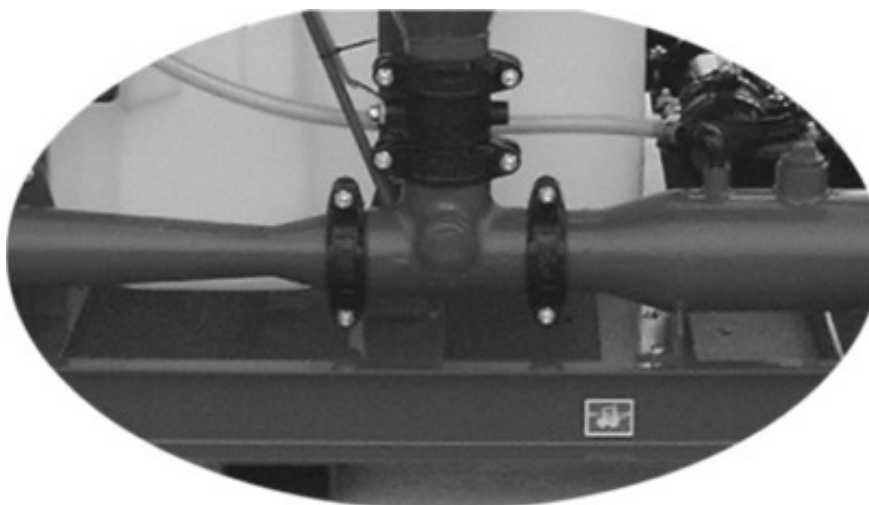
TRAPPED FLUID MAY BE PRESENT and will spill out when piping, hoses, pump or filter shear are removed.

Description, Care and Maintenance

Venturi Mixing Tee

The Venturi Mixing Tee (Fig8a.) is the very heart of this system and requires very little maintenance. However parts may wear as a result of the application in time and require replacement. This wear will become evident, when the operator notices a reduction in the vacuum that helps pull in the dry product from the hopper. When mixing dry product, over time, you will see an accumulation of damp product inside of the mixing tee around the nozzle. If this accumulation is left unattended, over time it will build to the point of restricting the inlet of the mixing chamber. This situation is easily rendered, by using the wash wand to “flush out the accumulation, and force it back into the fluid stream.

Fig.8a



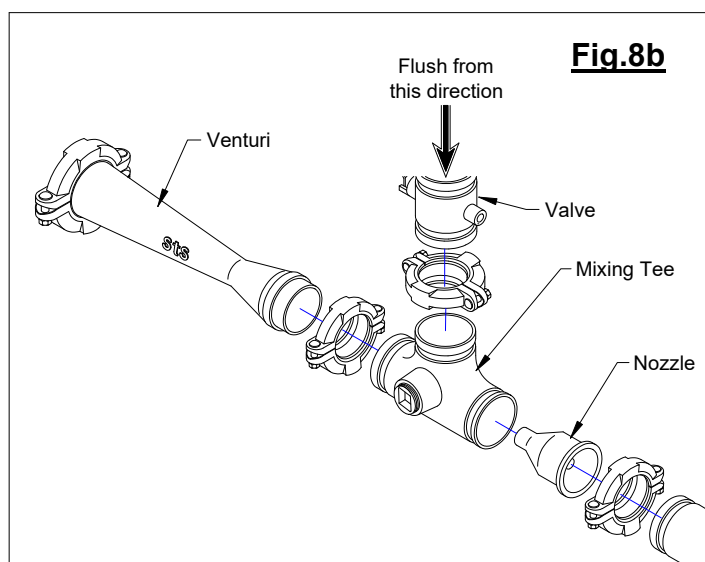
CAUTION

AVOID ALLOWING FOREIGN MATERIAL
into the Venturi Mixing Tee thru the
Hopper, by keeping the valve closed
when not in use.

⚠ WARNING

**NEVER USE BODY PARTS,
OR FOREIGN OBJECTS**
in an attempt to unplug or clean the
hopper valve or mixing tee.
Serious personal injury or
damage will result.

Fig.8b



M-1500D

Description, Care and Maintenance

Wash Wand

The M-1500 is equipped with a pressurized wash wand (Fig.9a) for clearing obstructions and accumulation in the jetting tee. It is recommended that the jetting tee be cleaned with the wash wand after the introduction of material into the hopper after each batch.

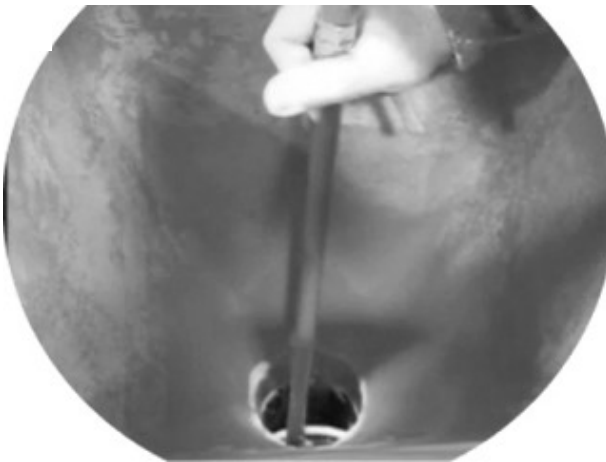
The wash wand uses the high-pressure fluid from the mixing system piping which can reach pressures of up to 50psi. **CAUTION** should always be used when handling the wash wand. A valve is located on the wash wand to regulate the flow of fluid.

The wash wand is not to be used as a poker or pry bar, but instead use the fluid from it to “wash” away accumulations. Be careful when putting the wash wand inside the mixing chamber that it does not block the fluid stream coming out of the nozzle, as it will spray back up the hopper and towards the operator.

The wash wand can also be used to get a fluid sample for testing purposes. An example of this (Fig.9b) is to check the viscosity of the fluid using a marsh funnel. Simply slow the engine speed down to reduce flow and pressure, and put the wash wand inside the hopper (with the hopper valve open) and open the small valve located on the wash wand. Rotate the valve handle to the on position, and let it flow for approx. 15 seconds, close the valve and place the wash wand in the screening area of the marsh funnel. Fill the marsh funnel to the proper volume, close the valve on the wand, and store back the small hose holder rack. Follow the instructions of the march funnel for the rest of the test.

The sample of fluid taken from the wash wand is the same as the fluid going out of the top discharge of the filter / shear housing to the drill rig or reservoir tank.

Fig.9a



! WARNING

**NEVER USE BODY PARTS,
OR FOREIGN OBJECTS**
in an attempt to unplug or clean the
hopper valve or mixing tee.
Serious personal injury or
damage will result.

! CAUTION

**DO NOT POSITION
ANY PART OF YOUR BODY**
over the hopper, valve,
or mixing tee while cleaning.

! CAUTION

**WHEN THE UNIT
IS IN OPERATION,**
the fluid in the piping may reach
pressures up to 50 p.s.i.
When the engine is idling, the system is
still pumping fluid under pressure.

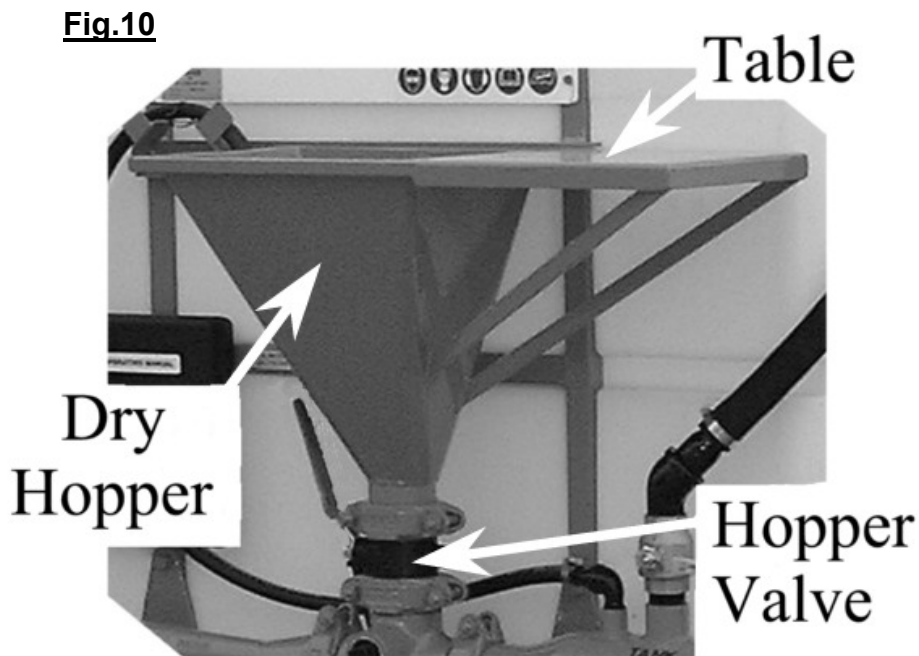
Fig.9b



Description, Care and Maintenance

Dry Hopper with Table and Hopper Valve

The Dry Hopper and Table (Fig.10) are used during the initial mixing of the dry product and fluid. The hopper and table require very little daily maintenance, however care should be used that this unit does not become overloaded. There should never be more than 100 lb. in or on the hopper and table at any time. The hopper and table are not ladders and should not be climbed on or sat on, damage can result. The hopper valve must be kept free of dried Bentonite, ice or other buildups to reduce the chance of damage during opening and closing. The valve operates more smoothly if the surfaces are kept damp or wet. All valves are to be opened and closed by hand. **DO NOT FORCE THE VALVE OPEN OR CLOSED**, visually check the valve if a problem occurs!



⚠ WARNING

NEVER USE BODY PARTS, OR FOREIGN OBJECTS
in an attempt to unplug or clean the hopper valve or mixing tee.
Serious personal injury or damage will result.

⚠ CAUTION

DO NOT POSITION ANY PART OF YOUR BODY
over the hopper, valve, or mixing tee while cleaning.

CAUTION

AVOID ALLOWING FOREIGN MATERIAL
into the Venturi Mixing Tee thru the Hopper, by keeping the valve closed when not in use.

Description, Care and Maintenance

Internal Tank Jet Gun(s)

The Internal Jet Gun(s) (Fig.11a) are located inside the polyethylene plastic reservoir tanks, and their main function is to keep the slurry product in the tank moving. This function assures the elimination of dead spots in the tank and a consistent mixture of fluid. The internal jet gun control valve labeled “Tank Gun #1” (Fig.11b) should always be in the open position, unless you are cleaning the filter / shear (described earlier) or performing repairs on the system. If the valve is not closed a siphoning action can occur, pulling fluid from the #1 tank and into the external piping. The internal jet gun control valve labeled “Tank Gun #2” (Fig.11b) will be in the open or closed position depending on the function or scenario (described in section IV) that the #2 tank is used.

The jet guns require little or no maintenance and will only require attention if the jets become clogged. Flushing the entire system weekly with clear water should eliminate any problems with this piece of the system. The fluid jetting from the Jet Gun is at a very high pressure and extreme caution should be used when removing and viewing through the small vent cap on the tank lid.

The tank jet gun(s) also acts as a relief valve to the system and relieves the pressure spikes caused when the flow to the drill rig or reservoir tank is interrupted.

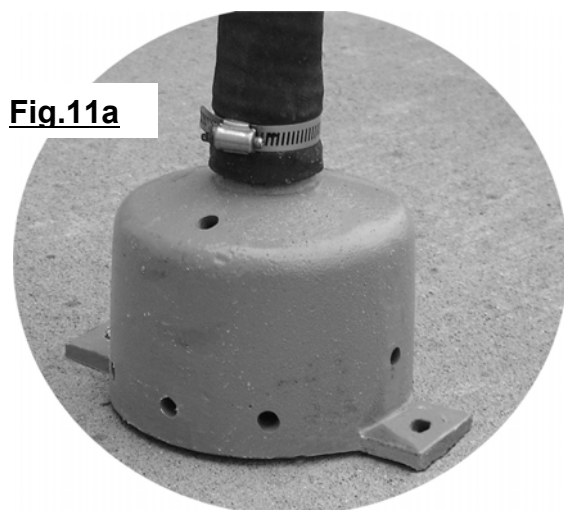


Fig.11a

Fig.11b



⚠ DANGER

NEVER ATTEMPT REPAIRS OR DISASSEMBLY

without shutting off the engine / motor
and disconnecting the power source.
Serious personal injury will result.

⚠ CAUTION

NEVER OPERATE THE MIXING unit with the tank lid open.

If viewing is necessary, open
only the small inspection
vent cap in the center of the lid.

CAUTION

TO ENTER THE TANK is not recommended
Personal injury could result from
the presents of hazardous fumes,
remaining fluid or unit start-up.

⚠ CAUTION

**WHEN THE UNIT
IS IN OPERATION,**
the fluid in the piping may reach
pressures up to 50 p.s.i.
When the engine is idling, the system is
still pumping fluid under pressure.

SECTION #III

Set-up and Installation of Unit in Detail

M-1500D

Set-up and Installation of M-1500 in detail

Permanent mounting of the unit

The M-1500 is built on 2 sub frames that can be bolted down to a permanent surface like a concrete pad, pull type trailer, flat deck of a truck or inside of a truck body. Securing the unit with adequate size and grade of fasteners is the sole responsibility of the customer and not of Surface to Surface Inc.

There are four locations inside the fork pockets (Fig.12) to fasten either sub frame. These are structurally designed to hold and withstand any movement of the unit when properly sized fasteners are inserted into the holes. When fastening down the unit, care should be used when drilling holes into the surface below to avoid such unseen items, as gussets, cross-members, wiring or other fixtures below the surface. Also consider the placement of the tank drain (supplied with unit). You will need access to this drain and any plugs or valves that are connected to it.

Adequate space or an opening will also have to be considered when mounting, for the removal of the filter / shear cartridge for regular cleaning and inspection.

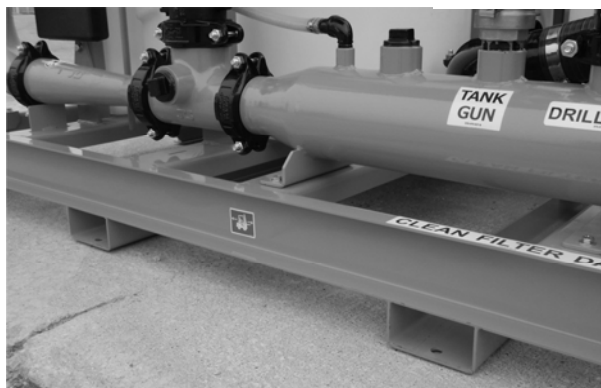
Be aware of the engine exhaust and how it will impact on the placement of the unit. If the unit is to be mounted in an enclosed area the exhaust will have to be vented outside where it will not affect the health of the operator or others working near the unit.

Portable use of the unit

If the M-1500 is to be used as a portable unit, there are tubes to slide the forks of the appropriate size lift truck under the main skid frame (Fig.12). Make sure that the mixer is properly balance on the forks before lifting or moving. Placing the forks into the tubes under the main skid frame **DOES NOT secure the unit to the forks when lifting or moving, therefore the unit should be secured to the forks with chain, cable or other fastening devices that will restrict movement.**

The M-1500 should always be placed on solid, level ground with a clear working area around it.

Fig.12

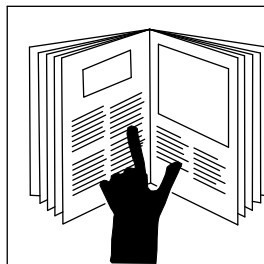


CAUTION

LIFTING LUGS OR THE LIFTING POINT(S) identified and labelled on the skid structure must be used in order to safely lift and transport the unit.

CAUTION

BEFORE LIFTING OR MOVING THE UNIT, all fluid should be removed from the tank.



WARNING

REFER TO THE SAFETY STATEMENTS IN THE ENGINE OEM MANUAL AND THIS MANUAL REGARDING THESE OPERATIONS.

SECTION #IV

Operating the M-1500 Unit



M-1500D

Operating the M-1500 Unit

Site Setup & Pre-Check

SITE SETUP

- **CHECK** for overhead hazards if unloading the units to the ground.
- **UNLOAD** the units by using the sub frame frame fork tubes (marked) with appropriate equipment.
- **SET** and position the unit on solid level surface to avoid settling or upset.
- **SET** and position the unit to have a clear unobstructed working area of 10ft (3m) on all 4 sides.
- **CONNECT** and secure all hoses onto the unit according to your layout.
- **SECURE** the truck and/or the trailer that the unit is mounted on, from movement.
- **PROTECT** any hose(s) that connect between the M-1500 and the drill rig, from possible damage or from being driven upon by a vehicle.

UNIT PRE-CHECK

- **READ** the engine operators manual for proper starting and running procedures.
- **CHECK** to ensure the engine oil level is correct. Refer to the engine operator manual supplied.
- **CHECK** to ensure the air filter is clean (replace if necessary). Refer to the engine operator manual supplied.
- **CHECK** to ensure the fuel tank is full and the fuel tank shut off valve is open.
- **CHECK** to ensure the grease cup on the pump is full of grease and the winged/lugged nut on the top, is backed off to allow the shaft to retract into the grease cup.
- **CHECK** to ensure any valves installed on the suction intake line between the tank and centrifugal pump are open.
- **CHECK** to ensure there is sufficient fluid in the tank, to insure the centrifugal pump does not run dry.
- **CHECK** to ensure the centrifugal pump is primed.
- **CHECK** to ensure the ball valve on the filter housing marked “#1 Tank Gun” is open.
- **CHECK** to ensure the ball valve on the filter housing marked “Drill Fluid” is closed.
- **CHECK** to ensure the small ball valve connected to the Wash Wand is closed.
- **CHECK** that the hopper valve is closed.

M-1500D

Operating the M-1500 Unit

Starting the Engine & Pump

***** The Engine Operators Manual should be consulted for a more detailed engine start up and shut down procedures.**

Starting the Diesel Engine

- Make sure the fuel shut off valve located under the fuel tank is open.
- Rotate the speed control knob 1/3 of the way out, towards the high-speed position.
- Insert the key into the key switch. If the engine is cold or the ambient temperature is low, use the pre-heat feature on the key switch as per the engine operators manual. Rotate the key to the start position. Do not operate the electric starter continuously for more than 5 seconds, even if the engine does not start. If the engine fails to start, turn the key to the run position and wait for about 10 seconds before retrying.
- After the engine starts, set the speed control knob at the low speed position and warm it up for approximately 10 minutes.
- Remember that the system is pumping water under pressure, even when the engine is at a slow speed.
- Gradually rotate the speed control knob toward the high-speed position and set at the required speed.

Note: Whenever high-speed operation is not required, slow the engine speed down to half speed by rotating the speed control knob, to save fuel and extend engine life.

