

5010 SERIES

END SUCTION PUMPS

INSTALLATION, OPERATION & MAINTENANCE MANUAL

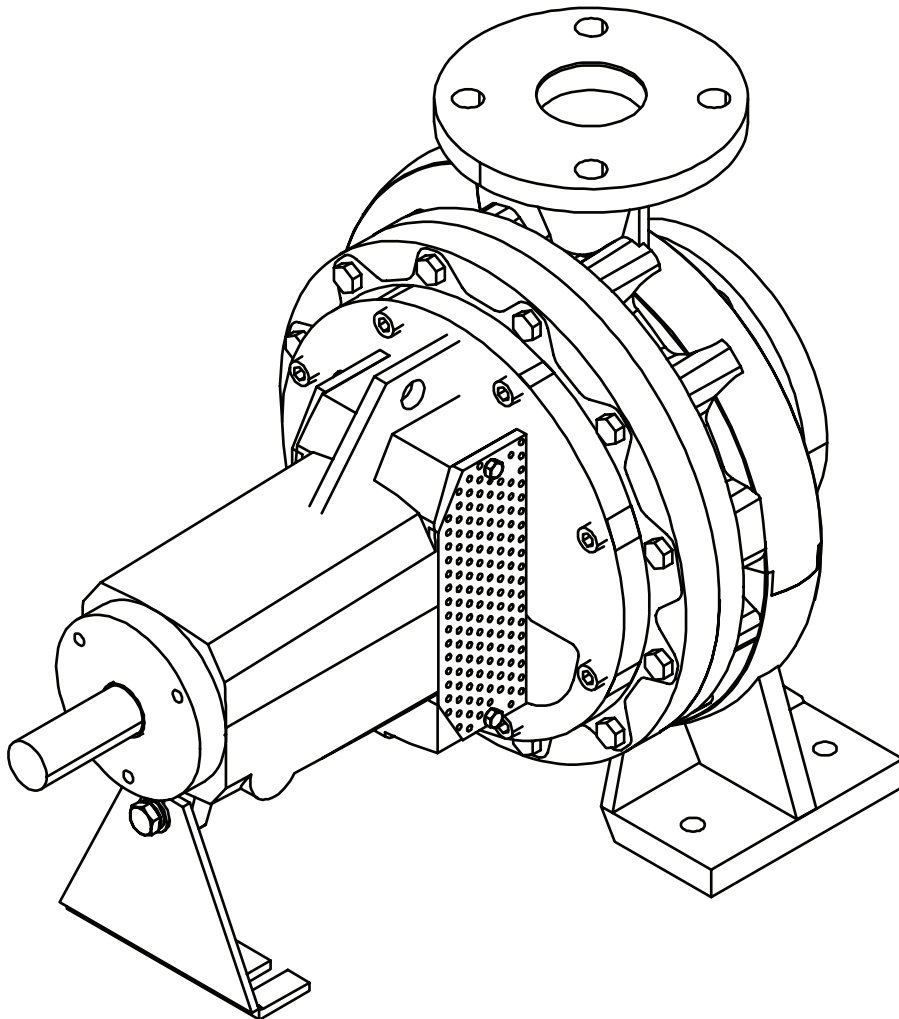


Table of Contents

4	.....OVERVIEW
4	.....SAFETY PRECAUTIONS
5	.....PERSONNEL QUALIFICATION
5	.....NON-COMPLIANCE
5	.....INSPECTION & INSTALLATION
5	.....UNAUTHORIZED MODIFICATION
5	.....GENERAL INSTRUCTIONS
5	.....TRANSPORT & LIFTING
6	.....STORAGE
6	.....SHORT-TERM STORAGE
7	.....LONG-TERM STORAGE
7	.....PUMP IDENTIFICATION
7	.....MANUFACTURER
7	.....CONSTRUCTION FEATURES
8	.....DATE OF MANUFACTURER
8	.....INSTALLATION, OPERATION & MAINTENANCE MANUAL IDENTIFICATION
8	.....NAMEPLATE INFORMATION
8	.....WARRANTY
8	.....FACTORY PRELIMINARY ALIGNMENT PROCEDURE
9	.....RECOMMENDED PROCEDURE FOR BASE PLATE INSTALLATION & FINAL FIELD ALIGNMENT
12	.....PIPING - SUCTION & DISCHARGE
13	.....PRESSURE GAUGES
13	.....ACCESSORIES
13	.....PUMP AND SHAFT ALIGNMENT
14	.....BEARING LUBRICATION
15	.....COUPLING GUARDS
15	.....VENTILATION
15	.....DIESEL ENGINE FLUIDS

17	.....PUMP STARTUP
17	.....ROTATION CHECK
17	.....PRE START-UP CHECKS
17	.....PRIMING
17	.....ENSURING PROPER NPSHA
18	.....STARTING THE PUMP & ADJUSTING FLOW
18	.....ADJUSTING THE PACKING
18	.....OPERATION IN SUB-FREEZING CONDITIONS
19	.....SHUTDOWN CONSIDERATIONS
19	.....TROUBLESHOOTING
23	.....MAINTENANCE
23	.....PREVENTATIVE MAINTENANCE
23	.....NEED FOR MAINTENANCE RECORDS
23	.....NEED FOR CLEANLINESS
23	.....MAINTENANCE OF PUMP DUE TO FLOOD DAMAGE
23	.....ROUTINE MAINTENANCE CHART
24	.....STUFFING BOX
24	.....DISASSEMBLY
25	.....INSPECTION
26	.....ASSEMBLY
28	.....RECOMMENDED SPARE PARTS
29	.....MODEL FP-ES - END SUCTION
30	.....MODEL FP-ES - END SUCTION, ELECTRIC, ACCESSORIES
31	.....DIESEL COOLING LOOP
32	.....DIESEL ENGINE BATTERIES, RACKS & CABLES
33	.....DIESEL ENGINE BATTERY CABLE DIAPHRAGM
34	.....DIESEL ENGINE SINGLE WALL FUEL TANKS
35	.....DIESEL ENGINE DOUBLE WALL FUEL TANKS

AMERIFLO has used the most current and advanced technology for research and design when engineering the pumps & system components of the product line. A concentrated focus on state-of-the-art quality control during the manufacturing process ensures safety and reliability as primary goals.

This manual is designed so that the end user becomes familiar with the characteristics and proper operation of the ES end suction product line.

This manual provides very important guidance for the installation, reliable operation and efficient maintenance when the need arises. The operating procedures must be strictly followed to ensure reliability of the product and to maximize the service life of the pump with a focus on avoiding injury and hazards.

Local laws & regulations are not taken into account in this manual as they can vary greatly from region to region. Operators must ensure total and strict compliance with local laws and regulations, including proper procedures required during the installation process.

Do not operate any equipment in excess of it's limits as specified in this operating manual, including transmission medium, flow, rated speed, density, pressure and temperature. The end user must ensure the operation of the pump & system is in accordance with this manual.

If you have any questions, please contact AMERIFLO with your serial number & nameplate information. AMERIFLO can assist you if damage has occurred to the equipment and/or if the need arises for spare parts.

SAFETY PRECAUTIONS

This installation, operation & maintenance manual contains general installation, operation and maintenance instructions that must be followed. This manual must be read and understood in it's entirety by the responsible personnel/operators prior to installation and commissioning and the manual must be kept readily available at the job site for easy access.

To minimize risk of injury or death, the "safety" provisions of this entire manual **MUST** be followed. AMERIFLO shall not be liable for physical injury, damage or delays caused by a failure to observe the instructions for installation, operation & maintenance contained in this manual.

Paying constant attention to safety is always extremely important. This manual covers areas of danger that require additional attention. These areas of precaution are identified by using the following symbols:



DANGER - Immediate hazards which **WILL** result in severe personal injury or death.



WARNING - Hazards or unsafe practices which **COULD** result in severe personal injury or death.



CAUTION - Hazards or unsafe practices which **COULD** result in minor personal injury or property damage.



SHOCK HAZARD - **ELECTRICAL** Hazards are present which **COULD** result in severe personal injury or death.



ROTATING EQUIPMENT - Hazards are present which **COULD** result in severe personal injury or death.

Equipment maximum lifting speed of 15 FT/S [4.6 M/S] should not be exceeded.



In colder climates where liquid could freeze in the pump or engine, precautions must be made to make sure the fluid never freezes. Freezing fluid can damage equipment. Drain fluid from any piece of equipment in this environment.

Never start or run equipment without a proper prime. Significant damage to the equipment can occur.

Never operate any pump for an extended period of time with a closed discharge valve. The allowable amount of time a pump can operate in this condition depends on several variables at the job site. Contact AMERIFLO for proper engineering support.

Never operate any pump for an extended period of time below minimum flow. Temperature rise and extreme damage can occur.

Never operate any pump with a closed suction valve.

DATE **APRIL 2021**

If excessive noise is heard from any rotating piece of equipment, shut the equipment down immediately.

Always lockout power before doing any maintenance on the pump or driver.

Never operate the pump & driver without a proper coupling guard in place.



If any leaks of hazardous fluids are identified, shut the unit down immediately and address the issue.

PERSONNEL QUALIFICATION

All personnel involved in the installation, operation & maintenance must be fully qualified to manage, operate, maintain, inspect and install the pump assembly. The responsibilities, competence and supervision of all personnel involved in installation, operation and maintenance must be clearly defined by the end user. Lack of knowledge must be addressed by means of training and instruction provided by sufficiently trained personnel. Upon request, the end user can contact AMERIFLO to train the operators and end user. In addition, it is the responsibility of the operator to ensure that the operating instructions contained in this manual are fully understood by all parties involved with the equipment.

NON-COMPLIANCE

Non-compliance with the safety instructions contained in this manual can result in an accident causing damage to equipment, the site and to personal injury or death. The end user is solely responsible for correctly installing all equipment and a safely run operation after installation.

INSPECTION & INSTALLATION

The operator will ensure that maintenance, inspection and installation is performed by authorized, qualified personnel who are thoroughly familiar with this manual and the operation of this equipment. **WORK MUST BE PERFORMED ON A PUMP OR DIESEL ENGINE ONLY AFTER THE PIECE IF EQUIPMENT HAS BEEN COMPLETELY LOCKED OUT OF OPERATION.** When taking the pump unit out of service always adhere to the strict procedures described in the manual. Properly decontaminate pumps which handle fluids posing a health hazard. As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, review all instructions before restarting any equipment.

AMERIFLO

UNAUTHORIZED MODIFICATION

Modifications or alterations to the pump unit are only permitted with the manufacturer's prior written consent. Use only original spare parts or parts authorized by AMERIFLO. The use of other parts will invalidate any remaining warranty. Warranty relating to the pump and driver unit is only valid if the equipment is used in accordance with its intended use and only authentic AMERIFLO parts are used for maintenance and repair. Never operate the pump & driver outside of the limits stated in the pump data sheet and information contained in this manual.

GENERAL INSTRUCTIONS

The pump and driver must be examined upon arrival to ascertain any damage caused during shipment. If damaged, immediately notify the carrier and/or the sender. Confirm that the goods correspond exactly to the description on the shipping documents and report any differences as soon as possible to AMERIFLO. Always reference the pump type and serial number stamped on the data plate.

The pumping unit must be used only for applications for which AMERIFLO has specified:

- The construction materials
- The operating conditions (flow, pressure, temperature, etc.)
- The field of application

In case of doubt, contact AMERIFLO.

TRANSPORT & LIFTING

The pump and driver must be transported in the horizontal position.

Proper handling measures must be followed during transportation of equipment. Observe the following precautions.



CAUTION - Maximum lifting speed is 15 FT/S (4.6 M/S)

During all phases of transportation (truck, rail & ocean) all components must be handled and transported by using suitable slings and hoists. All handling should be carried out by specially trained personnel to avoid damage to the equipment and persons. The lifting rings attached to various components should be used exclusively to lift the components for which they have been supplied.



CAUTION - All equipment shall be bolted to a suitable pallet or strapped down appropriately during transport. All loose parts should be crated accordingly.



CAUTION - The lugs on the pump and driver are only designed to lift that piece of equipment separately. When lifting the pump set attention needs to be placed on the tension direction. See below figure for proper lifting.

It is important to exercise extreme care in handling and installing all components. Certain items are precision machined for proper alignment and if dropped or mistreated in any way, misalignment and malfunction can result. The insulation on all wire must be protected. Parts which are too heavy to be lifted from the transporting vehicle should be skidded slowly and carefully to the ground to prevent damage. Never unload any item by dropping parts directly from the truck to the ground.

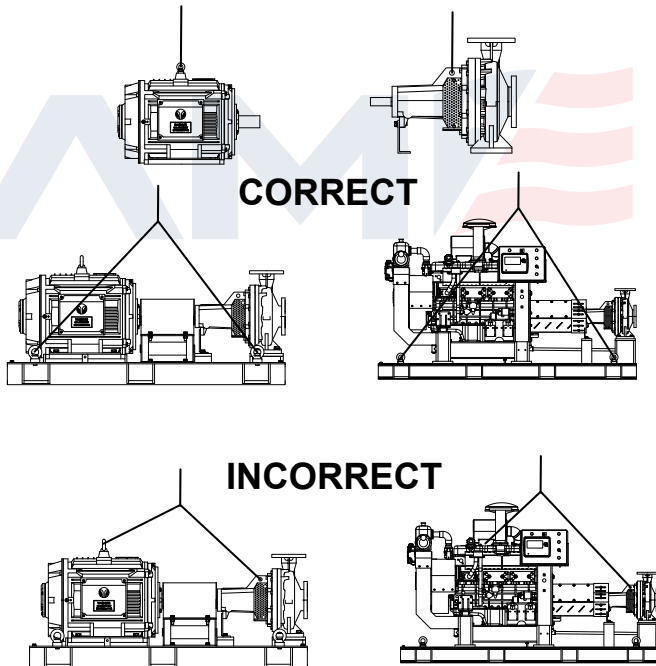


FIGURE 1 - PROPER LIFTING

If job site conditions permit, you may be able to install directly from the truck that delivered the equipment. If not, move the components to the installation area and lay them out in a clean and protected space convenient to the work location.

If installation cannot begin within a few days after delivery, segregate and identify all components of the shipment so

they will not be confused with other equipment arriving at the job site.

Read and follow the storage instructions carefully as care of the pump during this period before installation can be as important as maintenance after operation has begun.

Check all parts against the packing list to make sure nothing is missing. It is much better to find out now than during the installation. If damage occurred during transportation report it to the carrier immediately. Freight claims **MUST** be reported by the recipient. Report any item discrepancies immediately to AMERIFLO.

STORAGE

SHORT-TERM STORAGE

Normal shipment packaging is designed to protect the pump and driver during shipment and for dry, indoor storage for up to two months or less.

If the pump is not to be installed or operated soon after delivery, store the unit in a clean, dry place, having slow changes in environmental conditions. Steps should be taken to protect the pump against moisture, dirt and foreign particulate intrusion. The procedure followed for this short-term storage is summarized below:

Standard Protection for Shipment:

- Loose unmounted items, including, but not limited to, packing and coupling spacers are packaged in a water proof plastic bag and placed under the coupling guard. Larger items are boxed and metal banded to the base plate. All bags and cartons are identified with the AMERIFLO sales order number, the customer purchase order number and the pump item number (if applicable).
- Inner surfaces of the bearing housing, shaft (area through bearing housing) and bearings are coated with Cortec VCI-329 rust inhibitor or equal.
- Re-greasable bearings are packed with grease.
- After a performance test, the pump is tipped on the suction flange for drainage (some residual water may remain in the casing). Then, internal surfaces of ferrous casings, covers, flange faces and the impeller surface are sprayed with Calgon Vestal Labs RP-743m or equal. Exposed shafts are taped with Polywrap.
- Flange faces are protected with plastic covers secured with plastic drive bolts. 3/16 in (7.8 mm) steel or 1/4 in (6.3 mm) wood covers with rubber gaskets, steel bolts and nuts are all available for extra cost.

DATE **APRIL 2021**

f. All assemblies are bolted to a wood skid which confines the assembly within the perimeter of the skid.

g. Assemblies with special paint are protected with a plastic wrap.

h. Bare pumps, when not mounted on base plates, are bolted to wood skids.

i. All assemblies having external piping (seal flush and cooling water plans), etc. are packaged and braced to withstand normal handling during shipment. In some cases components may be disassembled for shipment. The pump must be stored in a covered, dry location.

It is recommended that the following procedure is taken:

1. Ensure that the bearings are packed with the recommended grease to prevent moisture from entering the bearing housings.
2. Remove all glands, packing and lantern rings from the stuffing box.
3. Ensure that the suction and discharge flanges are covered and secured with cardboard, plastic or wood to prevent foreign objects from entering the pump.
4. If the pump is to be stored outdoors with no overhead covering, cover the unit with a tarp or other suitable covering.

LONG-TERM STORAGE

Long-term storage is defined as more than two months, but less than 12 months. The procedure AMERIFLO follows for long-term storage of pumps is given below. These procedures are in addition to the short-term procedure above.

