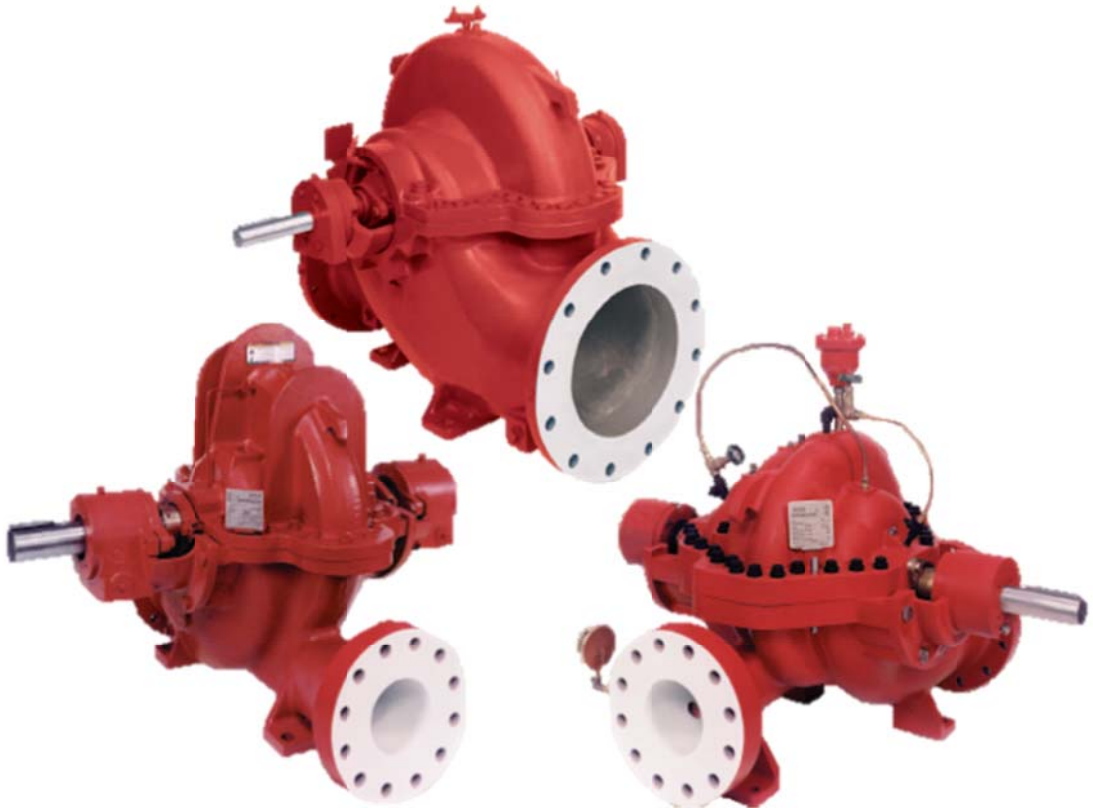
Installation, Operation, and
Maintenance manual



Centrifugal Split Case Fire Pumps
Series 8100, 8150, 8200, 9100

CE

AC FIRE PUMP
a xylem brand

EC Declaration of Conformity

Pump supplied complete with driver

We, the manufacturer:

A-C Fire Pump Systems
8200 N. Austin Ave.
Morton Grove, IL 60053,
USA,

declare under our sole responsibility that the product Horizontal Split Case Centrifugal Fire Pump, Series 8100, 8150, 8200, and 9100; to which this declaration relates, fulfills the relevant provisions of the following European Directive(s), Standard(s) or other normative document(s):

Directives:

- Machinery Directive (2006/42/EC).
- Low Voltage Directive (2006/95/EC).

Standards used:

- EN 809:1998+A1:2009.
- EN ISO 12100:2010.
- EN 60204-1:2006+A1:2009.

Pump supplied without driver

We, the manufacturer:

A-C Fire Pump Systems
8200 N. Austin Ave.
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declare under our sole responsibility that the product Horizontal Split Case Centrifugal Fire Pump, Series 8100, 8150, 8200, and 9100; to which this declaration relates, fulfills the relevant provisions of the following European Directive, Standard(s) or other normative document(s):

Directives:

- Machinery Directive (2006/42/EC).

Standards used:

- EN 809:1998+A1:2009.
- EN ISO 12100:2010.

The pump covered by this declaration must not be put into service until the equipment into which it is to be incorporated has been declared in conformity with the provisions of the Directive.

The technical file can be supplied, in response to a reasoned request by the competent national authorities, through our authorized representative established in the European Community:

Mauro Caldarde,
CoE Engineering Manager,
Lowara S.r.l. Unipersonale,
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Brian Buscher
Product Line Manager

Morton Grove, Illinois
August 8, 2014

Table of contents

1 Introduction

1.1 General

The A-C Fire Pump product line of horizontal split case centrifugal fire pumps are the product of careful engineering and skilled workmanship and, if properly installed, maintained, and operated, should deliver efficient and trouble-free service.

This manual introduces the user to the pump unit and its intended uses. It is extremely important that the instructions for operating the pump safely are read, understood and followed prior to handling the pump.

These instructions do not consider local regulations. The user alone is responsible for ensuring that such regulations are observed, including by those who are installing the pump unit.

CAUTION
Read this manual carefully before installing, operating, using and maintaining the pump. Improper use of the pump can cause personal injury and damage to property, and may void the warranty.

NOTICE
Save this manual for future reference, and keep it readily available at the location of the unit.

1.2 Target Group

This manual is intended for use by personnel with qualified training and experience in the operation and maintenance of pumps used for fire suppression.

1.3 Safety symbols used in this manual

WARNING
If these safety instructions are not followed, it could result in serious personal injury or death, or property damage.

CAUTION
If these safety instructions are not followed, it could result in equipment malfunction of damage.

WARNING
Electric Shock Hazard, failure to follow safety instructions could result in personal injury or death.

WARNING
The surface of the pump may be so hot that it may cause burns or personal injury.

NOTICE
Instructions that are not safety related but pertain to the operation of the pump.

WARNING
The sound pressure is so high that hearing protection must be used.

NOTICE
Read the installation, operation and maintenance instructions.

1.4 Manufacturer

A-C Fire Pump Systems
8200 N. Austin Avenue
Morton Grove, Illinois 60053
USA
Tel.: +1-847-966-3700
Web: www.acfirepump.com

1.5 Additional technical documents

- Order-related documents.
- Operating and maintenance instructions, motor, (if applicable).
- Operating and maintenance instructions, engine, (if applicable).
- Supplier documentation, (coupling, etc.).
- Documentation on accessories, (if applicable).
- General dimensional drawing of the pump unit.
- Performance curve of the pump.

2 Safety

2.1 General

This manual contains general installation, operating and maintenance instructions that must be observed to ensure safe pump operation and to prevent personal injury and damage to property.

2.2 Intended Use

The standard horizontal split case pump is designed for use in the fire suppression applications, with each pump being designed according to customer requirements.

The pump must only be operated with the operating limits described in this manual and other applicable documents listed in section 1.5, Additional technical documents.

2.3 Improper Use

The operational safety of the pump unit can only be guaranteed, if the pump is used in accordance with the specifications in the sections of this manual. The operational limits as stated on the pump unit's nameplate must never be exceeded.

2.4 Warning and Instruction Labels

The safety instructions labels placed directly on the pump must be observed and legible at all times. If the labels are missing or illegible, contact your local A-C Fire Pump representative for a replacement.

WARNING
Rotating Components. Disconnect and lockout power before servicing. Do not operate without all guards in place. Consult installation and service instruction sheet before operating or servicing. Failure to follow instructions could result in injury or death.

WARNING
Eyebolts or lifting lugs if provided are for lifting only the components to which they are attached. Failure to follow instructions could result in property injury or death.

WARNING
Do not operate at or near zero flow (closed shutoff valve). Explosion could result. Failure to follow these instructions could result in property damage, severe personal injury or death.

CAUTION
Do not run pump dry. Seal damage may occur. Inspect pump seal regularly for leaks. Replace as required. For lubrication requirements, consult service instructions. Failure to follow instructions could result in injury or property damage.

CAUTION
Coupler alignment is required! Level and grout pump before use! Check alignment before grouting, after system is filled, after servicing pump, and as required. Consult the service instructions for details. Failure to follow these instructions could result in injury, or property damage.

2.5 Personnel qualifications and training

All personnel involved in the operation, installation, inspection and maintenance of the pump unit must be qualified to perform the work involved. If the personnel do not already possess the necessary knowledge and skill, appropriate training and instruction must be provided.

2.6 Safety Awareness

The safety directions contained in this manual, health and safety regulations as well as any internal work, operating and safety rules issued by the user must be observed.

2.7 Safety instructions for the user

- Guards which are installed to prevent accidental contact with moving parts must not be removed while the pump is in operation.
- Electrical hazards must be prevented. Refer to the relevant safety regulations of the region in which the pump is installed.

2.8 Safety instructions for maintenance, inspection and installation

The user must ensure that all maintenance, inspection and installation work shall be performed by authorized and qualified personnel who are familiar with this manual.

Allow the pump to cool down to ambient temperature, the pump must be depressurized and the liquid must be drained.

Work in the pump unit must always be performed only when it is completely stopped and de-energized. The shutdown procedure described in this manual must be observed without fail.

Immediately after completion of the work, all guarding must be re-installed.

Before putting into operation, the procedure; outlined in section 8, Start-up, operation and shutdown; must be followed.

2.9 Noise Emissions

The pump unit produces a sound pressure level exceeding 85 dB(A). When performing the weekly functional test, it is recommended that hearing protection be worn by the personnel operating the equipment.

WARNING
The sound pressure is so high that hearing protection must be used.

2.10 Unauthorized modification and manufacture of spare parts

Changing or modifying the pump or pump unit is only permitted after consulting A-C Fire Pump. The safety of the pump can only be guaranteed if original spare parts and accessories, which are authorized by A-C Fire Pump are used. A-C Fire Pump does not assume responsibility for outcomes that result from using non-original parts.

2.11 Product Warranty

2.11.1 Coverage

A-C Fire Pump undertakes to remedy defects in their products under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to a local sales and service representative within the warranty period, as described in the Terms and Conditions of Sale provided with the Sales Contract.
- The product is used only under the conditions that are described in this manual.
- The monitoring equipment that is incorporated in the product is correctly connected and in use.
- All service and repair work is performed by qualified personnel.

2.11.2 Limitations

The warranty does not cover defects that are caused by these situations:

- Deficient maintenance.
- Improper installation.
- Modifications or changes to the product that are made without consulting an A-C Fire Pump authorized representative.
- Incorrectly executing repair work.
- Normal wear and tear.

A-C Fire Pump assumes no liability for these situations:

- Bodily injuries.
- Material damages.
- Economic losses.

2.11.3 Warranty Claim

A-C Fire Pump products are manufactured to the highest quality standards with expected reliable operation and long life. However, should the need for a warranty claim arise, contact your local sales and service representative.

3 Applications

A-C Fire Pump Horizontal Split Case Centrifugal Fire Pumps are designed to provide water to stand pipe, sprinkler, and hydrant systems for fire suppression in industrial and commercial facilities.

WARNING
Using the pump in an application other than as described is considered improper use. A-C Fire Pump shall assume no liability for product that is used improperly.

4 Operational Limits

WARNING
Do not operate the pump at pressures, flow rate or liquid temperature other than those for which the pump has been rated. Failure to follow these instructions could result in serious personal injury or death, or property damage.

Pumps are not to be operated outside the operating limits as stated on the nameplate.

4.1 Pumped liquids

The pumps are suitable for clean water that does not contain solid particles or fibers.

4.2 Liquid temperature

Maximum permissible liquid temperature for motor driven pump units is 105°F [40°C].

Maximum permissible liquid temperature for engine driven pump units is dependent on the cooling water requirements as identified in the Engine Manufacturer's Installation Manual.

The pump is designed to handle temperatures up to 250°F [120°C].

4.3 Pressure limits

The maximum working pressure for the horizontal split-case series of pumps are as follows:

Type	Casing Material	Maximum Working Pressure psi [bar]
8100	Cast Iron	225 [15]
	Ductile Iron	375 [25]
8150	Ductile Iron	325 [22]
8200	Cast Iron	450 [30]
	Ductile Iron	650 [45]
9100	Cast Iron	250 [17]
	Ductile Iron	375 [25]

Table 1 Maximum Working Pressure

4.4 Ambient temperature

Maximum ambient temperature for motor drive pump units is 105°F [40°C], based on the maximum ambient rating of the motor.

Maximum ambient temperature for engine driven pump units is identified in the engine manufacturer's installation manual.

4.5 Pump Speed

The pump speed is listed on the nameplate on the pump unit.

5 Delivery, handling, and storage

5.1 Delivery

The pump is delivered from the factory in a container specially designed for transport by fork-lift truck or a similar vehicle. Upon receipt, check the pump visually to determine whether any damage has happened during transport or handling.

Pumps and drivers are normally shipped from the factory mounted on a baseplate. Parts and accessories can be packaged in a separate container and shipped with the pump or attached to the baseplate.

If any damage has occurred, promptly notify the carrier's agent.

5.2 Handling

WARNING
Lifting devices must be sufficiently strong and must only be used by authorized personnel. Eyebolts or lifting lugs, if provided, are only for lifting the components to which they are attached. Do not stand underneath suspended loads. A failure in the lifting device or rigging can result in serious personal injury or death, or property damage.

NOTICE
Dispose of all packing materials in accordance with local regulations.

5.2.1 Bare Shaft Pump (Model 100)

The bare shaft pump should be lifted as shown in Fig. 1. Place a nylon sling around both bearing supports using pulled tight choker hitches.

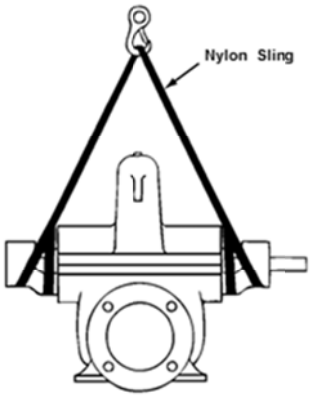

Fig. 1 How to lift a Model 100

5.2.2 Complete Pump unit (Model 150M)

5.2.2.1 Bases supplied with lifting holes

Large bases are supplied with lifting holes in the sides or the ends of the base, as shown in Fig. 2. Place lifting hooks in the holes provided in the four corners of the base. Be sure the points of the hooks do not touch the bottom of the pump base. Attach nylon slings, chains, or wire rope to the lifting hooks. Size the equipment for the load, so that the lift angle will be less than 45° from the vertical.

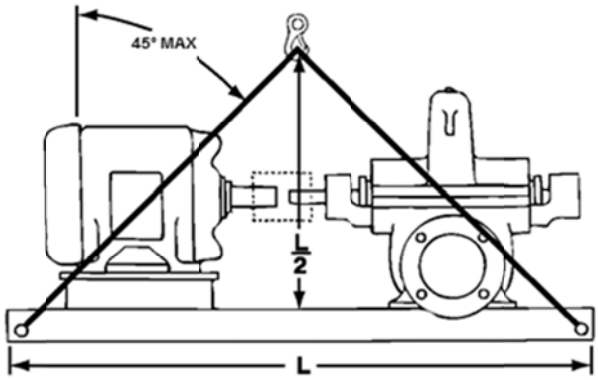

Fig. 2 How to lift a Model 150M pump unit large base

5.2.2.2 Bases supplied without lifting holes

WARNING
Do not use the lugs on the pump upper casing to lift the pump unit.

Pump units supplied with bases without lifting holes, as shown in Fig. 3. Place one sling around the outboard bearing housing. Place the remaining sling around the back end of the motor as close to the mounting feet as possible. Make sure the sling does not damage the housing cover or conduit box. Join the free ends of the slings together and place over the lifting hook. Use extreme care when positioning the sling under the motor so it cannot slip off.

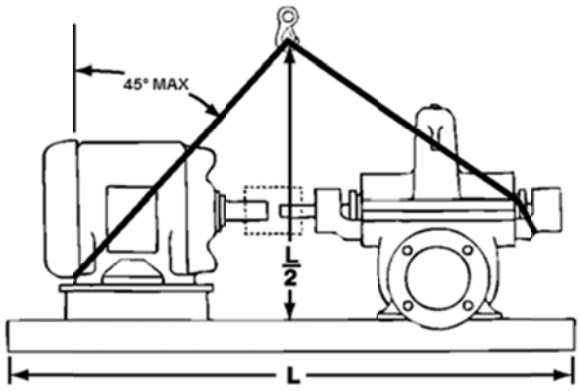

Fig. 3 How to lift a Model 150M pump unit large base

5.2.3 Engine driven pump units (Model 150E)

Before lifting engine driven pump unit, refer to the engine manufacturer's instructions.

5.3 Storage

CAUTION
Damage due to dirt and humidity resulting in corrosion and contamination of the pump unit.

NOTICE
For special protection of electric motors, diesel engines, and couplers, refer to the manufacturer's instruction for their long term storage procedures.

5.3.1 Temporary Storage

If the pump is not to be installed and operated soon after arrival, store it in a clean, dry place having slow moderate changes in ambient temperature. Leave piping connection covers in place to keep dirt and other foreign material out of the pump casing.

Shaft extensions and other exposed machine surfaces should be coated with an easily removable rust preventative such as Valvoline Tectyl 502-C.

