



NATURAL GAS COMPRESSOR VAPOR RECOVERY UNIT

VRU

PARTS, OPERATION & MAINTENANCE

VRU-POM-C-FEB13





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Since 1955



VRU

PARTS, OPERATION & MAINTENANCE

Natural Gas Compressor VAPOR RECOVERY UNIT

VRU-1 Single Throw VRU-2 Two Throw

VRU-POM-C-FEB13

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PREFACE

DEFINITIONS: Recommended Spare Parts

6 Month Spare Parts

Six month spares are intended to satisfy parts required for start-up spares, and consists primarily of gaskets, O-rings, and common wear parts. As valves are sometimes damaged from debris in the piping during start-up, Arrow recommends having a full set of replacement valves on hand. Arrow also has available valve repair kits.

1 Year Spare Parts

One year spare parts include the 1 year plus the 6 month spare parts. We have recommended some parts such as pumps, belts, divider block, etc., not because these parts are expected to wear out in 1 year, but because they could be damaged due to neglect, abuse, or abnormal wear and tear from extreme or dirty operating conditions.

2 Year Spare Parts

Two year spare parts include the 2 year parts plus the 1 year parts plus the 6 month parts. This is a more complete list of parts "recommended" as though the unit is in a *remote area* with limited replacement parts access, or for operating in a critical service. We have recommended some major parts such as a crankshaft and connecting rods not because these parts are expected to fail in 2 years, but they could be damaged due to neglect, abuse, or abnormal wear and tear from extreme or dirty operating conditions.

This list could also be used as a recommended overhaul repair kit to be used when a complete overhaul becomes necessary.

1 Special Tools

1

1.1 Recommended and Optional Special Tools

Special tools may be ordered as follows:

- 1) Toolbox – A complete set of recommended tools
- 2) Individual recommended tools
- 3) Individual optional tools
- 4) A combination of individual recommended tools and individual optional tools.

SPECIAL TOOLS			
NUMBER	PART NUMBER	DESCRIPTION	QTY
	VRU29400A	TOOLBOX, ASSY, VRU RECOMMENDED TOOLS	
1	VRC29400	TOOL BAG	1
2	VRU19490	TOOL, PISTON NUT ADAPTOR	1
3	VRU29482	TOOL, OIL SEAL ENTERING SLEEVE	1
4	VRC29492	TOOL, PISTON ROD ENTERING SLEEVE	1
5	VRC29496	TOOL, 2" JAM NUT WRENCH	1
6 *	VRC29494	TOOL, PISTON ROD CLAMP	



* OPTIONAL TOOL – Not included in Toolbox. This tool must be ordered separately.

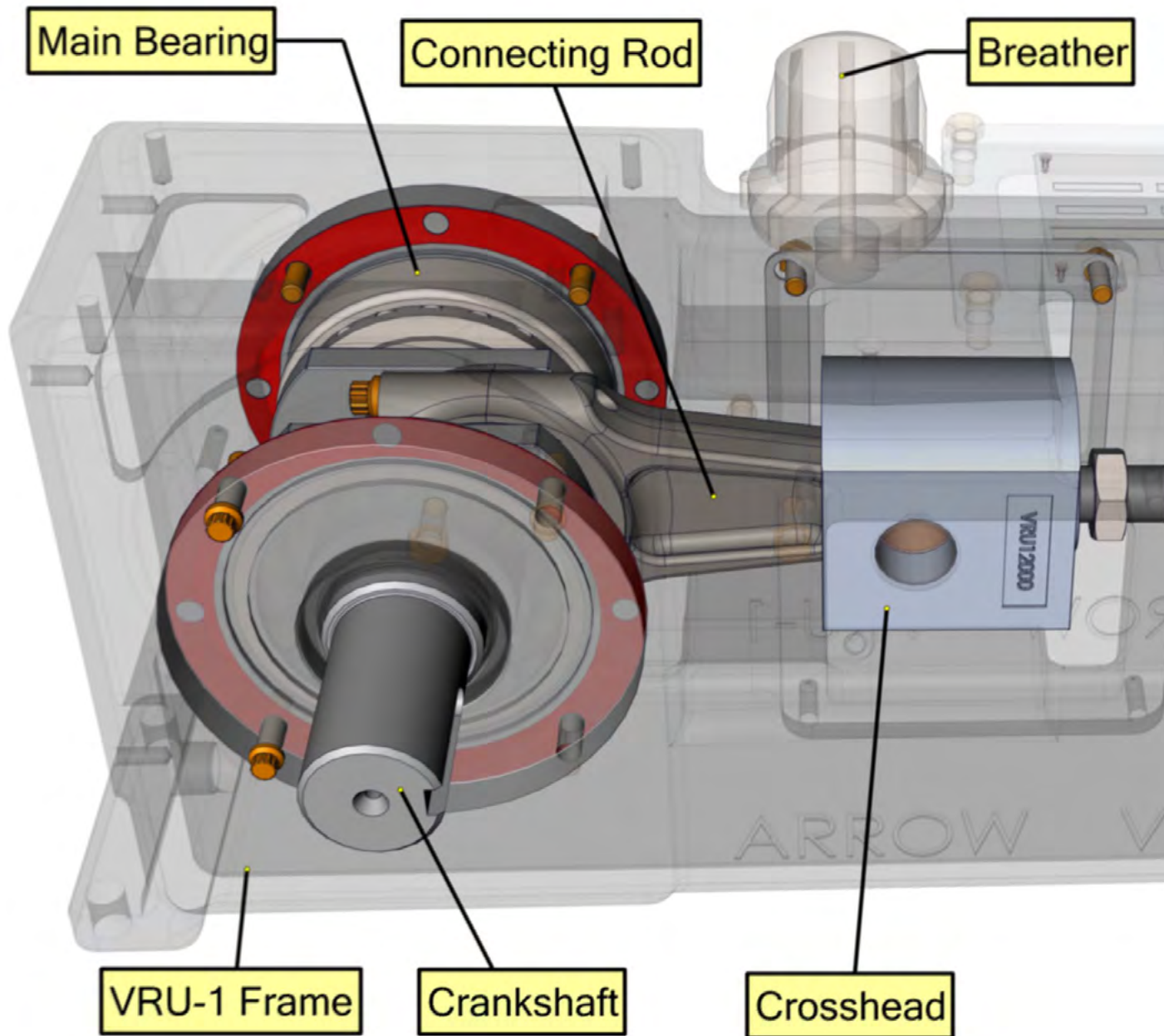
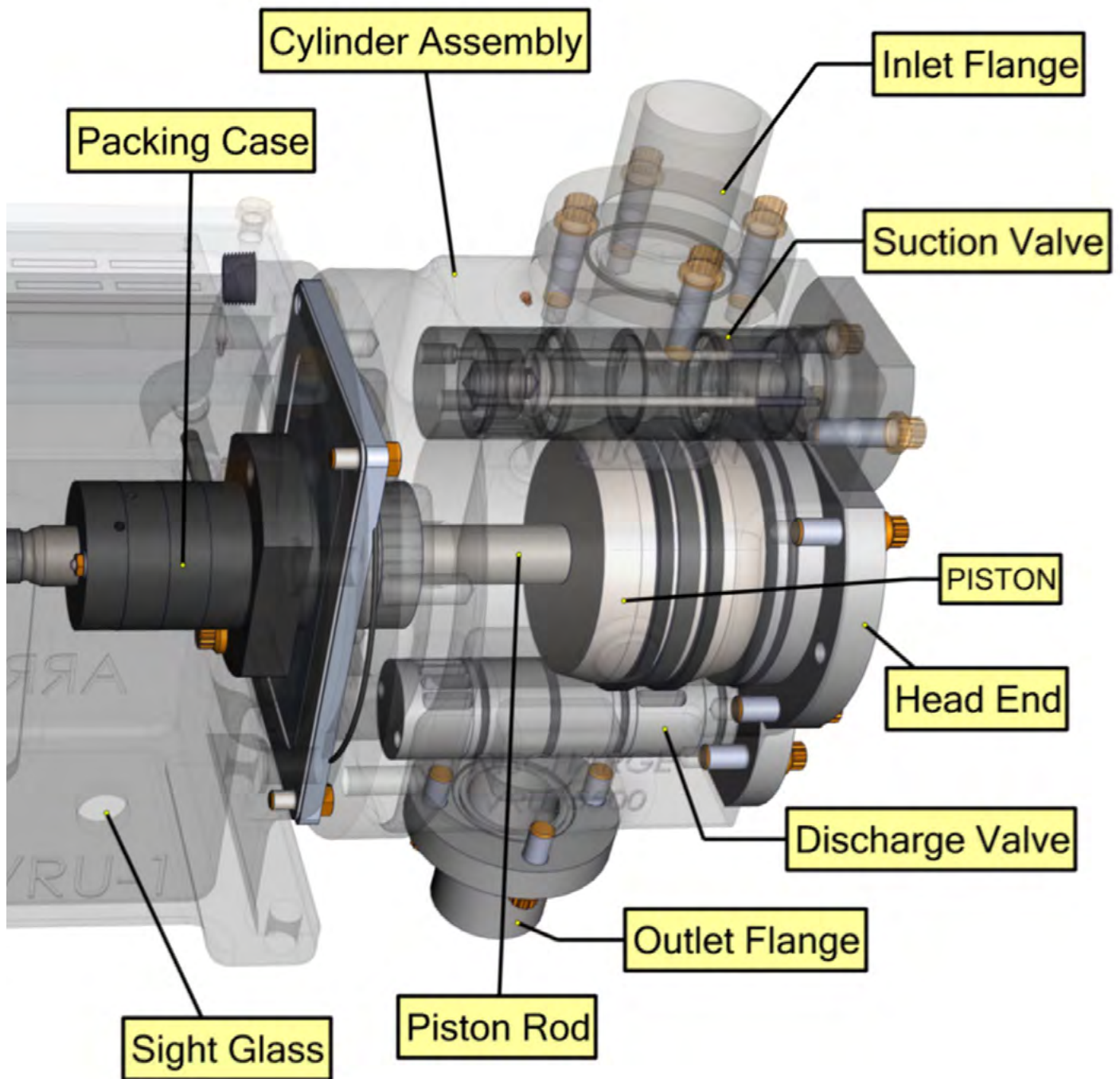


FIGURE 2.1 VRU-1 ASSEMBLY



2.1 VRU-1 Frame Parts

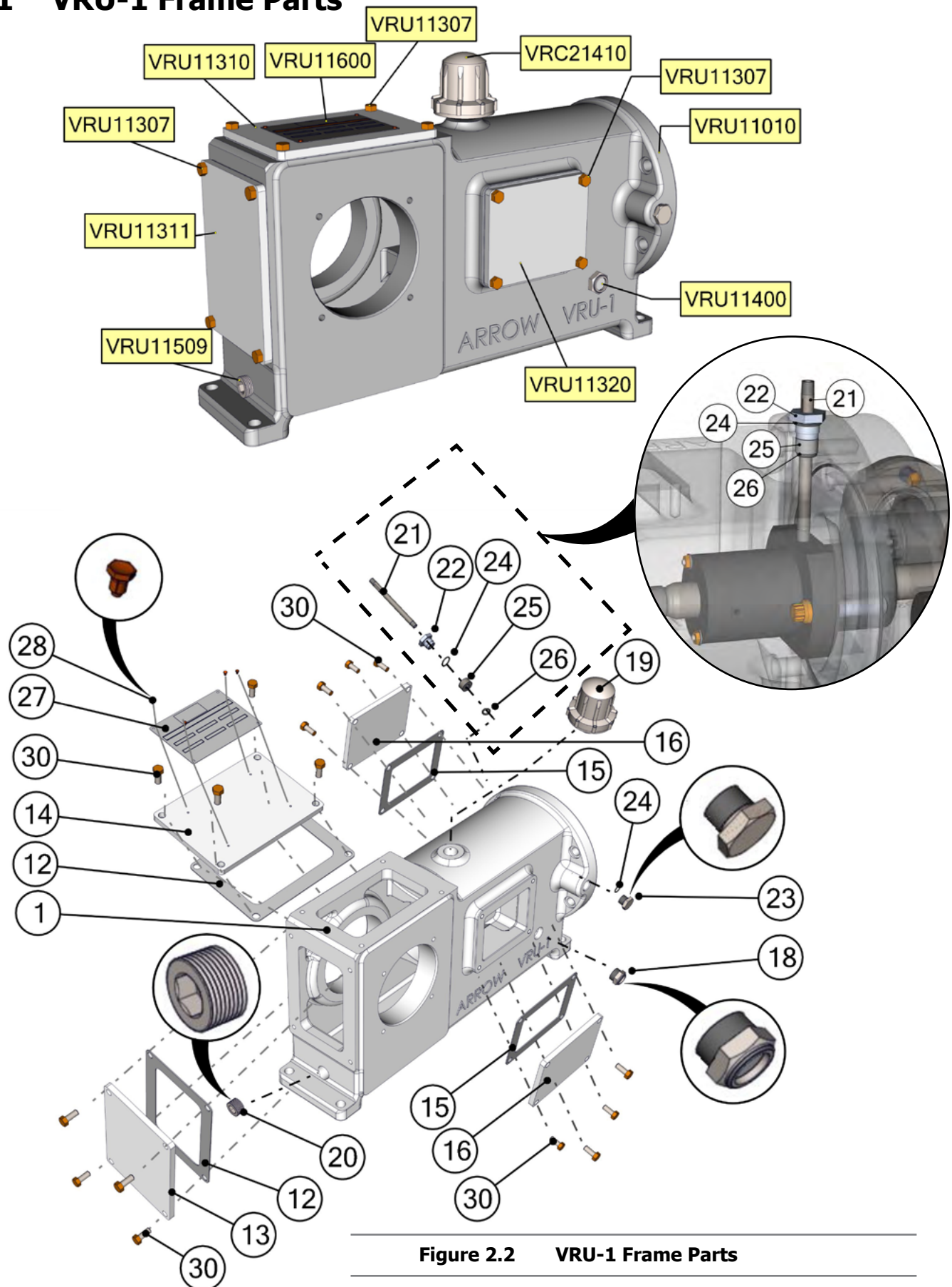


Figure 2.2 VRU-1 Frame Parts

VRU-1 FRAME PARTS

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU11010A	FRAME, SINGLE-THROW VRU-1 COMPRESSOR ASSEMBLY				
1	VRU11010	FRAME, SINGLE THROW VRU-1 COMPRESSOR	1			
2	VRU11100	CRANKSHAFT, VRU-1 COMPRESSOR	1			1
3	VRU11214	BEARING, CONNECTING ROD	1			1
4	VRU11210	ROD, CONNECTING VRU-1	1			1
5	VRU11101	CONE MAIN BEARING, VRU-1	2			2
6	VRU11102	CUP MAIN BEARING, VRU-1	2			2
7	VRU11119	SHIMPACK, BEARING RETAINER	2			2
8	VRU11120	RETAINER, MAIN BEARING, VRU-1	2			
9	VRU12000	CROSSHEAD, VRU-1 COMPRESSOR	1			1
10	VRU12110	PIN, CROSSHEAD, VRU-1 COMPRESSOR	1			1
11	VRU12113	RETAINER, CROSSHEAD PIN	2			2
12	VRU11315	GASKET, COVERPLATE, FRAME TOP & END	2	2	2	2
13	VRU11311	COVERPLATE, FRAME END, VRU-1	1			
14	VRU11310	COVERPLATE, FRAME TOP, VRU-1	1			
15	VRU11325	GASKET, COVERPLATE, FRAME SIDE	2	2	2	2
16	VRU11320	COVERPLATE, FRAME SIDE, VRU-1	2			
17	VRU11124	SEAL, OIL, CRANKSHAFT	2			2
18	VRU11400	SIGHTGLASS	1			1
19	VRC21410	BREATHER, FRAME VENT	1			1
20	VRU11509	PLUG, OIL DRAIN	1			
21	VRU13601	NIPPLE, PACKING VENT VRU-1	1			
22	VRU13602	NUT, PACKING VENT, VRU-1	1			
23	VRU13603	PLUG, PACKING VENT, VRU-1	1			
24	VRU13604	O-RING, PACKING PLUG & NUT	2	2	2	2
25	VRU13609	SPACER, PACKING NUT	1			
26	VRU13614	O-RING, PACKING NIPPLE	1	1	1	1
27	VRU11600	NAMEPLATE, VRU-1 FRAME	1			
28	VRC21606	PIN, NAME PLATE	4			
29	VRC29268	SCREW, RETAINER	8			
30	VRU11307	SCREW, COVERPLATE	16			
31	VRU11218	SPLASHER, OIL, VRU CONNECTING ROD	1			1
32	VRU11217	SCREW, CONNECTING ROD CAP	2			