Solid wood skids are utilized. Holes are drilled in the skid to accommodate the anchor bolt holes in the base plate or the casing and bearing housing feet holes on assemblies less base plate. Tackwrap sheeting is then placed on top of the skid and the pump assembly is placed on top of the Tackwrap. Metal bolts with washers and rubber bushings are inserted through the skid, the Tackwrap and the assembly from the bottom of the skid and are then secured with hex nuts. When the nuts are "snugged" down to the top of the base plate or casing and bearing housing feet, the rubber bushing is expanded, sealing the hole from the atmosphere. Desiccant bags are placed on the Tackwrap. The Tackwrap is drawn up around the assembly and hermetically (heat) sealed across the top. The assembly is completely sealed from the atmosphere and the desiccant will absorb any entrapped moisture. A solid wood box is then used to cover the assembly to provide protection from

the elements and handling. This packaging will provide protection up to twelve months without damage to bearings, lip seals, etc. due to humidity, salt laden air, dust, etc. After unpacking, protection will be the responsibility of the user. If units are to be idle for extended periods, the addition of lubricants, inhibitor oils and greases should be used.

Every three months, the shaft should be rotated approximately 10-15 revolutions. When the unit is ready to be installed, replace all old lubricant with new lubricant.

PUMP IDENTIFICATION

MANUFACTURER

AMERIFLO
125 Morrison Road, Rossville TN 38066
United States of America

www.ameriflo-usa.com

CONSTRUCTION FEATURES

The ES product line is a horizontal, single stage, center-line discharge, end suction centrifugal pump. It is designed with a horizontal fluid inlet and a top vertical outlet with cast integral feet under the casing. The discharge nozzle is at the 12 o'clock position and is self-venting by design. The impeller features hydraulic balancing holes to balance axial force. The pump features packing with a packing gland. Both suction and discharge flanges are raised face and rated for 250 pounds per square inch (PSI). The pump is standard clockwise rotation (as viewed from the driver end).

The casing features a radially split volute with renewable wear ring at the suction. The suction and discharge nozzles are integral to the casing. The impeller is of the single suction design with back pump out vanes designed to reduce axial forces. The rear cover features packing with packing gland. The power frame utilizes SKF, angular contact bearings for rotor support.

DATE OF MANUFACTURER

The date of manufacture is indicated on the Sales Order paperwork.

INSTALLATION, OPERATION & MAINTENANCE MANUAL IDENTIFICATION

PREPARED: MARCH 1, 2021
REVISION:

EDITION: 01
DATE:

NAMEPLATE INFORMATION

AMERIFLO
125 MORRISON ROAD
ROSSVILLE, TN 38066
UNITED STATES OF AMERICA

UL LISTED

FM APPROVED

CENTRIFUGAL FIRE PUMP - END SUCTION

MODEL	SERIAL NO.	NO. STAGES
RATED GPM	RATED RPM	RATED PSIG
MAX. BHP	IMP DIA. IN	PSIG@150% FLOW
DRIVER MANUFACTURER & SERIAL NUMBER		MAX. PSIG@SUCTION
CONTROLLER MANUFACTURER & SERIAL NUMBER		

FIGURE 2 - PUMP NAMEPLATE

MODEL:

Model of the pump

SERIAL NUMBER:

Serial number of the pump issued by Production Control

NO. STAGES:

Number of stages

RATED GPM:

Rated flow rate of pump in Gallons Per Minute

RATED RPM:

Rated speed of the pump in Revolutions Per Minute

RATED PSIG.:

Rated discharge pressure of the pump in Pounds Per Square Inch Gauge

MAX. PSIG.:

Maximum discharge pressure of the pump in Pounds Per Square Inch Gauge

RATED BHP:

Rated Brake Horsepower at duty point

MAX. BHP:

Maximum Brake Horsepower

IMP DIA. IN:

Impeller diameter in inches

PSIG @ 150% FLOW:

Rated discharge pressure of the pump at the 150% flow-rate

DRIVER MANUFACTURER & SERIAL NUMBER:

Driver manufacturer and serial number

MAX. PSIG@SUCTION:

Maximum pressure in Pounds Per Square Inch Gauge at suction flange

CONTROLLER MANUFACTURER & SERIAL NUMBER:

Controller manufacturer and serial number

WARRANTY

AMERIFLO offers new equipment manufactured by seller or service supplied by seller to be warranted to be free from defects in material and craftsmanship under normal use and service for a period of one year from date of shipment. Further details of the AMERIFLO warranty can be obtained from your AMERIFLO customer service representative.

Do not remove the pump warranty seal PRIOR to contacting AMERIFLO for warranty consideration. Removing the pump warranty seal without PRIOR AMERIFLO permission can invalidate a potential warranty claim.

INSTALLATION

FACTORY PRELIMINARY ALIGNMENT PROCEDURE

The purpose of factory alignment is to ensure that the end user will have full utilization of the clearance in the pump and driver feet holes for final job-site alignment. To achieve this, the factory alignment procedure specifies that the pump be aligned in the horizontal plane to the motor, with the motor foot bolts centered in the motor holes. This procedure ensures that there is sufficient clearance in the motor holes for the customer to field align the motor to the pump, to zero tolerance. This practice requires that the

DATE **APRIL 2021**

customer be able to place the base in the exact same condition as the factory had during the initial factory alignment procedure. In this scenario, the factory alignment will be done with the base sitting in an unrestrained condition on a flat and level surface. This procedure also emphasizes the need to ensure the shaft spacing is adequate to accept the specified coupling spacer (if supplied).

Reliable trouble-free and efficient operation of a unit depends upon correct alignment. Misalignment may be the cause of many job site issues including noisy pump operation, vibration, premature bearing failure and/or excessive coupling wear. Factors that may change the alignment of the pump unit are settling of the foundation, springing of the baseplate, pipe strain and movement of the pump or driver on the foundation.

Two types of misalignment may exist and should be addressed separately: parallel misalignment and angular misalignment. Limits of misalignment are stated in the coupling manufacturer's installation instructions, but should be kept to a minimum for maximum life of equipment components (refer to AMERIFLO limits below).

The factory alignment procedure is summarized below:

1. The baseplate is placed on a flat and level work space in a free and unstressed position. Do not attempt to hold the base in position to the work surface as this may cause bending in the base assembly.
2. The baseplate is leveled as necessary. Leveling is accomplished by placing shims or wedges under the rails (or feet of the base) at the appropriate anchor bolt hole locations. Levelness is checked in both the longitudinal and lateral directions. The location of the shims or wedges during this phase of alignment coincide to the location they would be placed in the field.
3. The motor and appropriate motor mounting hardware are placed on the baseplate and the motor is checked for any planar soft-foot condition. If any is present it is eliminated by shimming the motor feet to the baseplate.
4. The motor feet holes are centered around the motor mounting fasteners. It is extremely important that the motor hardware be centered into the holes as this gives the maximum amount of play for field alignment.
5. The motor is fastened in place by tightening the nuts on two diagonal motor mounting studs.
6. The pump is put onto the baseplate and leveled. If an adjustment is necessary, add or delete shims between the pump foot and the baseplate.

7. The spacer coupling gap is verified (if supplied).
8. The parallel and angular vertical alignment is made by shimming under the motor.
9. All four motor feet are tightened down.
10. The pump and motor shafts are then aligned horizontally, both parallel and angular, by moving the pump to the fixed motor. AMERIFLO structural baseplates feature jack-screw adjustments on each quadrant of the pump and motor feet making fine tuning for alignment very easy. The pump feet are tightened down.
11. Both horizontal and vertical alignment are again final checked as is the coupling spacer gap.

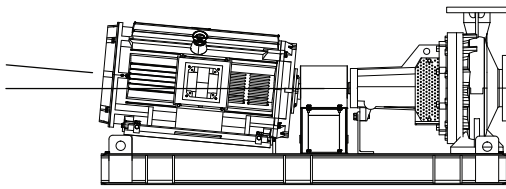
RECOMMENDED PROCEDURE FOR BASE PLATE INSTALLATION & FINAL FIELD ALIGNMENT

NEW GROUTED BASE PLATES

1. The pump foundation should be located as close to the source of the fluid to be pumped as practical. There should be adequate space for workers to install, operate and maintain the pump including room to remove the unit for maintenance at a future date. The foundation should be sufficient enough to absorb any vibration and should provide a rigid support for the pump and driver. The foundation's mass should be three (3) times that of the complete installed assembly (at a minimum). Recommended alignment of the baseplate is accomplished by adjusting the mounting hardware. After alignment, the baseplate is supported by metallic shims or wedges. These metallic shims or wedges are used to support the baseplate during the process of concrete pouring (grouting) of the anchor bolts. In order to avoid torsional twisting of the baseplate during the installation process, metallic shims or wedges should be placed as close to the anchor bolt locations as possible. The metallic shims or wedges are fixed permanently in location by pouring grout at a later step.
2. Special attention must be paid to the baseplate during the foundation installation making sure stress is not induced on the baseplate. The motor end of the baseplate shall not be higher than the pump at any condition and the deviation shall not exceed ± 0.004 IN/FT [0.1 MM/M] between the baseplate and horizontal level. Recommended mass of the concrete foundation should be three (3) times that of the complete installed assembly (at a minimum). Note that foundation bolts are imbedded in the concrete inside a sleeve to allow

some movement of the bolt making installation easier.

ANGULAR MISALIGNMENT



PARALLEL MISALIGNMENT

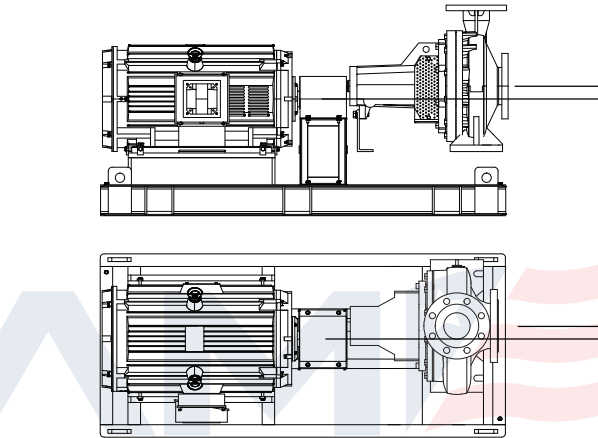


FIGURE 3 - PUMP ALIGNMENT

3. Level the pump baseplate assembly. If the baseplate has machined coplanar mounting surfaces, these machined surfaces are to be referenced when leveling the baseplate. This may require that the pump and motor be removed from the baseplate in order to reference the machined faces. If the baseplate is without machined coplanar mounting surfaces, the pump and motor are to be left on the baseplate. The proper surfaces to reference when leveling the pump baseplate assembly are the pump suction and discharge flanges. **DO NOT** stress the baseplate. **DO NOT** bolt the suction or discharge flanges of the pump to the system piping until the baseplate foundation is completely installed. Use shims and wedges to level the baseplate to the foundation. See FIGURE 4. Check for level in both the longitudinal and lateral directions. Shims or wedges should be placed at all baseplate anchor bolt locations and in the middle of the baseplate if the base is more than five feet [1.5 meters] long. Do not rely on the bottom of the baseplate to be flat. Standard base plate bottoms are not machined and it is not likely that the field foundation surface is flat either.

4. After leveling the baseplate, tighten the anchor bolts in a diagonal pattern evenly. If shims or wedges were used, make sure that the baseplate was shimmed near each anchor bolt before tightening. Failure to do this may result in a torsional twisting of the baseplate, which could make it impossible to obtain a final and correct field alignment. Check the level of the baseplate to make sure that tightening of the anchor bolts did not disturb the level of the baseplate in any manner. If the anchor bolts did change the level, adjust the jackscrews or shims as needed to level the base plate again. Continue adjusting the jackscrews or shims and tightening the anchor bolts until the base plate is level.

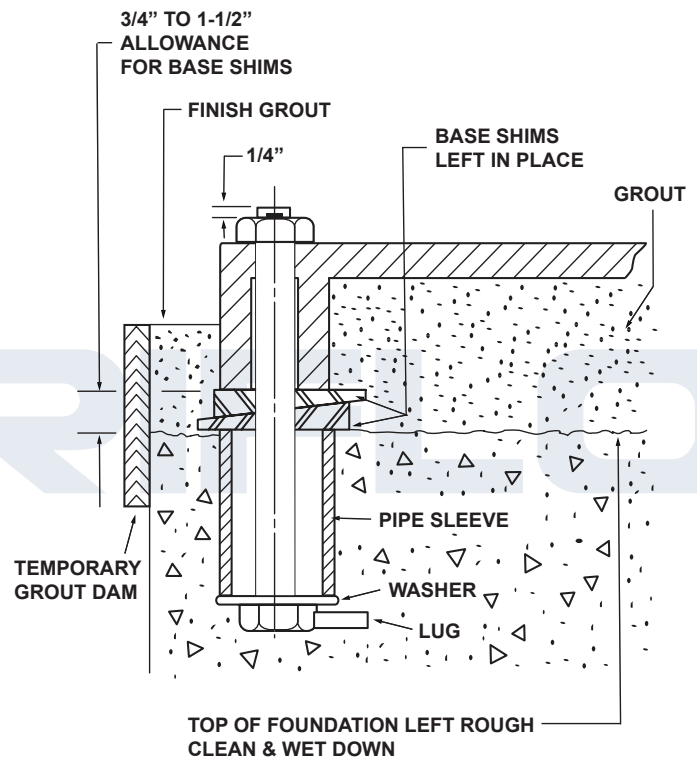


FIGURE 4 - BASEPLATE FOUNDATION

5. Check initial alignment of the pump and motor. If the pump and motor were removed from the baseplate proceed with step 6 first, then the pump and motor should be reinstalled onto the baseplate using AMERIFLO Factory Preliminary Alignment Procedure. Once completed, continue with the following. As described above, pumps are given a preliminary factory alignment PRIOR to shipment. This preliminary factory alignment is done in such a way that, if the installer duplicates the factory conditions, there will be sufficient clearance between the pump/motor hold down bolts and the pump/motor foot holes to move the pump/motor into final alignment. If the pump and mo-

tor were properly reinstalled to the baseplate or if they were not removed from the baseplate and there has been no damage during transit, and also if the above steps were done completed properly, the pump and driver should be within 0.015 IN [0.38 MM] FIM (Full Indicator Movement) parallel and 0.0025 IN/IN [0.0025 MM/MM] FIM angular alignment. If this is not the case first check to see if the driver mounting fasteners are centered in the driver feet holes. If not, re-center the fasteners and perform a preliminary alignment to the above tolerances by shimming under the motor for vertical alignment and by moving the pump for horizontal alignment.

6. **GROUT THE BASEPLATE.** A non-shrinking grout should be used. Grout compensates for uneven foundation, distributes weight of the unit and prevents the entire installation from shifting. Use only an approved, non-shrinking grout after setting and leveling the unit.

- a. Build a strong form around the foundation to contain the grout.
- b. Soak the top of the concrete foundation thoroughly and remove all surface water.
- c. A raised motor pedestal should also be completely filled with grout during this process.
- d. After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary.
- e. Approximately 14 days after the grout has been poured or when the grout has thoroughly cured, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

Make sure that the grout completely fills the area under the baseplate or in the case of an I-beam base, all compartments are completely filled to the top. After the grout has cured, check for voids and repair them.



CAUTION - Once the baseplate is grouted, the baseplate cannot be adjusted so it is extremely important that all alignment procedures be completed **PRIOR** to grouting.

7. Run the system piping to the suction and discharge flanges of the pump. There should be no piping loads transmitted to the pump after connection is made. Re-check the alignment to verify that there are no significant loads being transferred to the pump. Remember, pipe strain is invisible and alignment checks must be made after system connection to make sure none exist.
8. Perform the final field alignment. Check for soft-foot under the driver. An indicator placed on the coupling,

reading in the vertical direction, should not indicate more than 0.002 in [0.05 mm] movement when any driver fastener is loosened. Align the driver first in the vertical direction by shimming underneath its feet. When satisfactory alignment is obtained the number of shims in the pack should be minimized. It is recommended that no more than five shims be used under any foot. Final horizontal alignment is made by moving the driver. Maximum pump reliability is obtained by having a near perfect alignment. AMERIFLO recommends no more than 0.002 in [0.05 mm] parallel and 0.0005 in/in [0.0005 mm/mm] angular misalignment. Set the coupling gap to the dimension as shown on the installation drawing.

- a. Check for parallel misalignment by placing a straight edge across both coupling halves at four points 90° apart. Correct alignment occurs when the straight edge is level across the coupling halves at all four quadrant points.
- b. Check for angular misalignment with a feeler gauge at four points 90° apart. Correct alignment occurs when the same gauge just enters between the halves at all four quadrant points.

Angular and parallel misalignment are corrected by shifting the motor (by using the integral baseplate jack screws) and adding or removing shims from under the motor feet. After each change, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustments already made in another direction.

9. Operate the pump for at least an hour or until it reaches final operating temperature. Shut the pump down and recheck alignment while the pump is hot. Piping thermal expansion may change the alignment. Realign the pump as necessary.

EXISTING GROUTED BASE PLATES

When a pump is being installed on an existing grouted baseplate, the procedure is somewhat different from the previous section "New Grouted Base Plates."

