

PSB100 Owner's Manual

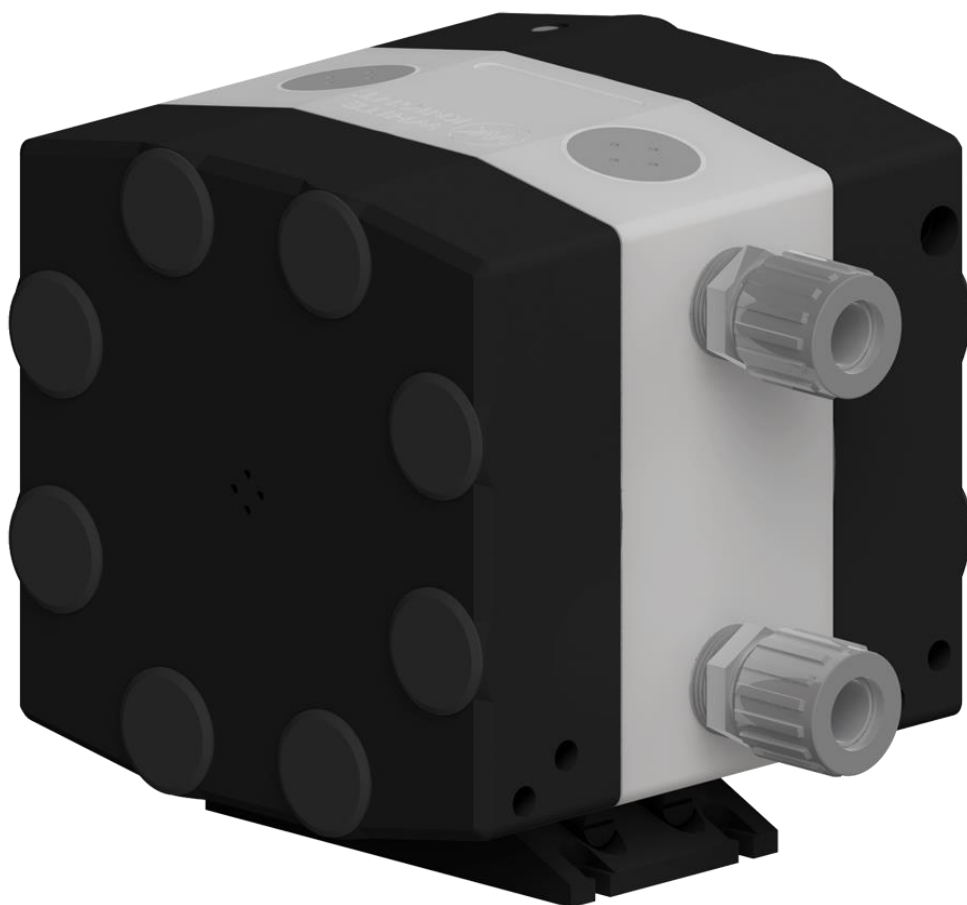


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1. Introduction

Thank You for Purchasing White Knight Products

You have purchased a White Knight product that has been built by a team of technicians with the highest commitment to quality!

White Knight is the world leader in zero-metal, Ultra High-purity pumps and continues to drive the industry with new technology and products. Since the inception of White Knight in 1995, we have been awarded over 14 US patents for our designs and have multiple other patents pending! White Knight currently produces over 30 sizes/models of pumps in varying materials to meet our customers' stringent requirements in numerous applications including ultra-high temperature re-circulation; slurry and high pressure chemical delivery systems.

White Knight has been the recipient of multiple prestigious industry awards for its designs and continues to lead the industry in quality because White Knight manufactures products from raw material to finished goods in our own facility located in Kamas, UT. This allows us to rigorously manage our quality assurance process to ensure that our strict cleanliness procedures are always followed and that components are built using consistent methods and conditions to make our products reliable and consistent.

Our strict process controls include assembling and testing our products in a class 100, temperature and humidity-controlled cleanroom. White Knight products also pass functional tests and are then dried with CDA and double bagged in the cleanroom to ensure cleanliness and operational integrity.

Before installing your White Knight product, please carefully review the product manual. There are many helpful hints and ways to optimize the set up and use of your White Knight product as well as instructions and requirements for installation. In addition, there are many accessories in this manual will enhance the functionality of your White Knight product.

Our team has gone to great lengths to provide you with the highest quality products at the best value and we back them up with excellent warranties and world class support! We hope you agree our products will serve your exacting needs and meet your stringent requirements every time you use a White Knight Product.

Sincerely,

Steve Smith
CEO
White Knight Fluid Handling

2. Installation

2.1. Unpacking

After unpacking, verify that no components of the pump have been damaged in shipping. Damage should be reported to the carrier immediately.

In the box, the Pump and a Product Manual will be found, in addition to any accessories ordered with the pump (when possible).

2.2. Tie Bolt Torque

The tie bolts on the pump are tightened before leaving the factory. However, relaxation may occur due to handling, material creep, or other unforeseen events. White Knights recommends that the pump is re-torqued on install, as well as after thermal cycling, or if the pump remains sitting for an extended period of time.

To re-torque the pump:

1. Remove black tie bolt caps from both sides of the pump
2. Apply 60in-lbs of torque to each bolt on the slave head, while holding the master side bolt stationary. A star pattern is recommended.
3. Replace the bolt caps

2.3. Utilities/Hookup

The pump is mounted with four ¼" bolts. It is recommended that the pump be mounted not more than 15° from level to maintain its self-priming ability and pumping efficiency.

Air Inlet: 1/2in FNPT (3/8in Diam. (8mm) supply tube minimum)

Air Supply: 25-80 PSI (1.4-4.1 bar) Clean Dry Air or nitrogen

Fluid Ports: See Supplier Specifications

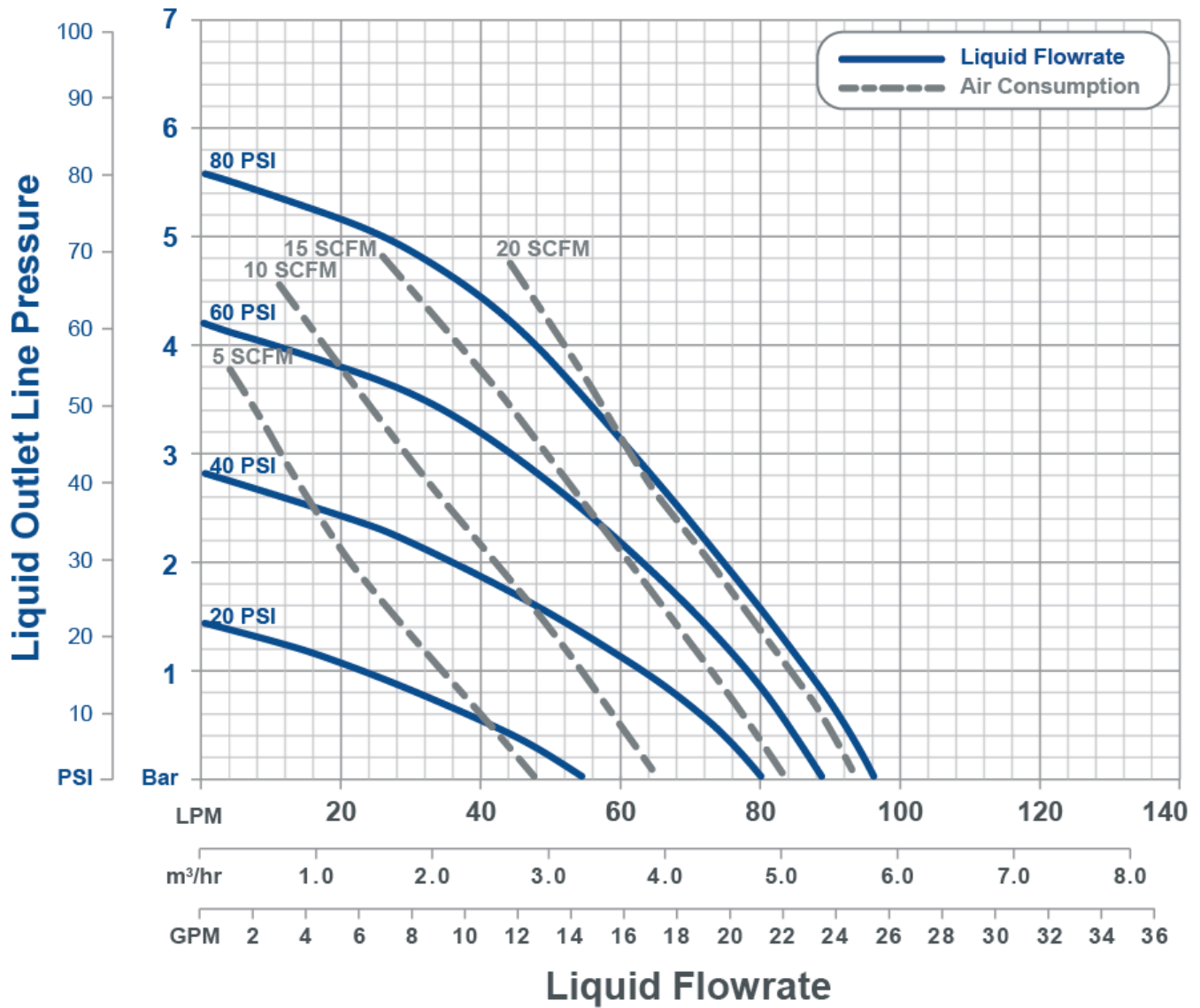
3. Specifications and Performance

3.1. Pump Specifications

PSB100 Pump Specifications								
Flow Rate	Fluid Connection Size ¹	Displacement Per Cycle ²	Max Cycles Per Minute	Fluid Path Materials	Non Fluid Path Materials	Weight	Sound Pressure dB(a)	Sound Power dB(a)
25 GPM 94.64 LPM	3/4in	500ml	156	PTFE, PFA	PTFE, PFA, PP, SS, PEEK			