Fig.13a

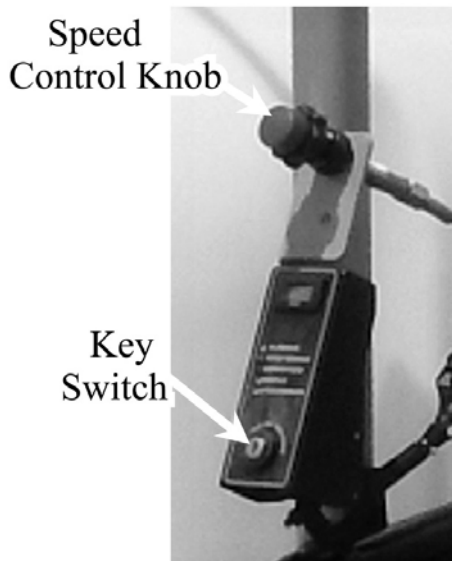
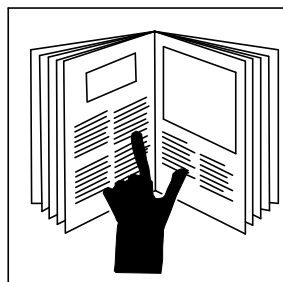
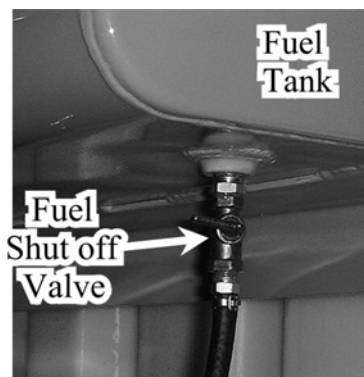


Fig.13b



⚠ WARNING

REFER TO THE SAFETY
STATEMENTS IN THE
ENGINE OEM MANUAL
AND
THIS MANUAL
REGARDING THESE
OPERATIONS.

CAUTION

**BEFORE STARTING THE ENGINE,
BE SURE THE PUMP IS PRIMED!**

Check the pump by slowly & carefully opening the plug located on the top of the centrifugal pump discharge elbow. A visual inspection can be made if the fluid escapes around the plug as it is loosened. Remove the plug to view inside fluid level.

The centrifugal pump seal **WILL** be damaged if allowed to cavitate or run dry.



M-1500D

Operating the M-1500 Unit

Typical Mixing Operations

Guide lines for Mixing

- Always operate the engine at high speed.
- Open the hopper valve at the bottom of hopper where it joins the venturi mixing tee.
- Introduce the dry or liquid raw material into the hopper.

When mixing a new batch, introduce the 1st bag of dry product at a rate of 40 lbs per minute. Once the first 40 lbs. of dry product are in the fluid stream, all dry products may be introduced as fast as the hopper will allow. This allows time for the 1st bag to be mixed well into the fluid and will now aid to suspend all remaining dry product that is added, in the fluid in the tank to achieve a better shear and stop any build-up in the tank.
- Suction created by the venturi mixing tee will draw the raw material into the jet stream for initial mixing.
- Flush jetting tee with wash wand.
- Close the butterfly valve on the hopper to keep debris out of the system.
- Allow the mixing system to circulate the product until the desired consistency is attained.
- A sample of the mixed fluid may be taken at from the wash wand as described earlier in this manual, on the wash wand description page.

Mixing Scenarios

The mixing operation of the M-1500 unit can be used in 3 different scenarios. The unit is set up at the factory with all the proper plumbing and hardware, and all that is required, is the proper opening and closing of valves as described below. Different combinations may be tried but **ALWAYS REMEMBER** the pump needs flow to the suction inlet and at least 1 jet gun valve is to be open.

***Scenario 1** is to use the back tank as a fresh water holding tank only. All the mud will be mixed in the front tank and then discharged to the drill rig. The fresh water to replenish the front tank will be drawn (sucked) from the back tank, thru the internal jet gun mounted inside the back tank. When the front tank is filled to the desired amount, the mixing operation can continue, and the back tank can be refilled with fresh water from an outside source. This scenario works well if the total amount of mud to be used is not great (less leftovers), or the outside water source is slow (mixing and delivering while filling rear tank with fresh water).

***Scenario 2** will make 1500 gallons of mud in 2 batches. The mud is mixed in the front tank and then transferred to the back tank. The front tank is then filled with fresh water from an outside source, and then the mud is mixed in, thus giving you 2 full tanks. The valves are opened and the mud from both tanks will flow together to the drill rig. This scenario works well if the mud is to be mixed to a very high viscosity.

***Scenario 3** will make 1500 gallons of mud in one batch. Both tanks are filled with fresh water and the valves are open, which lets both tanks function together. The mud is added in and both tanks will have the mixture circulated thru them and out to the drill rig. This scenario works well if the mud is to be mixed to light viscosity.



M-1500D

Operating the M-1500 Unit

Typical Mixing Operations

Scenario 1

- Open the 4" suction valve of the front tank, and #1 jet gun valve. All other valves are to be closed.
- With both tanks full of fresh water operate engine at high speed.
- Open the 4" butterfly valve at bottom of hopper where it joins the mixing tee.
- Introduce the dry or liquid raw material into the hopper.
- Suction created by the mixing tee will draw the raw material into the jet stream for initial mixing.
- Flush the jetting tee with the wash wand.
- Close the butterfly valve on the hopper to keep debris out of the system.
- Allow the mixing system to run at full speed to circulate the product until the desired consistency is attained.
- Open the drill fluid valve to send fluid to the drill rig. Engine speed can be set to obtain the required flow and pressure to the drill rig.
- When the fluid level in the front tank reaches approx 8" from the bottom, open the 2" valve located on the front of the jetting tee. The suction created in the jetting tee will draw the water from the rear tank thru its internal jet gun, and into the front tank.
- When the fluid level in the front tank reaches the desired level, close the previously opened 2" valve (located on the front of the jetting tee.)
- Open butterfly valve at bottom of hopper and mix in the product as mentioned previously. At this time the rear tank may be refilled with fresh water if required.

Scenario 2

- Open the 4" suction valve of the front tank, and #1 jet gun valve. All other valves are to be closed.
- With the front tank full of fresh water operate engine at high speed.
- Open the 4" butterfly valve at bottom of hopper where it joins the mixing tee.
- Introduce the dry or liquid raw material into the hopper.
- Suction created by the mixing tee will draw the raw material into the jet stream for initial mixing.
- Flush the jetting tee with the wash wand.
- Close the butterfly valve on the hopper to keep debris out of the system.
- Allow the mixing system to run at full speed to circulate the product until the desired consistency is obtained.
- Open #2 jet gun valve to send fluid to the rear tank.
- When the fluid level in the front tank reaches approx 8" from the bottom, close the #2 jet gun valve.
- Refill the front tank with fresh water and mix in the product as mentioned previously.
- When the desired consistency is obtained, reduce engine speed and open the 4" suction valve of the rear tank and #2 jet gun.
- Open the drill fluid valve to send fluid to the drill rig. Engine speed can be set to obtain the required flow and pressure to the drill rig.



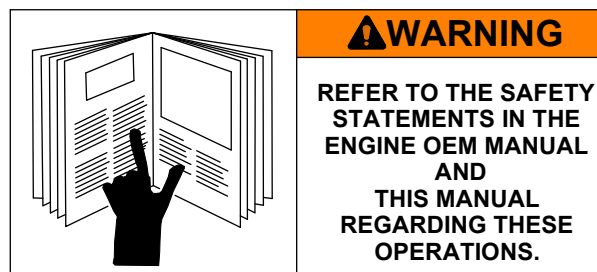
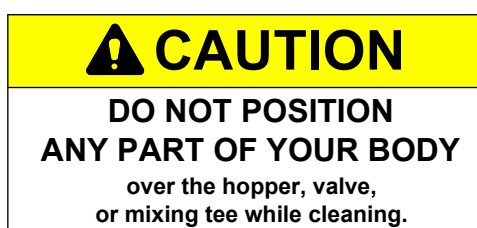
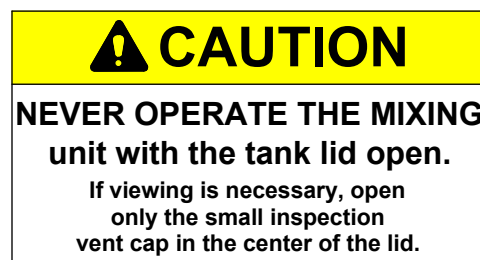
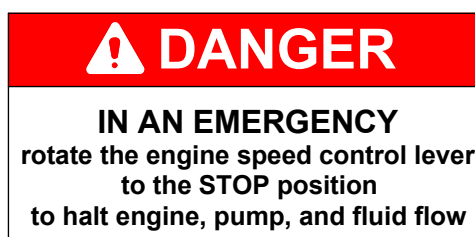
M-1500D

Operating the M-1500 Unit

Typical Mixing Operations

Scenario 3

- Open the 4" suction valves of the front and rear tank, and #1 and #2 jet gun valves. All other valves are to be closed.
- With both tanks full of fresh water operate engine at high speed.
- Open the 4" butterfly valve at bottom of hopper where it joins the mixing tee.
- Introduce the dry or liquid raw material into the hopper.
- Suction created by the mixing tee will draw the raw material into the jet stream for initial mixing.
- Flush the jetting tee with the wash wand.
- Close the 4" butterfly valve on the hopper to keep debris out of the system.
- Allow the mixing system to run at full speed to circulate the product until the desired consistency is attained.
- It should be noted and watched, that the front tank may gain in volume because of the viscosity and hose length over the back tank. This difference can be kept in check by slightly closing the #1 jet gun valve. The amount of adjustment (closing) will depend on the condition of the fluid and engine speed and therefore will be up to the operator to monitor.
- Open the drill fluid valve to send fluid to the drill rig. Engine speed can be set to obtain the required flow and pressure to the drill rig.






M-1500D

Operating the M-1500 Unit

Typical Transfer/Offloading Operation

Transferring Operation


- On the top of the filter / shear housing of the M-1500 you will see a 2 in. ball valve (2"NPT.) marked "Drill Fluid".
- A transfer hose with a minimum size of 2 in. can be attached to the ball valve to carry the finished product to a holding tank or directly to the drill rig.
- Make the necessary connections at the holding tank or the drill rig.
- Run the M-1500 pump at a favorable speed and slowly rotate the ball valve handle to the open position, to allow the fluid to flow to the holding tank or the drill rig.
- The speed and pressure of the fluid flow is determined by the engine speed.
- If the unit is supplying the drilling rig directly, a valve, mounted on the drilling rig, that is controlled by the operator of the drill rig, will be needed to stop the flow. The jet gun valve will need to be in the open position to act as a "relief" when the valve on the drill rig is closed.
- If transferring to a reservoir tank, the valve on top of the filter/shear housing is used to start / stop the flow of fluid.
- When removing the mixed fluid from the tank (to the drill rig or reservoir), leave approximately 4" of fluid in the bottom of the tank to keep the pump from sucking air (cavitation).

 **DANGER**

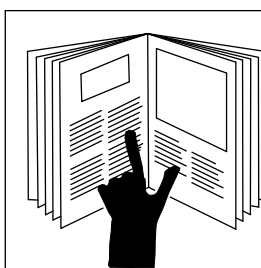
IN AN EMERGENCY
rotate the engine speed control lever
to the STOP position
to halt engine, pump, and fluid flow


CAUTION

WHEN TRANSFERRING FLUID
to the drill rig, fluid pressure may
reach or exceed 50 p.s.i.
CHECK the drill rig manufacturers
specifications regarding maximum inlet
pressures allowed for their pump.

 **CAUTION**

**WHEN THE UNIT
IS IN OPERATION,**
the fluid in the piping may reach
pressures up to 50 p.s.i.
When the engine is idling, the system is
still pumping fluid under pressure.



 **WARNING**

REFER TO THE SAFETY
STATEMENTS IN THE
ENGINE OEM MANUAL
AND
THIS MANUAL
REGARDING THESE
OPERATIONS.

M-1500D

Operating the M-1500 Unit

Typical Warm Weather Shutdown & Storage

Daily Shut Down

- Rotate the engine speed control knob (Fig. 13a) to the low speed position and allow the engine to run at low speed for 5 minutes.
- Rotate the key switch (Fig. 13a) to the off position.
- Close the fuel tank shut off valve (Fig. 13b)
- Close the valve on the suction line between the tank and the pump.
- If fluid is left in the tank, rotate the “tank gun(s)” valve to the closed position.
- Remove the filter / shear as described in maintenance section.
- Clean filter / shear as described in maintenance section.

Additional Week End Shut Down

- Pump or drain remaining mixed fluid out of the tank(s) and dispose of it according to local environmental approved practices.
- Make sure “Tank Gun(s)” and “Drill Fluid” valves are open.
- Fill and rinse the tank with clear water and then start the engine and pump. By pumping this water through the system, it will remove buildup and dilute any remaining mixed fluid in the system.
- Open the valve on the wash wand and flush it back into the hopper. Open the hopper valve to drain, then close.
- Stop the engine and pump.
- Drain the remaining water out of the tank(s) (*use the customer installed tank bottom drain valve*) and dispose of it according to local environmental approved practices.
- Remove the drain cap(s) on any of the suction tees located at the tank and allow remaining water to escape from the piping. After draining, replace the cap(s).
- Remove centrifugal pump front drain plug. Replace the plug when the pump is empty.
- Make sure “Tank Gun” and “Drill Fluid” and wash wand valves are open.
- Remove filter / shear and clean as described in the maintenance section of this manual.
- Using a wet/dry vacuum, vacuum remaining water and debris from the polyethylene plastic reservoir tank(s).

⚠ DANGER

**NEVER ATTEMPT REPAIRS
OR DISASSEMBLY**

without shutting off the engine / motor
and disconnecting the power source.
Serious personal injury will result.

CAUTION

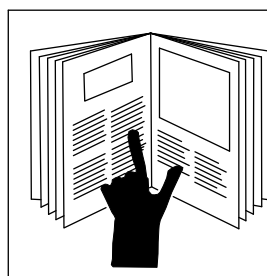
TO ENTER THE TANK is not recommended
Personal injury could result from
the presents of hazardous fumes,
remaining fluid or unit start-up.

CAUTION

CARE MUST BE TAKEN WHEN
INSTALLING THE COUPLER GASKETS.
If the gaskets are not properly lubricated
and installed, a leak may develop.

CAUTION

TRAPPED FLUID MAY BE PRESENT
and will spill out when piping, hoses,
pump or filter shear are removed.



⚠ WARNING

REFER TO THE SAFETY
STATEMENTS IN THE
ENGINE OEM MANUAL
AND
THIS MANUAL
REGARDING THESE
OPERATIONS.



M-1500D

Operating the M-1500 Unit

Typical Cold Weather Shutdown & Storage

Additional Winter and Freezing Weather Shut Down

- Pump or drain remaining mixed fluid out of the tank and dispose of it according to local environmental approved practices.
- Make sure “Tank Gun(s)” and “Drill Fluid” valves are open.
- Fill and rinse the tank with clear water and then start the engine and pump. By pumping this water through the system, it will remove buildup and dilute any remaining mixed fluid in the system. Open the valve on the wash wand to flush it.
- Stop the engine and pump.
- Drain the remaining water out of the tank (*use the customer installed tank bottom drain valve*) and dispose of it according to local environmental approved practices.
- Remove the drain cap on the suction tee located at the lower right end of tank and allow remaining water to escape from the piping. Leave the cap off.
- Remove centrifugal pump front drain plug. Leave the pump plug out.
- Make sure “Tank Gun(s)” and “Drill Fluid” and wash wand valves are open.
- Remove filter / shear and clean as described in the maintenance section of this manual. Leave filter / shear out of housing as this will allow remaining moisture to drain.
- Open the hopper valve and pour in a suitable environmentally friendly anti-freeze until it runs out of the filter / shear housing opened end.
- Shut the hopper valve and pour a suitable environmentally friendly anti-freeze into the hopper until about 2” of fluid cover the valve. This will stop the valve from freezing around the edges.

CAUTION

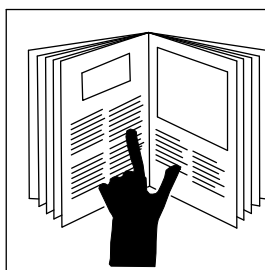
NEVER LEAVE LIQUID IN THE PUMP CASING, PIPING, OR HOSES during freezing weather conditions, as damage will result.
Follow instruction for winterizing.

CAUTION

CARE MUST BE TAKEN WHEN INSTALLING THE COUPLER GASKETS. If the gaskets are not properly lubricated and installed, a leak may develop.

CAUTION

TO ENTER THE TANK is not recommended
Personal injury could result from the presents of hazardous fumes, remaining fluid or unit start-up.



WARNING

REFER TO THE SAFETY STATEMENTS IN THE ENGINE OEM MANUAL AND THIS MANUAL REGARDING THESE OPERATIONS.

M-1500D

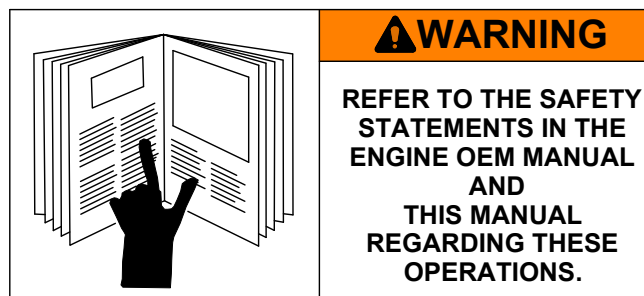
Operating the M-1500 Unit

Prolonged Periods of Storage

Prolonged Periods of Storage

After a thorough cleaning of the internal and external components of the M-1500, the following steps should be applied to extend the life of your unit.

- Prolonged periods of storage require extra care of the pump to protect from rusting internally. Separate the pump (as you would to replace the seal) to dry and spray with a protective oil film.
- Prolonged periods of storage require engine preparation. See engine operator's manual.



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Operating the M-1500 Unit

Optional Self-Loading Feature

Self Loading (*customer to install*)

If the self-loading feature of The M-1500 is required, you will find a 2 in. NPT (suction) port located on the venturi-mixing tee below the hopper valve (Fig.14a). All units are shipped with a plug installed in the port.

A common practice is to use this “suction port” to draw fresh water from another reservoir tank. quick coupler capable of being capped when not in use OR a hose barb and a non-collapsing hose (*hard hose*) can then be installed as a permanent connection AFTER the valve.

Caution should be used when threading in a connection into the suction port. Do not over tighten the Regardless of the configuration of the connection used, this port needs to be sealed off (valve or capped) when not being used as a suction port. The reason for this is that then the unit is shut off, fluid will fill the mixing tee and spill out the port or when the unit is in operation, it will draw air and a decrease the vacuum at the hopper inlet.

When the unit is mixing product from the hopper, this port will need to be closed. If you are using this port for suction, the hopper valve is to be closed. **THIS MEANS YOU CANNOT “MIX ON THE FLY” OR MIX AND SUCK AT THE SAME TIME!**

To use this option there must be an adequate amount of fluid in the reservoir for the pump to maintain flow and the speed of the centrifugal pump may have to be slowed at the first until the fluid is being “sucked” into the tee and the volume in the reservoir increases, then the pump may be sped up.