Rotate the pump shaft 10-15 times twice a month to coat the bearings with lubricant and to retard oxidation, corrosion, and to prevent false brinelling of the bearings.

5.3.2 Long Term Storage

Storage longer than six months is considered long term storage. Follow the same procedure for temporary storage with the following additions.

Remove the gland and the packing from the stuffing box.

Apply a corrosion inhibiting oil soluble product such as Cortec Corporation VpCI-329, to the interior of the pump casing and the stuffing box. [Prepare the corrosion inhibiting solution per the manufacturer's instructions].

Seal the end of the stuffing box with waterproof tape

Add 1/2oz [14g] of Cortec VpCI-329 to the bearing frames, seal all vents and apply waterproof tape around the grease seals.

Rotate the pump shaft 10-15 turns times at least every three months to prevent the shaft from seizing up.

6 Description

6.1 General

The horizontal split case centrifugal fire pump is a single stage [series 8100, 8150, and 9100] and two stage [series 8200] non self-priming pump.

6.2 Designation

The fire pump can be identified by size designation stated on the nameplate; for example, H10 X 8 X 17F-S represents:

Code	Description
H	No prefix=Cast iron A48; H=Ductile iron A536
10	Suction inlet size ANSI
8	Discharge outlet size ANSI
17	Nominal impeller diameter
F-S	S-small, M-medium, L-large capacity impeller

Table 2 Key for size designation

6.3 Nameplate

6.3.1 Pump nameplate

The nameplate shows all important data of the pump. It is attached to the upper casing. Records for the pump are referenced by the serial number and it must, therefore, be used to order all spare and replacement parts. [The last digit of the serial number indicates the specific pump on orders of more than one pump].

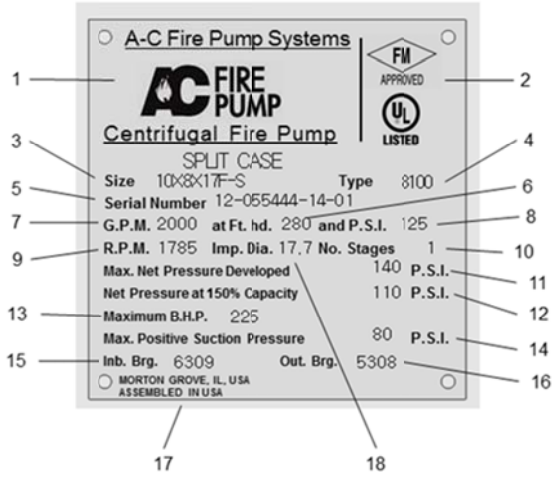

Fig. 4 Nameplate of a Fire pump

Item	Description
1	Manufacturer
2	Approval Agencies
3	Size
4	Model Type
5	Serial number
6	Head [feet]
7	Rated flow rate [GPM]
8	Rated pressure [psi]
9	Speed [RPM]
10	Number of stages
11	Net pressure developed [psi]
12	Net pressure at 150% of flow [psi]
13	Maximum power [BHP]
14	Maximum suction pressure [psi]
15	Inboard bearing number
16	Outboard bearing number
17	Country of origin
18	Impeller diameter [in]

Table 3 Nameplate of a Fire-pump

6.3.2 Pump unit nameplate

The nameplate shows all important data of the pump unit. It is attached to the upper casing.

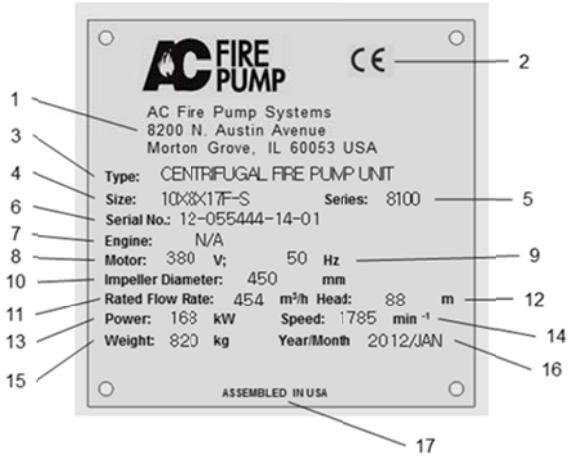

Fig. 5 Nameplate of a Fire pump unit

Item	Description
1	Manufacturer
2	CE Mark
3	Type
4	Pump Size
5	Model series
6	Serial number
7	Engine type [engine driven pump units]
8	Motor voltage
9	Frequency
10	Impeller diameter [mm]
11	Rated flow rate [m^3/hr]
12	Head [m]
13	Power [kW]
14	Speed [RPM]
15	Pump unit weight [kg]
16	Date of manufacture
17	Country of origin

Table 4 Nameplate of a Fire pump unit

6.4 Design detail

6.4.1 Casing

The pump casing is made from Cast Iron or Ductile Iron, and is an axially-split double suction volute design with the suction and discharge flanges and mounting feet cast integrally with the lower casing half.

Tapped and plugged holes are provided for priming, vent, drain, and gauge connections. The upper casing half can be removed without disturbing the suction or discharge piping. Pump flanges are made with ANSI Class 125 or 250 drillings, and come in the following combinations, [Suction/Discharge]: 125/125; 125/250; and 250/250.

The suction and discharge are on a common centerline in the vertical direction for all pump model types; and on a common horizontal centerline for model types 8100, 8150, and 9100.

6.4.2 Impeller

The impeller is an enclosed double suction type made of bronze, which is statically and hydraulically balanced. The impeller is firmly secured to the shaft by a key positioned by shaft sleeves and both locked in place by shaft sleeve lock nuts.

6.4.3 Shaft

The shaft is made of AISI 1045 or 4140 steel and of ample size to operate under load with a minimum deflection.

6.4.4 Shaft sleeves

The shaft sleeves are made of bronze and protect the shaft from wear and from contact with the pumped liquid. Shaft sleeves are locked in place by threaded bronze shaft sleeve nuts. An O-ring is furnished under the sleeve to prevent leakage.

6.4.5 Stuffing Box

The stuffing box consists of die formed, graphite coated, synthetic fiber packing rings; and a split type gland to permit removal and access to the packing. The 8100 stuffing box housing is made of cast iron, and is separate from the pump casing. The stuffing box housing is drilled and tapped for drain connections.

6.4.6 Casing Rings

The casing rings are made of bronze and are installed with an anti-rotation device and designed to restrict leakage across the ring fit.

6.4.7 Bearings

The bearings are grease lubricated rolling type selected to carry radial and thrust loads. The outboard bearing is retained to handle the axial thrust.

6.4.8 Bearing Housings

The bearing housings are bolted to the pump and are piloted to positive alignment of the rotating element. The housings provide a fit for the inboard bearing that allows freedom for thermal expansion while the outboard bearing(s) are clamped in place in order to take all the thrust loads and keep the rotating element in its proper axial location. Openings for adding grease and draining grease are provided.

6.4.9 Baseplate

The baseplate is welded construction, manufactured from steel and is sufficiently rigid to support the pump and the driver.

6.4.10 Coupling

The coupling is of the flexible type. The coupling hubs are secured to the driver and the driven shafts by a setscrew located over the key.

6.4.11 Coupling Guard

The coupling guard is made of metal, and meets the requirements of EN ISO 13857.

6.4.12 Rotation

Pumps have a clockwise or counterclockwise rotation when viewed from its driven end.

6.5 Noise characteristics

The maximum measured A-weighted sound pressure level [L_{pA}] for the pump and motor, measured at a distance of 3.3 ft. [1m] from the pump, under full load, in accordance with EN ISO 3746 is 90dB.

The maximum measured A-weighted sound pressure level [L_{pA}] for the pump and diesel engine, measured at a distance of 3.3 ft. [1m] from the pump, under full load, in accordance with EN ISO 3746 is 106dB.

6.6 Scope of supply

The pump unit includes the following items:

- Pump
- Driver, (motor or engine)
- Baseplate
- Coupling
- Coupling guard

6.7 Dimensions and weights

Refer to the general dimensional drawing supplied with the pump unit

7 Installation

This section describes the installation of a complete pump unit.

CAUTION
Installations should be performed by persons qualified in the setting up of pumping equipment.

WARNING
All electrical work should be carried out by qualified personnel.

7.1 Location

WARNING
Engine-driven pump units:
The engine must be provided with adequate ventilation to satisfy the requirements of the combustion system, and allow adequate dissipation of radiated heat and exhaust emissions.

Install the pump in a well-ventilated, dry place above the floor level wherever possible. Take care to prevent the pump from freezing during cold weather when not in operation.

The pump should be installed with sufficient space around it to facilitate ventilation and accessibility for inspection, maintenance and service. A clear space with ample head room should be allowed for the use of an overhead crane or hoist to lift the unit.

Install the pump as near to the suction supply as possible, with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold.

When installing the pump, consider its location in relation to the system to assure that sufficient Net Positive Suction Head [NPSH] is available at the pump inlet connection. Available NPSH [$NPSH_A$] must always equal or exceed the required NPSH [$NPSH_R$] of the pump.

The pump must be primed before starting. Whenever possible, the pump should be located below the fluid level to assure priming. This condition provides a positive suction head on the pump. It is also possible to prime the pump by pressurizing the suction vessel.

7.2 Foundation

We recommend that the pump unit should be installed on a concrete foundation, sufficiently substantial to absorb vibration and to form a permanent, rigid support for the baseplate.

A base of concrete weighing 3 to 5 times the weight of the pump unit is recommended.

The foundation should be 3 to 6 inches [75 to 150mm] longer and wider than that of the baseplate that will be installed.

Foundation bolts must match those of the base plate. The foundation should be poured without interruption to within 1/2 to 1-1/2 inches [12.7 to 38.1mm] of the finished height. The top surface of the foundation should be well scored and

grooved before the concrete sets; this provides a bonding surface for the grout.

Foundation bolts should be set in concrete as shown in Fig. 6. An optional 4 inch [102mm] long sleeve around the bolts at the top of the concrete will allow some flexibility in bolt alignment to match the holes in the base plate. Allow enough bolt length for grout, shims, lower base plate flange, nuts and washers. The foundation should be allowed to cure for several days before the base plate is shimmed and grouted.

In installations where lower sound and vibration levels are particularly important, we recommend a foundation with a mass of at least 5 times that of the complete pump unit.

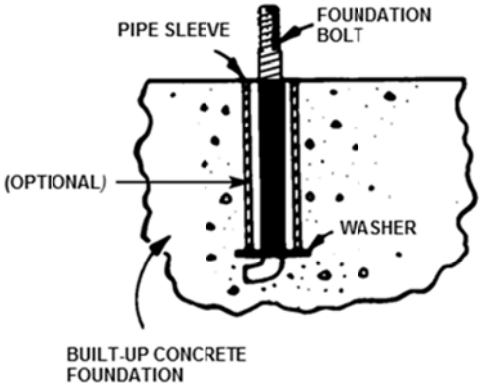

Fig. 6 Foundation

7.3 Leveling the baseplate

WARNING
Lifting devices must be sufficiently strong and must only be used by authorized persons. Eyebolts or lifting lugs, if provided, are only for lifting the components to which they are attached. Do not stand underneath suspended loads. A failure in the lifting device or rigging can result in serious personal injury or death, or property damage.

NOTICE
This procedure assumes that a concrete foundation has been prepared with anchor or hold down bolts extending up ready to receive the pump unit. It must be understood that the pump and driver have been mounted and rough aligned at the factory. If the driver is to be field mounted, consult AC Fire Pump for recommendations. AC Fire Pump cannot assume responsibility for final alignment.

Use blocks and shims under the baseplate for support at the anchor bolts and midway between bolts, so as to position the baseplate approximately 1 inch [25.4mm] above the concrete foundation, with studs extending through holes in the base plate, as shown in Fig. 7.

By adding or removing shims under the base, level and plumb the pump shaft and flanges. The baseplate does not have to be level.

Draw anchor nuts tight against base, and observe pump and motor shafts or coupling hubs for alignment. (Temporarily remove coupling guard, see section 8.2 Coupling Guard, for checking alignment.)

If alignment needs improvement, add shims or wedges at appropriate positions under the baseplate, so that retightening of the anchor nuts will shift the shafts into closer alignment. Repeat this procedure until a “reasonable alignment” is reached.

NOTE: Reasonable alignment is defined as that which is mutually agreed upon by pump contractor and the accepting facility (final operator).

Check to make sure that the piping can be aligned to the pump flanges without placing pipe strain on either flange.

Pour grout in the base plate completely (see section 7.4 Grouting) and allow grout to dry thoroughly before attaching piping to pump. (24 hours is sufficient time with approved grouting procedure.)

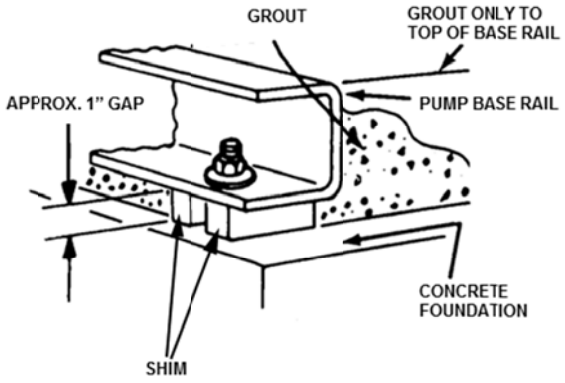

Fig. 7 Leveling of pump unit

7.4 Grouting

Grout compensates for uneven foundation, distributes the weight of the pump unit, and prevents shifting. Use an approved, non-shrinking grout, after setting and leveling the unit, (see Fig. 7).

Build a strong form around the foundation to contain the grout. Soak the top of the concrete foundation thoroughly, and then remove any surface water. The base plate should be completely filled with grout.

After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary. Check the alignment after the foundation bolts are tightened.

Approximately 14 days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

7.5 Initial Alignment

WARNING
Disconnect and lock out power before performing alignment. Failure to follow these instructions could result in serious personal injury.

NOTICE
The alignment procedures that follow are for motor driven pump units. Alignment procedures for Engine-driven pump units are available in the Engine manufacturer's Installation Manual.

WARNING
Replace coupler guard after performing alignment. Failure to follow these instructions could result in serious personal injury.

CAUTION
Misalignment causes excessive wear, vibration, and bearing loads that result in premature bearing failure and ultimate seizing of the pump.

NOTICE
Alignment should be made before connecting the pipes; if not, it may not be possible to move the pump, and it will be difficult to move the driver.

NOTICE
Read Coupling Manufacturer instructions supplied with the pump unit before attempting to perform alignment.

When a complete pump unit comes pre-assembled from the factory, the coupling has been accurately aligned by means of shims inserted under the pump and driver.

The pump/driver could have become misaligned during transport and installation. Misalignment can be angular, parallel, or a combination of these, and in the horizontal and vertical planes.

Proper alignment is essential for correct pump operation. This should be performed after base plate has been properly set and grout has dried thoroughly according to instructions.

Alignment should be made by moving and shimming the driver only until the coupling hubs are within the recommended tolerances, and should be made at operating temperatures under normal conditions.

All measurements should be taken with the pump and driver foot bolts tightened.

There are two types of misalignment encountered with flexible couplings: angular misalignment, in which the shafts are not parallel, and parallel misalignment, where the shafts are parallel but not on the same axis.

There are three methods commonly used to determine misalignment:

1. Straight edge and calipers.
2. Dial indicator
3. Laser Alignment Equipment (see manufacturer's instructions for use).

7.5.1 Straightedge method of alignment

The most simple alignment check is with a straight edge and calipers. This method is the least accurate, but will serve if a dial indicator or laser is not available.

7.5.1.1 Angular Alignment

With coupling hubs stationary, use calipers to measure the gap between the coupling hubs at 90° intervals. Adjust and/or shim equipment until the gap difference at all points around the hubs are within the coupler manufacturers guidelines, (see Fig. 8).

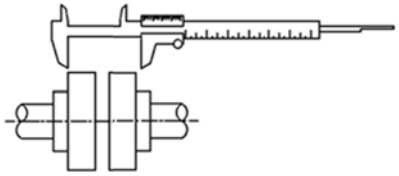

Fig. 8 Angular Alignment

7.5.1.2 Parallel Alignment

With coupling hubs stationary, lay straight edge flat against the rim of the coupling hub at 90° intervals to determine vertical and horizontal alignment offsets. Adjust and/or shim equipment until the straight edge lies flat against both hub rims, vertical and horizontal. Check the coupler manufacturer's guideline for permissible gap, (see Fig. 9).

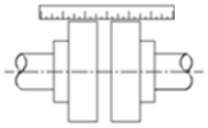

Fig. 9 Parallel Alignment

7.5.2 Dial indicator method of alignment

The dial indicator should be used when greater alignment accuracy is required. Check the coupler manufacturer's guideline for acceptable alignment tolerances.

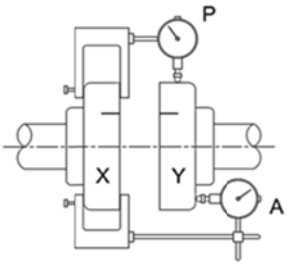

Fig. 10 Dial Indicator

7.5.2.1 Angular Alignment

To check angular alignment, mount dial indicator (A) to the coupling half (X), and position the dial indicators button on the face of the opposite coupling half (Y). Scribe index lines on both coupling hubs as shown in Fig. 10. Set the dial to zero, rotate both coupling halves together, so that the index lines match; ensuring that the indicator button always indicates off the same spot. Check the coupler manufacturer's guideline for acceptable alignment tolerances.

