



# **Operators Manual**

**\*\* M4-D \*\***

**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](http://www.stsmixers.com)  
[www.grpumps.com](http://www.grpumps.com)

Dealer

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## Limited Warranty

### United States and Canada

Surface to Surface Inc. or it's 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 engine 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.  
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.

## M4-D

# **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**

**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 beside the 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**

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**

**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.



### **⚠ WARNING**

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

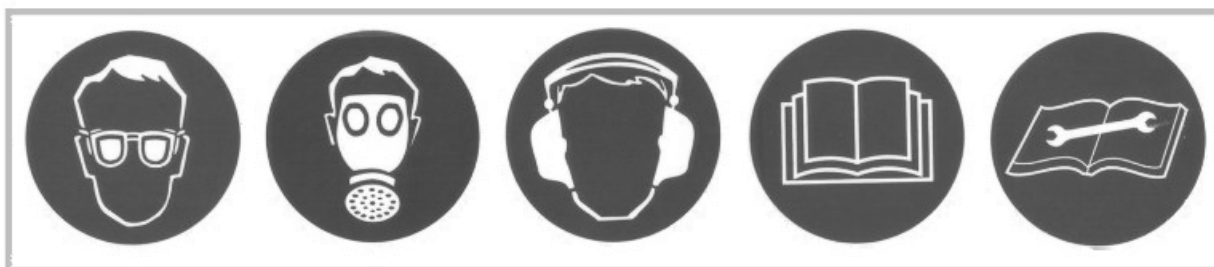
## M4-D

### 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



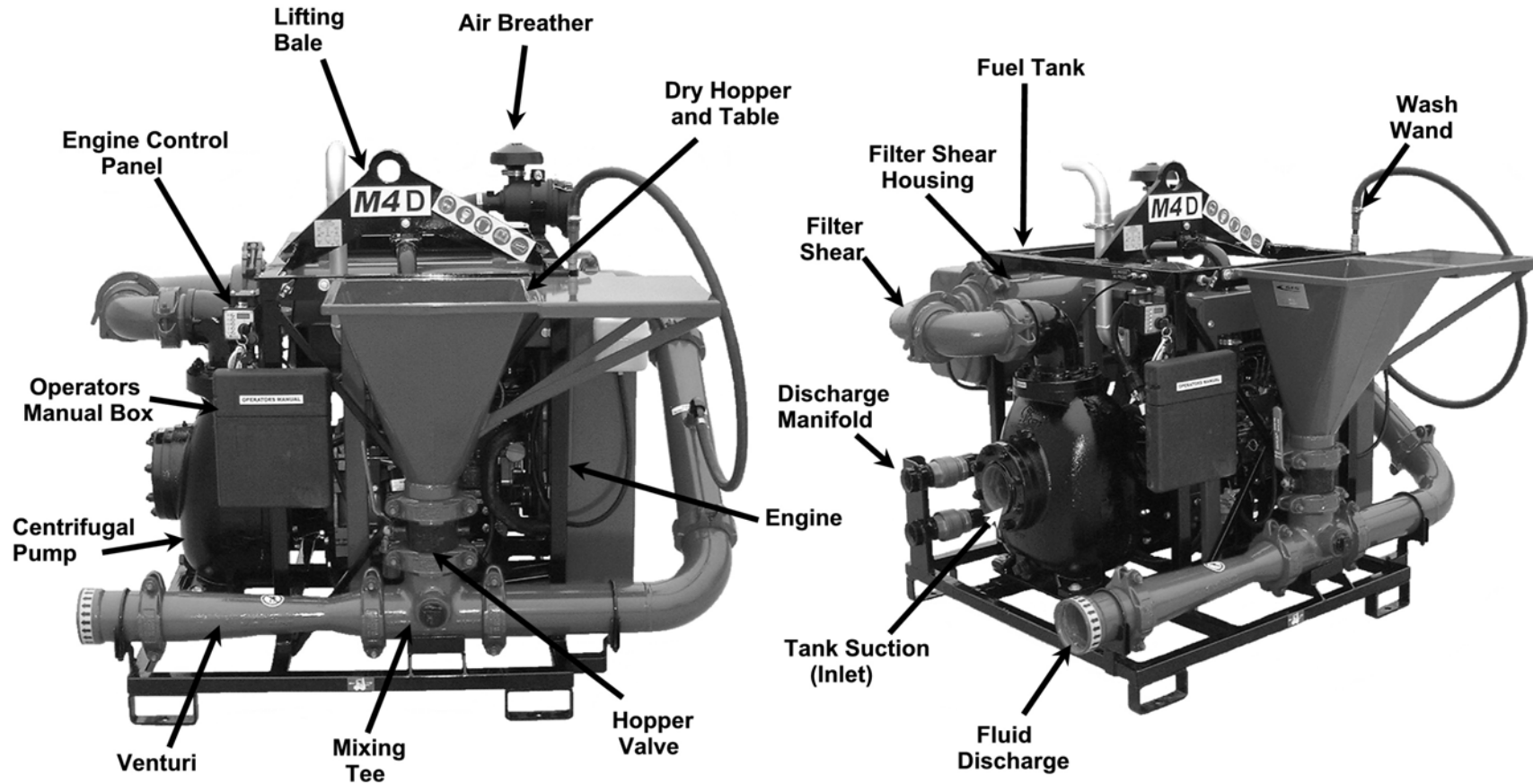
Fluid Flow Direction

CLEAN FILTER DAILY

Maintenance Instructions

# M4-D

## Main Working Components



**Surface to Surface Inc.®**

# M4

(Hose Hook-ups)

DRILL FLUID OUT  
[to Drill Rig]  
\*\* 2" NPT \*\*

OUT FLOW  
[to Tank Gun(s)]  
\*\* 2" NPT \*\*

PUMP INTAKE  
[in from Tank]  
\*\* 4" NPT \*\*

*This line should have a valve installed at the tank to facilitate shut down or repairs.*

FLUID RETURN  
[out to Tank]  
\*\* 4" NPT \*\*

*This line should discharge above the maximum fill line of the tank. The air space will stop the siphon action of the fluid.*

"ALL HOSES SHOULD BE KEPT TO THE SHORTEST LENGTH POSSIBLE TO ACHIEVE MAXIMUM PERFORMANCE."



## **M4-D**

### **Operators Manual**

*Congratulations on your acquisition of the world renowned M4-D 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-4.*

*Thank you, for choosing the M4 series mixer.*

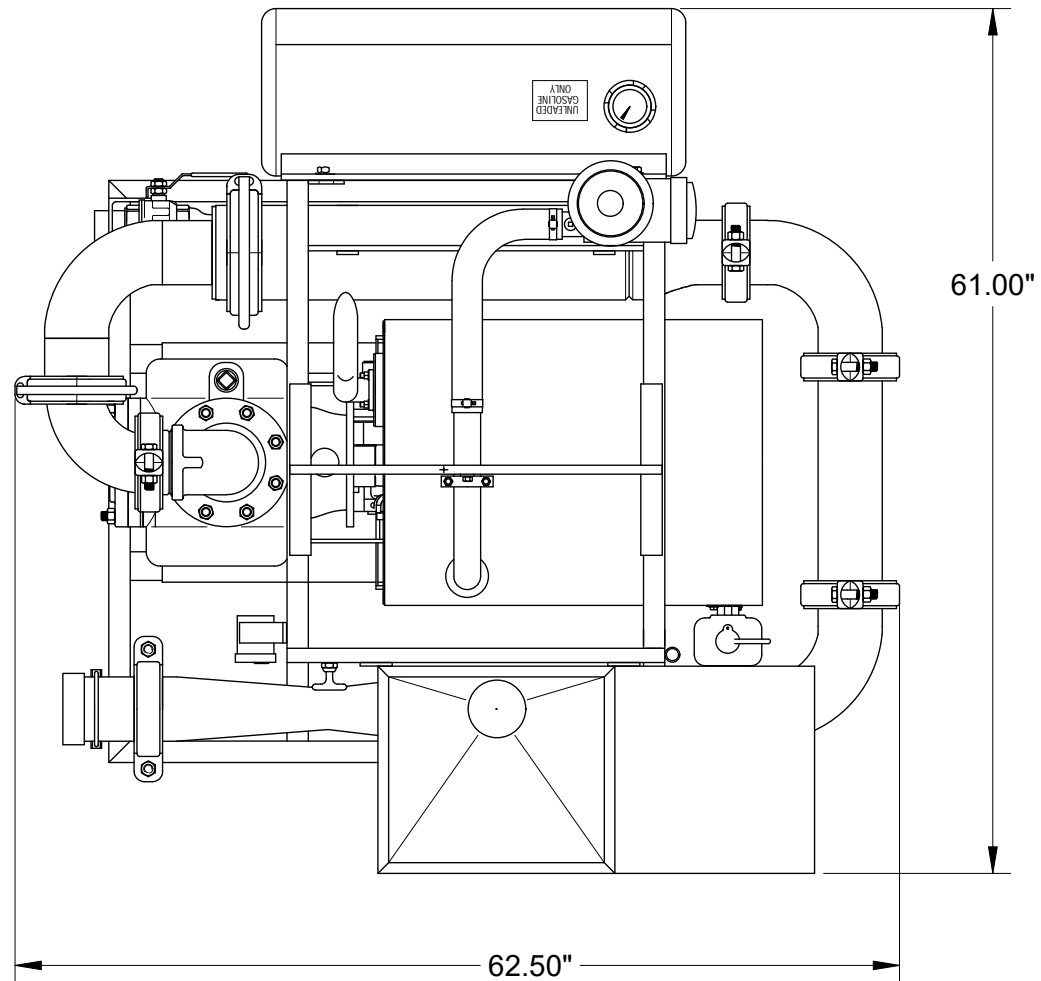
**The M4 mixing unit was designed to mix dry or liquid drilling products with clean water, into a slurry. The slurry is continually circulated through the mixing cycle until it reaches the desired consistency. The operator can then transfer the final product to a holding reservoir or directly to the drilling equipment.**

**The M4 mixing unit consists of a diesel powered centrifugal pump, filter/shear unit, venturi mixing tee assembly, dry hopper with a table, a set of tank internal jets.**

**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: \_\_\_\_\_
- Date Purchased/Leased: \_\_\_\_\_
- Dealer Purchased/Leased From: \_\_\_\_\_
- Special Custom Features: \_\_\_\_\_



### **M4-D(GR)Y**

Dry Weight: 1375 lbs

Height: 49.00"

	
DWR. NUM.	DATE. 11 / 17 / 11
<b>M4-D (GR)Y</b>	REV.



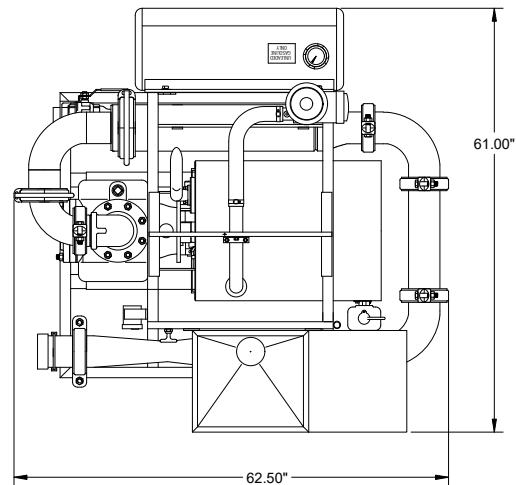
## Universal 4" Mixer Model M4-D

**Surface to Surface Inc.**



### Features and Benefits      M4-D Mixer

The M4-D universal mixer is designed around the time proven M series mixers of STS. Powered by a 22 hp water-cooled Diesel engine driving a 4" centrifugal pump, it makes effective use of the proprietary 4 point mixing system. The M4-D can be used as a new installation or retrofitted into an existing system of tank(s). Since the unit is connected by hose and not hard pipe, the placement of the mixer verses the tank(s) is less restricted and a configuration to suit the needs of the contractor are easier to achieve. The small size also makes it a portable, independent unit that is easier to transport from site to site.



### Specifications

Dimensions  
Weight  
Hopper Height  
Mixing System  
Flow Valves  
Skid Frame  
Engine  
Pump  
Pump Coupling  
Vacuum Port  
Pipe Couplers  
Pressure Wand  
Internal Tank Jets

### M4-D Mixer

61" W x 62 1/2" L x 49" H  
1375 Lbs  
38" High  
4" Proprietary StS Mixing System  
Brass and Steel construction  
1 1/2" steel tube with Lifting bale  
21.9 hp water-cooled, electric start  
4" Cast iron centrifugal trash pump  
Direct coupled engine & pump  
2" NPT Inlet  
Bolt & Snap-groove type  
Hopper maintenance wand  
TurboMix™ Eductor Nozzles

### Benefits

Small space saving footprint.  
Light weight for easy transportation.  
Waist high hopper reduces back strain.  
Fast & efficient with high shearing ability.  
Withstand the abuse of daily operations  
Built tough for the construction trade.  
Industrial rated for longer service life.  
Rugged & repairable for extended service life.  
No expensive couplers or inserts to replace.  
Draw Fluid into system without additional pump.  
Fast cold weather draining of system.  
Removal of blockages caused by additive.  
Fast and effective rolling and mixing action.