If the suction port is connected (as described above) but not used frequently, a build-up of dry product may form inside the port at the mixing Tee. The wash wand can usually wash this out. If you notice a decrease or stoppage in the amount of fluid being drawn in to the system through this port, then there is build-up at the port and should be cleaned.

Fig.14a

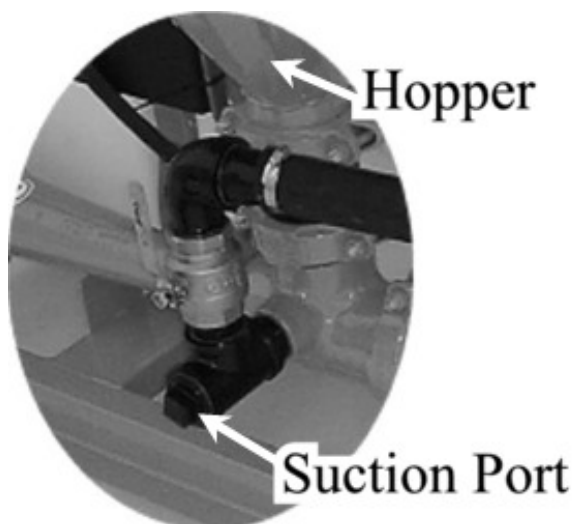
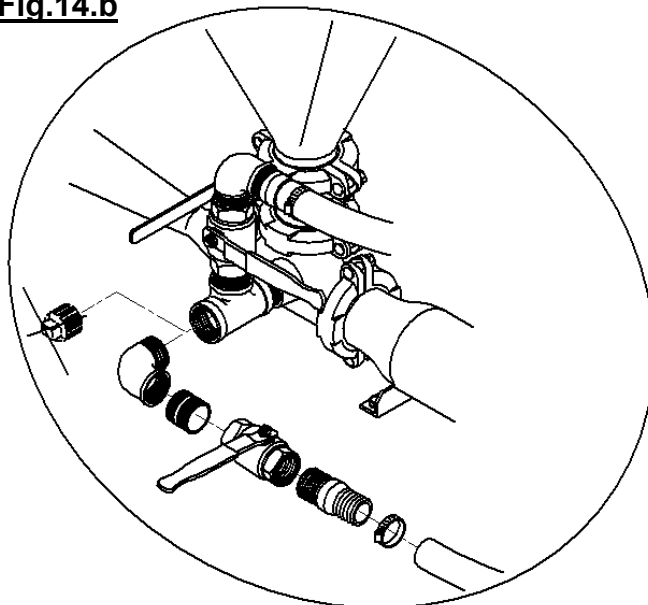


Fig.14.b



SECTION #V

Troubleshooting the M-1500 Unit



M-1500D

Troubleshooting the M-1500 Unit

The M-1500 mixing unit is of a simple design with limited moving parts or consumable pieces. The basic system works with a pump that draws fluid from a reservoir tank. The fluid then exits the pump and by building pressure, and velocity, forces the fluid through the filter / shear and into the mixing Tee. The fluid enters the mixing Tee through a nozzle and exists through a venturi. As the fluid enters the venturi, it creates a vacuum in the mixing tee to aid in introducing the dry product from the hopper into the mixing Tee and fluid stream. As the fluid passes through the venturi it carries the dry product with it and into the reservoir tank.

As the fluid travels through the filter / shear, a set amount of fluid is taken from that fluid stream and forced with pressure, to the jet gun inside the reservoir tank. The jet gun has multiple outlets that distribute the fluid throughout the tank to “stir up the tank bottom.”

The M-1500 can discharge fluid to the drill rig or another reservoir by allowing some fluid from the filter shear to be discharged and controlled by a valve.

**A good rule to follow when troubleshooting is as follows
Everything before the pump is being sucked, “has vacuum”.
*Everything after the pump is being blown, “has pressure”.***

The following, may aid in any problems that may arise.

- *No fluid flow/ low fluid flow*
 - Pump not primed. - Prime pump**
 - Suction valve is closed - Open suction valve**
 - Suction valve is broken and not opening inside properly. - Replace valve**
 - Plugged suction inlet inside of the tank. - Clean build-up inside of the tank**
 - Not enough fluid in the tank or cavitation - Add fluid to tank**
 - Impeller wore and gap to big. - Shim the impeller or remove gaskets**
 - Pump speed to slow. - Speed up pump**
 - Blockage in pump. - Remove blockage**
 - Fluid too thick to pump. - Thin fluid by adding more water.**
 - Filter / shear is plugged. - Clean filter shear**
- *Fluid backs up into hopper*
 - No fluid flow / low fluid flow - See above solutions**
 - Large build-up in mixing Tee - Clean mixing Tee**
 - Blockage in small part of venturi. - Remove blockage in venturi**
 - Pump speed is set to low - Increase speed of the pump.**
 - Mixing Tee suction port is open - Close off valve or cap (customer installed)**
- *Dry product is slow or will not be drawn down through the hopper.*
 - No fluid flow/ low fluid flow - See above solutions**
 - Fluid is backing up into hopper - See above solutions**
 - Dry product has lumps / debris blocking hopper valve - New product or clean valve**
 - Hopper valve closed - Open hopper valve**
 - Buildup in throat of mixing Tee - Clean throat of mixing Tee**



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Troubleshooting the M-1500 Unit

- *Tank does not stir / roll the fluid inside.*
 - No fluid to the tank jet gun** - Make sure “Tank Gun” valve is open.
 - Tank jet gun holes plugged.** - Flush fresh water through system or clean Tank jet gun
 - Hose is disconnected from tank jet gun** - Reconnect hose
 - No fluid flow/ low fluid flow** - See above solutions
- *Discharge from the unit is slow or stopped.*
 - “Drill Rig” discharge valve is closed** - Make sure “Drill Rig” valve is open.
 - Discharge hose is blocked, kinked, or pinched off.** - Repair problem(s) with hose.
 - Valve installed at the end of the discharge hose is closed or damaged.** - Open or replace valve.
 - No fluid flow/ low fluid flow** - See above solutions
- *Wash wand has little or no flow or pressure.*
 - Wash wand valve is closed or damaged** - Open wash wand valve or replace.
 - Wash wand nozzle (hole in the end) is plugged** - Shut off unit and clean out wash wand hole.
 - No fluid flow/ low fluid flow** - See above solutions
- *Fluid does not seem to mix well or is slow to mix*
 - Most of the above problems will cause poor mixing or slow mixing** - See above solutions.
- *Engine will not start*
 - See engine operator’s manual for trouble shooting engine.**

**For problems that can not be solved by the above steps,
call your local distributor or STSI (1-800-567-0978) and talk to a company
representative who would be glad to assist you with your problem.**

SECTION #VI

Periodic Maintenance & Repair Information

Basic M-1500 Diesel Periodic Maintenance Schedule ***

Consult the OEM engine manual for a more detailed maintenance schedule

<i>Engine Components</i>							
Maintenance Items	Every 8 hours (daily)	Every 50 hours (weekly)	Every 100 hours	Every 250 hours (monthly)	Every 300 hours	Every 400 hours	Every 2000 hours (or yearly)
Visual check of engine for oil, fuel leaks	0						
Clean engine and check bolts & nuts	0						
Check engine oil level & top-up if necessary	0						
Check fuel level and top up	0						
Replace engine oil	(initial 50 hr)			0			
Replace engine oil filter	(initial 50 hr)			0			
Check battery fluid level (if applicable)		0					
Check & refill engine coolant	0						
Check fuel filter / water separator	0						
Check and adjust cooling fan V-belt	0	0		0			
Lube pivot point & linkage pins on throttle control			0				
Clean or replace fuel filter						0	
*** The above engine items have been listed as basic items to check. A full and complete maintenance schedule is listed in the accompanying OEM engine manual and should be followed. STSI is not to be held liable for any discrepancies or errors in the above schedule.							
<i>Pump Components</i>							
Check General Condition Visual (Temperature, Unusual Noise or Vibrations, Cracks, Leaks, Loose hardware.	0						
Check & Fill grease cup for mechanical seal	0						
Check pump mechanical seal for leakage (dripping)	0						
Clean old grease build-up from inside of grease cup				0			
Check front impeller clearance (wear plate)						0	
Check rear impeller clearance (seal plate)						0	
Inspect the check valve						0	
<i>Equipment Components</i>							
Wash out Jetting Tee	0						
Remove & clean shear unit	0						
General Condition Visual (Cracks, Leaks, Loose hardware)	0						
Clamps are tight and safety pins installed	0						
Lube valve stems		0					
Clean reservoir tank of build-up (internal)			0				
Disassemble and visually inspect piping (internal)							0

M-1500D

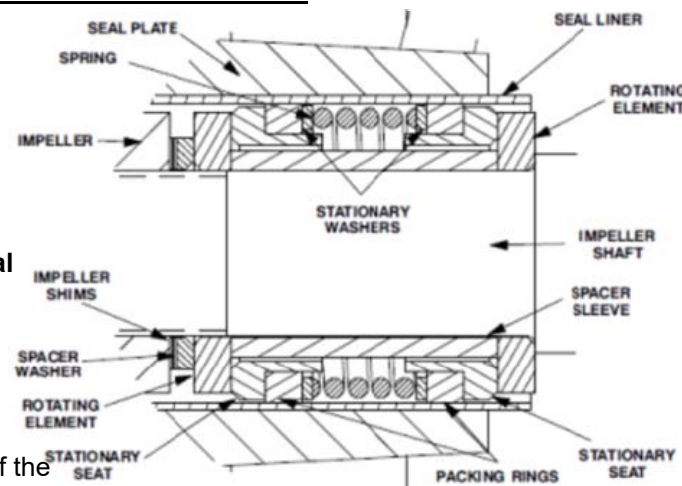
Grease Seal Installation Instructions Centrifugal Pump Application

When replacing the sea, never mix old and new parts. Wear patterns on the old seal faces cannot be realigned during reassembly, and use of old parts can result in premature failure of the new seal.

Before installing the seal, inspect the bore of the seal liner for excessive wear or grooves that might cause leakage or damage to the seal packing rings. If the seal liner must be replaced, use the new seal liner and arbor (or hydraulic) press to force the old one out. **After the liner is installed, drill a 3/8" diameter hole through it to permit the flow of lubricant to the seal liner.** Be Careful to center the drill in the threaded lubrication hole so not to damage the threads. Debur the hole from the inside of the seal liner after drilling.

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent. Be sure to follow all safety precautions described on the solvent container.

Remove the new seal and inspect the precision finished faces to ensure that they are free of any foreign matter. To ease installation of the seal, lubricate the packing rings, spacer sleeve, and seal liner with water or a very small amount of oil and apply a drop of light lubrication oil on the precision finished faces. Refer to the illustration, and assemble the seal as follows.



Installation of the inboard rotating element is dictated by the configuration of the shaft shoulder. If there is a radius at the shaft shoulder, the larger chamfer on the I.D. of the inboard rotating element must be positioned toward the shaft shoulder. If there is an undercut at the shaft shoulder, the larger chamfer must be positioned away from the shaft shoulder. Determine the correct position for the rotating element and slide it onto the shaft.

Sub assemble the inboard stationary element, packing ring and spring washer, and press this subassembly into the lubricated seal liner. A push tube cut from a length of plastic will aid seal installation. The O.D. of the tube should be about the same size as the O.D. of the seal spring.

Install the spacer sleeve and spring.

Sub assemble the outboard stationary element, packing ring and spring washer. Press this subassembly into the lubricated seal liner. If the outboard rotating element has a chamfered side, install it with the chamfer facing the impeller end of the shaft.

If your pump requires a spacer washer, install the spacer washer with the chamfer on the I.D. positioned toward the seal.

Install the impeller adjusting shims and impeller (consult the operator's manual for impeller clearance and installation instructions).

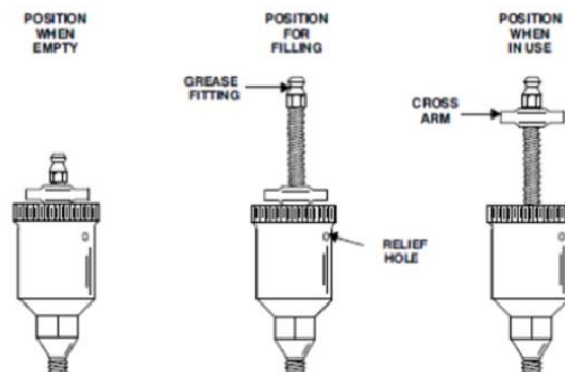
Before starting the pump, reinstall the automatic lubricating grease cup and piping (if removed for seal liner replacement). Lubricate the seal as indicated below.

LUBRICATION

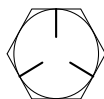
Fill the grease cup through the grease fitting with No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal.

NOTE:

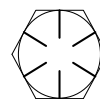
Some smoking and leakage may occur after installing a new seal assembly. This should stop after the pump has run a while and the lapped seal faces have seated in.



Bolt Torque Specifications



Grade 5



Grade 8

SAE SIZE	Lubricated *		Dry **	
	N.m	ft-lbs	N.m	ft-lbs
1/4	9.5	7	12	9
5/16	20	15	25	18
3/8	35	26	44	33
7/16	55	41	70	52
1/2	85	63	110	80
9/16	125	90	155	115
5/8	170	125	215	160
3/4	300	225	375	280
7/8	490	360	625	450
1	725	540	925	675

Lubricated *		Dry **	
N.m	ft-lbs	N.m	ft-lbs
13.5	10	17	12.5
28	21	35	26
50	36	63	46
80	58	100	75
120	90	150	115
175	130	225	160
215	160	300	225
425	310	550	400
700	500	875	650
1050	750	1300	975

* "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

** "Dry" means plain or zinc plated without any lubrication.

Metric size

Thread size x pitch mm	N.m	ft-lbs
M6 X 1.0	10.8 ± 1.0	8.0 ± 0.5
M8 x 1.25	25.5 ± 2.9	19.0 ± 2.0
M10 x 1.5	49.0 ± 4.9	36.0 ± 4.0
M12 x 1.75	88.3 ± 9.8	65.0 ± 7.0
M14 x 1.5	137.0 ± 9.8	101.0 ± 7.0
M16 x 1.5	226.0 ± 9.8	167.0 ± 7.0

Apply 60% torque to bolts that are not listed.

Apply 80% torque when tightened to aluminum alloy.



M-1500D

NOTES:

[illegible]

SECTION #VII

OEM Repair Information

GR PUMP INTRODUCTION

Read this manual carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump.

This Operation, and Maintenance section is designed to help you achieve the best performance and longest life from your pump.

This pump is an 80 Series, semi-open impeller, self-priming centrifugal model with a suction check valve. The pump is designed for straight-in suction where the medium being pumped enters directly into the impeller eye. It is designed for handling most non-volatile, non-flammable liquids containing specified entrained solids. The basic material of construction for wetted parts is gray iron.

This manual cannot possibly provide detailed instructions and precautions for every aspect of each specific installation by the customer. Therefore, it is the responsibility of the owner/installer of the mixing unit to ensure that applications not addressed in this manual are performed **only** after establishing that neither operator safety nor pump integrity are compromised by the installation. Pumps and related equipment **must** be installed and operated according to all national, local and industry standards.

If there are any questions regarding the pump or its application, which are not covered in this manual or in other literature accompanying this unit, please contact Surface to Surface or your STS distributor.

Surface to Surface Inc 1-800-567-0978

The following are used to alert maintenance personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:



Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury, which will result from failure to follow the procedure.



Hazards or unsafe practices, which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury, which could result from failure to follow the procedure.



Hazards or unsafe practices, which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage, which could result from failure to follow the procedure.

NOTE

Instructions to aid in installation, operation, and maintenance, or which clarify a procedure.

SAFETY

This information applies to 80 Series basic pumps. The power source, which is used to drive the pump, may differ from unit to unit. Refer to the manual accompanying the power source before attempting to begin operation.



WARNING!

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out or disconnect the power source to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close any suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



WARNING!

This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump liquids for which the pump, driver and/or controls have not been approved, or which may damage the pump or endanger personnel as a result of pump failure.



WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Suction and discharge hoses and piping must be removed from the pump before lifting.



WARNING!

Make certain that the unit and all piping or hose connections are tight, properly supported and secure before operation.



WARNING!

Do not operate the pump without the shields and/or guards in place over the drive shaft, belts, and/or couplings, or other rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.



WARNING!

Do not operate the pump against a closed discharge valve for long periods of time. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.

SAFETY continued



WARNING!

Overheated pumps can cause severe burns and injuries. If overheating of the pump occurs:

1. Stop the pump immediately.
2. Ventilate the area.
3. Allow the pump to completely cool.
4. Check the temperature before opening any covers, plates, gauges, or plugs.
5. Vent the pump slowly and cautiously.
6. Refer to instructions in this manual before restarting the pump.



WARNING!

Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to completely cool before servicing.



WARNING!

Never run this pump backwards. Be certain that rotation is correct before fully engaging the pump.



CAUTION

Pumps and related equipment must be installed and operated according to all national, local and industry standards.

OPERATION

Review all SAFETY information in this manual. Follow the instructions on all tags, labels and decals attached to the pump.



This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump liquids for which the pump, driver and/or controls have not been approved, or which may damage the pump or endanger personnel as a result of pump failure.

PRIMING

Install the unit and hoses as described in this manual.

Make sure that the piping and hose connections are tight, and that the unit is securely mounted. Check that the pump is properly lubricated (see LUBRICATION and REPAIR).

This pump is self-priming, but the pump should never be operated unless there is liquid in the pump casing.



Never operate this pump unless there is liquid in the pump casing. The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly.

Add liquid to the pump casing when:

1. The pump is being put into service for the first time.
2. The pump has not been used for a considerable length of time.
3. The liquid in the pump casing has evaporated.

Once the pump casing has been filled, the pump will prime and re-prime as necessary.



After filling the pump casing, reinstall and tighten the fill plug. Do not attempt to operate the pump unless all connecting piping and hoses are securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.

To fill the pump, remove the pump casing fill cover or fill plug in the top of the casing, and add clean liquid until the casing is filled. Replace the fill cover or fill plug before operating the pump.

TROUBLESHOOTING

Review all SAFETY information in Section A.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out or disconnect the power source to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Not enough liquid in casing. Suction check valve contaminated or damaged. Air leak in suction line. Leaking or worn seal or pump gasket.	Add liquid to casing. See PRIMING . Clean or replace check valve. Correct leak. Check pump vacuum. Replace leaking or worn seal or gasket.
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Air leak in suction line. Leaking or worn seal or pump gasket. Impeller or other wearing parts worn or damaged. Impeller clogged.	Correct leak. Check pump vacuum. Replace leaking or worn seal or gasket. Replace worn or damaged parts. Check that impeller is properly centered and rotates freely. Free impeller of debris.