1. Standard connection. Additional connection sizes are available
2. Displacement per cycle will vary based on air supply and fluid head pressures

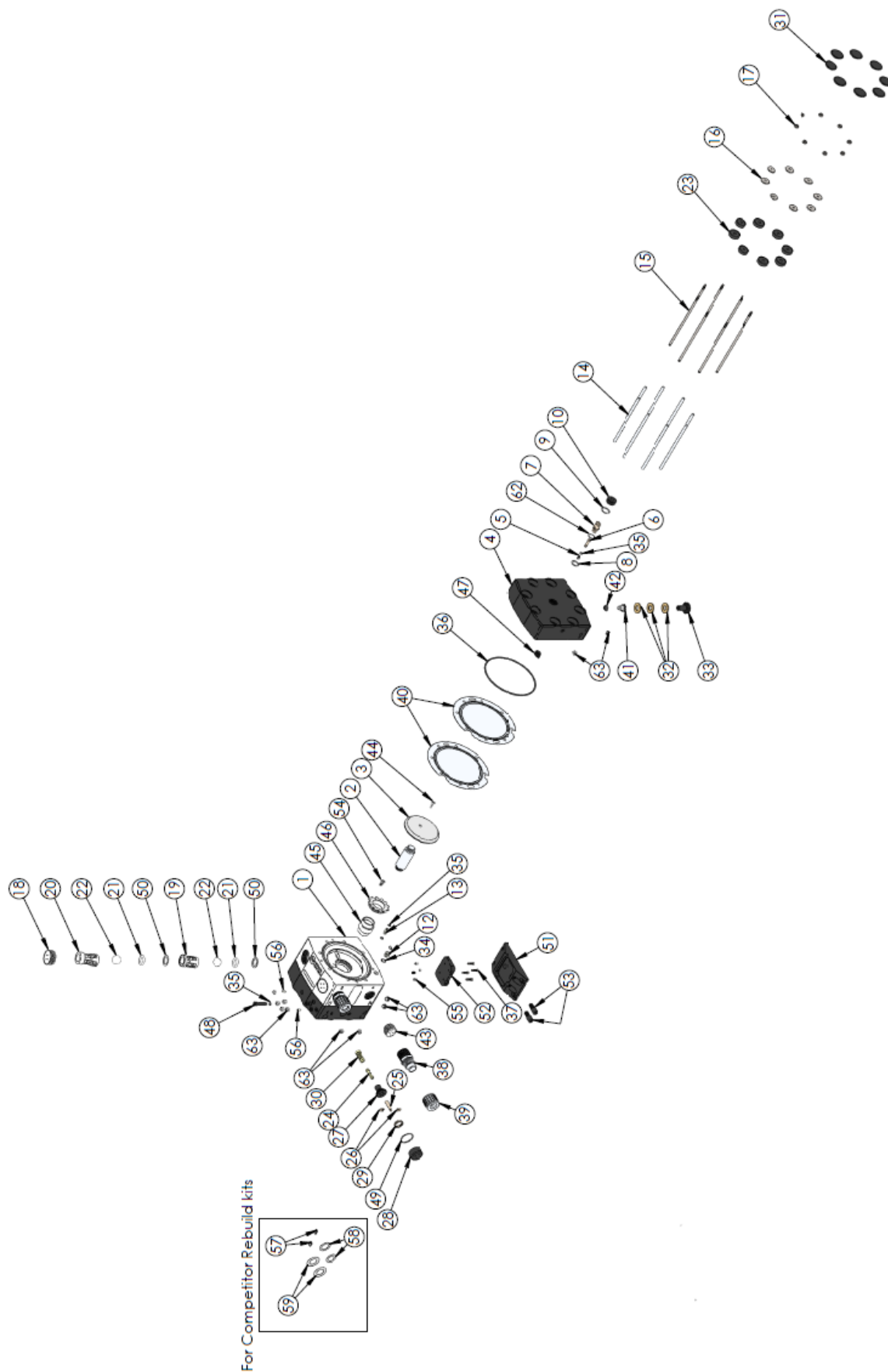
3.2. Performance Curve



Please note that this flow curve represents actual testing with water at ambient temperatures at elevation, and has been mathematically adjusted to represent values at sea level.