1. Mount the pump on the existing baseplate.
2. Level the pump by putting a level on the discharge flange. If not level, add or delete shims between the pump foot and the baseplate.
3. Check initial field alignment. (Step 5 above)
4. Run the piping to the suction and discharge flanges of the pump. (Step 7 above)

5. Perform final field alignment. (Step 8 above)
6. Recheck field alignment after the pump is hot. (Step 8 above)

All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges.

All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but that do not bottom out in the tapped holes before the joint is tight.

a suction head line with a continuous downward slope towards to the pump. The suction line shall be as short as possible and connected to the pump properly without transmitting any stresses or stains from the system piping to the pump.

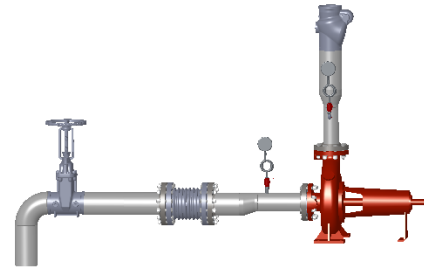


FIGURE 5 - PROPER ES SUCTION & DISCHARGE PIPING

PIPING - SUCTION & DISCHARGE

SUCTION PIPING

Suction and discharge piping should be installed per Hydraulic Institute and NFPA 20 standards. Do not use the pump as an anchorage point for the piping. A suction lift line should be laid with a continuous upward slope and

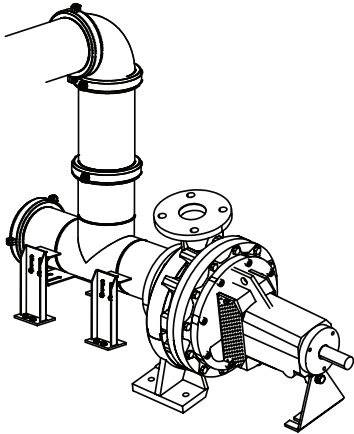
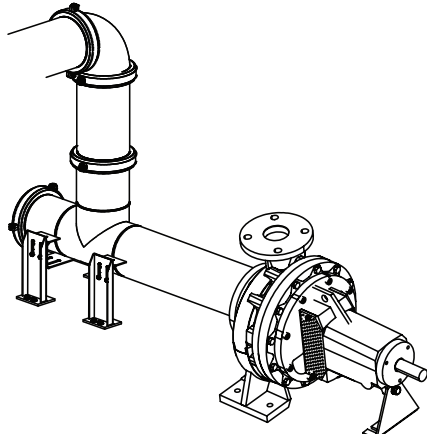
INCORRECT	CORRECT
Distance between elbow/tee and pump suction flange is less than 10 pipe diameters in length	Distance between elbow/tee and pump suction flange is more than 10 pipe diameters in length
	

FIGURE 6 - PROPER ES SUCTION PIPING

DATE **APRIL 2021**

Tie bolts should be used with expansion joints to prevent pipe strain being transferred to the pump casing. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes.

It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

Piping should be supported independently of the pump so as to not transfer any strain to the pump casing. Piping runs should be as short as possible with the nominal diameter of the piping equal to or greater than the diameter of the pump suction. The additional loads on the nozzles are mainly the weight of piping filled with water. The fluctuation of medium temperature leads to the change of pipeline length. The stress caused by the unsupported auxiliary equipment shall not exceed the limit.

Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump. After all piping connections have been made, the alignment should be checked again.

DISCHARGE PIPING

If the discharge piping is short, the pipe diameter can be the same as the pump discharge opening. If the piping is long, pipe diameter should be one or two sizes larger than the pump discharge opening. On long horizontal runs, it is desirable to maintain as even a grade as possible.



WARNING - When fluid velocity in the pipe is high, for example, at or above 10 ft/s [3 m/s], a rapidly closing discharge valve can cause a damaging pressure wave. A dampening arrangement should be provided in the piping.

PRESSURE GAUGES

Properly sized pressure gauges are installed on both the suction and discharge nozzles in supplied gauge taps. Stainless steel tubing (with integral pulsation damping) are supplied standard at both the suction and discharge locations. These gauges will allow the end user a proper differential pressure reading that the pump is generating. These gauges will enable the operator to easily observe the operation of the pump and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapor binding or other unstable operation should occur, widely fluctuating discharge pressure readings will be noted.

ACCESSORIES

Dimensions and installation locations of accessories (control panel, main relief valves, fuel tank, battery, etc.) are specified in the equipment installation and piping layout drawings. More detailed installation instructions are provided in the operating instructions for each component. These accessories will ensure the normal operation of the pump and driver.

PUMP AND SHAFT ALIGNMENT

ELECTRIC MOTOR

After connecting the suction and discharge piping, rotate the pump drive shaft clockwise (as view from driver end) by hand several complete revolutions to be sure there is no binding and that all parts are free to rotate. Recheck the shaft alignment one more time. If suction or discharge piping caused the unit to be out of alignment, correct the piping issue to relieve strain on the pump before starting up the unit.

DIESEL ENGINE

During the factory alignment of diesel engine driven units, the concentricity between the pump and the diesel engine has been adjusted, however, movement during transportation is possible. Make sure that the driveshaft and all mounting hardware are checked PRIOR to pump start up.

After the diesel engine is connected to the pump through the driveshaft and universal couplings, make sure that the two coupling end faces of the universal coupling are kept parallel.

The diesel bearing center and the pump bearing center must be aligned with the centerline of the driveshaft, allowing for a maximum deviation of ± 0.03 in [± 0.76 mm]. See FIGURE 7.

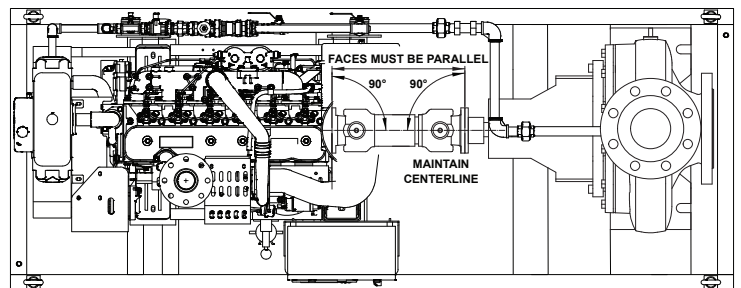


FIGURE 7 - DIESEL ENGINE DRIVESHAFT

Confirm that the distance from the driveshaft to the universal joint is only half of the total travel available. There should still be space available for movement when ready.

to operate.

The diesel engine bearing centerline and the pump bearing centerline angle must be kept to 2° (with a $\pm 1^\circ$ deviation). See FIGURE 8.

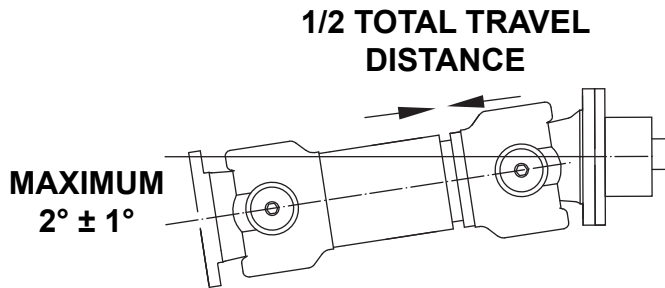


FIGURE 8 - DIESEL ENGINE OFFSET ANGLE & SPACING

PACKING

All fire protection equipment supplied by AMERIFLO are equipped with shaft packing. It is AMERIFLO standard practice to install the packing in the stuffing box prior to shipment. Bring the packing gland up squarely against the last packing ring and tighten the nuts evenly to finger pressure. Turn the shaft to ensure it does not bind on the bore of the gland assembly. After start-up break in the packing as described later in the PUMP START-UP section.



CAUTION - It is very important to inspect and ensure that the packing is installed correctly. Failure to do so could result in serious leakage of the pumped fluid.

Refer to Section "PACKING REPLACEMENT" at the end of this manual for proper packing break-in and adjustment procedure.

BEARING LUBRICATION

Grease lubricated, angular contact ball bearings are packed with grease at the factory and ordinarily will require no attention before starting, provided that the pump has been stored in a clean, dry place prior to its first operation (as detailed in the STORAGE instructions above). The bearings should be watched for the first hour or so after the pump has been started up to ensure that they are operating properly. If higher than normal bearing temperatures are seen in the field immediately shut down the unit to investigate the source.

The importance of proper lubrication cannot be overem-

phasized. It is difficult to say how often a bearing should be greased, since that depends on the conditions of operation. It is good advice to add one ounce of grease at regular intervals, but it is equally important to avoid adding too much grease. For average operating conditions, it is recommended that 1 oz. of grease be added at intervals of three to six months and only clean grease be used. It is always best to stop the unit while adding grease to avoid overloading.

Frequency of lubrication depends upon operating conditions and environmental conditions, therefore, lubrication intervals must be determined by experience. TABLE 2 may be used as a general guide for grease re-lubrication times. Lubricants need replacing only because of contamination by dirt or dust, metal particles, moisture or high temperature breakdown. A small amount of grease may be added about every 400 hours of operation. The bearing housing should be about 1/3 full of grease when properly lubricated.

When re-lubricating the pump bearings:

- Thoroughly clean the grease fitting and outside of bearing housing.
- Remove the drain plug.
- Inject clean, new grease forcing out the old grease.
- Start and run the pump for a short time to eject any excess grease.
- Wipe off all excess grease and replace drain plug.



WARNING - Proper lubrication is essential to pump operation. Do not operate the pump if sufficient lubricant is not present in the bearing housing or if lubricant is contaminated with excessive dirt or moisture. Operation of the unit under these conditions will lead to reduced pump performance and possible bearing failure. Do not operate the pump with an excessive amount of lubricant. Excessive grease is the most common cause of bearing overheating.

A lithium based NLGI #2 grade grease should be used for lubricating bearings where the ambient temperature is above -20°F . Grease lubricated bearings are packed at the factory with an approved NLGI #2 grease. Other recommended greases are listed in TABLE 1. Greases made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Do not use graphite. The maximum desirable operating temperature for ball bearings is 180°F . Should the temperature of the bearing power frame rise above 180°F , the pump should be shut down immediately to determine the cause.

MANUFACTURER	GREASE
Chevron	SRI
CITGO	Premium Lithium EP2
Exxon	Lidok EP2
Keystone	81EP2
Pennzoil	PennLith 712
Shell	Alvania EP2
Texaco	Multifak EP2

TABLE 1 - RECOMMENDED NLGI #2 GREASES



WARNING - Use of lubricants other than those listed in TABLE 1 or their equivalent will cause reduced pump performance, reduced bearing life and possible catastrophic bearing failure.

COUPLING GUARDS

It is very important that all coupling guards (at the driver coupling and near the pump packing housing locations) be installed PRIOR to startup. Failure to do so can cause serious injury or death.



ROTATING EQUIPMENT - Severe injury and/or death can occur if all coupling guards are not properly installed PRIOR to pump startup.

A direction arrow is cast on the pump casing. Make sure the motor rotates in the correct direction before coupling the motor to the pump. Three phase wiring can be connected in an incorrect manner allowing the motor to operate in the incorrect direction.

It is absolutely essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time period, can dislodge the impeller nut which may cause serious damage to the rotating assembly.

The coupling should be installed as advised by the coupling manufacturer. Pumps are shipped without the spacer installed to make sure proper rotation and the proper alignment procedures are followed. If the spacer has been installed to facilitate alignment, then it must be removed prior to checking rotation. Remove all protective material from the coupling and any exposed portions of the shaft before installing the coupling itself.

VENTILATION

Pumps with electric and diesel engine drivers MUST have adequate ventilation in the pump room. During operations, the pump & driver assembly will emit heat and a significant temperature rise will affect the efficiency of the unit. Therefore, it is necessary to take measures to ensure that the pumping unit remains cool. Cooler air should enter the room at a level near the floor and the warmer air should be ventilated out of the top of the room.

If the unit is diesel engine driven, all heat and exhaust gases must be properly vented out of the pump room. See Appendix at the end of this manual for proper drawing.

DIESEL ENGINE FLUIDS

It is essential that the fluids in the diesel engine are monitored for proper operation. These fluids include oil, coolant and fuel.

OIL

When checking the proper oil level, the engine must have been shut down for a minimum of 10 minutes before taking any oil reading. The oil level should never be below the minimum dipstick indication or above the maximum dipstick indication. The target of proper oil level should be at the 80% mark between the upper and lower indicators. Refer to the proper diesel engine Installation, Operation & Maintenance manual for all engine details.



WARNING - Operating the engine with oil level indication out of the range as indicated on the dipstick can cause catastrophic engine damage.

COOLANT

The AMERIFLO diesel engines utilize an internal, closed cooling loop connected to an external, open cooling loop. The external cooling loop uses water from the pump and then discards the fluid to an external drain. Never operate the diesel engine while disconnected from the pump as fluid in the outer cooling loop will be absent not allowing the internal cooling loop a means for dissipating heat. Refer to the proper diesel engine Installation, Operation & Maintenance manual for all engine details.



DANGER - Never open the coolant cap on the engine while the engine is running or while the engine is hot. Doing so can cause severe injury and/or death.

AMBIENT CONDITIONS		OPERATING CONDITIONS		BEARING OPERATING TEMPERATURE		SUGGESTED GREASING INTERVALS ❶	GREASE TYPE NEEDED
DIRTY	MOIST	LOAD	SPEED	LOW	HIGH		
CLEAN	DRY	LIGHT TO MEDIUM	SLOW TO MEDIUM	0°F [-18°C]	120°F [49°C]	2 TO 6 MONTHS	HIGH QUALITY NLGI #2 MULTIPURPOSE BEARING GREASE WORK SATISFACTORY. CONSULT WITH A HIGH QUALITY LUBRICANT SUPPLIER.
				120°F [49°C]	200°F [93°C]	1 TO 2 MONTHS	
MODERATE TO DIRTY	DRY	LIGHT TO MEDIUM	SLOW TO MEDIUM	0°F [-18°C]	120°F [49°C]	1 TO 4 WEEKS	
				120°F [49°C]	200°F [93°C]	1 TO 7 DAYS	
EXTREMELY DIRTY	DRY	LIGHT TO MEDIUM	SLOW TO MEDIUM	0°F [-18°C]	200°F [93°C]	DAILY	LITHIUM OR OTHER CORROSION RESISTANT GREASE
	HIGH HUMIDITY (DIRECT CONTACT WITH WATER)	LIGHT TO MEDIUM	SLOW TO MEDIUM	32°F [0°C]	200°F [93°C]	1 TO 4 WEEKS GREASE AT SHUTDOWN	
		HEAVY TO VERY HEAVY	SLOW	0°F [-18°C]	120°F [49°C]	1 TO 8 WEEKS	HIGH VISCOSITY LUBRICATION
				120°F [49°C]	200°F [93°C]	1 TO 8 WEEKS	
		LIGHT	HIGH SPEED	100°F [38°C]	200°F [93°C]	1 TO 8 WEEKS	HIGH SPEED RATED GREASE
	POSSIBLE FROST	LIGHT TO HEAVY	SLOW TO MEDIUM	-65°F [-54°C]	+250°F [121°C]	1 TO 4 WEEKS GREASE AT SHUTDOWN	WIDE TEMPERATURE RANGE GREASE (SILICONE-DIESTER POLYESTER LUBRICANTS)
CLEAN TO MODERATE	DRY	LIGHT TO MEDIUM	SLOW TO MEDIUM	-65°F [-54°C]	+250°F [121°C]	1 TO 8 WEEKS	HIGH TEMPERATURE GREASES
CLEAN TO DIRTY	DRY	LIGHT	SLOW	80°F [27°C]	300°F [149°C]	1 TO 4 WEEKS	SYNTHETIC GREASES

❶ Suggested starting interval for maintenance program. Check grease conditions for oiliness & dirt and adjust greasing frequency accordingly. Watch operating temperatures as sudden rises may show the need for grease or indicate over lubrication on higher speed applications.

TABLE 2 - SUGGESTED RE-LUBRICATION INTERVALS FOR VARIOUS ENVIRONMENTAL, OPERATING & TEMPERATURE CONDITIONS

FUEL

Be sure that the proper grade of diesel fuel is used. Alternative grades can drastically reduce power generated by the engine. PRIOR to starting the engine make sure all fuel lines are open and there are no obstructions in any fuel lines or fuel filters. Refer to the proper diesel engine Installation, Operation & Maintenance manual for all engine details.



DANGER - Diesel fuel is a toxic fuel that can cause fire or explosion. Take all precautions necessary to eliminate any dangers and quickly clean up any spilled fuel.

BATTERY CONNECTIONS

All AMERIFLO engines operate on a 24 volt negative ground system. Wiring of any battery should only be done by qualified persons. Refer to the proper diesel engine Installation, Operation & Maintenance manual for all engine details. See FIGURE 15.



DANGER - If sulfuric acid makes direct contact with the eyes, it can cause permanent blindness. If ingested, this chemical may cause internal burns, irreversible organ damage, and possibly death. Exposure to sulfuric acid aerosols at high concentrations leads to severe eye and respiratory tract irritation and tissue damage.

Refer to PRE-START UP and START-UP sheets at the end of this manual for proper start-up procedures.