2.1 VRU-1 Frame Parts (continued)

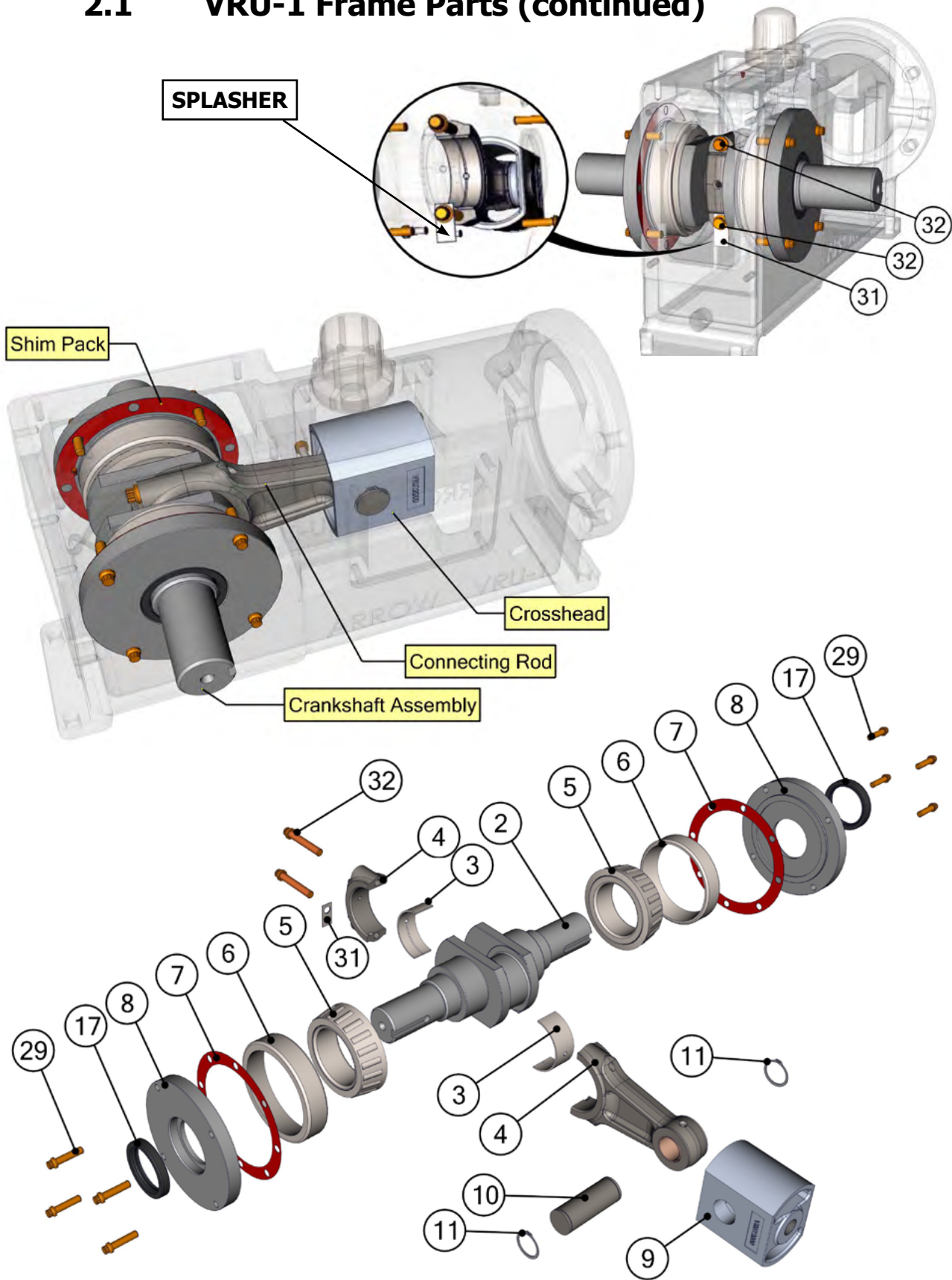


Figure 2.3 VRU-1 Frame Parts (Crankshaft)

VRU-1 FRAME PARTS

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU11010A	FRAME, SINGLE-THROW VRU-1 COMPRESSOR ASSEMBLY				
1	VRU11010	FRAME, SINGLE THROW VRU-1 COMPRESSOR	1			
2	VRU11100	CRANKSHAFT, VRU-1 COMPRESSOR	1			1
3	VRU11214	BEARING, CONNECTING ROD	1			1
4	VRU11210	ROD, CONNECTING VRU-1	1			1
5	VRU11101	CONE MAIN BEARING, VRU-1	2			2
6	VRU11102	CUP MAIN BEARING, VRU-1	2			2
7	VRU11119	SHIMPACK, BEARING RETAINER	2			2
8	VRU11120	RETAINER, MAIN BEARING, VRU-1	2			
9	VRU12000	CROSSHEAD, VRU-1 COMPRESSOR	1			1
10	VRU12110	PIN, CROSSHEAD, VRU-1 COMPRESSOR	1			1
11	VRU12113	RETAINER, CROSSHEAD PIN	2			2
12	VRU11315	GASKET, COVERPLATE, FRAME TOP & END	2	2	2	2
13	VRU11311	COVERPLATE, FRAME END, VRU-1	1			
14	VRU11310	COVERPLATE, FRAME TOP, VRU-1	1			
15	VRU11325	GASKET, COVERPLATE, FRAME SIDE	2	2	2	2
16	VRU11320	COVERPLATE, FRAME SIDE, VRU-1	2			
17	VRU11124	SEAL, OIL, CRANKSHAFT	2			2
18	VRU11400	SIGHTGLASS	1			1
19	VRC21410	BREATHER, FRAME VENT	1			1
20	VRU11509	PLUG, OIL DRAIN	1			
21	VRU13601	NIPPLE, PACKING VENT VRU-1	1			
22	VRU13602	NUT, PACKING VENT, VRU-1	1			
23	VRU13603	PLUG, PACKING VENT, VRU-1	1			
24	VRU13604	O-RING, PACKING PLUG & NUT	2	2	2	2
25	VRU13609	SPACER, PACKING NUT	1			
26	VRU13614	O-RING, PACKING NIPPLE	1	1	1	1
27	VRU11600	NAMEPLATE, VRU-1 FRAME	1			
28	VRC21606	PIN, NAME PLATE	4			
29	VRC29268	SCREW, RETAINER	8			
30	VRU11307	SCREW, COVERPLATE	16			
31	VRU11218	SPLASHER, OIL, VRU CONNECTING ROD	1			1
32	VRU11217	SCREW, CONNECTING ROD CAP	2			

2.2 VRU-2 Frame Parts

The VRU-2 frame is built using two VRU-1 frames. For detail views see the diagrams for the VRU-1 frame parts in Section 2.1.

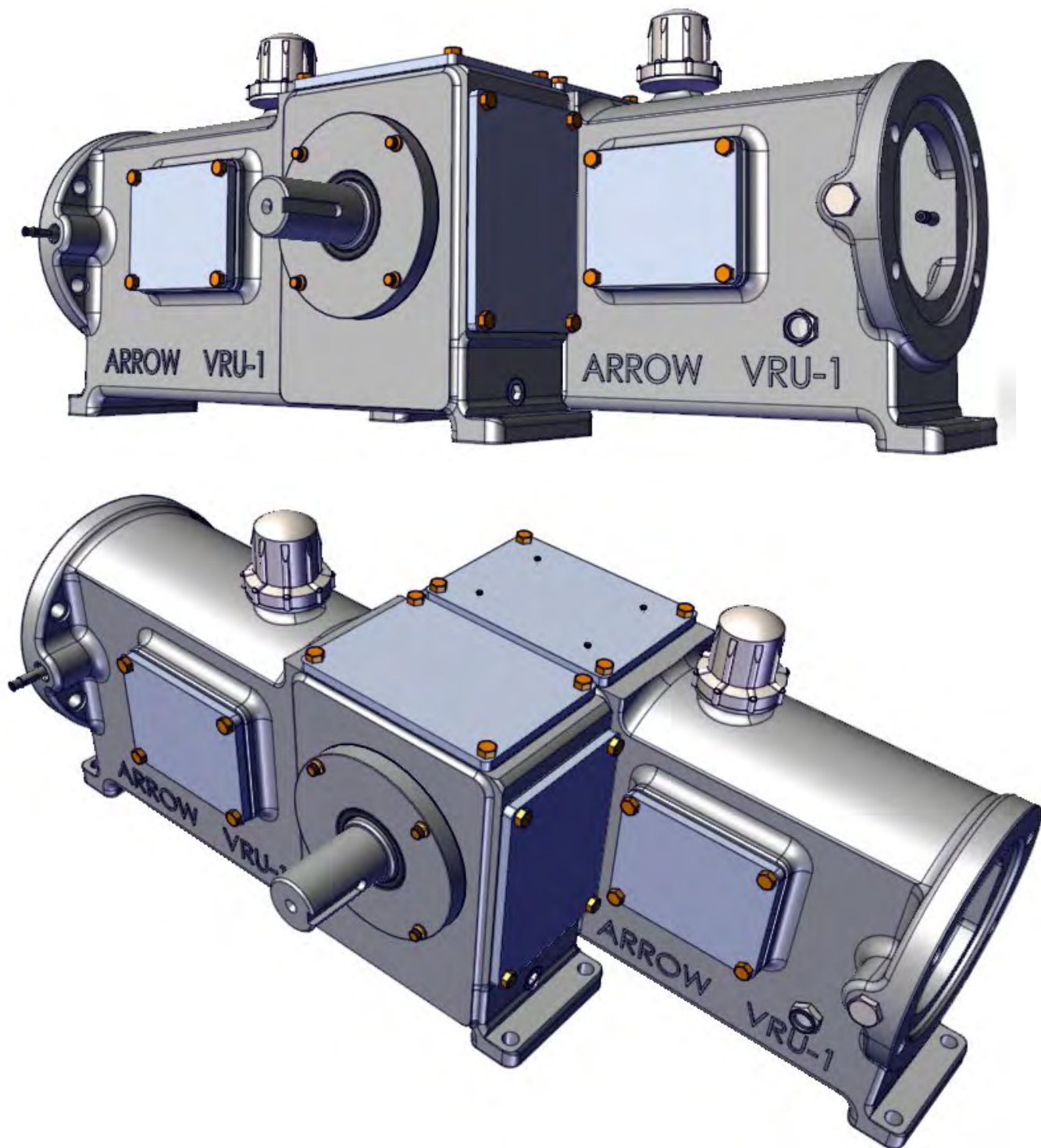


Figure 2.3 VRU-2 Assembly

VRU-2 FRAME PARTS

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU21020A	FRAME, TWO-THROW VRU-2 COMPRESSOR ASSEMBLY				
1	VRU11010	FRAME, SINGLE THROW VRU-1 COMPRESSOR	2			
2	VRU21100	CRANKSHAFT, VRU-2 COMPRESSOR	1			1
3	VRU11214	BEARING, CONNECTING ROD	2			2
4	VRU11210	ROD, CONNECTING VRU-1	2			2
5	VRU11101	CONE MAIN BEARING, VRU-1	2			2
6	VRU11102	CUP MAIN BEARING, VRU-1	2			2
7	VRU11119	SHIMPACK, BEARING RETAINER	2			2
8	VRU11120	RETAINER, MAIN BEARING, VRU-1	2			
9	VRU12000	CROSSHEAD, VRU-1 COMPRESSOR	2			2
10	VRU12110	PIN, CROSSHEAD, VRU-1 COMPRESSOR	2			2
11	VRU12113	RETAINER, CROSSHEAD PIN	4			4
12	VRU11315	GASKET, COVERPLATE, FRAME TOP & END	4	2	4	4
13	VRU11311	COVERPLATE, FRAME END, VRU-1	2			
14	VRU11310	COVERPLATE, FRAME TOP, VRU-1	2			
15	VRU11325	GASKET, COVERPLATE, FRAME SIDE	4	2	4	4
16	VRU11320	COVERPLATE, FRAME SIDE, VRU-1	4			
17	VRU11124	SEAL, OIL, CRANKSHAFT	2			2
18	VRU11400	SIGHTGLASS	2			2
19	VRC21410	BREATHER, FRAME VENT	2			2
20	VRU11509	PLUG, OIL DRAIN	2			
21	VRU13601	NIPPLE, PACKING VENT VRU-1	2			
22	VRU13602	NUT, PACKING VENT, VRU-1	2			
23	VRU13603	PLUG, PACKING VENT, VRU-1	2			
24	VRU13604	O-RING, PACKING PLUG & NUT	4	4	4	4
25	VRU13609	SPACER, PACKING NUT	2			
26	VRU13614	O-RING, PACKING NIPPLE	2	2	2	2
27	VRU21600	NAMEPLATE, VRU-2 FRAME	2			
28	VRC21606	PIN, NAME PLATE	8			
29	VRC29268	SCREW, RETAINER	16			
30	VRU11307	SCREW, COVERPLATE	32			
31	VRU11218	SPLASHER, OIL, VRU CONNECTING ROD	2			2
32	VRU11217	SCREW, CONNECTING ROD CAP	4			
33	VRU21108	STUD, VRU-2 FRAME (NOT SHOWN)*	4			
34	VRU21109	NUT, STUD, VRU-2 FRAME (NOT SHOWN)*	8			

*Studs nuts are used to attach the two frames together

2.3 5.0 Cylinder

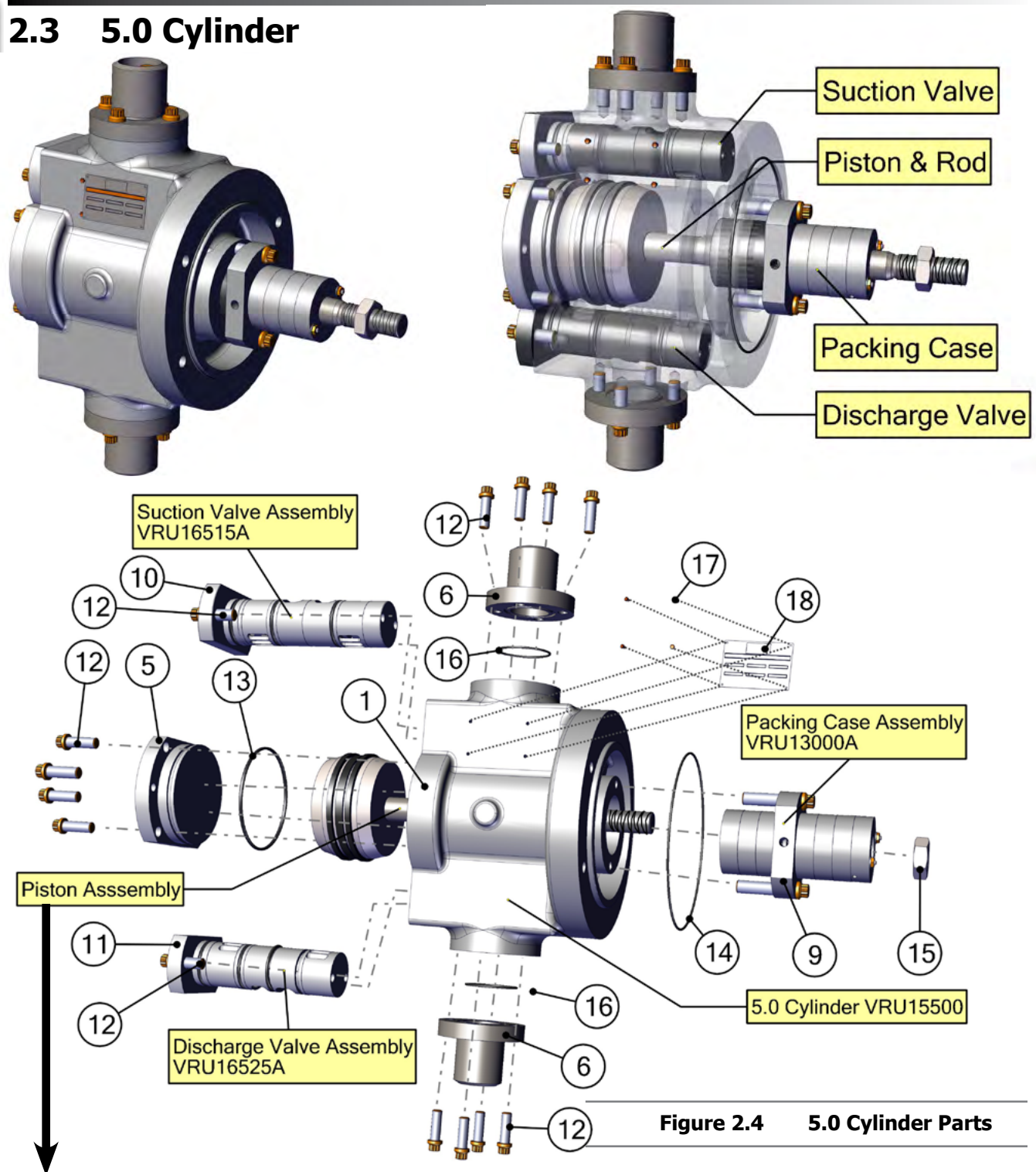
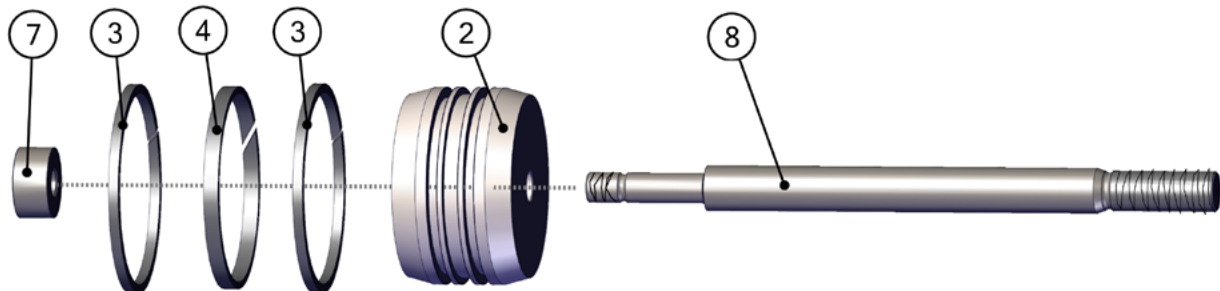


Figure 2.4 5.0 Cylinder Parts



5.0 Cylinder

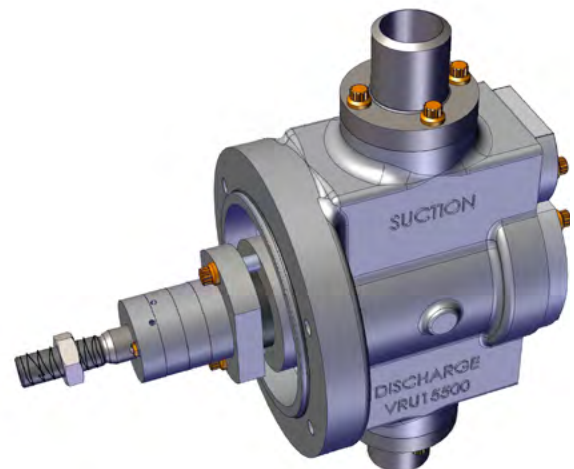
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NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU15500A	CYLINDER, 5.0 INCH VRU ASSEMBLY				
1	VRU15500	CYLINDER, 5.0" VRU	1			
2	VRU14500	PISTON, 5.0 INCH VRU CYLINDER	1			1
3	VRU14501	RING, 5.0 INCH VRU PISTON	2		2	2
4	VRU14502	BAND, RIDER, 5.0 INCH VRU PISTON	1		1	1
5	VRU15507	HEAD, HEAD END, 5.0 INCH CYLINDER	1			
6	VRU15509	FLANGE, CYLINDER, VRU	2			
7	VRU14919	NUT, PISTON, VRU	1			1
8	VRU14150	ROD, PISTON, VRU	1			1
9	VRU13000A	CASE, PACKING, VRU, ASSEMBLY*	1			
10	VRU16515A	VALVE, SUCTION, 5.0" & 8.0" VRU**	1			1
11	VRU16525A	VALVE, DISCHARGE, 5.0" & 8.0" VRU***	1			1
12	VRC25007	SCREW, HEAD	16			
13	VRC25502	O-RING, HEAD, 5.0" CYL.	1	1	1	1
14	VRU15562	O-RING, HEAD, VRU FRAME TO CYL.	1	1		1
15	VRC14909	NUT, JAM, PISTON ROD	1			1
16	VRU15504	O-RING, FLANGE, VRU CYLINDER	2	2	2	2
17	VRC21606	PIN, NAMEPLATE	4			
18	VRU15100	NAMEPLATE, VRU CYLINDER	1			

