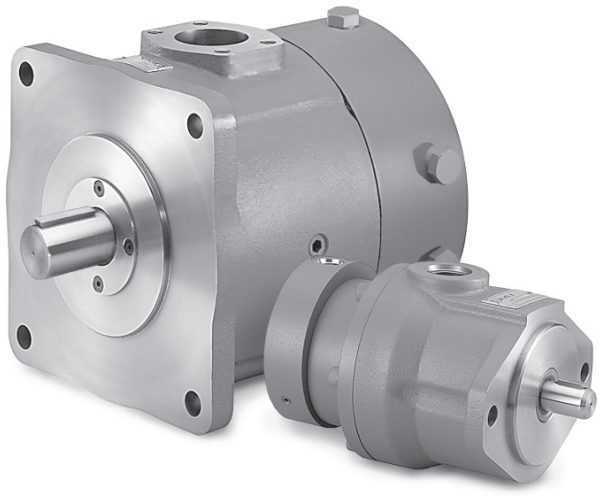
DYNEX
High Pressure Hydraulics

SERVICE INSTRUCTIONS

General Instructions: Checkball Piston Pumps



Checkball hydraulic pumps are axial piston pumps, which use two check valves in each piston pumping chamber to direct flow from the inlet side of the pump to the pump outlet port. During operation, a fixed-angle wobble plate rotates with the drive shaft. The angled surface imparts a reciprocating motion to the pistons, which move in and out of the bores in the stationary barrel.

SERVICE GUIDELINES

These instructions assume a basic understanding of standard hydraulic system installation, operating practices and maintenance procedures.

Avoid Contamination

Contamination is detrimental to any hydraulic system. Absolute cleanliness is essential during servicing and installation to prevent foreign material from contaminating the pump and hydraulic system.

Identify the Pump

The pump nameplate is located on the flat surface between the inlet port and the mounting flange. See FIGURE 1.

This stamped metal tag includes either a ten-digit model number (i.e., PF2006-1808) or a descriptive model code (i.e., PF1002H-SXEA-22-10). The serial number, also stamped on the plate, can be helpful when communicating with the sales department.

Confirm Pump Capability

Refer to the published pump specifications. Exceeding the performance recommendations will reduce operating life.

Contact the sales department for a review of any application which requires operating above rated pressures or flows, or beyond the specified speed range.

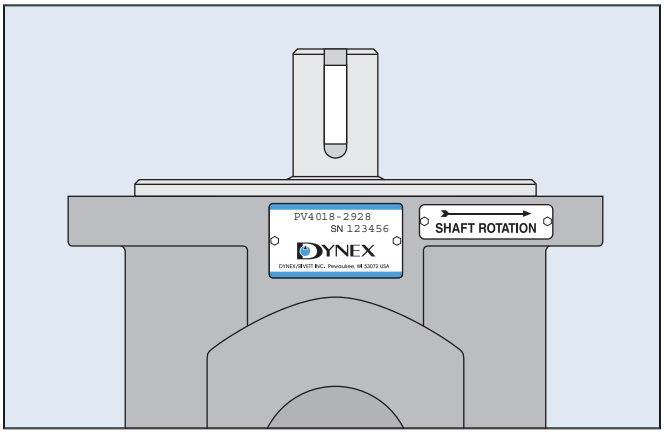


FIGURE 1: Typical pump showing location of nameplate and shaft rotation tag, adjacent to inlet port. Rotation is indicated only on pumps which are unidirecional (do not have bi-directional shaft rotation). Refer to "Pump Rotation" on page 2.

Be Aware of Design Changes

Dynex reserves the right to change designs and specifications at any time without incurring any obligation. Contact the sales department if you have any questions about pump operating parameters, proper installation or operation.

INSTALLATION INSTRUCTIONS

Inlet Pipe/Hose Sizing

1. Recommended maximum inlet fluid velocity is 4 feet per second (1,2 metres per second).
2. Recommended maximum outlet fluid velocity is 30 feet per second (9,1 metres per second).