7.5.2.2 Parallel Alignment

To check parallel alignment, mount dial indicator (P) to the coupling half (X), and position the dial indicators button on the outside diameter of the opposite coupling half (Y), (see Fig. 10). Set the dial to zero, rotate both coupling halves together, so that the index lines match; ensuring that the indicator button always indicates off the same spot. Check the coupler manufacturer's guideline for acceptable alignment tolerances.

7.5.3 Alignment of grid couplings

The following procedure is intended for mounting and alignment of Rexnord Industries, LLC and Clarke Fire Protection Products, Inc., Type T10 Close Coupled Grid Couplings.

Alignment is shown using a spacer bar and straight edge, which has been prove to be accurate for many industrial applications. However, for superior final alignment, the use of dial indicators is recommended, per 7.5.2.

7.5.3.1 Mount Seal and Hubs

Clean all metal parts using non-flammable solvent. Coat the seals lightly with coupling manufacturer supplied grease and place on shafts before mounting shaft hubs. Install keys and mount hubs with flange faces flush with the shaft ends. Reposition hubs on shafts as required achieving the hub gap specified in table 5. The length of engagement on each shaft should be approximately equal to the shaft diameter. Tighten the setscrews.

7.5.3.2 Gap and Angular Alignment (X-Y)

Use a spacer bar equal to thickness to the gap specified in Table 5. Insert bar, as shown above to the same depth at 90° intervals and measure clearance between the bar and hub face with feeler gage. The difference in minimum and maximum measurements must not exceed the angular installation limits specified in Table 5.

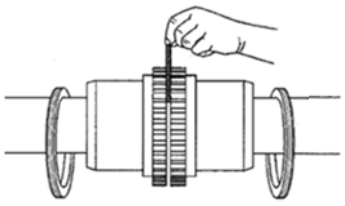

Fig. 11 Using Spacer Bar

7.5.3.3 Parallel Offset Alignment (P)

Align so that a straight edge rests squarely, (or within the limits specified in Table 5 on both hubs as shown above and also at 90° intervals, (see Fig. 12). Check with feeler gages. The clearance must not exceed the Parallel Offset installation limits specified in Table 5.

If adjustment is needed, loosen the motor bolts and add or remove an equal amount of shims under each motor foot to align the height. To correct side misalignment, strike the side of the motor foot with a mallet.

Tighten the motor bolts and check again. Re-check alignment in all directions, if a correction is made. Repeat the process until the desired result is obtained.

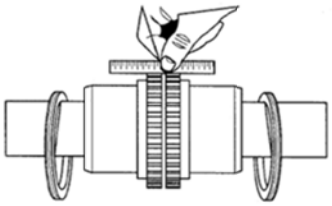

Fig. 12 Using Straight edge

7.5.3.4 Insert Grid

Completely pack gap and grooves with coupling manufacturer supplied grease before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction as shown in Fig. 13. This will ensure correct grid contact with non-rotating pin in cover halves.

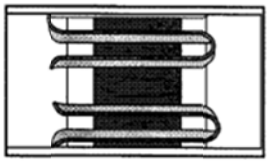

Fig. 13 Grids magnified

Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet, (see Fig. 14).

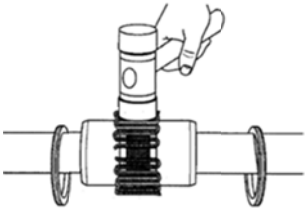

Fig. 14 Seating the grid

7.5.3.5 Pack with grease and assemble covers

Completely pack the spaces between and around the grid with as much grease as possible and wipe off excess flush with top of the grid. Position seals on hubs to line up with the grooves in the cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side, (see Fig. 15). Secure cover halves with fasteners tightening to torque specified in Table 5.

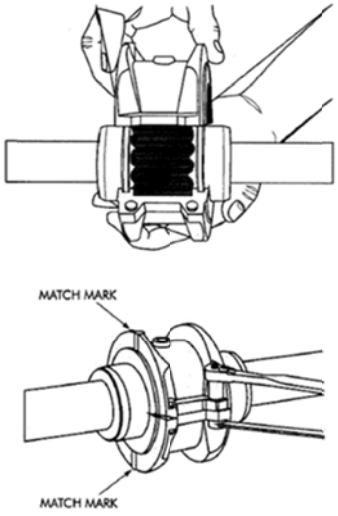

Fig. 15 Cover installation

WARNING
Do not operate coupling without proper lubrication.

CAUTION
Ensure that the lube plugs are installed in the cover.

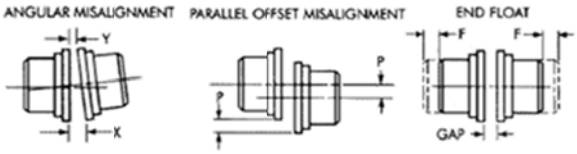

Fig. 16 Misalignment and End Float

Installation Limits								
Size	Parallel Offset (P)		Angular (x-y)		Hub Gap ± 10%		End Float (Min) 2 x F	
	MAX INCH	MAX mm	MAX INCH	MAX mm	MAX INCH	MAX mm	MAX INCH	MAX mm
1040T	0.01	0.15	0	0.08	0.13	3	0.21	5.36
1050T	0.01	0.20	0	0.10	0.13	3	0.21	5.38
1060T	0.01	0.20	0.01	0.13	0.13	3	0.26	6.55
1070T	0.01	0.20	0.01	0.13	0.13	3	0.26	6.58
1080T	0.01	0.20	0.01	0.15	0.13	3	0.29	7.32

Table 5 Misalignment and End float

SIZE	Cover Fastener Tightening Torque		Maximum Allowable Speed (rpm)	Lube Wt.	
	in.lb	Nm		oz	g
1040T	100	11.3	3600	1.90	54
1050T	200	22.6	3600	2.40	68
1060T	200	22.6	3600	3.00	86
1070T	200	22.6	1800	4.00	114
1080T	200	22.6	1800	6.10	172

Table 5 Continued

7.6 Pipe connections

CAUTION
Do not draw piping into place by using force at the flanged connections of the pump. Pipe strain adversely affects the operation of the pump, which could result in serious injury or damage.

7.6.1 Suction and discharge piping general precautions

When installing the pump piping, be sure to observe the following precautions:

1. Piping should always be run to the pump.
2. Do not move pump to pipe. This could make final alignment impossible.
3. Use pipe hangers or other supports at necessary intervals to provide support.
4. When expansion joints are used in the piping system they must be installed beyond the piping supports closest to the pump.
5. 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.
6. Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long radius 90° fittings to decrease friction losses.
7. Make sure that all piping joints are air-tight.
8. Where flanged joints are used, assure that inside diameters match properly.
9. Remove burrs and sharp edges when making up joints.

Maximum forces and moments allowed on the pump flanges vary with the pump size and series. To minimize these forces and moments that may, if excessive, cause misalignment, hot bearings, worn couplings, vibration and premature pump failure, the following should be observed:

1. Prevent excessive external pipe loading.
2. Never “spring” piping when making any connections.
3. Anchor independently both the suction and discharge piping near the pump and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened.
4. 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 recommended that tie bolts and spacer sleeves should be used with expansion joints to prevent pipe strain.

The tables in 7.6.2 summarize the maximum forces and moments allowed on 8100, 8150, 8200, and 9100 series Horizontal Split Case fire pump casing.

7.6.2 Maximum forces and moments allowed on pump flange

7.6.2.1 8100 series Horizontal Split Case maximum forces and moments allowed

Size	Maximum forces (F) in lbf (N) and moments (M) in lbf.ft (Nm)											
	Suction						Discharge					
	F_x	F_y	F_z	M_x	M_y	M_z	F_x	F_y	F_z	M_x	M_y	M_z
3X2X11	37	46	40	20	25	51	28	30	38	24	25	30
	(165)	(205)	(178)	(27)	(34)	(69)	(125)	(133)	(169)	(33)	(34)	(41)
6X4X9	143	178	102	103	129	258	32	40	47	20	25	51
	(636)	(792)	(454)	(140)	(175)	(350)	(142)	(178)	(209)	(27)	(34)	(69)
6X4X10	143	178	102	103	129	258	32	40	47	20	25	51
	(636)	(792)	(454)	(140)	(175)	(350)	(142)	(178)	(209)	(27)	(34)	(69)
6X4X11	143	178	102	103	129	258	32	40	47	20	25	51
	(636)	(792)	(454)	(140)	(175)	(350)	(142)	(178)	(209)	(27)	(34)	(69)
6X4X12	124	155	88	89	112	224	33	42	44	21	26	54
	(552)	(689)	(391)	(121)	(152)	(304)	(147)	(187)	(196)	(28)	(35)	(73)
6X6X9	143	178	102	103	129	258	117	147	89	91	114	229
	(636)	(792)	(454)	(140)	(175)	(350)	(520)	(654)	(396)	(123)	(155)	(311)
8X6X9	143	178	102	103	129	258	117	147	89	91	114	229
	(636)	(792)	(454)	(140)	(175)	(350)	(520)	(654)	(396)	(123)	(155)	(311)
8X6X10	201	251	116	156	195	390	117	147	89	91	114	229
	(894)	(1116)	(516)	(212)	(264)	(529)	(520)	(654)	(396)	(123)	(155)	(311)
8X6X12	201	251	116	156	195	390	117	147	89	91	114	229
	(894)	(1116)	(516)	(212)	(264)	(529)	(520)	(654)	(396)	(123)	(155)	(311)
8X6X13	181	227	116	156	195	390	80	100	71	57	72	144
	(805)	(1010)	(516)	(212)	(264)	(529)	(356)	(445)	(316)	(77)	(98)	(195)
8X6X18	227	284	150	202	253	506	68	85	78	53	66	132
	(1010)	(1263)	(667)	(274)	(343)	(686)	(302)	(378)	(347)	(72)	(89)	(179)
8X8X12	170	213	116	156	195	390	117	147	89	91	114	229
	(756)	(947)	(516)	(212)	(264)	(529)	(520)	(654)	(396)	(123)	(155)	(311)
8X8X17	195	244	133	179	223	447	90	112	92	75	93	187
	(867)	(1085)	(592)	(243)	(302)	(606)	(400)	(498)	(409)	(102)	(126)	(254)
10X8X17	463	579	274	463	579	1158	150	187	129	133	166	333
	(2059)	(2575)	(1219)	(628)	(785)	(1570)	(667)	(832)	(574)	(180)	(225)	(452)
10X8X20	514	643	304	514	643	1287	167	208	143	148	184	370
	(2286)	(2860)	(1352)	(697)	(872)	(1745)	(743)	(925)	(636)	(201)	(250)	(502)
12X10X18	490	613	270	544	680	1361	169	211	153	168	211	422
	(2180)	(2727)	(1201)	(738)	(922)	(1846)	(752)	(939)	(681)	(228)	(286)	(572)

7.6.2.2 8200 series Horizontal Split Case maximum forces and moments allowed

Size	Maximum forces (F) in lbf (N) and moments (M) in lbf.ft (Nm)											
	Suction						Discharge					
	F_x	F_y	F_z	M_x	M_y	M_z	F_x	F_y	F_z	M_x	M_y	M_z
8X6X14	454	568	300	404	506	1012	136	170	156	106	132	264
	(2019)	(2526)	(1334)	(548)	(686)	(1372)	(605)	(756)	(694)	(144)	(179)	(358)
8X6X18	454	568	300	404	506	1012	136	170	156	106	132	264
	(2019)	(2526)	(1334)	(548)	(686)	(1372)	(605)	756	(694)	(144)	(179)	(358)

7.6.2.3 9100 series Horizontal Split Case maximum forces and moments allowed

Size	Maximum forces (F) in lbf (N) and moments (M) in lbf.ft (Nm)											
	Suction						Discharge					
	F_x	F_y	F_z	M_x	M_y	M_z	F_x	F_y	F_z	M_x	M_y	M_z
12X8X21	193	242	167	226	282	565	79	98	108	92	115	230
	(858)	(1076)	(743)	(306)	(382)	(766)	(351)	(436)	(480)	(125)	(156)	(312)
12X8X22	193	242	167	226	282	565	79	98	108	92	115	230
	(858)	(1076)	(743)	(306)	(382)	(766)	(351)	(436)	(480)	(125)	(156)	(312)
14X10X20	571	714	284	666	833	1666	196	245	160	207	259	518
	(2540)	(3176)	(1263)	(903)	(1130)	(2259)	(872)	(1090)	(712)	(281)	(351)	(702)
16X12X23	623	779	323	865	1081	2163	215	268	192	298	373	746
	(2771)	(3465)	(1437)	(1173)	(1466)	(2933)	(956)	(1192)	(854)	(404)	(506)	(1012)

7.6.2.4 8150 series Horizontal Split Case maximum forces and moments allowed

Size	Maximum forces (F) in lbf (N) and moments (M) in lbf.ft (Nm)											
	Suction						Discharge					
	F_x	F_y	F_z	M_x	M_y	M_z	F_x	F_y	F_z	M_x	M_y	M_z
16X10X22	623 (2771)	779 (3465)	323 (1437)	865 (1173)	1081 (1466)	2163 (2933)	196 (872)	245 (1090)	160 (712)	207 (281)	259 (351)	518 (702)

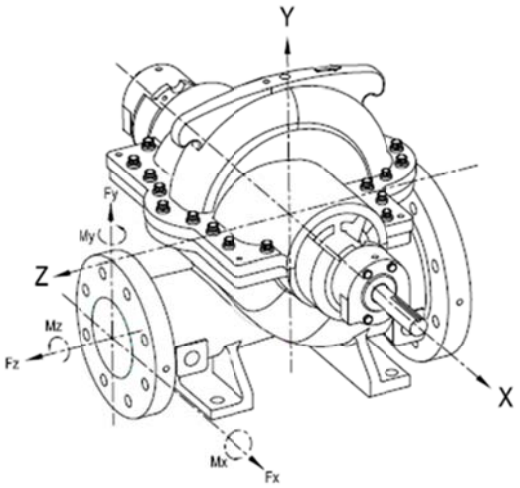

Fig. 17 Load and moment orientation for Horizontal Split Case fire pump casings

Notes:

1) F = External force (tension or compression (+/-))
2) M = External moment (clockwise or counter-clockwise)
3) $\sum F = \sqrt{F_x^2 + F_y^2 + F_z^2}$, ($\sum F$ = resultant force).
4) $\sum M = \sqrt{M_x^2 + M_y^2 + M_z^2}$, ($\sum M$ = resultant moment).
5) The nozzle loads applied to the pump flanges must not exceed the values given in the tables.
6) Values given are for loads applied concurrently in + or – direction. Individual forces and moments can be increased provided that $\sum F$ and $\sum M$ are not exceeded.

7.6.3 Suction piping

The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimized and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be directly attributed to improper suction piping systems.

Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening.

A minimum of ten (10) pipe diameters between any elbow or tee and the pump should be allowed. If a long suction pipe is required, it should be one or two sizes larger than the suction opening, depending on its length.

CAUTION
An elbow should not be used directly before the suction of a double suction pump if its plane is parallel to the pump shaft. This can cause an excessive axial load or NPSH problems in the pump due to an uneven flow distribution. If there is no other choice, the elbow should have straightening vanes to help evenly distribute the flow.

Eccentric reducers should be limited to one pipe size reduction each to avoid excessive turbulence and noise. They should be of the conical type. Contour reducers are not recommended. When operating on a suction lift, the suction pipe should slope upward to the pump nozzle.

A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe can become filled with air and prevent proper operation of the pump. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

NOTE: When operating on suction lift never use a concentric reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe. Some correct and incorrect suction piping arrangements are shown in Fig. 18.

When installing valves in the suction piping, observe the following precautions: If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started.

This valve should be of the flapper type, rather than the multiple spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line, see section 7.6.4 Discharge Piping).

When foot valves are used, or where there are other possibilities of “water hammer,” close the discharge valve slowly before shutting down the pump.

Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line.

Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets.

Globe valves should not be used, particularly where NPSH is

critical.

The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump for maintenance purposes, and should always be installed in positions to avoid air pockets.