PRIMING

If the pump is installed with a positive head on the suction line, it can be primed by opening the suction valve and venting air through the air relief valve in the pump or system to allow the liquid to enter the casing. If the pump is installed with a suction lift, priming must be done by some other method such as by using foot valves, ejectors or by manually filling the casing and suction line.



WARNING - It is **EXTREMELY** important that the rotation of the motor is confirmed before installing the shaft coupling. Incorrect rotation, even for a short period, can cause catastrophic damage to the pumping unit.

ES pumps can only operate clockwise (as viewed from the driver). Double check the rotation PRIOR to starting up the pump unit.



WARNING - Failure to ensure that the pump is completely filled with liquid PRIOR to start-up can cause catastrophic damage to the pumping assembly and Diesel engine (if supplied).

ENSURING PROPER NPSHA

Net Positive Suction Head – Available (NPSHA) is the measure of the energy in a liquid above the vapor pressure. It is used to determine the likelihood that a fluid will vaporize within the pump. It is a critical number because a centrifugal pump is designed to pump a liquid, not a vapor. Vaporization within a pump will result in damage to the pump, deterioration of the Total Differential Head (TDH) and possible catastrophic damage to the pump.

Net Positive Suction Head – Required (NPSHR) is the decrease of fluid energy between the inlet of the pump and the point of lowest pressure in the pump. This decrease occurs because of friction losses and fluid accelerations near the inlet region of the pump suction as the fluid enters the impeller vanes. The value for NPSHR for the specific pump is given in the pump data sheet and on the pump performance curve.

For a pump to operate properly the NPSHA must be greater than the NPSHR. Good design practice dictates that this margin should be at least 5 ft (1.5 m) or 20% more than NPSHR, whichever is greater. By using this guideline, it will reduce the likelihood of cavitation which can severely damage the pump and cause possible catastrophic damage.



WARNING - It is important to make sure that the NPSHA is larger than the NPSHR by the suggested margin above. Incorporating this into the system design will enhance pump performance & reliability.

ROTATION CHECK

PRE START-UP CHECKS

In order to have a smooth start-up, the following list **MUST** be checked.

- The pump and driver are securely bolted to the foundation.
- The motor rotation has been confirmed.
- The parallel and angular alignment has been completed successfully.
- The system piping is connected correctly, is liquid tight and is not transmitting any pipe strain to the pump casing.
- The shaft assembly is free to rotate without any binding.
- The coupling guards are installed correctly.
- Confirm that no damage is present to any system device including the pump and driver.
- Confirm that all safety devices are installed correctly (casing relief valve, main relief valve, diesel engine cooling loop, etc.) according to their respective installation instructions.
- Pump has been properly lubricated.
- System piping and pump are properly primed with no air present.
- Packing is installed correctly and the gland bolts are loose.

STARTING THE PUMP & ADJUSTING FLOW

1. When starting the pump it is very important to make sure the suction valve is completely open. Any throttling of the pump to control flowrate should always be done with the valve located in the discharge piping.



DANGER - Never operate the pump with the suction and discharge valves in the closed position. This could cause the fluid within the pump to vaporize and cause an explosion which could cause personal injury and/or death.

2. The pump must be fully primed for correct operation. while keeping the discharge valve closed. Open the suction valve to allow the pump to be primed. The casing air release valve should help evacuate any air from the pump and system.
3. Be sure that all cooling lines are connected to the pump and that all fluids are at proper levels if using a diesel engine.
4. Be sure that all fuel lines are open if using a diesel engine.
5. Start the driver.
6. Slowly open the discharge valve until the correct flowrate is achieved. Be sure that the unit does not operate at a lower than specified flows for extended periods as this could cause damage to the pump and/or other system equipment.



DANGER - Never allow the pump to operate for an extended period of time at shut-off. This could cause the fluid within the pump to vaporize and cause an explosion which could cause personal injury and/or death.

7. Monitor the pump performance, motor performance (if equipped), diesel engine fluid levels (if equipped) and any other overall performance measures to make sure the unit is operating as it should be.
8. Allow the pump to operate for some time and then proceed to adjust the packing leakage in the following section below.

The pump and driver assembly should be shut down immediately if any of the following situations exist.

- No liquid is delivered.

- A significantly lower amount of fluid is being delivered.
- A significantly lower discharge pressure is being delivered.
- Loss of liquid after the pump starts up.
- Excessive vibration from the pump and/or driver.
- Electric motor or diesel engine is running hot or overheating.
- Pump bearings are running very hot and outside of design limits.



WARNING - Pump bearings should not exceed 250°F [121°C]. If the temperature exceeds this number shut the pump down immediately and investigate the cause.

ADJUSTING THE PACKING

The purpose of a stuffing box is to limit leakage of the pump fluid and to prevent air from entering the suction area along the pump shaft. Pumps are equipped with packing. Normally, the pumped liquid is used to lubricate the stuffing box. If the liquid is dirty, gritty or contains material that would gum or jam up the packing, an external fluid must be used. For pumps equipped with packing, there must always be a slight leakage from the gland. The amount of leakage is hard to define, but a steady dripping of liquid through the gland is a must. Stuffing box glands should be adjusted after the pump is started. When leakage is excessive, tighten the gland bolts evenly a little at a time. Allow 10 minutes for the packing to adjust to its new position. Never tighten the gland to completely eliminate all leakage as this will cause overheating and undue wear on the shaft sleeve.



WARNING - Failure to allow for an initially higher amount of fluid to leak through the packing and then gradually adjusted over the first hour of operation can damage the packing and score the shaft sleeve.

OPERATION IN SUB-FREEZING CONDITIONS

If the unit will operate in sub-freezing temperatures, measures must be taken to ensure that no fluid is allowed to freeze within the pump, system piping and/or diesel engine. Frozen fluid can cause catastrophic damage to the pump and system. A heater or other means for keeping the equipment warm must be placed in the field for proper pump operation.

SHUTDOWN CONSIDERATIONS

When the pump is ready to be shutdown, follow the start-up procedures in reverse. Slowly shut the discharge valve (if desired), shutdown the driver and then close the suction valve (if desired).

TROUBLESHOOTING

The following is a guide to troubleshooting problems with AMERIFLO Pumps & Engines. Common problems are analyzed and solutions are offered. Obviously, it is impossible to cover every possible scenario. If a problem exists that is not covered by one of these examples, then contact a local AMERIFLO Engineer or Distributor/Representative for assistance. Refer to the appropriate AMERIFLO diesel engine Installation, Operation & Maintenance manual for specific engine service and troubleshooting instructions.



TROUBLESHOOTING

EXCESSIVELY LOW DISCHARGE PRESSURE	EXCESSIVELY HIGH DISCHARGE PRESSURE	FLOW RATE TOO HIGH	FLOW RATE TOO LOW	MOTOR HIGH AMPERAGE	NO LIQUID AFTER PUMP START-UP	NO LIQUID PRESENT IN SYSTEM	NOISY OPERATION & EXCESSIVE VIBRATION	HIGH PUMP TEMPERATURE	HIGH PUMP BEARING TEMPERATURE	EXCESSIVE PACKING LEAKAGE	PUMP LEAKAGE (NOT AT PACKING GLAND)	POSSIBLE CAUSE	REMEDY
★	★	★	★	★	★		★	★				PUMP DUTY POINT NOT COMPATIBLE WITH SYSTEM HEAD CURVE	<ul style="list-style-type: none"> RE-EVALUATE THE PUMP DUTY AND MAKE A NEW HYDRAULIC SELECTION
							★					PUMP AND/OR SYSTEM PIPING ARE NOT PRIMED AND VENTED	<ul style="list-style-type: none"> VENT AND/OR PRIME THE PUMP AND SYSTEM PIPING
★			★		★	★	★	★				SUCTION PIPING PLUGGED OR IMPELLER OBSTRUCTION	<ul style="list-style-type: none"> INSPECT/CLEAN IMPELLER INSPECT THE SUCTION PIPING REMOVE OBSTRUCTIONS IN THE IMPELLER OR SYSTEM PIPING REMOVE DEBRIS FROM ANY STRAINERS IN THE SYSTEM
						★	★	★				CAVITATION SOUND IN PIPING	<ul style="list-style-type: none"> ADJUST THE SYSTEM PIPING WITH A FOCUS ON NPSHA & NPSHR ALTER THE SYSTEM PIPING TO IMPROVE NPSHA
★			★		★	★	★					INADEQUATE NPSHA	<ul style="list-style-type: none"> CHECK PUMP OPERATION IMPROVE SUCTION PIPING IMPROVE NPSHA THROTTLE THE PUMP INSTALL THE PUMP AT A LOWER POINT IN THE SYSTEM MODIFY THE SUCTION PIPING BY CHANGING SIZE AND LENGTH
★			★	★			★					INCORRECT ROTATION	<ul style="list-style-type: none"> CHECK MOTOR WIRING CONFIRM CONTROL PANEL WIRING CONFIRM IMPELLER INSTALLED CORRECTLY
★			★				★					SPEED IS TOO LOW	<ul style="list-style-type: none"> INCREASE THE SPEED INSPECT SYSTEM CONTROLS INSTALL A LARGER IMPELLER
★			★	★	★	★						WORN INTERNAL COMPONENTS	<ul style="list-style-type: none"> CONFIRM DUTY POINT REQUIREMENTS THROTTLE THE PUMP INSPECT PUMP FLUID FOR ABRASIVES OR CHEMICAL ATTACK REPLACE WORN COMPONENTS
				★								NEEDED DISCHARGE PRESSURE IS LOWER THAN ORDERED	<ul style="list-style-type: none"> READJUST THE DUTY POINT THROTTLE THE PUMP
				★								HIGHER VISCOSITY OF PUMPED FLUID	<ul style="list-style-type: none"> REDUCE THE SPEED INSPECT THE PUMP & MOTOR
	★	★		★			★					SPEED IS TOO HIGH	<ul style="list-style-type: none"> REDUCE THE SPEED INSPECT THE PUMP & MOTOR

TROUBLESHOOTING

EXCESSIVELY LOW DISCHARGE PRESSURE	EXCESSIVELY HIGH DISCHARGE PRESSURE	FLOW RATE TOO HIGH	FLOW RATE TOO LOW	MOTOR HIGH AMPERAGE	NO LIQUID AFTER PUMP START-UP	NO LIQUID PRESENT IN SYSTEM	NOISY OPERATION & EXCESSIVE VIBRATION	HIGH PUMP TEMPERATURE	HIGH PUMP BEARING TEMPERATURE	EXCESSIVE PACKING LEAKAGE	PUMP LEAKAGE (NOT AT PACKING GLAND)	POSSIBLE CAUSE	REMEDY
										★		CAPSCREWS/STUDS ARE LOOSE OR DEFECTIVE	<ul style="list-style-type: none"> INSPECT CAPSCREWS/STUDS RE-TIGHTEN THE FASTENER REPLACE THE HARDWARE INSPECT THE PIPING AND MAKE SURE ALL HARDWARE IS TIGHT
										★		WORN PACKING	<ul style="list-style-type: none"> INSPECT FLUSHING SYSTEM & FLUSHING SYSTEM PRESSURE CLEAN THE STUFFING BOX AND FLUSH LINES INSTALL NEW PACKING REPLACE WORN COMPONENTS
★		★					★	★				INSUFFICIENT FLUID AT SUCTION	<ul style="list-style-type: none"> CORRECT SYSTEM PIPING INSPECT SYSTEM PIPING FOR WEAR AND/OR DAMAGE
								★		★		PACKING GLAND INSTALLED INCORRECTLY	<ul style="list-style-type: none"> CHANGE PART REPLACE PART CORRECT INSTALLATION REPLACE PACKING REPLACE WORN COMPONENTS
								★		★		COOLING FLUID INADEQUATE	<ul style="list-style-type: none"> CHECK FLUSHING SYSTEM CLEAN FLUSHING SYSTEM OR INCREASE PRESSURE OF LIQUID INCREASE AMOUNT OF LIQUID LOOSEN GLAND ASSEMBLY
							★	★				COUPLING MISALIGNMENT AND VIBRATION	<ul style="list-style-type: none"> REALIGN PUMP & DRIVER CHECK SYSTEM PIPING FOR PIPE STRAIN INSTALL ANTI-VIBRATION ACCESSORIES
									★			HIGH AXIAL THRUST	<ul style="list-style-type: none"> CONFIRM THE DUTY POINT CHECK THE SYSTEM CHECK THE SUCTION FLOW RATE
									★			EXCESSIVE LUBRICATION	<ul style="list-style-type: none"> CLEAN THE BEARINGS RE-LUBRICATE CHANGE TYPE OF GREASE
★		★	★									MOTOR RUNNING ON ONLY TWO-PHASES	<ul style="list-style-type: none"> CHECK FUSES INSPECT ELECTRICAL CONNECTIONS INSPECT CONTROL PANEL
							★	★	★			ROTOR IMBALANCE	<ul style="list-style-type: none"> CLEAN THE IMPELLER CHECK ROTOR BALANCE RE-BALANCE THE IMPELLER
							★	★	★			DEFECTIVE BEARINGS	<ul style="list-style-type: none"> REPLACE

TROUBLESHOOTING

EXCESSIVELY LOW DISCHARGE PRESSURE	EXCESSIVELY HIGH DISCHARGE PRESSURE	FLOW RATE TOO HIGH	FLOW RATE TOO LOW	MOTOR HIGH AMPERAGE	NO LIQUID AFTER PUMP START-UP	NO LIQUID PRESENT IN SYSTEM	NOISY OPERATION & EXCESSIVE VIBRATION	HIGH PUMP TEMPERATURE	HIGH PUMP BEARING TEMPERATURE	EXCESSIVE PACKING LEAKAGE	PUMP LEAKAGE (NOT AT PACKING GLAND)	POSSIBLE CAUSE	REMEDY
							★	★				FLOW RATE IS TOO LOW	<ul style="list-style-type: none"> RE-ADJUST THE DUTY POINT OPEN THE SUCTION VALVE COMPLETELY OPEN THE DISCHARGE VALVE COMPLETELY RE-CALCULATE SYSTEM FRICTION LOSSES
★			★									STAR-DELTA MOTOR STUCK IN DELTA MODE	<ul style="list-style-type: none"> CHECK THE ELECTRICAL CABLE CONNECTIONS CHECK THE CONTROL PANEL
★			★				★					ENTRAPPED AIR IN THE FLUID	<ul style="list-style-type: none"> VENT THE SYSTEM INSPECT THE PACKING AREA
★			★		★	★	★					AIR ENTERING SYSTEM THROUGH SUCTION PIPING	<ul style="list-style-type: none"> IMPROVE SUCTION PIPING REDUCE FLUID VELOCITY IN SUCTION PIPING INSPECT THE PACKING SEAL AREA REPLACE DAMAGED PIPING
							★					CAVITATION NOISE	<ul style="list-style-type: none"> REDUCE FLUID VELOCITY IN SUCTION PIPING INSPECT SYSTEM PIPING SHORTEN SUCTION PIPING INSTALL THE PUMP AT A LOWER POINT IN THE SYSTEM
							★		★			BASE PLATE FLEXING	<ul style="list-style-type: none"> INSPECT REPLACE
★			★		★	★	★					PARALLEL PUMP OPERATION ISSUES	<ul style="list-style-type: none"> RE-ADJUST THE DUTY POINT ALTER THE PUMP PERFORMANCE
							★		★			SHAFT SIZE INCORRECT	<ul style="list-style-type: none"> REPLACE
				★		★	★	★				IMPELLER WEAR ON PUMP CASING	<ul style="list-style-type: none"> CHECK THE ROTOR CHECK THE IMPELLER POSITION CONFIRM NO PIPE STRAIN PRESENT

MAINTENANCE OF PUMP DUE TO FLOOD DAMAGE

Due to the location of many pump rooms, flooding is a common occurrence. Servicing the pump is a fairly straightforward process.

The bearings in the rotor assembly need the most attention during this time period. Completely remove the pump from the installation and proceed to the later section for DISASSEMBLY. AMERIFLO's recommendation is that all gaskets and roller bearings be replaced as all most likely have been in contact with water.

Inspect the stuffing boxes and make sure that they are clear of any foreign debris. AMERIFLO also recommends that the stuffing boxes be repacked with new packing to make sure foreign debris will not score any shaft sleeves while in service.

Dismantle all couplings and thoroughly clean them.