* See Section 2.5 for packing case assembly parts

** See Section 2.6 for suction valve assembly parts

*** See Section 2.7 for discharge valve assembly parts



2.4 8.0 Cylinder

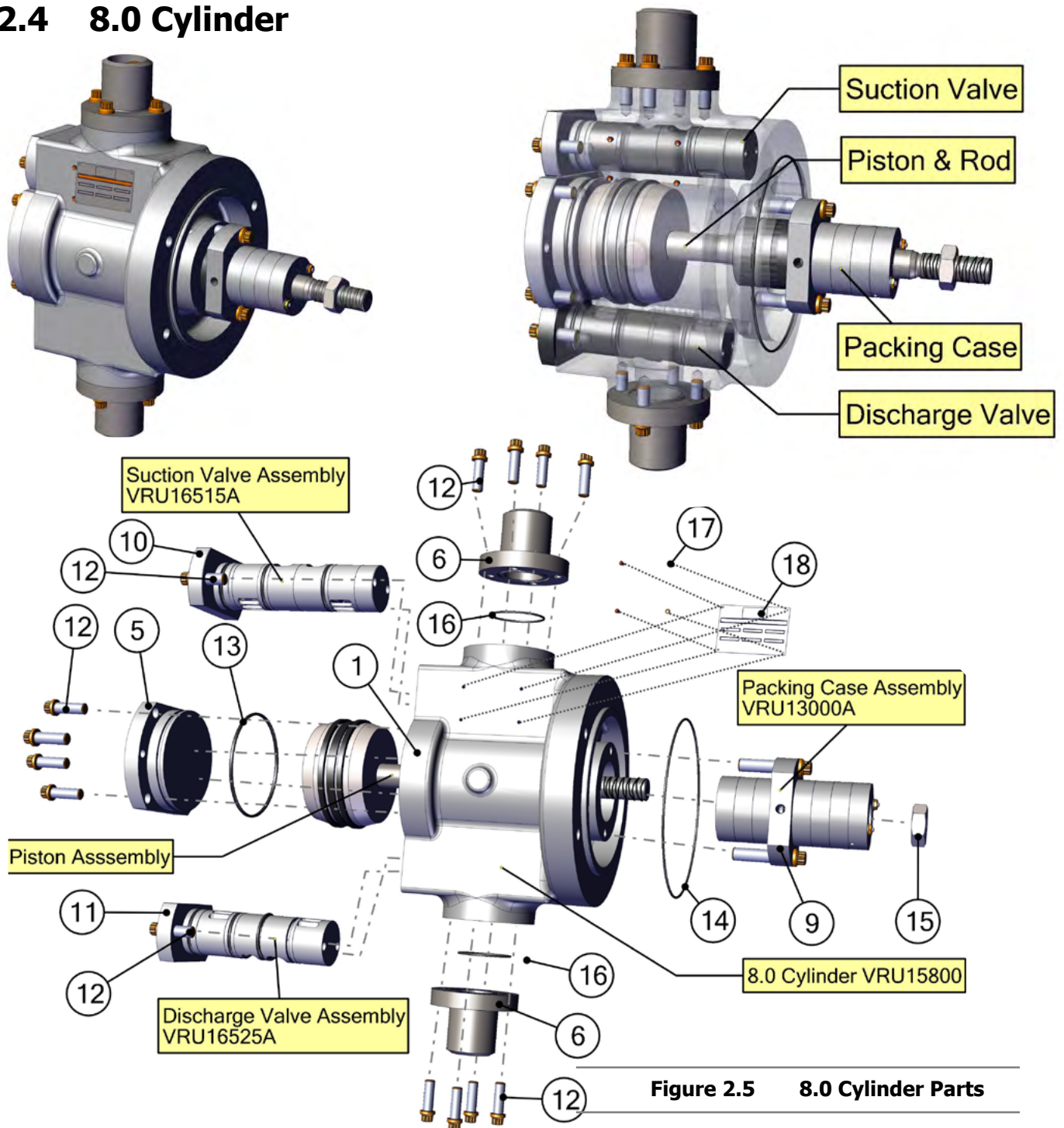
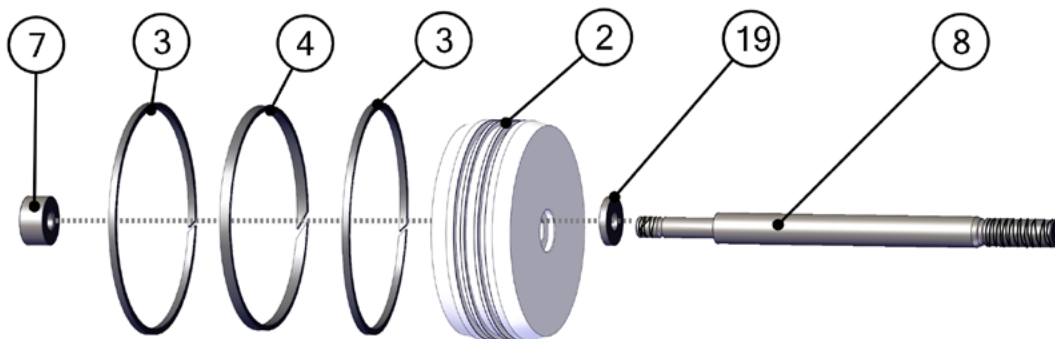


Figure 2.5 8.0 Cylinder Parts



8.0 Cylinder

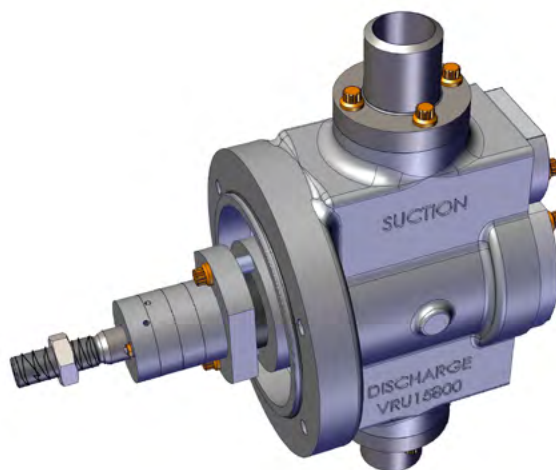
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NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU15800A	CYLINDER 8.0 INCH VRU ASSEMBLY				
1	VRU15800	CYLINDER, 8.0" VRU	1			
2	VRU14800	PISTON, 8.0 INCH VRU CYLINDER	1			1
3	VRU14801	RING, 8.0 INCH PISTON	2		2	2
4	VRU14802	BAND, RIDER, 8.0 INCH VRU PISTON	1		1	1
5	VRU15807	HEAD, HEAD-END, 8.0 INCH CYLINDER	1			
6	VRU15509	FLANGE, CYLINDER, VRU	2			
7	VRU14919	NUT, PISTON VRU	1			1
8	VRU14150	ROD, PISTON, VRU	1			1
9	VRU13000A	CASE, PACKING, VRU, ASSEMBLY*	1			
10	VRU16515A	VALVE SUCTION 5.0" & 8.0" VRU**	1			1
11	VRU16525A	VALVE DISCHARGE, 5.0" & 8.0" VRU***	1			1
12	VRC25007	SCREW, HEAD	16			
13	VRC25802	O-RING, HEAD, 8.0" CYL.	1	1	1	1
14	VRU15562	O-RING, HEAD, VRU, FRAME TO CYL.	1	1		1
15	VRC14909	NUT, JAM, PISTON ROD	1			
16	VRU15504	O-RING, FLANGE, VRU CYLINDER	2			
17	VRC21606	PIN, NAMEPLATE	4			
18	VRU15100	NAMEPLATE, VRU CYLINDER	1			
19	VRU14805	WASHER, THRUST, VRU PISTON	1			1

* See Section 2.5 for packing case assembly parts

** See Section 2.6 for suction valve assembly parts

*** See Section 2.7 for discharge valve assembly parts



2.5 Packing Case Assembly

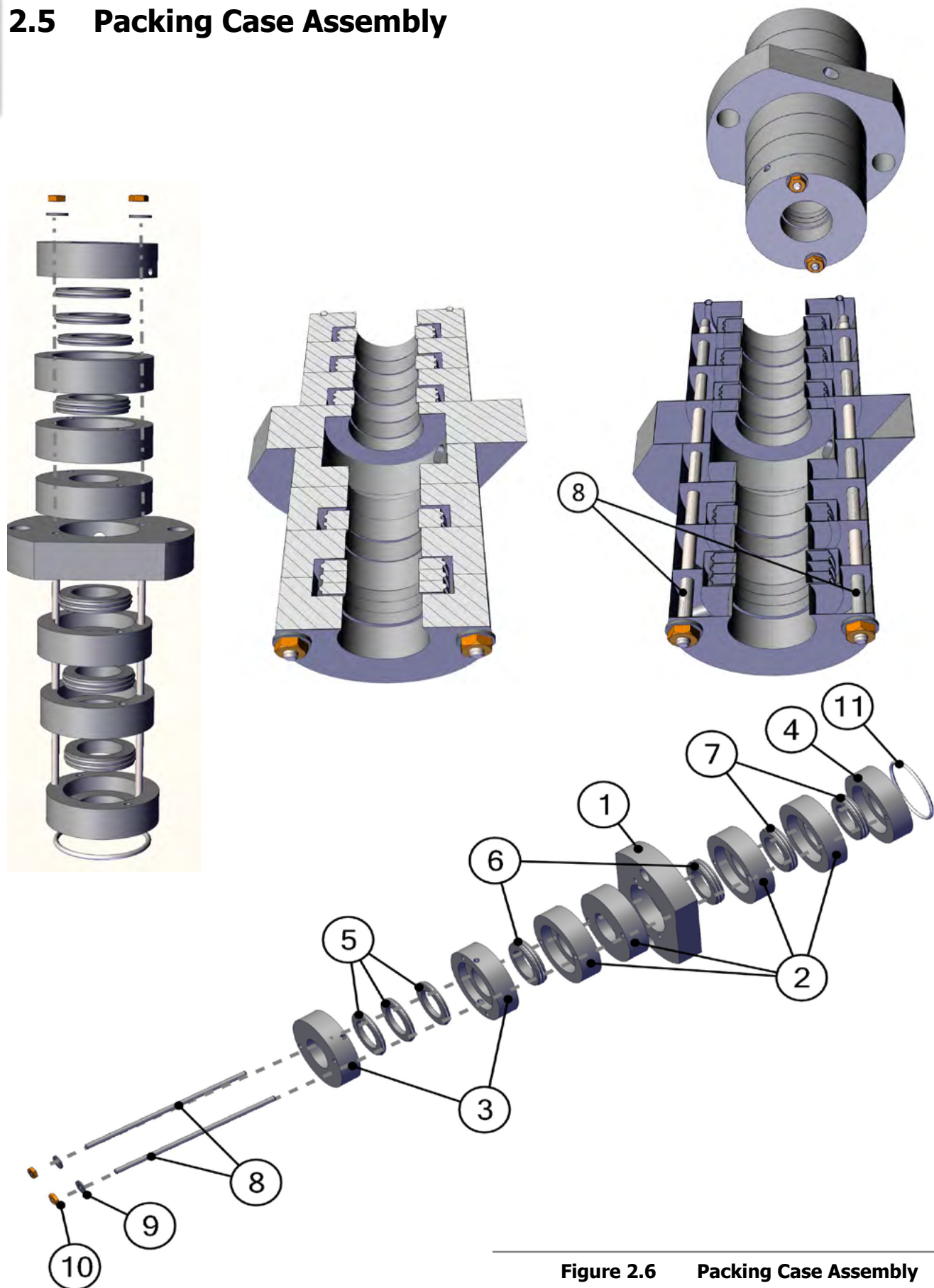


Figure 2.6 Packing Case Assembly

Packing Case Assembly

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU13000A	CASE, PACKING, VRU, ASSEMBLY				
1	VRU13241	CUP, PACKING, CENTER	1			
2	VRU13221	CUP, PACKING, PLAIN	4			
3	VRU13351	CUP PACKING WIPER	2			
4	VRU13211	CUP, PACKING BOTTOM	1			
5	VRC23441	RING, PACKING, WIPER	1	1	1	1
6	VRC23431	RING, PACKING, DOUBLE ACTING	2	2	2	2
7	VRC23421	RING, PACKING, SINGLE ACTING	2	2	2	2
8	VRU13118	STUD, PACKING CASE	2			2
9	VRU13115	WASHER, SEAL, PACKING CASE STUD	2			2
10	VRU13109	NUT, LOCK, PACKING CASE STUD	2			2
11	VRC23106	GASKET, WIRE, PACKING CASE NOSE	1	1	1	1

2.6 Suction Valve

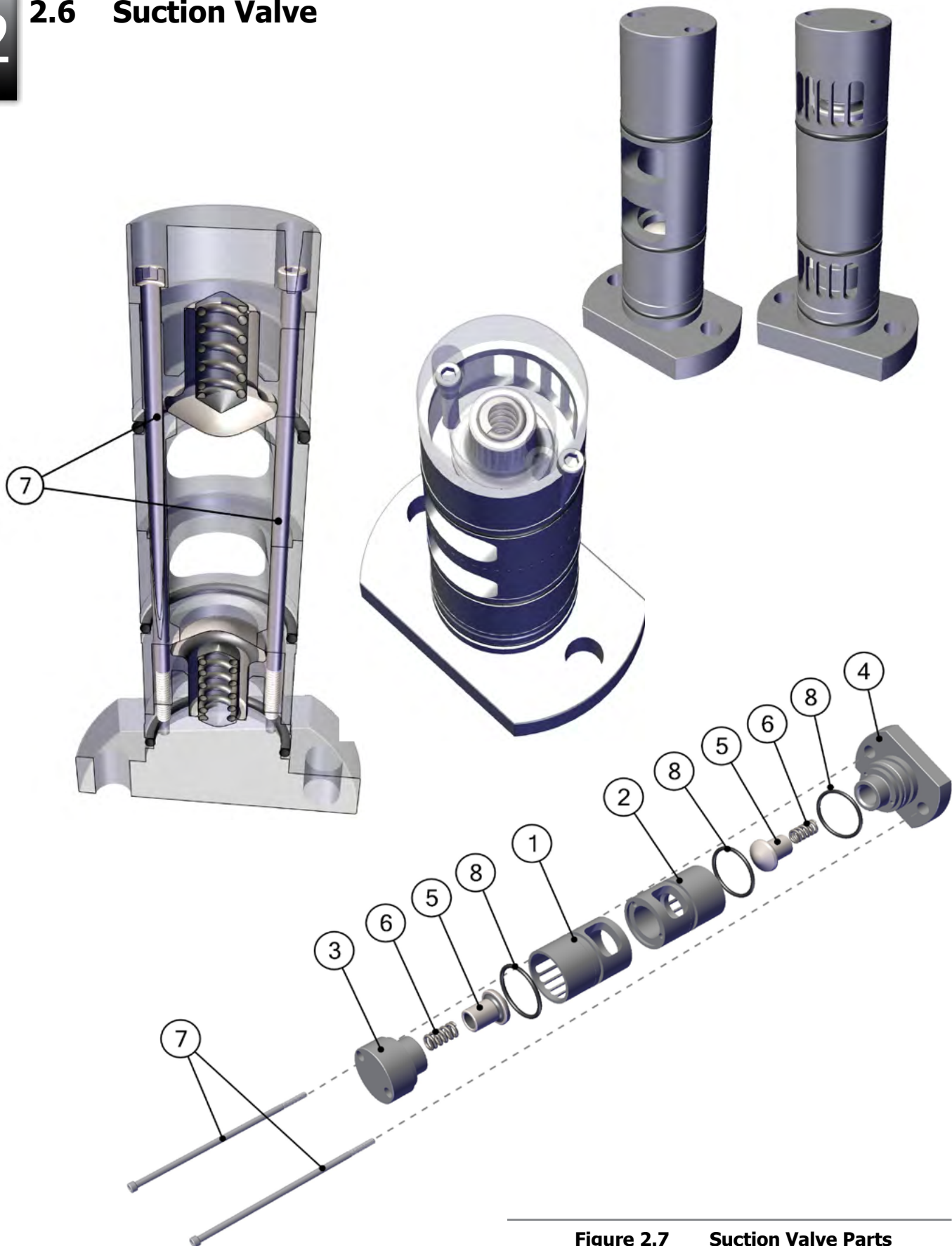


Figure 2.7 Suction Valve Parts

Suction Valve

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU16515A	VALVE, SUCTION, 5.0" & 8.0" VRU				
1	VRU16531	SEAT, VALVE, INSIDE	1			
2	VRU16532	SEAT, VALVE, OUTSIDE	1			
3	VRU16551	RETAINER, CE, SPRING, SUCTION VALVE	1			
4	VRU16552	RETAINER, HE, SPRING, SUCTION VALVE	1			
5	VRU16570	POPPET, VALVE, VRU	2		2	2
6	VRU16595	SPRING, VALVE, VRU	2		2	2
7	VRU16558	SCREW, VALVE, SUCTION, VRU	2			
8	VRC25304	O-RING, VRU VALVE	3	3	3	3