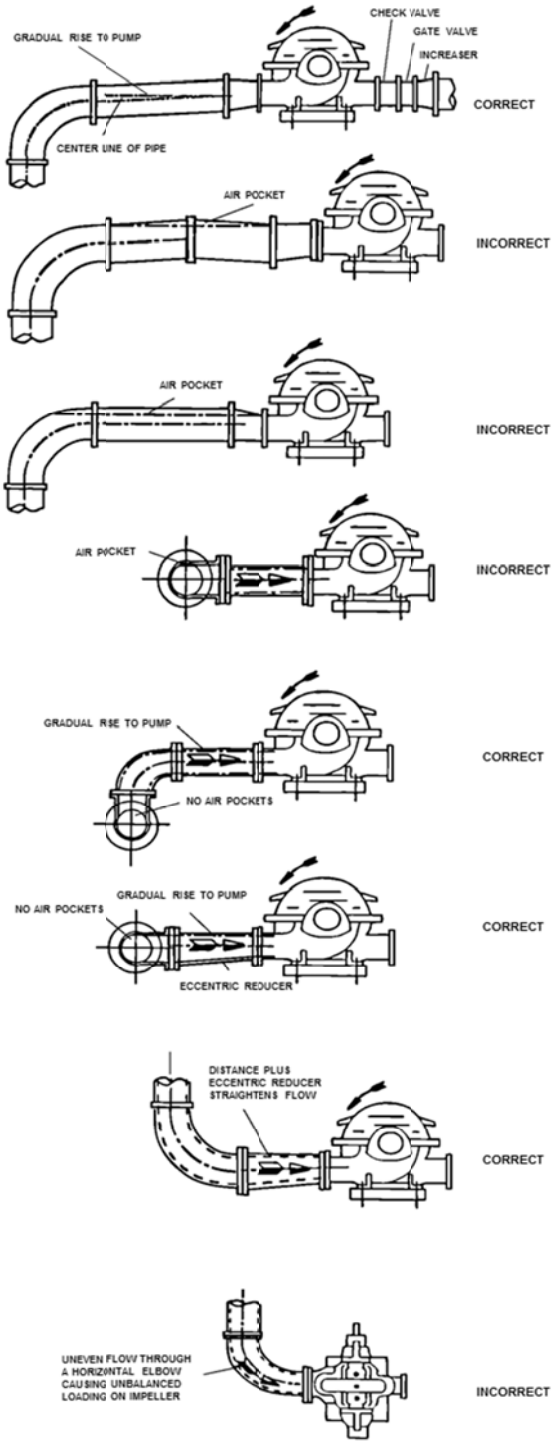

Fig. 18 Suction piping arrangements

7.6.4 Discharge piping

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, the pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain an even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

A slow closing check valve and an isolating gate valve should be installed in the discharge line. The check valve (triple duty valve), placed between pump and gate valve, protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure. The gate valve is used in priming and starting, and when shutting the pump down.

7.6.5 Bypass Piping

Where the suction supply is of sufficient pressure to be of material value without the pump, the pump shall be installed with a bypass.

The bypass pipe diameter shall be at least as large as the discharge pipe diameter.

7.6.6 Cooling System

NOTICE
This section is only applicable to engine-driven pump units that have water cooled heat exchangers.

The cooling water supply for a heat exchanger-type engine shall be from the discharge of the pump taken off prior to the pump discharge check valve.

The cooling water flow shall be set based on the maximum ambient cooling parameters provided by the Engine Manufacturer.

7.6.7 Exhaust system

NOTICE
This section is only applicable to engine-driven pump units.

WARNING
Exhaust emissions must be discharged to a safe point outside the pump room where they shall not affect persons or endanger buildings. Operation of an engine without an adequate exhaust system can result in serious personal injury.

WARNING
Exhaust pipes are hot and will cause serious injury if touched.

Each pump engine shall have an independent exhaust system. The exhaust pipe shall not be any smaller in diameter than the engine exhaust outlet and shall be as short as possible.

The exhaust pipe shall be covered with high-temperature insulation or otherwise guarded to protect from personal injury.

The exhaust pipe and muffler, if used, shall be suitable for the use intended, and the exhaust back-pressure shall not exceed the engine manufacturer's recommendations.

Exhaust pipes shall be installed with clearances of at least 9 inch [229mm] to combustible materials.

7.6.8 Pressure Gages

Properly sized pressure gages should be installed in both the suction and discharge nozzles in the gauge taps provided. The 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.

7.6.9 Stuffing box lubrication

7.6.9.1 General guidelines

Contaminants in the pumped liquid must not enter the stuffing box. These contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing deterioration; even plugging the stuffing box flushing and lubrication system.

The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing.

This is normally achieved with a supply from the pump discharge volute to the stuffing box. A control valve may be fitted into the supply line to control the pressure to the stuffing box.

7.6.9.2 Packing

Pumps are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication.

If the pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, inspect the packing before the pump is started.

It is important to establish the optimum flushing pressure that will keep contaminants from the stuffing box cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing wear may result; and extreme heat may develop in the shaft causing higher bearing temperatures.

The most desirable condition, therefore, is to apply seal water at a flow rate of approximately 0.25 gpm [0.95 lpm] at a pressure approximately 15-20 psig [1 bar] above the maximum stuffing box pressure. [Approximately one [1] drop per second.]

NOTE: Packing adjustment is covered in section 9, Maintenance.

7.7 Final alignment

WARNING
Do not operate pump with coupling out of alignment. Ensure final coupling alignment is within the values according to the coupling manufacturer's instructions. Coupling, pump, or driver failure may occur. Failure to follow these instructions could result in serious personal injury.

After connecting piping to the pump, rotate the shaft several times by hand to ensure that there is no binding and all parts are free. Recheck the coupling alignment, as previously described, to ensure that there is no pipe strain. Correct, if necessary, by adjusting the motor only.

7.8 Electrical Connection

WARNING
Risk of electric shock. All electrical connections shall be performed by a qualified electrician in accordance with all applicable codes, ordinances and good practices. Failure to follow these instructions could result in serious injury, death and/or property damage.

WARNING
Risk of injury due to rotating parts. Isolate the motor from its supply voltage and keep it locked out when performing any work on the pump.

NOTICE
Follow the instructions of the motor manufacturer.

NOTICE
Engine-driven pump units: The requirement for the electrical connection of the engine unit is covered in the engine manufacturer's Installation Manual.

The operating voltage and frequency are marked on the motor nameplate.

The motor must be suitable for the power supply at the installation site.

The electrical connections should be carried out as shown on the motor nameplate and/or the terminal box.

8 Start-up, operation and shutdown

8.1 Start-up

WARNING
Start-up should be carried out by authorized personnel. Do not start the pump until all pre-start-up checks have been performed

CAUTION
Do not start the pump until it has been completely filled with liquid and vented. The pump must not run dry as this will result in serious damage to the pump.

WARNING
Electric Shock Hazard: Electrical connections are to be made by qualified personnel, in accordance with applicable codes, ordinances, and good practices.

NOTICE
See also installation and operating instructions for the electric motor, if applicable.

NOTICE
See also installation and operating instructions for the diesel engine, if applicable. We recommend that you register the diesel engine with the manufacturer before start-up. Otherwise, the engine manufacturer cannot provide any warranty if the engine is faulty.

8.1.1 Preparation for startup

WARNING
Unexpected Start-up Hazard: Disconnect and lockout power before performing pre-start-up checks. Failure to follow these instructions could result in serious personal injury or death.

Before the initial start of the pump, perform the following inspections:

1. Remove all corrosion protection materials, referenced in section 5.3 Storage, in accordance with the manufacturer's recommendations.
2. Check alignment between pump and driver, (motor or engine). See section 7.5 Initial Alignment.
3. Check that all pipes and hoses are installed correctly.
4. Check all electrical connections. Check voltage, phase, and frequency.
5. Check suction and discharge piping and pressure gauges for proper operation.
6. Check that all safety devices are installed.
7. Turn rotating element by hand to assure that it rotates freely.
8. Check stuffing box adjustment, lubrication, and piping.
9. Check driver lubrication.
10. Assure that pump bearings are properly lubricated.
11. Assure that coupling is properly lubricated, if required.
12. Assure that pump is full of liquid and all valves are properly set and operational, with the discharge valve closed and the suction valve open. Purge all air from top of casing.
13. Check rotation. Be sure that the driver operates in the direction indicated by the arrow on the pump casing as serious damage can result if pump is operated with incorrect rotation.

8.1.2 Priming

NOTICE
Flushing: New and old systems should be flushed to eliminate all foreign matter. Heavy scale, welding splatter and wire or other large foreign matter can clog the pump impeller.

If the pump is installed with a positive head on the suction, it can be primed by opening the suction valve, and loosening the vent plug on top of the casing (Do not remove), allowing air to be purged from the casing.

If the pump is installed with a suction lift, priming must be done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

All drains should be closed when filling the system. Filling should be done slowly so that excessive velocities do not cause rotation of the pumping elements which may cause damage to the pump or its driver. The adequacy of the piping anchors and hangers may be checked at this time by mounting a dial indicator off of any rigid structure not tied to the piping and setting the indicator button on the pump flange in the axial direction of the nozzle.

If the indicator moves, as the filling proceeds, the anchors and supports are not adequate or set properly and should be corrected.

8.2 Coupling Guard

WARNING
Unexpected Start-up Hazard: Disconnect and lockout power before performing pre-start-up checks. Failure to follow these instructions could result in serious personal injury or death.

NOTICE
The coupling guarding described herein refers to guarding that is supplied by A-C Fire Pump for pumps that have a motor driver. For pumps with an engine driver refer to the engine manufacturers instructions, supplied with the pump unit.

NOTE: The coupling guard fasteners have devices that keep them from completely detaching from the guard or the pump. Do not remove these devices or separate the fasteners from the guard or the pump.

NOTE: Do not spread the inner and outer guards more than necessary for guard removal or installation. Over-spreading the guards may alter their fit and appearance.

8.2.1 Removing the coupling guard

1. Identify the parts of the coupling guard, see Fig. 19.
2. Unfasten the (4) cap screws, [item 6], that secure the outer guard, [item 8], to the inner guard, [item 5].
3. Spread the outer guard, [item 8], and pull it off the inner guard, [item 5].
4. Remove the (4) cap screws, [item 6], that holds the inner guard, [item 5], to the support brackets, [item 2].
5. Spread the inner guard, [item 5], and pull it over the coupling.

8.2.2 Installing the coupling guard

1. Identify the parts of the coupling guard, see Fig. 19.
2. Attach the support brackets, [item 3], to the inboard bearing housing of the pump, [item 1], using (4) cap screws, [item 4] and (4) flat washers, [item 3]; (if a new installation). See step 1.
3. Spread the inner guard, [item 5]; and place it over the coupling.
4. Attach the inner guard, [item 5], to the support brackets, [item 2]; using (4) cap screws, [item 6], and (4) screw retainers, [item 7]. See step 2.
5. Spread the outer guard, [item 8]; and place it over the inner guard, [item 5]. See step 3.
6. Position the outer guard, [item 8] so that its slots line up with the hardware on the inner guard, [item 5]. See step 4.
7. Attach the outer guard, [item 8], to the inner guard, [item 5]; using (4) cap screws, [item 6], and (4) screw retainers, [item 7]. Do not tighten so as to allow the outer guard to slide over the inner guard. See step 3.
8. Slide the outer guard, [item 8], towards the motor so that there is less than a 1/4 in. [6.35 mm] of the motor shaft exposed. See step 4.
9. Holding the outer guard in this position, tighten the (4) cap screws.

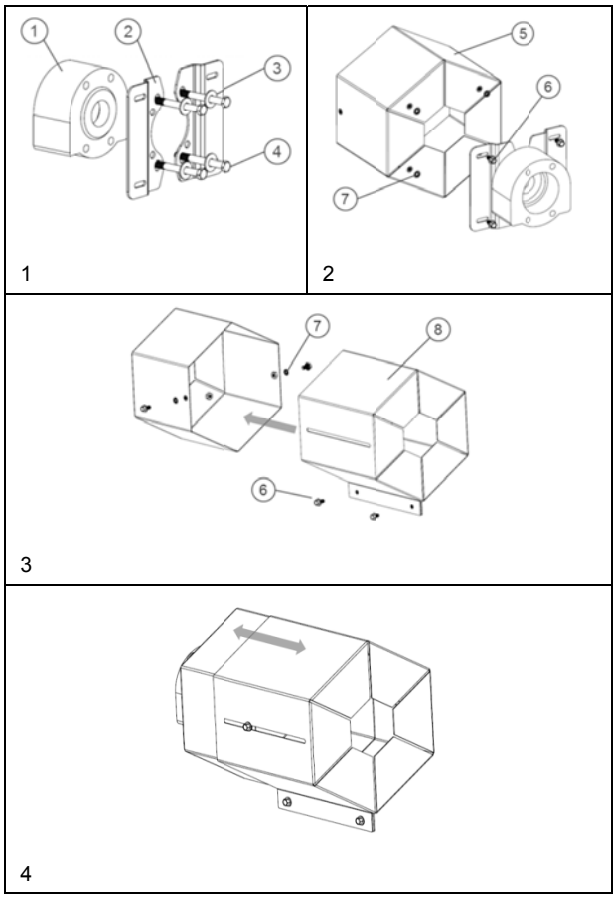

Fig. 19 Coupling Guard

8.3 Operation

WARNING
Pump units have a sound pressure level higher than 85 dB(A). Hearing protection must be worn when the pump is running.

WARNING
Do not operate the pump at or near zero flow, i.e. closed discharge valve. Explosion could result. Failure to follow these instructions could result in serious personal injury and part damage.

WARNING
Do not operate the pump unless all guarding are in place.

8.3.1 General Procedure

1. Close drain valves and valve in discharge line.
2. Open fully all valves in the suction line.
3. Slowly turn on seal water to the stuffing box. (If pumped fluid is dirty or if leakage of air is to be prevented, these lines should be always left open.)
4. Prime the pump. [**NOTE:** If the pump does not prime properly, or loses prime during start-up, it should be shut down and the condition corrected before the procedure is repeated.]
5. Start the pump driver (Engines may require warming up; consult the manufacturer's instructions).
6. When the pump is operating at full speed, open the discharge valve slowly. This should be done promptly after start-up to prevent damage to pump by operating at zero flow.
7. Adjust the liquid seal valves to produce the recommended pressure for the packed stuff box.

8.3.2 Optional Checklist

NOTICE
This section applies to parameters that contribute to assessing the performance of the pump unit.

1. Driver/Pump Rotation: Check the rotation each time that the motor leads have been disconnected. Be sure that the driver operated in the direction indicated by the arrow on the pump casing.
2. Flow: An accurate measurement of the flow rate is difficult to in the field. Venturi meters, flow nozzles, orifice plates, or timing the draw down in a wet well are all possible methods. Record any reading for future reference.
3. Pressure: Check and record both suction and discharge pressure gauge readings for future reference.
4. Power: Record voltage, amperage per phase, kilowatts if an indicating wattmeter is available, and the pump speed.
5. Temperature: Check and record the bearing temperature using a thermometer. Temperature should not exceed 225°F [107°C] for polyurea-greased bearings and180°F [82°C] for lithium-greased bearings.

8.4 Shutdown

WARNING
Escaping pressurized liquids. Liquid draining from the pump could result in personal injury and equipment damage.

NOTICE
This section applies to the complete pump unit. See also installation and operating instructions for the driver, (electric motor or diesel engine), and controller.

The following steps will take care of most normal shutdowns of the pump, i.e. maintenance or to make any further adjustments of process piping, valves, etc., as required.

1. Shut off power supply to the driver.
2. Close suction and discharge valves.
3. Close seal liquid valves. (If pumped liquid is dirty, or if leakage is to be prevented, these lines should always be left open, except when the pump is completely drained.)
4. Open drain valves as required.

8.5 Returning to service

After long-term storage and before commissioning, check seals, bearings, and lubrication.

8.6 Freeze Protection

CAUTION
If heat is used to keep the pump from freezing, do not let the temperature rise above 150°F [66°C].

Pumps that are shut down during freezing conditions should be protected by one of the following methods:

1. Drain the pump; remove all liquid from the casing.
2. Keep fluid moving in the pump and insulate or heat the pump to prevent freezing.

8.7 Field testing

A performance curve for the pump-unit is included in the document package shipped with the pump unit or it can be obtained from A-C Fire Pump. This can be used in conjunction with a field test, if one is required.

All A-C Fire Pump tests and curves are based on the Hydraulic Institute Standards. Any field tests must be conducted according to these standards.

Unless otherwise specifically agreed, all capacity, head, and efficiencies are based on factory tests using clear water at a temperature not greater than 85°F [29°C].

9 Maintenance

WARNING
Rotating parts. Disconnect and lock out power before performing maintenance. Failure to follow these instructions could result in serious personal injury.

WARNING
Electrical Shock Hazard.
Disconnect and lock out power before performing maintenance. Failure to follow these instructions could result in serious personal injury.

NOTICE
It is the operator's responsibility to ensure that all maintenance work is performed by authorized and qualified personnel.

NOTICE
Read the installation and operation instructions for the driver and coupling for maintenance requirements not covered in this instruction.

9.1 General

A regular inspection and maintenance program must be planned and followed in order to keep the pump in good working condition. We suggest a permanent record be kept of the periodic inspections and maintenance performed on your pump. This recognition of maintenance procedure will keep your pump in good working conditions, and prevent costly breakdowns.

9.2 Maintenance Interval

Inspection intervals should be carried out in accordance with the maintenance table, Table 6.

Action	Weekly	Monthly	Every six months	Annually
Test run the pump	X			
Check pump/driver alignment			X	
Check bearing housing temperature		X		
Check bearing grease			X	
Check the stuffing box leak rate		X		
Lubricate bearings				X
Check anchor bolts and tighten			X	
Check coupling guard bolts and tighten		X		
Check for unusual noise and vibration		X		
Check the pump and piping for leaks		X		
Check pump shaft end play				X
Check impeller assembly for wear				X
Test pump against performance curve				X

Table 6 Maintenance Interval

9.3 Lubrication

9.3.1 Lubricating grease requirements

Use a high-quality grease lubricant corresponding to NLGI Grade 2. The recommended grease lubricants are shown in Table 7.

Polyurea-based grease (pumps built after December 2014)	
Manufacturer	**Brand Name**
Exxon Mobil	Polyrex EM
Chevron	SRI NLGI 2
Shell	Gadus S5 T100 2

Lithium-based grease (pumps built before December 2014)	
Manufacturer	**Brand Name**
Exxon Mobil	Mobilux EP 2
Chevron	Multifak EP2
Shell	Gadus S2 V100 2

Table 7 Recommended Grease Lubricants

9.3.2 Grease Lubrication

WARNING
Never check the temperature of the bearing frame by hand, use a temperature measuring device.