ROUTINE MAINTENANCE CHART

ROUTINE MAINTENANCE CHART		
SCHEDULE	# PEOPLE	TASK
EVERY WEEK	1	<ul style="list-style-type: none"> VISUALLY CHECK FOR LEAKS CHECK FOR LUBRICATION ADJUST GLANDS AS NECESSARY TO MAINTAIN PROPER LEAKAGE HAND TEST BEARING HOUSING FOR ANY SIGN OF TEMPERATURE RISE
EVERY MONTH	1	<ul style="list-style-type: none"> CHECK BEARING TEMPERATURE WITH INSTRUMENTATION
EVERY 6 MONTHS	1	<ul style="list-style-type: none"> CHECK THE PACKING AND REPLACE IF NECESSARY CHECK ALIGNMENT OF THE PUMP AND MOTOR CHECK HOLDING DOWN BOLTS FOR TIGHTNESS CHECK COUPLING FOR WEAR
EVERY YEAR	1	<ul style="list-style-type: none"> CHECK ROTATING ELEMENT FOR WEAR CHECK WEAR RING CLEARANCES CHECK AND REGREASE BEARINGS MEASURE TOTAL DYNAMIC SUCTION AND DISCHARGE HEAD
EVERY 5000 HOURS	2	<ul style="list-style-type: none"> BEARING INSPECTION
EVERY 4 YEARS	2	<ul style="list-style-type: none"> COMPLETE PUMP INSPECTION

PREVENTATIVE MAINTENANCE

The MAINTENANCE section of this manual will give the end user a complete procedure for giving the pump a complete overhaul. There are also sub-sections that detail other important maintenance procedures that may come up during normal pump & driver operation. It is also important to note that periodically the PRE START-UP checklist should be reviewed to make sure that site conditions have not changed since the initial start-up.

NEED FOR MAINTENANCE RECORDS

It is very important that the end user keep a record of daily, weekly, monthly and yearly maintenance records. These records are important when certain milestone events that need to be performed are recorded in a central location. From these records other important information can be gathered including trending in certain data. The analysis of this data can help with future maintenance issues and also help with eliminating certain issues that may be affecting pump or driver performance. Lastly, when and if a warranty claim is ever addressed at some future date, AMERIFLO personell will ask for all pertinent maintenance records so that they have a clear picture of what has been done to the unit.

NEED FOR CLEANLINESS

Perhaps the major cause of pump & driver failure has to do with contamination at the job site. Contamination can be in the form of moisture, dust, dirt or other foreign debris from the job site. This contamination is very harmful to the bearings in the pump. Dust and other debris can plug air and fuel filters in diesel engine drivers.

It is very important to maintain as clean of an area as job site conditions permit. When preventative maintenance is being performed on the pump & driver, make sure this maintenance is done in a clean area as well. Do not unpack bearings until they are ready to be immediately installed. Make sure filters and engine fluids are changed per the recommended intervals. Work should be done in an area free of moisture, dust, dirt, oil or grease. Never re-use bearings, gaskets, lip seals, o-rings and filters. Only use clean towels, shop rags and other tools when performing maintenance.

The purpose of a stuffing box is to limit leakage of the pump fluid and to prevent air from entering the suction areas of the pump casing along the pump shaft. All UL/FM pumps are equipped with packing. In a normal application, the pumped liquid is used to lubricate the stuffing box and packing. If the liquid is dirty, gritty or contains material that would clog the stuffing box, use a sealing liquid from an external source. If suction pressure is above atmospheric pressure, external seal piping may not be required. For pumps equipped with packing, there must always be a slight leakage from the gland. The amount of leakage is hard to define, but AMERIFLO recommends a steady dripping of liquid through the gland assembly. Stuffing box glands should be adjusted after the pump is started. When leakage is excessive, tighten gland bolt nuts evenly a quarter turn at a time. Allow 10 minutes for packing to adjust to it's new position. Never tighten the gland nuts to completely eliminate all leakage, as this will cause overheating and undue wear on shaft sleeves.



CAUTION - Overtightening gland bolt nuts can cause damage to the packing gland, packing and shaft sleeve. NEVER attempt to completely eliminate all leakage. Make sure proper packing break-in procedure is followed.

PACKING REPLACEMENT

Replace the stuffing box packing as follows. Refer to FIGURE 9 for item numbers.

- Shutdown the pump and follow all rotating equipment safety protocols.
- Take precautions to prevent the driver from being inadvertently started. Proper lockout procedures MUST be followed.



DANGER - Lockout power to the driver to prevent personal injury or death.

- Remove the gland bolt nuts (#168D & #169D) and packing gland (#372).
- Remove and discard old packing rings (#567) – note the location of the lantern ring (#676L). When repacking stuffing box (#116), the lantern ring (#676L) must be positioned such that the flush port connection is lined up with the lantern ring (#676L).

- Clean out the stuffing box (#116).
- Inspect the shaft sleeve (#756) for wear – if it is scored or grooved, it should be replaced.
- Insert the rings of packing (#567) and tap lightly to seat in the stuffing box (#116) bore. Be sure the packing rings (#567) are of the proper size and length and installed with all cuts staggered. The lantern ring (#676L) must be positioned to line up with the flush port connection.
- Install the packing gland (#372) and finger tighten the packing gland nuts and washer (#168D & #169D). With the pump running, adjust the gland nuts (#168D & #169D) as described previously. Care should be taken during the first hour of operation to gradually tighten up on the gland nuts (#168D & #169D) just enough to maintain the required amount of leakage.

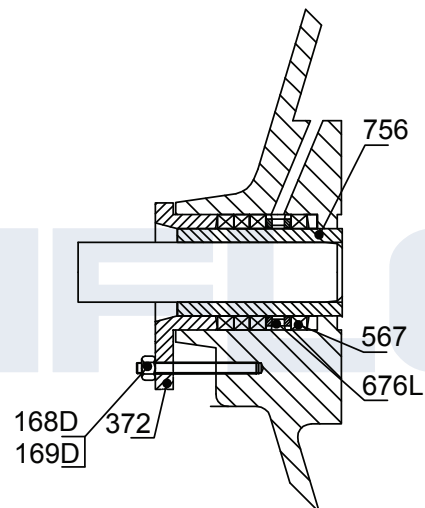


FIGURE 9 - ES STUFFING BOX

DISASSEMBLY

DRIVER

Refer to the specific Installation, Operation and Maintenance manual for the driver.

PUMP

Refer to FIGURE 11 for item numbers used in the disassembly process.



DANGER - Lockout power to the driver to prevent personal injury or death.

Whenever any disassembly work is to be done on the pump, disconnect the power source to the driver to eliminate any possibility of the unit starting. Close the valves in the suction and discharge line. Allow the pump set to cool to ambient temperature. Properly depressurize and drain the pump.

Always have repair work and maintenance work performed by specially trained, qualified personnel. Only use original authentic parts from AMERIFLO. Contact AMERIFLO if any questions regarding disassembly or assembly arise.

No special tools are required to remove the coupling. Please refer to the manufacture instructions for proper disassembly.

Removal of the back-pullout assembly:

- Remove the coupling guard and disconnect the half-coupling.
- Unbolt the driver from the baseplate and move the motor from the pump if a non-spacer coupling is used. Note: please refer to the driver manual instruction.
- Disconnect the piping from the pump casing (#180) if a complete pump removal is to be accomplished. If a back-pullout repair is to be done, leave the pump casing (#180) bolted to the system piping and to the baseplate.
- Remove the casing nuts & washers (#168A & #169A) between the rear cover (#116) and the pump casing (#180). Remove the baseplate bolts that connect the power frame foot (#820) to the baseplate.
- Remove the back-pullout assembly from the casing (#180) until the impeller(#443) is clear of the pump casing (#180).

Disassembly of the back-pullout assembly:

- Remove the impeller nut(#168) and impeller lock washer (#968).
- Remove the impeller (#443) from the pump shaft (#728). Carefully remove the impeller key (#472A).



DANGER - Do not apply heat to the impeller. If liquid is trapped within the impeller hub an explosion could occur causing personal injury or death.

- Remove the rear cover nuts & washer (#168B & #169B) and remove the rear cover (#116) from the

power frame (#356). Remove and discard the casing o-ring (#364A).

- Loosen the packing gland nuts and washer (#168D & #169D) and remove the packing gland (#372) from the rear cover (#116). Remove all packing rings (#567) and lantern ring (#676L) from the rear cover. Be sure to also remove any packing rings (#567) below the lantern ring (#676L). Discard all old packing rings.
- Remove the shaft sleeve (#756) from the pump shaft (#728). Remove the water deflector (#764) from the pump shaft (#728).
- Remove the pump coupling half from the pump shaft (#728). Remove the coupling key (#472B) from the pump shaft (#728).
- Remove the nuts & washers (#168C & #169C) from the bearing housing cap (#164P). Remove the bearing cover (#164P) and bearing housing cover gasket (#364C) from the power frame and discard. Remove the inboard lip seal (#712P) from the bearing housing cap (#164P) and discard.
- Press the shaft assembly (consisting of the shaft (#728), outboard bearing (#068N) and inboard bearing (#068P)) out of the power frame (#356).
- An arbor or hydraulic press may be used to remove the bearings (#068N and #068P) from the shaft (#728). It is extremely important to apply even pressure to the inner bearing race only during removal. Never apply pressure to the outer race as this exerts excess loads on the balls and causes damage to the bearing.



CAUTION - Applying pressure to the outer race of a roller bearing can permanently damage the bearing.

- Remove the outboard lip seal (#712P) from the power frame (#356) and discard.

INSPECTION

All parts should be thoroughly cleaned.



WARNING - It is important that only non-flammable, non-contaminated cleaning fluids are used. These fluids must comply with plant safety and environmental guidelines.

Visually inspect all parts for any damage that could effect performance. Replace all o-rings (#364A), gaskets (#364C), packing (#567), lip seals (#712N & #712P) and bearings (#068N & #068P). Install the shaft (#728) between centers and check the concentricity over it's entire length. Concentricity should not exceed 0.002 in [0.051 mm]. Bearing surfaces should be smooth with square shoulders and no other scoring marks. Replace any parts that are outside of factory tolerances.

Inspect the case wear ring (#676W) and impeller hub (#443) for any excessive wear. Confirm that the running clearances between the impeller (#443) and case wear ring (#676W) are within factory tolerances. Surfaces must be smooth and concentric. Inspect impeller passages for any cracks, dents or foreign material. Replace any parts that are outside of factory tolerances.

Check the shaft sleeve (#756) for wear and replace if necessary.

When replacing parts only use genuine AMERIFLO parts. Refer to the appropriate AMERIFLO aftermarket repair manual for the correct part numbers.

ASSEMBLY

Refer to TABLE III for all bolt tightening torque information and FIGURE 10 for tightening sequence.

BOLT SIZE		TIGHTENING TORQUE	
METRIC	STANDARD	LB-FT	N-M
4 MM	5/32 IN	2.7	3.6
5 MM	3/16 IN	5.2	7.0
6 MM	1/4 IN	8.9	12.0
7 MM	9/32 IN	14.6	19.8
8 MM	5/16 IN	21.8	29.6
9 MM	11/32 IN	28.0	38.0
10 MM	3/8 IN	38.7	52.5
12 MM	1/2 IN	65.6	89.0
14 MM	9/16 IN	99.6	135
16 MM	5/8 IN	151	205
18 MM	11/16 IN	190	257
20 MM	3/4 IN	264	358
22 MM	7/8 IN	321	435
24 MM	15/16 IN	411	557

TABLE 3 - CAPSCREW & NUT TIGHTENING TORQUE RATINGS

It is very important that all pipe threads be sealed properly. PTFE tape provides a very reliable seal over a wide range of fluids but it has serious shortcomings if not used properly. If, during application to the threads, the tape is wrapped over the end of the male thread, strings of the tape will be sheared off when threaded into the female fitting. This string can then tear away and lodge in the piping system. If this occurs in the seal flush system, small orifices can become blocked effectively eliminating the flow. For this reason, AMERIFLO does not recommend the use of PTFE tape as a thread sealant.

AMERIFLO has investigated and tested alternate sealants and has identified two that provide an effective seal, have the same chemical resistance as the PTFE tape and will not plug flush systems.

These are La-co SlicTite and Bakerseal. Both products contain finely ground PTFE particles in an oil based carrier. They are supplied in a paste form which is brushed on the male pipe threads. AMERIFLO recommends using one of these paste sealants.

Full thread length engagement is required for all fasteners.

Reassembly of the pump can be accomplished in the reverse order.



BEARING INSTALLATION

Mounting of the inboard and outboard bearings onto the shaft must be done in a very clean environment. Bearing and power frame life can be drastically reduced when contaminated bearings are install in pumps.

Bearings should be removed from their protective packaging only immediately before assembly to limit exposure to possible contamination. After removing the packaging they should only come in contact with clean hands, fixtures, tools and work surfaces.

The chart shown in TABLE V gives the SKF part numbers for bearings used in AMERIFLO ES pumps. Note that the term “Inboard bearing” refers to the bearing nearest to the impeller. “Outboard bearing” refers to the bearing nearest to the motor.

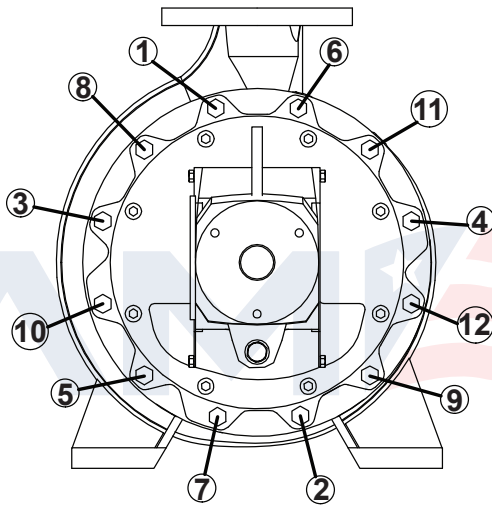


FIGURE 10 - ES BOLT TIGHTENING SEQUENCE

Install the inboard bearing (#069P) onto the shaft (#728). The inboard bearing (#069P) must be fully positioned against the shaft (#728) shoulder. Both bearings have a slight interference fit which requires that they be pressed onto the shaft with an arbor or hydraulic press. Even force should be applied to the inner race only. Never press on the outer race, as this force will damage the balls and cage assembly. An alternate method of installing bearings is to heat the bearings to 200°F [93°C] in an oven or induction heater. Once heated place them quickly into position on the shaft.



CAUTION - Never heat the bearing above 230°F [110°C]. Exceeding this temperature will cause permanent damage to the bearing assembly. If this occurs, discard the bearing.

Using clean gloves, install the outboard bearing (#069N) firmly against the shaft (#728) shoulder. If hot bearing mounting techniques are used, steps must be taken to ensure the outboard bearing (#069N) is firmly positioned against the shaft (#728) shoulder. An approximate press force needed to seat the bearing is listed in TABLE IV. This value may be used if the press has load measuring capability.

PUMP MODEL	PRESS FORCE LBF [N]	LOCKNUT TORQUE LB-FT [N-M]
1.5x2.5-9	1,300 [5,780]	20 [27]
1.5x2.5-11		
2x2.5-9		
2x2.5-11		
2.5x3-9	2,500 [11,100]	40 [54]
2.5x3-11		
2.5x3-13		
3x4-9		
3x4-11		
3x4-13		
5x6-13		

TABLE 4 - BEARING PRESS FORCE

PUMP MODEL	TYPE OF BEARING	INBOARD SINGLE ROW ❶	OUTBOARD SINGLE ROW ❶
1.5x2.5-9	REGREASABLE SINGLE SHIELDED	7307-ZC3	7306-ZC3
1.5x2.5-11	REGREASABLE SINGLE SHIELDED	7307-ZC3	7306-ZC3
2x2.5-9	REGREASABLE SINGLE SHIELDED	7307-ZC3	7306-ZC3
2x2.5-11	REGREASABLE SINGLE SHIELDED	7307-ZC3	7306-ZC3
2.5x3-9	REGREASABLE SINGLE SHIELDED	7308-ZC3	7307-ZC3
2.5x3-11	REGREASABLE SINGLE SHIELDED	7309-ZC3	7308-ZC3
2.5x3-13	REGREASABLE SINGLE SHIELDED	7309-ZC3	7308-ZC3
3x4-9	REGREASABLE SINGLE SHIELDED	7309-ZC3	7308-ZC3
3x4-11	REGREASABLE SINGLE SHIELDED	7309-ZC3	7308-ZC3
3x4-13	REGREASABLE SINGLE SHIELDED	7309-ZC3	7308-ZC3
5x6-13	REGREASABLE SINGLE SHIELDED	7310-ZC3	7309-ZC3

TABLE V - BEARING PRESS FORCE

❶ These bearings are pre-greased by AMERIFLO. Replacement bearings will generally not be pre-greased, so grease must be applied by the end user. These bearings have a single shield, which is located on the side next to the grease buffer, or reservoir. The bearings draw grease from the reservoir as it is needed. The shield protects the bearing from getting too much grease, which would generate heat. The grease reservoir is initially filled with grease by AMERIFLO. Lubrication fittings are provided to allow the end user to periodically replenish the grease, as recommended by the bearing and/or grease manufacturer.