Inlet Conditions

1. Failure to meet minimum inlet pressure requirements will result in reduced output flow.

   IMPORTANT: Refer to the "Minimum Inlet Pressure" table on page 6.
2. Inlet pressures higher than 10 psi (0,7 bar) require a high-pressure shaft seal. On most Dynex pump models a high-pressure seal is an option that must be specified. Refer to the published pump specifications.

Fluid Guidelines

Contact the sales department when operating with low-lubricity or non-petroleum based fluids, or beyond the optimum fluid viscosity range.

IMPORTANT: Refer to “Fluid Recommendations” below.

Port/Fitting Configurations

1. Dynex pumps are available with outlet ports suitable for use at various pressure ranges. Refer to page 7 for port descriptions.
2. Contact the fitting manufacturer to ensure the selected fittings are rated for the maximum pump operating pressure.

Minimum Filtration Levels

1. Pump inlet: 150 µ nominal;

   Pressure or return line: 25 µ nominal.
2. While finer filtration levels than these are desirable and will result in longer component life, restricting flow to the pump inlet should be avoided. Minimum recommended inlet conditions must be maintained.

Pump Mounting

1. Mounting with shaft horizontal and inlet vertically up is preferred. Vertical mounting with shaft up is possible, but special steps must be followed to bleed air from housing.

   IMPORTANT: Refer to "Air Bleed Procedure" on page 3.
2. Direct drive is recommended.

   WARNING: Side loading of the pump shaft, as with an unsupported pulley/belt drive system, will void the warranty.
3. Connect the pump to the motor drive with a flexible coupling. Maintain angular and radial alignment within the coupling manufacturer's specifications for your application.

   Dynex recommends that the shaft alignment be within 0.005 inch (0,13 mm) TIR. If a rigid coupling must be used, alignment must be within 0.002 inch (0,05 mm) TIR.
4. The coupling half on the pump shaft must be locked on the key with a set screw, such that it can not shift and contact the end face of the pump when operating.

OPERATING RECOMMENDATIONS

Pump Rotation

1. Variable delivery models with hydraulic volume control and all fixed displacement models allow bi-directional shaft rotation, providing constant direction of output flow regardless of the direction of drive shaft rotation.
2. Variable delivery models with mechanical volume control (PV4000 Series and Pressure Compensated PV4000 and PV6000 Series) are unidirectional. The direction of rotation is determined viewed from shaft end and must be specified when ordering. A plate designating rotation is mounted on the edge of the mounting flange, adjacent to the inlet port. Refer to FIGURE 1 on page 1.

FLUID RECOMMENDATIONS

Mineral Oil

A high-grade premium petroleum-based fluid should be used to assure long component and system life. The fluid should have a combination of anti-wear, demulsibility, rust protection, oxidation-resistant and foam-resistant properties.

Special Fluids

Some pump models may require reduced operating pressures when using low-lubricity fluids.

Because of the wide range of fluid characteristics, contact the sales department for a review of any application using non-petroleum based fluids.

Viscosity Specifications

Using fluid with the correct viscosity range is critical to achieving long component life. Fluid conditions outside the “Optimum” range shown in the table may result in reduced pump output, requiring pressurized inlet conditions. For more information, contact the sales department.

Hydraulic Fluid Viscosity①

Pump Models	Operating						Start-up	
	Minimum		Optimum		Maximum			
	SUS	cSt	SUS	cSt	SUS	cSt	SUS	cSt
Fixed Displacement Pumps:								
PF500-10	52	8	98 to 324	20 to 70	1911	413	3706	800
PF1000-10	59	10	98 to 324	20 to 70	1911	413	3706	800
PF1300-10	31	1,5	–	–	927	200	927	200
PF2000	59	10	98 to 324	20 to 70	1911	413	1911	413
PF2000②	34	2,3	98 to 324	20 to 70	1911	413	1911	413
PF3000-10	59	10	98 to 342	20 to 70	1911	413	3706	800
PF4000-30	34	2,3	98 to 324	20 to 70	1911	413	1911	413
PF4200-10	34	2,3	98 to 324	20 to 70	1911	413	1911	413
PF4300-11	31	1,5	–	–	927	200	927	200
PF6000	34	2,3	98 to 324	20 to 70	1911	413	1911	413
Mechanical Variable Delivery Pumps:								
PV4000	34	2,3	98 to 324	20 to 70	1911	413	1911	413
PV6000	34	2,3	98 to 324	20 to 70	1911	413	1911	413
Hydraulic Variable Delivery Pumps:								
PV6000	34	2,3	98 to 324	20 to 70	1911	413	1911	413