3.3. Exploded View

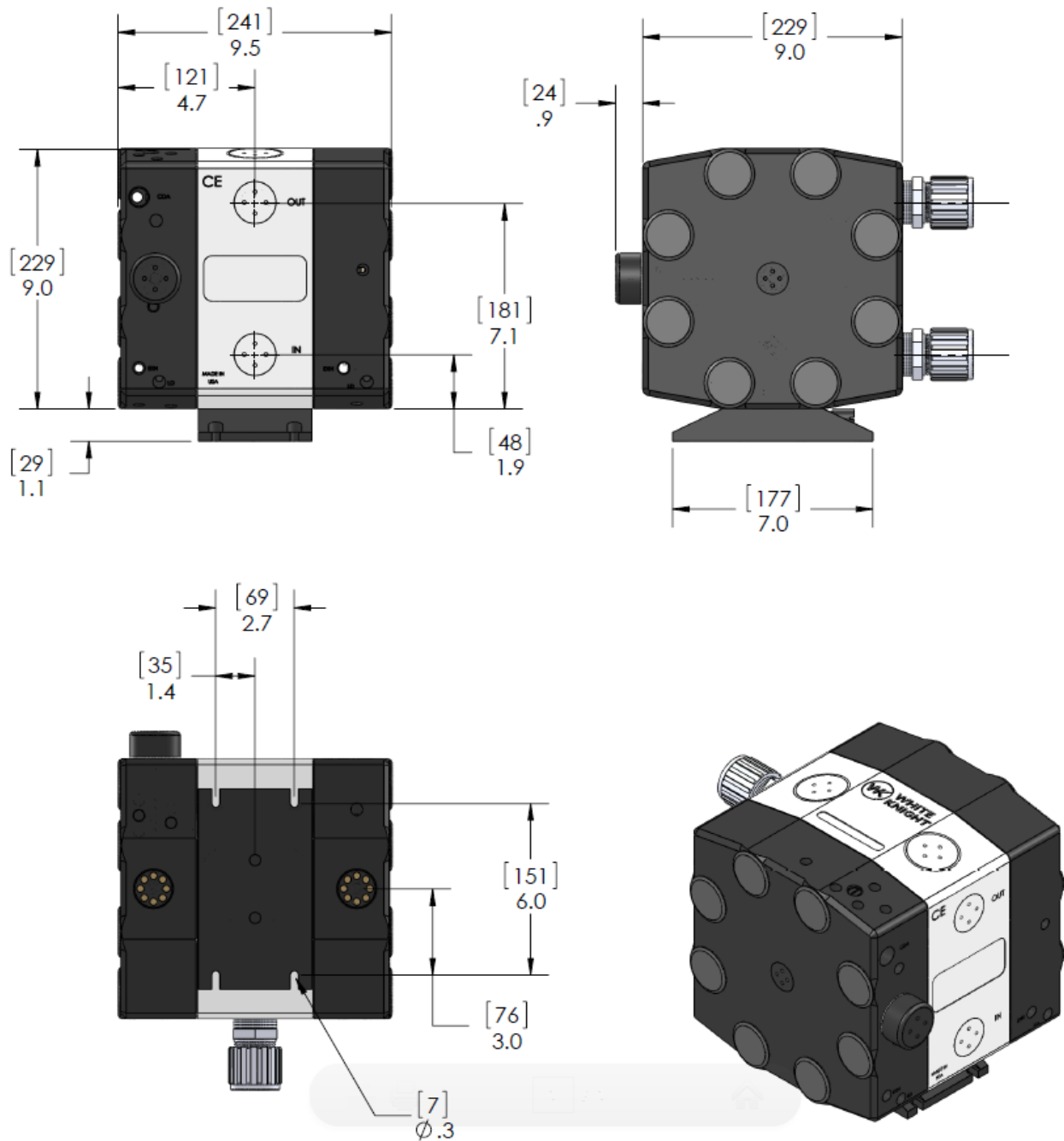
PSB100



ITEM NO.	PART NUMBER	DESCRIPTION	Material	QTY.	ITEM NO.	PART NUMBER	DESCRIPTION	Material	QTY.
1	1125-TE-0027	BODY, PSB100	PTFE	1	33	6140-BP-0001	MUFFLER CAP, PSB100	BPP	2
2	5144-PF-0026	SHAFT, PSB100	PFA	1	34	10080-VI-014-75	014 O-RING	FKM	4
3	3300-TE-0001	STRIKE PLATE, PSB100	PTFE	2	35	10080-VI-010-75	010, O-RING	FKM	7
4	2127-BP-0012	HEAD, SLAVE, PSB100	BPP	1	36	10080-VI-262-75	262 O-RING	FKM	2
5	10010-TE-0020	SHIFT PN SCREW, PSB100	PTFE	2	37	10010-SS-0050	10-32 SCREW, .750 LONG	SS	4
6	2128-PKC-0002	SHIFT PISTON, PSB100	CARBON PEEK	2	38	7200-PF-0010	1" FLARETEK-30GPM	PFA	2
7	2128-PKC-0001	PILOT VALVE SLEEVE PSB100	CARBON PEEK	2	39	7210-PF-0005	1" FLARETEK NUT (PFA)	PFA	2
8	10050-MP-0011	SHIFT PN INNER CAP WASHER SEAL	MPTE	2	40	3200-PF-0001	DIAPHRAGM, PSB100	PFA FILM	4
9	10050-MP-0012	SHIFT PN OUTER CAP WASHER SEAL	MPTE	2	41	6150-UH-0003	QUICK EXHAUST SEAT, PSB100	UHMW PE	2
10	6530-BP-0003	SHIFT PN OUTER CAP, PSB100	BPP	2	42	3200-VI-0001	DIAPHRAGM, Ø .782	FKM	2
11	2127-BP-0013	HEAD, MASTER, PSB100	BPP	1	43	7130-TE-0008	OUTLET PLUG, PSB100	PTFE	2
12	10070-NP-0001	AIR TUBE, SUPPLY	NPP	2	44	10010-TE-0021	SHAFT LOCK SCREW, PSB100	PTFE	2
13	10070-NP-0002	AIR TUBE, SHIFT	NPP	2	45	5143-TE-0009	SHAFT SEAL, PSB100	PTFE	1
14	10070-PF-0016	TIE BOLT SLEEVE	PFA	8	46	5143-TE-0010	RETAINER SHAFT SEAL, PSB100	ddd	1
15	10010-SS-0048	TIE BOLT, PSB100	SS	8	47	6150-BP-0004	AIR DIFFUSER, PSB100	BPP	2
16	10050-SS-0010	TIE BOLT WASHER	SS	16	48	10040-BP-0002	SECONDARY AIR PLUG, PSB100	BPP	1
17	10010-SS-0049	FLANGE NUT, 1/4-20	SS	16	49	10050-MP-0013	SHUTTLE OUTER CAP SEAL, PSB100	MPTE	1
18	4140-TE-0008	TOP CHECK PLUG, PSB100	PTFE	2	50	10050-MP-0004	CHECK SEAT WEAR WASHER, PSB100	MPTE	4
19	4137-TE-0009	BOTTOM CHECK CAGE, PSB100	PTFE	2	51	1146-BP-0005	QUICK CHANGE BASE PLATE, PSB100	BPP	1
20	4142-TE-0011	TOP CHECK CAGE, PSB100	PTFE	2	52	1146-BP-0006	QUICK CHANGE ADAPTER PLATE, PSB100	BPP	1
21	10080-TE-317-75	317 O-RING	PTFE	4	53	10010-BP-0011	BASE PLATE SCREW, PSB100	BPP	2
22	4100-TE-0004	CHECK BALL- 1-1/8"	PTFE	4	54	10010-TE-0022	FLAT HEAD PHILLIPS, .3125-18, .75 LONG	PTFE	1
23	10050-NE-0001	TIE BOLT RUBBER INSERT	CR	8	55	10010-SS-0062	THREADED INSERT 10-32 INTERNAL THREAD	SS	4
24	6560-CE-0006	SHUTTLE SPOOL, PSB100	CE	1	56	10040-NP-0009	.0625 SHIFT AIR ORIFICE	NPP	2
25	6570-PK-0001	SHUTTLE DETENT SPOOL ADAPTER, PSB100	PEEK	1	57	6570-PH-0001	SHUTTLE DETENT LEG, PSB100	PAI	2
26	6570-PK-0003	SHUTTLE DETENT LEG-ROUNDED ENDS	PEEK	2	58	10050-GY-0001	INLET/OUTLET WASHER SEAL, PSB100	GYLON	2
27	6530-BP-0004	SHUTTLE INNER CAP, PSB100	BPP	1	59	10050-GY-0002	CHECK PLUG WASHER SEAL, PSB100	GYLON	2
28	6530-BP-0005	SHUTTLE OUTER CAP, PSB100	BPP	1	60	6140-BP-0002	MUFFLER CAP PLUG, PSB100	BPP	1
29	6570-PK-0002	SHUTTLE RING DETENT, PSB100	PEEK	1	61	10080-VI-123-75	123 O-RING, 75 DUROMETER	FKM	1
30	6550-CE-0006	SLEEVE, PSB100	CERAMIC	1	62	10080-VI-018-75	018 O-RING, 75 DUROMETER	FKM	2
31	10040-BP-0001	TIE BOLT CAP	BPP	16	63	10040-TE-0003	NPT PLUG - 1/4"	PTFE	11
32	6140-PP-0007	MUFFLER FELT BAFFLE, PSB100	NPP	6					

3.4. Dimensional





PSB100



4. Installation and Precautions

4.1. Precautions

High Temperature Operation
Operating the pump at temperatures exceeding 60°C requires periodic tightening of the tie bolt nuts. The time period in between tie bolt nut tightening will be affected by ambient temperature, process fluid temperature as well as any temperature fluctuations (thermal cycling).
Service Schedule
Inspection of the torque placed on the tie bolts should be inspected every 6 months. Select Internal components should be inspected every 12 months
Required Air Flow (White Knight shuttle valve)
Required air flow for the PSB100 pump is 3/8" minimum orifice unrestricted.
Required Air Flow (External Solenoid Valve)
Required solenoid C_v for the PSB100 pump is 1.5 C_v . Using a pump with a reduced C_v will result in reduced flow rates as compared to White Knight published flow curves. Using a pump with a solenoid valve with over 20% greater C_v will result in the pump operating outside its normal operating parameters which will result in reduced pump life and will void the pump warranty.
Liquid Inlet/Outlet
THESE LIQUID PORTS ARE NOT NPT OR ANY OTHER STANDARD. Attempting to use connectors other than those supplied by White Knight will damage the pump, and will void warranty.
Running Dry
Wet shaft pumps use the liquid that they are pumping to lubricate the shaft. Running the pump dry causes it to cycle much faster than normal - accelerating normal wear. Running the pump dry for more than a couple of minutes will damage the pump, and it may cause it to lose its ability to self-prime. For applications requiring dry run situations, White Knight recommends an SD pump model
Supply Pressure Recommendations
The life of your pump may be extended significantly by operating your pump 30%-40% below redline operating supply pressures. A minimal operating supply pressure of 20 PSI is required.
Operating a Pulsation Dampener with a White Knight Shuttle Valve
When using a pulsation dampener with a White Knight shuttle valve driven pump, the air operating pressure of the pump should be at least ten PSI higher than that of the liquid line. Failure to do so may cause the pump to run erratically.
Orientation
White Knight does not recommend installing your pump in any position other than its upright position. Check valves within White Knight high purity pumps are actuated by gravity and/or flow and perform most effectively in the upright position.
Restriction of Liquid Inlet Line
Restricting the liquid supply of the pump forces the pump to work harder than normal and should be avoided when possible. Pumping against a closed liquid inlet will cause serious damage to your pump. All White Knight high purity diaphragm pumps may be controlled by closing off the liquid outlet.

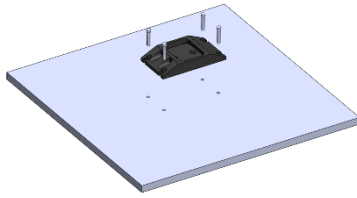
Under Supply of Air	
Undersupplying air to a pump will cause it to run erratically or stall. For best results, White Knight recommends running pumps at air pressures slightly above the averaged air consumption curves found on the performance curves graph. Additionally, air supply lines and fittings must meet the minimal ID (inner diameter) requirements published in the installation instructions.	
Cross Contamination	
PTFE and many other plastics are very porous and may retain chemicals in the pores of the material. Record chemistries used in a pump to avoid cross contamination.	
WARNING: Liquids and Gasses Under Pressure	
	While in a live system, pumps contain pressurized liquids and gasses. All pressure, liquid and air must be eliminated via shut off valves before the pump may be removed or detached from the system.
WARNING: Potential for High Surface Temperatures	
	When pumps are operated with high temperature fluids, heat may transfer to the exterior surfaces of the pump. Avoid direct contact with the pump when high temperature fluids are present.
WARNING: Handling of Chemicals	
	In the event that hazardous chemicals are used in or around the pump, ensure that appropriate personal protective equipment is used before handling. Reference the chemistry's Material Safety Data Sheet (MSDS) for handling instructions or other information specific to that chemical.
WARNING: Noise Potential	
	The exiting of exhaust air from the pump will contribute to a work area's noise level. Always operate White Knight pumps with the approved muffler media. When working in noisy conditions, use the necessary ear protection.