2.7 Discharge Valve

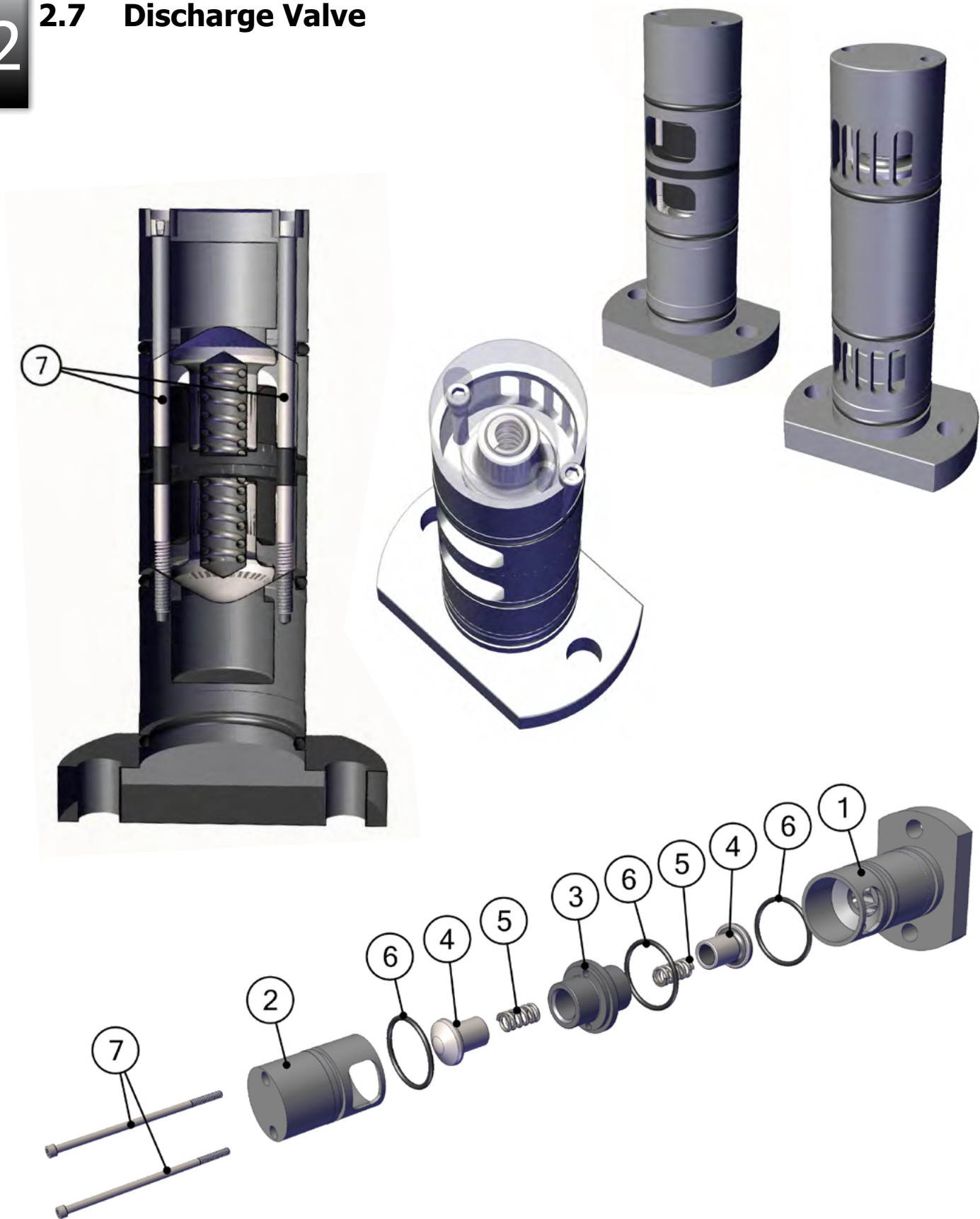


Figure 2.8 Discharge Valve Parts

Discharge Valve

NUMBER	PART NUMBER	DESCRIPTION	PART QTY	RECOMMENDED SPARE PARTS		
				6 MO	1 YR	2 YR
	VRU16525A	VALVE, DISCHARGE, 5.0" & 8.0" VRU				
1	VRU16542	SEAT, VALVE, HE, DISCHARGE	1			
2	VRU16541	SEAT, VALVE, CE, DISCHARGE	1			
3	VRU16560	RETAINER, SPRING DISCHARGE VALVE	1			
4	VRU16570	POPPET, VALVE, VRU	2		2	2
5	VRU16595	SPRING VALVE VRU	2		2	2
6	VRC25304	O-RING, VRU VALVE	3	3	3	3
7	VRU16548	SCREW, VALVE, DISCHARGE, VRU	2			

3 VRU Compressor Introduction

3.1 VRU-1 Single-Throw Vapor Recovery Unit

The VRU-1 is designed to be perfectly suited as a Vapor Recovery Unit, as well as a small natural gas booster compressor. The VRU-1 is a small unit with a simple design, but it has been engineered with heavy duty components and extremely durable running gear, operating at a relatively low speed. These robust features make this unit more reliable and longer lasting than other compressors of this type.

The VRU-1 is a single-throw, single-stage compressor rated 15HP and typically belt driven at a maximum of 600RPM. It is available with either 5" or 8" double acting cylinders which utilize simple poppet valves. The VRU-1 has a relatively high capacity due to the combined rod-load capability of 10,000 lbs.

Please contact Arrow Engine Company for more information on the new VRU-1 or VRU-2 Compressor, or consider having the Arrow Compression Products Packaging Division provide a complete turn-key compressor package built to your specifications.

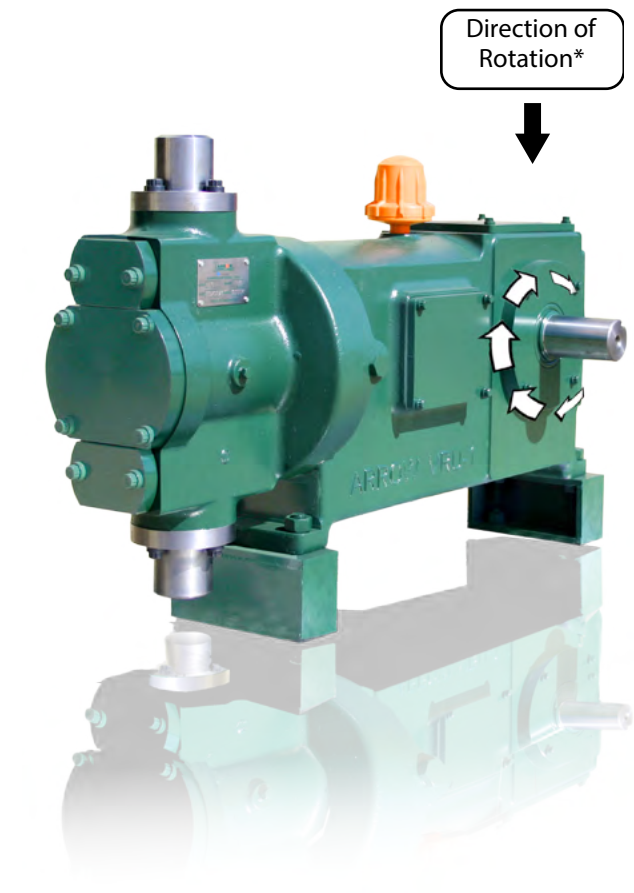


Figure 3.1 VRU-1

3.2 VRU-2 Two-Throw Vapor Recovery Unit

The VRU-2 is a two-throw, two-stage compressor. Two VRU-1 compressor frames can be bolted together to make a VRU-2 two-throw compressor frame. The two-throw crankshaft is required for this, but essentially all other parts are a duplication of the same parts used in the VRU-1 compressor frame.

The VRU-2 can be configured as a single-stage or two-stage compressor using the 8" cylinder as the first stage and the 5" cylinder as the second stage. It is rated 30 HP and has a combined rod-load capability of 10,000 lbs.

*Note: The VRU can be driven in either a clockwise or counter-clockwise direction. As a standard, Arrow will typically set up a VRU-1 to rotate clockwise as shown above. On the VRU-2, one of the frames will rotate clockwise and the other frame will rotate counterclockwise.

DESIGN SPECIFICATIONS

4

4.1 Frame Specifications

FRAME SPECIFICATIONS	
Stroke	2-1/4 inches
Horsepower: VRU-1	15 BHP
Horsepower: VRU-2	30 BHP
Friction Horsepower: VRU-1	2 HP
Friction Horsepower: VRU-2	4 HP
Speed Range	150 - 600 RPM
Maximum Combined Rod Load	10,000 Pounds
Frame Lubrication	Splash
Crankcase	Cast Iron
Crankshaft	Ductile Iron
Connecting Rods	Forged Steel
Main Bearings	Tapered Roller
Connecting Rod Bearings	Precision Insert Trimetal
Crosshead	Aluminum
Crosshead Wrist Pin	Hardened Steel - Full Floating
Wrist Pin Bushing	Bronze
Frame Oil Capacity VRU-1	2 gallons
Frame Oil Capacity VRU-2	4 gallons

4.2 Cylinder Specifications

CYLINDER SPECIFICATIONS	
5" diam, Double Acting	350 psig MAWP
5" diam Piston Material	Ductile Iron
8" diam, Double Acting	150 psig MAWP
8" diam Piston Material	Anodized Aluminum
Piston Rod Diameter	1-1/8 Inches
Piston Rod Material	Hardened Steel w/Rolled Threads
Piston Rings & Rider Band	Carbon-Filled Teflon
Rod Packing	Carbon-Filled Teflon
Cylinder Lubrication	Non-Lube
Valves	Ductile Iron with PEEK Poppets

Continued)

CYLINDER SPECIFICATIONS (continued)

Valve Covers	Ductile Iron
Oil Wiper	Tinized Cast Iron
Cylinder Barrel	Cast Iron
Heads	Ductile or Cast Iron

4.3 Cylinder Size Data**CYLINDER SIZE DATA**

Diameter	MWP psig	Test psig	Piston Displ. cfm @ 600 rpm	Valve Lift Area Sq. In.	Avg. Base Clearance	Suction Discharge
5"	350	525	29.9	1.0	15%	2"
8"	150	225	77.8	1.0	10%	2"

4.4 Bolt Torque Specifications**BOLT TORQUE SPECIFICATIONS**

Piston Nut (Loctite®)	120 ft lbs
Cylinder to Frame	60 ft lbs
Cylinder Head	45 ft lbs
Cylinder Packing Assembly	35 ft lbs
Piston Rod Jam Nut	65 ft lbs
Rod Bearing Cap	50 ft lbs
Valve Screws	45 ft lbs

4.5 Clearance Specifications**CLEARANCE SPECIFICATIONS**

Head End Piston Clearance	.050 to .062"
Crank End Piston Clearance	.050 to .062"
Crank Shaft Main Bearing Clearance	.000 to .001" pre-load
Rod Bearing Clearance	.002 to .003"
Crosshead Clearance	.005 to .009"
Crosshead Writs Pin	.001 to .002"
Cnd-Play	0"

5 Compressor Start Up

5

5.1 Startup Precautions

1. Prior to starting, flush all suction lines leading to the compressor.
2. Fill crankcase with the proper amount of the proper type of lubricant*.
(* When unit is running, sight glass should be full.)
3. Verify that packing has been installed in the compressor and is properly tightened.
4. Verify that suction and discharge piping are installed correctly. Suction and discharge are identified on the casting of the cylinder.
5. Turn compressor over by hand several times to verify free rotation.
6. Verify proper driver **rotation** prior to putting unit in service. (See figure 3.1)
7. Be sure that all valves in discharge piping are open.
8. Avoid starting against a full discharge load. Bring compressor up to speed using either a bypass or unloading, then gradually place compressor on line.
9. The compressor has been broken in at the factory. For operational data and performance specs, see Arrow's VRC-SIM Compressor sizing program for your particular application.

** Normally, a good quality non-foaming engine oil will be satisfactory for use in the compressor crankcase and lubricator. A viscosity of SAE-30 weight is recommended for all normal operations. However, for ambient temperatures below freezing for extended periods of time, SAE-20 weight is recommended.*

5.2 Power End Lubrication

**WARNING: Crankcase is drained before shipping.
Fill before Operating!**

1. For normal service use SAE-30 weight oil.
2. Detergent oil is preferable.
3. At temperatures below 20°F use SAE-20 weight oil or a multi-grade oil like SAE 10W-40 or 10W-30.
4. OIL CAPACITY

VRU-1 8 Quarts / 2 Gal.

VRU-2 16 Quarts / 4 Gal.

5. Check oil level and appearance daily. Change oil at least every three months. The crankcase and breather should be thoroughly cleaned at each oil change.
6. Contamination of the oil by water will be indicated in only a few hours by the oil turning white, milky, or foamy. Contamination of the oil by moisture condensation will be indicated by the oil slowly turning dark or a rusty brown. Whenever any type of contamination is detected, drain the crankcase, remove the crankcase cover, thoroughly flush out the oil and refill with clean oil. At the same time, check and clean the breather or vents. If any doubt exists as to the quality of the oil, change it.

5.3 Start-up Checklist

COMPRESSOR GENERAL INFORMATION				
Compressor Model			Serial No.	
Cylinder Serial No.				
Driver			Rated Speed	
Packager			Packager Unit No.	
Date Packager Shipped			Start Up Date	
Serviceman			Customer	
Location			Field Contact	
Field Telephone No.			Unit Location	
Frame Oil - Make			Grade	
Cylinder Oil - Make			Grade	
NOTES / COMMENTS:				

6 Compressor Maintenance

6

6.1 General Maintenance

1. Keep compressor, distance piece, vent connection, and area around compressor clean. This helps to detect leaks from seals and power end packing. Keep cylinder packing vent connection open.
2. Visually check connecting rod bearings and main bearings **WHENEVER CHANGING OIL**.
3. Check crankcase **WEEKLY** for contamination.
4. Change oil at least **EVERY THREE MONTHS**.
5. Check compressor packing **DAILY** for leakage.
6. Inspect and service compressor valves **EVERY THREE MONTHS**, or as needed.

MAINTENANCE	DAILY	WEEKLY	3 MOS	AT OIL CHANGE
Clean compressor	X			
Check packing for leakage	X			
Check oil level and appearance	X			
Check crankcase for contamination		X		
Change oil			X	
Check rod and main bearings				X
Clean crankcase and breather				X
Inspect and service valves			X	

6.2 Wrist Pin and Rod Bearing

Check wrist pin to wrist pin bushing clearance and clearance on rod bearing rod journal. Wear on this can be determined by a visual inspection of the layers of babbitt, any appreciable wear of babbitt would indicate the need for replacement. Clearance may be checked with Plasta Gauge®. If any damage to connecting rod has been done by bearing failure, replace connecting rod assembly.

Replacement of wrist pin bushing should be done by a machine shop for proper alignment and running clearance.

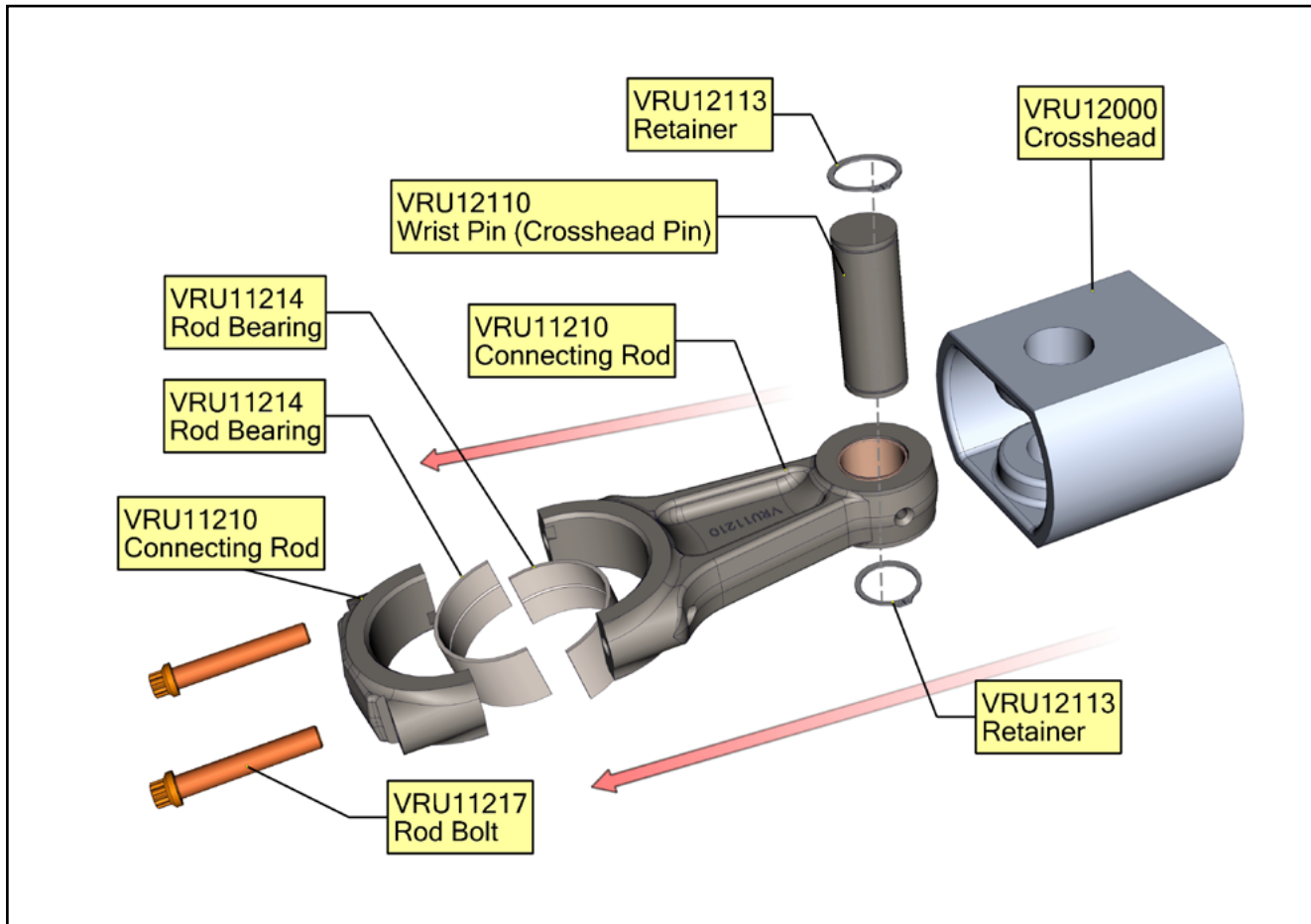


Figure 6.1 Crosshead and Rod Assembly

6.3 Connecting Rod/Crosshead Assembly

1. Assemble connecting rod to crosshead. Replace wrist pin and wrist pin retainer in crosshead.
2. Slide connecting rod/crosshead assembly into crosshead guide from the cylinder end.
3. Snap bearing shell in rod with bearing tab properly located in notch in rod.

4. Reassemble rod cap and rod cap bolts to crankshaft.
5. The crossheads in the compressors are aluminum, therefore, no bushings are needed in the crosshead itself. The wrist pins are made of steel and should be oiled before assembly.
6. The crosshead guide should be oiled before reassembly of the connecting rod/crosshead assembly to the crankshaft.
7. Before the cylinder assembly is assembled to the crosshead guide, the crosshead jam nut should be started on the piston rod.
8. All VRU compressors are balanced at the factory. Crosshead balance weights are not required.