① *Fluid conditions outside the “Optimum” range may result in reduced output, requiring pressurized inlet conditions. Contact the sales department.*

② *Models with special mounting. Refer to "Bulletin PES".*

Gate Valve and Relief Valve

1. Be sure that any gate valve in the system is fully open to the pump prior to start-up, to avoid restricting flow to the inlet.
2. A relief valve in the circuit is required to protect against excessive pressures. The maximum relief valve setting should be no higher than the maximum intermittent pressure rating of the pump.

Air Bleed Procedure

1. HORIZONTAL MOUNTING WITH INLET UP:

   Crack the inlet fitting or remove the plug from the uppermost bleed port in the pump housing to bleed all air from pump case. Replace the plug prior to start-up.
2. HORIZONTAL MOUNTING WITH INLET DOWN OR AT RIGHT ANGLE:

   Remove the plug from the uppermost bleed port in housing to bleed all air from the pump case. Replace the plug prior to start-up.
3. VERTICAL MOUNTING WITH SHAFT UP (PUMP EXTERNAL TO RESERVOIR):

   Remove the plug from the vertical bleed port (nearest to mounting flange face) and bleed all air from the pump case. Replace the plug prior to start-up.
4. VERTICAL MOUNTING WITH SHAFT UP (WITH PUMP IMMERSED IN FLUID RESERVOIR):

   Refer to FIGURE 2.

   During installation, remove the plug from the vertical bleed port (nearest to the mounting flange) and connect a pipe to the top of the reservoir.

   Fill reservoir and allow all air to bleed from pump case. Replace plug prior to start-up.

   IMPORTANT: In all cases, bleed air from the inlet hose prior to start-up. This air bleed procedure should be followed each time the reservoir has been drained and the pump emptied.

INITIAL START-UP

1. Assure that the pump case is void of air, as described previously.
2. Ensure all pipes and hoses are secure and that the pump is in a hydraulically unloaded condition.
3. First jog the electric motor, by quickly turning it on and off several times, to check that the pump runs smoothly. Also, check for correct circuit connections and leaks.
4. Then, run the pump at no-load pressure (all valves in an open, neutral position) for several minutes. Check to be sure the pump does not leak or develop excessive heat or noise.
5. If operation is normal, then the pressure can be increased to the normal operating settings.

If you have problems achieving full flow, first refer to “Trouble-Shooting” on page 5. If problems continue, contact the sales department.

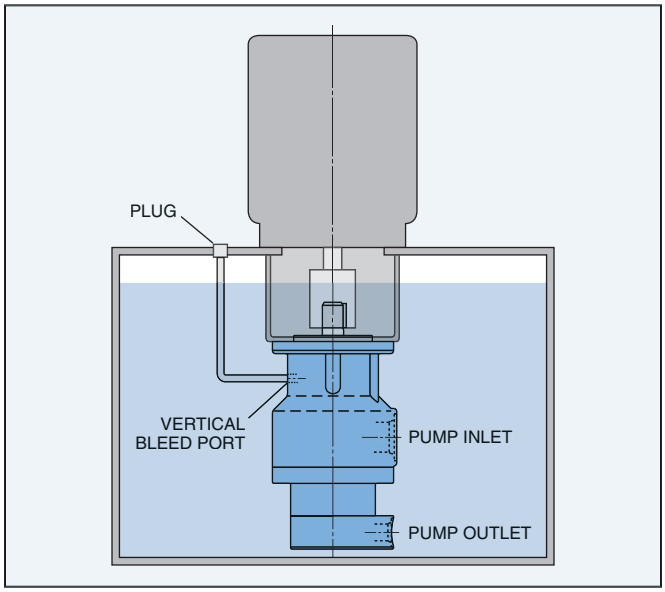


FIGURE 2: Bleeding the air on a typical vertical pump installation inside the reservoir requires connecting a pipe to the top of the tank. Do not allow the fluid level in the reservoir to drop below the inlet port during all machine cycles.