4.2. System and Pump Environment Recommendations/Requirements

Oversized Inlet Line
Pumps operate optimally with liquid inlet lines larger than the liquid outlet lines. This reduces strain on the diaphragms and may reduce pulsation in the pump outlet.
Clean Supply Air (CDA)
White Knight high purity bellows pumps require the use of class 2 air for particles and moisture per ISO 8573-1. (Use 10 micron filter, maintain -40° C dew point)
Flammable Solvents
White Knight high purity diaphragm pumps are not constructed from conductive materials. Any system used to pump flammable solvents should be properly grounded to avoid ignition by static charge. A test from River's Edge on using isolative pumps to pump flammable liquids indicated that the liquid itself must be grounded and that other procedures should be followed. A copy of the test is available upon request from White Knight.
Pumping Liquids Near Boiling Point
Minimizing suction lift in a system reduces pulsation and the potential boiling or outgassing of liquid in the inlet of the pump. Reciprocating pumps are designed to pull suction lift, but pump performance and life will increase when suction lift can be minimized or eliminated.
Abrasive Slurries
Pumping of abrasive slurries will shorten the life of any pump. White Knight high purity pumps are still warrantied when used in abrasive applications however; wear of components will be accelerated. Normal wear is not a condition covered by warranty.
Environmental Temperature
This pump is rated to withstand environmental temperatures up to 50°C.

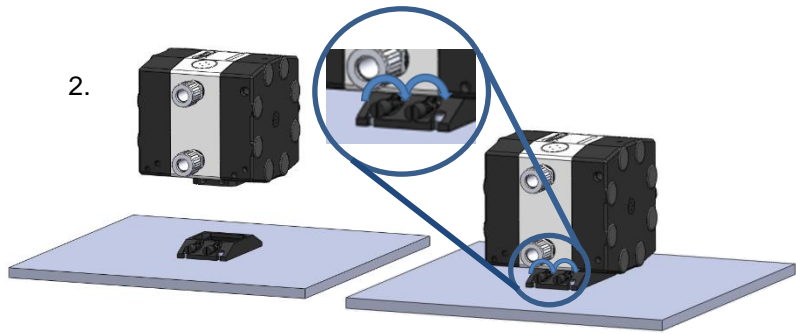
4.3. Installation Instructions

1.



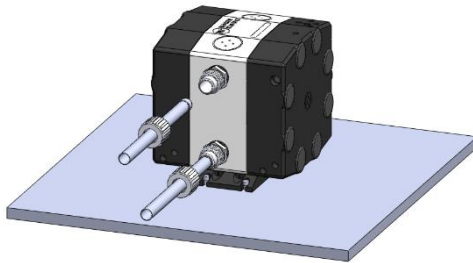
Attach base plate to work space using 4 bolts, in predrilled holes.

2.



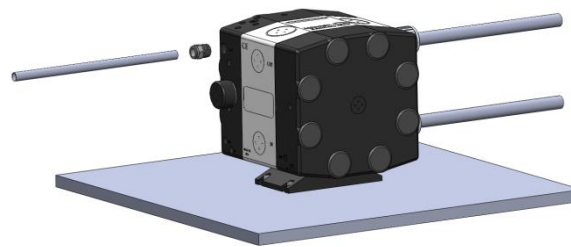
Align pump to base plate and lower onto stand, ensuring base is fully seated. Tighten set screws on front of base.

3.

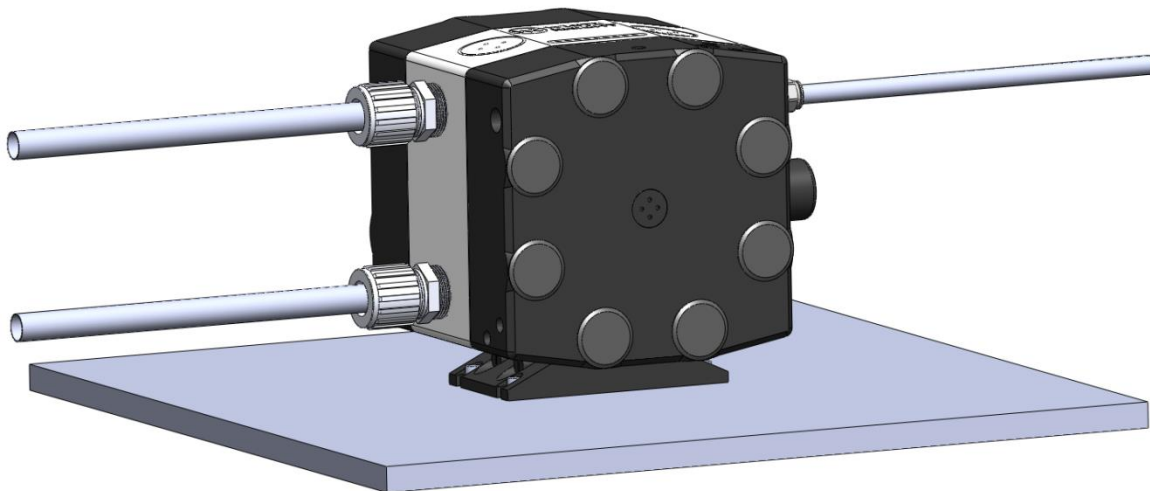


Attach liquid fittings per manufacturer's instructions.

4.



Attach air supply using 1/2in FNPT port (CDA Port) on pump head



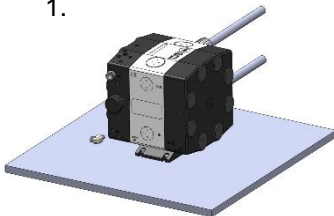
5. Pump Control and Monitoring

- PROGRAMMABLE CONTROLLING: White Knight offers the CPT-1 pump controller as a solution to control a White Knight pump. Run mode, flow rate and leak detection are a few items the CPT-1 controls or monitors.



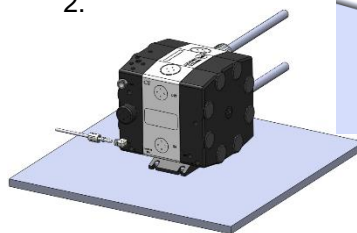
5.1. Pressure Switch Stroke Detection Attachment Instructions

1.

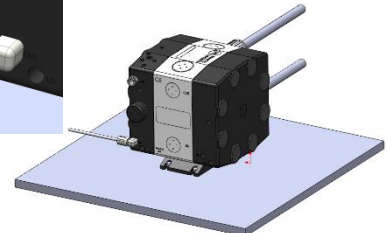
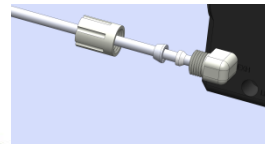


Attach the elbow to the EXH port in the head.

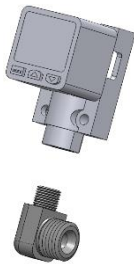
2.



Attach tubing using air gripper assembly

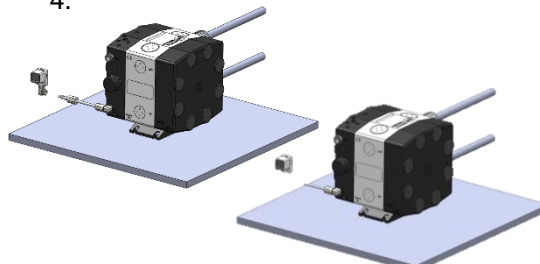


3.



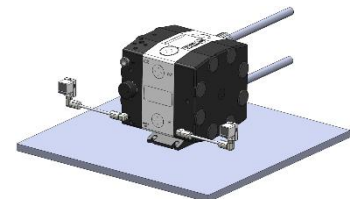
Attach the gripper elbow to the Pressure Switch

4.



Attach pressure switch to tubing

5.

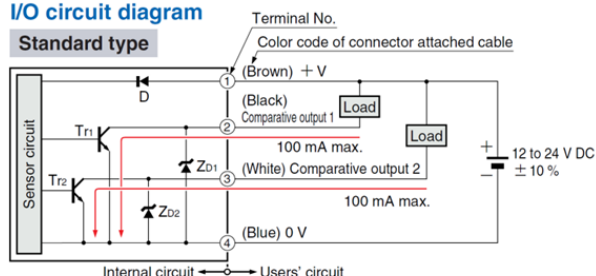


For Dual Pressure Switch, repeat all steps for second head.