RECOMMENDED SPARE PARTS

PART	NUMBER OF INSTALLED PUMPS						
	2	3	4	5	6	8	≥ 10
	QUANTITY OF SPARE PARTS ❶						
IMPELLER	1	1	1	2	2	2	30%
CASE WEAR RING	4	4	4	6	6	6	50%
HARDWARE	1	1	2	2	2	3	30%
BEARING	2	2	4	4	6	8	100%
SHAFT SLEEVE	4	4	4	6	6	8	50%
LIP SEAL	4	6	8	8	10	12	150%
PACKING	4	6	8	10	12	16	150%

❶ Recommended spare parts for 2 years of operation

MODEL FP-ES - END SUCTION COMPONENT BREAKDOWN

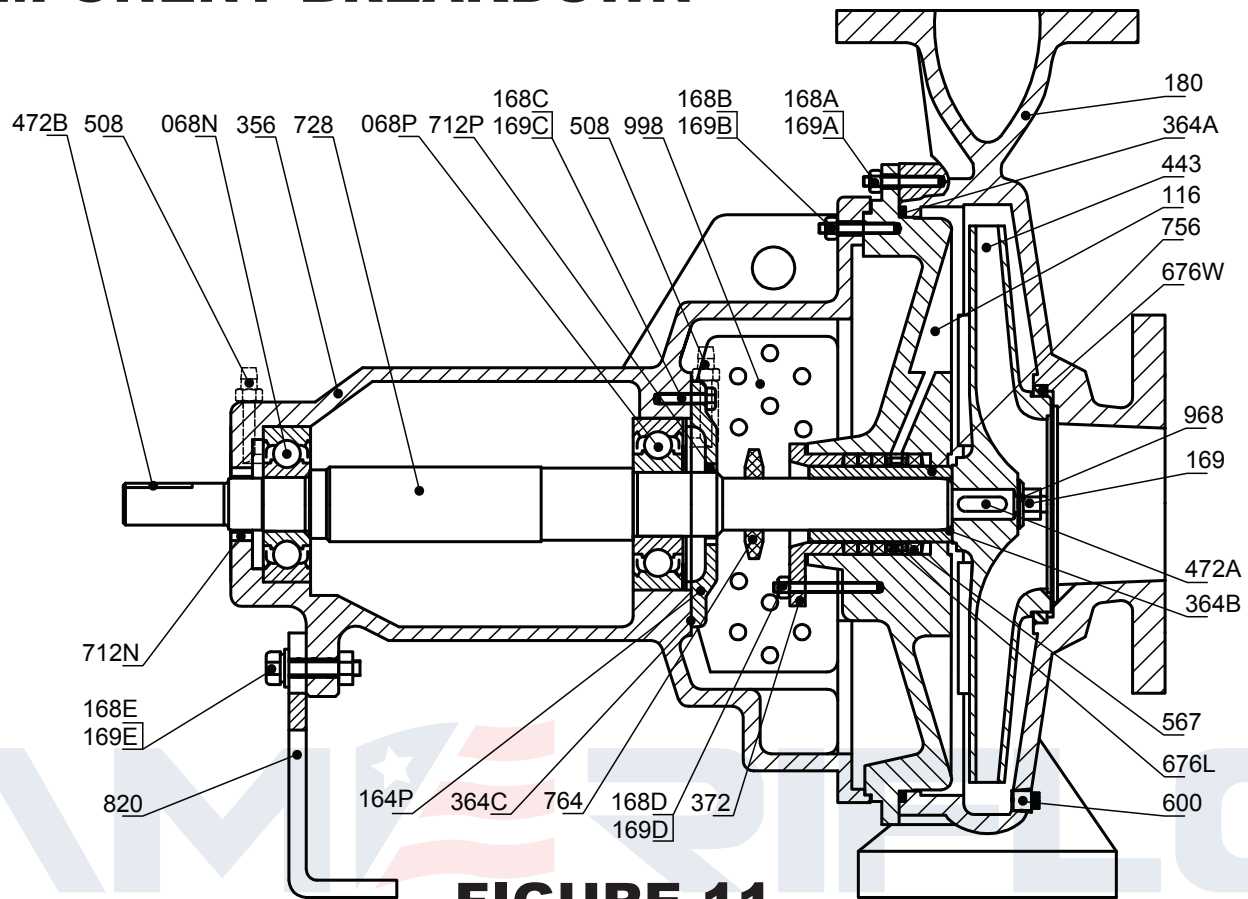


FIGURE 11

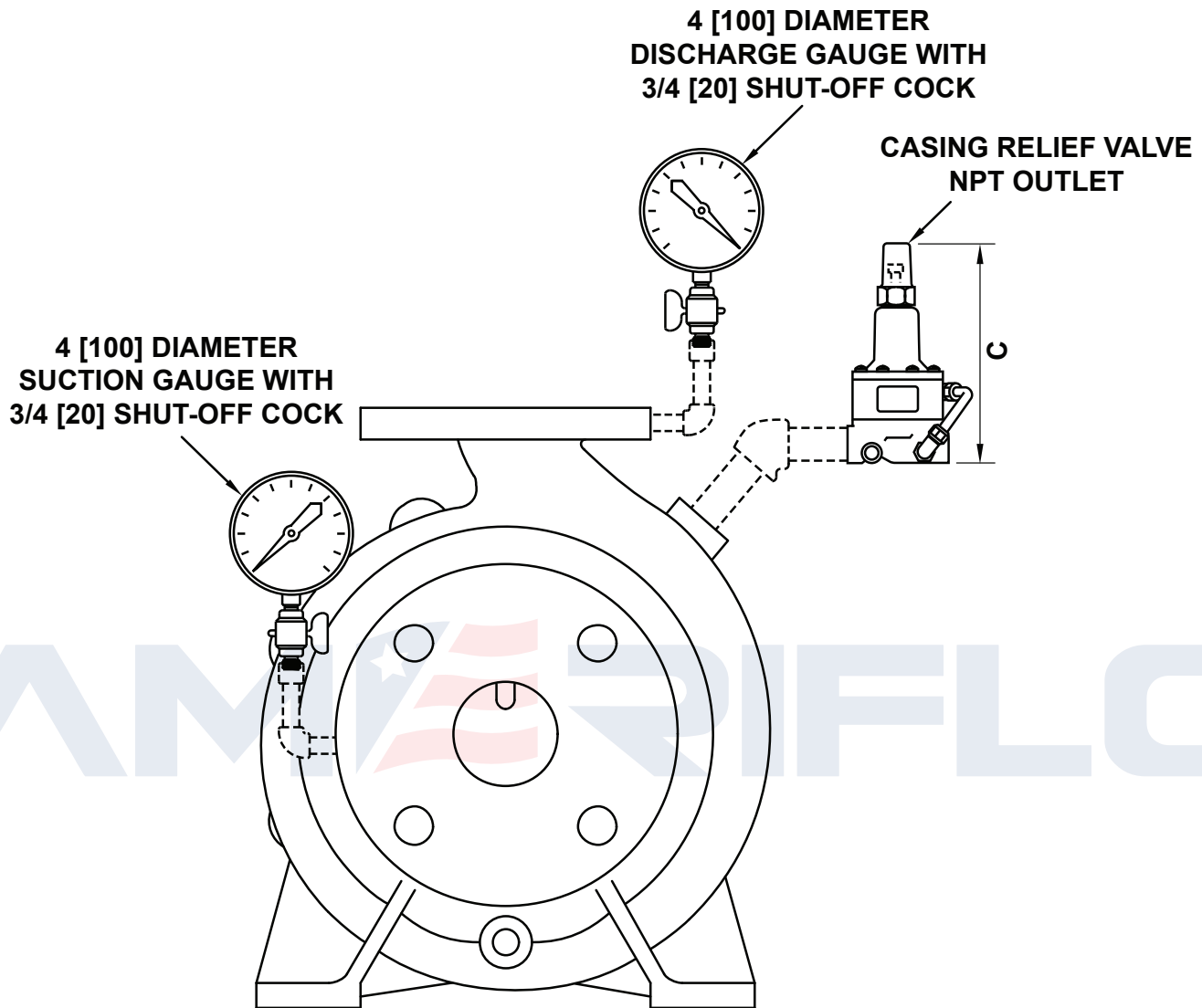
ITEM	DESCRIPTION
068N	BEARING, OUTBOARD
068P	BEARING, INBOARD
116	REAR COVER
164	COVER, BEARING HOUSING
168A	NUT, CASING
168B	NUT, REAR COVER
168C	NUT, BEARING HOUSING CAP
168D	NUT, PACKING GLAND
168E	NUT, POWER FRAME FOOT
169	NUT, IMPELLER
169A	STUD, CASING
169B	STUD, REAR COVER
169C	STUD, BEARING HOUSING CAP
169D	STUD, PACKING GLAND
169E	STUD, POWER FRAME FOOT
180	CASING
356	POWER FRAME
364A	O-RING, CASING
364B	O-RING, SHAFT SLEEVE

ITEM	DESCRIPTION
364C	GASKET, BEARING HOUSING CAP
372	GLAND, PACKING
443	IMPELLER
472A	KEY, IMPELLER
472B	KEY, COUPLING
508	FITTING, GREASE
567	PACKING
600	PLUG, DRAIN
676L	RING, LANTERN
676W	WEAR RING, CASING
712N	LIP SEAL, OUTBOARD
712P	LIP SEAL, INBOARD
728	SHAFT
756	SLEEVE, SHAFT
764	SLINGER
820	FOOT, POWER FRAME
968	WASHER, IMPELLER
998	GUARD

① RECOMMENDED SPARE PARTS ARE IN BOLD.

MODEL FP-ES - END SUCTION, ELECTRIC, ACCESSORIES

GENERAL ARRANGEMENT DRAWING

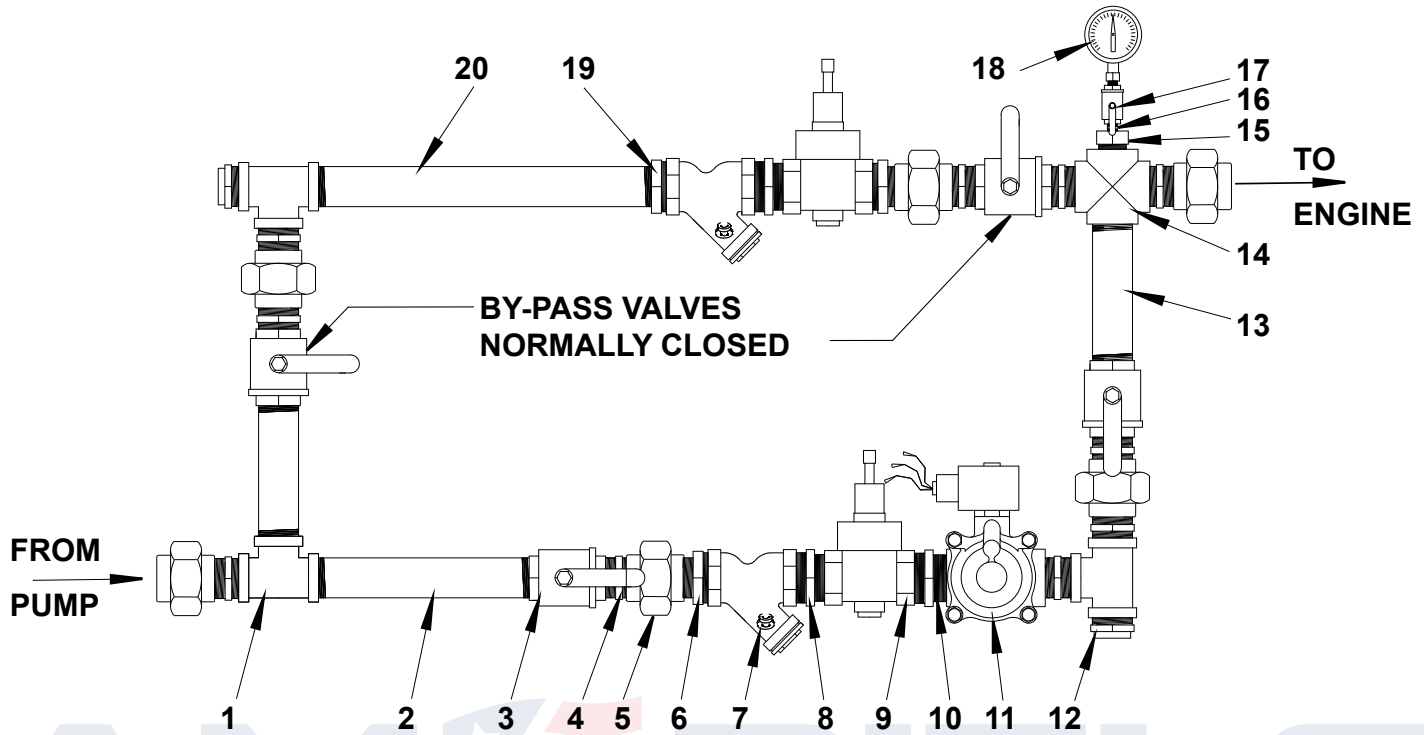


CASING RELIEF VALVE		
PUMP FLOW (GPM)	VALVE INLET	"C" DIMENSION
50 - 2500	3/4"	4-1/2 [114]
3000 - 5000	1"	5-1/2 [140]

NOTES:

- ❶ ALL DIMENSIONS ARE IN INCHES [MM] AND MAY VARY ± 0.375 INCHES.
- ❷ REFER TO AMERIFLO INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR PROPER PUMP INSTALLATION.
- ❸ ACCESSORIES ARE SHIPPED LOOSE FOR FIELD INSTALLATION.
- ❹ CASING RELIEF VALVE IS FURNISHED ON ELECTRIC MOTOR DRIVEN PUMPS ONLY.
- ❺ SUCTION GAUGE RANGE IS -14.5 - 0 - 130 PSI FOR SUCTION PRESSURE UP TO 75 PSI OR -14.5 - 0 - 300 PSI FOR SUCTION PRESSURE ABOVE 75 PSI.
- ❻ DISCHARGE GAUGE IS 0 - 300 PSI FOR PUMPS WITH RATED DISCHARGE PRESSURE UP TO 150 PSI OR 0 - 600 PSI FOR PUMPS WITH RATED PRESSURE OVER 150 PSI.
- ❼ THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS CERTIFIED BY AMERIFLO LLC.

FIGURE 12

DIESEL COOLING LOOP**AMERIFLO DIESEL ENGINES**

AMERIFLO DIESEL ENGINE COOLING LOOP			
ITEM #	NAME	DESCRIPTION	QTY
1	TEE JOINT	1"	3
2	PIPE	1" x 9"	1
3	BALL VALVE	1"	4
4	INNER JOINT	1"	8
5	UNION	1"	4
6	INNER JOINT	1-1/2" x 1"	1
7	FILTER	1-1/2"	2
8	INNER JOINT	1-1/2" x 1-1/4"	2
9	RELIEF VALVE	1-1/4"	2
10	INNER JOINT	1-1/4" x 1"	2
11	SOLENOID VALVE	1"	1
12	PLUG	1"	2
13	PLUG	1" x 4.75"	2
14	CROSS TEE	1"	1

AMERIFLO DIESEL ENGINE COOLING LOOP			
ITEM #	NAME	DESCRIPTION	QTY
15	BUSHING	1" x 1/2"	1
16	INNER JOINT	1-1/5" x 1/4"	1
17	BALL VALVE	1/4"	1
18	PRESSURE GAUGE	1/4", 0 - 100 PSI	1
19	BUSHING	1-1/2" x 1"	1
20	PIPE	1" x 14-1/4"	1

① TYPICAL COOLING LOOP DETAIL.

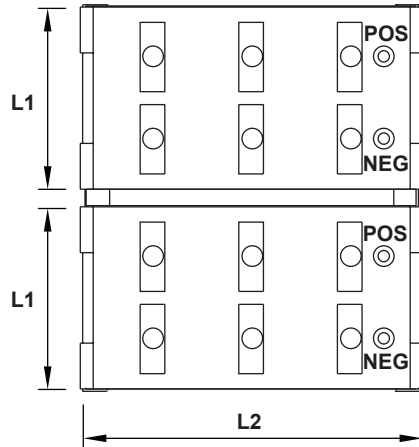
FIGURE 13

AMERIFLO

DIESEL ENGINE BATTERIES, RACKS & CABLES

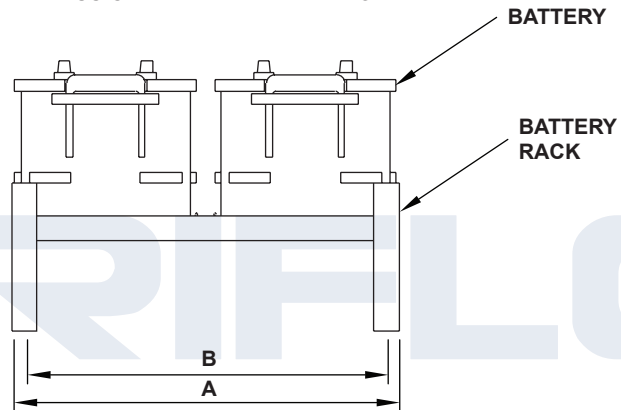
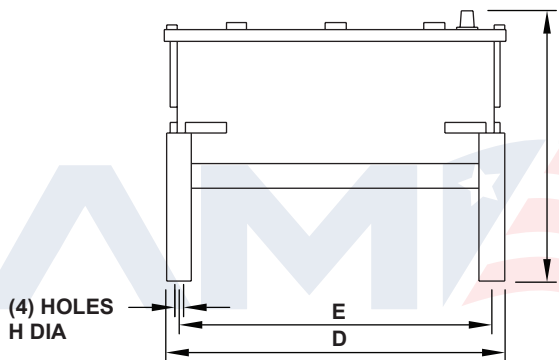
AMERIFLO DIESEL ENGINES

SECTION **5010** PAGE **32** OF **41**
DATE **APRIL 2021**



NOTES:

- ❶ ALL DIMENSIONS ARE IN INCHES [MM] AND MAY VARY ± 0.375 INCHES.
- ❷ BATTERIES ARE 12 VOLT, LEAD-ACID TYPE 8-8D. APPROXIMATELY 95 POUNDS DRY, EACH.
- ❸ BATTERIES ARE SHIPPED DRY. ELECTROLYTE (APPROXIMATELY 19 QUARTS PER BATTERY) MUST BE PROCURED LOCALLY.
- ❹ REFER TO GENERAL ARRANGEMENT DRAWING "DIESEL BATTERIES & CABLE DIAGRAM" FOR PROPER 24 VOLT CABLE DIAGRAM.
- ❺ BATTERY RACKS ARE FABRICATED STEEL AND WEIGH APPROXIMATELY 20 POUNDS EACH.
- ❻ EACH BATTERY RACK HOLDS TWO BATTERIES. RACKS ARE NOT TO BE STACKED.
- ❼ THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS CERTIFIED BY AMERIFLO.