CAUTION
Greases of different bases (lithium, polyurea, etc.) may not be compatible when mixed. Mixing greases can result in reduced lubricant life and premature bearing failure.

Grease lubricated ball bearings are packed with grease at the factory and ordinarily will require no attention before starting, provided the pump has been stored in a clean, dry place prior to its first operation.

The bearing temperature, measured at the bearing frame, should never exceed 225°F [107°C] for polyurea-based grease, and 180°F [82°C] for lithium-based grease when checked monthly. Should the temperature of the bearing frame rise above the limit, the pump should be shut down to determine the cause.

9.3.3 Lubrication procedure

CAUTION
Over-greasing is the most common cause of overheating and premature bearing failure.

CAUTION
Use only manual grease gun. High pressure may damage the bearings or seals, cause unnecessary loss of grease, create a danger of overheating due to over-greasing, and produce unsightly conditions around the bearing.

Add grease while the pump is stopped to avoid overloading.

Adequate lubrication is assured if the level of grease is maintained at about the capacity of the bearing and 1/3 to 1/2 of the cavity between the bearing and grease fitting. Any greater amount will, as a rule, be discharged by the seal or vent and be wasted.

To lubricate the bearings with grease, proceed as follows:

1. Remove dirt from the grease fitting.
2. Fill the grease cavities through the fittings with the recommended grease.
3. Wipe off any excess grease.
4. Run the pump to distribute the grease.

The bearing temperature usually increases after you re-grease due to an excess supply of grease. Temperatures return to normal as the pump runs and purges the excess grease from the bearings.

9.4 Packed Stuffing Box

9.4.1 Packing specifications

Pumps are supplied with a graphite-coated general service fiber packing as standard, using John Crane style 1340, or equivalent.

9.4.2 Packing maintenance

In accordance with the maintenance schedule, the packing should be visually inspected once a month and the leakage rate checked. If the leakage rate is excessive then the gland nuts may be tightened, until the required leak rate is obtained, which should be least 40 to 60 drops per minute.

When the gland follower has reached the limit of its movement and the packing cannot be compressed any further, all of the packing should be removed and replaced. Never reuse old and lifeless packing or merely add some new rings.

9.4.3 Removal of Packing

WARNING
Ensure that the pump has cooled sufficiently to allow safe handling of the stuffing box. A packing tool should be used to remove all old packing from the stuffing box. Make sure the stuffing box is thoroughly cleaned before new packing is installed. Also check the condition of the shaft or sleeve for possible scoring or eccentricity. Any parts with significant damage should be replaced.

9.4.4 Installing Packing

New packing may be supplied as molded rings made to specified dimensions or, more usually, as a length of coil. When supplied as a continuous length, it is necessary to cut off lengths of material to make the required number of rings. Usually 5 or 6 rings are required per stuffing box.

If molded rings are used, the rings should be opened sideways and the joints pushed into the stuffing box first.

If coil packing is used, wrap the packing around the shaft and mark the cutting position. The packing should be cut 1/8-1/4 in. [3-6mm] over size. The larger the shaft diameter, the more excess length is required. The packing must not be cut undersized. Cut one ring to accurate size with either a butt or mitered (45°) joint. (An accurately cut butt joint is superior to a poor fitting mitered joint).

Fit the ring over the shaft to assure proper length. Then remove and cut all other rings to the first sample. When the rings are placed around the shaft a tight joint should be formed.

Place the first packing ring around the shaft, and form a neat butt or mitered joint between the two ends. Push the ring into the stuffing box. Push the joint first, then the side opposite to the joint, and then the two remaining sides. It is essential that the two packing ends are pushed tightly together.

Push the ring to the bottom of the stuffing box, applying reasonable pressure to ensure that the ring is seated properly but it is not over compressed.

NOTICE
The packing rings must be fitted individually and under no circumstances should complete sets be fitted as a unit.

The rings are installed one at a time, each ring seated firmly and the joints staggered at about 90° rotation from each preceding joint. For 3 adjacent rings, use the 4, 8 and 12 o'clock positions.

Check the shaft to ensure that it can be rotated after fitting each packing ring.

Fit as many rings as possible into the stuffing box without having any packing protruding, and without over-compressing the packing

NOTE: The last ring in each box may not be required until after the pump has operated for a period of time.

NOTE: When supplied, the seal cage will replace the third packing ring from the bottom of the stuffing box. The seal cage must be aligned with the seal water inlet when the packing is compressed.

Bring the gland follower up squarely against the last packing ring and tighten the nuts evenly to finger pressure.

9.4.5 Packing Adjustment

Install the proper flush set up.

Start the pump and allow the packing to leak freely at start-up. During the break-in period, adjustments should be made gradually (tightening the gland nuts one 1/4 revolution at a time), allowing 5 to 10 minutes between adjustments.

After the break-in period, the leakage rate can be controlled to 40 to 60 drops per minute.

10 Service

The procedures outlined in this section cover the dismantling and reassembly of four different model types of Horizontal Split Case fire pumps:

1. 8100
2. 8150
3. 8200
4. 9100

When working on the pump, use accepted mechanical practices to avoid unnecessary damage to parts. Check clearances and conditions of parts when pump is dismantled and replace if necessary. Steps should usually be taken to restore impeller and casing ring clearance when it exceeds three times the original clearance.

WARNING
Rotating parts. Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury.

WARNING
Electrical Shock Hazard.
Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury.

WARNING
During dismantling/assembly of the pump, ensure that lifting devices are sufficiently strong and that the pump-unit and parts are secured to prevent tipping over. Failure to follow these instructions could result in serious personal injury and part damage.

CAUTION
Before dismantling the pump, ensure that genuine AC-Fire Pump parts are available.

10.1 Tools required

In order to assemble and disassemble the pump, the following tools are required:

- Hex wrenches
- Open end wrenches
- Spanner wrench
- Torque wrench with sockets
- Feeler gauges
- Range of screwdrivers
- Soft mallet
- Bearing pullers
- Bearing induction heater
- Allen wrenches
- Dial indicators
- Lifting sling

10.2 Dismantling

Refer to section 12, Replacement Parts, for exploded drawings and parts lists. Part numbers listed in this procedure refer to the 8100 series pumps; corresponding part numbers for 8150, 8200, and 9100 can be identified by the description in the parts lists.

10.2.1 Rotating Element

1. Isolate driver and lock out power supply in accordance with local regulations.
2. Isolate suction and discharge valves.
3. Remove coupling guards and separate the coupling to disconnect the pump from the driver.
4. Drain the pump by opening the vent plug [0-910-0] and removing the drain plugs [0-910-0] on the suction and discharge nozzles.
5. Remove flushlines [0-952-0], if supplied.
6. *Series 8150, 8200, and 9100*: Remove gland bolts [1-904-9], washers [1-909-9], and slide gland [1-014-9] away from the lower casing [2-001-8].
7. Remove all casing main joint cap screws [2-904-1] and dowels [2-916-1].
8. Using the slot in the casing main joint, separate the casing halves with a pry bar. Lift the upper half casing [2-001-0] by the cast lugs.

   NOTE: Some casings have jacking screws.

9. *Series 8100 only*: Tap the stuffing boxes [3-073-9] with a soft-headed hammer to break the seal between the stuffing box and the lower casing [2-001-0].
10. *Series 8200 and 9100*: Remove packing [1-924-9] and seal cage [1-013-9] from each stuffing box.
11. *Series 8150, 8200, and 9100*: Remove cap screws [3-904-9] which hold the bearing housings [3-025-3] to the lower casing.
12. The rotating element may now be removed. Carefully lift the complete rotating element, protecting the packing surface on the outside diameter of the shaft sleeve [3-009-9] from damage and place on two support blocks.

10.2.2 Bearing Housing

1. Remove four cap screws [3-904-9] from each bearing housing [3-025-3, 3-025-4] and remove the bearing housings from the shaft [3-007-0].
2. Bend back the lock-washer tab and remove locknut [3-516-4] and lock-washer [3-517-4] from the outboard end of the shaft and, using a bearing puller, remove the bearing [3-026-4] from the shaft. Remove the inboard end bearing [3-026-3] in the same manner.

NOTE: Locknut and lock-washer are not used on inboard end bearings.

3. *Series 8200 and 9100*: Remove bearing covers [5-018-0] out of bearing housings. Pull deflectors [3-136-9] off the shaft. Slide stuffing box bushings [6-008-0] off the shaft.

4. *Series 8150* Remove the four capscrews [3-904-9] from each bearing housing and remove the housings from the bearing brackets. Remove the snap ring [3-177-3] (outboard side only), bearings [3-026-2] and backing snap rings [0-915-0]. Remove the bearing brackets from the shaft.

10.2.3 Shaft seal – gland packing

1. Series 8100 Slide both stuffing boxes [3-073-9] off the shaft, working deflector rings [3-136-9] off the shaft at the same time.
2. Remove the lip seals [3-177-9] from the stuffing box.
3. Remove the gland bolts [1-904-9], gland halves [1-014-9], packing [1-924-9] and, if supplied, seal cage [1-013-9] from each stuffing box. Remove the O-rings [3-914-1]

from the stuffing boxes.

10.2.4 Shaft sleeve

1. Loosen set screws [3-902-3] in shaft nuts [3-015-9] and then remove shaft nuts using pin spanner wrench. Remove O-rings [3-914-9] from the counter-bore in shaft sleeve. Remove the shaft sleeves [3-009-2] from the shaft.

10.2.5 Impeller and casing wear rings

1. The impeller and casing rings can now be removed if required.
2. When removing the rotating element, the casing wear rings [3-003-9] will be attached to the impeller [4-002-0] by locking pins [3-943-9] inserted into the casing ring and located in grooves in the lower half casing.
3. If impeller rings [0-004-0] are also fitted, they are shrunk onto the impeller, and can be removed by cutting with a cold chisel.

10.3 Examination of parts

CAUTION
Used parts must be inspected before assembly to ensure that the pump will operate correctly.

10.3.1 Casing and impeller

Inspect for excessive wear, pitting, corrosion, erosion or damage and any sealing surface irregularities. Replace as necessary.

10.3.2 Shaft and sleeve

Replace if grooved, pitted or worn.

10.3.3 Gaskets and O-rings

After dismantling, discard and replace.

10.3.4 Bearings

CAUTION
Do not reuse the ball bearings.

It is recommended that bearings are not reused after removal from the shaft.

10.3.5 Bearing isolators and lip seals

1. The lubricant, bearings and bearing housing seals are to be inspected for contamination and damage. Damaged parts should be replaced.
2. If bearing damage is not due to normal wear and the lubricant contains adverse contaminants, the cause should be corrected before the pump is returned to service.
3. Bearing isolators (if used) should be inspected for damage but are normally non-wearing parts and can be usually reused.

10.4 Assembly

Refer to section 12, Replacement Parts, for exploded drawings and parts lists. Part numbers listed in this procedure refer to the 8100 series pumps; corresponding part numbers for 8200 and 9100 can be identified by the description in the parts lists.

10.4.1 Wear Rings

1. Impeller rings [0-004-0] (when fitted) should be heated up to approximately 300°F - 400°F [150°C - 200°C] and then slipped onto the impeller. Using gloves hold rings against the impeller shoulder until they cool.
2. Slide the casing rings [3-003-9] over the impeller hubs before mounting the rotating element into the lower casing, ensuring that the locking pins in the rings locate into the grooves in the casing.
3. Check the wear ring clearance against the appropriate pump size in Table 8.

Pump Size	Series/Type	Wear Ring Clearance in [mm]
3X2X11F-S	8100	0.015 - 0.017 [0.38 – 0.43]
6X4X9F		
6X4X10F-M		
6X4X11F		
6X4X12F		
6X6X9F		
8X6X9F		
8X6X10F		
8X6X12F		
8X6X12F-M		
8X6X13F		
8X6X18F		
8X8X12F		
8X8X17F		
10X8X17F		
10X8X20F		
12X10X18F		
8x6x14F-S	8200	
8X6X14F-L		
8x6x18F		
12X8X21F	9100	
12X8X22F-M		
14X10X20F		
16X12X23F		
14X10X20F-L		
16X10X22F	8150	.019-.021 [.48-.53]

Table 8 Wear ring clearance

10.4.2 Impeller

10.4.2.1 Series 8100, 8150, and 9100

1. Assemble the impeller key [3-911-1] in the shaft [3-007-0].
2. Check the impeller [4-002-0] and casing to determine the correct impeller rotation, and locate the impeller on the shaft in accordance with Figs. 20 and 21 and Tables 9 and 10.
3. Starting with the outboard end, apply a 6.4mm [1/4 inch] bead of RTV silicone sealant, (Dow Corning or equivalent), at the impeller hub face, making sure to fill up the keyway.
4. Slide the sleeve [3-009-9] onto the shaft, rotating the sleeve to evenly distribute the silicone sealant.

   NOTE: The pin in each shaft sleeve must seat in the impeller key slot. (not used on 8150)

5. Place the sleeve O-ring [3-914-9] onto the shaft, into the sleeve counter-bore. Assemble the shaft sleeve nut [3-015-9]
6. Repeat steps (3)-(5) for the inboard shaft sleeve, O-ring and nut. Wipe off excess RTV silicone sealant.

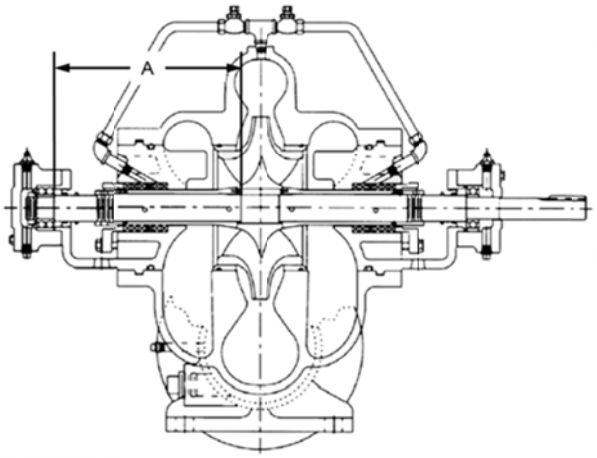

Fig. 20 Series 8100 Impeller location

Pump Size	A	Packing Size
3X2X11F-S	8.755	0.375
6X4X9F	9.312	
6X4X10F-M	10.625	0.500
6X4X11F	10.750	0.375
6X4X12F	9.755	
6X6X9F	9.312	
8X6X9F	9.755	
8X6X10F	10.625	0.500
8X6X12F	9.755	0.375
8X6X12F-M	10.625	0.500
8X6X13F		
8X6X18F		
8X8X12F		
8X8X17F	11.495	
10X8X17F		
10X8X20F	11.620	
12X10X18F	11.495	

Table 9 Series 8100 Impeller Location

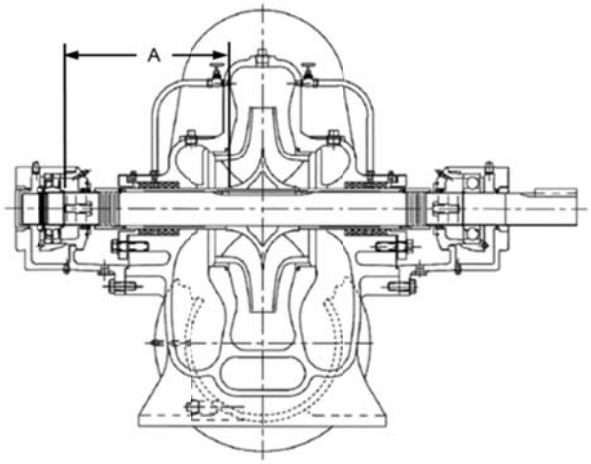

Fig. 21 Series 9100 Impeller location

Pump Size	A	Packing Size
12X8X21F	13.50	0.625
12X8X22F-M		
14X10X20F	15.81	
16X12X23F		
14X10X20F-L	16.60	

Table 10 Series 9100 Impeller Location

10.4.2.2 Series 8200

1. Assemble the impeller key [3-911-1] in the shaft [3-007-0].
2. Identify the first and second stage impellers [4-002-0] by the casted label, and locate the second stage impeller on the shaft in accordance with Fig. 22 and Table 11.
3. Pre-assemble the interstage bushing [3-034-1] and the diaphragm [3-231-0] as follows:
   i. Install O-rings [3-914-7, 3-914-8] in the three grooves of the interstage bushing.
   ii. Lightly press the bushing into the diaphragm, locating the hole in the bushing over the pin in the diaphragm. Install snap ring [3-915-0] to secure the assembly.
4. Slide the interstage bushing assembly over the shaft and place over the rear hub of the impeller.
5. Place the other impeller on the shaft and slide over the interstage bushing until it touches the impeller already installed.
6. Apply a 1/4 in. [6.4mm] bead of RTV silicone sealant, (Dow Corning or equivalent), uniformly about the shaft sleeve [3-009-9] inside diameter, covering an area of about 1/2 in. [12.8mm] at each impeller end of the sleeve. Also apply sealant to the face of the impellers.
7. Slide the shaft sleeves onto the shaft to evenly distribute the sealant. Rotate until the pin in the sleeve engages into the keyway of the impellers and push the sleeves against the impeller face until the sleeve is flush against the face. Wipe off excess RTV silicone sealant.
8. Place the sleeve O-ring [3-914-9] onto the shaft, into the sleeve counterbore. Assemble the shaft sleeve nut [3-015-9].