5.2. Pressure Switch Stroke Detection Electrical Hookups and Dimensions

NPN I/O circuit diagram

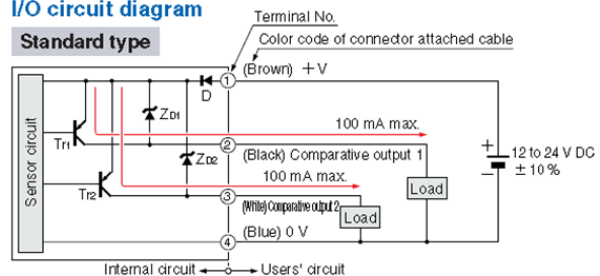
Standard type



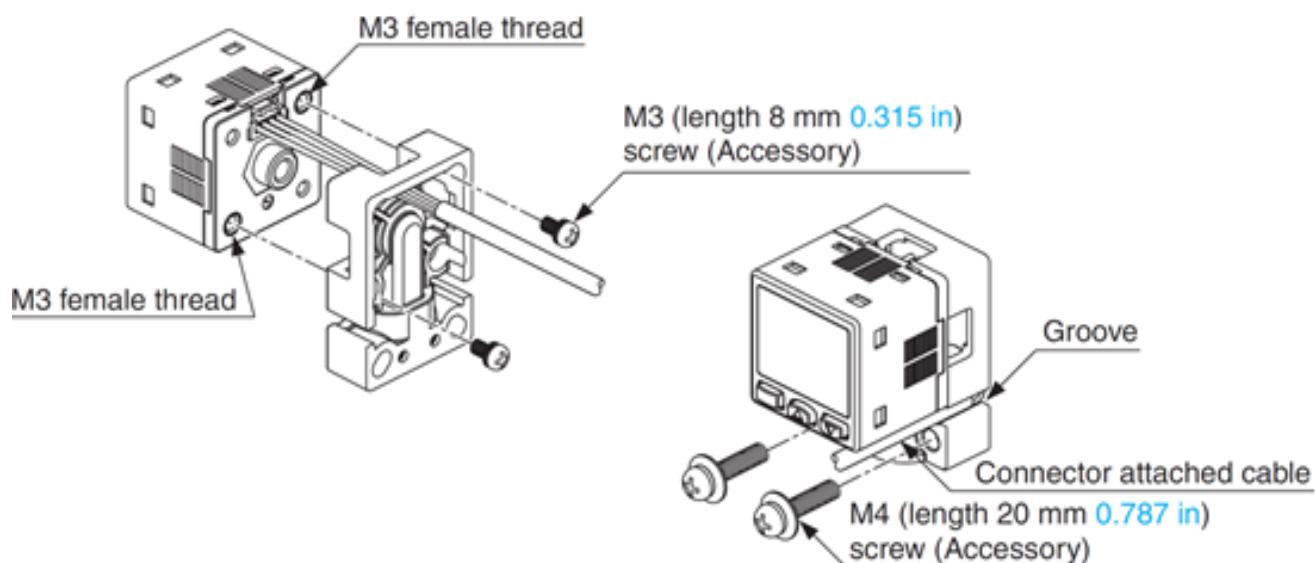
Symbols ... D : Reverse supply polarity protection diode
Z_{D1}, Z_{D2} : Surge absorption zener diode
T_{r1}, T_{r2} : NPN output transistor

PNP I/O circuit diagram

Standard type

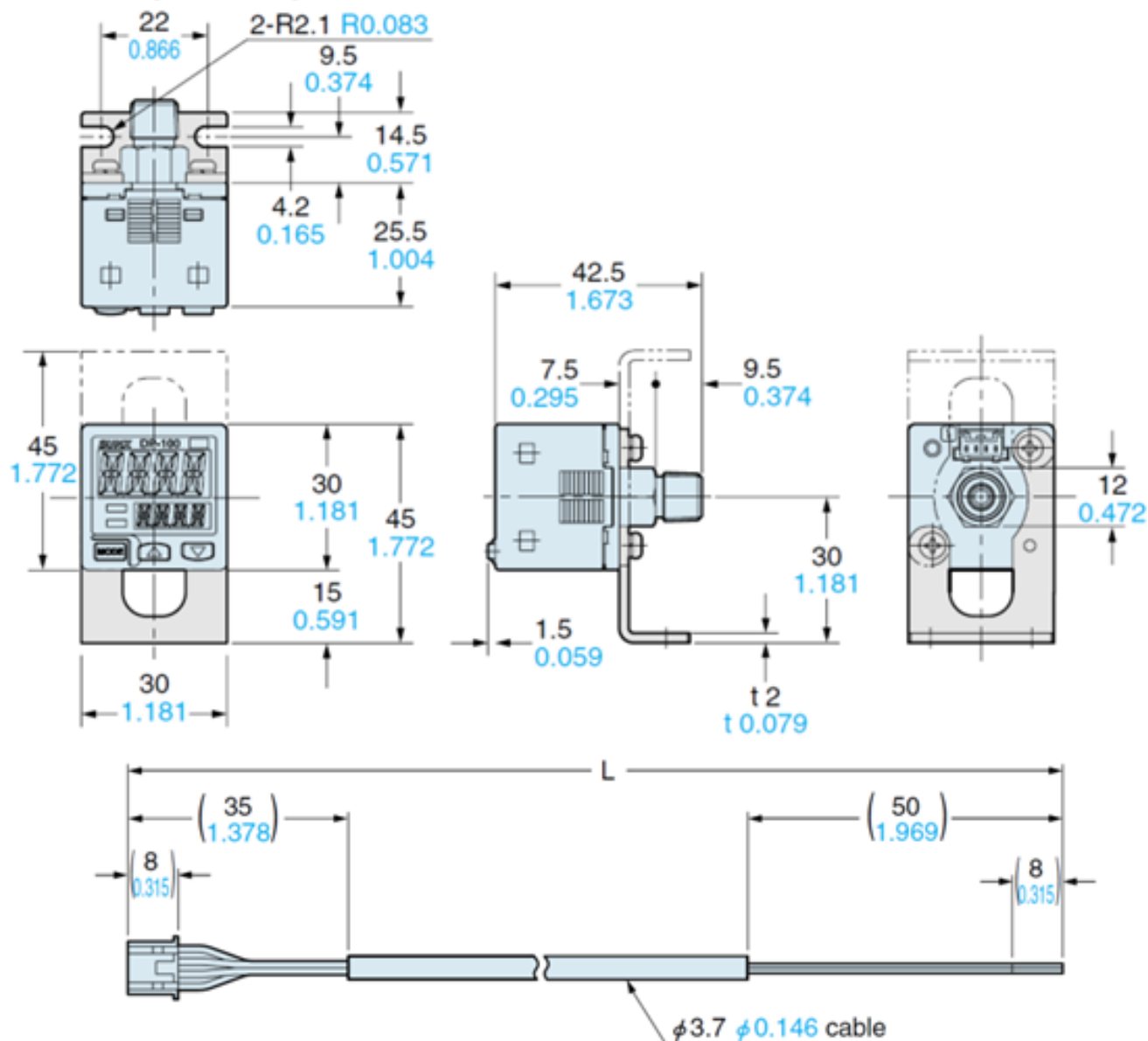


Symbols ... D : Reverse supply polarity protection diode
Z_{D1}, Z_{D2} : Surge absorption zener diode
T_{r1}, T_{r2} : PNP output transistor



Assembly dimensions

Mounting drawing with DP-10□



6. Accessories

Control and Monitoring Options

Stroke Detection

- Solid State Pressure Switch SP1
- Solid State Dual Pressure Switch SP2

Leak Detection

- Conductivity Leak Detection LC0
- Control Options – Run mode and flow rate are two of the items which the CPT-1 can control/monitor

Pump Catcher

- In-line and pump-mounted options available
- Large through holes to avoid loading
- Filter may be removed without removing the Catcher™ from the pump or the line
- If a pump were damaged by passing solids while using the Catcher™ it would be repaired under warranty

Filter Housing

- 100% Non-metallic
- Allows for filter changing without disconnecting the inlet/outlet lines
- Options available for up to 210°C
- Available with industry standard fluid connections
- Designed to allow for thermal cycling
- Upright and invert installation options available
- Space saving manifold options available in series and parallel configurations

Quick Exhaust Valves

- Allows for immediate escape of exhaust air, reducing pulsation and exposure of solenoid valve to corrosive fumes
- In-line and pump mounted options available
- Polypropylene and PTFE designs available
- Comes standard with a one-year warranty

Pulse Dampeners

- Operates with self-adjusting Auto Level Valve regulated by liquid line pressure
- Operates with the same CDA supplied to the pump
- Inline and pump-mounted options available
- Available with compatible sizes for all White Knight high purity pumps

7. Pump Warranty

White Knight Fluid Handling® follows strict procedures in all phases of manufacturing, assembly and testing to ensure reliability of its products. Each pump is individually tested to assure its functional operation integrity.

White Knight Fluid Handling® warrants PSB100 pumps, subassemblies and components to be free from defects in materials and workmanship for the period of Two years from the date of start-up or 30 months from the date of shipment, whichever applies. Failures due to misuse, abuse or any unauthorized disassembly of a White Knight® pump will nullify this warranty. Pump warranty subject to recommended service at intervals during the warranty period.

PSB100 pumps are warranted for up to 80 PSI air supply pressures. They are not covered under dry run condition. Wearable parts are not covered if used to pump abrasive slurries.

Due to the broad and ever-evolving applications for usage of White Knight® pumps we cannot guarantee the suitability of any pump component or subassembly for any particular or specific application. White Knight Fluid Handling shall not be liable for any consequential damage or expense arising from the use or misuse of its products in any application. Responsibility is limited solely to the replacement or repair of defective White Knight® pumps, components or subassemblies. All options to rebuild or replace aforementioned items shall remain under the judgment of White Knight Fluid Handling. Decisions as to the cause of failure shall be solely determined by White Knight Fluid Handling.

