Plunger Pumps

Torque Specifications in/lbs:(ft/lbs)

Oil Capacity	Manifold (Head)	Piston Nut	Rear Cover	Side Cover	Valve Cap	Connecting Rods
12	92/(5)	N/A	71/(6)	N/A	442/(37)	N/A

Limited Warranty

Annovi Reverberi (A.R.) *Cam Shaft Plunger Pumps* are warranted for a period of five years and *Axial Radial Pumps* are warranted for a period of one year to the original purchaser. *Electric Pressure Washers* are warranted for a period of one year to the original purchaser. This is from the date shipped from factory or U.S. Warehouse. **AR, ArrowLine** and **GF** accessories are warranted for a period of 90 days.

Warranty covers manufacturing defects or workmanship that may develop under normal use and service in a manner up to the directions and usage recommended by the manufacturer.

Warranty does not apply to misuse or when pump or accessory is altered or used in excess of recommended speeds, pressures, temperatures or handling fluids not suitable for pump or accessory material construction. Warranty does not apply to normal wear, freight damage, freezing damage or damage caused by parts or accessories not supplied by AR North America, Inc.

Liability of manufacturer for warranty is limited to repair or replacement at the option of the manufacturer when such products are found to be of original defect or workmanship at the time it was shipped from factory. This warranty is in lieu of all other warranties, expressed or implied, including any warranty of merchantability and of any and all other obligations or liabilities on the part of the manufacturers or equipment.

Warranty Returns

Items returned for warranty consideration must have a ***Returned Merchandise Authorization (RMA)*** number. All unauthorized returns will be refused and shipped back to sender. Please fax requests to: 763-398-2009 or e-mail to shop@arnorthamerica.com.

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Operating Instructions and Parts Manual RC Series Pumps

Plunger Pumps

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Description

Plunger Pumps are designed for a wide variety of high pressure washing applications. They are constructed with die-cast bodies and feature a brass head. Internal components include special thick solid ceramic plungers for long life and durability. Precision cast cooling fins are anodized for maximum heat dissipation. Oversized needle bearings on the drive side, and ball on the non-drive side together with the precision supports assure positive alignment and centering in relation to the crankcase. Valve cages of special designed Ultra-Form provide positive seating and extended life. Ball bearings on both sides of solid shaft drive pumps. One-piece connecting rods are special alloy aluminum, oversized for strength and load disbursement. These pumps are designed for, belt drive, or coupling drive systems driven by electric motor or gasoline driven systems, electric motor direct drive systems, and gasoline engine direct drive systems.

RC/RCA - N

RCA/RCV - F8

RCV - F7

RC 1450 rpm N Version - Solid Shaft

Model	Max GPM	Max PSI
RC11.17N	2.9	2500
RC13.17N	3.4	2500

RCA 1750 rpm N Version - Solid Shaft

Model	Max GPM	Max PSI
RCA2.5G25N	2.5	2500
RCA3G25N	3	2500
RCA3.5G25N	3.5	2500

RCA 1750 rpm E Version - 5/8"

Model	Max GPM	Max PSI
RCA2G25E-F8	2	2500
RCA2G25E-F8-SX	2	2500
RCA3G25E-F8	3	2500
RCA3.5G18E-F8	3.5	1800

RCV 3400 rpm E Version - 5/8"

Model	Max GPM	Max PSI
RCV2G25D-F8	2	2500
RCV3G25E-F8	3	2500

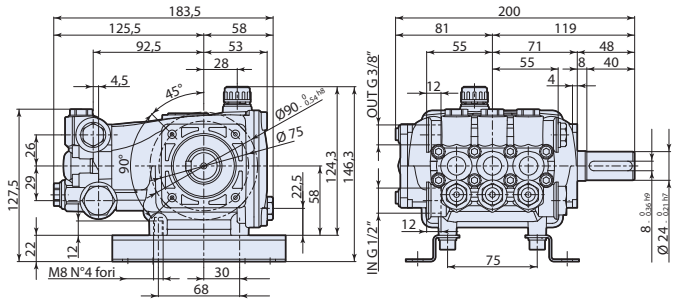
RCV 3400 rpm D Version - 1"