PREVENTIVE MAINTENANCE

Pump wear is directly affected by such things as the abrasive qualities, pressure and temperature of the liquid being pumped, this section is intended only to provide general recommendations and practices for preventive maintenance. Regardless of the application however, following a routine preventive maintenance schedule will help assure trouble-free performance and long life from your 80 series pump.

Record keeping is an essential component of a good preventive maintenance program. Changes in suction and discharge gauge readings (if so equipped) between regularly scheduled inspections can indicate problems that can be corrected before system damage or catastrophic failure occurs.

The appearance of wearing parts should also be documented at each inspection for comparison as well. Also, if records indicate that a certain part (such as the seal) fails at approximately the same duty cycle, the part can be checked and replaced before failure occurs, reducing unscheduled down time.

For new applications, a first inspection of wearing parts at 250 hours will give insight into the wear rate for your particular application. Subsequent inspections should be performed at the intervals shown on the chart below. Critical applications should be inspected more frequently.

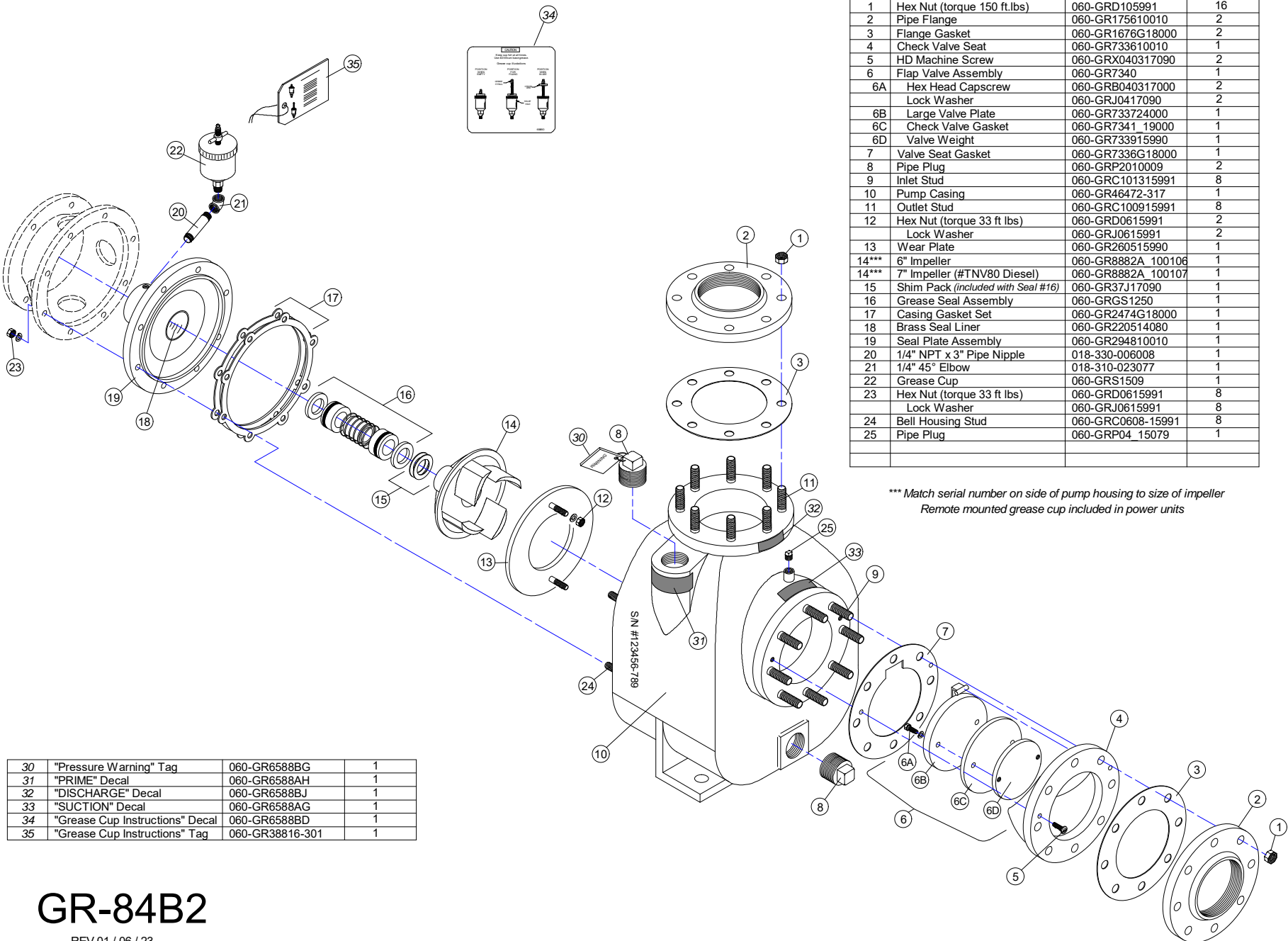
Preventive Maintenance Schedule					
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Bearing Lubrication (if so Equipped)	I	I			R
Seal Lubrication (If So Equipped)	I	I			R
Front Impeller Clearance (Wear Plate)				I	
Rear Impeller Clearance (Seal Plate)				I	
Check Valve				I	
Pump and Driver Alignment				I	
Bearings				I	
Bearing Housing				I	
Piping				I	
Driver Lubrication - See Mfgr's Literature					
Legend: I = Inspect, Clean, Adjust, Repair or Replace as Necessary R = Replace <i>* Service interval based on an intermittent duty cycle equal to approximately 4000 hours annually Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.</i>					

GR-84B2 ASSEMBLY PARTS LIST

(P/N #060-GR84B2-KIT)

REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.
1	Hex Nut (torque 150 ft.lbs)	060-GRD105991	16
2	Pipe Flange	060-GR175610010	2
3	Flange Gasket	060-GR1676G18000	2
4	Check Valve Seat	060-GR733610010	1
5	HD Machine Screw	060-GRX040317090	2
6	Flap Valve Assembly	060-GR7340	1
6A	Hex Head Capscrew	060-GRB040317000	2
	Lock Washer	060-GRJ0417090	2
6B	Large Valve Plate	060-GR733724000	1
6C	Check Valve Gasket	060-GR7341_19000	1
6D	Valve Weight	060-GR733915990	1
7	Valve Seat Gasket	060-GR7336G18000	1
8	Pipe Plug	060-GRP2010009	2
9	Inlet Stud	060-GRC101315991	8
10	Pump Casing	060-GR46472-317	1
11	Outlet Stud	060-GRC100915991	8
12	Hex Nut (torque 33 ft lbs)	060-GRD0615991	2
	Lock Washer	060-GRJ0615991	2
13	Wear Plate	060-GR260515990	1
14***	6" Impeller	060-GR8882A_100106	1
14***	7" Impeller (#TNV80 Diesel)	060-GR8882A_100107	1
15	Shim Pack (included with Seal #16)	060-GR37J17090	1
16	Grease Seal Assembly	060-GRGS1250	1
17	Casing Gasket Set	060-GR2474G18000	1
18	Brass Seal Liner	060-GR220514080	1
19	Seal Plate Assembly	060-GR294810010	1
20	1/4" NPT x 3" Pipe Nipple	018-330-006008	1
21	1/4" 45° Elbow	018-310-023077	1
22	Grease Cup	060-GRS1509	1
23	Hex Nut (torque 33 ft lbs)	060-GRD0615991	8
	Lock Washer	060-GRJ0615991	8
24	Bell Housing Stud	060-GRC0608-15991	8
25	Pipe Plug	060-GRP04_15079	1

*** Match serial number on side of pump housing to size of impeller
Remote mounted grease cup included in power units



30	"Pressure Warning" Tag	060-GR6588BG	1
31	"PRIME" Decal	060-GR6588AH	1
32	"DISCHARGE" Decal	060-GR6588BJ	1
33	"SUCTION" Decal	060-GR6588AG	1
34	"Grease Cup Instructions" Decal	060-GR6588BD	1
35	"Grease Cup Instructions" Tag	060-GR38816-301	1

GR-84B2

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PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Review all **SAFETY** information in Section A.

Follow the instructions on all tags, label and decals attached to the pump.

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions, which are keyed to the sectional view (see Figure 1) and the accompanying parts list.

This manual will alert personnel to known procedures which require special attention, to those, which could damage equipment, and to those, which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that **only** safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed **only** after establishing that neither personal safety nor pump integrity are compromised by such practices.

Before attempting to service the pump, lock out or disconnect the power source to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

For power source disassembly and repair, consult the literature supplied with the power source, or contact your local power source representative.



Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Lock out or disconnect the power source to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.

4. Check the temperature before opening any covers, plates, or plugs.
5. Close any suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.



Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Suction and discharge hoses and piping must be removed from the pump before lifting.

Suction Check Valve Disassembly

Before attempting to service the pump, remove the pump casing drain plug (8) and drain the pump. Clean and reinstall the drain plug.

For access to the check valve, remove the suction hose. Remove the nuts (1) and separate the suction flange (2) and check valve (4) from the pump casing (10).

Inspect the check valve parts for wear or damage. If replacement is required, remove the hardware and separate the check valve gasket and weights.

Pump Casing and Wear Plate Removal

To service the wear plate (13), remove the nuts & lock washers (23), securing the pump casing to the seal plate (19) and bell housing. Separate the pump casing and remove the gasket set (17).

Inspect the wear plate for scoring or excessive wear.

To remove the wear plate, disengage the Hardware(12). Pull the wear plate out of the pump casing.

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Impeller Removal

Before removing the impeller, screw the cross arm on the automatic lubricating grease cup (22) clockwise until it rests against the cover (see Figure 4) to prevent the grease in the cup from escaping. Remove the grease cup and piping.

Using a hardwood block of wood positioned against the impeller vane, strike the hardwood block with a hammer, in a counter clock-wise rotation (viewed from the impeller end).

Loosening the impeller is the same rotation as loosening a standard nut and bolt.

Inspect the impeller and replace it if cracked or badly worn. Slide the impeller adjusting shims (15) off the impeller shaft. Tie and tag the shims, or measure and record their thickness for ease of reassembly.

Seal Removal and Disassembly

Remove the outer rotating element, shaft sleeve, and remaining seal parts off the shaft as a unit. Carefully remove the stationary and rotating seal elements, packing rings and washers, seal spring and spacer sleeve from the seal plate.

Inspect the seal plate and replace it if cracked or badly worn. To remove the seal plate (19) from the bell housing, remove the bolts and lock washers, or nuts and lock washers from the studs. Inspect the seal liner (18) for wear or grooves that could cause leakage or damage to the seal packing rings. The seal liner is a press fit into the seal plate and does not normally require replacement.

If the seal liner requires replacement, remove the seal plate assembly as described above, and position it on the bed of an arbor (or hydraulic) press. Use a new sleeve to force the old one out. After the new liner is properly installed, **a 3/8-inch (9.5 mm) diameter hole must be drilled through it to permit the flow of lubricant to the seal assembly.** Be careful to center the drill in the threaded grease piping hole and not damage the threads. Deburr the hole from the inside of the seal liner after drilling.

Seal Reassembly and Installation

(Figures 1 and 3)

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent.



Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

The seal is not normally reused because wear patterns on the finished faces cannot be realigned during reassembly. This could result in premature failure. If necessary to reuse an old seal in an emergency, carefully wash all metallic parts in fresh cleaning solvent and allow to dry thoroughly.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe lightly in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage.

Clean and polish the shaft sleeve, or replace it if there are nicks or cuts on either end. If any components are worn, replace the complete seal.

Never mix old and new seal parts.

If a replacement seal is being used, remove it from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the seal liner (18) with water or a very small amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure 3).

Slide the seal plate assembly over the impeller shaft and secure the seal plate to the engine using the bolts and lock washers or nuts and lock washers on studs.

Slide the inboard rotating element into the lubricated seal liner with the chamfered side toward the shaft shoulder.

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Seal Reassembly and Installation *continued* (Figures 1 and 3)

Sub assemble the inboard stationary seat, packing ring and stationary washer. Press this unit into the lubricated seal liner until the seal faces contact.

A push tube cut from a length of plastic pipe or deep socket would aid in this installation. The I.D. of the tube or socket should be approximately the same size as the I.D. of the seal spring.

Slide the spacer sleeve onto the shaft until it seats against the inboard rotating element and install the seal spring.

Sub assemble the outboard stationary seat, packing ring and stationary washer. Press this unit into the lubricated seal liner. Install the outboard rotating element with the chamfered side toward the impeller. Lubricate the seal assembly as indicated in LUBRICATION *after the impeller has been installed.*

Impeller Installation

Inspect the impeller and replace it if cracked or badly worn.



The shaft and impeller threads must be completely clean before reinstalling the impeller. Even the slightest amount of dirt on the threads can cause the impeller to seize to the shaft, making future removal difficult or impossible without damage to the impeller or shaft.

Install the same thickness of impeller shims (15) as previously removed and screw the impeller onto the shaft until tight. Bump the impeller tight with a wood block or soft mallet.

**The clearance between the back of the
impeller and the seal plate should be
between 0.010 and 0.020 inch
(0,25 to 0,51 mm).**

Measure this clearance and add or remove shims from the impeller adjusting shim set until the correct clearance is achieved.

Pump Casing and Wear Plate Installation

If the wear plate assembly (13) was removed, install the new wear plate in the pump casing and secure it with the hardware (12).

Install a new set of casing gaskets (17) and slide the pump casing over the impeller and against the gaskets.

**The clearance between the face of the
impeller and the wear plate should be
between .010 and .020 inch
(0,25 to 0,51 mm).**

Remove gaskets from the gasket set until the correct clearance is achieved. Secure the pump casing to the seal plate with nuts & lock washers.

Suction Check Valve Installation

Inspect the check valve components and replace them as required. Sub assemble the check valve weights and gasket using the attaching hardware.

Install the check valve assembly on to the studs (9). Replace the suction flange onto the studs, and secure with the nuts.

Check the operation of the check valve to ensure proper seating and free movement.

Final Pump Reassembly

Be sure all hardware and drain plugs are tight, and that the pump is secure to the base and power source.

Install the suction and discharge lines / hoses and open all valves. Make certain that all piping connections are tight, and that the weight of the hose is independently supported and secure.

Before starting the pump, fill the pump casing with clean liquid.

Apply Pipe Sealant or equivalent compound to the fill plug (8). Reinstall and tighten the fill plug.

Refer back to OPERATION, before putting the pump back into service.

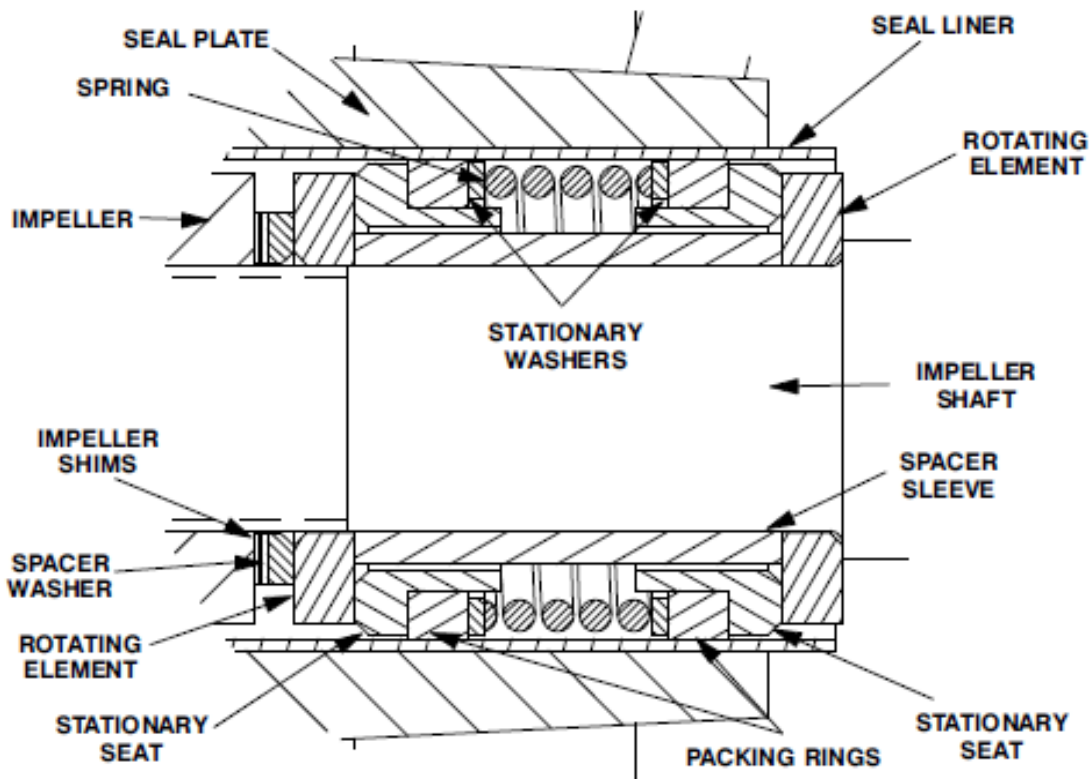


Figure 3. Seal Assembly

LUBRICATION

Fill the grease cup (11) through the grease fitting with No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal (see Figure 4).

NOTE:

Some smoking and leakage may occur after installing a new seal assembly. This should stop after the pump has run a while and the lapped seal faces have seated in

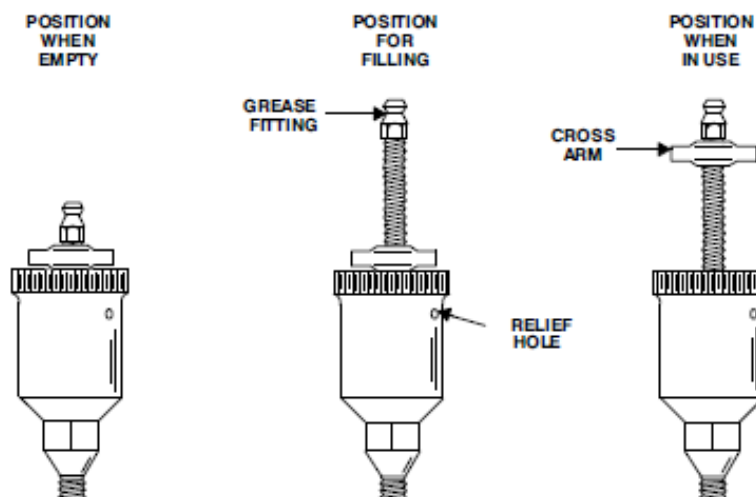


Figure 4. Automatic Lubricating Grease Cup

Grease Seal Installation Instructions

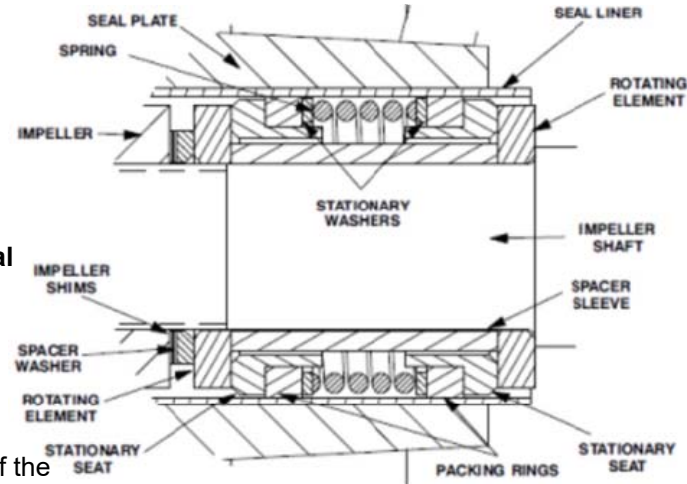
Centrifugal Pump Application

When replacing the seal, never mix old and new parts. Wear patterns on the old seal faces cannot be realigned during reassembly, and use of old parts can result in premature failure of the new seal.