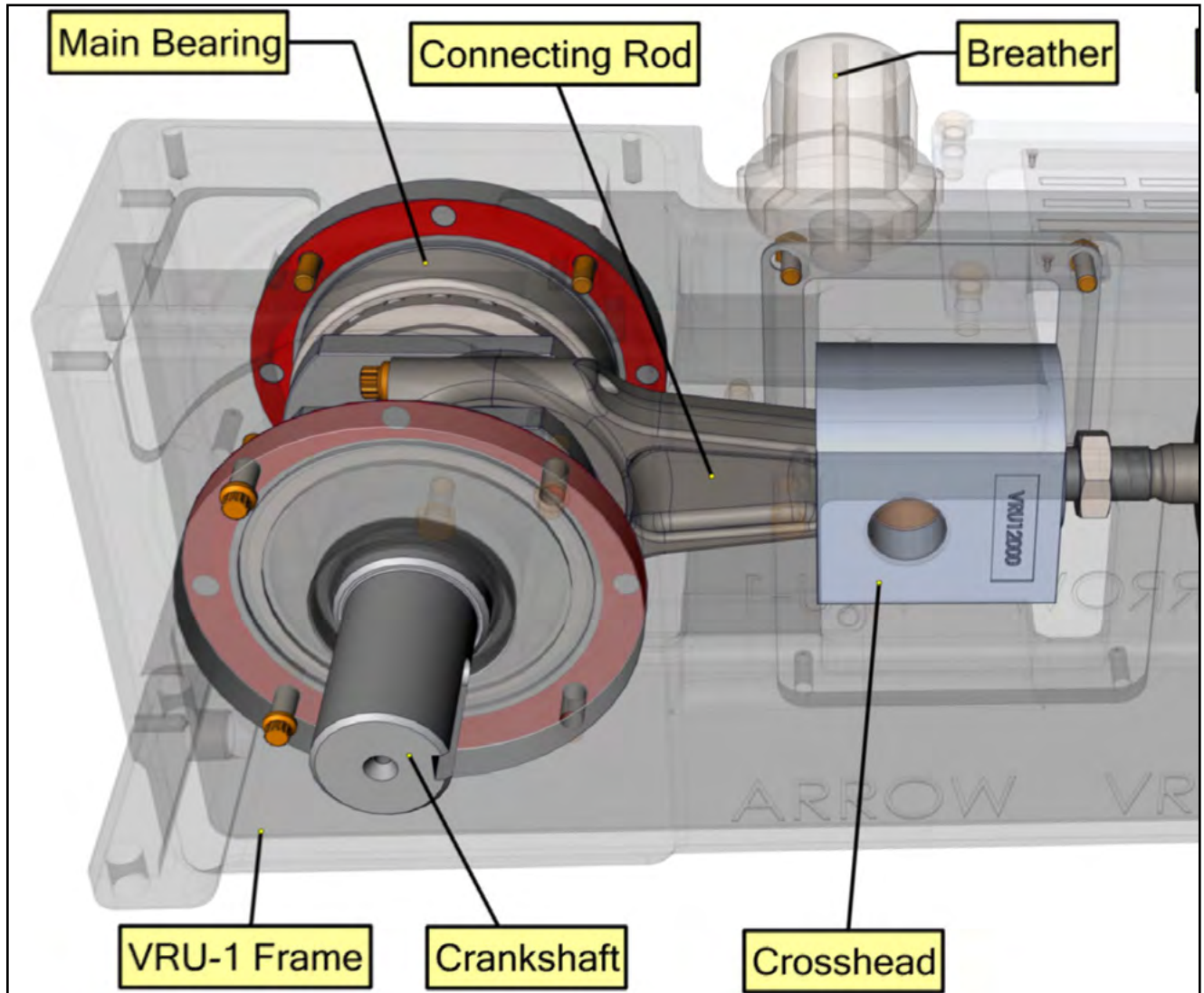


Figure 6.2 Crankshaft, Connecting Rod, and Crosshead Assembly

6.4 Crankshaft Installation

1. Push the crankshaft with bearings through the side opening in the crankcase.
2. Place a .015 shim pack on each side of the compressor frame and tighten both bearing retainer

plates. Measure crankshaft end play and remove shims as required to obtain **zero end play**.

NOTE: The shims are color coded for identification in the following manner.

Red	.002"	thick
Blue	.005"	thick
Brown	.010"	thick

3. Making sure the bearing cone and bearing cup are clean and properly oiled, replace the bearing to the crankcase.
4. Position crankshaft as necessary to install connecting rod to the crankshaft.
5. Replace connecting rod cap bolts.

NOTE: Torque all nuts and bolts to recommended specs.

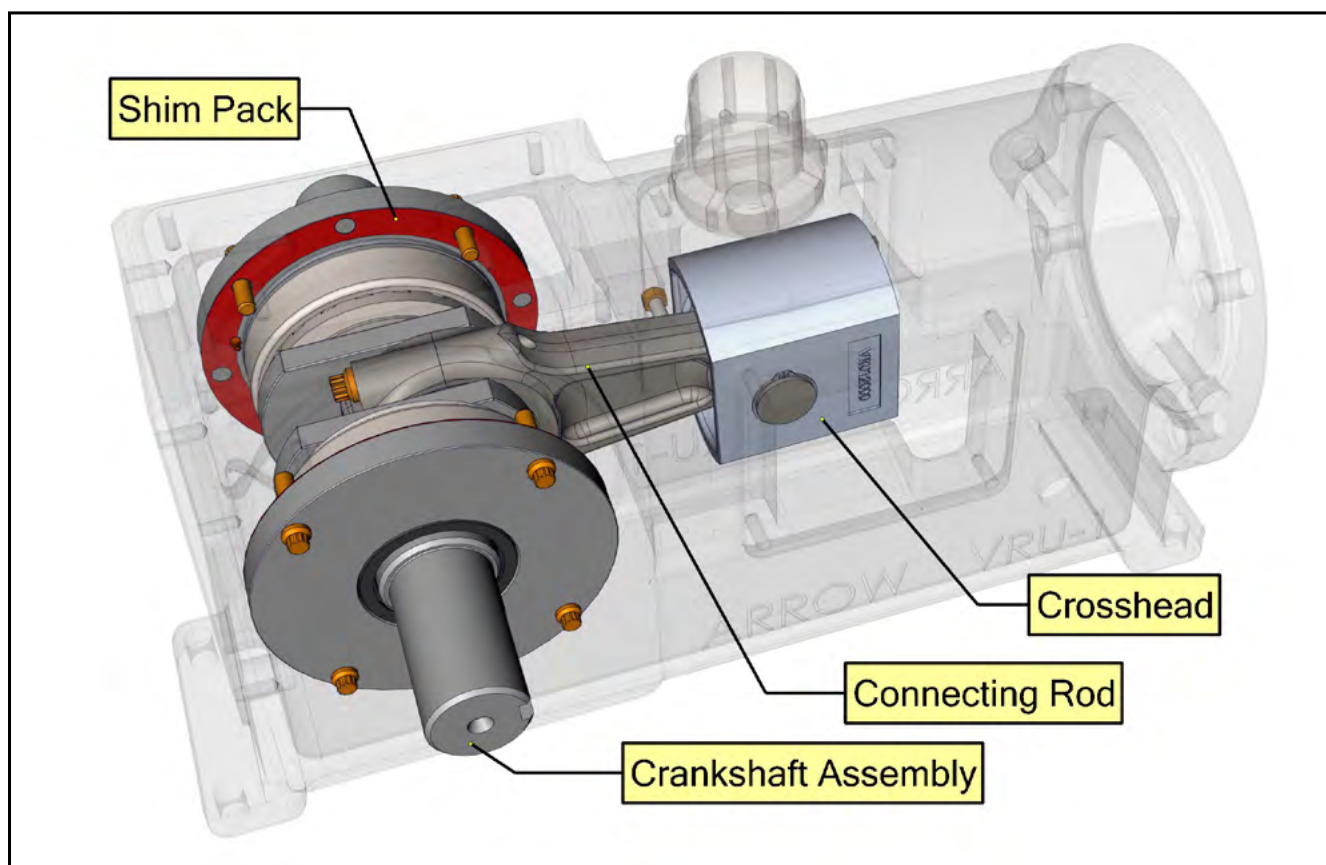


Figure 6.3 Crankshaft, Connecting Rod, Crosshead

6.5 Piston and Rod Removal

WARNING! Completely vent system before performing any maintenance. Back off all bolts approximately 1/8" and make sure head is loose and cylinder is vented before removing cylinder head.

1. Remove cross head guide covers and cylinder outer head (which has been properly vented).
2. Rotate crankshaft to position crosshead.
3. Remove crosshead jam nut.
4. Remove piston/piston rod assembly from cylinder outer end carefully.

NOTE: The threaded end of the piston rod is smaller in diameter than the part of the rod that goes through the packing gland assembly. The rod should be backed out of the cylinder being careful not to destroy the packing rings.

6.6 Piston and Rod Disassembly

1. A special Piston Rod Clamp tool (VRC29494) is available and should be used to hold the piston and piston rod during assembly. Reattach the piston rod to the crosshead and tighten with jam nut. With a special piston nut adaptor (VRU19490), unscrew piston nut.

NOTE: The piston nut has been coated with Loctite® bearing and stud locking compound during factory installation. To unscrew these parts, the connection may have to be heated to 400°F to release the Loctite® compound. Care must be taken not to overheat the material.

2. Slide piston and rings off the rod.
3. To remove cylinder from power frame, remove four 5/8" bolts.

6.7 Reassembly and Installation

1. Install cylinder to frame, if removed. Make note of O-ring between cylinder and frame (see cylinder assembly drawing). Torque bolts to 60 ft/lbs.
2. Oil piston and piston rings.
3. Install piston and rod assembly using piston rod entering sleeve tool (VRC29492). Do not force piston rod through packing assembly. Oil rod and very lightly push and wiggle until rod enters packing. CAUTION: DO NOT FORCE! Packing is made of Teflon® and will damage easily. Screw piston rod into crosshead. Rotate crankshaft to bottom dead center and screw piston rod in until back of piston just hits crank end cylinder head, then turn out or counterclockwise 1/2 turn. This will automatically set the head end piston clearance at .050" when crankshaft rotates 180°. Hold piston and tighten jam nut to 65 ft/lbs. Rotate crankshaft 360° and recheck clearance and make sure piston is centered in cylinder.

4. Install cylinder head end head with proper O-ring and torque 1/2" bolts evenly to 25 ft/lbs cross-
ing from side to side and then retorque to 45 ft lbs. After installing head, rotate crankshaft to
check for possible problems in piston clearance adjustment.
5. Before starting, roll compressor through by hand several times to make sure piston clearance is
set properly.
6. Replace cross head guide covers and tighten the bolts.

NOTE: Torque all nuts and bolts to recommended specs.

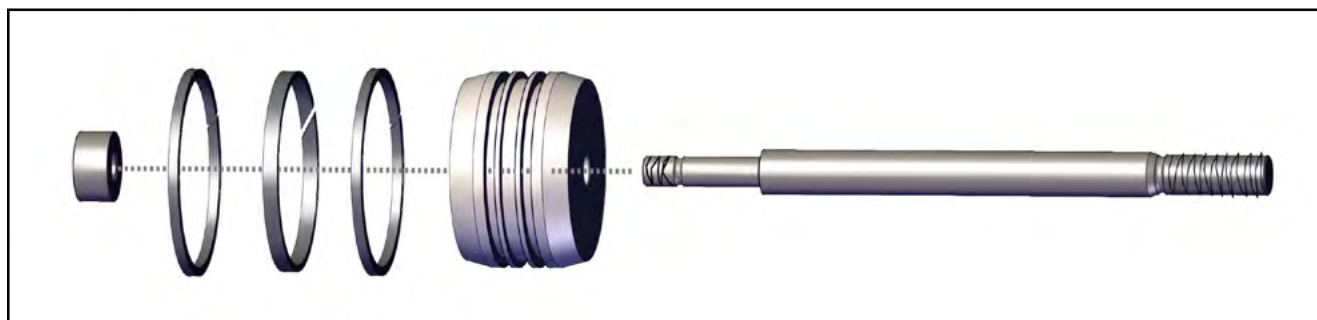


Figure 6.4 5.0 Piston Assembly

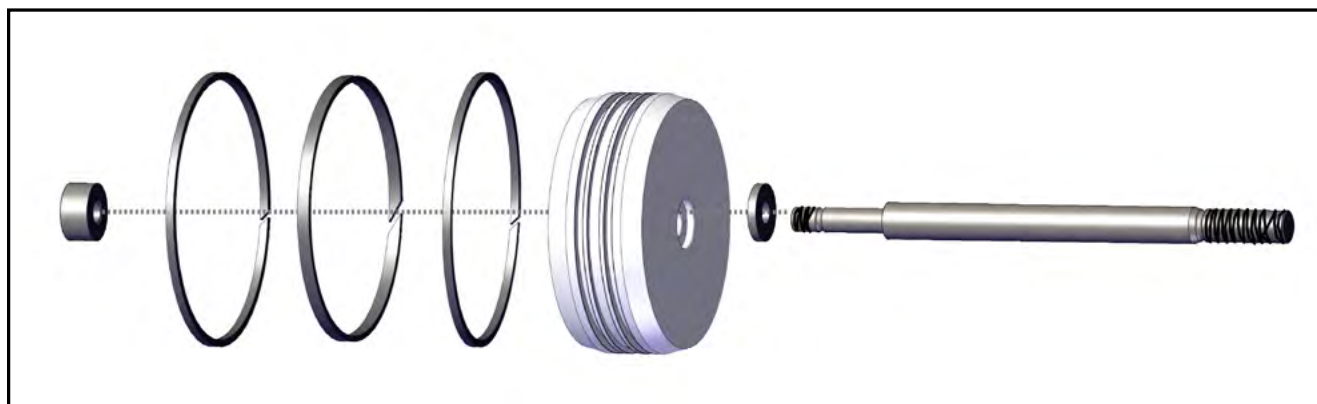


Figure 6.5 8.0 Piston Assembly

6.8 Piston Rod Packing Removal and Disassembly

REMOVAL

WARNING: Completely vent system before performing any maintenance. Back off all bolts approximately 1/8" and make sure head is loose and cylinder is vented before removing cylinder head.

1. Remove crosshead guide covers and outer cylinder head (which has been properly vented).

2. Remove piston/piston rod assembly.

DISASSEMBLY

1. To disassemble cylinder packing gland assembly, remove gland assembly from crank end head. Place the bottom O-ring cup on the table with O-ring face down. Unscrew the two machine screw nuts from packing hold-down ring studs and slide packing hold-down ring off of studs, remove packing and packing cups as needed.

REASSEMBLY AND INSTALLATION

1. Install cylinder to frame, if removed. Make note of O-ring between cylinder and frame. (see cylinder assembly drawing.) Torque bolts to 60 ft/lbs.
2. Oil piston and piston rings.
3. Install piston and rod assembly using piston rod entering sleeve tool (VRC29492). Do not force piston rod through packing assembly. Oil rod and very lightly push and wiggle until rod enters packing. CAUTION: DO NOT FORCE! Packing is made of Teflon® and will damage easily. Screw piston rod into crosshead. Rotate crankshaft to bottom dead center and screw piston rod in until back of piston just hits crank end cylinder head, then turn out or counterclockwise 1/2 turn. This will automatically set the head end piston clearance at .050" when crankshaft rotates 180°. Hold piston and tighten jam nut to 65 ft/lbs. Rotate crankshaft 360° and recheck clearance and make sure piston is centered in cylinder.
4. Install cylinder head end head with proper O-ring and torque 1/2" bolts evenly to 25 ft/lbs cross- ing from side to side and then retorque to 45 ft lbs. After installing head, rotate crankshaft to check for possible problems in piston clearance adjustment.
5. Before starting, roll compressor through by hand several times to make sure piston clearance is set properly.
6. Replace cross head guide covers and tighten the bolts.

NOTE: Torque all nuts and bolts to recommended specs.

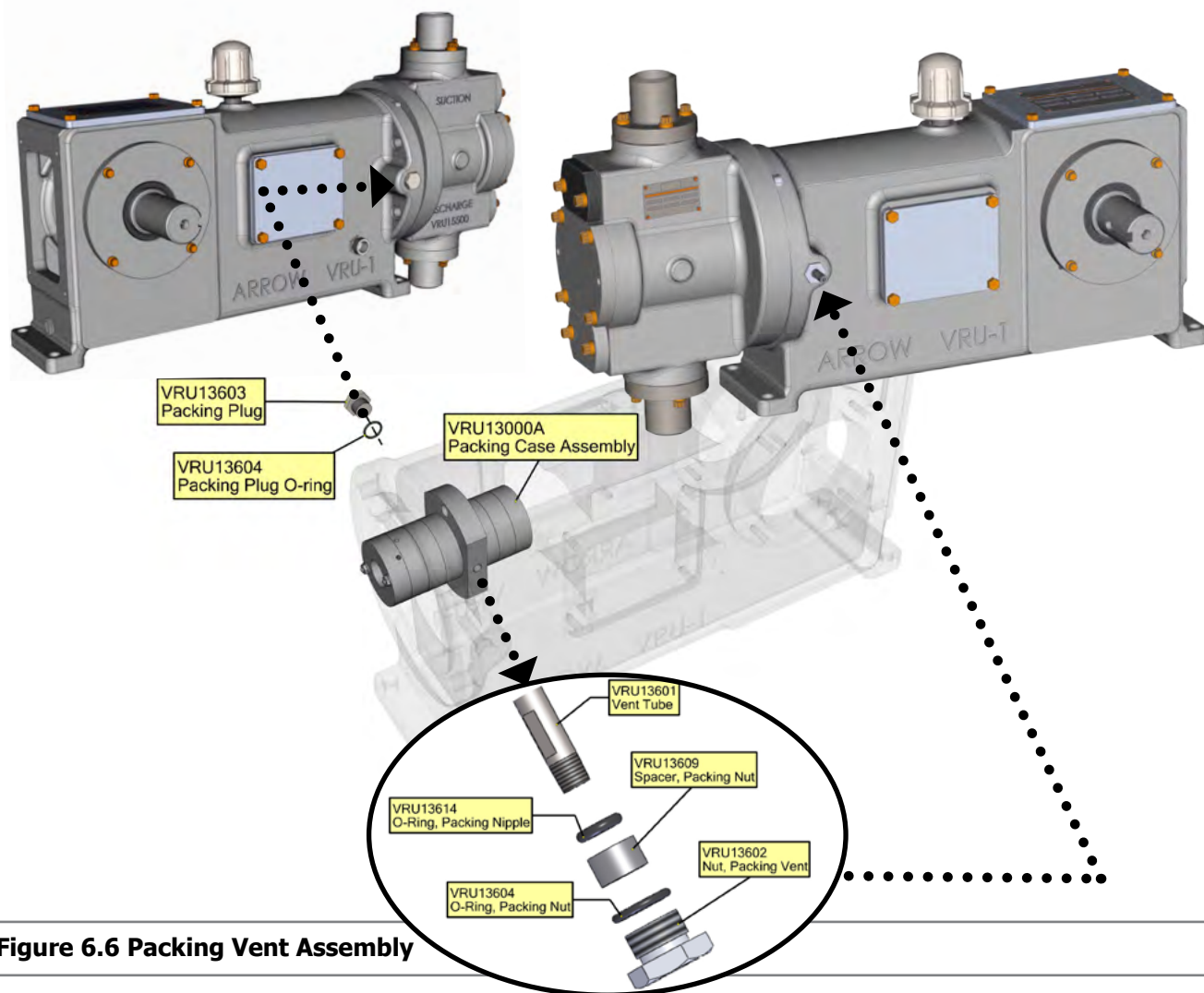


Figure 6.6 Packing Vent Assembly

REASSEMBLY

1. When reassembling packing assembly, it is important that all surfaces be free from dirt and nicks between packing cups.
2. Place the bottom O-ring on the table with O-ring groove face down. Screw in studs.
3. Place pressure breaker (if used) in the cup.
4. Slide on the packing cups with packing rings face up.
5. Slide on vent cups.
6. Slide on the wiper cup.
7. Place the wiper rings in the proper position in the wiper cup.
8. Place the wiper flange on the top of the assembly.
9. Replace the two (2) nuts and tighten.
10. Lubricate packing rings with 30W oil as you assemble packing gland. After gland is assembled, make sure all packing rings are free floating in cups by moving them with your finger.