**Also available in Gasoline (M4-G), Electric (M4-E) or Hydraulic (M4-H) models.**

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

Check our website for the latest products and specifications

**[www.stsmixers.com](http://www.stsmixers.com)**

**Surface to Surface Inc.**

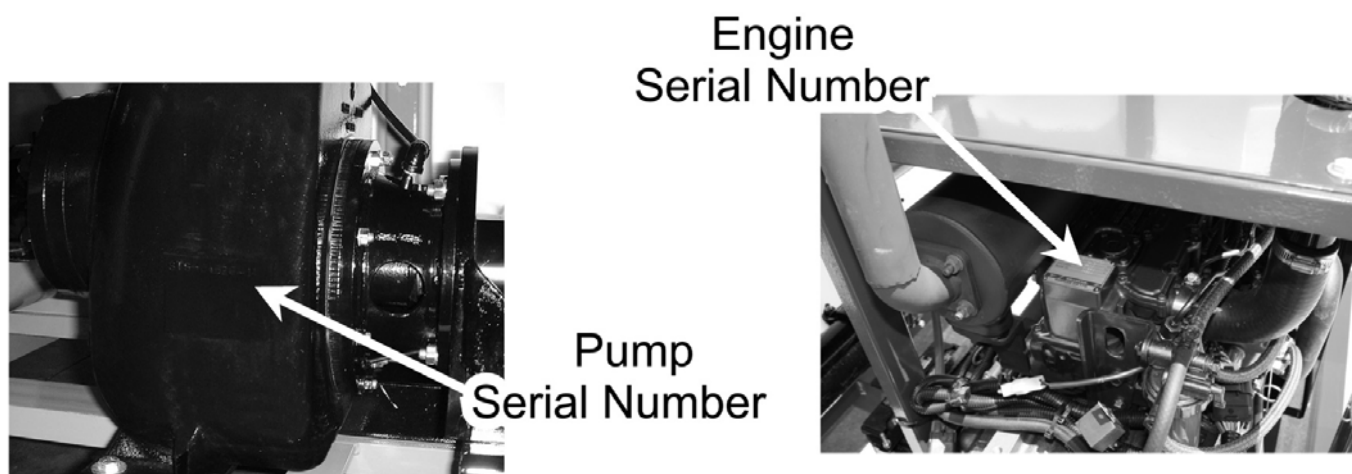
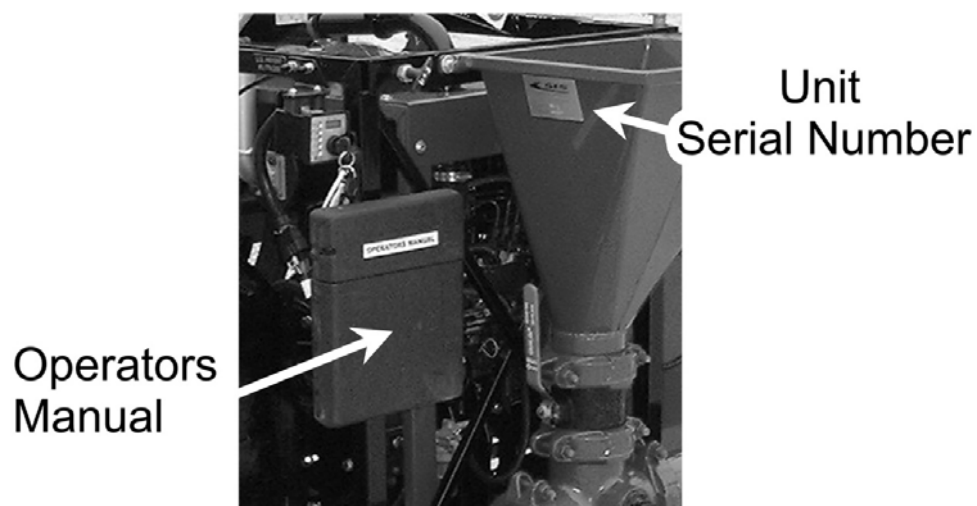
5150 Forest Road, R.R.#3, Watford, Ontario, N0M 2S0  
Tel: 1-800-567-0978

11/17/11

**M4-D**

**Identifying Your Machine & Components**

**Location of Tags and PIN Plates**





# **SECTION #II**

*Description, Care and Maintenance*



## M4-D

### 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.

 **DANGER**

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

**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.

 **DANGER**

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

**CAUTION**

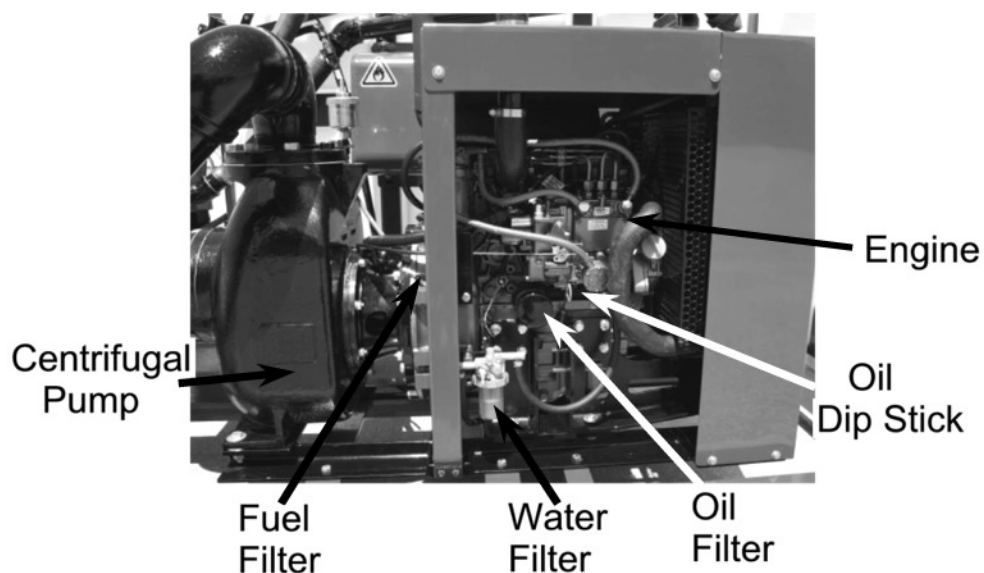
IMPROPER INSTALLATION OF THE  
MECHANICAL or GREASE SEAL  
will result in leakage and possible  
damage to the seal. All maintenance,  
operating and repair of this unit, must be  
done per the instructions in the operators  
manual for safety and reliability.

## M4-D

### Description, Care and Maintenance

#### Diesel Powered Centrifugal Pump

**Fig.4**

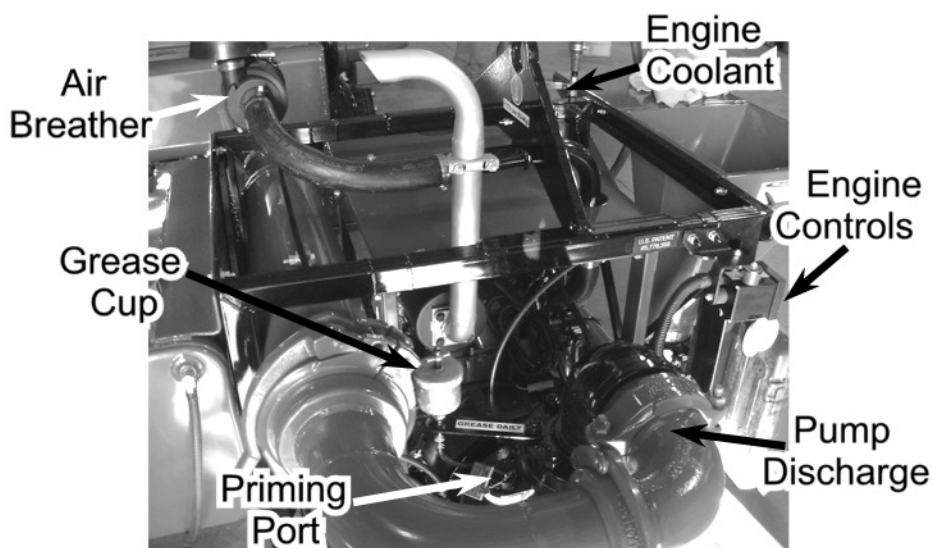


### CAUTION

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.

## M4-D

### 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**

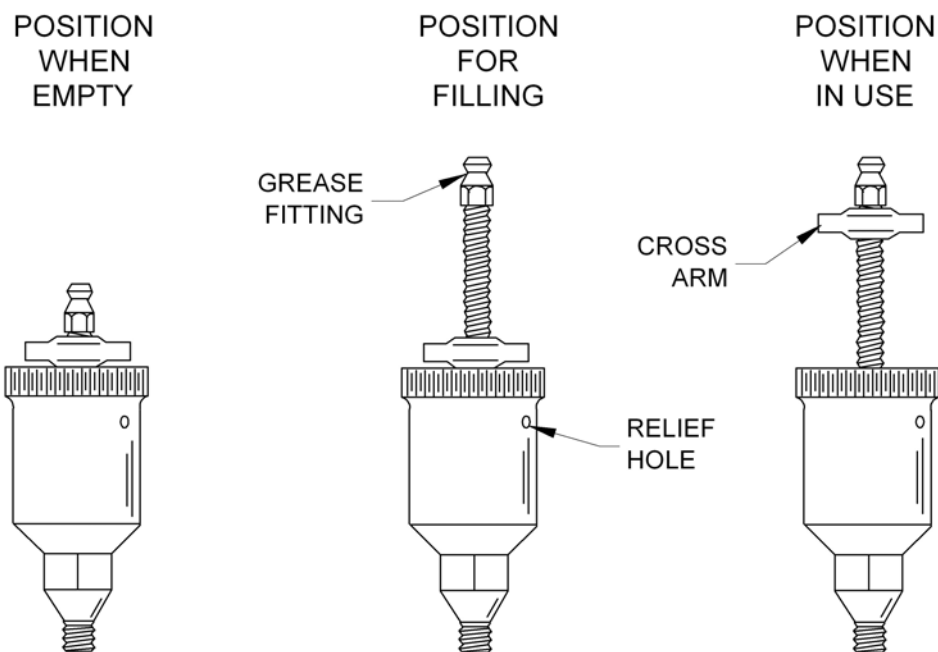


Figure 4. Automatic Lubricating Grease Cup

## **M4-D**

### **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**



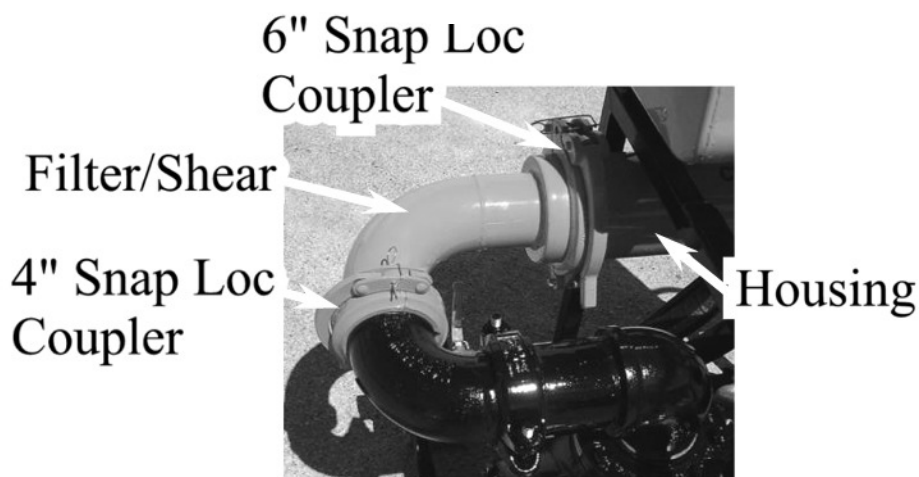
## M4-D

### Description, Care and Maintenance

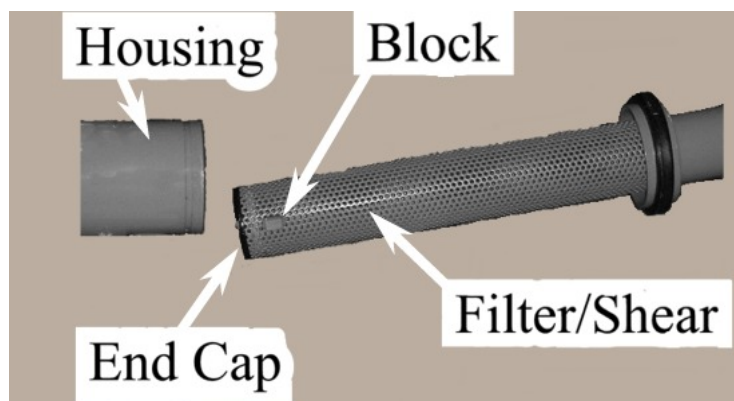
#### Filter / Shear System

The filter / shear (Fig.6a) system on the M4 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 left 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 1<sup>st</sup> and 4 inch coupler 2<sup>nd</sup> 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.

## M4-D

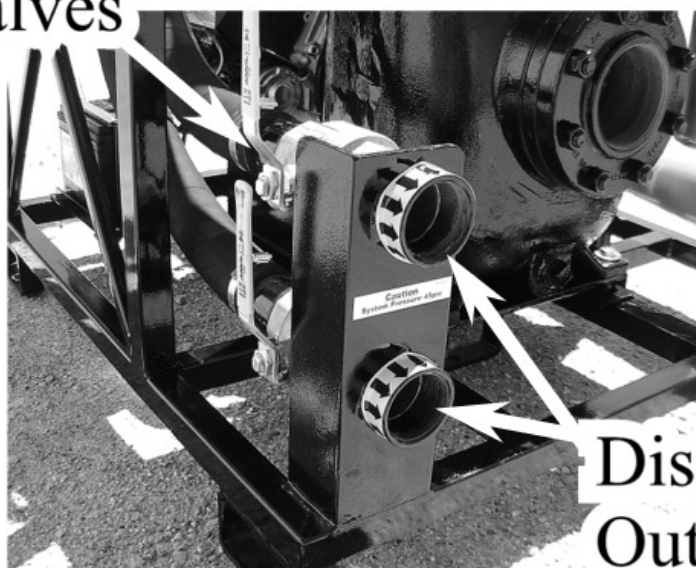
### Description, Care and Maintenance

#### Filter / Shear System *continued*

On the left side of the unit (near the back side) is a upright “discharge manifold” (see Fig.7). The two outlets are connected to the filter shear and controlled by independent ball valves. The connections are 2” NPT thread. One of the outlets is to be connected to the internal tank jets inside of the reservoir tank (explained further on in this manual) and the other outlet 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.