Model	Max GPM	Max PSI
RCV2G25D-F7	2	2500
RCV2.5G25D-F7	2.5	2500
RCV2.5G25D-F7-SX	2.5	2500
RCV2.5G27D-F7	2.5	2700
RCV3G25D-F7	3	2500
RCV3.5G25D-F7	3.5	2500

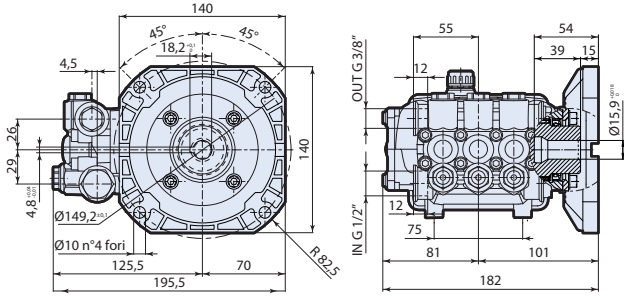
Form RC-OM 0611

ANNOVI REVERBERI
High Performance Pumps

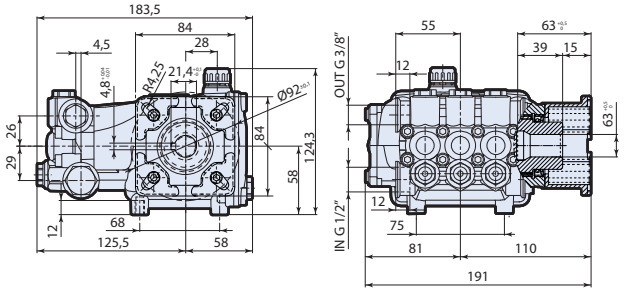
RC/RCA N version
Solid shaft pump / ø 24 mm



RCA/RCV E version + F8
Hollow shaft pump ø 5/8"



RCV D version + F7
Hollow shaft pump ø 1"



Plunger Pumps

Notes

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Plunger Pumps

Notes

Operating Instructions and Parts Manual RC Series Pumps

Plunger Pumps

Formulas	Conversions
Nozzles:	Gallons x 3.785412 = Liters
Impact Force (lbs.) = .0526 x GPM x √PSI	Gallons x 128 = Oz.
Nozzle # = GPM x $\frac{4000}{\sqrt{PSI}}$	PSI x .06896 = Bar
GPM= Nozzle # x $\frac{PSI}{\sqrt{4000}}$	Bar x 14.5038 = PSI
PSI = $(GPM/Nozzle\ \#)^2$ x 4000	1 inches = 25.4 millimeters
Horse Power:	Liters x .2642 = Gallons (US)
$\frac{GPM \times PSI}{1714}$ = Hydraulic HP	Ft. Lbs. x 1.356 = Newton Meters
$\frac{GPM \times PSI}{1457}$ = EBHP	Inch Lbs. x .11298 = Newton Meters
$\frac{EBHP \times 1457}{PSI}$ = GPM	Newton Meters x .737562 = Ft. Lbs. (force)
$\frac{EBHP \times 1457}{GPM}$ = PSI	Newton Meters x 8.85 = In. Lbs. (force)
HP loss due to altitude = 3% per 1000 FT above sea level	Temperature = 1.8(C° + 17.78) = F°,.555(F° - 32) = C°
Pump Speed and Flow:	1 U.S. Gallon of freshwater = 8.33 lbs.
$\frac{Rated\ GPM}{Rated\ RPM} = \frac{Desired\ GPM}{Desired\ RPM}$	1 PSI = 2.31 feet of water
$\frac{Motor\ Pulley\ Ø}{Pump\ RPM} = \frac{Pump\ Pulley\ Ø}{Motor\ RPM}$	1 PSI = 2.04 inches of mercury
	1 Foot of water = .433 PSI
	1 Foot of water = .885 inches of mercury
	1 Meter of water = 3.28 feet of water
	Kilograms x 2.2 = Lbs.

General Safety Information

⚠ WARNINGS

Gasoline Drive Pumps

The pump is designed to pump non-flammable or non-explosive fluids. These pumps are intended to pump clean filtered water only.