PREVENTIVE MAINTENANCE

A systematic maintenance program can help achieve maximum life for the pump and other system components. Standard recommended procedures include:

1. Regularly inspect system for leakage, worn or damaged piping or connections, wear of any moving parts and secure mounting of all components.
2. Regularly check the system for smooth operation, unusual noise or vibration, excessive temperatures, proper operating pressures and actuator speeds.
3. Check for proper fluid level in reservoir.
4. Check the condition of the fluid and change the fluid if it is dirty or contaminated with any foreign matter or water. Change the fluid regularly as recommended using only approved fluid.
5. Change filter elements and clean any reservoir filter screen at recommended intervals.

GENERAL REPAIR INSTRUCTIONS

Parts Lists and Instructions

Refer to separate "Parts List" for the pump model being serviced. Contact the sales department for availability of "Maintenance Instructions" with detailed disassembly and assembly instructions, and for information on any required special tools.

General Guidelines

1. Before servicing, completely drain fluid from the pump. Plug all ports. Clean external surfaces using a solvent to remove dirt and grease. If necessary, use a dull blade to remove excess paint.

2. Absolute cleanliness is necessary while working to prevent contamination and potential pump damage.
3. To aid proper reassembly, note the relative position of the housing, barrel and cover (some models). Apply a paint stripe or center punch marks on the external service across the seams.
4. Be prepared with new seals and o-rings, which should be installed during reassembly as standard hydraulic service practice.

IMPORTANT: If a system component fails resulting in fluid contamination, it is important to drain and clean the reservoir, all lines, filter screens and all components. Refill the system with new fluid. This must be done to prevent immediate failure of new pump when replacing a failed pump.

Disassembly Notes

1. Handle parts with care to prevent nicks and scratches on critical machined surfaces. As parts are removed and set aside for inspection, cover them with a clean cloth for protection.
2. Keep similar, non-identical parts (springs, checkballs, bearing plates) separated and identified to avoid confusion during reassembly.
3. Be careful when separating the barrel and housing, which may spring apart in models with spring-loaded parts.
4. To avoid damage, the pistons need to be retained in the barrel as it is separated from the housing. Tip the barrel slightly to keep the piston assemblies in place.
5. In some pump models, removal of outlet seats or retainers may be difficult without using a special tool. Contact the sales department for more information.

   If excessive wear requires replacement, it may be more advantageous to replace the entire barrel.
6. Similarly, if a piston is stuck in the barrel, it is likely that the piston bore was damaged. Replacement of the entire barrel is recommended.

Reassembly Notes

1. Replacements for certain parts must be ordered as a kit. Typically, these include the seals and o-rings, pistons, outlet check valves, the shaft and bearings, and any pump control components (i.e. pressure compensator assembly). Refer to the specific Parts List, or contact the sales department for kit numbers.
2. During reassembly, coat all parts in pump fluid or compatible grease.

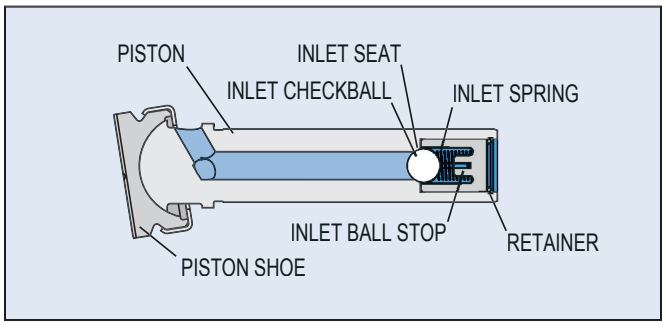


FIGURE 3: Typical piston assembly showing piston shoe and inlet checkball components inside piston.