Before installing the seal, inspect the bore of the seal liner for excessive wear or grooves that might cause leakage or damage to the seal packing rings. If the seal liner must be replaced, use the new seal liner and arbor (or hydraulic) press to force the old one out. After the liner is installed, drill a 3/8" diameter hole through it to permit the flow of lubricant to the seal liner. Be careful to center the drill in the threaded lubrication hole so not to damage the threads. Debur the hole from the inside of the seal liner after drilling.

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent. Be sure to follow all safety precautions described on the solvent container.

Remove the new seal and inspect the precision finished faces to ensure that they are free of any foreign matter. To ease installation of the seal, lubricate the packing rings, spacer sleeve, and seal liner with water or a very small amount of oil and apply a drop of light lubrication oil on the precision finished faces. Refer to the illustration, and assemble the seal as follows.



Installation of the inboard rotating element is dictated by the configuration of the shaft shoulder. If there is a radius at the shaft shoulder, the larger chamfer on the I.D. of the inboard rotating element must be positioned toward the shaft shoulder. If there is an undercut at the shaft shoulder, the larger chamfer must be positioned away from the shaft shoulder. Determine the correct position for the rotating element and slide it onto the shaft.

Sub assemble the inboard stationary element, packing ring and spring washer, and press this subassembly into the lubricated seal liner. A push tube cut from a length of plastic will aid seal installation. The O.D. of the tube should be about the same size as the O.D. of the seal spring.

Install the spacer sleeve and spring.

Sub assemble the outboard stationary element, packing ring and spring washer. Press this subassembly into the lubricated seal liner. If the outboard rotating element has a chamfered side, install it with the chamfer facing the impeller end of the shaft.

If your pump requires a spacer washer, install the spacer washer with the chamfer on the I.D. positioned toward the seal.

Install the impeller adjusting shims and impeller (consult the operator's manual for impeller clearance and installation instructions).

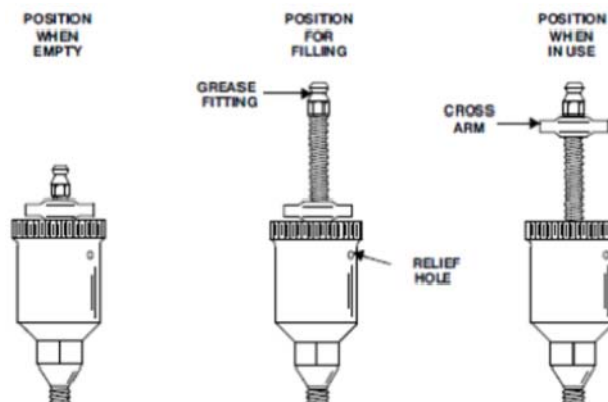
**Before starting the pump, reinstall the automatic lubricating grease cup and piping (if removed for seal liner replacement).
Lubricate the seal as indicated below.**

LUBRICATION

Fill the grease cup through the grease fitting with No. 2 lithium base grease until grease escapes from the relief hole. Turn the grease cup arm counterclockwise until it is at the top of the stem; this will release the spring to apply grease to the seal.

NOTE:

Some smoking and leakage may occur after installing a new seal assembly. This should stop after the pump has run a while and the lapped seal faces have seated in.



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Surface to Surface has a limited engine parts inventory. Parts not in stock will have to be ordered.



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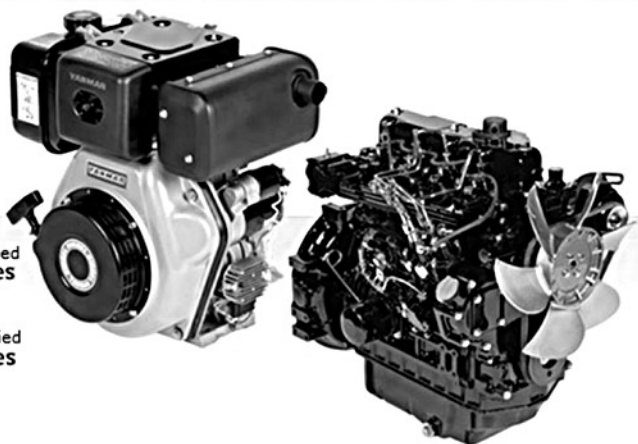
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Product Manual



Part Number: KS-105

Revision: 1.1

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PANEL OVERVIEW



Provisions for Auto Start

The panel is designed so that it can be upgraded to an auto start version in the same product platform.

Integrated Panel & Bracket

- Compact One Pieces Design
- Powder Coated Steel
- Welded Corners for Support and Minimized Vibration
- Mounts Directly into Engine Mounting Foot

Potted Electronics Module

- Operating Range 5.5 VDC to 36 VDC
- Temperature Range -40°C (-40°F) to 80°C (176°F)
- Potting Provides Water Tightness and Superior Vibration/Shock Protection

5 High Intensity LED Lamps

- Water Tight, Tough and Long Lasting
- Oil Pressure, Coolant Temperature, Alternator Charge, Glow Plug, Altitude Compensation

Key Switch

- Water Tight, Rated IP67
- Water Tight Plug and Play Connector
- Dedicated Pre-Heat Position

Hour Meter

- Potting Provides Water Tightness and Superior Vibration/Shock Protection

Connector

- 10 Inch Pigtail to Delphi 15422562 Connector

Pre-Heat / Glow Plug

- 4 Seconds or 15 Seconds (Selectable)
- Dedicated Pre Heat position on Key Switch
- Glow Plug Energized During Cranking

Crank Protection

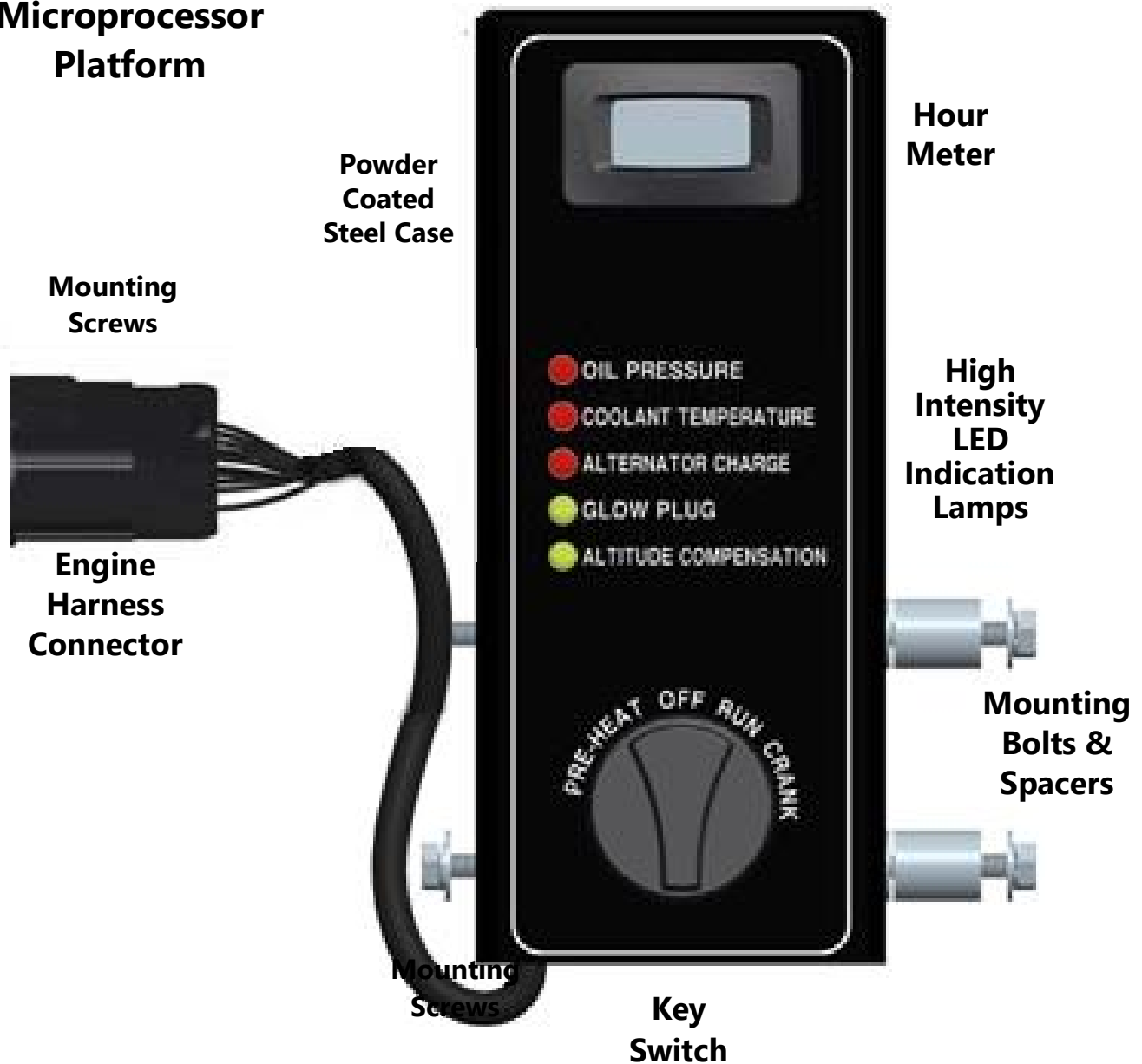
- Starter will not engage during engine running
- Over crank protection (over-crank >30 seconds)

Engine Safety Shutdowns

- Low Oil Pressure
- High Engine Temperature
- Shutdown bypass is 10 seconds during engine start

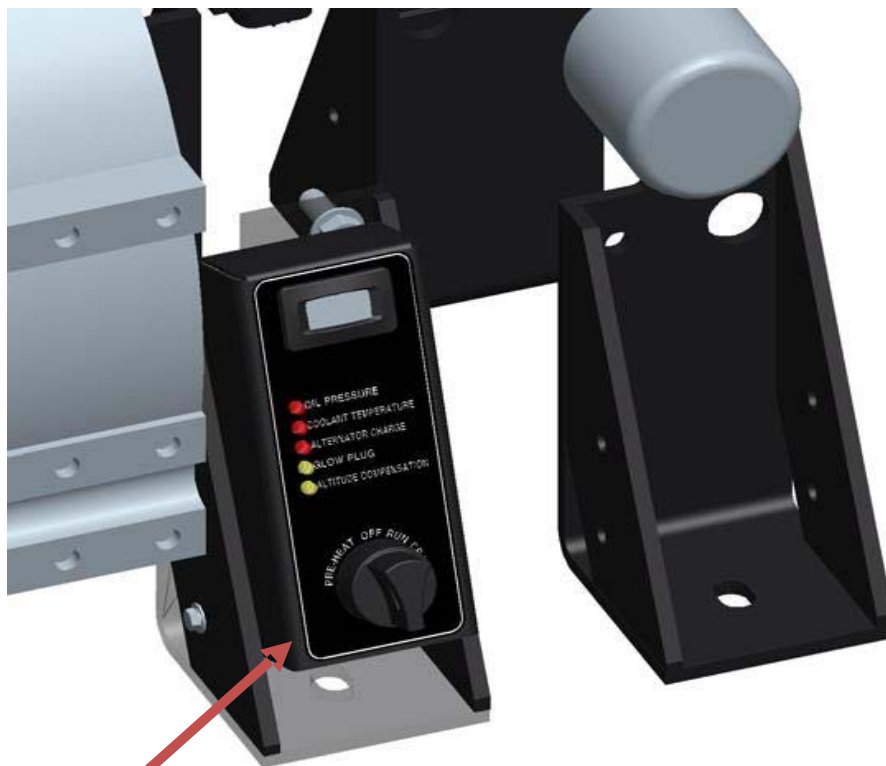
PANEL COMPONENTS

INSIDE KS Series Microprocessor Platform



INSTALLATION

The KS-105 installs into the engine mounting bracket via four bolts, spacers and a plug and play connector.



**Control Panel Mounted Inside
Bracket**

Installation Procedure

- 1) Turn Power Off
- 2) Insert unit into bracket
- 3) Install four screws
- 4) Plug in connector



**Mounting
Bolts and
Spacers**

PRODUCT IDENTIFICATION

Every panel has a product label that provides the part number and individual serial number for identification.



 www.controlsinc.com	
Model	Kick Start Series
P/N	KS-105
S/N	2140000
Made in USA	

PANEL OPERATION

The KS-105 provides manual start and stop with a key switch. The key switch is an independently water tight component with a simple plug and play connector. The individual keys are provided with a rubber boot to protect the key and key switch.

Key Switch

The key switch provides the following operational positions

- OFF Position
- Run Position
- Crank Position
- Pre-Heat



Engine Pre-Heat

When the key is turned to the PRE-HEAT position, the KS-105 energizes the pre-heat signal (connector pin W5) for a 4 second period. If engine connector pin W1 (pre-heat interval select) is grounded, the pre-heat period is 10 seconds. During pre-heat operation, the yellow GLOW PLUG lamp illuminates.

Engine Start

When the key is turned to the CRANK position, the KS-105 energizes the crank signal (connector pin W3), the fuel pull signal (connector pin W6) and the fuel hold signal (connector pin W7) to initiate the engine crank and start process.

Engine Start Protections

- 1) **Over Crank Protection** – Over crank protection is provided by the KS-105. Cranking is discontinued after holding the key in the CRANK position for 30 seconds.
- 2) **Starter Re-Engage Protection** – While the engine is running, the KS-105 disables the crank signal to prevent the starter engagement during running.

Engine Stop

Turn the key switch to the OFF position to turn the engine off.

LAMP OPERATION

The KS-105 comes with five high intensity LEDs lamps.



Hour Meter

Displays engine run hours.

Oil Pressure Lamp

Oil pressure lamp turns ON when the oil pressure switch is "closed" indicating a low oil pressure condition (after initial 10 second bypass period on engine start).

Coolant Temperature Lamp

Coolant temperature lamp turns ON when the engine temperature switch is "closed" indicating a high engine temperature condition.

Alternator Charge Lamp

Alternator charge lamp turns ON when alternator excite signal is received from the alternator.

Glow Plug Lamp

The glow plug lamp turns "ON" when the glow plug signal is being sent from the KS-105. The glow plug signal is initiated when the key is in the "PRE-HEAT" position or the "CRANK" position. The pre-heat period is either 4 or 10 seconds depending on the pre-heat interval select circuit being grounded or not.

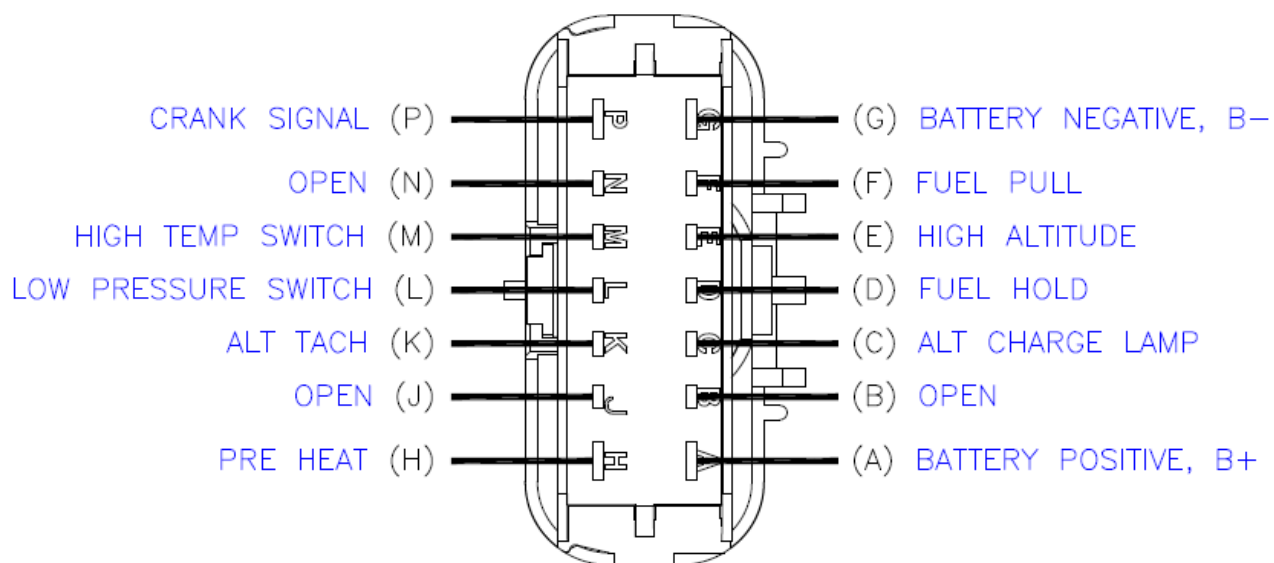
Altitude Compensation Lamp

The altitude compensation lamp turns ON when the altitude compensation signal is received from the altitude compensation module mounted on the engine.

ENGINE HARNESS CONNECTOR

The KS-105 provides a plug and play connector to the Yanmar engine harness.

15422562 CONNECTOR
15359005 LOCK
15304732—L x4 TERMINAL
15326269—L x7 TERMINAL
15366060 SEAL
15366066 SEAL
15305171 x3 CAVITY PLUG



Pre-Heat Interval Select

- A loose wire with a bullet connector provides connectivity for the Pre-Heat Interval Selection.