PRIOR WRITTEN, FAXED OR EMAILED APPROVAL MUST BE OBTAINED FROM WHITE KNIGHT FLUID HANDLING BEFORE RETURNING ANY PUMP COMPONENT OR SUBASSEMBLY FOR WARRANTY CONSIDERATION.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING ANY WARRANTIES OF SUITABILITY FOR ANY PARTICULAR PURPOSE. NO VARIATIONS OF THIS WARRANTY BY ANYONE OTHER THAN THE PRESIDENT OF WHITE KNIGHT FLUID HANDLING IN A SELF-SIGNED AGREEMENT SHALL BE HONORED OR CONSIDERED LEGALLY BINDING.

Steve Smith, CEO
White Knight Fluid Handling

8. Pump Service and Rebuilds

8.1. Ordering Instructions

White Knight Fluid Handling, Inc.

PSB100 Ordering Instructions

Required Configurations			Additional Options (Not Required)					Rev					
PSB100	-	F	16	-	LC0	-	SP1	-	T	S	12	-	8
		①	②		③		④		⑤	⑥	⑦		⑧

Bold = standard option

Please select one option from each of the required fields (1 - 2). To configure your pump with different inlet and outlet fittings, leak or stroke detection, or request a specific revision level, please select options from the appropriate additional options (3-8).

① ② Liquid Fitting Configuration

Pump Configuration		Inlet Style	① Fitting Style		② Fitting Size	
PSB100	Standard Configuration	Front Straight Only	F	= Flaretek® compatible	12	= 3/4"
			T	= Tube Out	16	= 1"
			W	= Weldable <small>*Not available in 1-1/4"</small>	20	= 1-1/4"
			P	= Pillar S-300®	If the liquid inlet and outlet fitting styles are different, please define the liquid inlet fitting from section 1-2 and use the liquid outlet section below (5-7) to differentiate.	
			N	= Female NPT <small>*Not available in 1-1/4"</small>		
			D	= Accessible Disk Seal Liquid Connection (NO FITTING)		

Optional Configurations

③ Leak Detection

LC0 = 15' conductivity cable

④ Stroke Detection

SP1	= Pressure Switch (NPN) (single pressure switch)
SP2	= Pressure Switch Dual (NPN) (comes with two each DP2 pressure switches)*
SP3	= Pressure Switch Dual (no Pressure switches supplied)*
SP4	= Pressure Switch (PNP) (single pressure switch)
SP5	= Pressure Switch Dual (PNP) (comes with two each DP2 pressure switches)*

⑤ ⑥ ⑦ Liquid Outlet and Fitting Configuration (if different from inlet)

⑤ Outlet Style		⑥ Fitting Style		⑦ Fitting Size	
F	Front Straight Outlet	F	= Flaretek® compatible	12	= 3/4"
T	Top Straight Outlet	T	= Tube Out	16	= 1"
		W	= Weldable <small>*Not available in 1-1/4"</small>	20	= 1-1/4"
		P	= Pillar S-300®	If the liquid inlet and outlet fitting styles are different, please define the liquid outlet fitting from section 5-7 and use the fitting section above (1-2) to differentiate.	
		N	= Female NPT <small>*Not available in 1-1/4"</small>		
		D	= Accessible Disk Seal Liquid Connection (NO FITTING)		

⑧ Revision Level: Contact factory for copy exact code activation information.

Operating this pump in timer mode requires the use of an end of stroke detection mechanism (pressure switch) to prevent the pump from over stroking. Failure to use end of stroke detection as a safety while operating in timer mode will void the warranty of this pump.

Rebuild Parts for the PSB100 Pump (12 Month Kit)

Kit Number: RBPSB100-1

Part Number	Description	Qty.
5143-TE-0009	Shaft Seal, PSB100	1
6570-PI-0001	Shuttle Detent Leg, PSB100	2
6570-PK-0002	Shuttle Ring Detent, PSB100	1
6570-PK-0003	Shuttle Detent Leg – Rounded Ends	2
10010-TE-0020	Shift Pin Screw, PSB100	2
10040-BP-0001	Tie Bolt Cap	16
10080-TE-317-75	317 PTFE O-ring	4
10080-VI-010-75	010 O-Ring	4
10080-VI-014-75	014 O-Ring	4
10080-VI-262-75	262 O-ring	2
10050-GY-0001	Inlet/Outlet Washer Seal, PSB100	2
10050-GY-0002	Check Plug Washer Seal, PSB100	2
10050-MP-0004	Wear Seat	4

Rebuild Parts for PSB100 Pump (24 Month Kit)

Kit Number: RBPSB100-2

Part Number	Description	Qty.
3200-PF-0001	Diaphragm, PSB100	4
3200-VI-0001	QEV Diaphragm, 0.782	2
4100-TE-0004	Check Ball - 1-1/8in	4
5143-TE-0009	Shaft Seal, PSB100	1
6570-PI-0001	Shuttle Detent Leg, PSB100	2
6570-PK-0002	Shuttle Ring Detent, PSB100	1
6570-PK-0003	Shuttle Detent Leg – Rounded Ends	2
10010-TE-0020	Shift Pin Screw, PSB100	2
10040-BP-0001	Tie Bolt Cap	16
10080-TE-317-75	317 PTFE O-ring	4
10080-VI-010-75	010 O-Ring	4
10080-VI-014-75	014 O-Ring	4
10080-VI-262-75	262 O-ring	2
10050-GY-0001	Inlet/Outlet Washer Seal, PSB100	2
10050-GY-0002	Check Plug Washer Seal, PSB100	2
5144-PF-0026	Shaft, PSB100	1
10050-MP-0004	Wear Seat	4

8.2. Maintenance Schedule

PSB100 Maintenance Schedule	Install	6 Months	12 Months	18 Months	24 Months
Tie Bolt (60Lb-in)	I	I	I	I	I
C-Ring and Detent Legs			R		
Pilot Button			R		
Check Seat Wear Rings			R		
Shaft Bushing			R		
Shaft (High Suction Applications)			R		
Shaft					R
Diaphragms and Main Seal					R
Quick Exhaust Seal					R
Check Balls and Seals					R
Check Balls and Seals (High Suction Applications)					R
Exhaust Muffler Media					R
I=Inspect, R=Replace					

8.3. Disassembly

Throughout a pumps life, rebuilds will be performed to ensure consistent, quality operation. The instructions below are included to facilitate the disassembly required to service the pump.

- Ensure the pump is purged and clean of any chemistry in the pump. White Knight recommends the pump be flushed for 30 minutes with Deionized water, under its own power if possible. If the pump is not functional, deionized water should be pumped into the inlet of the pump, and out of the outlet for 1 hour.
- Remove tie bolt caps from the slave head
- Remove nuts from the tie bolts (Slave Head Side). Leave tie bolts in place
- Lay the pump on its side with slave side up
- Lift off the slave head
- Remove the main seal and diaphragms
- Remove the O-rings from the shuttle transfer tube
- Remove the body assembly
- Remove the second set of diaphragms and main seal
- Remove the transfer tube and O-rings from the heads and body
- Remove the remaining tie bolt caps and tie bolts

NOTE: All plastic pump components should be immersed in Deionized water to ensure complete neutrality of any residual fluid on the components and reduce the risk of chemical exposure.

8.3.1. Head Disassembly

- Remove Label Cap
- Remove pilot cap from both heads
- Remove the pilot valve and seals from the Master and Slave heads
- Remove the shuttle spool assembly from the adapter detent
- Remove C-ring and detent legs from shuttle spool assembly
- Remove detent adapter
- **DO NOT REMOVE** the shuttle sleeve assembly from the shuttle bore
- Remove the muffler spool and muffler pads from each head
- Remove quick exhaust ports from heads
- Remove quick exhaust seals
- Remove remote exhaust plugs (if necessary)

8.3.2. Body Disassembly

- Remove check bore caps using appropriate pin tool
- Remove sleeves, balls, O-rings and check seat wear rings. **DO NOT USE EXCESSIVE FORCE**
- Unthread push plate locking screw and push plate from the one side of the shaft
- Remove remaining shaft and push plate from body
- Unthread second locking screw and push plate from shaft
- Unthread shaft bushing locking screw from body
- Using appropriate pin tool, insert pins in shaft bushing locking ring located in the master head side of chamber and rotate CCW to remove bushing. Then push out bushing from the slave head chamber side

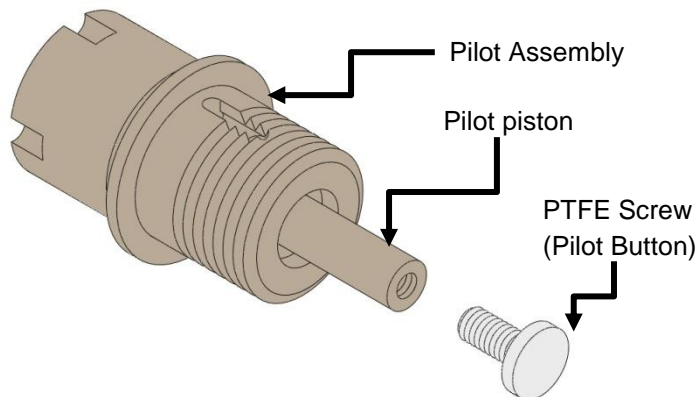
8.4. Assembly

Prior to beginning assembly, inspect all parts to ensure they are clean and dry. Wear clean protective gloves.