Ball  
Valves

Fig.7



Discharge  
Outlets

### **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.



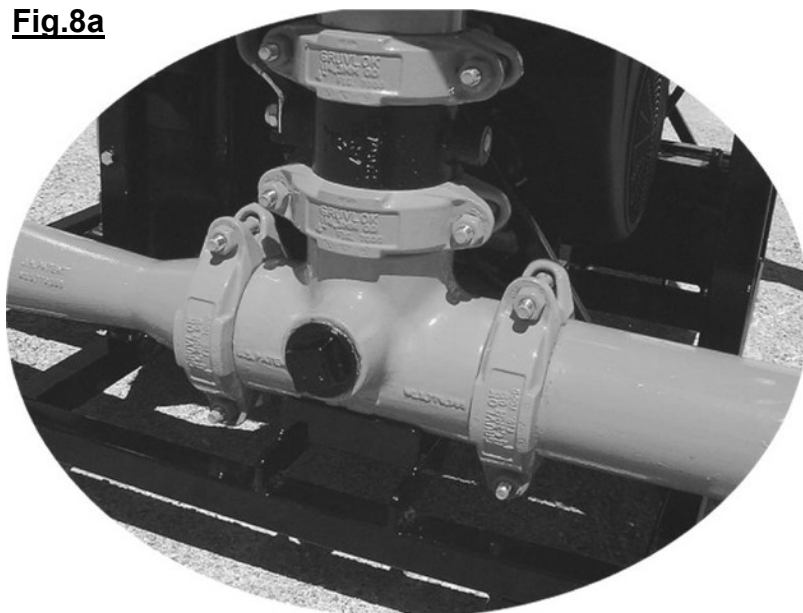
## M4-D

### 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 M4 unit 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**



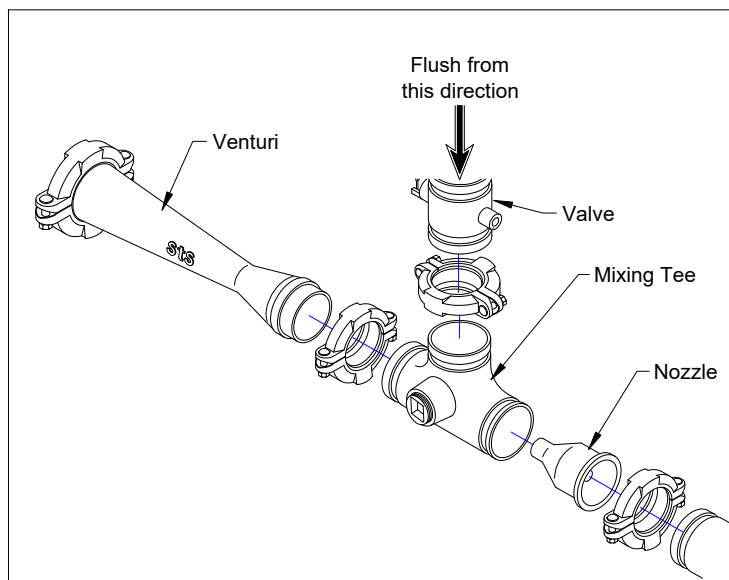
### CAUTION

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

**Fig.8b**

### ⚠ 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.





## M4-D

### Description, Care and Maintenance

#### Wash Wand

The M4 unit 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.

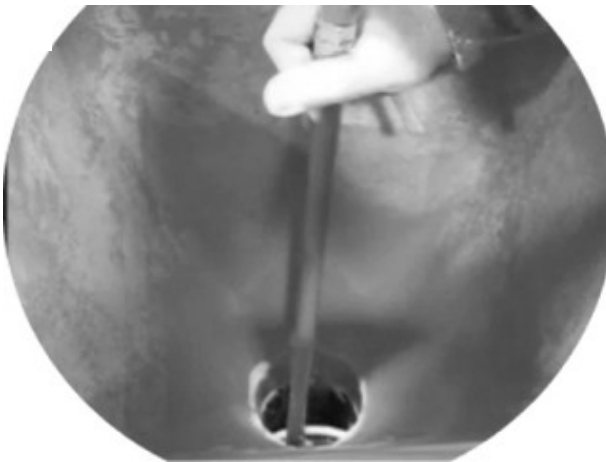
The wash wand uses the high-pressure fluid from the mixing system piping which can reach pressures of up to 50psi. **CAUTION** should always be used when handling the wash wand. A valve is located on the wash wand to regulate the flow of fluid.

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 marsh 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**



## M4-D

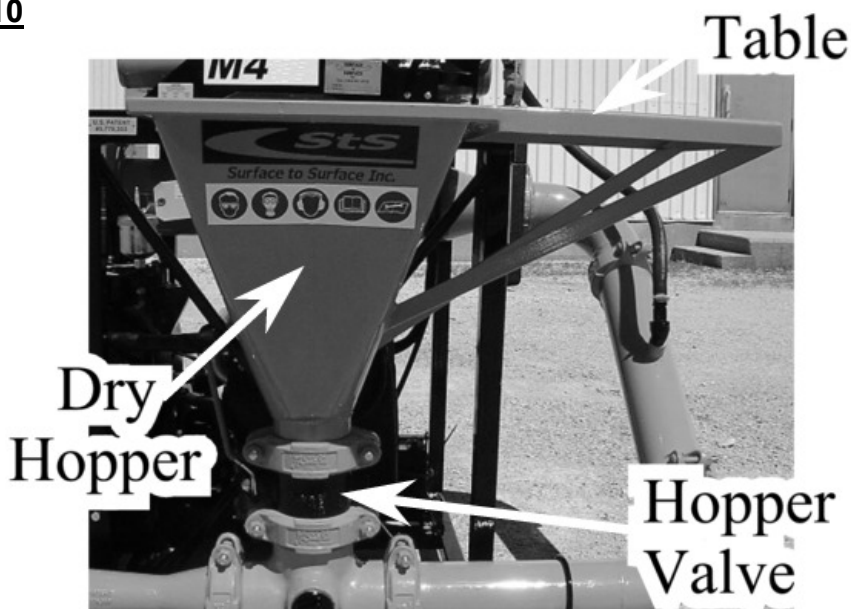
### Description, Care and Maintenance

#### 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!

Fig.10



#### **! 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.

## M4-D

### Description, Care and Maintenance

#### Internal Tank Jets

The Internal Tank Jets (Fig.11a) are supplied with the M4 unit, and are installed (by the customer) inside the reservoir tank, 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 tank jets are connected together in series, usually by a manifold design, (suggested by STS) where all jets receive the same amount of fluid and pressure. This manifold design is supplied with fluid from one of the outlets on the discharge manifold (Fig.11b). The manifold has a ball valve to control the flow, and 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, when performing these tasks, a siphoning action can occur, pulling fluid from the tank and into the external piping. The internal tank jets require little or no maintenance and will only require attention if they become clogged. Flushing the entire system weekly with clear water should eliminate any problems with this piece of the system. The fluid passing through the internal tank jets is at a very high pressure and extreme caution should be used when viewing the inside of the tank.

The internal tank jets also act as a relief valve to the system and relieve the pressure spikes caused when the flow to the drill rig or second reservoir tank is interrupted.

**Fig.11a**



### **⚠ DANGER**

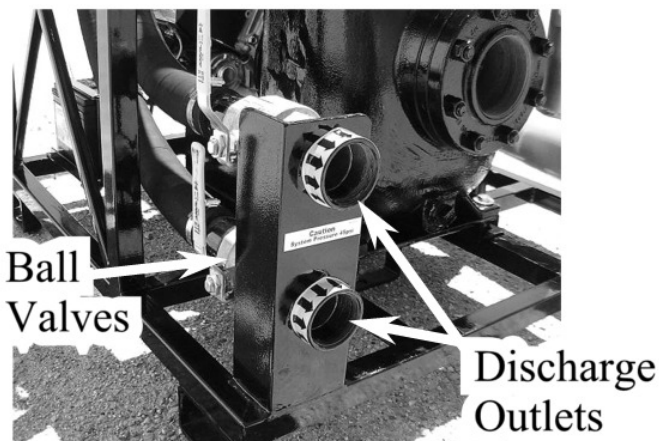
#### **NEVER ATTEMPT REPAIRS OR DISASSEMBLY**

without shutting off the engine.  
Serious personal injury will result.

### **CAUTION**

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

**Fig.11b**



### **⚠ CAUTION**

**NEVER OPERATE THE MIXING  
unit with the tank lid open.**

### **⚠ 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.

## M4-D

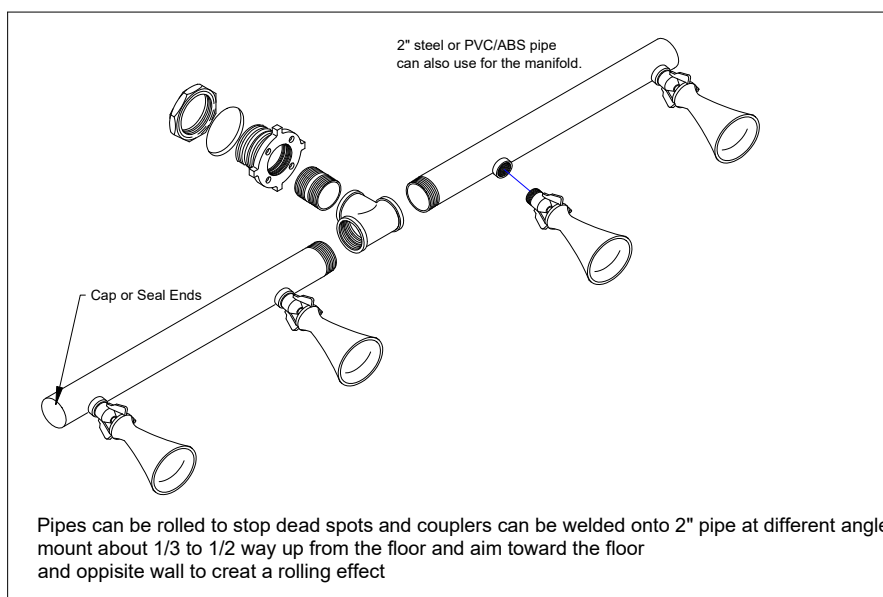
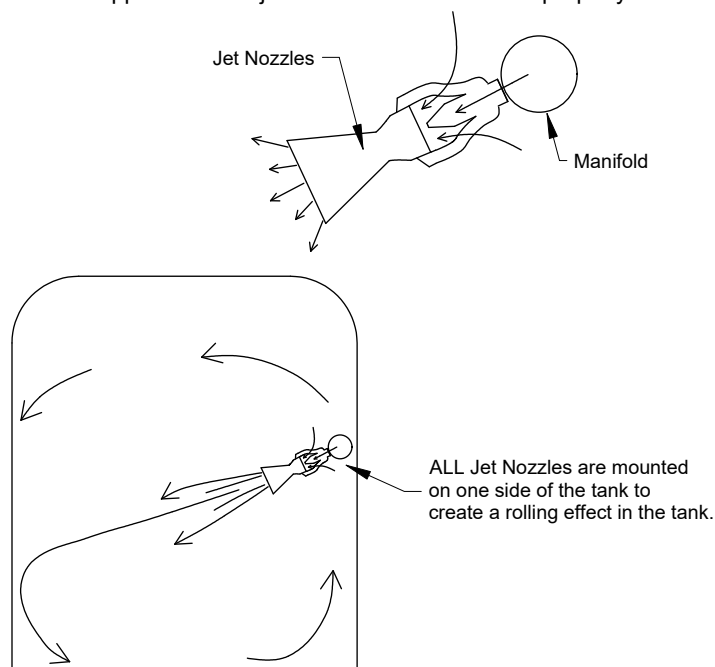
# Description, Care and Maintenance

## Internal Tank Jets - Installation

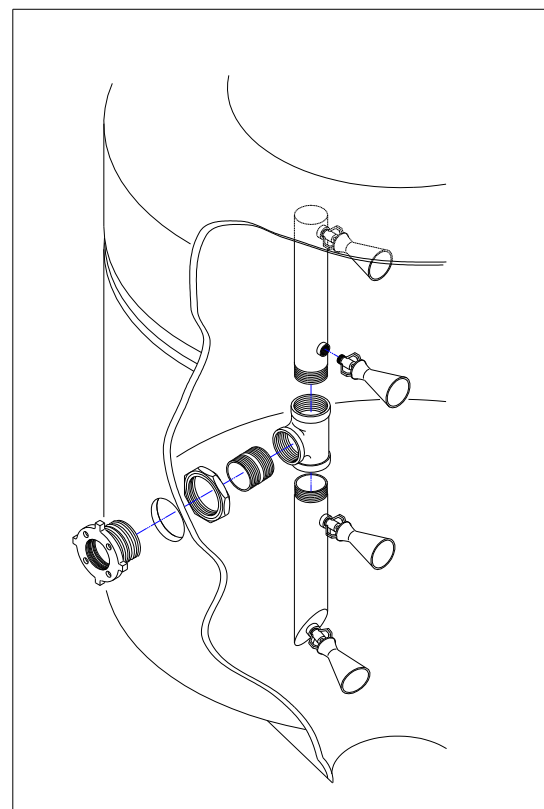
### How they work.

For every gallon of fluid passing through the jet nozzle from the manifold pipe, the jet nozzle will draw in another 4-5 gallon more from around the outside of the nozzle, creating a larger volume of fluid movement in the tank.

Connect the manifold to the outlet on the filter/shear of the STS Mixing Unit. Each unit is shipped with 2-4 jet nozzles that have been properly sized for the unit.



**Typical horizontal installation in a tank**



**Typical vertical installation in a round cone bottom tank**

**For help with design and placement in your tank, call Surface to Surface Inc. and they will work with you to find the best solution**

# **SECTION #III**

*Set-up and Installation of Unit in Detail*

## M4-D

### Set-up and Installation of M4 in detail

#### Permanent mounting of the unit

The M4 unit is built on a sub frame 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 welded, tube type feet (Fig.12a) fastened to the underside corners of the sub frame. These are structurally designed to hold and withstand any movement of the unit when properly sized fasteners are inserted into the holes in the feet. 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.

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 effect the health of the operator or others working near the unit.

#### Portable use of the unit

If the M4 unit is to be used as a portable unit, there is a lifting bale (Fig.12b) connected to the sub frame to support and balance the unit when lifting or moving. Properly approved and rated lifting apparatus should be used at all times and lifting done by qualified personal only.

The M4 should only be placed on solid, level ground with a clear working area around it.