BATTERY CAPACITY	A	B	C	D	E	H	L1	L2
80AH	26.00 [660]	24.44 [620]	15.00 [380]	15.38 [390]	13.75 [350]	0.50 [14]	6.60 [168]	11.13 [283]
100AH	33.88 [860]	32.25 [820]					6.80 [173]	13.00 [330]
120AH							6.75 [171]	13.00 [330]
150AH	41.75 [1060]	40.19 [1020]		18.13 [460]	16.50 [420]		8.00 [203]	15.00 381]
180AH				18.88 [480]	17.38 [440]		8.00 [203]	16.00 [406]
200AH				23.25 [590]	21.63 [550]		8.00 [203]	20.00 [508]

NOTES:

- ❶ ALL CABLES ARE SAE J55BA TYPE SGT WITH TENSILE ATTACHMENT OF 700-800 POUNDS.
- ❷ POSITIVE AND NEGATIVE CABLES ARE 60 INCHES [1524 MM] AND ARE 2/0 GAUGE OR POSITIVE AND NEGATIVE CABLES ARE 80 INCHES [2032 MM] AND ARE 3/0 GAUGE.
- ❸ TERMINAL CLAMPS HAVE STEEL REINFORCED INSERTS.

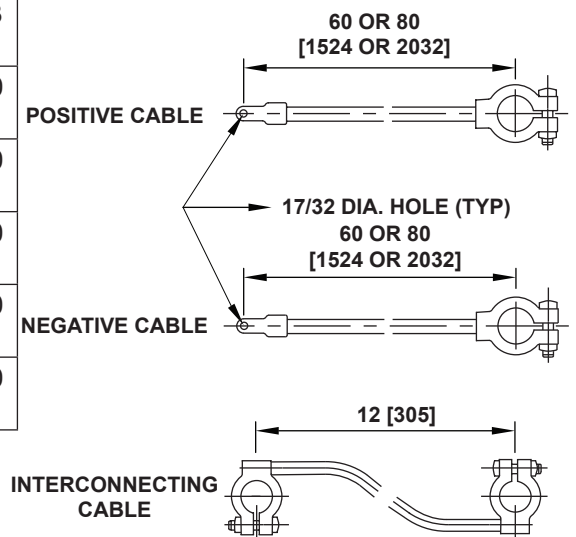
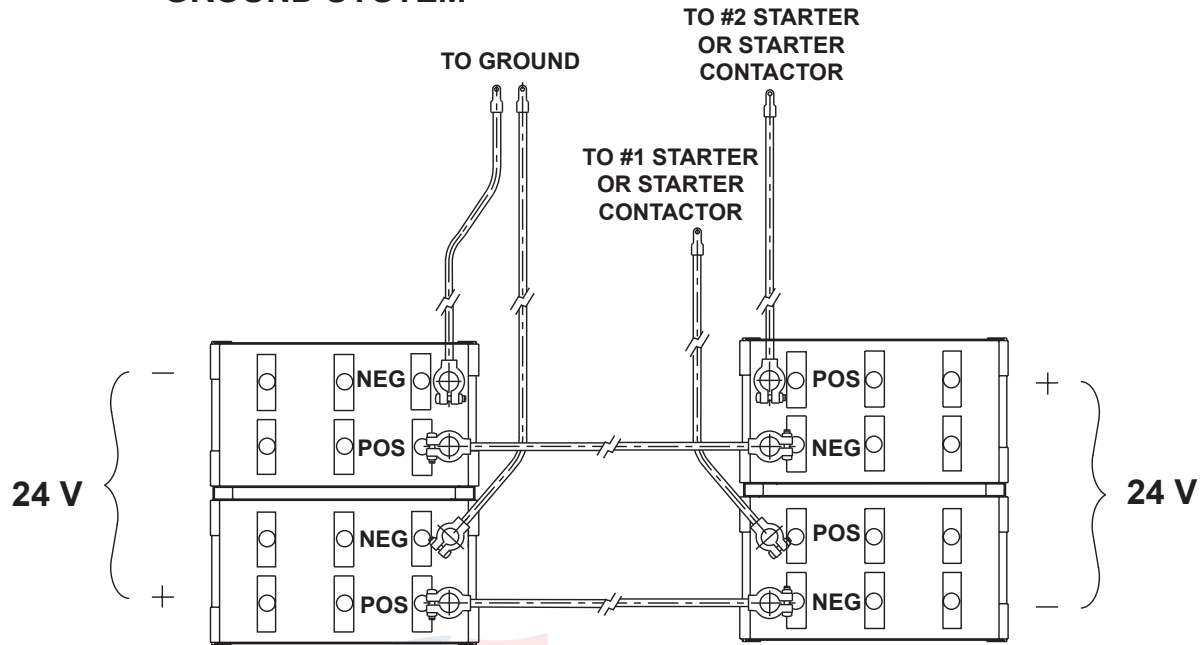


FIGURE 14

DIESEL ENGINE BATTERY CABLE DIAPHRAGM**AMERIFLO DIESEL ENGINES****24 VOLT NEGATIVE
GROUND SYSTEM****24 VOLT SYSTEM CONSISTS OF:**

- (2) BATTERY RACKS
- (4) BATTERIES
- (2) POSITIVE CABLES
- (2) NEGATIVE CABLES
- (2) INTERCONNECTING CABLES

● THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS CERTIFIED BY AMERIFLO.

FIGURE 15

PRESTART-UP CHECKLIST

AMERIFLO REPRESENTATIVE: _____
CONTRACTOR: _____
PROJECT ENGINEER: _____
PROJECT NAME: _____

REP PHONE NUMBER: _____
CONTRACTOR PHONE NUMBER: _____
ENGINEER PHONE NUMBER: _____
PUMP LOCATION: _____

EQUIPMENT INFORMATION

PUMP MODEL: _____ PUMP S/N: _____ ES: ☐
MOTOR MODEL: _____ MOTOR S/N: _____ VI: ☐
ENGINE MODEL: _____ ENGINE S/N: _____ SC: ☐
GEAR MODEL: _____ GEAR S/N: _____ VT: ☐

PROCEDURE

PROCEDURE	YES	NO	N/A	COMMENTS
1. SHIPMENT				
WAS THERE ANY DAMAGE DURING SHIPMENT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
WERE ALL ORDERED ITEMS RECEIVED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. STORAGE				
HAS EQUIPMENT BEEN PROTECTED FROM THE WEATHER?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
WAS EQUIPMENT SUBJECT TO DAMAGE IN STORAGE?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE ALL BEARINGS BEEN PROTECTED FROM MOISTURE?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. INSTALLATION				
IOM MANUAL COMPLETELY READ AND UNDERSTOOD?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
WERE FASTENERS USED IN SHIPPING AND REMOVED PRIOR TO INSTALLATION?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
IS GROUTING UNDER BASE PROPERLY COMPACTED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
IS GROUT OF THE NON-SHRINK TYPE?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE PROPER ANCHOR BOLTS BEEN USED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE SUCTION AND DISCHARGE PIPING BEEN CHECKED FOR THE PRESENCE OF PIPE STRAIN?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ARE LUBRICATION LINES AND COOLING LINES CONNECTED PROPERLY?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ARE ACCESSORIES MOUNTED AND PROPERLY INSTALLED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ARE ALL SAFETY GUARDS INSTALLED PROPERLY?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE IMPELLERS BEEN CHECKED FOR PROPER CLEARANCE?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
IS ALL WIRING CONNECTED PROPERLY AND CHECKED FOR VOLTAGE, PHASE, FREQUENCY, ETC.?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. ALIGNMENT				
HAS THE PUMP & DRIVER ALIGNMENT BEEN CHECKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE INDICATOR READINGS BEEN TAKEN?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. ROTATION				
HAS THE DRIVER ROTATION BEEN CHECKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
COUPLING & SHAFT TURNED AND FREE TO ROTATE?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. SYSTEM				
IS THE SYSTEM FREE OF FOREIGN DEBRIS?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
IS LIQUID PRESENT IN SYSTEM?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ALL SYSTEM PIPING IS PROPERLY SUPPORTED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ARE THE PUMPS AND CONTROLS ACCESSIBLE AND UNLOCKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CUSTOMER'S REPRESENTATIVE WITNESSING START-UP	AMERIFLO REPRESENTATIVE WITNESSING START-UP:			
NAME: _____ DATE: _____	NAME: _____	DATE: _____		

DATE **APRIL 2021****AMERIFLO****START-UP CHECKLIST**

AMERIFLO REPRESENTATIVE: _____
 CONTRACTOR: _____
 PROJECT ENGINEER: _____
 PROJECT NAME: _____

REP PHONE NUMBER: _____
 CONTRACTOR PHONE NUMBER: _____
 ENGINEER PHONE NUMBER: _____
 PUMP LOCATION: _____

EQUIPMENT INFORMATION

PUMP MODEL: _____ PUMP S/N: _____ ES: ☐
 MOTOR MODEL: _____ MOTOR S/N: _____ VI: ☐
 ENGINE MODEL: _____ ENGINE S/N: _____ SC: ☐
 GEAR MODEL: _____ GEAR S/N: _____ VT: ☐

DESIGN CONDITIONS

FLOW: _____ RPM: _____ VOLTAGE: _____
 PRESSURE: _____ HP: _____ PHASE: _____

PROCEDURE

	YES	NO	N/A	COMMENTS
1. PRESTART-UP				
HAS THE PROCEDURE CHECKLIST FOR PRE-START-UP BEEN COMPLETED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
VERIFY PUMP ROTATION:				<input type="checkbox"/> CW <input type="checkbox"/> CCW (AS VIEWED FROM THE MOTOR)
VERIFY DRIVER ROTATION:				<input type="checkbox"/> CW <input type="checkbox"/> CCW (AS VIEWED FROM THE MOTOR)
2. IMPELLER CLEARANCE SETTING				
HAS IMPELLER BEEN PROPERLY ADJUSTED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
VTP AXIAL IMPELLER CLEARANCE: _____ IN				
3. LUBRICATION				
HAVE THE BEARINGS BEEN PROPERLY LUBRICATED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAS THE COUPLING BEEN PROPERLY LUBRICATED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAS THE MOTOR BEEN PROPERLY LUBRICATED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DIESEL ENGINE COOLANT LEVEL CHECKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DIESEL ENGINE OIL LEVEL CHECKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DIESEL ENGINE FUEL LEVEL CHECKED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. SYSTEM				
HAS FLOW BEEN ESTABLISHED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HAVE GAUGE READINGS BEEN TAKEN?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
EXCESSIVE VIBRATION PRESENT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
BEARING TEMPERATURE NORMAL?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
ENGINE TEMPERATURE NORMAL?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. PACKING				
PACKING BROKEN IN CORRECTLY?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PACKING LEAKAGE IS ACCEPTABLE AFTER BREAK-IN PERIOD?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CUSTOMER'S REPRESENTATIVE WITNESSING START-UP:		AMERIFLO REPRESENTATIVE WITNESSING START-UP:		
NAME: _____	DATE: _____	NAME: _____	DATE: _____	

FIELD TEST REPORT

AMERIFLO REPRESENTATIVE: _____
CONTRACTOR: _____
PROJECT ENGINEER: _____
PROJECT NAME: _____

REP PHONE NUMBER: _____
CONTRACTOR PHONE NUMBER: _____
ENGINEER PHONE NUMBER: _____
PUMP LOCATION: _____

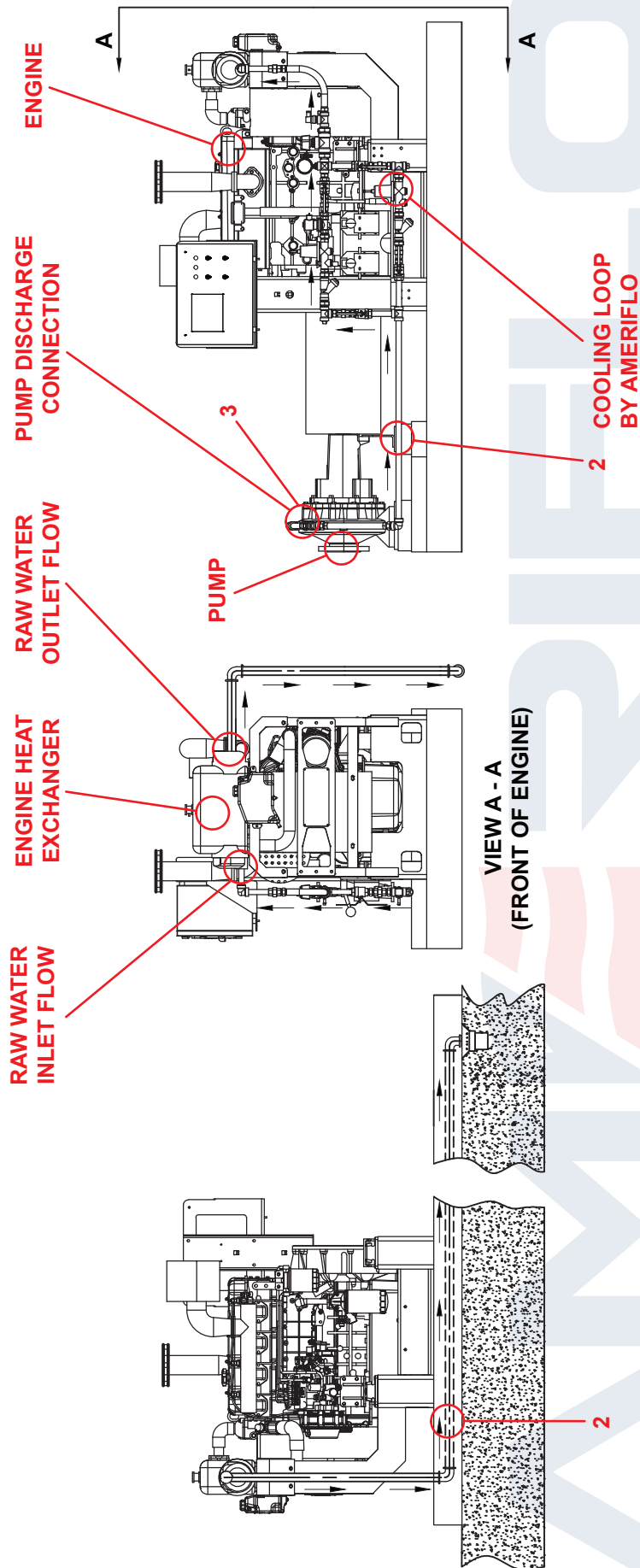
EQUIPMENT INFORMATION

PUMP MODEL: _____ PUMP S/N: _____ ES: ☐
MOTOR MODEL: _____ MOTOR S/N: _____ VI: ☐
ENGINE MODEL: _____ ENGINE S/N: _____ SC: ☐
GEAR MODEL: _____ GEAR S/N: _____ VT: ☐

DESIGN CONDITIONS

FLOW: _____ RPM: _____ VOLTAGE: _____
PRESSURE: _____ HP: _____ PHASE: _____

PROCEDURE	YES	NO	N/A	COMMENTS	
1. PRESTART-UP					
HAS THE PROCEDURE CHECKLIST FOR PRE-START-UP BEEN COMPLETED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
2. START-UP					
HAS THE PROCEDURE CHECKLIST FOR START-UP BEEN COMPLETED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
3. SYSTEM					
SUCTION VALVE OPEN?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
SUMP LIQUID LEVEL CORRECT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
SUMP CLEAR OF DEBRIS?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
ARE ALL SYSTEM VALVES IN THE CORRECT POSITION?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
IS ALL PIPING SECURE AND FLOW PROPERLY ROUTED?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
4. RECORDED DATA	POINT 1	POINT 2	POINT 3	POINT 4	POINT 5
SPEED (RPM):					
FLOW (GPM):					
DISCHARGE PRESSURE (PSIG):					
SUCTION PRESSURE (PSIG):					
LIFT (WATER LEVEL TO DISCHARGE CENTERLINE) (FEET):					
INPUT POWER (KW):					
CURRENT (AMPS):					
VOLTAGE (VOLTS):					
ESTIMATED FRICTION LOSS TO DISCHARGE GAUGE (FEET):					
MOTOR EFFICIENCY:					
5. CALCULATED DATA	POINT 1	POINT 2	POINT 3	POINT 4	POINT 5
TOTAL DYNAMIC HEAD (TDH):					
PUMP BHP (KW x MOTOR EFFICIENCY / 0.746):					
PUMP EFFICIENCY (TDH x SG x GPM) / BHP x 3960):					
CUSTOMER'S REPRESENTATIVE WITNESSING START-UP:	AMERIFLO REPRESENTATIVE WITNESSING START-UP:				
NAME: _____ DATE: _____	NAME: _____ DATE: _____				



NOTES:

- ① PIPING ARRANGEMENT PER NFPA 20:

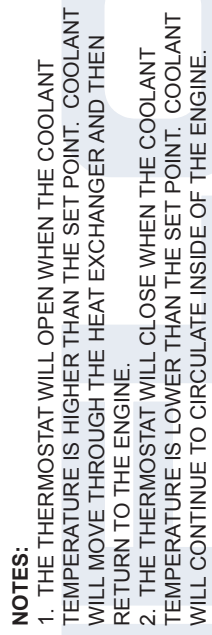
1. THE WASTE OUTLET LINE SHALL BE AS SHORT AS PRACTICAL, SHALL PROVIDE DISCHARGE INTO A VISABLE OPEN WASTE CONE AND SHALL HAVE NO VALVES IN IT.
2. IT SHALL BE PERMITTED TO DISCHARGE TO A SUCTION RESERVOIR PROVIDED A VISUAL FLOW INDICATOR AND TEMPERATURE INDICATOR ARE INSTALLED.
3. WHEN THE WASTE OUTLET PIPING IS LONGER THAN 15 FEET [4.6 METERS] OR ITS OUTLET DISCHARGE IS MORE THAN 4 FEET [1.2 METERS] HIGHER THAN THE HEAT EXCHANGER OR BOTH, THE PIPING MUST BE INCREASED TO THE NEXT LARGER SIZE.