3. Replace all seals and o-rings as standard hydraulic practice.
4. To assure correct assembly sequence and orientation, refer to the marks applied to the external surfaces (See "General Guidelines", step 3).
5. When applying adhesive sealant (*Loctite® Threadlocker*, or equivalent), apply enough sealant to coat one or two center threads. Do not apply excessive sealant that can seep beyond the thread area.
6. Refer to the specific Parts List for proper torque values when installing parts.
7. To prevent damaging the seal when installing over the shaft, the keyway or spline should be masked with thin tape and coated with grease.
8. Before installing the pistons, check each one to confirm that the inlet checkball is seating properly. See page 5.

Part Inspection, Evaluation and Reconditioning

Part	Inspection Procedure
Barrel	Check piston bores for galling or excessive wear.
Outlet Seats and Checkballs	Using microscope, check for pitting and excessive wear. Always replace seats and checkballs as a matching pair.
Outlet Springs and Control Springs of Variable Models	Check for set, worn (end coils and coil ID) or bent or broken springs. Replace all springs as standard hydraulic service practice.
Piston Assemblies (Refer to Figure 3)	Check for galling on outer diameter of each piston, damage or wear to piston shoes, inlet seat pitting or excessive coining/recession, excessive wear to inlet ball stop. Confirm inlet checkball is seating properly (See procedure on page 5).
Piston Return Springs and Spring Retainers	If present, check for excessively worn or bent springs and worn spring retainers.
Bearings, Thrust Plates and Wobble Plate	Replace if any pitting is present or if roller/race surfaces have excessive wear.
O-rings and Seals	Replace all seals during reassembly, as standard hydraulic service practice.
Drive Shaft	Check for excessive or abnormal wear.
Face Surface of Barrel and Cover	Use a fine-grit oil stone (i.e., India Medium) to remove any nicks and ensure flatness on the faces. Replace if any nicks are near sealing surface.
Thrust Plate Surface (Some Models)	Lap the surface of the plate that contacts the piston shoes. Use several figure-8 motions on 600 grit wet/dry paper on a flat plate or stone until surface is uniform. Replace the bearing if deep nicks or abrasion are evident.

Testing Pump Rotation

Before start-up, look through the inlet port to assure piston shoes are seated properly. Manually rotate the shaft at least two revolutions, to ensure that no binding is occurring.

STORAGE AND CORROSION PREVENTION

General Guidelines (All Pumps)

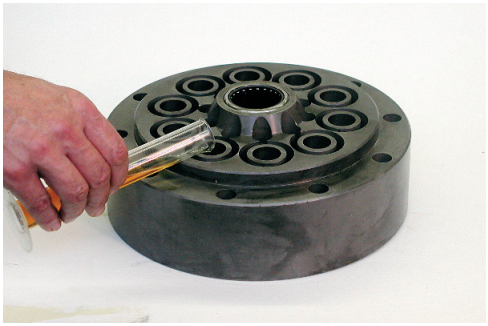
1. Lightly coat the drive shaft with grease prior to long term storage.
2. Always keep the shipping plugs installed in the ports during storage and installation, until the unit is ready for connection to the circuit. This will prevent ingress of dirt and moisture.

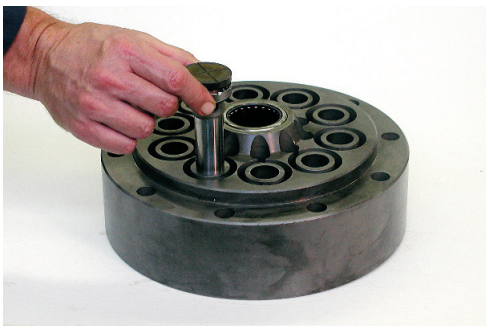
Water Glycol Pumps

1. All external surfaces should be protected prior to exposure to sea atmosphere.
2. All water glycol pumps are filled with an equipment preservative fluid prior to shipment from factory.

   When storing for extended periods, keep the pump case filled with a preservative fluid that has a vapor phase corrosion inhibitor ("Canning EPF", or equivalent). Fill the case at least three-quarters full to cover the pump wobble plate.

   After filling the case, rotate the drive shaft several revolutions to distribute the fluid throughout the pump.
3. Install shipping plugs in ports, to prevent contamination.





CHECKING FOR PROPER SEATING

Confirm that the inlet checkball is seating properly, using the following procedure:

Set the barrel on a smooth, flat surface, with piston bores facing up.