INSTALLATION

1. Put packing gland assembly into the crank end head.
2. Replace piston/piston rod assembly.
3. Replace outer cylinder head.

NOTE: Use caution when starting piston/piston rod assembly through packing gland assembly protecting the packing rings from damage.

TYPES OF PACKING RINGS

WIPER RINGS

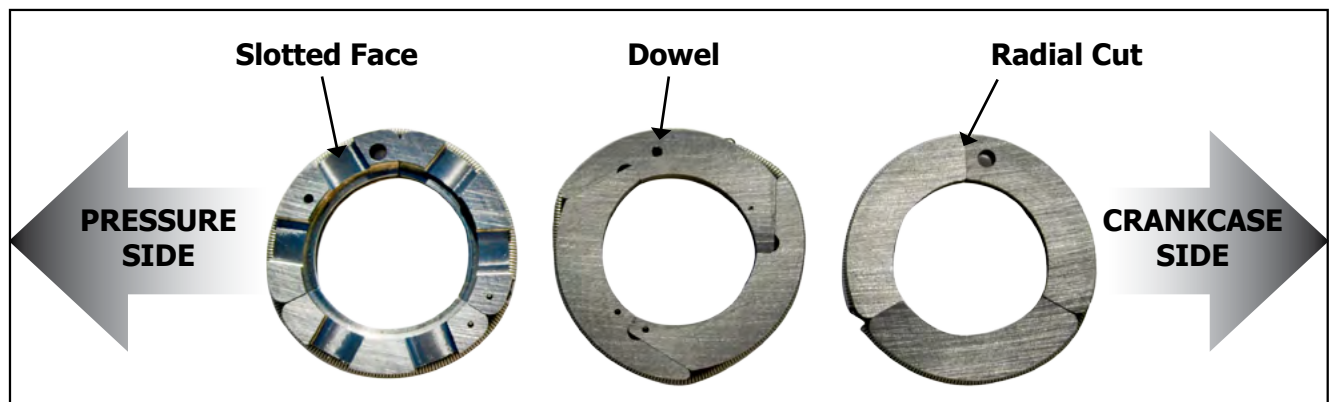


Figure 6.7 Packing Case – Wiper Rings

There are three rings in this unit. The rings are doweled to provide a staggered arrangement. Its purpose is to keep the crankcase oil out of the stuffing box and cylinder. Rings are assembled with the slotted face toward the oil (crankcase) and the blank side toward the packing and cylinder.

DOUBLE ACTING PACKING RINGS

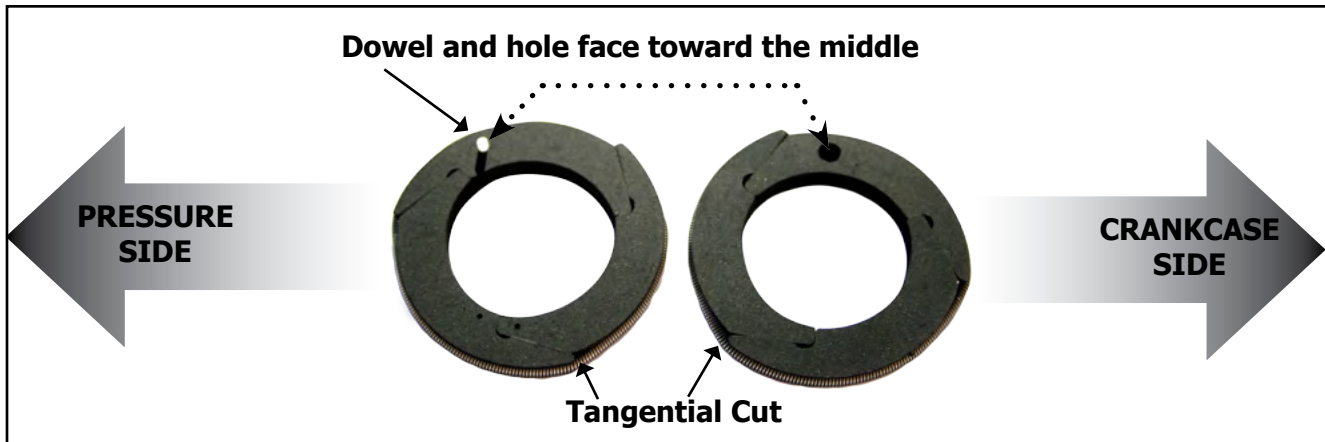


Figure 6.8 Packing Case – Double Acting Rings

This unit consists of two tangentially cut rings operating as a pair. The rings are doweled so the tangential cuts are staggered from one ring to the other and the gas flow blocked. It is double acting in that it will seal in either direction. Single acting packing uses one tangentially cut ring and one radial cut ring for a backup. These rings straddle the packing gland flange.

SINGLE ACTING PACKING RINGS

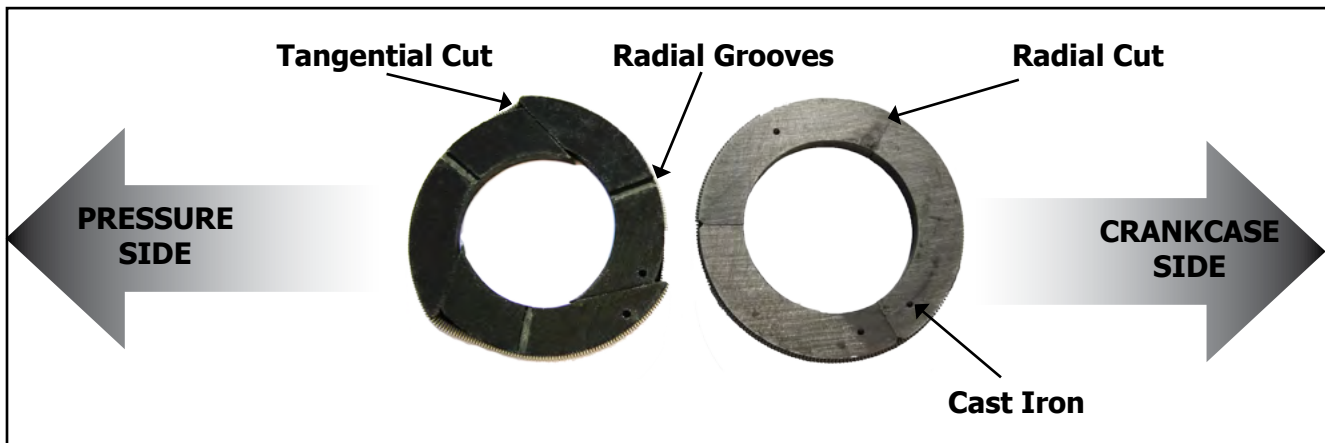


Figure 6.9 Packing Case – Single Acting Rings

This unit consists of two rings that operate as a pair. One ring is tangentially cut and has three radial grooves. This face is toward the pressure. The second ring is cast iron (often plated) and serves as a backup for the ring facing the pressure.

6.10 Suction and Discharge Valve Maintenance

WARNING: Make sure all gas pressure is vented from the cylinder before attempting to remove any valve covers.

VALVE REMOVAL

1. Loosen all bolts equally for the valve covers to make sure all pressure is vented from cylinder.
2. Remove suction and discharge valves from the cylinder head end by removing the bolts. Pry out with a screw driver.

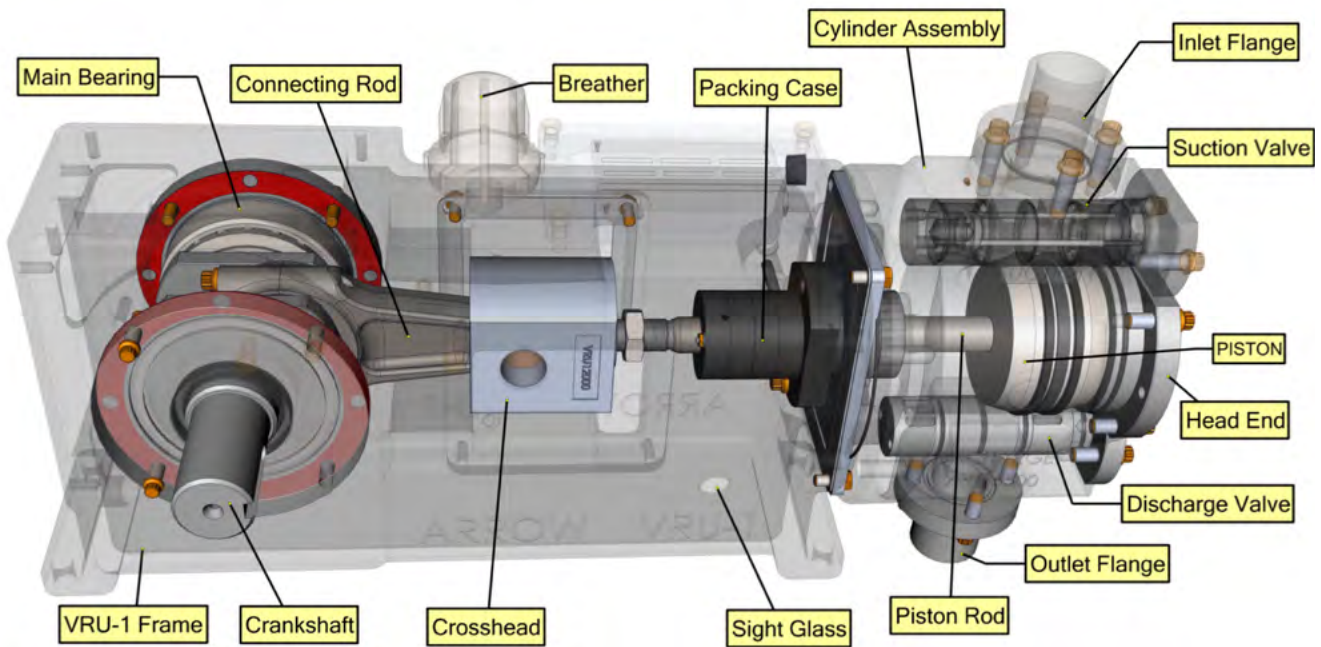
VALVE MAINTENANCE

1. Disassemble valve assembly by removing cap screws.
2. Clean and remove any foreign matter.
3. Check the seating surface finish of the seat and replace if necessary.
4. Inspect and replace broken poppets and springs.
5. Reassemble the valves.
6. Preventive maintenance suggested every three months for compressor valves, or as needed.



Figure 6.10 Suction and Discharge Valve

VRU-1 Assembly



7 VRU Compressor Assembly

7

7.1 Frame Assembly

1. Inspect frame and clean with solvent as necessary to remove any dirt or preservative.
2. Install oil level sight glass (VRU11400) after applying thread sealant and insert in threaded hole in frame. (*figure 7.1*)



Figure 7.1 Oil level sight glass

3. Install oil drain plug (VRU11509) after applying thread sealant and insert in threaded hole at bottom of frame. (*figure 7.2*)



Figure 7.2 Oil drain plug

7.2 Crankshaft Installation

1. Clean and inspect crankshaft (VRU11100) and prepare to install main bearings.
2. Slide the main bearing cone (VRU11101) over one end of the crankshaft. This is a tight slip fit and may require some gentle tapping with a rubber mallet until the cone has fully seated on the crankshaft. Repeat this procedure on the other end of the crankshaft. (*figure 7.3*)



Figure 7.3 Main bearing cone

3. Install a main bearing cup (VRU11102) into either side of the frame. (*figure 7.4*)



Figure 7.4 Main bearing cup



Figure 7.5 Flat side flush

4. Make sure the tapered side is toward the inside of the frame and the flat side is flush with the outside of the frame. (*figure 7.5*)



Figure 7.6 Press in oil seals

5. Press oil seals (VRU11124) into main bearing retainers (VRU11120) with a bench press or wooden block and mallet. (*figure 7.6*)

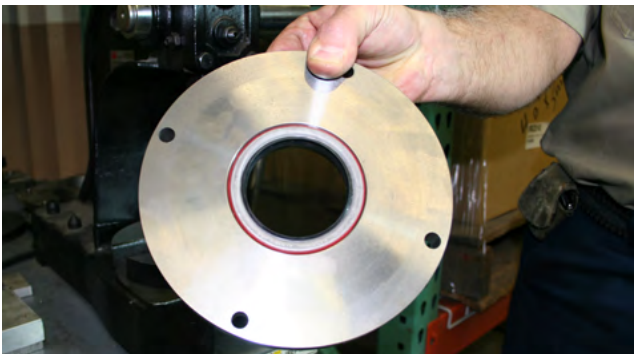


Figure 7.7 Press seal in until flush

6. Be careful to press seal straight in, as getting it cocked or crooked may cause permanent damage to the seal. Press seal in until seal face is flush with retainer. (*figure 7.7*)

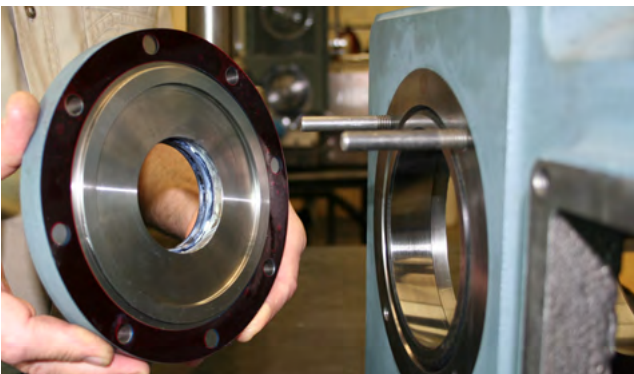


Figure 7.8 Insert all shims

7. Insert all shims from shim pack (VRU11119) on either one of the bearing retainers. Install one bearing retainer on either side of the frame using alignment studs, if necessary, to hold shims in place while installing the main bearing retainer. (*figure 7.8*)

NOTE: After crankshaft end-play is checked, it may be necessary to remove some shims.

8. Insert and tighten the (4) retainer screws (VRC29268). *(figure 7.9)*



Figure 7.9 Insert retainer screws

9. Prepare crankshaft assembly for installation into frame by first sliding the oil seal entering sleeve tool (VRU29482) over either end of the crankshaft *(figure 7.10)*



Figure 7.10 Slide on oil seal tool

10. Apply lubricant to the crankshaft. *(figure 7.11)*

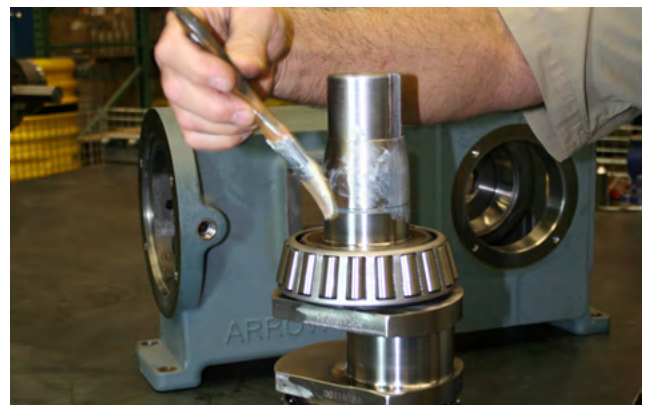


Figure 7.11 Lubricate the crankshaft

11. Apply lubricant to the oil seal. *(figure 7.12)*



Figure 7.12 Lubricate the oil seal

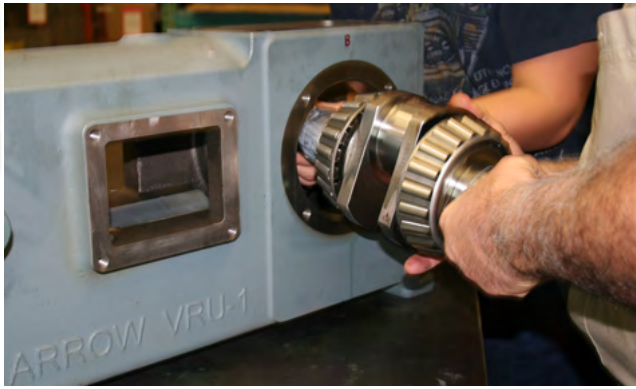


Figure 7.13 Install crankshaft assembly



Figure 7.14 Tap with rubber mallet



Figure 7.15 Remove oil sleeve tool



Figure 7.16 Lubricate sleeve and oil seal

12. Install crankshaft assembly through open side of frame, (*figure 7.13*) and while holding crankshaft up, install the second main bearing cup into the frame.

It may be necessary to gently tap the cup into the frame with a rubber mallet until cup is flush with the frame. (*figure 7.14*)

NOTE: This procedure will be easier if a second person is available to help.

13. Remove the oil seal entering sleeve and slide it over the opposite end of the crankshaft. (*figure 7.15*)

14. Apply lubricant to the sleeve and the oil seal in the second main bearing retainer. (*figure 7.16*)

15. Put the second shim pack on the second bearing retainer and slide retainer and seal over end of crankshaft being careful to not damage the seal. (figure 7.17) Remove the entering sleeve, install the (4) screws and tighten them.