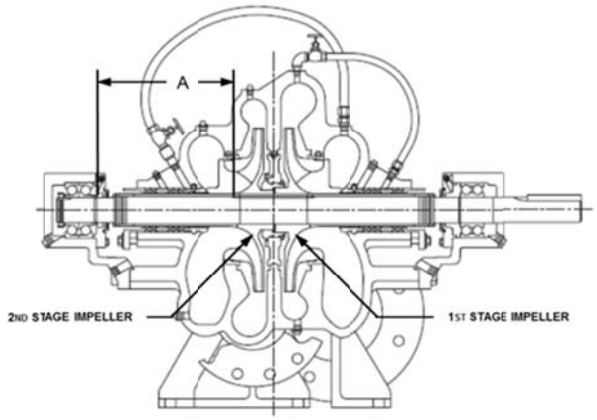

Fig. 22 Series 8200 Impeller location

Pump Size	A	Packing Size
8x6x14F-S	12.06	0.500
8X6X14F-L		
8x6x18F		

Table 11 Series 8200 Impeller Location

10.4.3 Bearings and bearing housings

10.4.3.1 Series 8100

1. Press a new lip seal [3-177-9] into each stuffing box [3-073-9]. Before installing the seal, lubricate it with lightweight oil.

   NOTE: Lip seals should seat against the machined shoulder in the bracket.

   NOTE: The seal lip or pressure side of the seal should point away from the bearings [3-026-3, 3-026-4].

2. Lubricate and roll O-ring [3-914-1] into the groove of each stuffing box.
3. Slide the outboard stuffing box on the shaft so that the shaft end extends through the packing area, but does not enter the lip seal. This will permit the installation of the deflector [3-136-9].
4. Slide the deflector over the shaft end then carefully push the shaft end through the lip seal and slide the stuffing box fully onto the shaft.
5. Heat the ball bearing [3-026-4], using either a dry heat, or a 10-15% soluble oil and water solution.

   NOTE: Do not exceed 275°F [135°C].

6. Using gloves slide the heated bearing onto the shaft against the shaft shoulder.
7. Install the lock washer [3-517-4] and locknut [3-516-4] on the outboard end of the shaft. Ensure that the locknut is secured and then bend over the tabs on the lock washer.

   NOTE: A lock washer and locknut are not installed on the inboard end of the shaft.

8. Allow the bearing to cool to room temperature. Coat the exposed sides with 2 to 3 oz. [55 to 85 g] of the recommended grease.
9. Coat the inside of the bearing housing [3-025-4] with grease and slide into place over the bearing. Attach the bearing housing to the stuffing box with four cap screws [3-909-9].
10. Repeat steps for the inboard end.

10.4.3.2 Series 8200

1. Press a new lip seal [3-177-9] into each bearing cap [5-018-0].

   NOTE: Seal lip or pressure side of seal must point away from the end of the shaft the lip seal is assembled on.

2. Place two O-rings [6-914-9] on each stuffing box bushing [6-008-0], and then slide over the shaft sleeve with the beveled end facing the impeller.
3. Slide the deflectors [3-136-9] and bearing caps onto the shaft. Install snap ring [5-915-3] on the inboard side of the shaft. Install the split ring [5-050-4] and retaining collar [5-421-4] on the outboard side of the shaft.
4. Heat the ball bearings [3-026-3-026-4], using either a dry heat, or a 10-15% soluble oil and water solution.

   NOTE: Do not exceed 275°F [135°C].

5. Using gloves slide the heated ball bearing [3-026-3] onto the inboard end of the shaft against the snap ring.
6. Using gloves slide the two heated ball bearing [3-026-4] onto the outboard end of the shaft. These bearings must be installed back to back. Place the first bearing on the shaft; when installing the second bearing, push against the inner race to remove all clearance between the inner races of the two bearings, and between the inner race of the first bearing and the retaining collar.
7. Install the lock washer [3-517-4] and locknut [3-516-4] on the outboard end of the shaft. Ensure that the locknut is secured and then bend over the tabs on the lock washer.
8. Allow the bearings to cool to room temperature. Coat the exposed sides with 2 to 3 oz. [55 to 85 g] of the recommended grease.
9. Slide the bearing housings [3-025-3, 3-025-4] into place over the bearing. Attach the bearing caps to the bearing housing with four cap screws [5-904-9].

10.4.3.3 Series 9100

1. Press bearing isolators [1-333-1] in each bearing cover [3-018-3, 3-018-4]. Install gaskets [3-409-9] on each bearing cover.

   NOTE: Inboard bearing cover [3-018-3] is 1/4 in. [6.4mm] less in width than outboard [3-018-4].

2. Slide bearing covers onto the shaft. Install the snap rings [3-915-9]. Install thrust washer on the outboard end.
3. Heat the ball bearings [3-026-2], using either a dry heat, or a 10-15% soluble oil and water solution.

   NOTE: Do not exceed 275°F [135°C].

4. Using gloves slide the heated ball bearing [3-026-2] onto the shaft against the snap ring on the inboard end and the thrust washer on the outboard end.
5. Install the lock washer [3-517-4] and locknut [3-516-4] on the outboard end of the shaft. Ensure that the locknut is secured and then bend over the tabs on the lock washer.
6. Allow the bearings to cool to room temperature. Coat the exposed sides with 2 to 3 oz. [55 to 85g] of the recommended grease.
7. Press a bearing isolator [1-333-1] in the inboard bearing housing and an oil seal [3-177-4] in the outboard bearing housing.
8. Slide the bearing housings [3-025-2] into place over the bearings. Attach the bearing covers to the bearing housing with two cap screws [3-904-9].

10.4.3.4 Series 8150

1. Install slingers onto shaft
2. Press new lip seals into the bearing brackets.
   Note: Seal lip or pressure side of seal must point away from bearing
3. Place brackets onto shaft. Install backing snap rings into the shaft grooves.
4. Heat the bearings using a dry heat.
   Note: Do not exceed 275°F [135°C].
5. Using gloves slide the bearing onto the shaft. The shielded side goes on first.
6. Install the beveled snap ring into the groove in the shaft, outboard side only.
7. Install both bearing housings.

10.4.4 Rotating element

After completion of the preceding steps, carefully place the shaft assembly into the lower half pump casing.

10.4.4.1 Series 8100

1. Set the rotating element in the pump casing [2-001-0], assuring correct rotation. Locate both stuffing box tongues in their respective casing grooves.
2. Locate pins [3-943-9] in the stuffing box and the casing wear rings in their respective slots at the casing parting line. Correct any O-ring bulging.

10.4.4.2 Series 8200

1. Set the rotating element in the pump casing [2-001-8], assuring correct rotation. Correctly locate casing ring pins, stuffing box bushing pins, and interstage diaphragm pins in the casing main joint slots. (Sliding the inboard bearing housing towards the coupling slightly will ease assembly).
2. Bolt the outboard bearing housing in place. Ensure that both housings are seated properly in the lower half casing.
3. Bolt inboard bearing housing in place. Rotating element should now turn freely.

10.4.4.3 Series 9100

1. Set the rotating element in the pump casing [2-001-8], assuring correct rotation. Correctly locate casing ring pins in the casing main slot. (Sliding the inboard bearing housing towards the coupling slightly will ease assembly).

2. Bolt the outboard bearing housing in place. Ensure that both housings are seated properly in the lower half casing.
3. Bolt inboard bearing housing in place. Rotating element should now turn freely.

10.4.4.4 Series 8150

1. Set the rotating element in the pump casing [2-001-0], assuring correct rotation. Correctly locate casing ring pins in the casing main slot. (Sliding the inboard bearing housing towards the coupling slightly will ease assembly).
2. Bolt the outboard bearing bracket in place. Ensure that both housings are seated properly in the lower half casing.
3. Bolt inboard bearing bracket in place. Rotating element should now turn freely.
4. Adjust the shaft sleeve nuts to get the impeller centered in the casing water passage.
5. Tighten the sleeve nut setscrews.

10.4.5 Casing Gaskets

1. The main casing joint gasket can be made using the upper and lower half as a template. Lay the gasket material on the casing joint and mark it by pressing it against the edges of the casing. Trim the gasket by lightly tapping with a ball peen hammer so that it is flush with the inside edges of the casing.
2. Precut casing gaskets [2-123-5, 2-123-6] can be ordered to minimize the amount of trimming.
3. Clean the gasket surfaces of the casing. Apply a multipurpose spray adhesive, (3M Super 77, or equivalent) to the lower half of the casing.
4. Within one minute of spraying, set the untrimmed gaskets [2-123-5, 2-123-6] in place on the lower half casing, align the holes in the casing and press the gaskets firmly against the lower half casing face in the area coated by the adhesive.
5. Machined casing bores must remain sharp at the casing parting line.
6. The gaskets must be flush with the bore in order to contact the O-rings so as to prevent leakage around the stuffing box (8100 only).
7. Lower the upper half casing [2-001-0] into place using the tapered dowel pins [2-916-1], ensuring the stuffing box and bearing housing are correctly aligned.
8. Tighten the upper half casing joint bolts to the correct torque.

10.4.6 Stuffing Box Assembly – Packing

Install two rings of packing and tap fully to bottom of stuffing boxes. Install seal cage [1-013-9] and ensure that it will line up with the seal water inlet when the packing is compressed. Install the remaining rings. Loosely fit the gland [1-014-9] square with the stuffing box and connect the flush lines.

10.5 Tightening Torques

10.5.1 Casing Bolts

The standard bolt class is SAE J429 or higher with a non-lubricated thread. The torque values listed in Table 12 shall be applied on the pump casing bolts.

CAUTION
Gasket compression: Non-metallic gaskets incur creep relaxation, before starting the pump ensure that the casing bolts are tightened to the correct torque.

NOTICE
Tightening sequence: Torqueing bolts to the correct values in accordance with the correct bolt tightening pattern is essential for obtaining the proper gasket compression so that no leakage can occur at the main joint. Always use a torque wrench when tightening casing bolts.

10.5.1.1 Tightening sequence

Tighten the casing bolts in accordance with the following bolt tightening pattern, see Fig. 23:

1. Tighten the four corner bolts marked 1 - 4.
2. Working outward along the shaft axis toward the stuffing boxes in opposite quadrants, tighten bolts in regions 5 - 8.
3. Working outward along the flanges and in opposite quadrants, tighten bolts in zones 9 - 12.
4. Repeat sequence 1 - 3.

Tighten the casing bolts in five steps:

1. Tighten bolts loosely by hand in the first instance, according to the bolt tightening pattern, then hand tighten evenly.
2. Using a torque wrench, torque to a maximum of 30% of the full torque first time around, according to the bolt tightening pattern. Check that the casing flange is compressing the gasket evenly.
3. Torque to a maximum of 60% of the full torque, according to the bolt tightening pattern.
4. Torque to the full torque, according to the bolt tightening pattern.
5. Perform final pass at full torque, in a clockwise direction on adjacent bolts.

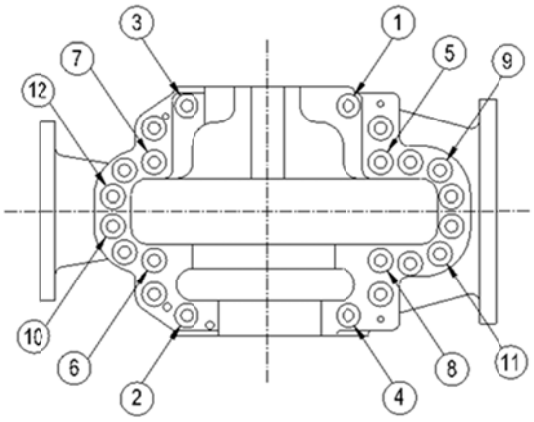

Fig. 23 Bolt tightening pattern

Bolt Size	Grade SAE	Head Identification	Torque Min. Value ft-lb [N.m]
5/8-11	G5		140 [190]
5/8-11	B8		75 [100]
3/4-10	G8		300 [405]
7/8-9			350 [475]
1-8			400 [540]
1-8 16X10X22		12pt	900 [1220]

Table 12 Torque requirements for Casing bolts

10.5.2 Other bolt locations

Bolt Size	Grade SAE	Head Identification	Torque Max Value ft-lb [N.m]
5/16-18	G2		11 [15]
3/8-16			20 [27]
7/16-14			32 [43]
1/2-13			49 [66]
5/8-11			97 [132]
3/3-10			172 [230]
1-8			250 [340]
3/8-16	G5		31 [42]
½-13			90 [122]
5/8-11			150 [203]
5/16-18	B8		11 [15]
1/2-13			45 [61]

Table 13 Torque requirements for other bolts

10.6 Spare Parts

10.6.1 Ordering Spare Parts

When ordering parts always provide the following information to the A-C Fire Pump distributor in your region:

1) Pump Serial Number
2) Pump Size and Type
3) Description of Part
4) Part number
5) Quantity required
6) Billing and Shipping instructions
7) Date required

The pump size and serial number are shown on the pump nameplate; refer to section 6, Description.

The part numbers and descriptions are shown in section 12, Replacement Parts, which also indicates a list of recommended spare parts for the pump.

10.6.2 Storage of spare parts

Spare parts should be stored in a clean dry area. Inspection and re-treatment of metallic surfaces (if necessary) with a corrosion inhibitor is recommended at six (6) month intervals.

11 Troubleshooting

Between regular maintenance inspections, be alert for signs of driver or pump trouble. Common symptoms are listed below. Correct any trouble immediately and avoid costly repair and shutdown.

WARNING
Disconnect and lock out power to the pump before trying to determine a failure. Failure to follow these instructions could result in serious personal injury.

FAULTS								
↓ PUMP DOES NOT DELIVER LIQUID								
↓	↓ INSUFFICIENT CAPACITY DELIVERED							
↓	↓	↓ INSUFFICIENT PRESSURE DEVELOPED						
↓	↓	↓	↓ PUMP LOSES PRIME AFTER STARTING					
↓	↓	↓	↓	↓ PUMP REQUIRED EXCESSIVE POWER				
↓	↓	↓	↓	↓	↓ PUMP VIBRATES OR IS NOISY AT ALL FLOWS			
↓	↓	↓	↓	↓	↓	↓ BEARINGS HAVE SHORT LIFE		
↓	↓	↓	↓	↓	↓	↓	↓ PUMP OVERHEATS OR SEIZES	
							POSSIBLE CAUSE	**REMEDY**
●	●						Air pocket in suction line	Vent and improve piping arrangement
●	●		●		●		Pump suction pipe not completely filled with liquid	Fill suction pipe completely with pumped liquid
●						●	Pump not primed	Fill pump completely with pumped liquid
●	●				●	●	Insufficient $NPSH_A$	Recalculate $NPSH_A$, must be > $NPSH_R$. Increase positive suction head on pump by lowering pump or increasing suction pipe and fittings size.
	●	●	●				Excessive amount of air in liquid	Remove air from pumped liquid by venting
	●	●	●				Air leaks in suction piping	Replace or repair defective pipe section or flange.
	●	●	●				Air leaks into pump through stuffing box	Clean flushing pipe. Replace stuffing box packing rings, if necessary
●	●	●	●		●		Inlet of suction pipe insufficiently submerged	Lower the suction inlet
●	●	●			●	●	Pump operating with closed or partially closed suction valve	Ensure that the suction line shutoff valve is fully open and that the line is unobstructed.
●	●	●			●		Obstruction in suction line	Remove any obstructions in the suction pipe
	●	●			●		Excessive friction losses in suction lines	Redesign piping system
●	●	●		●	●		Plugged impeller	Back-flush the pump in order to clean the impeller or dismantle the pump to clean impeller
				●			Speed of pump too high	Reduce driver speed if possible, or contact AC Firepump
●	●	●					Speed of pump too low	Make sure the motor receives full voltage; Make sure the frequency is correct; Make sure all phases are connected.
●	●	●		●			Wrong direction of rotation	Compare direction of rotation with directional arrow on pump casing. If required, change direction of rotation by interchanging two phases in the motor.
	●	●		●			Uncalibrated instruments	Verify monitoring equipment is functioning correctly
					●	●	Running the pump against a closed discharge valve without opening a by-pass	Open by-pass
					●	●	Operating the pump below the recommended minimum flow	Increase the flow, increase speed of driver
●	●			●			Total head of system higher than design of pump	Contact AC Firepump
				●	●		Total head of system lower than design of pump	Contact AC Firepump
				●	●	●	Misalignment	Realign pump and motor
					●		Foundation insufficiently rigid	Retighten foundation bolt: Ensure that the foundation was made according to installation and operating instructions
					●		Loose foundation bolts	Retighten foundation bolts; tighten to correct torque
					●		Loose pump or motor bolts	Retighten pump and motor bolt/nuts; tighten to correct torque
					●		Inadequate grouting of baseplate	Ensure that the foundation was made according to installation and operating instructions.
					●	●	Excessive piping forces and moments on pipe nozzles	Check the flange connections and eliminate strains using flexible couplings or reposition piping to eliminate piping strain, use pipe supports.