Place a small amount of fluid in one of the piston bores until the bottom is covered. Coat each piston with fluid.

Push each piston into the barrel bore. There should be resistance from the compressing air trapped in the bores. If the piston drops straight down with no resistance, the ball is not sealing properly with its seat.

TROUBLE-SHOOTING

Trouble-shooting pump performance problems varies with the complexity of the system. It is important to review information provided by manufacturers of all components, to have a complete understanding of how the system operates.

Trouble-Shooting Guidelines

Problem	Cause/Remedy
Low Flow or No Pump Flow	1. Check fluid level in reservoir to ensure that suction line is completely submerged. 2. Check inlet line to ensure filter or screen is clear and valves are open. 3. Check power source and coupling to ensure that pump is being driven at proper speed. 4. Check inlet line, fittings and shaft seal for possible air leaks which would cause the pump to lose suction. 5. Ensure that air is bled from pump case and inlet lines.
System Not Developing Pressure	1. Check possible causes listed above for "Low Flow or No Pump Flow". 2. Check the relief valve and any pressure control valves in the circuit for proper setting and operation. 3. Look for leaks in the system (see "External Leakage" below).
External Leakage	1. Replace any worn or damaged pump seals. 2. Check for leaking fittings and other connections. To remedy, apply sealer to pipe threads, replace o-rings on S.A.E. straight thread fittings, or replace entire fitting as needed. Tighten to specified torque values.
Excessive Heat	1. Check for adequate fluid in the system. 2. Confirm proper fluid viscosity. 3. Check the relief valve pressure setting. 4. Check for cavitation caused by a break in the suction line. Ensure filter or screen is clear and valves are open.
Abnormal Pump Noise or Vibrating Pressure Line	1. Check for air or contamination in the system. 2. Check for misalignment of drive shaft at power source. 3. Inspect and repair pump as required.

Minimum Inlet Pressure ①

Pump Models	Operating Speed											
	1200 rpm		1500 rpm		1800 rpm		2400 rpm		2800 rpm		3600 rpm	
	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
Fixed Displacement Pumps:												
PF501 and PF504	0	0	0	0	0	0	0	0	0	0	5	0,4
PF507	0	0	0	0	0	0	0	0	5	0,4	10②	0,7②
PF510	0	0	0	0	0	0	0	0	10②	0,7②	15②	1,0②
PF1002	0	0	0	0	0	0	0	0	0	0	5	0,4
PF1003 and PF1004	0	0	0	0	0	0	0	0	5	0,4	10②	0,7②
PF1005 and PF1006	0	0	0	0	0	0	③	③	10②	0,7②	–	–
PF1007 and PF1008	0	0	0	0	0	0	③	③	10②	0,7②	–	–
PF2007	0	0	0	0	0	0	3	0,2	5	0,4	–	–
PF2008	0	0	0	0	0	0	5	0,4	–	–	–	–
PF2009	0	0	0	0	0	0	3	0,2	5	0,4	–	–
PF2012	0	0	0	0	0	0	5	0,4	–	–	–	–
PF2000 Series (Special Mounting)	0	0	0	0	0	0	5	0,4	–	–	–	–
PF3011	0	0	0	0	0	0	④	④	10②	0,7②	–	–
PF3015	0	0	0	0	3	0,2	④	④	–	–	–	–
PF3017	0	0	0	0	5	0,4	④	④	–	–	–	–
PF3021	0	0	0	0	3	0,2	④	④	–	–	–	–
PF3024	0	0	0	0	5	0,4	④	④	–	–	–	–
PF4011	0	0	0	0	0	0	5	0,4	–	–	–	–
PF4016	0	0	0	0	0	0	5	0,4	–	–	–	–
PF4018	0	0	0	0	5	0,4	10②	0,7②	–	–	–	–
PF4020	0	0	5	0,4	10②	0,7②	15②	1,0②	–	–	–	–
PF4203 and PF4205	0	0	0	0	0	0	–	–	–	–	–	–
PF4208	0	0	0	0	5	0,4	–	–	–	–	–	–
PF4209 and PF4210	0	0	5	0,4	10	0,7	–	–	–	–	–	–
PF6023	0	0	5	0,4	10	0,7	–	–	–	–	–	–
PF6033	0	0	10	0,7	15	1,0	–	–	–	–	–	–
PF6046	0	0	5	0,4	10	0,7	–	–	–	–	–	–
PF6054	0	0	5	0,4	5	0,4	10	0,7	–	–	–	–
PF6070	0	0	5	0,4	10	0,7	⑤	⑤	–	–	–	–
PF6080	5	0,4	5	0,4	10	0,7	⑤	⑤	–	–	–	–
Fixed Displacement Pumps for Water-Based Fluids:⑥												
All PF1300 Models	0	0	0	0	0	0	–	–	–	–	–	–
PF4303 and PF4304	0	0	0	0	0	0	–	–	–	–	–	–
PF4305 and PF4306	0	0	0	0	0	0	–	–	–	–	–	–
PF4308	0	0	0	0	5	0,4	–	–	–	–	–	–
PF4309	0	0	5	0,4	10	0,7	–	–	–	–	–	–
PF4310 and PF4312	0	0	5	0,4	15	1,0	–	–	–	–	–	–
Variable Delivery Pumps:												
PV4018 and PV4026	0	0	5	0,4	5	0,4	10	0,7	–	–	–	–
PV4033	0	0	5	0,4	5	0,4	–	–	–	–	–	–
PV6054	0	0	5	0,4	5	0,4	10	0,7	–	–	–	–
PV6070	0	0	5	0,4	10	0,7	⑤	⑤	–	–	–	–
PV6080	5	0,4	5	0,4	10	0,7	⑤	⑤	–	–	–	–
Pressure Compensated Pumps:												
PV4000 Series	0	0	5	0,4	5	0,4	–	–	–	–	–	–
PV6046 and PV6054	0	0	3	0,2	5	0,4	–	–	–	–	–	–
PV6070	3	0,2	8	0,6	10	0,7	–	–	–	–	–	–
PV6089	5	0,4	10	0,7	15	1,0	–	–	–	–	–	–