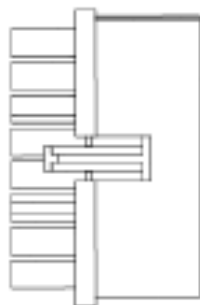
Panel Ratings:

- The KS Panel is rated at 3 Amp Maximum
- Fuel Hold: 2.1A max @ 12v sourcing
- Crank and Preheat: 500mA max (Close to Ground)

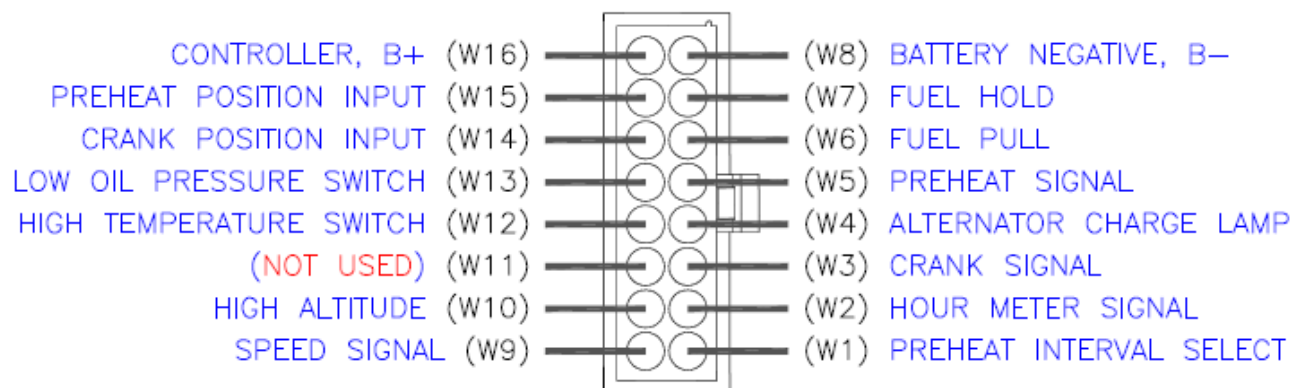
INTERNAL CONNECTOR

The KS-105 provides a plug and play connector to the KS Series microprocessor electronics module.

794824-1 Connector
1-1586359-6 Wire Seal
1-1586362-6 Connector Seal
794831-1 Terminals



WIRE NUMBER = PIN LOCATION



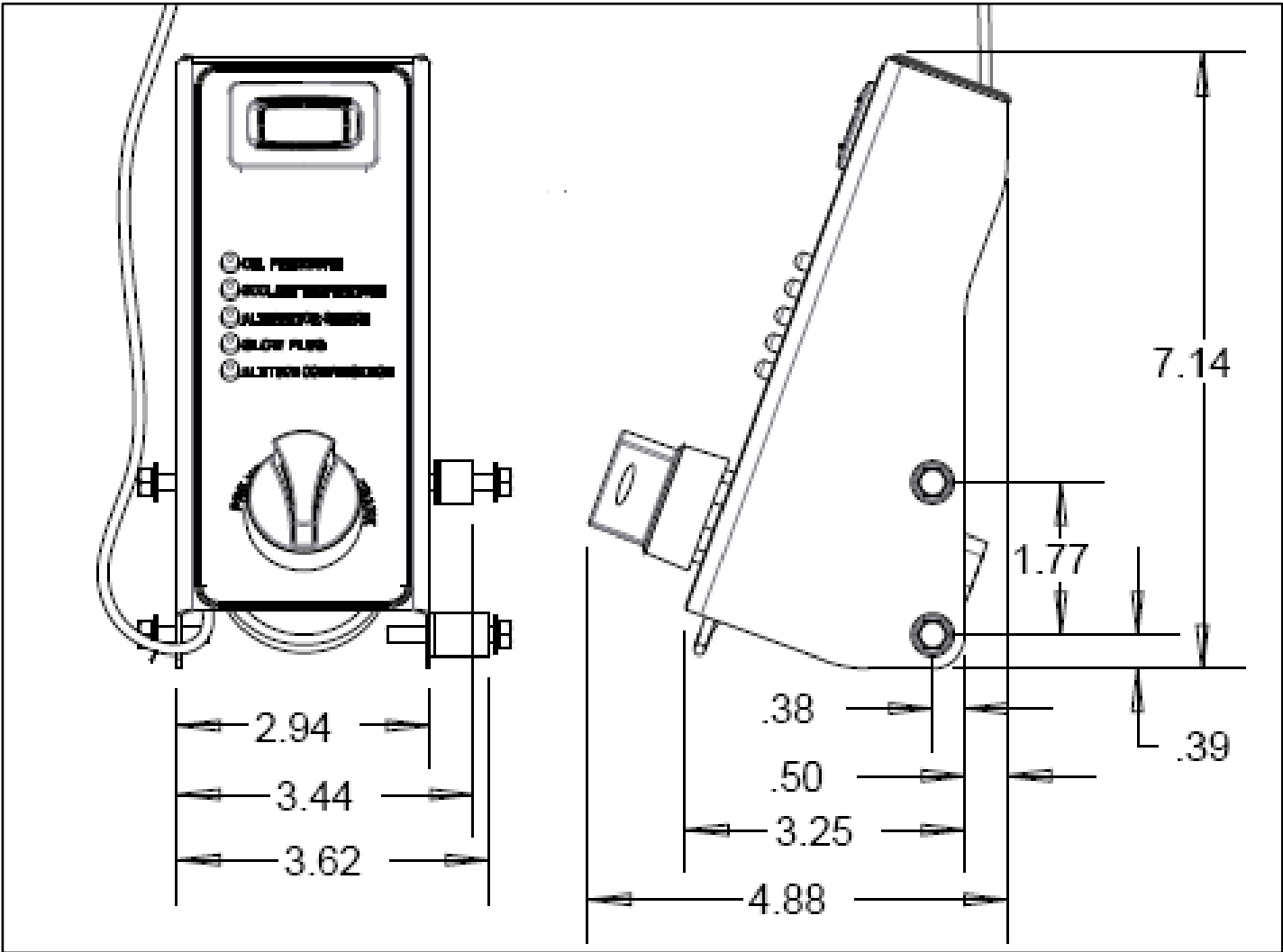
CIRCUIT OPERATION *(for 12VDC battery system)*

A detailed description of each KS-105 circuit is provided to address both operational and troubleshooting questions. Controls Inc technical assistance is also available by calling 330.239.4345 and asking to speak with a technician. *(Please have the product part number and serial number available.)*

#	Description	Operation
Loose Wire to W1	Pre-Heat Interval Select	Two options for pre-heat timer based on this input being open or closed to ground: Not Ground = 4 second Pre-Heat Signal Ground = 10 second Pre-Heat Signal
Hour Meter to W2	Hour Meter Signal	Solid state close to ground signal based on engine running condition (200mA max)
P to W3	Crank Signal	Close to ground output when key is in the "CRANK" position <i>(This is a close to ground signal circuit to energize the crank relay with a 500mA max. This circuit is disabled while engine is running.)</i>
C to W4	Alternator Charge Lamp	12VDC signal from the alternator used to turn the alternator excite lamp ON
H to W5	Pre-Heat Signal	Close to ground signal when key is in the "PRE-HEAT" or "CRANK" position <i>(This is a close to ground signal circuit to energize the pre-heat relay with a 500mA max)</i>
F to W6	Fuel Pull Signal	12VDC signal to fuel pull circuit when key is in the "CRANK" position for a max of 5 seconds <i>(This is a 12VDC signal circuit to energize the fuel pull relay with a 2.1A max)</i>
D to W7	Fuel Hold Signal	12VDC signal to fuel hold circuit when key is in the "CRANK" or "RUN" position <i>(This is a 12VDC signal circuit to energize the fuel hold relay with a 2.1A max)</i>
G to W8	Battery Negative (B-)	Battery negative supply from B- terminal on battery
K to W9	Speed Signal	Input to KS-105 from engine alternator tach output. The speed signal is used to indicate the engine is running and is required for the panel to operate the engine properly.
E to W10	High Altitude Signal	12VDC input to KS-105 from the engine altitude module
M to W12	High Temp Switch	Normally open input Open = Temperature below Yanmar switch specification Close to Ground = High temperature alarm (engine shutdown)

L to W13	Low Pressure Switch	<p>Normally closed input</p> <p>Open = Oil pressure within Yanmar switch specification</p> <p>Close to Ground = Low oil pressure alarm (engine shutdown)</p> <p><i>(There is a 10 second oil pressure shutdown bypass period during engine start to allow pressure to build and open the low-pressure switch)</i></p>
Key Switch Pos 2 to W14	Crank Position Input	KS-105 key switch position detect
Key Switch Pos 3 to W15	Pre-Heat Position Input	KS-105 pre-heat key switch position detect
A to W16	Battery Positive (B+)	12VDC power supply for panel from B+ terminal on battery

DIMENSIONS



SPECIFICATIONS

Voltage: (12v Operation)

• Input Voltage Range	7-28v
• Nominal Operating Voltage	12.6v
• Reverse Battery Protection	15.0v
• Load Dump Protection	60.0v
• Module Operating Current Draw (Outputs Off)	10.0mA
• Module Operating Current Draw (Maximum)	3.10A

Output Drive Capacities:

• Fuel Hold	3A
• Fuel Pull (Independent Power Source)	150.0mA
• Glow Plug (Independent Power Source)	150.0mA
• Starter (Independent Power Source)	150.0mA

Inputs:

• Wetting current @ 12v (Lo Oil P, Hi Temp Trips)	8.0mA
• Wetting Current Preheat Interval	200.0uA

Temperature:

• Operating Temperature Range	-40C to 125C
• Storage Temperature Range	-50C to 130C
• Operating Relative Humidity Range	to 80%RH
• Storage Humidity Range	to 95%RH

Vibration, Random Wide-Band:

• Acceleration:	20g
• Duration:	25 hours

Vibration, Sine Wave:

• Frequency Range	10-200Hz
• Acceleration (Exciter)	24.53m/s ² (2.5g)
• Test Duration	3 hours per axis
• Sweep Rate	9 minutes

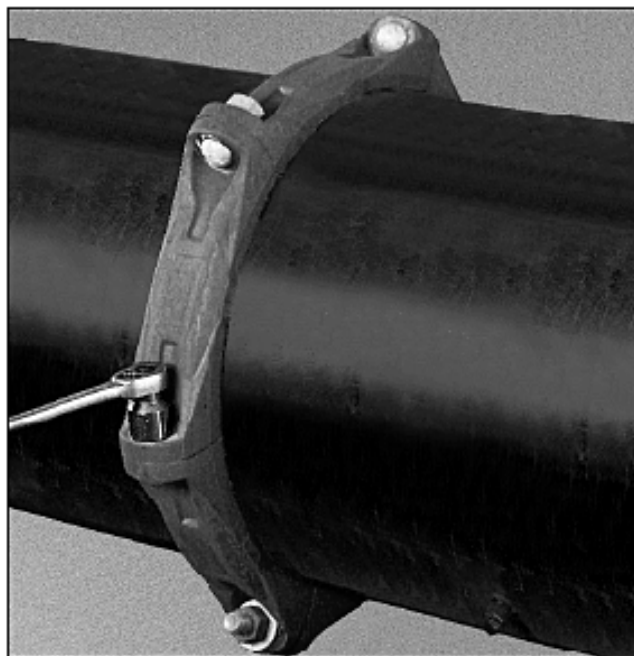
Shock:

• Functional	196m/s ² (20g)
• Destructive	980m/s ² (100g)

REPLACEMENT COMPONENTS

Replacement components are listed below. Please contact Controls Inc for details.

COUPLING INSTALLATION & ASSEMBLY



The instructions are based on pipe grooved in accordance with Gruzlok® grooving specifications. Check pipe ends for proper groove dimensions and to assure that the pipe ends are free of indentations and projections which would prevent proper sealing.

ALWAYS USE A GRUVLOK® LUBRICANT FOR PROPER COUPLING ASSEMBLY. Thorough lubrication of the external surface of the gasket is essential to prevent pinching and possible damage to the gasket. For temperatures above 150° F (65.6° C) use Gruzlok Xtreme™ Lubricant and lubricate all gasket surfaces, internal and external. See Gruzlok Lubricants in the Technical Data section of the Gruzlok catalog for additional important information.

SPECIFIED BOLT TORQUE

Specified bolt torque is for the oval neck track bolts used on Gruzlok® couplings and flanges. The nuts must be tightened alternately and evenly until fully tightened. Caution: Use of an impact wrench is not recommended because the torque output can vary significantly due to many variables including air pressure supply, battery strength and operational variations.

CAUTION: Proper torquing of coupling bolts is required to obtain specified performance. Over torquing the bolts may result in damage to the bolt and/or casting which could result in pipe joint separation. Under torquing the bolts may result in lower pressure retention capabilities, lower bend load capabilities, joint leakage and pipe joint separation. Pipe joint separation may result in significant property damage and serious injury.

ANSI SPECIFIED BOLT TORQUE		
Bolt Size	Wrench Size	Specified Bolt Torque *
In.	In.	FT-Lbs
3/8	11/16	30-45
1/2	3/4	80-100
5/8	1 1/16	100-130
3/4	1 1/4	130-180
7/8	1 3/8	180-220
1	1 3/4	200-250
1 1/8	1 7/8	225-275
1 1/4	2	250-300

* Non-lubricated bolt torques.

METRIC SPECIFIED BOLT TORQUE		
Bolt Size	Wrench Size	Specified Bolt Torque *
mm	mm	N-m
M10	16	40-60
M12	22	110-150
M16	24	135-175
M20	30	175-245
M22	34	245-300
M24	36	270-340

* Non-lubricated bolt torques.

NOTE: Specified torques are to be used unless otherwise noted on Product Installation Instructions.

FIG. 7000**Lightweight Flexible Coupling**

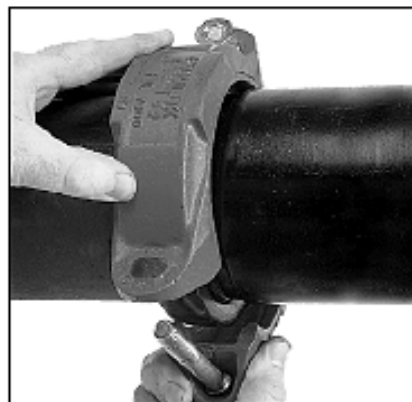
1 CHECK & LUBRICATE GASKET— Check gasket to be sure it is compatible for the intended service. Apply a thin coating of Gruvlok lubricant to outside and sealing lips of the gasket. Be careful that foreign particles do not adhere to lubricated surfaces.



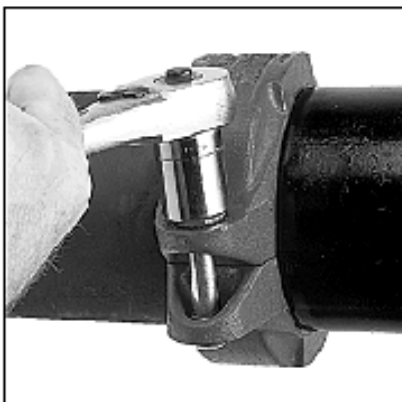
2 GASKET INSTALLATION— Slip the gasket over the pipe end, making sure the gasket lip does not overhang the pipe end.



3 ALIGNMENT— After aligning the two pipe ends together, pull the gasket into position, centering it between the grooves on each pipe. Gasket should not extend into the groove on either pipe.

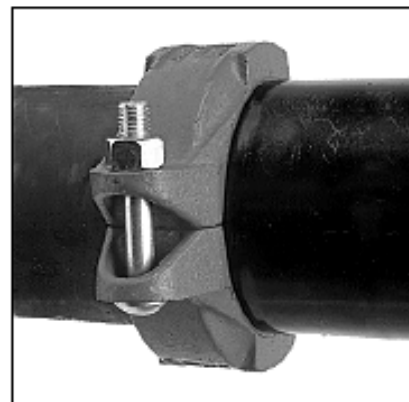


4 HOUSINGS— With one nut unthreaded to the end of the bolt, unthread the other nut completely and swing the coupling housing halves over the gasket, making sure the housing keys engage the grooves. Insert the bolt and turn the nuts finger tight.



5 TIGHTEN NUTS— Tighten the nuts alternately and equally to the specified bolt torque. The housing bolt pads must make metal-to-metal contact.

CAUTION: Uneven tightening may cause the gasket to pinch.



6 ASSEMBLY IS COMPLETE— Visually inspect the pipe joint to assure the coupling keys are fully engaged in the pipe grooves and the bolt pads are in firm even metal-to-metal contact on both sides of the coupling.

CAUTION: Use of an impact wrench is not recommended because the torque output can vary significantly due to many variables including air pressure supply, battery strength and operational variations.

CAUTION: Proper torquing of coupling bolts is required to obtain specified performance. Over torquing the bolts may result in damage to the bolt and/or casting which could result in pipe joint separation. Under torquing the bolts may result in lower pressure retention capabilities, lower bend load capabilities, joint leakage and pipe joint separation. Pipe joint separation may result in significant property damage and serious injury.

NOTE: VdS - Roll Grooving Approval Specifications, see the Technical Data/Installation Instructions section on Anvil's web site - www.anvilintl.com

FIG. 7003**Hingelok™ Coupling**

NOTE: Remove locking pin from handle before opening coupling.



1 CHECK & LUBRICATE GASKET— Check gasket to be sure it's compatible for the intended service. Apply a thin coating of GUVLOK lubricant to outside and sealing lips of the gasket. Be careful that foreign particles do not adhere to lubricated surfaces.



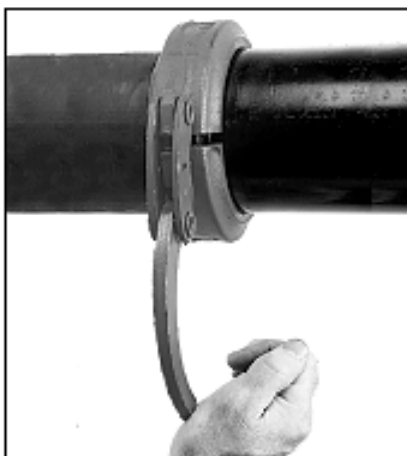
2 GASKET INSTALLATION— Slip the gasket over the pipe end making sure the gasket lip does not overhang the pipe end.



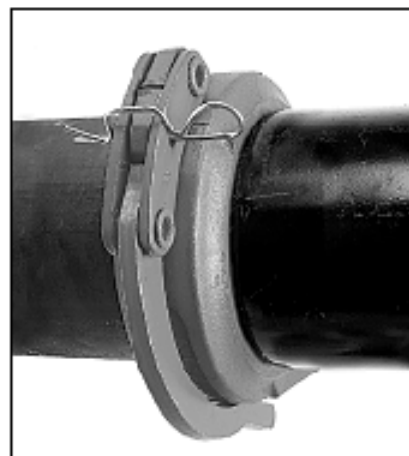
3 ALIGNMENT— After aligning the two pipe ends, pull the gasket into position centering it between the grooves on each pipe. Gasket should not extend into the groove on either pipe.



4 HOUSINGS— Put one half of the open coupling over the gasket as the coupling keys fit firmly into the grooves on each pipe and. Swing the other half of the coupling into position around the gasket and into the grooves.



5 LOCK COUPLING— Fit the nose of the locking handle in the notch of the opposite housing. Press firmly down on the handle until it makes contact with the coupling housing. Insert locking pin into handle linkage to secure handle in closed position. (See Caution.)