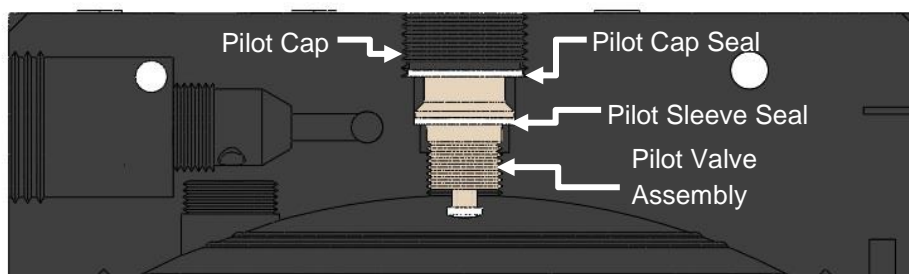
8.4.1. Pilot Valve (Both Heads)

NOTE: Do not use any tools to install the pilot button. Use of tools may damage the button.

- Remove existing pilot button and discard
- Replacement pilot button should be tightened enough that the underside of the head touches the pilot piston
- Replacement pilot button should be tightened enough that the underside of the head touches the pilot piston
- No light should be visible between the bottom of the button head and the piston



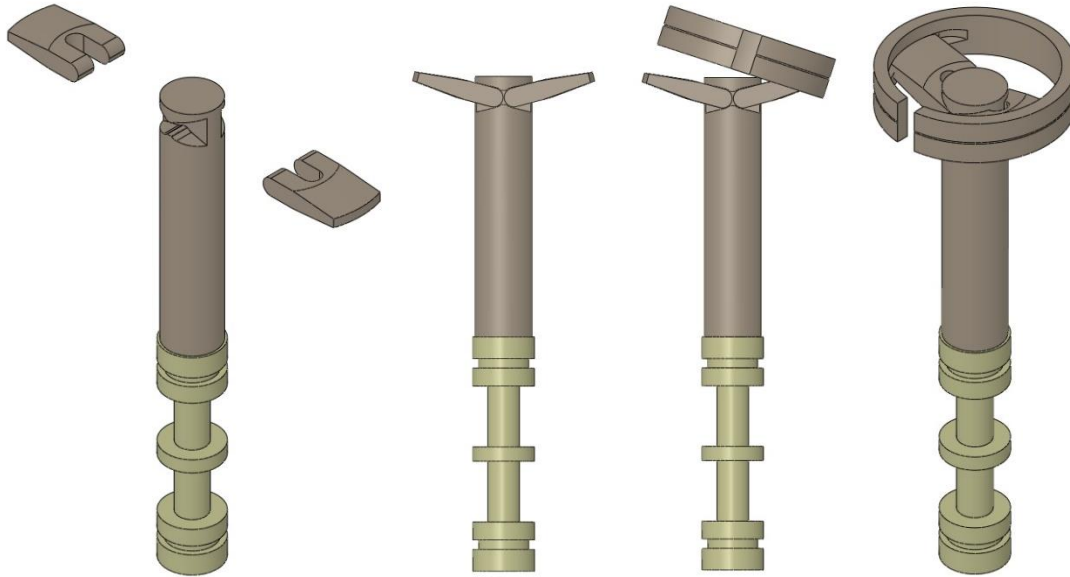
- Slide seal onto pilot valve body until even engagement with the shoulder is reached. The shoulder is located in the center of the pilot valve body
- Thread the pilot valve assembly into the pilot bore of the head as shown in the image below. Tighten to 25 in-lbs. Do not over tighten



- Install pilot cap seal
- Thread pilot valve cap to engage seal. Tighten to 30 in-lbs
- Repeat process for both heads
- Install label cap (Slave Head Only)

8.4.2. Shuttle Spool Assembly

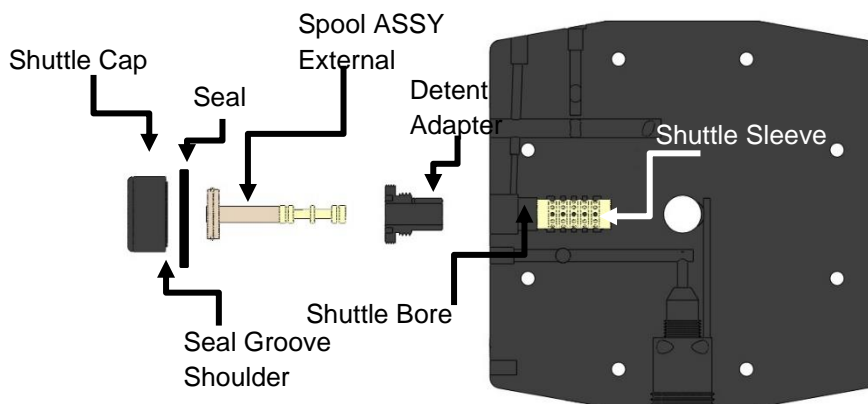
- Hold shuttle spool upright and align slot in detent legs with notch on shuttle spool
- Apply pressure upward onto base of detent legs with thumb and index finger
- Tilt the detent ring over one of the left and align the groove on the inside of the detent ring with the end of the detent leg. Tilt the other side of the ring down, expanding it slightly, so that the other detent leg snaps into the detent ring groove. The completed assembly should look like the final image.



8.4.3. Shuttle Assembly (Master Head)

NOTE: Ensure that the spool moves freely inside the sleeve prior to installation

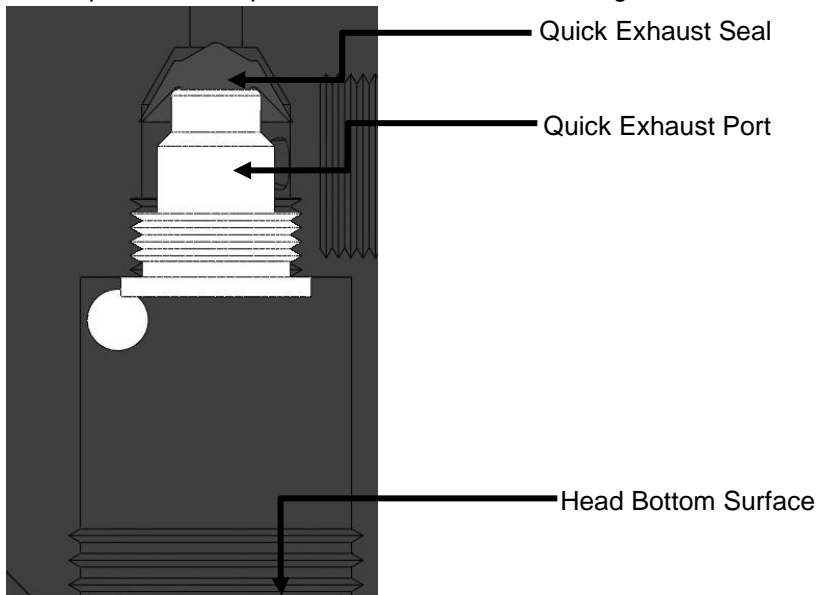
- Thread detent adapter into shuttle bore until flush against head. Tighten to 45 in-lbs
- Insert shuttle spool assembly into adapter detent and Shuttle Sleeve (**DO NOT LUBRICATE**)



- Install the seal onto the seal groove shoulder of the shuttle cap
- Thread shuttle cap onto detent adapter. Tighten to 40 in-lbs

8.4.4. Quick Exhaust (Both Heads)

- Insert quick exhaust seal
- Insert quick exhaust port in each head as shown. Tighten to 20in-lbs. Do not over tighten

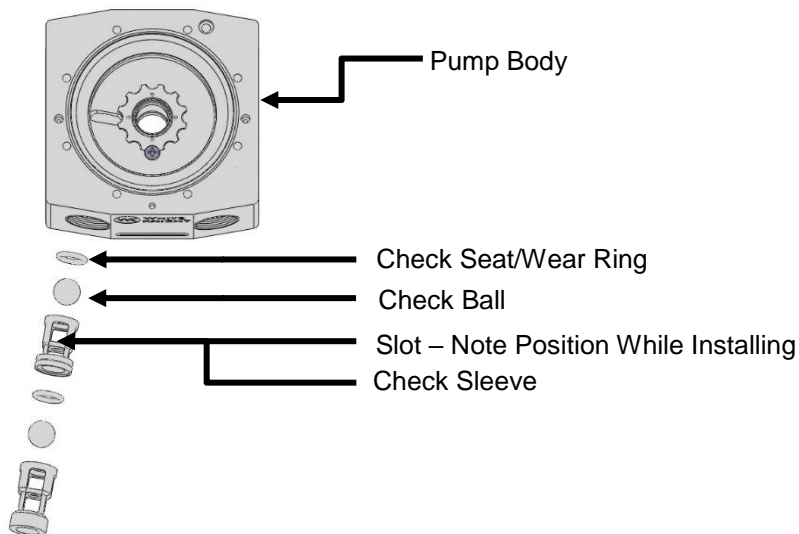


- Install 3 each muffler pads onto muffler spool and insert into exhaust port. Tighten to 40 in-lbs