① *Values shown are based on fluid viscosity of 100 SUS (20 cSt) mineral oil, except pumps for water-based fluids as indicated.*

② *Inlet pressures higher than 10 psig (0,7 bar) require a high-pressure shaft seal.*

③ *Minimum inlet pressure: 5 psi (0,4 bar) at 2200 rpm.*

④ *Minimum inlet pressure for Model PF3011: 5 psi (0,4 bar) at 2200 rpm and 7 psi (0,5 bar) at 2500 rpm; for Models PF3015 and PF3021: 7 psi (0,5 bar) at 2200 rpm and 10 psi (0,7 bar) at 2500 rpm maximum speed; for Models PF3017 and PF3024: 10 psi (0,7 bar) at 2200 rpm maximum speed.*

⑤ *Minimum inlet pressure for Models PF6070 and PV6070: 10 psi (0,7 bar) at 2300 rpm maximum speed; for Model PF6080 and PV6080: 15 psi (1,0 bar) at 2200 rpm maximum speed.*

⑥ *Values shown are based on fluid viscosity of 33 SUS (1,9 cSt) water glycol fluid. Higher viscosity fluids may require pressurized inlet conditions then indicated.*

PORT DESCRIPTIONS

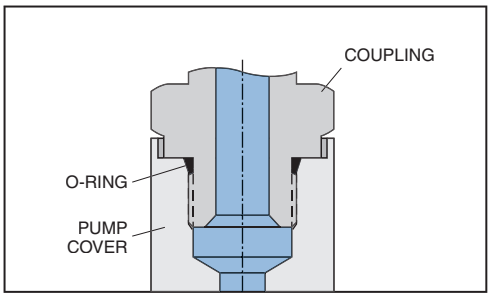
Dynex pumps are available with outlet ports suitable for use at various pressure ranges. Contact the fitting manufacturer to ensure the selected fittings are rated for the maximum pump operating pressure.