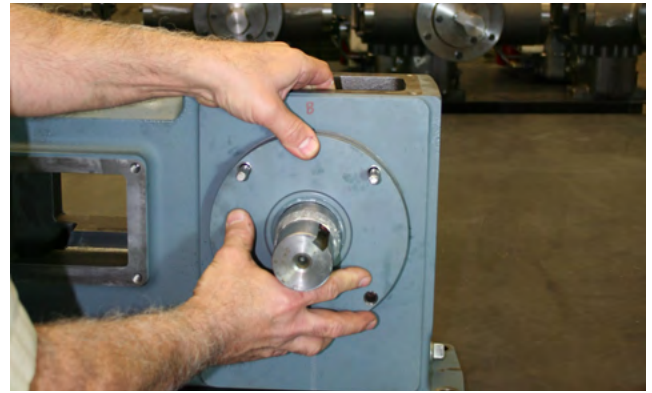


Figure 7.17 Install shims and retainer

7.3 Setting Crankshaft End-Play

NOTE: At this point, both complete shim-packs have been installed and there will be more end-play than the required end-play of 0".

1. Tap both ends of the crankshaft to seat the crankshaft in the frame. (figure 7.18)
2. Rotate the crankshaft to make sure it rotates freely. (figure 7.19)
3. Install a dial indicator on either side of the frame with indicator located on the end of the crankshaft. (figure 7.20)



Figure 7.18 Seat crankshaft in frame



Figure 7.19 Rotate crankshaft



Figure 7.20 Install a dial indicator

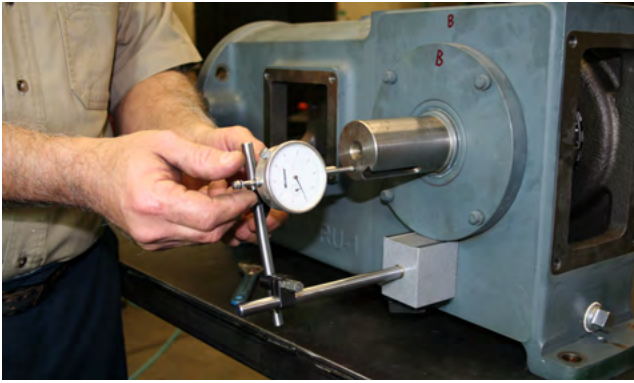


Figure 7.21 Measure end-play



Figure 7.22 Lubricate parts



Figure 7.23 Insert pin retainer



Figure 7.24 Slide pin the rod

4. Measure total end-play and determine how many shims need to be removed to achieve an end-play of 0". Divide the total shim thickness to be removed by two, and then remove this equal quantity of shims from both of the bearing retainers. (*figure 7.21*)
5. Install both retainers and shims and check end-play once more to make sure it is set at 0" end-play.

7.4 Connecting Rod to Crosshead Installation

1. Clean and inspect parts prior to assembly.
2. Lightly lubricate parts and check to make sure the crosshead pin (VRU12110) fits snugly into the crosshead (VRU12000) and rotates freely. (*figure 7.22*)
3. Using snap-ring pliers, insert one pin retainer (VRU12113) into the groove at one end of the pin. (*figure 7.23*) Lubricate pin and crosshead pin bore and partially insert pin into crosshead.
4. Lubricate pin end of connecting rod assembly (VRU11210) and hold rod in place while sliding the pin through the rod. (*figure 7.24*)

5. Install the second retainer on the pin (*figure 7.25*) and check to see that pin rotates freely.

7.5 Connecting Rod and Crosshead to Frame Installation

1. Install connecting rod bearings (VRU11214) in connecting rod and rod cap, making sure tabs in the bearings are inserted in the notches in the rod and cap. (*figure 7.26*)

2. Lubricate the bearings, crosshead surfaces, and crosshead guides in the frame. (*figure 7.27*)

NOTE: The VRU has a splash lubrication system and the oil hole at the connecting rod bushing (*figure 7.28*) must be on the top so that splashed oil can gravity flow into the crosshead pin.



Figure 7.25 Install the second retainer



Figure 7.26 Install rod bearings



Figure 7.27 Lubricate crosshead



Figure 7.28 Oil hole



Figure 7.29 Slide in crosshead assembly



Figure 7.30 Rod cap marking

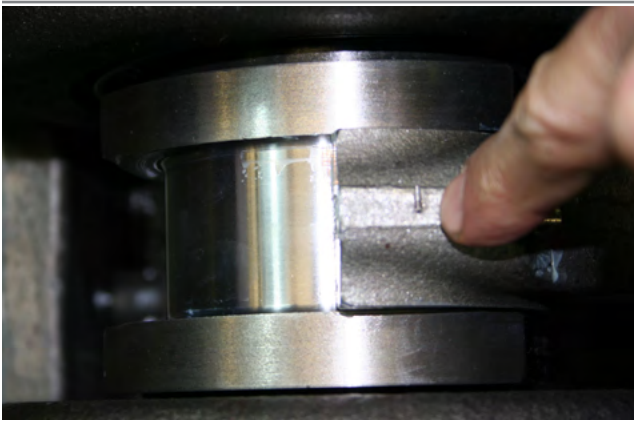


Figure 7.31 Line up marks



Figure 7.32 Insert upper rod cap screw

3. With oil hole pointing up, slide the cross-head and connecting rod assembly into the frame. This is a tight fit, so go slowly and take caution to keep the crosshead from getting crooked in the crosshead guides. Do not use a hammer or use much force as that could cause damage to the precision running surfaces. (*figure 7.29*)

4. Locate the connecting rod on the crankshaft pin and install the connecting rod cap so that the marks on the rod and cap line up. (*figure 7.30*) and (*figure 7.31*)

5. Insert the upper connecting rod cap screw (VRU11217) and finger tighten. (*figure 7.32*)

6. Insert the lower connecting rod cap screw, first through the oil splasher tab and then into the connecting rod cap. *(figure 7.33)*



Figure 7.33 Insert lower rod cap screw

NOTE: It may be necessary to hold the splasher in place so that it does not rotate while tightening the connecting rod cap screws. *(figure 7.34)*

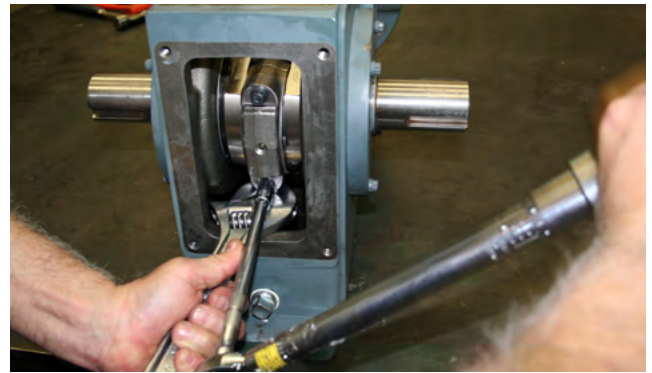
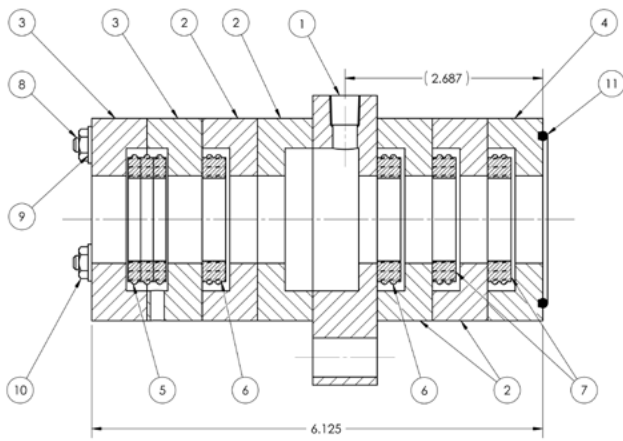


Figure 7.34 Hold splasher in place

6. Torque the rod bearing cap screws to 50 ft. lbs. and then check to make sure the crankshaft and running gear all rotate freely. *(figure 7.35)*



Figure 7.35 Check Rotation



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	VRU13241	CUP, PACKING, CENTER	1
2	VRU13221	CUP, PACKING, PLAIN	4
3	VRU13351	CUP, PACKING, WIPER	2
4	VRU13211	CUP, PACKING, BOTTOM	1
5	VRC23441	RING, PACKING, WIPER	1
6	VRC23431	RING, PACKING, DOUBLE ACTING	2
7	VRC23421	RING, PACKING, SINGLE ACTING	2
8	VRU13118	STUD, PACKING CASE	2
9	VRU13115	WASHER, SEAL, PACKING CASE STUD	2
10	VRU13109	NUT, LOCK, PACKING CASE STUD	2
11	VRC23106	GASKET, WIRE, PACKING CASE NOSE	1

Figure 7.36 Packing case assembly

7.6 Packing Case Assembly

Assemble the packing case per the assembly drawing shown. (*figure 7.36*)

NOTE: The packing case nose wire gasket (VRC23106) is designed to crush to provide a good pressure seal. It is recommended that a new gasket be used every time a packing case is installed.



Figure 7.37 Inspect an clean cylinder

7.7 Cylinder Assembly

1. Inspect cylinder and clean with solvent as necessary to remove any dirt or preservative. (*figure 7.37*)



Figure 7.38 Install packing case

2. Install the packing case with the nose gasket toward cylinder and tighten the (2) packing case screws (VRU13107) to a torque of 35 ft lbs. (*figure 7.38*)

NOTE: The packing case vent hole can be on either side but generally will be mounted with the vent hole toward the side of the cylinder where the cylinder nameplate is located. (figure 7.39)

7.8 Cylinder To Frame Assembly

1. Install the frame to cylinder O-Ring (VRU15562) on the cylinder. (figure 7.40)

2. Apply lubrication to the O-Ring area and the frame. (figure 7.41)

3. Install the cylinder to the frame with the "Suction" port on top and the "Discharge" port on the bottom. (figure 7.42)

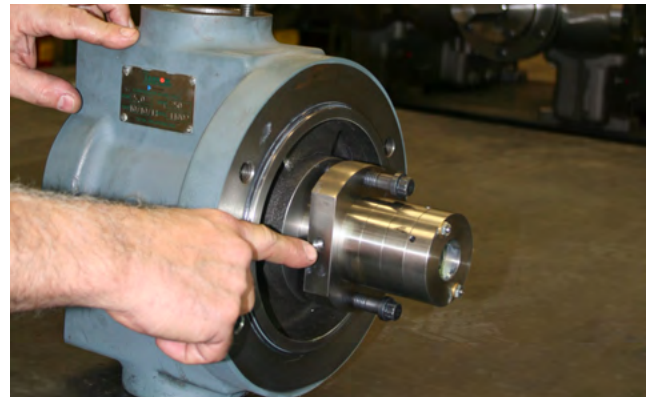


Figure 7.39 Packing case vent hole



Figure 7.40 Install cylinder O-ring



Figure 7.41 Lubricate the O-ring area

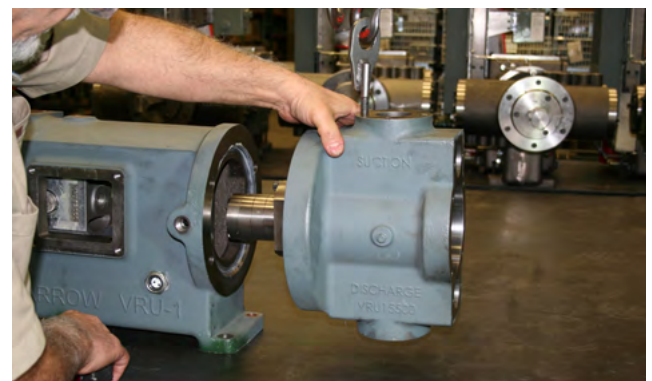


Figure 7.42 Install cylinder to frame

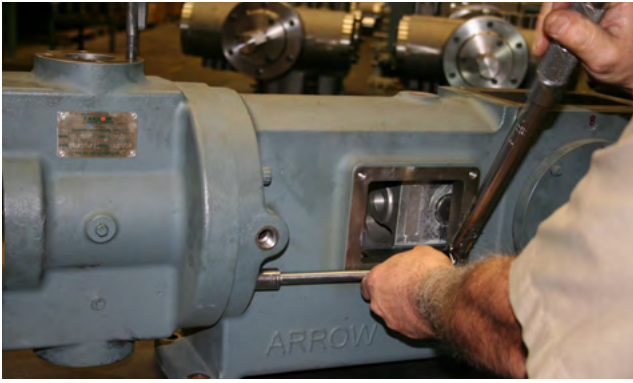


Figure 7.43 Torque screws to 60 ft. lbs.



Figure 7.44 Insert vent needle



Figure 7.45 Install vent tube



Figure 7.46 Tighten vent tube

4. Use (4) screws (VRU15027) and tighten them in a criss-cross pattern to a torque of 60 ft lbs. (*figure 7.43*)

7.9 Packing Vent Tube and Plug Installation

1. Start on the nameplate side of the frame or the side that the packing case vent hole lines up with the vent hole in the frame.
2. Apply thread sealant to the vent nipple (VRU13601) and insert it, with flats out, through the vent hole in the frame and into the vent hole in the packing case. (*figure 7.44*)
3. Apply lubrication to the vent-nipple/tube and install the spacer (VRU13609) and O-Ring (VRU13614).
4. Install O-Ring (VRU13604) on the packing vent nut (VRU13602) and slide it over the vent tube and into the vent hole in the frame. (*figure 7.45*) (*See figure 6.6 for further packing vent assembly instructions if needed.*)
5. Tighten nipple finger tight, then using a 9mm open-end wrench, tighten the vent tube being careful not to over tighten, (*figure 7.46*)

6. Finish tightening the nut. *(figure 7.47)*

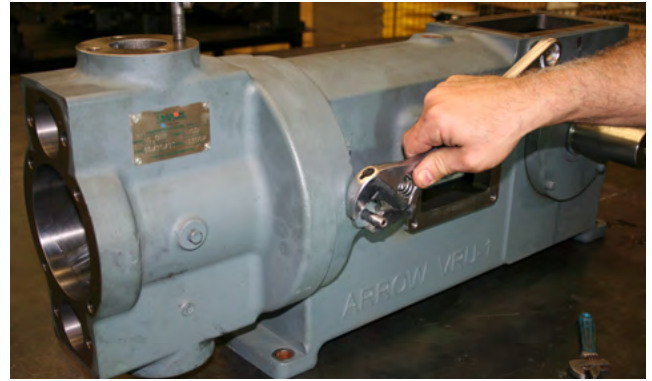


Figure 7.47 Tighten the nut

7. Finish on the opposite side of the frame by plugging the extra vent hole.
8. Install O-Ring (VRU13604) on the packing vent plug (VRU13603), apply thread sealant and tighten. *(figure 7.48)*



Figure 7.48 Install vent plug

7.10 Piston and Rod Assembly

1. Place piston rod (VRU14150) in the special piston rod clamp tool (VRC29494) and use a vise to hold the piston rod securely without causing any damage to the precision rod surface. *(figure 7.49)*



Figure 7.49 Piston rod clamp tool

2. Slide piston on the small end of piston rod and with the countersunk end of piston toward threaded end of rod.
3. Screw on piston nut (VRU14919) using special piston nut adaptor tool (VRU19490). *(figure 7.50)*



Figure 7.50 Piston nut adaptor tool



Figure 7.51 Stagger ring gaps

4. Carefully stretch the piston rings and rider band just enough to slip into the ring grooves. First install a ring, followed by a rider band in the center groove, and then the second ring.
5. Stagger the ring gaps so that they do not line up and create a leak-path. (*figure 7.51*)



Figure 7.52 Rod entering sleeve tool

6. Slide the special piston rod entering sleeve tool (VRC29490) over the threads. (*figure 7.52*)



Figure 7.53 Lubricate sleeve and piston

7. Lubricate the sleeve and piston rod. (*figure 7.53*)

8. Lubricate the cylinder bore. (*figure 7.54*)

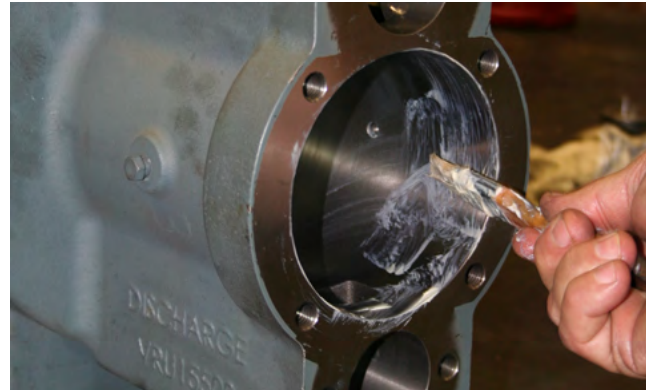


Figure 7.54 Lubricate cylinder bore

9. Insert the piston and rod assembly through the packing case being careful not to damage the packing rings. (*figure 7.55*)



Figure 7.55 Insert piston assembly

9. Remove the sleeve. (*figure 7.56*)



Figure 7.56 Remove sleeve

10. Install the piston rod jam nut (VRC24909) on the rod with the flat side toward the cross-head. and (*figure 7.57*)

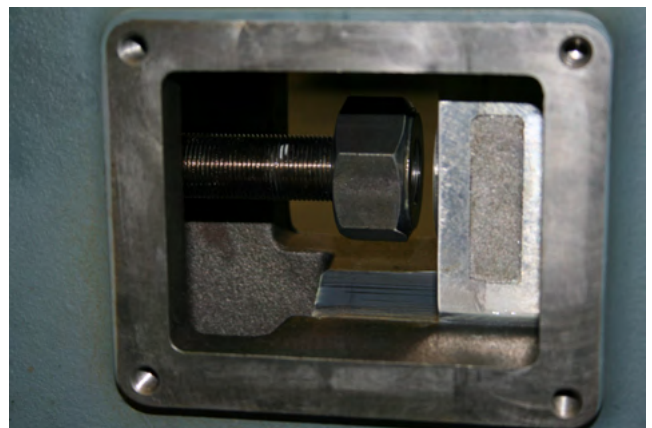


Figure 7.57 Install piston rod jam nut

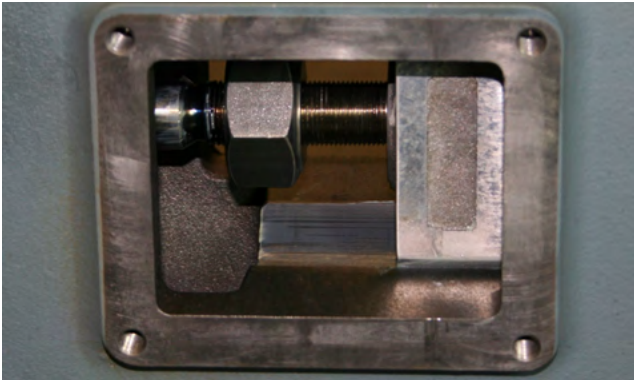


Figure 7.58 Thread nut onto rod



Figure 7.59 Piston nut adapter tool

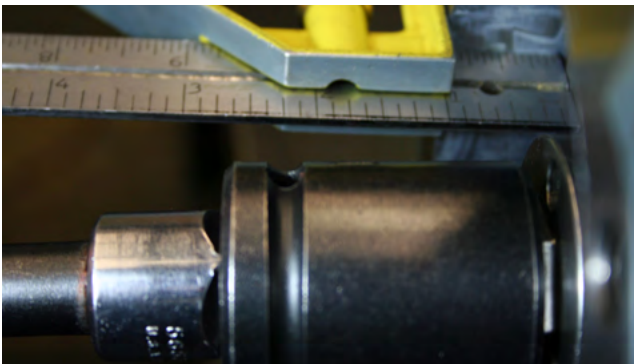


Figure 7.60 Screw in piston assembly



Figure 7.61 Jam nut wrench

11. Thread the nut all the way on the rod.
(figure 7.58)

12. Using the piston nut adaptor tool, rotate the piston and rod assembly to thread the rod into the crosshead. (figure 7.59)

7.11 Setting Piston Clearance

1. Rotate the crankshaft until the crosshead is at top-dead-center or at the end of its throw.
2. Screw the piston and rod assembly into the crosshead until the piston is approximately 1 inch or $31/32$ " into the cylinder. (figure 7.60)
3. Tighten the jam nut and using the special 2" jam nut wrench (VRC29496), tighten the jam nut to about 65 ft. lbs. torque or strike the hammer wrench with a mallet. (figure 7.61)
4. Rotate the crankshaft to check that everything is rotating freely.