- ## ② PIPING BY OTHERS.

- ③ DISCHARGE PIPING FROM HEAT EXCHANGER OUTLET IS MINIMUM ONE PIPE SIZE LARGER THAN THE INLET PIPING TO THE HEAT EXCHANGER.

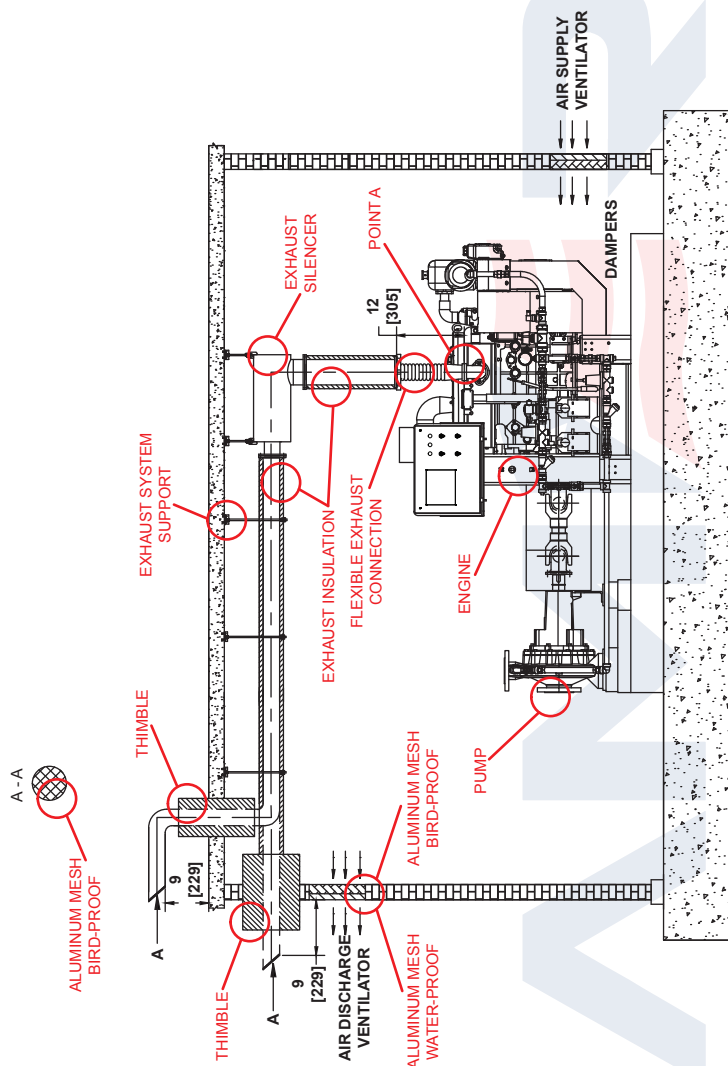
→ COOLING LOOP WATER DIRECTION OF FLOW

[illegible]



INSTALLATION GUIDELINES:

1. REFER TO NFPA 20 SECTION 11.5 FOR ADDITIONAL INFORMATION.
2. OTHER PIPING SYSTEMS ARE POSSIBLE. SCHEMATIC SHOWN IS FOR EGRESS THROUGH WALL WITH BOTTOM IN AND SIDE OUT SILENCER.
3. THE EXHAUST SYSTEM AND SILENCER USED MUST BE SUITABLE FOR THIS USE AND THE INSTALLER MUST ENSURE THAT THE BACK PRESSURE DOES NOT EXCEED THE ENGINE MANUFACTURERS RECOMMENDATION.
4. THE EXHAUST PIPING SHALL NOT BE SMALLER IN DIAMETER THAN THE ENGINE EXHAUST PIPING.
5. THE EXHAUST PIPING SHALL BE COVERED WITH HIGH TEMPERATURE INSULATION OR OTHERWISE GUARDED TO PROTECT PERSONNEL FROM INJURY (NFPA 11.5.2.4).
6. THE EXHAUST PIPING SYSTEM MUST BE SUPPORTED SUCH THAT THERE IS NO WEIGHT ON THE FLEXIBLE EXHAUST CONNECTION.
7. THE EXHAUST PIPING SHALL BE POSITIONED IN SUCH A WAY AS TO PREVENT EXHAUST GASES FROM RE-ENTERING THE PUMP ROOM.
8. THE EXHAUST PIPING AND THE POINT OF EGRESS FROM THE PUMP ROOM SHALL BE CONSTRUCTED OR INSULATED SO THAT IT DOES NOT CAUSE A FIRE IGNITION RISK TO THE STRUCTURE.
9. THE EXHAUST SYSTEM SHALL TERMINATE OUTSIDE OF THE STRUCTURE AT A POINT WHERE HOT GASES, SPARKS OR COMBUSTION PRODUCTS WILL DISCHARGE TO A SAFE LOCATION.
10. EXHAUST SYSTEM TERMINATIONS SHALL NOT BE DIRECTED TOWARDS COMBUSTIBLE MATERIAL, STRUCTURES OR INTO ATMOSPHERES CONTAINING FLAMMABLE GASES, FLAMMABLE VAPORS OR COMBUSTIBLE DUST.
11. EXHAUST PIPING SHALL BE INSTALLED WITH A CLEARANCE OF AT LEAST 9 INCHES [229 MILLIMETERS] TO COMBUSTIBLE MATERIALS (NFPA 11.5.2.7).
12. EXHAUST PIPING PASSING DIRECTLY THROUGH COMBUSTIBLE ROOFS SHALL BE GUARDED AT THE POINT OF PASSAGE BY METAL THIMBLES THAT EXTEND NOT LESS THAN 9 INCHES [229 MILLIMETERS] BELOW THE ROOF CONSTRUCTION AND ARE AT LEAST 6 INCHES [152 MILLIMETERS] LARGER IN DIAMETER THAN THE EXHAUST PIPING (NFPA 11.5.2.7).
13. EXHAUST PIPING PASSING DIRECTLY THROUGH COMBUSTIBLE WALLS OR PARTITIONS SHALL BE GUARDED AT THE POINT OF PASSAGE BY ONE OF THE FOLLOWING METHODS:
 - (1) METAL VENTILATED THIMBLES NOT LESS THAN 12 INCHES [305 MILLIMETERS] LARGER IN DIAMETER THAN THE EXHAUST PIPING.



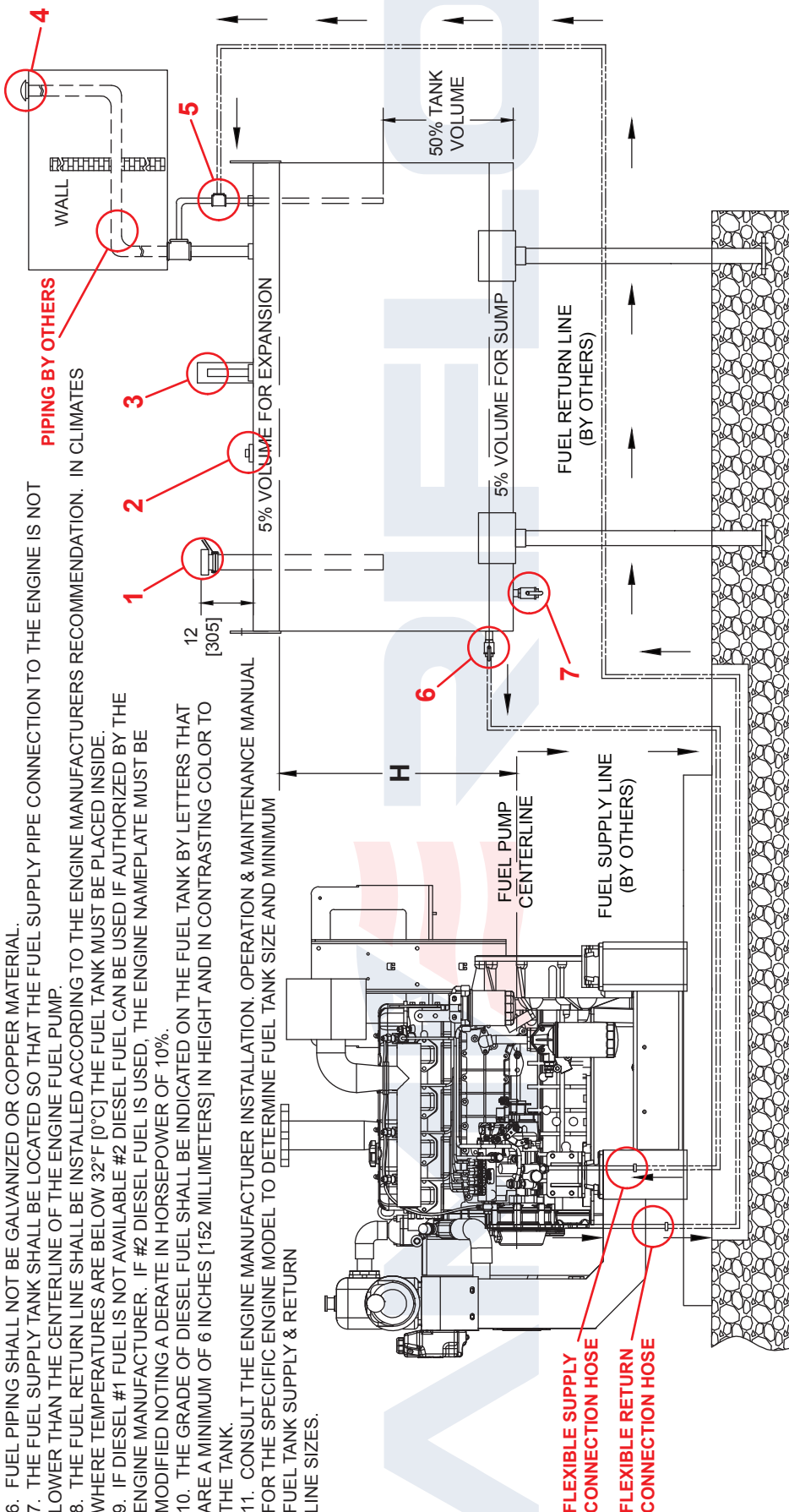
WARNING:

THE BACK PRESSURE TO THE ENGINE EXHAUST CONSIDERABLY INFLUENCES THE POWER OF THE ENGINE AND IT'S THERMAL LOADING. EXCESSIVE BACK PRESSURE MEASURED AT THE ENGINE EXHAUST OUTLET CONNECTION (POINT A) WILL DECREASE POWER, INCREASE THE TEMPERATURE OF THE EXHAUST GAS, PRODUCE SMOKE, INCREASE FUEL CONSUMPTION, SULPHURISES THE INTERNAL COOLING WATER (WITH SUBSEQUENT DAMAGE TO THE LUBRICANTS) AND PRODUCES SERIOUS CONSEQUENCES FOR OTHER ENGINE ELEMENTS (I.E. TURBOCHARGER, ETC.).

[illegible]

1. REFER TO THE LATEST EDITION OF NFPA 20 FOR ADDITIONAL REQUIREMENTS.

2. THE FUEL SUPPLY TANK SHALL HAVE A CAPACITY OF AT LEAST 1 GALLON [5.07 LITERS] PER HP [KW] PLUS 5% FOR EXPANSION AND 5% FOR THE SUMP.
3. DOWN PIPE RECOMMENDED FOR FUEL RETURN LINE TO PREVENT FOAMING OF THE FUEL WITHIN THE TANK IS TO TERMINATE IT AT ONE HALF THE TANK HEIGHT.
4. DOWN PIPE RECOMMENDED FOR FUEL FILLING LINE TO PREVENT FOAMING OF THE FUEL WITHIN THE TANK IS TO TERMINATE IT AT 3 - 6 INCHES [76.2 - 152.4 MILLIMETERS] FROM THE TANK BOTTOM.
5. THE ENGINE MANUFACTURER'S FUEL PUMP STATIC HEAD PRESSURE LIMITS SHALL NOT BE EXCEEDED WHEN THE LEVEL OF THE FUEL TANK IS AT ITS MAXIMUM LEVEL.
6. FUEL PIPING SHALL NOT BE GALVANIZED OR COPPER MATERIAL.
7. THE FUEL SUPPLY TANK SHALL BE LOCATED SO THAT THE FUEL SUPPLY PIPE CONNECTION TO THE ENGINE IS NOT LOWER THAN THE CENTERLINE OF THE ENGINE FUEL PUMP.
8. THE FUEL RETURN LINE SHALL BE INSTALLED ACCORDING TO THE ENGINE MANUFACTURERS RECOMMENDATION. IN CLIMATES WHERE TEMPERATURES ARE BELOW 32°F [0°C] THE FUEL TANK MUST BE PLACED INSIDE.
9. IF DIESEL #1 FUEL IS NOT AVAILABLE #2 DIESEL FUEL CAN BE USED IF AUTHORIZED BY THE ENGINE MANUFACTURER. IF #2 DIESEL FUEL IS USED, THE ENGINE NAMEPLATE MUST BE MODIFIED NOTING A DERATE IN HORSEPOWER OF 10%.
10. THE GRADE OF DIESEL FUEL SHALL BE INDICATED ON THE FUEL TANK BY LETTERS THAT ARE A MINIMUM OF 6 INCHES [152 MILLIMETERS] IN HEIGHT AND IN CONTRASTING COLOR TO THE TANK.
11. CONSULT THE ENGINE MANUFACTURER INSTALLATION, OPERATION & MAINTENANCE MANUAL FOR THE SPECIFIC ENGINE MODEL TO DETERMINE FUEL TANK SIZE AND MINIMUM FUEL TANK SUPPLY & RETURN LINE SIZES.
-
- The diagram illustrates the installation of a fuel tank and its connection to an engine. Key components and their locations are labeled with numbers 1 through 5, with a red arrow pointing to the text 'PIPING BY OTHERS'.
- 1:** Points to the fuel supply pipe connection to the engine.
 - 2:** Points to the fuel return line connection to the engine.
 - 3:** Points to the fuel supply pipe connection to the engine.
 - 4:** Points to the fuel supply pipe connection to the engine.
 - 5:** Points to the fuel return line connection to the engine.
- Other labels in the diagram include:
- WALL:** Indicated by a dashed line.
 - 12 [305]:** A vertical dimension line indicating a height of 12 inches or 305 millimeters.
 - 5% VOLUME FOR EXPANSION:** A label for a section of the fuel tank.
 - FUEL TANK SUPPLY & RETURN LINE SIZES:** A label for the fuel tank.



ITEM	DESCRIPTION
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- 1 LOCKABLE FUEL CAP COMBINED WITH A REMOVABLE
- 2 STRAINER (MAX. 0.06 MESH)
- 3 LOW FUEL LEVEL SWITCH
- 4 FUEL GAUGE
- 5 SCREENED TANK VENT
- 6 FUEL RETURN
- 7 MANUAL VALVE WITH PROVISION FOR PADLOCK

NOTES:

1. MAXIMUM ALLOWABLE FUEL HEIGHT ABOVE FUEL PUMP IS 9.8 FEET [3 METERS].
2. CHECK VALVE OPENING PRESSURE IS 5 PSI [34.3 KPA].

[illegible]