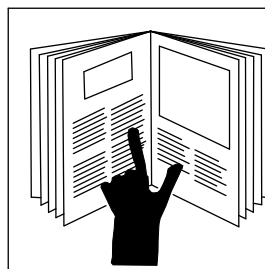
**Fig.12a**

### 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.



**Fig.12b**



### ⚠ WARNING

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

# **SECTION #IV**

*Operating the M4 Unit*



## M-4-D

# Operating the M4 Unit

### Site Setup & Pre-Check

#### SITE SETUP

- **CHECK** for overhead hazards if unloading the unit to the ground.
- **UNLOAD** the unit by using the sub frame lifting bale (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 M4 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 discharge manifold connected to the “tank jets” is open.
- **CHECK** to ensure the ball valve on the discharge manifold connected to the drill rig is closed.
- **CHECK** to ensure the small ball valve connected to the Wash Wand is closed.
- **CHECK** that the hopper valve is closed.



## M4-D

# Operating the M4 Unit

## Starting the Engine & Pump

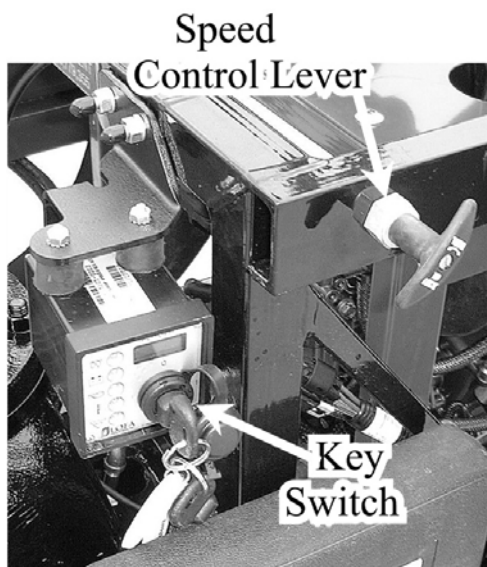
**\*\*\* The Engine Operators Manual should be consulted for a more detailed engine start up and shut down procedures.**

### Starting the Diesel Engine

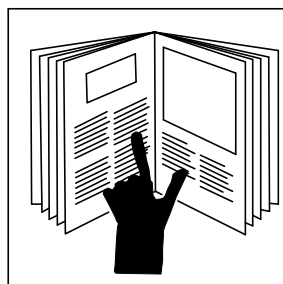
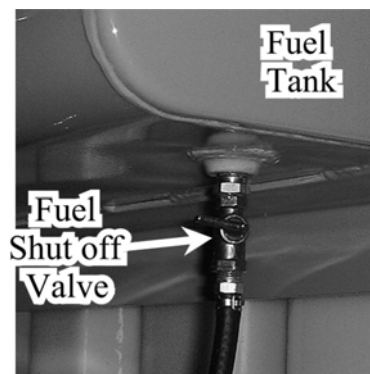
- Make sure the fuel shut off valve located under the fuel tank is open.
- Pull the speed control tee handle 1/3 of the way out, towards the high-speed position.
- Insert the key into the key switch. If the engine is cold or the ambient temperature is low, use the pre-heat feature on the key switch as 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 handle 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 pull the speed control handle 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 moving the speed control lever, 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.

## M4-D

# Operating the M4 Unit

## Typical Mixing Operation

### Mixing Operation

- Operate the engine at high speed.
- If not already open, open internal tank jet valve.
- 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 1<sup>st</sup> 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 1<sup>st</sup> 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.

***Note:*** Whenever high-speed operation is not required, slow the engine down by moving the engine speed control tee handle to save fuel and extend engine life.

**⚠ DANGER**

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

**⚠ 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**

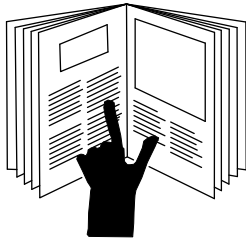
**DO NOT POSITION  
ANY PART OF YOUR BODY**  
over the hopper, valve,  
or mixing tee while cleaning.

**CAUTION**

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

**⚠ 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.



**⚠ WARNING**

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

## M4-D

# Operating the M4 Unit

## Typical Transfer/Offloading Operation

### Transferring Operation

- On the discharge manifold of the M4 you will see a 2<sup>nd</sup> outlet with a ball valve (2"NPT.) that is not used.
- A transfer hose with a minimum size of 2 in. can be attached to this outlet 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 M4 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, this valve is kept in the open position and a valve that is controlled by the operator of the drill rig, will be needed to stop the flow (normally mounted on the drill rig). The tank jet 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 the discharge manifold 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).
- Close the valve to the reservoir, add water to the tank and begin mixing a new batch of mixed fluid.

**⚠ DANGER**

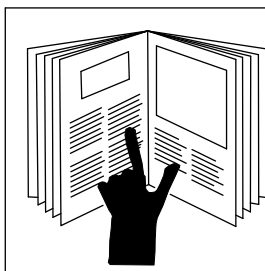
**IN AN EMERGENCY**  
rotate the engine speed control lever  
to the STOP position  
to halt engine, pump, and fluid flow

**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.

## M4-D

### Operating the M4 Unit

#### Typical Warm Weather Shutdown & Storage

##### Daily Shut Down

- Push in the engine speed control tee handle (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 valves on the discharge manifold 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 and dispose of it according to local environmental approved practices.
- Make sure the valves on the discharge manifold are open.
- Disconnect the 2" discharge hose that went to the drill rig or reservoir tank, at the drill rig or reservoir, and securely fasten it, back into the mixing tank to recalculate the fluid.
- Fill and rinse the tank with clear water and then start the engine and pump. By pumping this water through the entire 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.
- Stop the engine and pump.
- Drain the remaining water out of the tank and dispose of it according to local environmental approved practices.
- Remove centrifugal pump front drain plug. Replace the plug when the pump is empty.
- Make sure both valves on the discharge manifold and the wash wand valve are open.
- Remove filter / shear and clean as described in the maintenance section of this manual.

### **DANGER**

#### **NEVER ATTEMPT REPAIRS OR DISASSEMBLY**

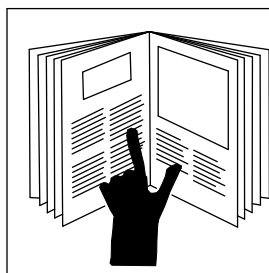
without shutting off the engine / motor  
and disconnecting the power source.  
Serious personal injury will result.

### **CAUTION**

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

### **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.

## M4-D

### Operating the M4 Unit

#### Typical Cold Weather Shutdown & Storage

##### Additional Winter and Freezing Weather Shut Down

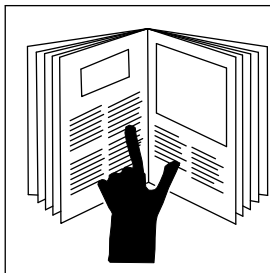
- Pump or drain remaining mixed fluid out of the tank and dispose of it according to local environmental approved practices.
- Make sure the valves on the discharge manifold are open.
- Disconnect the 2" discharge hose that went to the drill rig or reservoir tank, at the drill rig or reservoir, and securely fasten it, back into the mixing tank to rerecirculate the fluid.
- 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.
- Stop the engine and pump.
- Drain the remaining water out of the tank and dispose of it according to local environmental approved practices.
- Disconnect all hoses and let them drain.
- Remove centrifugal pump front drain plug. Leave the pump plug out.
- Make sure both valves on the discharge manifold and the wash wand valve 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 venturi open end (hose is disconnected).
- 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.



### WARNING

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

## **M4-D**

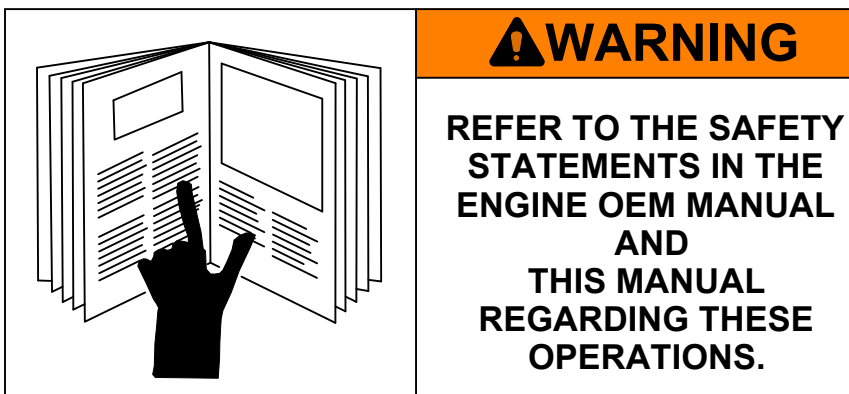
### **Operating the M4 Unit**

#### **Prolonged Periods of Storage**

#### **Prolonged Periods of Storage**

After a thorough cleaning of the internal and external components of the M4, 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.



## M4-D

### Operating the M4 Unit

#### Optional Self-Loading Feature

##### Self Loading (*customer to install*)

If the self-loading feature of The M4 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. As shown in (Fig.14b) remove the plug and install an elbow, close nipple, full flow ball valve and a type of 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.

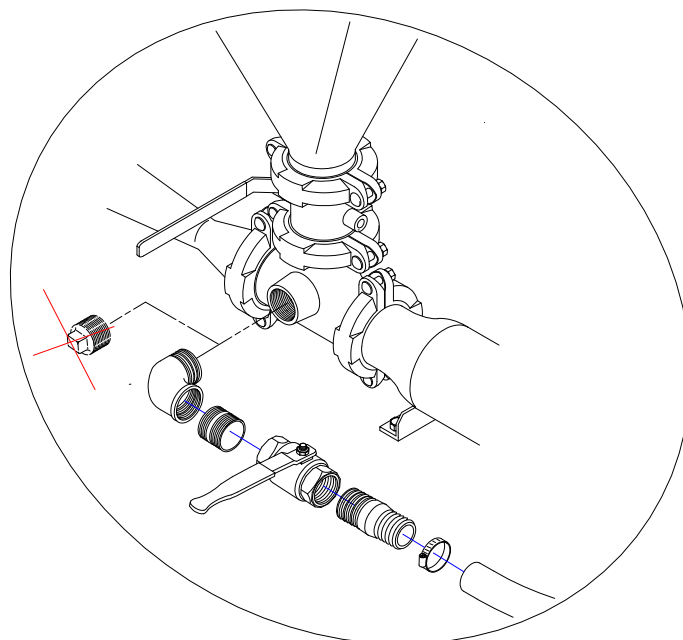
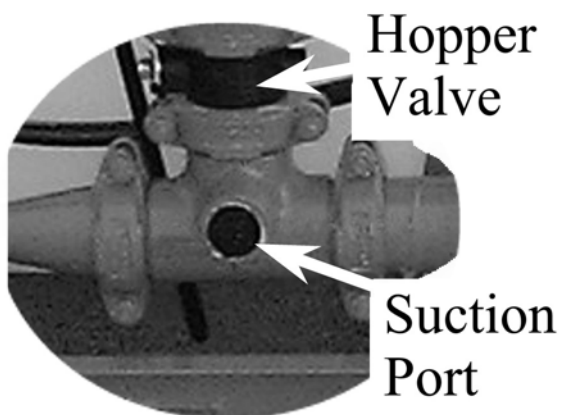
Caution should be used when threading in a connection into the suction port. Do not over tighten the Regardless of the configuration of the connection used, this port needs to be sealed off (valve or capped) when not being used as a suction port. The reason for this is that then the unit is shut off, 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!**

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.14b**

**Fig.14a**



# **SECTION #V**

*Troubleshooting the M4 Unit*



## M4D

### Troubleshooting the M4 Unit

The M4 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 internal tank jets inside the reservoir tank. Multiple tank jets distribute the fluid through out the tank to “stir up the tank.”

The M4 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**
  - Optional Mixing Tee valve closed. - Open Mixing Tee valve**
- *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**



## M4-D

### Troubleshooting the M4 Unit

- *Tank does not stir / roll the fluid inside.*
  - No fluid to the tank jets** - Make sure discharge manifold valve is open.
  - Tank jet holes plugged.** - Flush fresh water through system or clean Tank jets
  - Hose is disconnected from tank jets** - Reconnect hose
  - No fluid flow/ low fluid flow** - See above solutions
- *Discharge from the unit is slow or stopped.*
  - Discharge manifold valve is closed** - Make sure 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 M4-D (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	
<b>*** 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.</b>							
<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

## M4-D

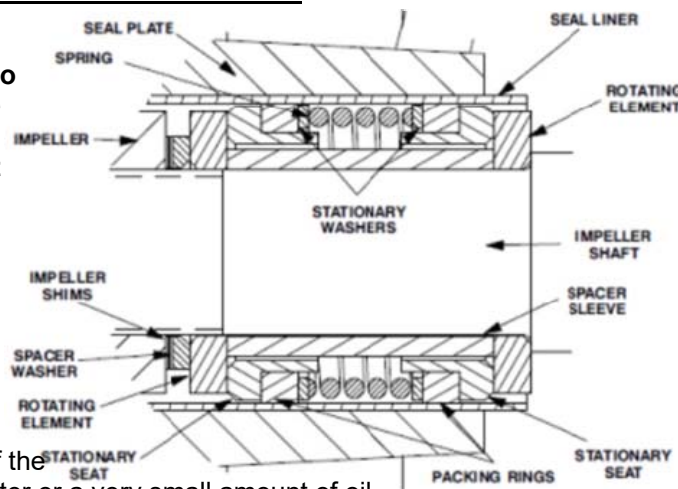
### Grease Seal Installation Instructions Centrifugal Pump Application

**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 1/4" 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. Deburr 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).

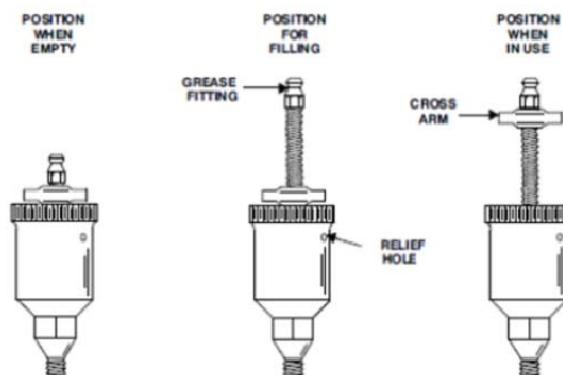
**Before starting the pump, reinstall the automatic lubricating grease cup and piping (if removed for seal liner replacement). Lubricate the seal as indicated below.**

#### **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.

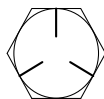
#### **NOTE:**

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.