NOTE: Another way to check piston clearance is to use a feeler gauge through the

suction port to set piston to crank-end head clearance at 0.50" to .062".

7.12 Cover Plate Installation

1. Install frame end coverplate (VRU11311) and gasket (VRU11315). (*figure 7.62*)



Figure 7.62 Coverplate and gasket

2. Use (4) coverplate screws (VRU11307). (*figure 7.63*)

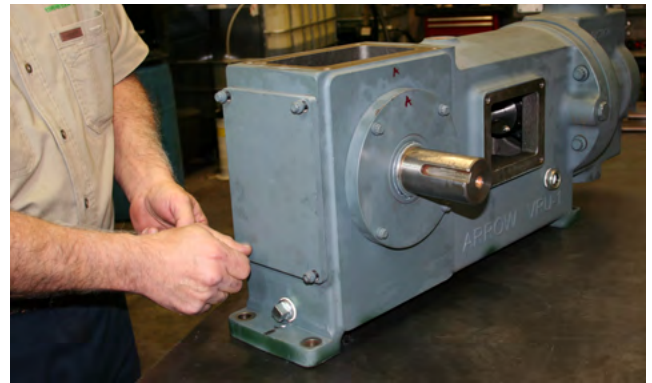


Figure 7.63 Install coverplate screws

3. Install frame top coverplate (VRU11310) and gasket (VRU11315). (*figure 7.64*)



Figure 7.64 Top coverplate and gasket

4. Use (4) screws (VRU11307). (*figure 7.65*)

NOTE: It is not necessary to use gasket adhesive; however, if you do like to use gasket adhesive, apply it between the gasket and coverplate only.



Figure 7.65 Top coverplate screws

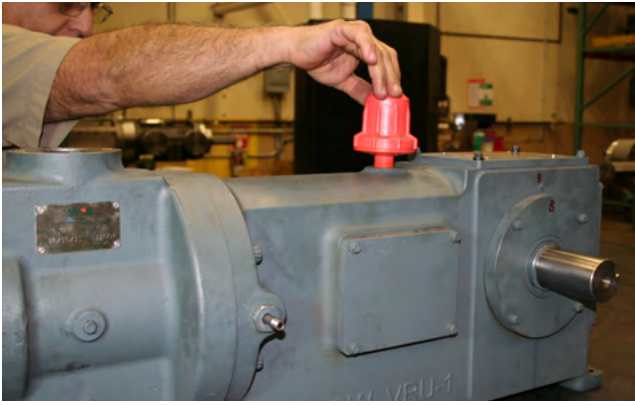


Figure 7.66 Install frame vent breather



Figure 7.68 Install O-ring and bore

5. Install frame vent breather (VRC21410) in top of frame and hand tighten. (*figure 7.66*)

7.13 Cylinder Head Installation

1. Install 5" head O-Ring (VRC25502) to the 5" head-end head (VRU15507) or
2. Install 8" head O-Ring (VRC25802) to the 8" head-end head (VRU15807). (*figure 7.67*)

3. Apply lubrication to the O-Ring and cylinder bore and slide the head into the cylinder. (*figure 7.68*)
4. Using (4) screws (VRC25007), tighten in a cross-cross pattern to a torque of 45 ft. lbs.

7.14 Suction and Discharge Valve Assembly

1. Assemble the suction valve per the assembly drawing shown. (figure 7.69)

Item No.	Part No.	Description	QTY.
1	VRU16531	SEAT, VALVE, INSIDE	1
2	VRU16532	SEAT, VALVE, OUTSIDE	1
3	VRU16551	RETAINER, CE, SPRING, SUCTION VALVE	1
4	VRU16552	RETAINER, HE, SPRING, SUCTION VALVE	1
5	VRU16570	POPPET, VALVE, VRU	2
6	VRU16595	SPRING, VALVE, VRU	2
7	VRU16558	SCREW, VALVE, SUCTION, VRU	2
8	VRC25304	O-RING, VRU VALVE	3

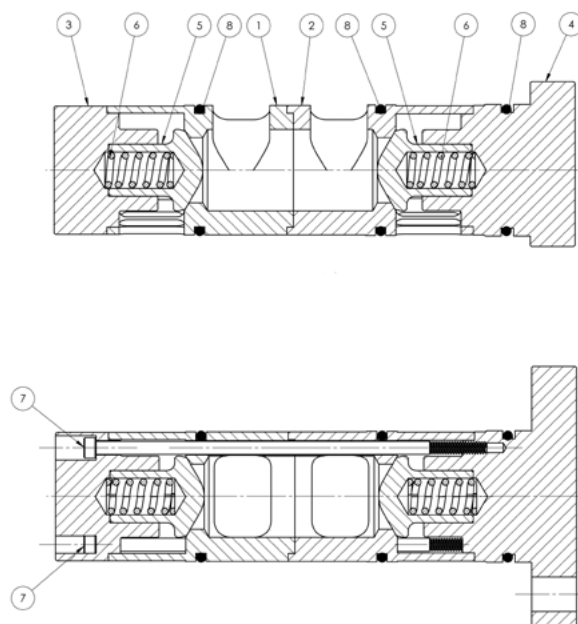


Figure 7.69 Suction valve assembly

2. Assemble the Discharge Valve per the assembly drawing shown. (figure 7.70)

NOTE: It is a good idea to install the cylinder head before installing the valve assemblies as the valve assemblies cannot be installed incorrectly when the cylinder head is installed.

Item No.	Part No.	Description	QTY.
1	VRU16542	SEAT, VALVE, HE, DISCHARGE	1
2	VRU16541	SEAT, VALVE, CE, DISCHARGE	1
3	VRU16560	RETAINER, CE, SPRING, SUCTION VALVE	1
4	VRU16570	POPPET, VALVE VRU	2
5	VRU16595	SPRING, VALVE, VRU	2
6	VRC25304	O-RING, VRU VALVE	3
7	VRU16548	SCREW, VALVE, DISCHARGE, VRU	2

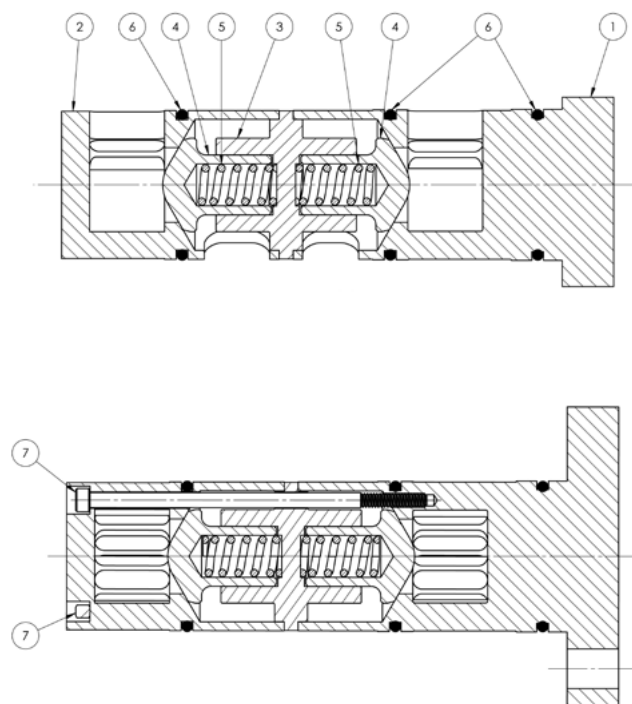


Figure 7.70 Discharge valve assembly

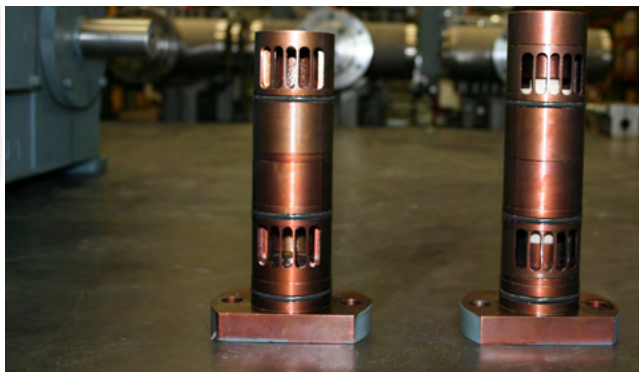


Figure 7.71 Valve assemblies



Figure 7.72 Lubricate suction valve



Figure 7.73 Lubricate discharge valve



Figure 7.74 Install flange O-rings

7.15 Valve Assembly Installation

NOTE: After valve assemblies have been assembled, you can identify the suction valve assembly as the longer assembly and the discharge valve assembly as the shorter assembly. (figure 7.71)

1. Apply lubrication to the suction valve assembly O-Rings and slide the assembly into the top or "Suction" valve port. The large holes in the valve assembly should be pointing up toward the suction flange, and the louvered holes should be pointing down toward the cylinder bore. (figure 7.72)
2. Insert (2) screws (VRC25007) in the valve assembly and tighten to a torque of 45 ft. lbs.
3. Apply lubrication to the discharge valve assembly O-Rings and slide the assembly into the bottom or "Discharge" valve port. The louvered holes in the valve assembly should point up toward the cylinder bore and the large holes should point down toward the discharge flange. (figure 7.73)
4. Insert (2) screws (VRC25007) in the valve assembly and tighten to a torque of 45 ft. lbs.

7.16 Suction and Discharge Flange Installation

1. The suction and discharge flanges are identical. Install flange O-Rings (VRU15504) in the O-Ring groove in the flanges (VRU15509). (figure 7.74)

2. Install the suction and discharge flanges on the suction and discharge ports. (figure 7.75)

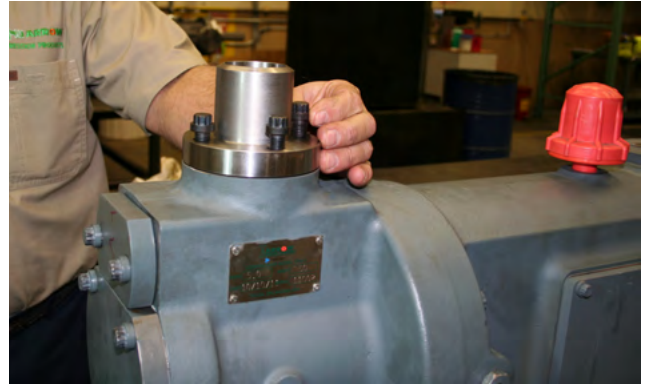


Figure 7.75 Install the flanges

3. Use (4) screws (VRC25007) on each flange and tighten them. (figure 7.76)



Figure 7.76 Install flange screws

7.17 Serial Numbers

1. The compressor frame has a serial number stamped in the frame nameplate (VRU11600) located on the frame top cover. (figure 7.77)



Figure 7.77 Frame plate

2. The frame serial number is also stamped on the top of the frame next to the frame top cover. (figure 7.78)

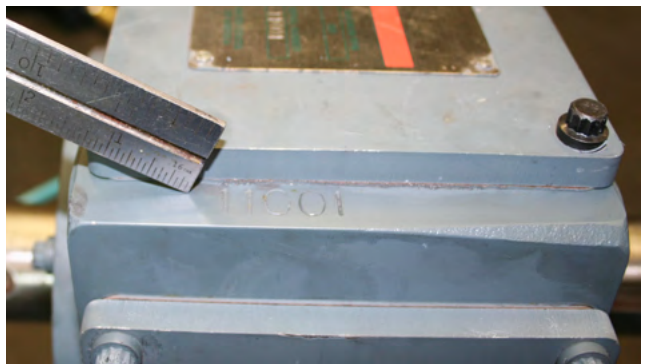


Figure 7.78 Frame is stamped



Figure 7.79 Cylinder nameplate

3. The compressor cylinder has a serial number stamped in the cylinder nameplate (VRU15100). (*figure 7.79*)

NOTE: If you need to contact the factory concerning your compressor, please refer to the compressor frame serial number.

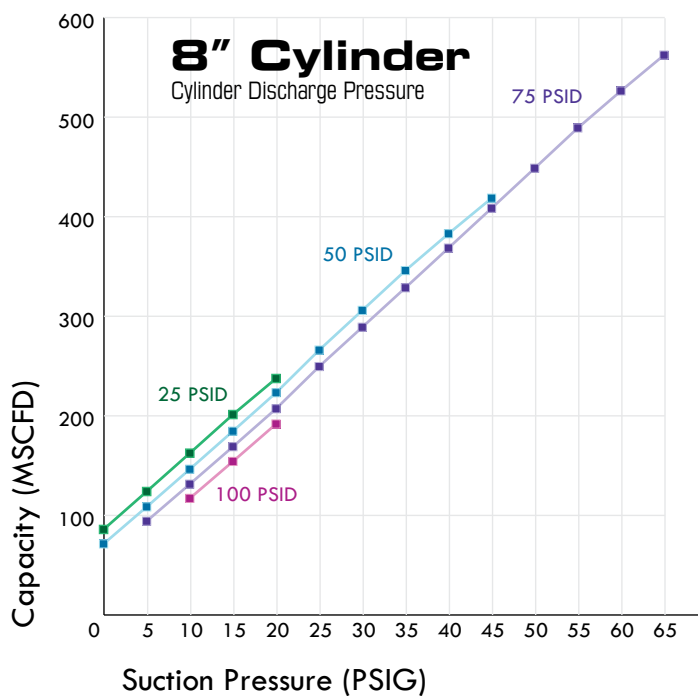
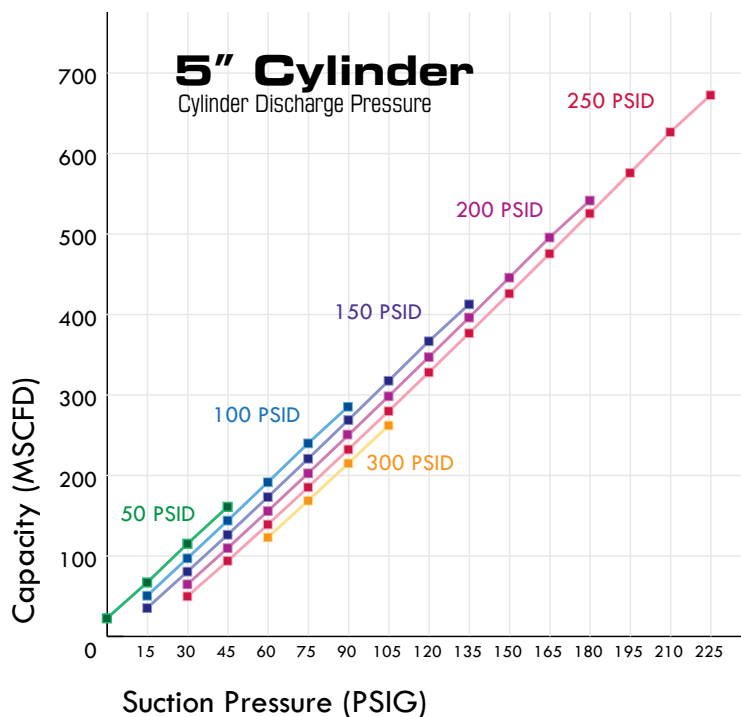
8 VRU Performance Curves

8

8.1 Estimated Performance Curves

Performance numbers used in these charts are estimated. For most accurate performance use the Arrow engine Company "VRC-SIM" performance program available at www.ArrowEngine.com → Literature → VRC → VRC-2 Compressor Sizing Program link (http://www.ArrowEngine.com/Literature/VRC_2_Compressor.php) and submit a request.

Please contact Arrow Engine Company and ask for the Compression Products sales team for further assistance.



Charts based on natural gas with a specific gravity of 0.65

Figure 8.1 VRU Performance Curves

OEM

ARROW ORIGINAL EQUIPMENT

* Products currently manufactured by Arrow Engine Company & owned as OEM.

A-SERIES (VR-SERIES)

*A-32	*A-42	*A-54	*A-62	*A-90	
VR-155	VR-220	VR-232	*VR-260	VR-265	VR-283

C-SERIES

*C-46	*C-66	*C-96	*C-101	*C-106	*C-255
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K-SERIES

*K6

L-SERIES

L-333	*L-795	L-1770	L-2165		
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WITTE ENGINES

98	B12	E15	E20	F32	F42
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*VRU-1	*VRU-2	*VRC-2	*VRC-CNG	*VRS-2	
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	F18	H24			
FAIRBANKS® ENGINES	ZC-118	ZC-208	ZC-503	ZC-739	ZC-346
AJAX® ENGINES	5X6½	EA-22, 6½ × 8 CMA		EA-30, 7¼ × 8 CMA	
		EA30, 7½ × 10 CMA		E-42, 8½ × 10 CMA	
		DP-60, 9½ × 10 CMA		DP-70/80/160, 11 × 14 CMA	
		DP-115/230, 13½ × 16			