6 ASSEMBLY IS COMPLETE— Visually inspect the pipe joint to assure the coupling keys are fully engaged in the pipe grooves and the bolt pads are in firm even metal-to-metal contact on both sides of the coupling.

CAUTION:

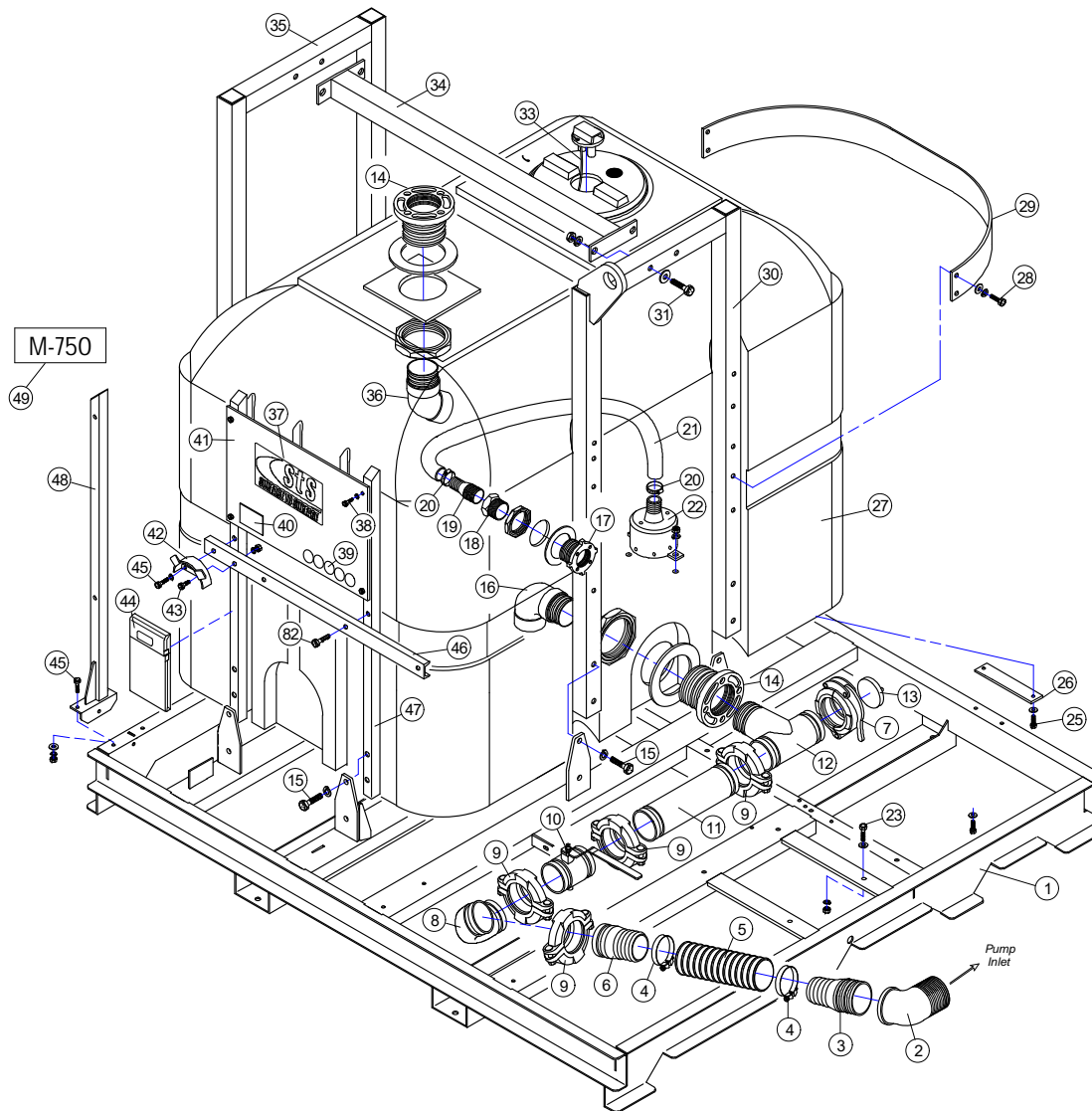
- 1) Hammering or banging on the handle or coupling housing could cause serious damage to the locking device and coupling assembly. The result may be an unsuitable pipe joint and unusable coupling assembly.
- 2) Care needs to be taken so that fingers do not get caught or pinched when handle is placed in locked position as a result of cam action of handle assembly.
- 3) When re-using coupling and gasket, always inspect gasket for damage and hinge/handle assembly for looseness, distortion or any other damage.

SECTION #VIII

(Parts Manual)

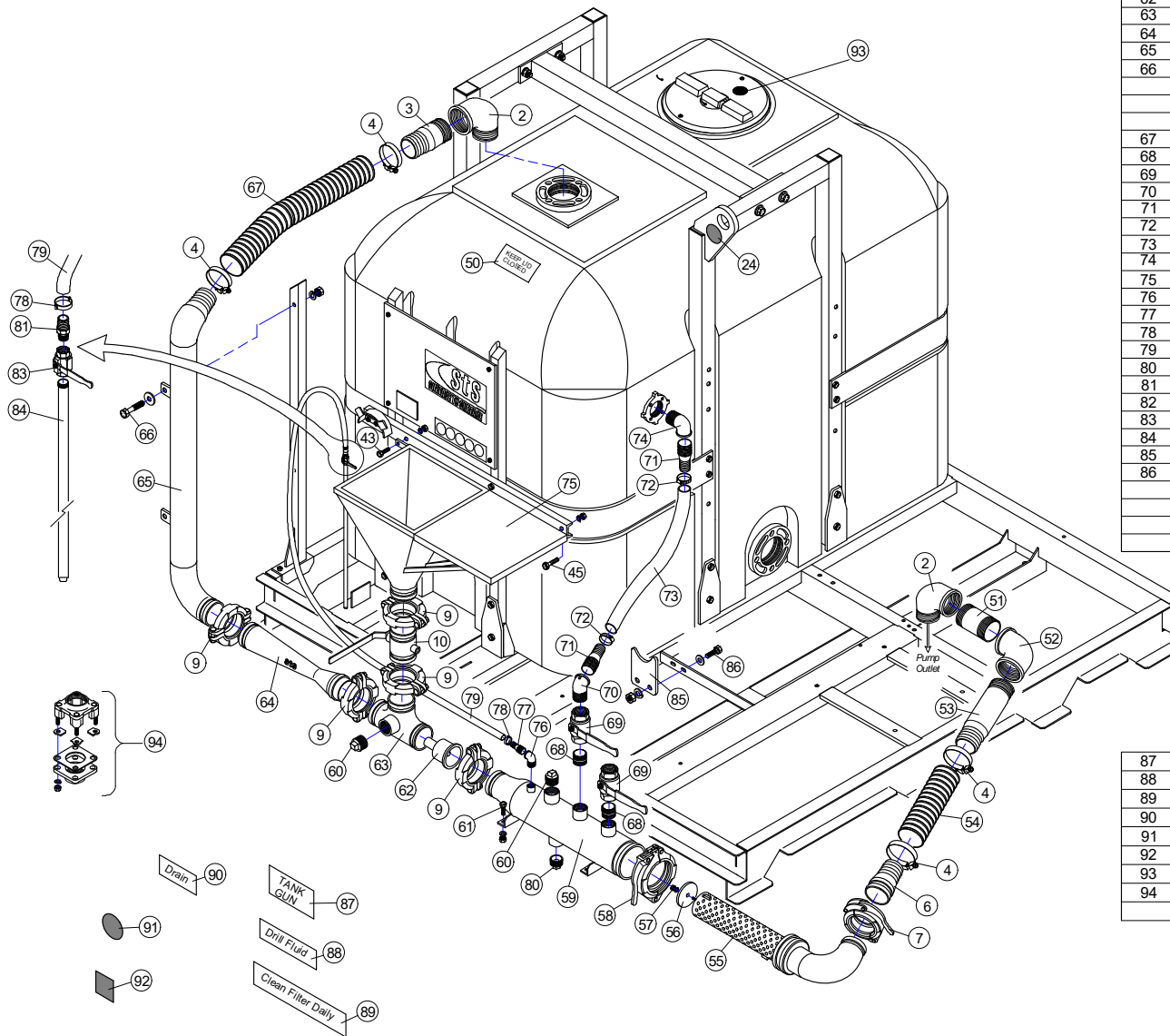
BU-750(GR) ASSEMBLY PARTS LIST

(P/N #BU-750(GR))



NOTE:
4" suction tee #12 to have
minium 6 wraps of HD teflon tape
and then coated with liquid teflon sealant
before installing into plastic tank bung #14.

REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.	
1	Skid Frame	SR-75130	1	O
2	4" NPT 90° Street Elbow	018-310-01780-1	3	B
3	4" NPT x Hose Barb	018-1661268266	2	B
4	4" Band Clamp	025-MIK-112-121	6	
5	4" Flex Hose	SR-75078-G	1	
6	4" Groove x Hose Barb	020-004-00109-9	2	B
7	4" Hinge-Loc Coupler	020-390-20010-3	2	B
8	4" Grooved 90° Elbow	020-390-01430-6	1	B
9	4" Groove-Loc Coupler	020-390-00034-7	4	B
10	4" Grooved Butterfly Valve	023-7005-011403	2	
11	4" Sched. 40 Suction Pipe	SR-75073	1	B
12	Suction Tee	SR-75051	1	B
13	Grooved End Cap	020-390-03022-9	1	B
14	4" Tank Bung	086-4" TANK BUNG	2	
15	1/2" x 1" Bolt	076-13205	12	
16	1/2" L/W	076-33626	12	
17	90° PVC Suction Elbow	SR-75075-A	1	
18	2" x 1 1/2" NPT Pipe Bushing	018-318-90768-0	1	B
19	1 1/2" NPT x Hose Barb	018-1661268233	1	B
20	1 1/2" Gear Clamp	025-HS-28	2	
21	1 1/2" Rubber Hose	SR-75078-B	1	
22	Jet Gun Casting	SR-15012	1	B
23	7/16" x 1 1/4" Bolt	076-13159	4	
24	7/16" L/W	076-33624	4	
25	7/16" Nut	076-36308	4	
26	" Lift Here " Decal	070-16071-B	1	
27	1/4" x 1 1/2" S/S Bolt	076-7009	2	
28	1/4" S/S L/W	076-0173192	2	
29	1/4" S/S F/W	076-11545141	2	
30	1/4" S/S Nut	076-70710	2	
31	Jet Gun Mounting Bar	SR-75049	1	B
32	750 gal. Tank	086-SR-75019	1	
33	3/8" x 1" Bolt	076-13105	8	
34	3/8" L/W	076-33622	8	
35	Tank Strap	SR-75089	2	O
36	Tank Up-rite (with eye)	SR-75010	1	O
37	5/8" x 4" Gr. 8 Bolt	076-15319	4	
38	5/8" F/W	076-33016	4	
39	5/8" L/W	076-33630	4	
40	5/8" Nut	076-36314	4	
41	3/16" Poly Nylon Rope	084-3/16 ROPE	18"	
42	Tank Support Cross Member	SR-75067	1	O
43	Tank Up-rite	SR-75011	1	O
44	45° PVC Return Elbow	SR-75075-B	1	
45	"Logo" Decal	070-STS-026	1	
46	1/4" x 1/2" Bolt	076-13001	4	
47	1/4" L/W	076-33618	4	
48	Safety Decals	070-STS-038	1	
49	Serial Number Plate	071-STS-001-750	1	
50	Sign Plate	SR-75068	1	W
51	Wash Wand Holder	SR-75017	1	O
52	3/8" x 1" Bolt	076-13105	2	
53	3/8" L/W	076-33622	2	
54	3/8" Nut	076-36306	2	
55	Operators Manual Holder	084-9000-07	1	
56	3/16" Rivet	076-41228	2	
57	"Operators Manual" Decal	070-STS-036	1	
58	3/8" x 1 3/4" Bolt	076-13110	5	
59	3/8" L/W	076-33622	5	
60	3/8" Nut	076-36306	4	
61	3/8" F/W	076-33008	11	
62	Hopper Mount	SR-75012-A	1	O
63	Hopper Post	SR-75069	2	O
64	Pipe Support Post	SR-75006	1	O
65	" M-750 " Decal	070-STS-028-A	1	
66	" Keep Lid Closed " Decal	070-STS-030-B	1	
67	4" NPT Pipe Nipple	018-330-05420-6	1	B



52	4" NPT 90° Elbow	018-310-00260-5	1	B
53	Pump Outlet Pipe	SR-75052	1	B
54	4" Flex Hose	SR-75078-F	1	
55	Filter Shear Carriage	SR-75028	1	O
56	Filter Shear Carriage End Cap	SR-75030-4	1	O
57	5/16" NC Nut	076-36304	1	
	5/16" L/W	076-33620	1	
58	6" Hinge-Loc Coupler	020-390-20060-8	1	O
59	Filter Shear Housing	SR-75026	1	O
60	2" NPT Pipe Plug	018-318-90256-6	2	O
61	3/8" x 1 1/4" Bolt	076-13107	4	
	3/8" F/W	076-33008	4	
	3/8" L/W	076-33622	4	
	3/8" Nut	076-36306	4	
62	Jetting Nozzle	SR-75020-NE	1	O
63	Jetting Tee	SR-75021	1	O
64	Venturi Tube	SR-75022	1	O
65	Return Pipe	SR-75038	1	O
66	1/2" x 2 1/2" Bolt	076-13213	2	
	1/2" F/W	076-33012	2	
	1/2" L/W	076-33626	2	
	1/2" Nut	076-36310	2	
67	4" Flex Hose	SR-75078-E	1	
68	2" NPT x Close Nipple	018-330-03700-3	2	B
69	2" Ball Valve	022-423-00014-0	2	
70	2" NPT 45° Street Elbow	018-310-02820-4	1	B
71	2" NPT x Hose Barb	018-1661268241	2	B
72	2" Gear Clamp	025-HS-36	2	
73	2" Rubber Hose	SR-75078-A	1	
74	2" NPT 90° Street Elbow	018-310-01720-7	1	B
75	Hopper with Table	SR-75032	1	O
76	3/4" NPT 90° Street Elbow	018-310-01640-7	1	B
77	3/4" NPT x Hose Barb	018-1661268225	1	B
78	Pinch Clamp	025-2731	2	
79	3/4" Rubber Hose	SR-75074-H	1	
80	1 1/2" NPT Pipe Plug	018-318-90252-5	1	O
81	3/8" MNPT x 3/4" Hose Barb	018-125-12C	1	
82	3/8" x 1 3/4" Bolt	076-13110	1	
83	3/8" Ball Valve	022-423-00002-5	1	
84	Wash Wand	SR-75047	1	O
85	Pipe Support	SR-75001-J	1	O
86	3/8" x 1 1/4" Bolt	076-13107	2	
	3/8" L/W	076-33622	2	
	3/8" F/W	076-33008	2	
	3/8" Nut	076-36306	2	

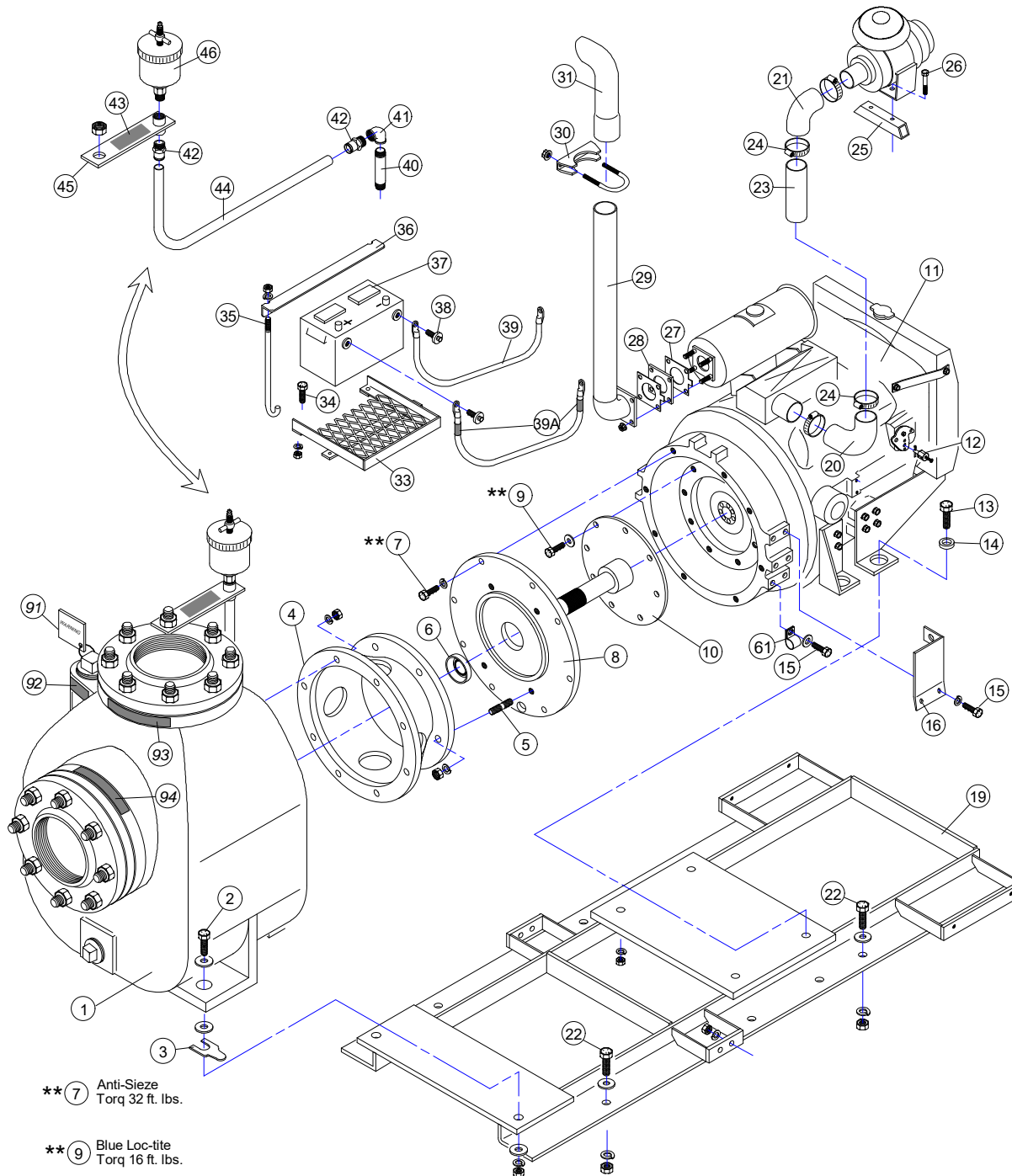
Paint Color

B = Black
O = Orange
W = White

87	" Tank Gun " Decal	070-ST5-027-B	1	
88	" Drill Fluid " Decal	070-ST5-027-D	1	
89	" Clean Fluid Daily " Decal	070-ST5-027-A	1	
90	" Drain " Decal	070-ST5-027-C	1	
91	" No Step " Decal	070-15080-B	1	
92	" Forklift " Decal	070-16072-B	2	
93	" Do Not Enter " Decal	070-16051-B	1	
94	2" Bottom Drain Bung	086-BF220BD	1	