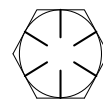


## M4-D

# *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.



M4-D

NOTES:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

# **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!**

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

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.



## **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.

**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.

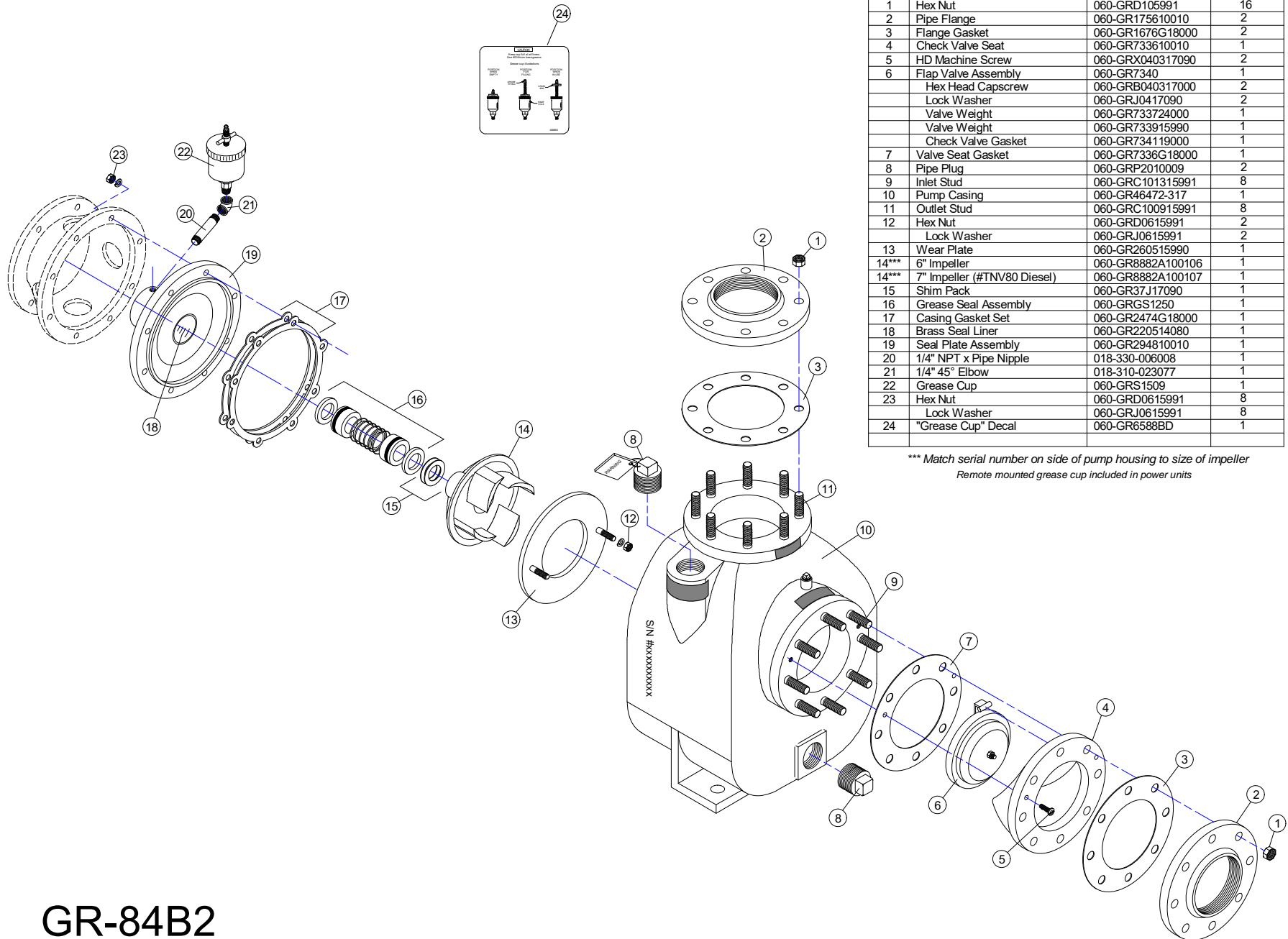
Preventive Maintenance Schedule					
Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Bearing Lubrication (if so Equipped)	I	I			R
Seal Lubrication (If So Equipped)	I	I			R
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					
<b>Legend:</b> 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	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
	Hex Head Capscrew	060-GRB040317000	2
	Lock Washer	060-GRJ0417090	2
	Valve Weight	060-GR733724000	1
	Valve Weight	060-GR733915990	1
	Check Valve Gasket	060-GR734119000	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	060-GRD0615991	2
	Lock Washer	060-GRJ0615991	2
13	Wear Plate	060-GR260515990	1
14***	6" Impeller	060-GR8882A100106	1
14***	7" Impeller (#TNV80 Diesel)	060-GR8882A100107	1
15	Shim Pack	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 Pipe Nipple	018-330-006008	1
21	1/4" 45° Elbow	018-310-023077	1
22	Grease Cup	060-GRS1509	1
23	Hex Nut	060-GRD0615991	8
	Lock Washer	060-GRJ0615991	8
24	"Grease Cup" Decal	060-GR6588BD	1

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



# GR-84B2

REV.09 / 28 / 22

## **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.

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.



**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.



## **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.

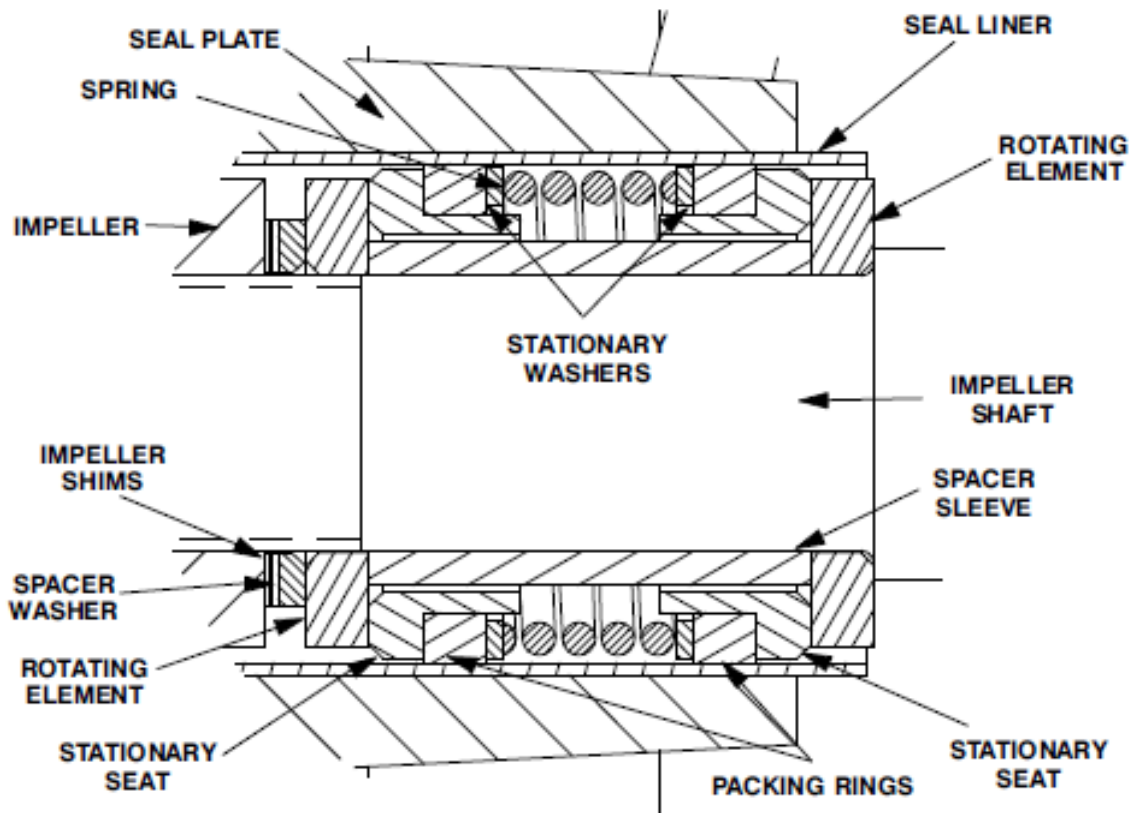


Figure 3. Seal Assembly

## 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

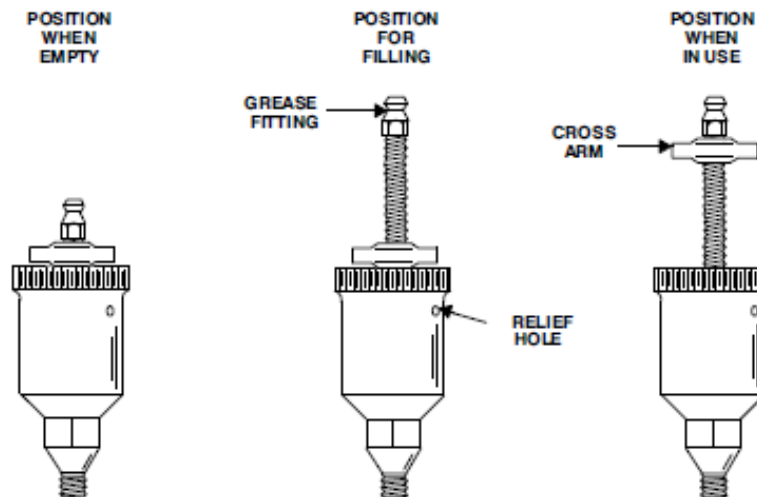


Figure 4. Automatic Lubricating Grease Cup

## **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 1/4" 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).**

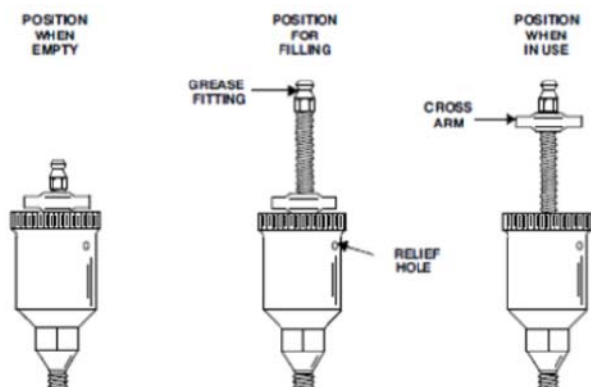
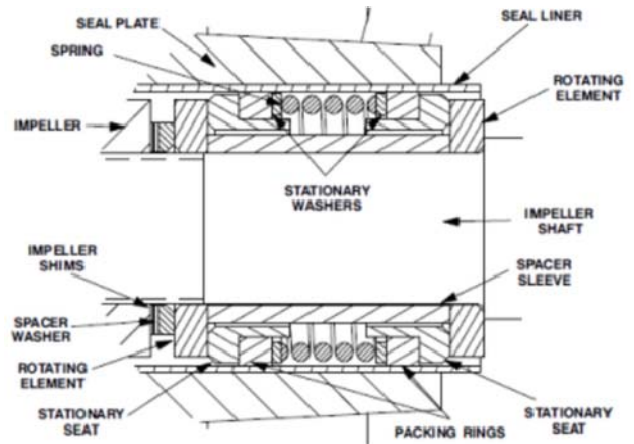
**Lubricate the seal as indicated below.**

### **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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# **LOFA MC704 and MC704 G4 Operation and Troubleshooting**

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## ***Introduction***

This document provides general information on LOFA Industries MC704 control systems operation and troubleshooting. MC704 control systems are a very flexible platform for diesel engine control, monitoring, and protection, featuring LOFA's powerful First Fault Diagnostics (FFD). After pinpointing the initial failure, FFD stores it in memory and alerts the end user via a single bright LED. FFD monitors battery charge, low oil pressure, high temperature and one additional contact closure input. The microprocessor-based solid-state design uses high-power semiconductors instead of outdated electromechanical relays to ensure reliable high-current switching.

The MC704 panels are offered in two versions. The MC704HP has a built-in tamperproof LED hourmeter while the reduced cost MC704LCP eliminates the hourmeter. The G4 variant includes up to four 2 inch gauges. All panel versions can be factory configured with specific preheat & afterglow requirements. If preheat is not required, this output can function as an alarm.

All standard panels include feature a 12 inch wiring harness terminating into a sealed weather proof plug. This robust universal wiring connection performs well in harsh environments and allows interchanging a number of different panels and harnesses. This design allows for simplified installation as well as a flexible means to incorporate custom plug-and-play engine wiring harnesses and standard harness extension

### **Note**

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The engine harness is not included with the panel.

A number of standard engine harnesses are available or  
LOFA can develop a custom harness for you exact needs.

Generic harnesses in various lengths are available for field customization.

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### **Warning**

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When replacement parts are required, LOFA Industries recommends using replacement parts supplied by LOFA or parts with equivalent specifications.

Failure to heed this warning can lead to premature failure,  
product damage, personal injury or death.

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### ***Important Safety Information***

The warnings in this publication are not all inclusive.

LOFA Industries cannot anticipate every potential hazard.

Appropriate safety rules and precautions should be followed with any tool, work method or operating procedure.

Improper procedures, tools and materials may cause damage or make the equipment unsafe to operate.

Only persons with appropriate training, skills and tools should perform these functions.

Improper operation, maintenance or repair of this product can be dangerous and may result in injury or death.

Do not operate or perform any maintenance or repair on this product until all operation, maintenance and repair information is read and understood.

The information, specifications, and illustrations in this publication are based on information available at the time of publication.

All items are subject to change at any time without notice.

## Operation

Turning the control system key to the run position starts a self-test which causes all LEDs to flash three times, activates the alarm output (if preheat is not used) for one second and enables the fuel run/stop solenoid output. After self-test, the LEDs indicate the state of the inputs they monitor. The normal indications are battery charge and oil pressure on most applications. If these LEDs are not illuminated at this time it may indicate the inputs are not properly connected.

The Preheat/OK LED begins to blink when the key switch is turned to the run position if automatic preheat is configured (See Preheat Options). Preheat time varies from application to application. After waiting for the Preheat/OK LED to become solid, the engine is cranked by turning and holding the key switch in the start position until the engine starts. The key switch is spring loaded to return automatically to the run position when released.

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### Note

The key switch is equipped with a mechanical start locking device. An attempt to re-crank the engine can only be made by turning the key switch to the off position to reset the start locking mechanism.