FAULTS								
PUMP DOES NOT DELIVER LIQUID								
INSUFFICIENT CAPACITY DELIVERED								
INSUFFICIENT PRESSURE DEVELOPED								
PUMP LOSES PRIME AFTER STARTING								
PUMP REQUIRED EXCESSIVE POWER								
PUMP VIBRATES OR IS NOISY AT ALL FLOWS								
BEARINGS HAVE SHORT LIFE								
PUMP OVERHEATS OR SEIZES								
							POSSIBLE CAUSE	REMEDY
					●		●	Mounting surfaces of internal fits (at wear rings, impellers, shaft sleeves, shaft nuts) not perpendicular to shaft axis	Check alignment. Examine pump for rubbing between impeller and casing. Replace damaged parts
					●	●	●	Shaft bent due to damage from shipment, operation, or overhaul	Check deflection of shaft. Total indicator runout should not exceed 0.002" [0.05mm] TIR. Possibly replace shaft.
					●	●	●	Impeller out of balance	Check misalignment and correct if necessary. If alignment satisfactory check bearings for excessive wear.
					●			Parts loose on the shaft	Check bearings and impeller for damage. Check key, locknut and set screws. Fix parts to shaft or contact AC Firepump.
					●		●	Shaft running off-center because of worn bearings	Check misalignment and correct if necessary, If alignment saisfactory check bearings for excessive wear.
				●	●	●	●	Rotating part rubbing on stationary part internally	Dismantle pump, check for interference, replace worn parts.
	●	●						Damaged, worn or incorrectly installed casing gasket	Inspect and replace with new gasket. Tighten casing bolts to correct torque
					●			Couplings not lubricated	Inspect and replace/add lubricant per manufacturers instructions
				●				Incorrect type of packing for operating conditions	Replace the packing
				●				Packing improperly installed	Check the packing and repack the stuffing box
				●				Gland too tight, prevents flow of liquid to lubricate packing	Back-off gland follower to allow sufficient flow. Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing.
					●	●	●	Excessive thrust caused by a mechanical failure inside the pump	Check the wear condition of impeller, its clearances and water passages
					●	●		Incorrect grade of grease used	Clean bearings and bearing housings according to instructions, add correct lubricant per manufacturers instructions.
					●	●		Excessive grease in bearing housings	Clean bearings and bearing housings according to instructions, add correct lubricant per manufacturers instructions.
					●	●		Lack of lubrication for bearings	Inspect bearing for wear, lubricate per manufacturers instructions
					●	●	●	Improper installation of bearings such as damage during installation, incorrect assembly, use of unmatched bearings as a pair, etc	Check method of assembly, possible damage or state of cleanliness during assembly and type of bearing used. Replace or contact AC Firepump.
				●	●	●		Moisture or dirt infiltrating grease	Clean bearings and bearing housings according to instructions and relubricate bearings.
				●	●	●	●	Bearings worn	Replace bearings

Table 14 Troubleshooting List

12 Replacement Parts

12.1 Series 8100 Horizontal Split Case Fire pump

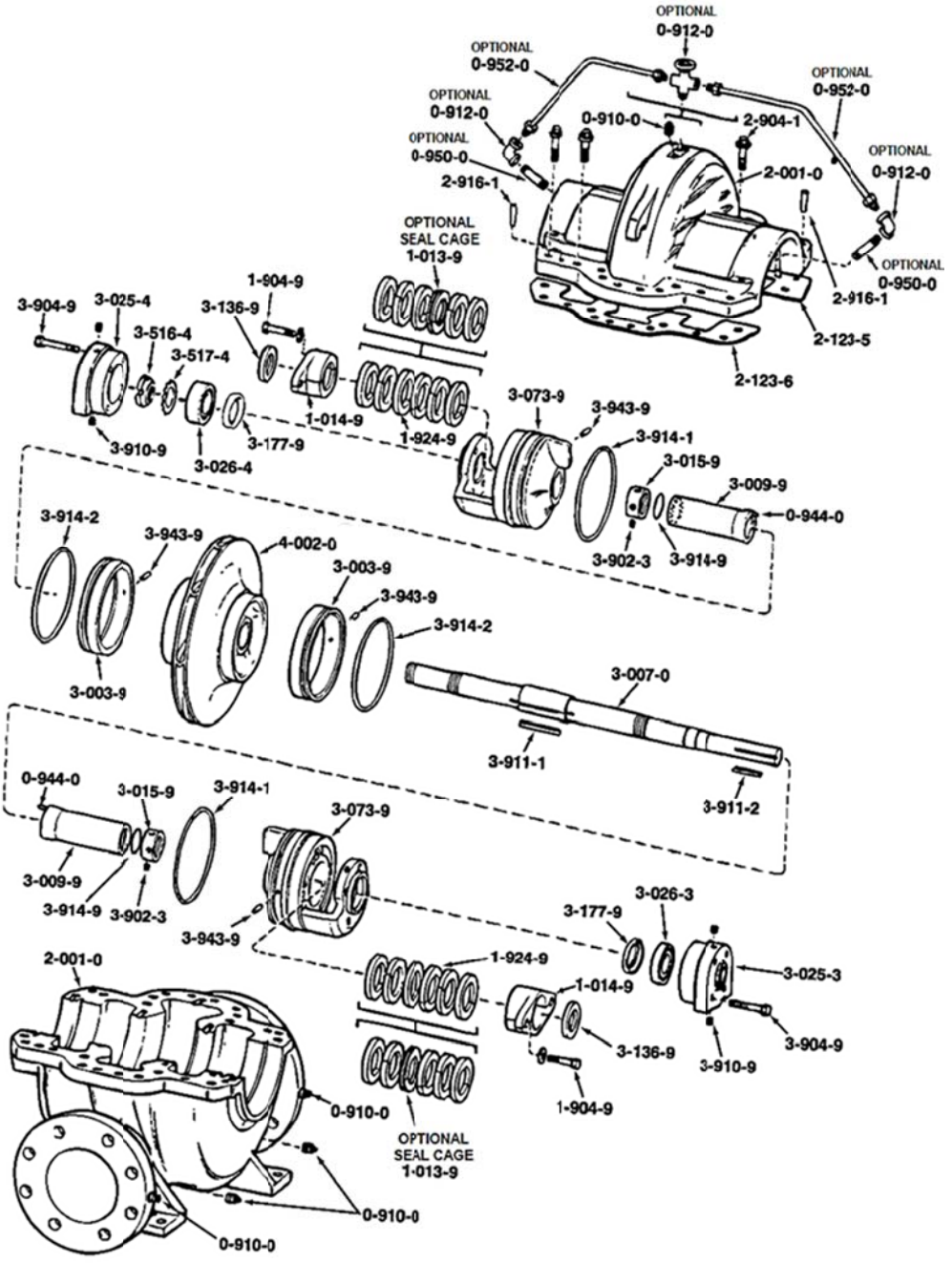

Fig. 23 Exploded view of 8100 Horizontal Split Case Fire Pump

Table 15 List of components 8100 Horizontal Split Case Fire pump

Cat. No.	Description	Qty	Cat. No.	Description	Qty
0-910-0	Pipe Plug (Casing)	5	3-025-3	Housing, Inboard Bearing	1
0-912-0	Pipe Fitting	3	3-025-4	Housing, Outboard Bearing	1
0-944-0	Spirol Pin (Shaft Sleeve)	2	**3-026-3**	**Bearing, Inboard**	**1**
0-950-0	Pipe Nipple	2	**3-026-4**	**Bearing, Outboard**	**1**
0-952-0	Tubing & Connectors	2	3-073-9	Stuffing Box	2
1-013-9	Seal Cage	2	3-136-9	Deflector	2
1-014-9	Gland, Packing	2	**3-177-9**	**Lip Seal**	**2**
1-904-9	**Cap Screw (Gland)**	**4**	3-516-4	Locknut, bearing	1
1-909-9	**Washer (Gland)**	**4**	3-517-4	Lockwasher, bearing	1
1-924-9	**Packing**	**12**	3-902-3	Shaft Nut Set Screw	2
2-001-0	Casing, Lower Half	1	3-904-9	Cap Screw (Bearing Housing)	8
2-001-0	Casing, Upper Half	1	3-910-9	Pipe Plug (Bearing Housing)	4
2-123-5	**Gasket, Casing (Suction)**	**1**	3-911-1	Impeller Key	1
2-123-6	**Gasket, Casing (Discharge)**	**1**	3-911-2	Coupling Key	1
2-904-1	Cap Screw (Casing)	VARIES	**3-914-1**	**O-Ring (Stuffing Box)**	**2**
2-916-1	Casing Taper Pin	2	**3-914-2**	**O-Ring (Casing Ring)**	**2**
3-003-9	**Casing Ring Assembly**	**2**	**3-914-9**	**O-Ring (Shaft Sleeve)**	**2**
3-007-0	Shaft	1	3-943-9	Spirol Pin	4
3-009-9	**Shaft Sleeve**	**2**	4-002-0	Impeller	1
3-015-9	Nut, Shaft Sleeve	2			

Bold Face: Recommended spare parts.

12.2 Series 8200 Horizontal Split Case Fire pump

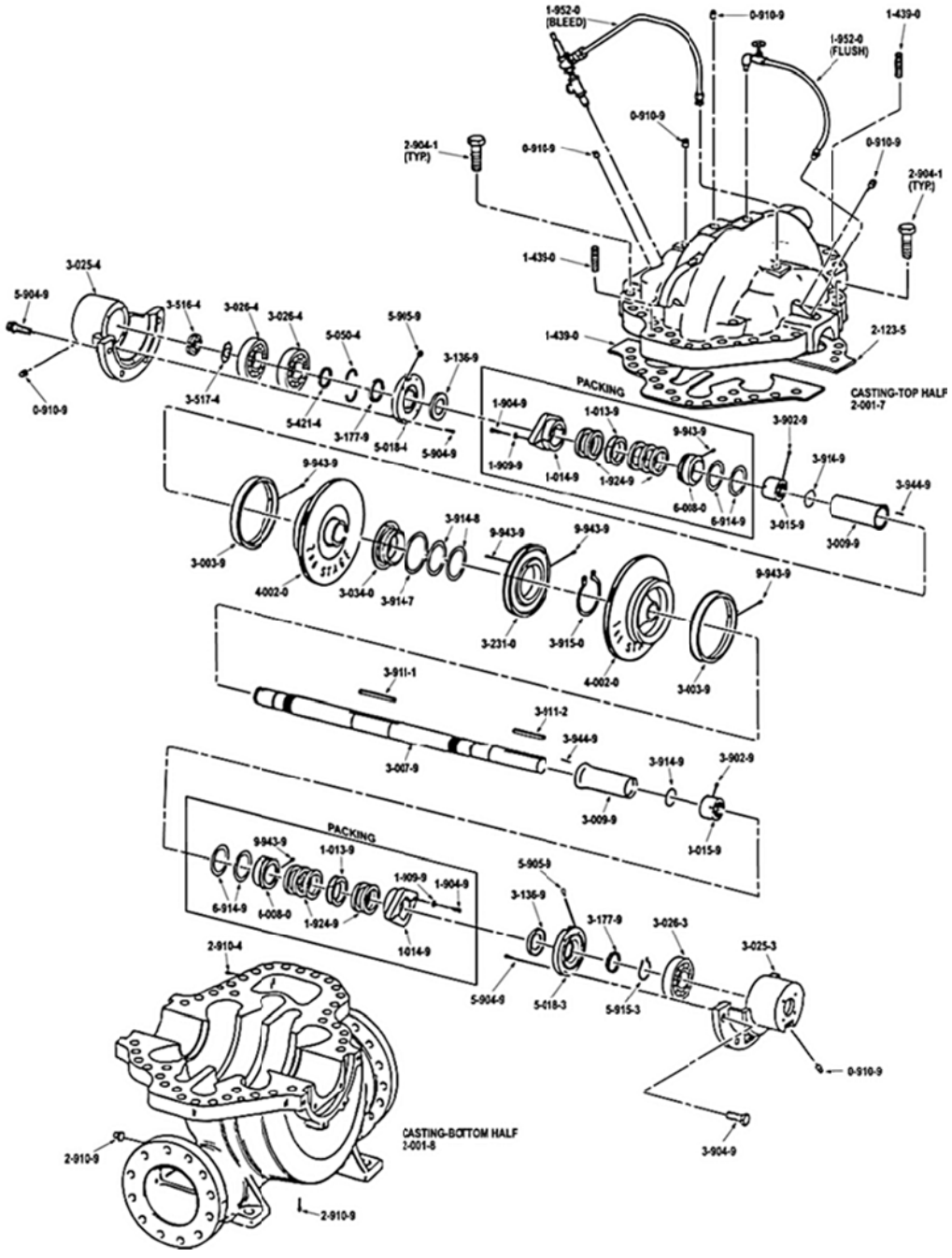

Fig. 24 Exploded view of 8200 Horizontal Split Case Fire Pump

Table 16 List of components 8200 Horizontal Split Case Fire pump

Cat. No.	Description	Qty	Cat. No.	Description	Qty
1-952-0	Bleed Line	1	**3-026-4**	**Bearing, Outboard**	**2**
1-952-0	Flush Line	1	5-050-4	Split Ring	1
0-910-9	Pipe Plug	14	5-421-4	Retaining Collar	1
1-013-9	Seal Cage	2	3-169-9	Deflector	2
1-014-9	Gland	2	**3-177-9**	**Lip Seal**	**2**
1-901-9	**Gland Bolt**	**4**	3-516-4	Locknut	1
1-909-9	**Washer, Gland Bolt**	**4**	3-514-4	Lockwasher	1
1-924-9	**Packing Ring**	**10**	3-902-9	Set Screw	2
2-001-7	Casing, Upper Half	1	5-904-9	Bearing Cover Bolt	8
2-001-8	Casing, Lower Half	1	3-911-1	Key (Impeller)	1
2-123-5	**Gasket, Casing (Suction)**	**1**	3-911-2	Key (Coupling)	1
2-123-6	**Gasket, Casing (Discharge)**	**1**	**3-914-9**	**O-Ring (Shaft Sleeve)**	**2**
2-904-1	Cap Screw (Casing)	VARIES	**3-914-9**	**O-Ring (Stuffbox Bushing)**	**4**
1-439-0	Dowel	2	6-008-0	Stuffbox Bushing	2
3-003-9	**Casing Ring Assembly**	**2**	3-034-0	Interstage Bushing	1
3-007-0	Shaft	1	3-231-0	Interstage Diaphragm	1
3-009-9	**Shaft Sleeve**	**2**	3-914-7	O-Ring (Interstage Bushing)	3
3-015-9	Shaft Sleeve Nut	2	5-915-0	Snap Ring (Bearing)	1
5-018-0	Bearing Housing Cover	2	3-915-0	Snap Ring (Interstage Bushing)	1
3-025-3	Bearing Housing	1	4-002-0	Impeller	2
3-026-3	**Bearing, Inboard**	**1**			