S.A.E. Straight Thread Ports

The Straight Thread connection (S.A.E. J1926/1) is sometimes referred to as an S.A.E. o-ring boss, or ORB. The port consists of a machined spotface surface, a tapered seal cavity and a straight thread port.

The fitting forms a seal by compressing the o-ring in the seal cavity with the underside of the flanged wrench flat. Some adjustable fittings, such as elbows and tees, use a locknut with a captive backup washer for compression.

S.A.E. Straight Thread ports are not recommended for operation above 8000 psi (560 bar). Also, the maximum pressure of pumps with No. 12 S.A.E. outlet ports may be limited by the pressure rating of the available fitting. Contact the fitting manufacturer for ratings.



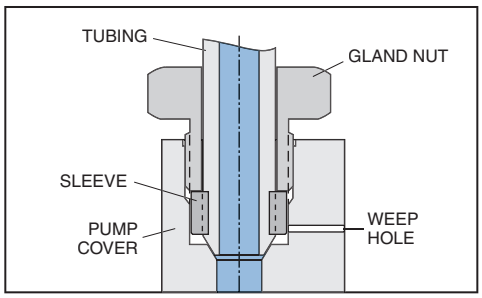
Typical S.A.E. Straight Thread port connection

Coned and Threaded Ports

High-pressure pumps are available with coned and threaded outlet ports, which use Autoclave Medium Pressure, Butech M/P, or equivalent fittings.

These fittings provide a metal-to-metal seal with an interference fit, not requiring an o-ring. The gland nut holds the sleeve and tubing against the cone surface.

A weep hole, visible on the outside of the pump cover, acts as an indicator of any abnormal leakage caused by system conditions (i.e., excessive pressure). It allows any fluid which does leak past the sealing surfaces to escape, preventing pressure build-up and possible damage.



Typical Coned and Threaded port connection

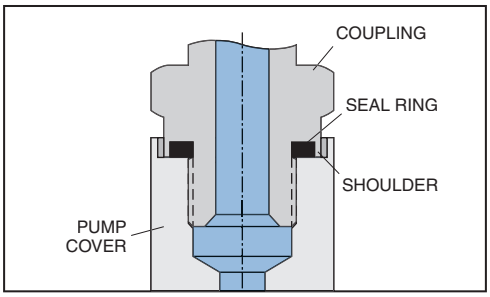
British Standard Pipe Ports

High-pressure pumps are available with flat face ports with British Standard Pipe (B.S.P.) parallel threads (BS 2779 or ISO 228), ideal for use on some European applications.

The fitting forms a seal by compressing a flat elastomer ring on a machined spotface surface. There are several sealing methods for these ports.

The recommended fitting has a recessed seal cavity formed by a shoulder on the underside of the flanged wrench flat (Voss “Peflex”, Form B Shoulder Seal; or Parker Type E, “EOlastic” Seal; or equivalent).

B.S.P. ports are not recommended for operation above 10 000 psi (700 bar). Contact the fitting manufacturer, to ensure the selected fittings are rated for the maximum pump operating pressure.



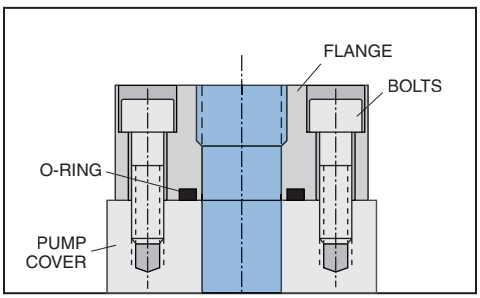
Typical British Standard Pipe (parallel fitting with shoulder) port connection

S.A.E. 4-Bolt Flange Ports

Flange connections are often used for higher flows requiring larger diameter tubing. The port consists of an unthreaded port with four bolt holes in a rectangular pattern on a machined face around the port (S.A.E. J518).

A typical fitting consists of a flanged head with a welded tube and a captive flange with bolt holes. A seal is formed by an o-ring in the groove on the underside mounting surface of the flange head. As the flange bolts are alternately tightened, the o-ring is compressed between the flange head and the machined face on the pump.

To make mounting easier in tight spaces a two-piece split-flange is often used.



Typical S.A.E. 4-Bolt Flange port connection

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