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If the engine is not started within 30 seconds of turning on the system, the fuel run/stop solenoid output is turned off to prevent battery discharge when the key switch is left in the run position. The fuel run/stop solenoid output is turned off after 30 seconds even if preheating. As soon as the key switch is turned to the start position the solenoid output is enabled. The afterglow cycle begins when the key switch returns to the run position.

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### Note

If conditions do not warrant preheat, the engine may be started by turning the key to the start position without waiting for the preheat time to expire.

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Control system instrument power, including the hourmeter and voltmeter, is provided by the fuel run/stop solenoid output. If the instruments do not power up when the key is turned to the run position, this indicates a problem with the solenoid circuit (see Troubleshooting).

After the engine starts, the control system electronics ignore all shutdown conditions for the first 10 seconds. This delay eliminates the requirement to hold a by-pass override button during starting and allows the system conditions such as oil pressure to normalize. The 10 second timer starts when the key switch returns to the run position.

---

### Note

Starter input is required for correct system operation. If the starter motor input is not activated (connected to battery positive) and the engine is started through another means (i.e. air starter) the engine will shutdown 30 seconds after the key switch is turned to the run position.

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To prevent unintentional engine shutdowns caused by intermittent conditions (i.e., pressure spikes, coolant movement) the control system requires a constant 1/3 second fault input to cause engine shutdown.

---

### Warning

When used in combination with mechanical float type switches engine vibrations may prevent constant contact closure.

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## Preheat Options

### Preheat Output

Preheat is a 3A positive output for control of an external power relay with predetermined preheat and afterglow times. A relay should be selected with appropriate amperage capacity for the installed cold starting aid (glowplug, intake air heater, etc.). Applications using multiple cold starting aids may require multiple relays.

#### Note

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Consult engine documentation when selecting cold starting aid, power relay and heating specifications.

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## Indicators



### Battery LED (Red)

A solidly illuminated Battery LED indicates a battery charge failure. A battery charge failure may be caused by a faulty alternator, broken drive belt or the alternator not excited. A battery voltage reading of approximately 14 volts on a 12 volt system (28 volts on a 24 volt system) while the engine is running indicates the battery is charging properly. Irregular blinking of the Battery LED may indicate a failing charge circuit. The system can be configured for battery charge failure to indicate only.



### Oil Pressure LED (Red)

A solidly illuminated Oil Pressure LED indicates low oil pressure failure. The control system typically senses low oil pressure from a ground contact switch on the engine. When a sender/switch combination is used on the engine, the marking WK generally indicates the switch terminal. This input typically expects a normally closed switch (ground contact when oil pressure is low). A defective switch or shorting the shutdown input to ground can cause low pressure fault indication. Additionally, when using sender/switch combinations, swapping the WK and G terminal can cause unintended shutdowns. The system can be configured for oil pressure failure to indicate only.

#### Warning

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Low oil pressure is not an indication of low oil level.

For best possible protection LOFA recommends using our solid-state oil level shutdown switch.

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#### Note

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Most shutdown switches are grounded through the switch body.  
Do not use insulating sealant (i.e. Teflon tape) when installing switches.

---



### Temperature LED (Red)

A solidly illuminated Temperature LED indicates high engine temperature failure. The control system typically senses high temperature from a ground contact switch on the engine. When a sender/switch combination is used on the engine, the marking WK or W generally indicates the switch terminal. This input typically expects a normally open switch (ground contact when engine temperature is too high). A defective switch or shorting the shutdown input to ground can cause over temperature fault indication. Additionally, when using

sender/switch combinations, swapping the WK or W and G terminal can cause unintended shutdowns. The system can be configured for temperature failure to indicate only.

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### **Warning**

If the temperature switch is not in contact with coolant due to coolant loss the engine is not protected from overheating.

For best possible protection, LOFA recommends using our solid-state coolant level shutdown switch.

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### **Note**

Most shutdown switches are grounded through the switch body. Do not use insulating sealant (i.e. Teflon tape) when installing switches.

Some thermostat housings are composites and do not provide ground for the switch.

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### **AUX LED (Red)**

A solidly illuminated AUX LED indicates an auxiliary failure (i.e., coolant level, oil level, belt breakage, hydraulic pressure, etc.). The control system typically senses failure using a ground contact switch. Auxiliary inputs are equipment specific and determined by the equipment manufacturer. A defective switch or shorting the shutdown input to ground can cause fault indications. The system can be configured for auxiliary failure to indicate only.



### **Preheat/OK LED (Green)**

A blinking green Preheat/OK LED is the system preheat indication. When the LED changes to solid the preheat period is complete and the engine may be cranked. The LED changes to solid illumination when the engine starts. There is no indication of afterglow.

# Harness

## ***Sealed Connectors***

The provided sealed weather proof plug includes a grey locking device which must be released to separate the connectors. Press the tab on the connector housing to release the connectors.

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### **Warning**

LOFA does not recommend using dielectric grease or sealant with sealed connectors.  
These chemicals may cause seal damage and allow water entry.

Use LOFA provided cavity plugs to seal the connector if wires are removed.

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## ***Unsealed Connectors***

For unsealed connectors exposed to the elements, LOFA recommends using dielectric grease to protect contacts.

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### **Warning**

LOFA does not recommend using sealant with unsealed connectors.  
Sealant traps moisture in the connector and encourages corrosion.

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## ***Harness Routing***

The minimum routing of radius of the wiring harnesses should be at least two times the diameter of the wiring harness. Bends should be avoided within 1 inch (25 mm) of any connector in order to avoid seal distortion allowing moisture to enter the connector.

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### **Note**

For harness length in excess of 10 ft a relay must be added to the start solenoid circuit.

LOFA offers starter relay kits for mounting near the engine.

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# Battery Circuit Requirements

## ***Battery Positive Connection***

The electronic control system operates on either a 12 VDC or 24 VDC electrical systems. The unswitched battery positive connection to the control system is made at the weather proof connector. The control system provides switched positive battery

Protection for the unswitched battery positive circuit is dependent on specific equipment configuration. The overload protection should not exceed 125% of the sum of all output currents plus 5 Amps for the control system. Powering the control system through dedicated circuits with appropriate overload protection reduces the possibility of system damage.

Circuit breakers are preferred over in-line fuses for circuit protection. Over current protection devices should ideally be located in a central location. If automatic reset circuit breakers are used, consideration of the environment of the breaker is critical and may affect the trip point. The trip point of some circuit breakers can be significantly reduced below the rated trip point if the circuit breaker is exposed to high temperatures.

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### **Warning**

Disconnecting the battery while the engine is running may damage electrical components.

When using a battery disconnect switch, LOFA recommends using a 2 pole switch to disconnect both the battery and alternator output.

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## ***Battery Negative Connection (Grounding)***

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### **Warning**

Improper grounding can cause electrical noise, unreliable operation and may damage the control system or other components. All ground connections must be free from foreign materials, including paint, which may interfere with proper grounding.

A reliable ground must be provided for the control system.  
LOFA recommends the ground connection be made directly to the battery negative.  
Grounding through frame members is not recommended.

All ground paths must be capable of carrying any likely fault currents.

Do not reverse the battery polarity. Attempting to crank the engine when the polarity of the battery connections is reversed may damage the control system.

---

### **Note**

A maximum of three ring terminals should be connected to a ground stud in order to ensure integrity of the ground connection. The use of more than three terminals can cause the connection to become loose.

---

## ***Voltage Drop***

If control system voltage drops below 6 volts for more than one tenth of a second, the control system may reset causing the self test to reactivate and the engine to shutdown after 30 seconds. Resetting the control

system is equivalent to quickly turning the key switch to off and back to run without starting the engine. Since the control system did not sense a start signal, the fuel run/stop solenoid deactivates after 30 seconds. Voltage drops can be caused by transients from external equipment, improper wire sizes, faulty wiring or nearby lightning strikes. In the absence of a LOFA Power Box, relays may be needed for long wire runs.

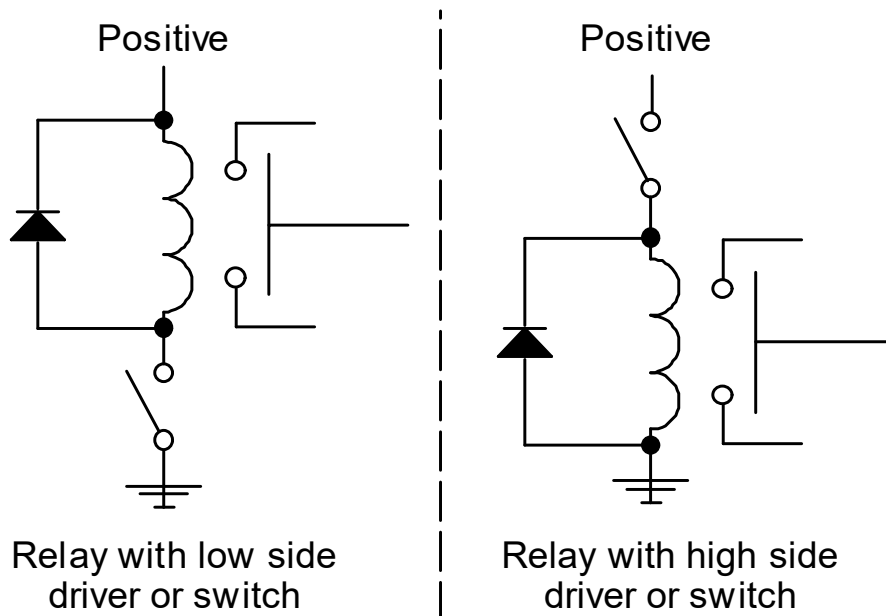
## Suppression of Voltage Transients (Spikes)

### Warning

The installation of voltage transient suppression at the transient source is required.

LOFA follows SAE recommended electrical environment practices.

Inductive devices such as relays, solenoids and motors generate voltage transients and noise in electrical circuits. Unsuppressed voltage transients can exceed SAE specifications and damage electronic controls.



Relays and solenoids with built-in voltage transient suppression diodes are recommended whenever possible. Refer to the illustration for proper installation of diodes when built-in voltage transient suppression is not available.

Locate inductive devices as far as possible from the components of the electronic control system. When using electric motors it may also be necessary to add isolation relays to eliminate voltage transients, noise and prevent back feed.

### Note

LOFA harness assemblies typically include all required engine control suppression devices. Added equipment will require additional protection.

## Welding on Equipment with Electronic Controls

Proper welding procedures are required to avoid damage to electronic controls, sensors, and associated components. The component should be removed for welding if possible.

The following procedure must be followed if the component must be welded while installed on equipment with electronic controls. This procedure will minimize the risk of component damage.

### Warning

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Do not ground the welder to electrical components such as the control ground or sensors.  
Improper grounding can cause damage to electrical components

---

Clamp the ground cable from the welder to the component being welded. Place the clamp as close as possible to the weld to reduce the possibility of damage.

1. Stop the engine. Turn the key switch to the OFF position.
2. Disconnect the negative battery cable from the battery.
3. Open any installed battery disconnect switch.
4. Unplug the control system if possible.
5. Connect the welding ground cable as close as possible to the area to be welded.
6. Protect the wiring harness from welding debris and spatter.
7. Use standard welding methods to weld the materials.

## General Troubleshooting

For additional information, refer to engine manufacturer troubleshooting guide.

### No response from starter motor

Possible Cause	Possible Remedy
No battery voltage to starter	Verify wiring and battery connection (power and ground)
Battery discharged	Charge or replace battery, verify alternator charging
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
No signal from control system	No power to control system (see Control System Troubleshooting below)
Defective starter solenoid	Replace starter solenoid
Defective starter motor	Replace starter motor

### Engine will crank but not start

Possible Cause	Possible Remedy
Engine not getting fuel	Check fuel level, filter, fuel pump, verify no air in fuel lines
Fuel run/stop solenoid not engaged	See Fuel Solenoid Run/Stop Troubleshooting (below)
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
No preheat (cold condition)	See Preheat Troubleshooting

### Engine runs for 10 seconds and shuts down

Possible Cause	Possible Remedy
Shutdown switch input active	Verify shutdown source exists, correct condition or correct faulty circuit
Battery not charging	Verify alternator charging (see Alternator not charging battery below)
Control board did not sense start signal	Engine started through alternate method (i.e., manual air start, push start, etc.)
Defective control system	See Control Panel Troubleshooting (below)

### Engine runs longer than 10 seconds and shuts down

Possible Cause	Possible Remedy
Shutdown switch input active	Correct engine fault, verify shutdown switch wiring
Circuit overload protection tripped	Correct overload, keep control system from overheating (over 185° F/85° C)
Voltage transients (spikes)	Add suppressor diodes, protect from nearby lightening strikes, shield induced spikes from other equipment, add electric motor control relay
Defective control system	See Control System Troubleshooting (below)

### Alternator not charging battery

Possible Cause	Possible Remedy
Broken or slipping alternator drive belt	Adjust or replace alternator drive belt
Alternator not excited	Verify excitation circuit connected, replace faulty regulator, add additional excitation resistor
Alternator output not connected	Install charge wire
Alternator not grounded	Clean or add ground connection
Alternator faulty	Replace faulty alternator

## ***Fuel Run/Stop Solenoid Troubleshooting***

### **Engine does not stop immediately**

<b>Possible Cause</b>	<b>Possible Remedy</b>
Back feed from motor (i.e., cooling fan)	Add relay or blocking diode
Sticking solenoid linkage	Repair or replace solenoid linkage
Fuel valve without check valve	Install or repair check valve

### **Fuel run/stop solenoid does not engage**

<b>Possible Cause</b>	<b>Possible Remedy</b>
No power to solenoid	Locate reason for lack of power and correct (Circuit overloaded? Failed suppressor diode? Faulty wiring?)
No power to solenoid pull coil	Correct faulty wiring, check pull control circuit (see Power Box Troubleshooting below)
Incorrect linkage adjustment	Adjust solenoid linkage
Faulty solenoid	Replace solenoid
Failed suppressor diode	Correct wiring (diode reversed?), replace suppressor diode
Optional e-stop engaged	Disengage e-stop