8.4.5. Body Assembly

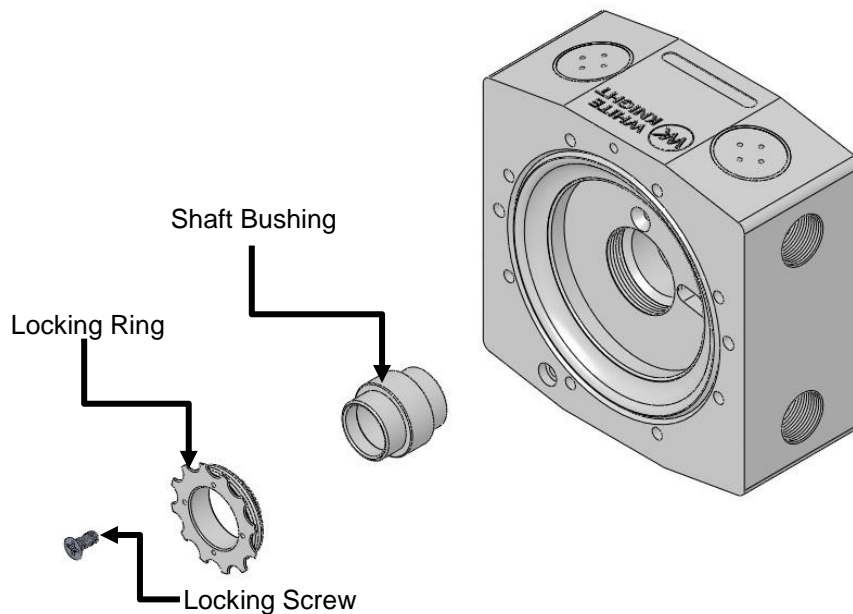
NOTE: For easy installation, check sleeves that do not install easily (minimal effort) can be placed in a freezer prior to assembly to assist insertion. Body must be upside down with check port extending over a table edge so that parts remain assembled during insertion of sleeves

- Insert suction sleeve, check ball, and wear ring carefully into check bore

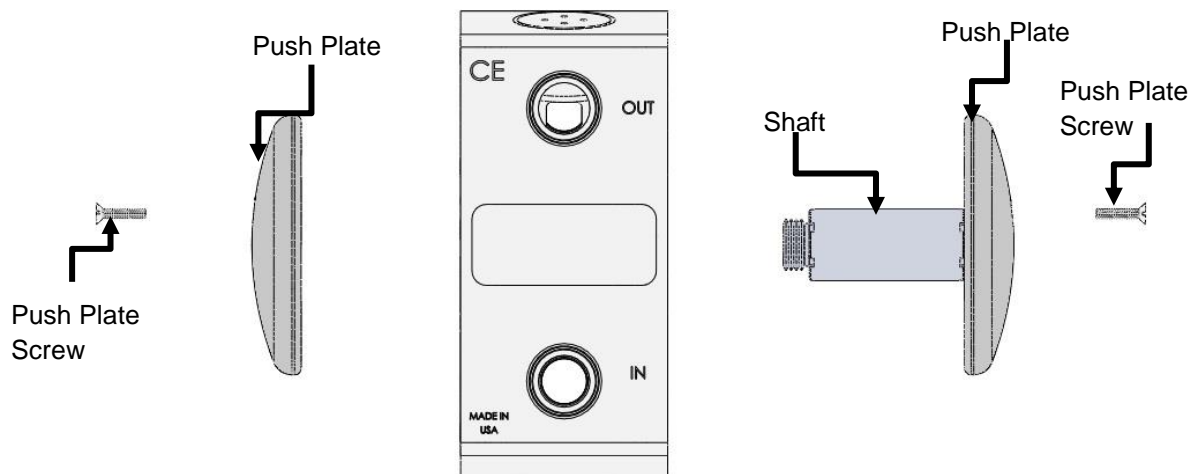


NOTE: the suction sleeves are 2.5in (6.35 cm) long. The discharge sleeves are 2.846in (7.2cm) long

- Repeat insertion process with the discharge sleeve, check ball, and wear ring
- Place seal and tighten check bore caps to 60 in-lbs
- Repeat process for second check bore



- Install shaft bushing per image above
- Install locking ring until flush with fluid cavity face and resistance is met
- Tighten until next available notch aligns with locking screw hole, check to assure that the shaft bushing does not move
- Insert locking screw into hole and tighten until flush with locking ring
- Thread one push plate onto shaft until push plate bottoms out on shaft shoulder
- Tighten push plate to 48 oz-in, and then rotate CW until locking screw hole is aligned with the next available hole in shaft. The first push plate can be visually aligned separate from the body
- Install push plate locking screw. Tighten to 12 oz-in



- Insert shaft through shaft bore as show in the image above
- Thread on remaining push plate until push plate bottoms out on shaft shoulder
- The second push plate, while in the pump body, cannot be visually aligned. Tighten push plate to 48 oz-in, then insert alignment pin into locking screw hole. Rotate push plate CW until locking screw hole is aligned with the next available hole in shaft and alignment pin drops into the shaft hole. Remove alignment pin
- Install push plate locking screw. Tighten to 12 oz-in

8.4.6. Final Assembly

- Insert tie bolts into master head (press fit) and lay head flat with tie bolts sticking up
- Insert main transfer tub and O-ring into head
- Install shuttle transfer tube with two O-rings
- Place main seal into the main seal groove in master head
- Install two diaphragms, removing all air from between diaphragms, onto the tie bolts and shuttle transfer tube. Note main seal groove alignment
- Place body assembly onto tie bolts and master head, ensuring alignment of shuttle transfer tube and its corresponding body passage hole
- Place remaining two diaphragms onto tie bolts, body and shuttle transfer tube. Note main seal groove alignment
- Place two O-rings onto shuttle transfer tube
- Place the main seal O-ring into the formed groove of the slave head
- Place a second main transfer tube and O-ring into slave head
- Lift the slave head and body, while maintaining compression of the seal, flip the head and body over and insert the tie bolts into the master head. Ensure that the main seal of the master head is not dislodged.
- Place all bushing and flat washers onto tie bolt threaded ends
- Install flange nuts onto tie bolts, tighten evenly in a star pattern (do not overload one side before applying torque to another as dislodgment of main seal can occur), final torque is 60 in-lbs
- Snap in tie bolt caps

8.5. Testing

8.5.1. Performance Test

- With the air supply at 0 psi open the air supply valve
- Increase the air pressure until the pumps starts to cycle
- Record the start pressure, Target = <20psig
- Pump must prime once even cycling is achieved
- Increase pressure to 60 psi
- Check for fluid leaks, listen for air leaks, check for irregularity
- Close the discharge valve and deadhead for 2 minutes
- Pump must not experience jog, erratic cycling or leaks
- Open discharge valve and expel the remaining DI water
- Prepare the pump for drying

8.5.2. Dry Pump

- Connect vacuum hose to discharge line
- Connect purge line to fluid inlet (CDA)
- 60psig Supply Pressure
- Cycle pump and vacuum dry by rotating pump side to side for 30 seconds
- Turn off air supply and allow the pump to purge for 5 minutes

8.5.3. Dry Suction

- 20 psig Supply pressure target
- Record suction value
- Target – 14 in-Hg.

9. Trouble Shooting

Pump will not Start, Fails to Operate

Cause:

Insufficient air pressure (must be enough to energize the pilot and shuttle valves).

Pilot valves 'buzzing'.

Insufficient air volume

Dirty or damaged shuttle valve.

Damaged, sticky pilot valve (not following diaphragm properly)

Fluid discharge line blocked.

Downstream valve closed, filter plugged or other obstruction.

Solution:

There must be minimum 20 psig at pump air hook-up

See Performance Charts (3.1) for requirements.

Reference regulator and control valve capacity specifications

Clean shuttle spool assembly and sleeve until free movement is assured, or replace.

Pilot valve piston must slide freely, full travel, in pilot valve sleeve.

Remove pilot pistons and check for debris or chemical attack

Replace damaged valve assembly
Remove Obstruction.

Bubbles in Fluid Discharge

Cause:

Leaking fluid inlet fitting.

Leaking main seal.

Pump inlet line pressure reached saturation point (due to high suction requirement).

Ruptured (perforated) diaphragm

Solution:

Tighten, liquid fittings. If using competitor fluid ports, PTFE tape may be used on the liquid connection, or consider replacing the adapter O-ring.

Tighten tie bolt nuts to 60 in-lbs. Replace main seals if damaged

Increase diameter of suction supply line (reduces restriction)

Reduce output flow

Replace diaphragms

Fluid Leaks

Cause:

Tie Bolt torque not enough to affect seal

Damaged main seal.

Check Bore Cap.

Ruptured diaphragm(s) can result in fluid leaks through air exhaust port.

Solution

Tighten all nuts to 60 in-lbs

Replace

check for irregularities in diaphragm groove on pump body

Tighten, or remove and replace seal

Replace diaphragms, and any parts that may have been damaged by fluid exposure.

Erratic Cycling

Cause:

Leaking detent cap.

Supply line restricted (cavitation).

Quick exhaust seal not seating

Pilot valve not following diaphragm correctly.

Check ball(s) not seating.

Pilot transfer leak

Solution

Tighten and/or replace seal

Reduce fluid restriction

Check for particles between seal and port, Replace seal.

Pilot valve piston must slide freely, full travel in pilot valve sleeve.

Verify no damage to check seals; replace if necessary.
Make sure check balls move freely in sleeves.

Tighten tie bolts to 60 in-lbs
Replace transfer seals



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