Bold Face: Recommended spare parts

12.3 Series 9100 Horizontal Split Case Fire pump

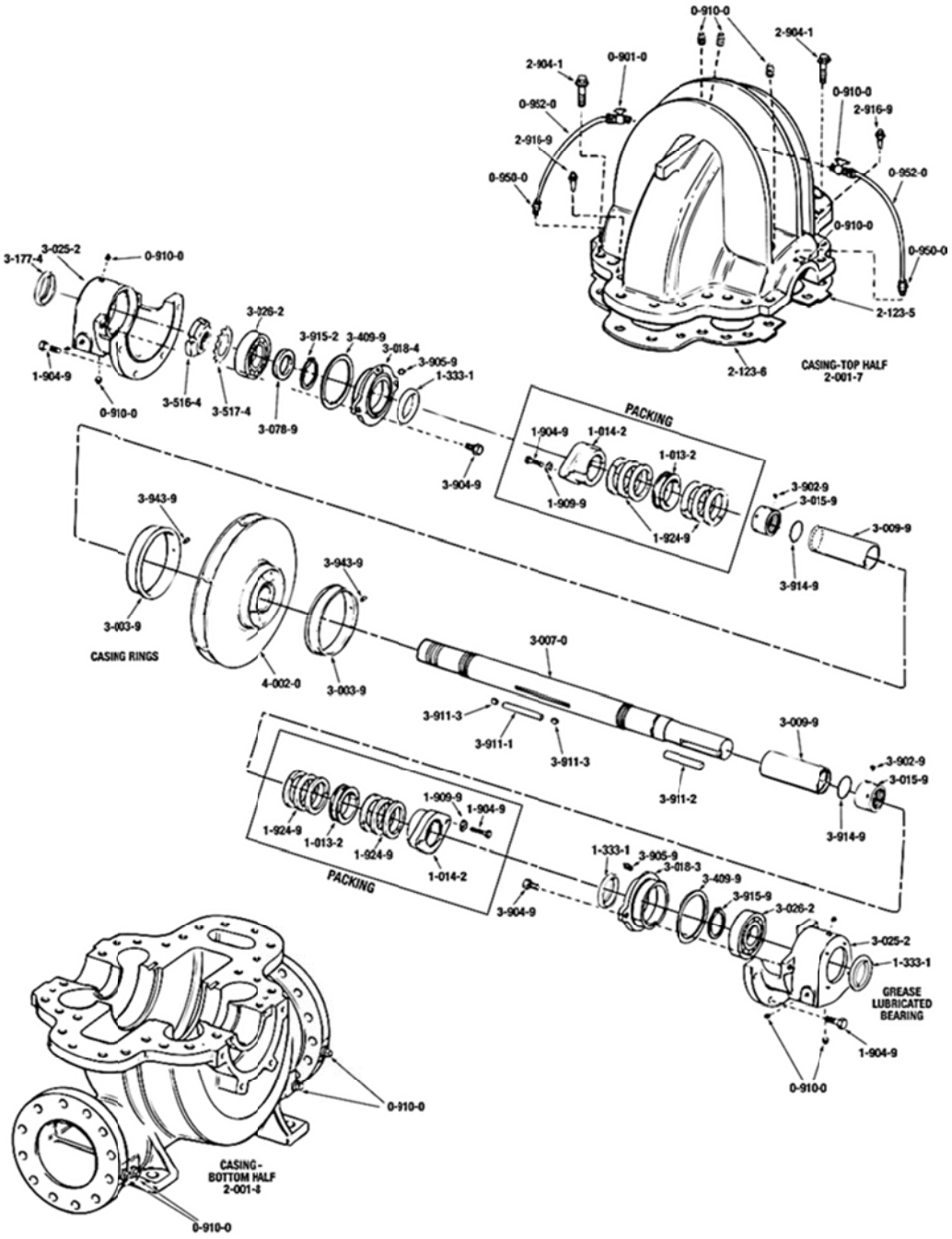

Fig. 25 Exploded view of 9100 Horizontal Split Case Fire Pump

Table 17 List of components 9100 Horizontal Split Case Fire pump

Cat. No.	Description	Qty	Cat. No.	Description	Qty
0-901-0	Valve	2	3-015-9	Shaft Sleeve Nut	2
0-910-0	Pipe Plug	20	3-018-3	Bearing Housing Cover (Inboard)	1
0-950-0	Pipe Nipple	2	3-018-4	Bearing Cover (Outboard)	1
0-952-0	Tubing	2	3-025-2	Bearing Housing	2
1-013-2	Seal Cage	2	**3-026-2**	**Bearing**	**2**
1-014-2	Gland	2	3-078-9	Thrust Washer (Outboard)	1
1-333-1	**Bearing Isolator**	**3**	**3-177-4**	**Lip Seal (Outboard Bearing)**	**1**
1-904-9	**Gland and Housing Bolt**	**12**	**3-409-9**	**Gasket (Bearing Housing Cover)**	**2**
1-909-9	**Washer, Gland Bolt**	**4**	3-516-4	Locknut	1
1-924-9	**Packing Ring**	**12**	3-517-4	Lockwasher	1
2-001-7	Casing, Upper Half	1	3-902-9	Set Screw (Shaft Sleeve Nut)	2
2-001-8	Casing, Lower Half	1	3-904-9	Gland and Cover Bolt	4
2-123-5	**Gasket, Casing (Suction)**	**1**	3-911-1	Key (Impeller)	1
2-123-6	**Gasket, Casing (Discharge)**	**1**	3-911-2	Key (Coupling)	1
2-904-1	Cap Screw (Casing)	VARIES	3-911-3	Key (Shaft Sleeve)	2
2-916-9	Taper Pin	2	**3-914-9**	**O-Ring (Shaft Sleeve)**	**2**
3-003-9	**Casing Wear Ring**	**2**	3-915-9	Snap Ring	2
3-007-0	Shaft	1	3-943-9	Spirol Ring	2
3-009-9	**Shaft Sleeve**	**2**	4-002-0	Impeller	1

Bold Face: Recommended spare parts

12.4 Series 8150 Horizontal Split Case Fire pump

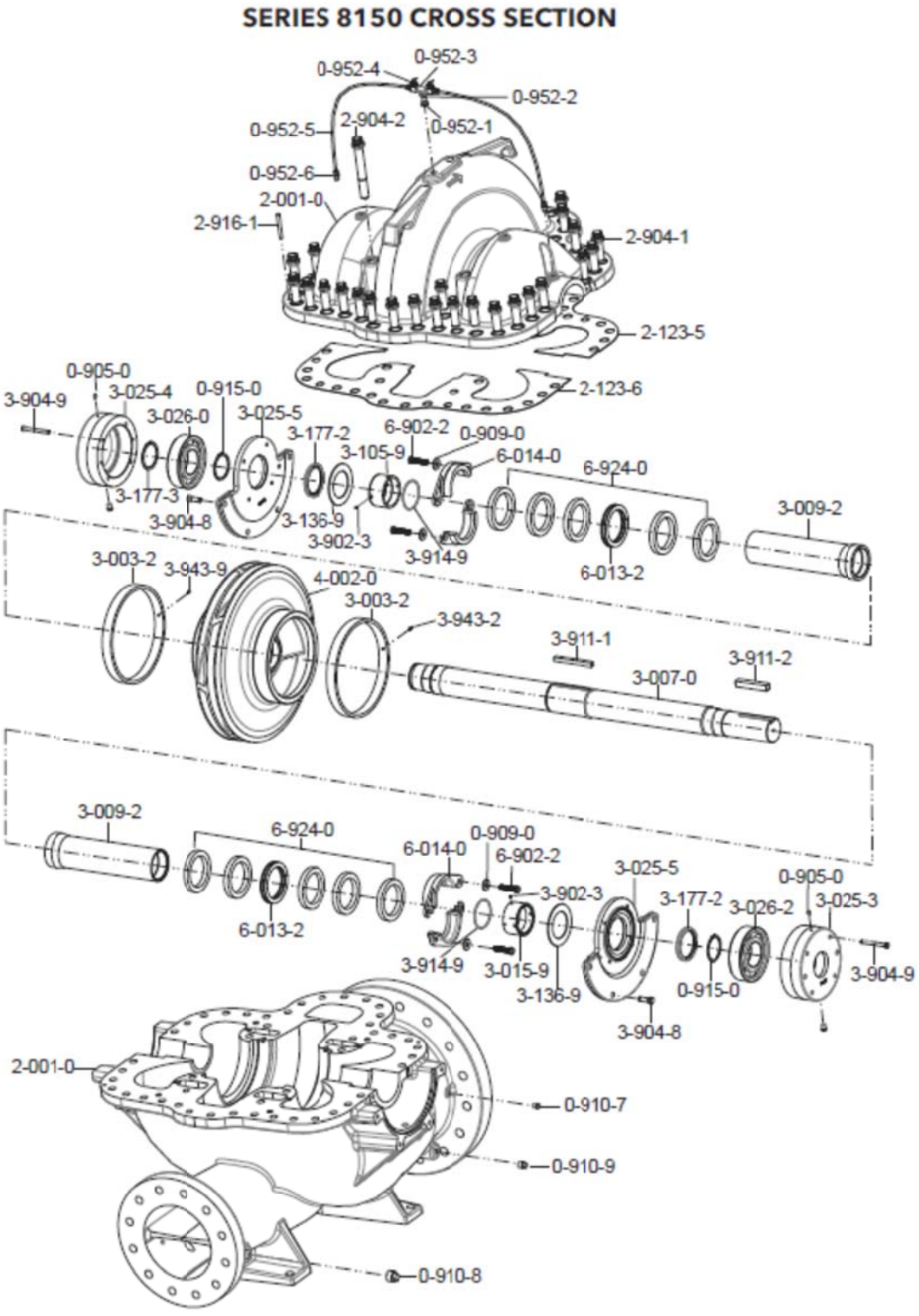

Fig. 23 Exploded view of 8150 Horizontal Split Case Fire Pump

Table 18 List of components 8150 Horizontal Split Case Fire pump

Cat. No.	Description	Qty	Cat. No.	Description	Qty
2-001-0	Casing Asm 125Flg DI	1	3-025-3	Housing Bearing Inboard	1
2-001-0	Casing Asm 250Flg DI	1	3-025-4	Housing Bearing Outboard	1
2-001-0	Casing Asm 125-250Flg DI	1	3-904-9	CAPSCREW 3/8-16UNCX3-1/2	8
			0-905-0	Grease Fitting	2
0-910-9	Pipe Plug 1/2NPT Brass	2	3-904-8	CAPSCREW 1/2-13NCX1-1/2	8
0-910-8	Pipe Plug 1NPT SS	2			
0-910-7	Pipe Plug 1/4NPT SS	8	2-904-1	BOLT, CASING 1-8UNCx2.75 12Pt	42
			2-904-2	BOLT, CASING 1-8UNCx7 12Pt	4
2-123-5	**Gasket: Suction, Casing**	**1**	2-916-1	PIN, TAPER	2
2-123-6	**Gasket: Discharge, Casing**	**1**			
			6-924-0	**Packing 5/8**	**10**
3-007-0	Shaft	1	**6-013-2**	**Lantern Ring**	**2**
4-002-0	Impeller Brz w/o rings	1	**6-014-0**	**Gland**	**4**
3-911-1	Impeller Key 1/2x5-3/4	1	**6-902-2**	**Capscrew 1/2-13UNCx2-1/2 SS**	**4**
3-009-2	**Shaft Sleeve**	**2**	**0-909-0**	**Washer 1/2**	**4**
3-914-9	**O-Ring Sleeve 2-153 (3.500x.103)**	**2**			
3-015-9	Shaft Sleeve Nut	2	0-952-1	HEX BUSHING 1/2NPT x 1/4NPT	1
3-902-3	Setscrew 1/4-28UNFx3/16 SS	4	0-952-2	NIPPLE 1/4NPT x 1-1/2	1
3-136-9	Slinger	2	0-952-3	TEE 1/4NPT	1
3-003-2	**Ring Casing: Brz**	**2**	0-952-4	NEEDLE VALVE 1/4NPT-1/4TUBE	2
3-943-9	**Pin W/R**	**2**	0-952-5	TUBING 1/4 COPPER	4
			0-952-6	CONNECTOR MALE COMP 1/4ODX1/4NPT	2
3-177-2	**Lip Seal**	**2**			
3-025-5	Bearing Bracket	2	3-911-2	Coupler Key 3/4x3/4x4.5	1
0-915-0	Snap Ring Bearing	2			
3-026-2	**Bearing 6316 w/Shield**	**2**			
3-177-3	Snap Ring Beveled	1			

Bold Face: Recommended spare parts.

A. Appendix

A1 Coupling Guard Removal and Installation (Non CE version)

NOTE: Do not spread the inner and outer guards more than necessary for guard removal or installation. Over-spreading the guards may alter their fit and appearance.

A1.1 Removal

1. Remove the two (2) cap screws that hold the outer (motor side) coupler guard, (item 1); to the support bracket(s), (items 3 (and item 6)).
2. Spread the outer guard and pull it off the inner guard, (item 2).
3. Remove the cap screw that holds the inner guard to the support bracket, (item 3).
4. Spread the inner guard and pull it over the coupler.

A1.2 Installation

1. Attach the Support Brackets, (items 3 and 4 preassembled); to the bearing housing, (if a new installation). Spread the inner guard, (item 2); and place it over the coupler.
2. With the inner guard straddling the support bracket, (item 3); install a cap screw through the hole (or slot) in the support bracket and guard located closest to the pump. Do not tighten the capscrew.
3. Spread the outer guard, (item 1); and place it over the inner guard.
4. Install the outer guard cap screws by following the step stated below which pertains to your particular pump:
   - 4.1 For pumps with a motor saddle support bracket, (item 5): Ensure the outer guard is straddling the support arm, (item 6); and install but do not tighten the two remaining cap screws. Locate the support arm, (item 6) between the outer guard ends, align the support arm with the holes in the outer guard and the holes in the motor saddle support bracket, (item 5).
   - 4.2 For pumps without a motor saddle support bracket: Insert the spacer washer, (item 7); between the holes located closest to the motor in the outer guard, and install, but do not tighten, the two remaining cap screws.
5. Position the outer guard so it is centered on the shaft, and so there is less than a 1/4 in. (6.35mm) of the motor shaft exposed. On guards that utilize a slotted support bracket, the inner guard will have to be positioned so there is only a 1/4 in. (6.35mm) of the pump shaft exposed.
6. Holding the guard in this position, tighten the three (3) cap screws.

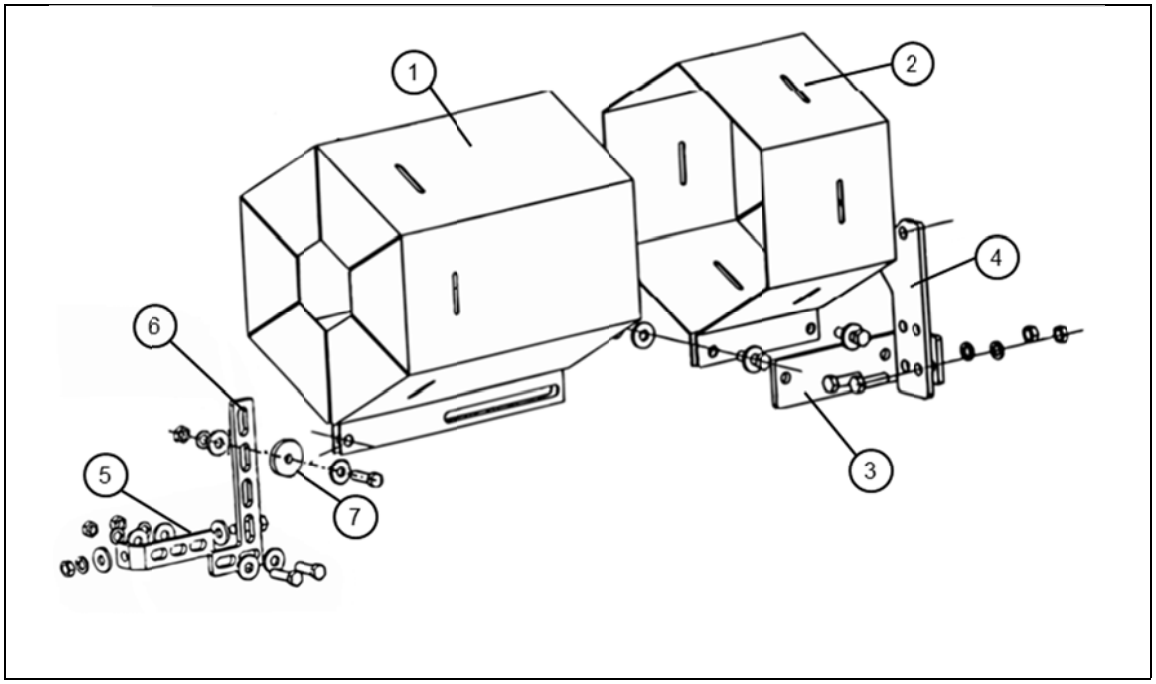

FIG A1 Coupler Guard Exploded View for typical Motor Driven HSC Fire pump

A2 Changing Pump Rotation

Every series Horizontal Split-case Centrifugal Fire Pumps can be operated clockwise or counter-clockwise when viewed from the coupling end of the pump. If you wish to reverse the suction and discharge nozzles, this can be accomplished with the same pump as follows:

NOTE: Refer to the disassembly and assembly procedures in section 10 of this manual for proper disassembly and assembly techniques.

A2.1 Procedure

1. Remove the impeller from the shaft, turn it 180° and replace it on the shaft. (Follow the disassembly procedures given in this manual.)
2. With the rotating element out of the casing, remove the casing from the baseplate and turn 180°.
3. Set the rotating element back in the casing and reassemble the pump.

NOTE: The impeller and the casing are in the same relationship to each other as they were originally. The shaft and motor are also in the same relationship to each other as they were originally.

4. Reassemble pump and realign the coupling as called for in the alignment instructions in section 7.
5. The rotation of the motor must be changed by switching the motor leads.

NOTE: Unless the motor rotation is reversed the impeller will run backwards.

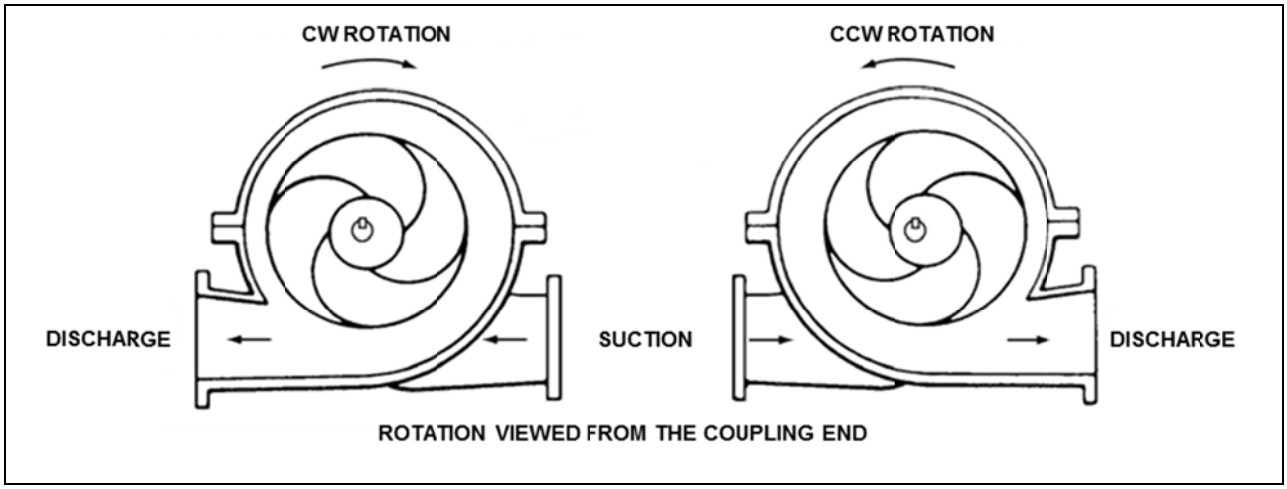

FIG A2 Correct relationship of impeller and casing HSC Fire pump

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1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

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