### **Engine not getting fuel**

<b>Possible Cause</b>	<b>Possible Remedy</b>
Empty fuel tank	Fuel engine
Clogged filter	Replace filter
Air in fuel lines	Bleed fuel lines
Low fuel pressure	Replace faulty fuel pump and/or clogged filter
Faulty fuel pump	Replace fuel pump, correct wiring fault (electric fuel pump)

## ***Preheat Troubleshooting***

### **Engine is hard to start in cold conditions**

<b>Possible Cause</b>	<b>Possible Remedy</b>
Start attempt before preheat complete	Wait for preheat time to elapse, crank as soon as time elapses
Incorrect preheat specification	Correct control system configuration, install correct control system
Heater faulty	Replace heater
Heater relay faulty	Replace relay
Preheat control not functioning	Correct wiring, correct control system configuration
Faulty control system	See Control System Troubleshooting (below)

### **Engine produces excessive white smoke after starting**

<b>Possible Cause</b>	<b>Possible Remedy</b>
Afterglow not enabled	Reconfigure control system
Heater faulty	Replace heater
Heater relay faulty	Replace relay
Preheat control not functioning	Correct wiring, correct control system configuration
Faulty control system	See Control System Troubleshooting (below)



## Control System Troubleshooting

### Control system does not perform self test

Possible Cause	Possible Remedy
Tripped overcurrent protection	Correct fault, replace or reset overcurrent protection
Faulty connection to battery	Correct battery connections (see Battery Circuit Requirements above)

### Control system performs normal self test, engine cranks, runs and shuts down

Possible Cause	Possible Remedy
Only Battery LED illuminated	Correct battery charge failure (see Battery not charging above)
Only Oil Pressure LED Illuminated	Correct low oil pressure condition or faulty switch, correct wiring fault
Only Temperature LED Illuminated	Correct overheating condition or faulty switch, correct wiring fault
Only Aux LED Illuminated	Correct fault condition (i.e. v-belt, coolant level) or faulty switch, correct wiring fault
All normally closed shutdowns illuminate for one second (control system reset)	Add suppressor diodes, protect from nearby lightening strikes, shield induced spikes from other equipment, add electric motor control relay

## Testing Shutdown Inputs

Shutdown switches signal a fault by ground contact in most systems. Shutdown operation can be verified by grounding the shutdown inputs individually. It may be necessary to remove the wire from the shutdown switch to perform this test.

### Note

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Most shutdown switches are grounded through the switch body.  
Do not use insulating sealant (i.e. Teflon tape) when installing switches.

Some thermostat housings are composites and do not provide ground for the switch.

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## " Power Box Option

The Power Box is a solid state, high current control system for mechanically governed, industrial diesel engines. In addition to allowing extended harnesses, the Power Box provides 3-wire fuel run/stop solenoid control to protect the pull coil from overheating. Power Box technology typically controls the starter solenoid, fuel run/stop solenoid and cold starting aid. All outputs are overload protected and the system is fused to avoid damage in the event of excess current demand. An additional fuse protects the control circuitry.

### Warning

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The Power Box is reverse polarity protected but may be damaged by attempting to start the engine with battery polarity reversed.

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When the fuel solenoid input is enabled, the fuel run/stop solenoid pull coil is enabled for the first second. In normal operation, all other Power Box outputs are active as long as their corresponding inputs are active.

## Power Box Troubleshooting

### One output never activates

Possible Cause	Possible Remedy
Input not active	See Control System Troubleshooting (above)
Output shorted	Correct fault
Failed Power Box	Replace Power Box/harness assembly

### All outputs never activate

Possible Cause	Possible Remedy
Blown fuse(s)	Correct fault, replace fuse(s)
Faulty connection to battery	Correct battery connections (see Battery Circuit Requirements above)
Failed Power Box	Replace Power Box/harness assembly

### Fuel run/stop solenoid pull output remains active

Possible Cause	Possible Remedy
Faulty wiring	Correct wiring
Faulty connection to battery	Correct battery connections (see Battery Circuit Requirements above)
Failed Power Box	Replace Power Box/harness assembly

## Revision History

Initial Release.

Rev A – 22-May-2006. Corrected typographical errors.

Rev B – 26-Oct-2006. Add symbols to Indicators, corrected typographical errors.

Rev C – 8-Jan-2007. Updated schematics

Rev C.1 – 28-Feb-2007. Added part numbers.

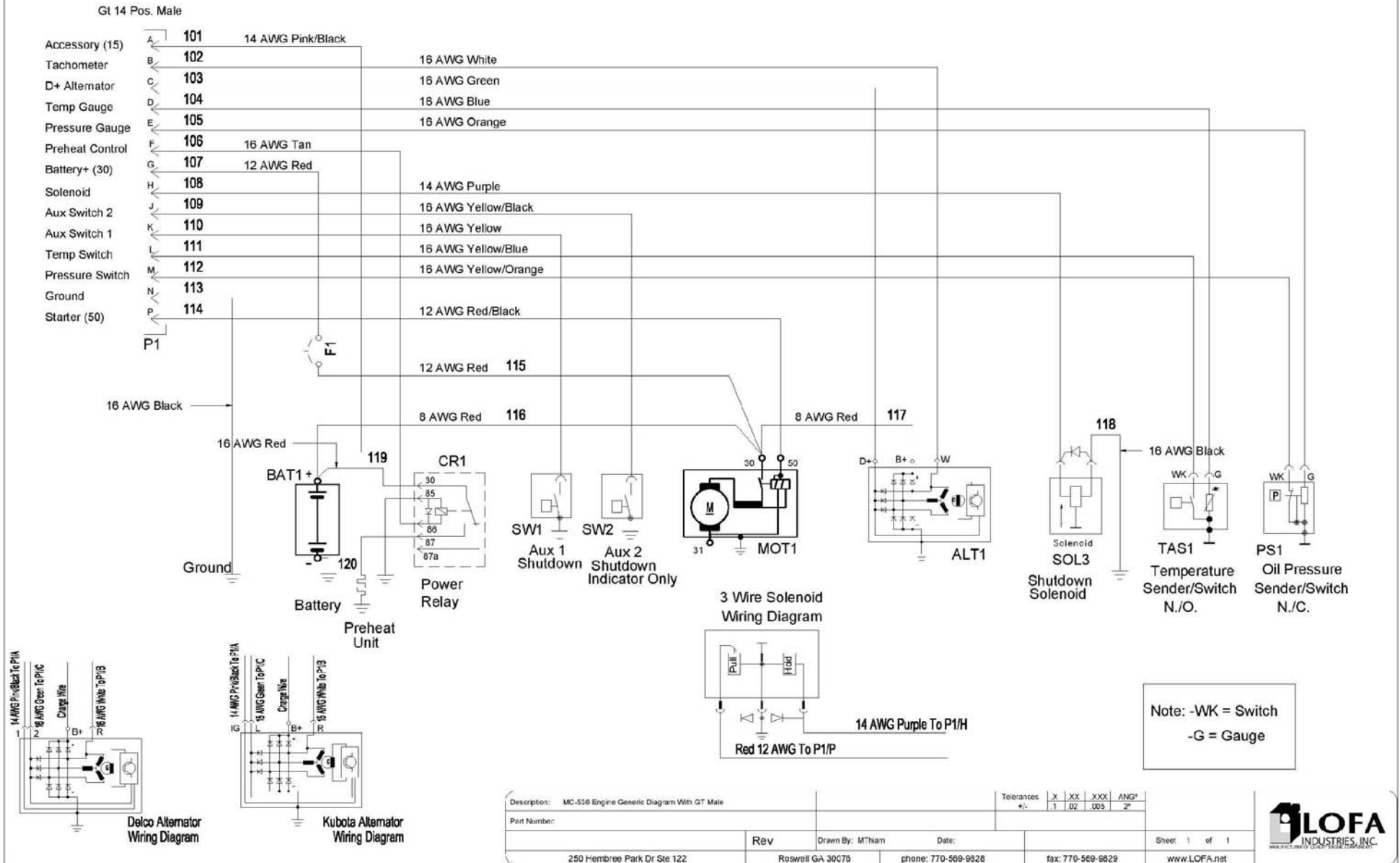
## **Typical Schematics**

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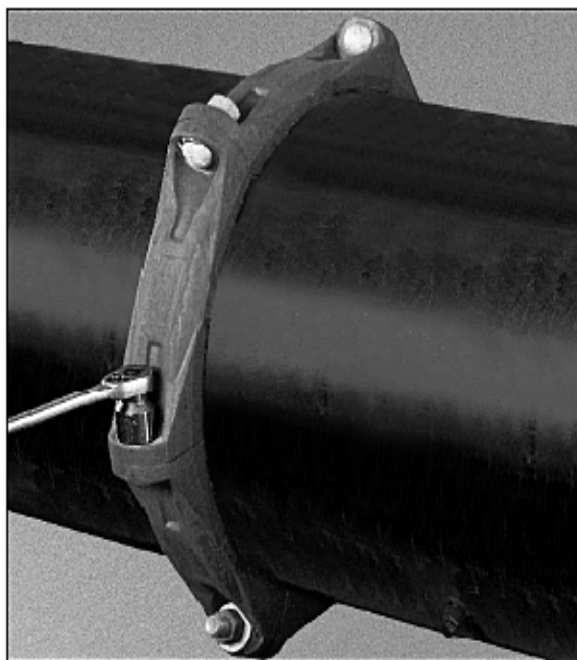
The following pages show typical schematics.  
Details vary from installation to installation.  
See the specific schematics for installation for details.

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Need MC704GT Panel Drawing.



## COUPLING INSTALLATION &amp; 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	7/16	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 5/8	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



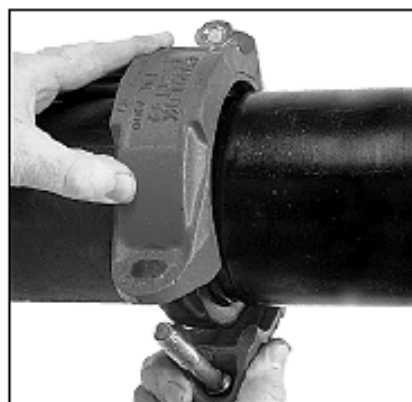
**1 CHECK & LUBRICATE GASKET**— Check gasket to be sure it is compatible for the intended service. Apply a thin coating of Gruvlok lubricant to outside and sealing lips of the gasket. Be careful that foreign particles do not adhere to lubricated surfaces.



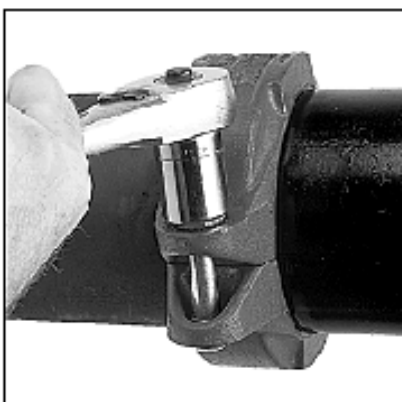
**2 GASKET INSTALLATION**— Slip the gasket over the pipe end, making sure the gasket lip does not overhang the pipe end.



**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.

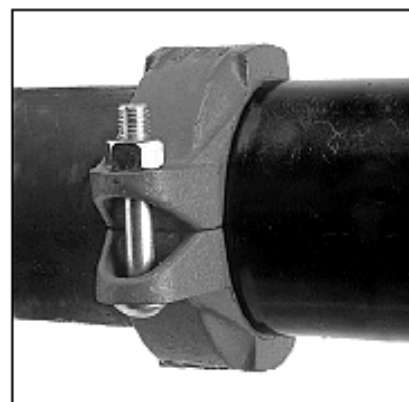


**4 HOUSINGS**— With one nut unthreaded to the end of the bolt, unthread the other nut completely and swing the coupling housing halves over the gasket, making sure the housing keys engage the grooves. Insert the bolt and turn the nuts finger tight.



**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](http://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.



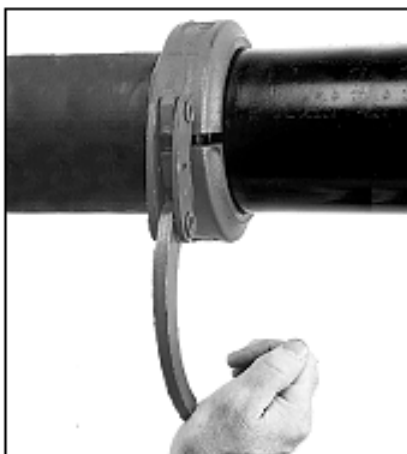
**2 GASKET INSTALLATION**— Slip the gasket over the pipe end making sure the gasket lip does not overhang the pipe end.



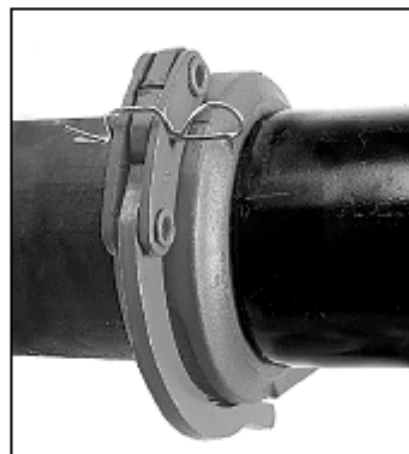
**3 ALIGNMENT**— After aligning the two pipe ends, pull the gasket into position centering it between the grooves on each pipe. Gasket should not extend into the groove on either pipe.