PU-D4(GR) ASSEMBLY PARTS LIST (3TNV80F)

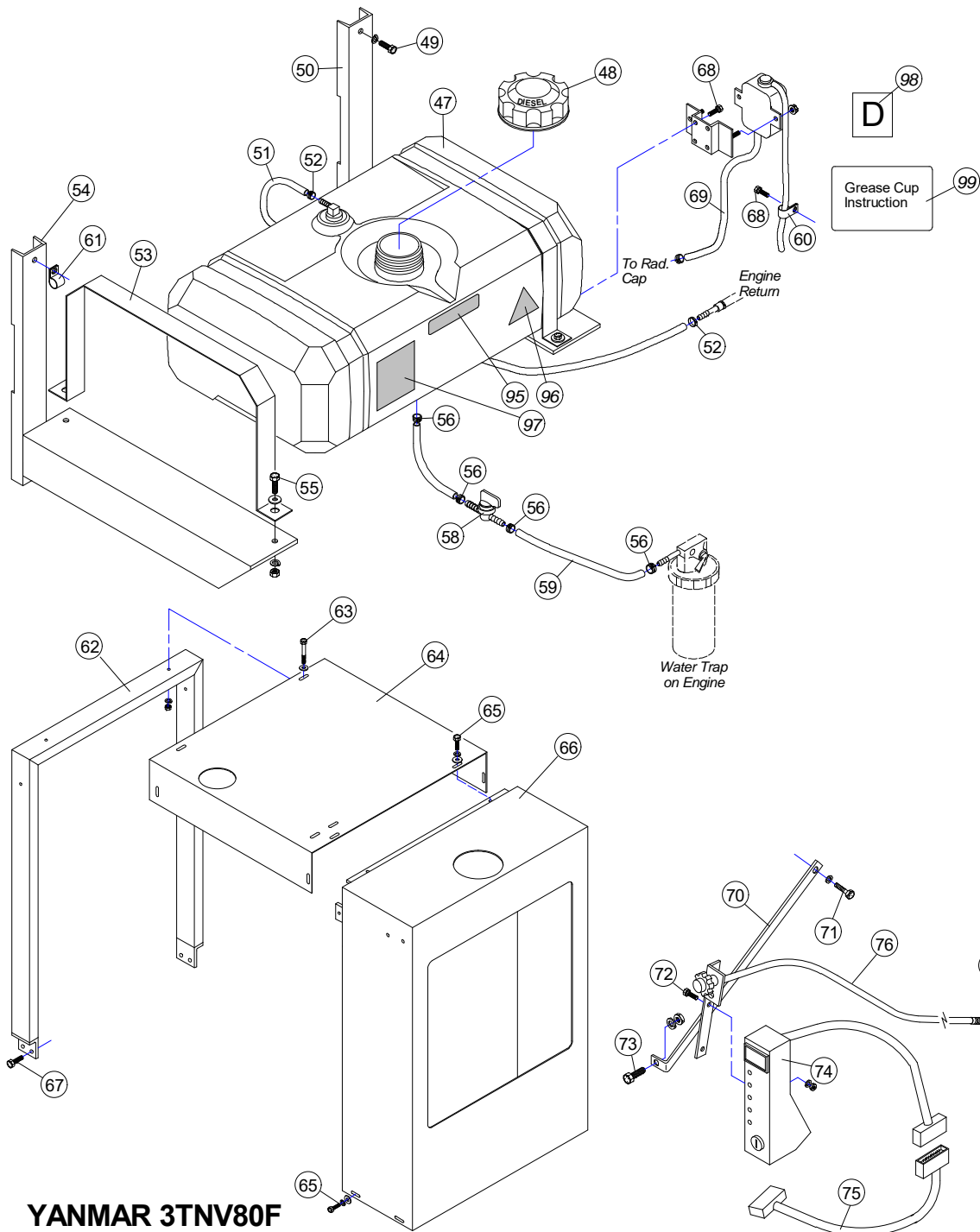
(P/N #PU-D4(GR)Y)



REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.	
1	Gorman-Rupp 4" Pump	060-GR84B2-KIT-7	1	B
2	1/2" x 2" Bolt	076-13211	2	
	1/2" L/W	076-33626	2	
	1/2" F/W	076-33012	6	
	1/2" Nut	076-36310	2	
3	Motor Shim S/S	034-QA SHIM PACK	2	
4	Bell Housing	060-GR84B2-02	1	
5	7/16" x 1 3/4" Stud	060-164940	4	
	7/16" L/W	076-33624	4	
	7/16" Nut	076-36308	4	
6	Lip Seal	036-CR17270	1	
7	10 mm x 1.5 x 30 Bolt	076-38656	8	
	10mm L/W	076-40384	8	
8	Flywheel Adaptor Plate	SR-D75050(GR)	1	B
9	8mm x 1.25 x 30 Bolt	076-38617	8	
	8mm F/W	076-40357	8	
10	Pump Drive	SR-D75051(GR)	1	B
11	Yanmar 31NV80F Diesel Engine	033-31NV80F-SDSA-SS	1	
12	Throttle Cable Pull	032-39011-2	1	
13	7/16" x 1 1/2" Bolt	076-13159	4	
	7/16" L/W	076-33624	4	
	7/16" F/W	076-33010	4	
	7/16" Nut	076-36308	4	
14	Engine Mount Washers	SR-D75094	4	B
15	M8 x 1.25 x 20 Bolt	076-38615	3	
	M8 x L/W	076-40383	3	
16	Throttle Mount	SR-D75022	1	B
17				
18				
19	Yanmar Engine / GR Pump Base	SR-D75090	1	B
20	Long Rubber Elbow	SR-D75100-A	1	
21	Short Rubber Elbow	SR-D75100-B	1	
22	7/16" x 1 1/2" Bolt	076-13159	6	
	7/16" F/W	076-33010	6	
	7/16" L/W	076-33624	6	
	7/16" Nut	076-36308	6	
23	Breather Extension Pipe	SR-D75086-B	1	B
24	S/S Gear Clamp	025-HS-36	4	
25	Breather Hood Riser	SR-D75086-A	1	O
26	5/16" x 2 1/2" Bolt	076-13063	2	
	5/16" L/W	076-33620	2	
	5/16" F/W	076-33006	2	
	5/16" Nut	076-36304	2	
27	Exhaust Gasket	033-119515-13200	2	
28	Exhaust Flange Spacer	SR-D75087-C	1	HHB
29	Modified Muffler Pipe	SR-D75087	1	HHB
30	Exhaust Clamp	031-WAL_32134	1	HHB
31	Exhaust Pipe Turndown	M4-045	1	HHB
32				
33	Battery Box	SR-D75088	1	B
34	5/16" x 1 1/2" Bolt	076-13059	2	
	5/16" L/W	076-33620	2	
	5/16" Nut	076-36304	2	
35	Battery Hold Down Bolt	087-EC HD61C	2	
	1/4" L/W	076-33618	2	
	1/4" Nut	076-36302	2	
36	Battery Hold Down Bar	SR-75046	1	B
37	12 Volt Battery	087-VL75DT	1	
38	Battery Bolt	087-EC BP78	2	
39	Battery Cable	087-EC A14-4L	2	
39A	Red Heat Swrink 1/2" ID	089-669985	2 @ 2"	
40	1/4" NPT x Pipe Nipple	018-330-006008	1	B
41	1/4" NPT x 90 deg Elbow	018-310-000401	1	B
42	Pipe to Hose connector	019-WEA 1868x8x4	2	
43	"GREASE " Decal	070-ST5-021-B	2	
44	Nylon Hose	025-1928-07	11 1/2"	
45	Grease Cup Mount	060-GR84B2-13	1	B
46	Grease Cup	060-S1509	1	

** 7 Anti-Sieze
Torq 32 ft. lbs.

** 9 Blue Loc-tite
Torq 16 ft. lbs.



47	Plastic Diesel Fuel Tank	SR-75122	1	
48	Diesel Fuel Tank Cap (Green)	X	1	
49	3/8" x 1 1/2" Bolt	076-13109	4	
	3/8" L/W	076-33622	4	
50	Right Fuel Tank Mount	SR-75044-R	1	O
51	1/4" Non-perm Fuel Line	024-RBR-27339	62"	
52	1/4" Fuel Line Clamp	025-PAP307-562	2	
53	Fuel Tank Strap	SR-75124	2	O
54	Left Fuel Tank Mount	SR-75044-L	1	O
55	3/8" x 1" Bolt	076-13105	4	
	3/8" F/W	076-33008	4	
	3/8" L/W	076-33622	4	
	3/8" Nut	076-36306	4	
56	5/16" Fuel Line Clamp	025-PAP307-564	4	
57				
58	Shut Off Valve	019-11-6294	1	
59	5/16" Non-perm Fuel Line	024-3225-5002	58"	
60	Wire Loom Clip	089-XBO-R4	1	
61	Wire Loom Clip	089-SPNW-8	2	
62	Rear Hood Support	SR-D75095	1	O
63	1/4" X 1 1/2" Bolt	076-13009	4	
	1/4" Nut	076-36302	4	
	1/4" L/W	076-33618	4	
	1/4" F/W	076-33004	4	
64	Top Hood	SR-D75085	1	O
65	1/4" X 1/2" Bolt	076-13001	8	
	1/4" L/W	076-33618	8	
	1/4" F/W	076-33004	8	
66	Front Hood	SR-D75080	1	O
67	5/16" x 1" Bolt	076-13055	4	
	5/16" L/W	076-33620	4	
	5/16" Nut	076-36304	4	
68	1/4" X 1" Bolt	076-13006	3	
	1/4" L/W	076-33618	3	
	1/4" F/W	076-33004	3	
	1/4" Nut	076-36302	3	
69	5/16" Black Rubber Fuel Line	024-3225-5002	36"	
70	Control Panel Mount	SR-75062	1	O
71	3/8" x 1" Bolt	076-13105	1	
	3/8" L/W	076-33622	1	
72	1/4" X 3/4" Bolt	076-13003	2	
	1/4" L/W	076-33618	2	
	1/4" Nut	076-36302	2	
73	3/8" x 1 1/2" Bolt	076-13109	1	
	3/8" L/W	076-33622	1	
	3/8" Nut	076-36306	1	
74	Yanmar control panel 3TNV80	033-KS-105	1	
	Yanmar control panel 3TNV70	033-KP3	1	
75	Wire Harness Extension	033-813-3110-52	1	
76	Throttle Cable	SR-D75065	1	
77	Throttle Cable Threaded End	032-161-581-X	1	
	3/8"-24 NF Nut	076-36356	2	
91	Pressure Warning Tag	060-GR6588BG	1	
92	"PRIME" Decal	060-GR6588AH	1	
93	"DISCHARGE" Decal	060-GR6588BJ	1	
94	"SUCTION" Decal	060-GR6588AG	1	
95	"Fill Level" Decal	070-ST5-042	1	
96	"Flammable" Decal	070-16020-A	1	
97	"Diesel Fuel Only" Decal	070-ST5-030-A	1	
98	"D" Decal	070-ST5-030-F	1	
99	"Grease Cup" Decal	060-GR6588BD	1	

PAINT COLORS
O - Orange
B - Black
HHB - High Heat Black

GR-84B2 ASSEMBLY PARTS LIST

(P/N #060-GR84B2-KIT)

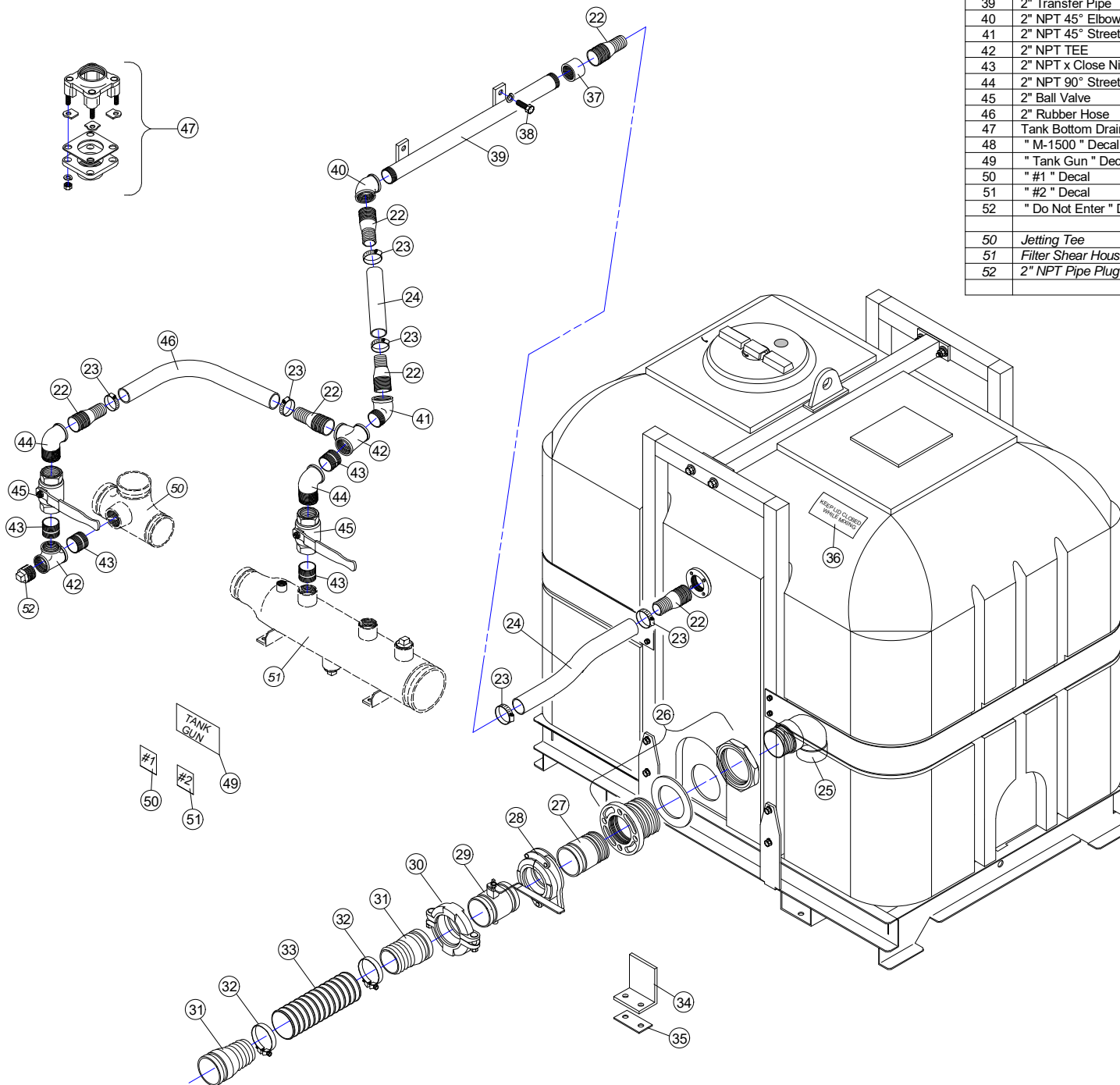
REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.
1	Hex Nut (torque 150 ft.lbs)	060-GRD105991	16
2	Pipe Flange	060-GR175610010	2
3	Flange Gasket	060-GR1676G18000	2
4	Check Valve Seat	060-GR733610010	1
5	HD Machine Screw	060-GRX040317090	2
6	Flap Valve Assembly	060-GR7340	1
6A	Hex Head Capscrew	060-GRB040317000	2
	Lock Washer	060-GRJ0417090	2
6B	Large Valve Plate	060-GR733724000	1
6C	Check Valve Gasket	060-GR7341 19000	1
6D	Valve Weight	060-GR733915990	1
7	Valve Seat Gasket	060-GR7336G18000	1
8	Pipe Plug	060-GRP2010009	2
9	Inlet Stud	060-GRC101315991	8
10	Pump Casing	060-GR46472-317	1
11	Outlet Stud	060-GRC100915991	8
12	Hex Nut (torque 33 ft lbs)	060-GRD0615991	2
	Lock Washer	060-GRJ0615991	2
13	Wear Plate	060-GR260515990	1
14***	6" Impeller	060-GR8882A 100106	1
14***	7" Impeller (#TNV80 Diesel)	060-GR8882A 100107	1
15	Shim Pack (included with Seal #16)	060-GR37117090	1
16	Grease Seal Assembly	060-GRGS1250	1
17	Casing Gasket Set	060-GR2474G18000	1
18	Brass Seal Liner	060-GR220514080	1
19	Seal Plate Assembly	060-GR294810010	1
20	1/4" NPT x 3" Pipe Nipple	018-330-006008	1
21	1/4" 45° Elbow	018-310-023077	1
22	Grease Cup	060-GRS1509	1
23	Hex Nut (torque 33 ft lbs)	060-GRD0615991	8
	Lock Washer	060-GRJ0615991	8
24	Bell Housing Stud	060-GRC0608-15991	8
25	Pipe Plug	060-GRP04 15079	1

*** Match serial number on side of pump housing to size of impeller
Remote mounted grease cup included in power units

30	"Pressure Warning" Tag	060-GR6588BG	1
31	"PRIME" Decal	060-GR6588AH	1
32	"DISCHARGE" Decal	060-GR6588BJ	1
33	"SUCTION" Decal	060-GR6588AG	1
34	"Grease Cup Instructions" Decal	060-GR6588BD	1
35	"Grease Cup Instructions" Tag	060-GR38816-301	1

GR-84B2

REV.01 / 06 / 23



39	2" Transfer Pipe	SR-15011	1	B
40	2" NPT 45° Elbow	018-310-02440-1	1	B
41	2" NPT 45° Street Elbow	018-310-02820-4	1	B
42	2" NPT TEE	018-310-03080-4	2	B
43	2" NPT x Close Nipple	018-330-03700-3	4	B
44	2" NPT 90° Street Elbow	018-310-01720-7	2	B
45	2" Ball Valve	022-423-00014-0	2	
46	2" Rubber Hose	SR-15030-E	1	
47	Tank Bottom Drain	086-BF-220BD	1	
48	" M-1500 " Decal	070-ST5-028-B	1	
49	" Tank Gun " Decal	070-ST5-027-B	1	
50	" #1 " Decal	070-ST5-027-E	1	
51	" #2 " Decal	070-ST5-027-F	1	
52	" Do Not Enter " Decal	070-16051-B	1	
50	Jetting Tee	SR-75021		
51	Filter Shear Housing	SR-75026		
52	2" NPT Pipe Plug	018-318-90256-6		

Paint:
Orange = O