**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.

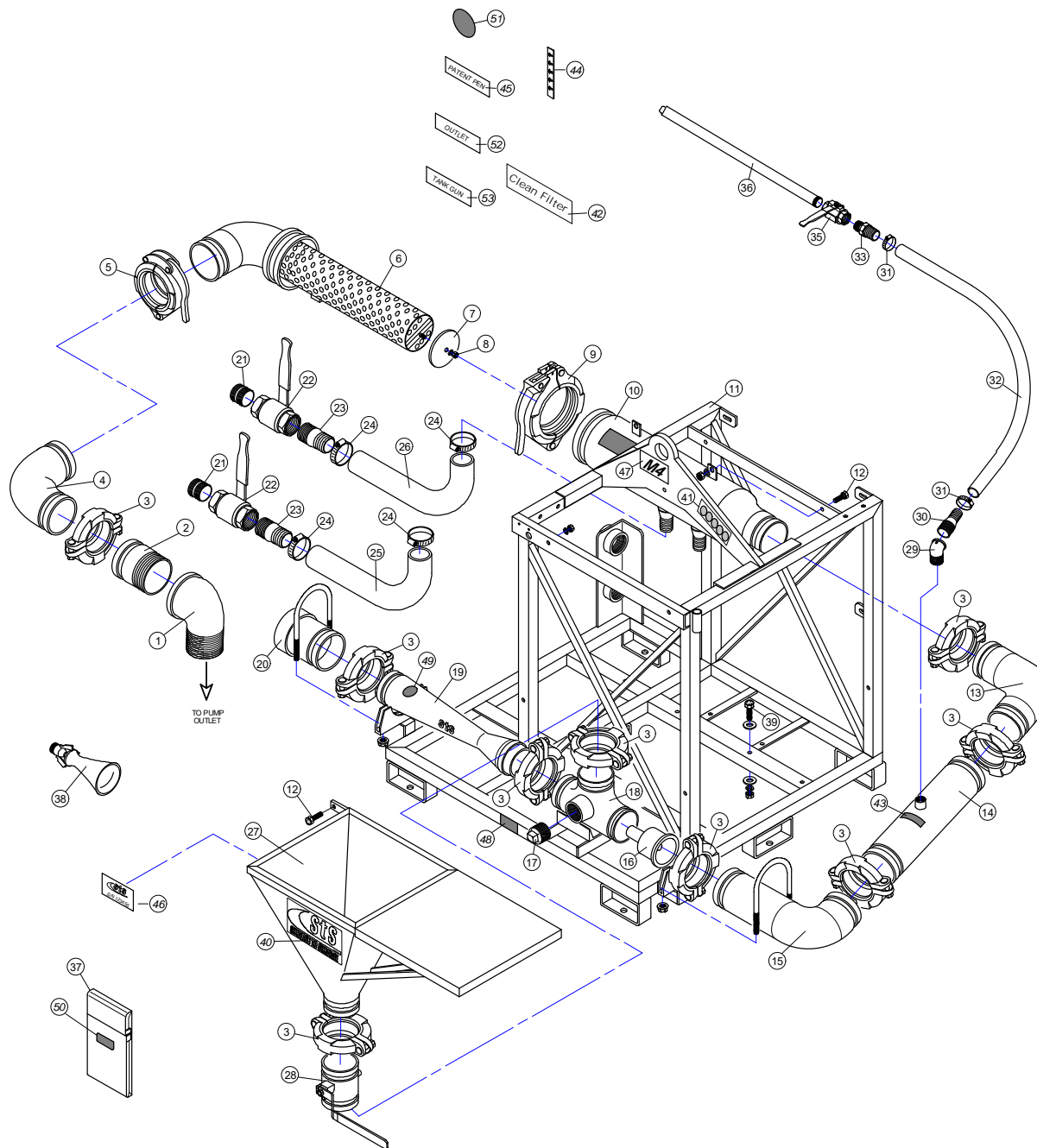
#### CAUTION:

- 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-M4 (V2) ASSEMBLY PARTS LIST

(P/N #BU-M4 (V2) )

REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.	
1	4" NPT 90° Street Elbow	018-310-01780-1	1	B
2	Pump Discharge Pipe	M4-011	1	B
3	4" Groove-Loc Coupler	020-390-00034-7	9	B
4	4" Grooved 90° Elbow	020-390-01430-6	1	B
5	4" Hinge-Loc Coupler	020-390-20010-3	1	B
6	Filter / Shear	M4-017	1	O
7	Filter Shear Carriage End Cap	SR-75030-4	1	O
8	5/16" NC Nut	076-36304	1	
9	5/16" L/W	076-33620	1	
10	6" Hinge-Loc Coupler	020-390-20060-8	1	B
11	Filter / Shear Housing	M4-016	1	O
12	Base Frame	M4-01	1	B
13	3/8" x 1 1/4" Bolt	076-13107	4	
14	3/8" F/W	076-33008	4	
15	3/8" L/W	076-33622	4	
16	3/8" Nut	076-36306	4	
17	Filter / Shear Outlet Pipe	M4-013	1	O
18	Long Grooved End Pipe	M4-014-C	1	O
19	Mixing Tee Inlet Pipe	M4-012	1	O
20	Jetting Nozzel	SR-75020-NE	1	O
21	2" NPT Pipe Plug	018-318-90256-6	1	O
22	Jetting Tee	SR-75021	1	O
23	Venturi Tube	SR-75022	1	O
24	Discharge Adaptor	M4-010-S	1	O
25	2" NPT x Close Nipple	018-330-03700-3	2	B
26	2" Ball Valve	022-423-00014-0	2	
27	2" NPT x Hose Barb	018-1661268241	2	B
28	2" Gear Clamp	025-HS-36	4	
29	2" Rubber Hose	M4-019-A	1	
30	2" Rubber Hose	M4-019-B	1	
31	Hopper with Table	SR-75032	1	O
32	4" Grooved Butterfly Valve	023-7005-011403	1	
33	3/4" NPT Street 45° Elbow MI	018-310-02740-4	1	B
34	3/4" NPT x Hose Barb	018-1661268225	1	B
35	3/4" Gear Clamp	025-HS-12	2	
36	3/4" Rubber Hose	M4-019-C	1	
37	3/8" MNPT x 3/4" Hose Barb	018-125-12C	1	
38	3/8" Ball Valve	022-423-00002-5	1	
39	Wash Wand	SR-75047	1	O
40	Operators Manual Holder	084-9000-07	1	
41	3/16" Rivet	076-41228	2	
42	Mixing Nozzel (Jet Guns)	086-TM4P-L	4	
43	7/16" x 1 1/2" Bolt	076-13159	6	
44	7/16" F/W	076-33010	12	
45	7/16" L/W	076-33624	6	
46	7/16" Nut	076-36308	6	
47	"Logo" Decal	070-ST5-029	1	
48	"Blue Safty Circles" Decal	070-ST5-038	1	
49	"Clean Filter" Decal	070-ST5-027-A	1	
50	"Caution pressure" Decal	M2-633-A	1	
51	Directional tape	STS-PIPE MARKER3/4"	18"	
52	Patent Plate	071-ST5-002-PAT	1	
53	Serial Number Plate	071-ST5-001-M4	1	
	"M4" Decal	M4-020	1	
	"Fork Lift" Decal	070-16072-B	1	
	"No Step" Decal	070-15080-B	1	
	"Operators Manual" Decal	070-ST5-036	1	
	"Lift Point" Decal	070-16071-B	1	
	"Outlet" Decal	M2-633-B	1	
	"Tank Gun" Decal	M2-633-D	1	

PAINT COLORS  
O - Orange  
B - Black

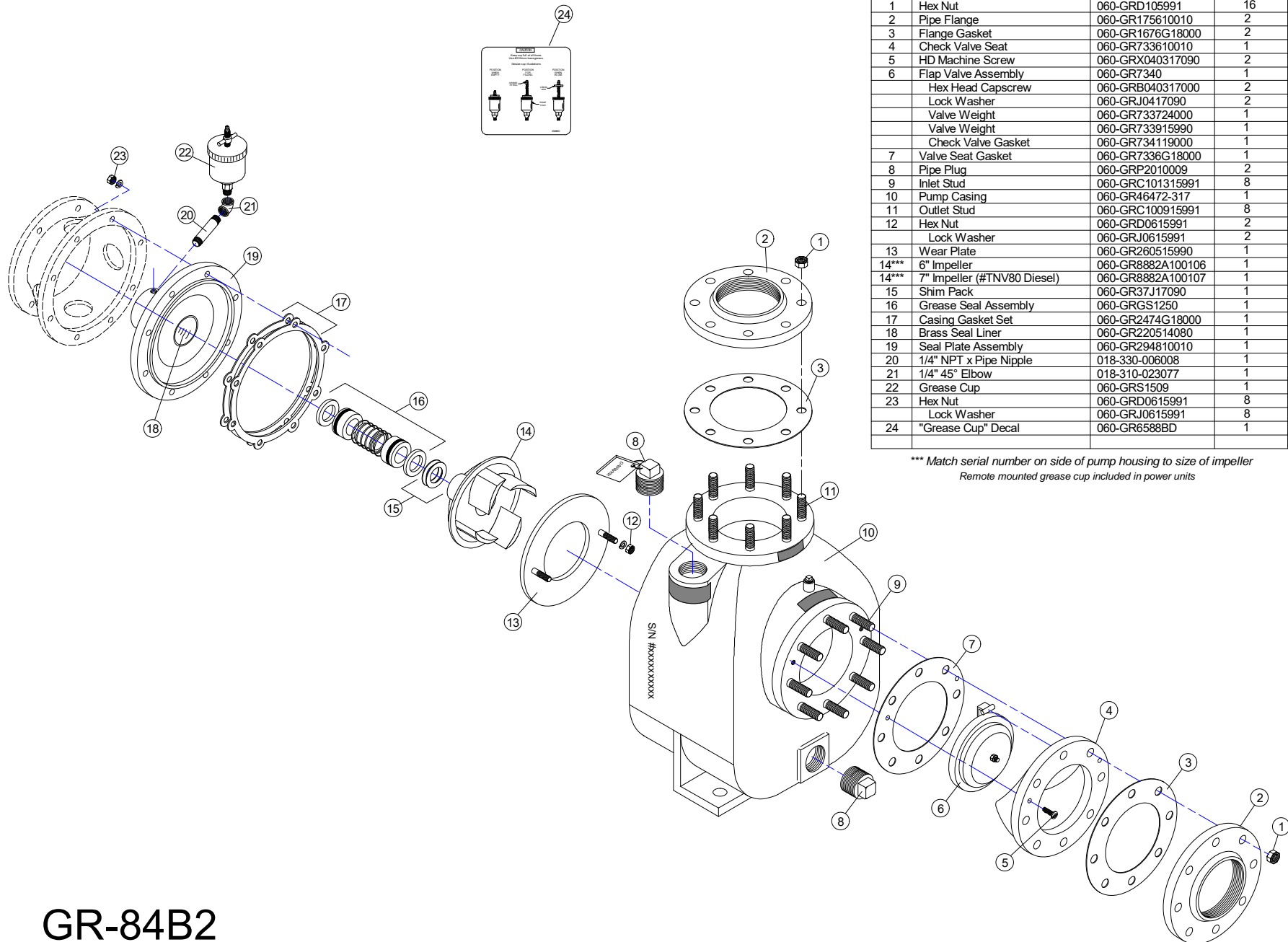
DWR. NUM.	DATE. 07 / 02 / 07
M4-Base Unit (V2)	REV. 02 / 08 / 23

## GR-84B2 ASSEMBLY PARTS LIST

( P/N #060-GR84B2-KIT )

REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.
1	Hex Nut	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
	Hex Head Capscrew	060-GRB040317000	2
	Lock Washer	060-GRJ0417090	2
	Valve Weight	060-GR733724000	1
	Valve Weight	060-GR733915990	1
	Check Valve Gasket	060-GR734119000	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	060-GRD0615991	2
	Lock Washer	060-GRJ0615991	2
13	Wear Plate	060-GR260515990	1
14***	6" Impeller	060-GR8882A100106	1
14***	7" Impeller (#TNV80 Diesel)	060-GR8882A100107	1
15	Shim Pack	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 Pipe Nipple	018-330-006008	1
21	1/4" 45° Elbow	018-310-023077	1
22	Grease Cup	060-GRS1509	1
23	Hex Nut	060-GRD0615991	8
	Lock Washer	060-GRJ0615991	8
24	"Grease Cup" Decal	060-GR6588BD	1

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



# GR-84B2

REV.09 / 28 / 22

# **PU-M4D(GR) ASSEMBLY PARTS LIST (3TNV70)** ( P/N #PU-M4D(GR)Y )

REF #	DESCRIPTION	STS PART NUMBER	QTY REQ.	
1	Gorman-Rupp 4" Pump	060-GR84B2-KIT	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				
5	Bell Housing	060-GR84B2-02	1	
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 3TNV70 Diesel Engine	033-3TNV70-ASA-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	Throttle Cable Retainer	032-161-011-001	1	
16	10/32 x 1/2" Machine Screw	076-29880	2	
	10/32 Nut	076-36029	2	
17	M8 x 1.25 x 20 Bolt	076-38615	2	
	M8 x L/W	076-40383	2	
18	Throttle Mount	SR-D75086-D	1	B
19	Water Separator Mount	SR-D75086-E	1	B
20	M10 x 1.5 x 30 Bolt	076-38656 (cut to 5/8")	2	
	M10 x L/W	076-40384	2	
21	Yanmar Engine / GR Pump Base	SR-D75090	1	B
22	7/16" x 1 1/2" Bolt	076-13159	4	
	7/16" F/W	076-33010	4	
	7/16" L/W	076-33624	4	
	7/16" Nut	076-36308	4	
23	Air Breather Pipe	M4-047	1	B
24	Air Breather Pipe Clamp	M4-046	1	B
25	S/S Gear Clamp	025-HS-28	4	
26	Rubber Elbow	025-RBR-20046	1	
27	5/16" x 2 1/2" Bolt	13063	2	
	5/16" L/W	076-33620	2	
	5/16" F/W	076-33006	2	
	5/16" Nut	076-36304	2	
28	Exhaust Gasket	033-119515-13200	2	
29	Exhaust Flange Spacer	SR-D75087-C	1	HHB
30	Exhaust Pipe	SR-D75087	1	HHB
31	Exhaust Clamp	031-WAL 41000	1	HHB
32	Exhaust Pipe Turndown	M4-045	1	HHB
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-D75088-B	1	B
37	12 Volt Battery	087-570DT	1	
38	Battery Bolt	087-EC BP78	2	
39	Battery Cable (Ground)	087-ECA14-6L-BLACK	1	
	Battery Cable (Positive)	087-ECA14-6L-RED	1	
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-STS-021-B	1	
44	Nylon Hose	025-1928-07	11 1/2"	
45	Grease Cup Mount	060-GR84B2-13	1	B
46	Grease Cup	060-S1509	1	
47	Filler Cap w/gauge	062-203417	1	
48	3/8" x 1 1/2" Bolt	076-13109	4	
	3/8" L/W	076-33622	4	
49	Plastic Fuel Tank	SR-75040-P	1	
50	1/8" NPT 90° Street Elbow	019-WEA 3400X2	1	