Do not operate in or around an explosive environment.

Always wear safety glasses or goggles and appropriate clothing.

Do not alter the pump from the manufacturers design.

Do not allow children to operate the pump.

Never point the high-pressure discharge at a person, any part of the body or animals.

Do not operate gasoline engines in a confined area; always have adequate ventilation.

Do not exceed the pump specifications in speed or pressure.

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Plunger Pumps

General Safety Information (continued)

Maximum water temperature is 140°F.

All positive displacement plunger pumps must have a safety relief valve installed on the discharge side of the pump, this valve could be either an unloader or regulator and must be of adequate flow and pressure for the pump.

Adequate protective guards must cover all moving parts. Perform routine maintenance on the pump and components.

Use only components that are rated for the flow and pressure of the pump, this would include hose, fittings, safety valves, spray guns etc.

Electric Drive Pumps

Your power supply must conform to the system requirements.

The motor must be grounded. Use GFCI plugs and receivers.

Do not handle the pump/motor with wet hands.

Only use power cords that are in good condition.

Never pull the unit by the power cord.

Never spray or clean the unit with water

Failure to follow these warnings may result in personal injury or damage to property.

Installation

DIRECT DRIVE PUMPS

1. Install the shaft key into the keyway and apply a light coating of anti-seize on the engine shaft. (See Figure 7 & 8)

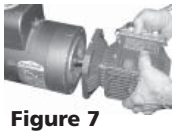

Figure 7

2. Align the two key ways and push the pump completely onto the engine.

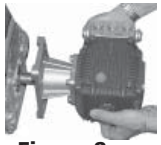

Figure 8

3. Install all four (4) bolts and tighten evenly.
4. Remove the red shipping oil cap and install the black crankcase vent cap. (See Figure 9)

Figure 9

5. Install the appropriate unloader valve and other accessories.
6. Install the appropriate water inlet and discharge fittings.
7. Connect the water supply hose and high-pressure discharge hose/spray gun.
8. Turn on the water supply.
9. Open the spray gun to purge the system of any air.
10. Start the engine.
11. Adjust the engine speed and unloader valve.

Operating Instructions and Parts Manual RC Series Pumps

Pos.	Code	Description	Qty.
1	3200110	Plug (216 in/lbs)	6
2	120690	O-Ring	6
3	2769050	Complete valve (92 in/lbs)	6
4	800410	Screw	8
5	1381550	Washer	8
6	3200020	Head	1
7	180101	O-Ring	1
8	820361	Plug (354 in/lbs)	1
9	740290	O-Ring	1
10	1980740	Plug (221 in/lbs)	1
11	1780140	Ring	3
12	1780720	Gasket	3
13	3200130	Piston guide	3
14	3200142	Gasket	3
15	3200260	Ring	3
16	770260	O-Ring	3
17	3200120	Piston guide	3
18	3200010	Pump body	1
19	1780490	Bearing	1
20	1260790	Snap ring	2
21	1780550	Snap ring	1
22	395081	O-Ring	1
23	3200090	Disc	1
24	3200080	Oil indicator	1
25	3200070	Cover	1
26	1200430	Screw (92 in/lbs)	8
27	880130	Oil cap	1
28	1260110	Nut (106 in/lbs)	3
29	1260100	Washer	3
30	1260210	Piston guide	3
31	1260091	Spacer	3
32	1260460	Seal	3
33	480480	O-Ring	3
34	3200060	Piston guide	3
35	3200040	Conrod	3
36	1780050	Conrod pin	3
37	2760280	O-Ring	1
38	3200030	Rear cover	1

Pos.	Code	Description	Qty.
39	820510	O-Ring	1
40	880581	Plug	1
41	3200220	Screw	4
44	3201200	Crankshaft - Solid Shaft ❍	1
44	3200860	Crankshaft - Solid Shaft ●	1
44	3201180	Crankshaft - Solid Shaft ◆	1
44	3201170	Crankshaft - Hollow Shaft ■	1
44	3200350	Crankshaft - Hollow Shaft ⌑	1
44	3200340	Crankshaft - Hollow Shaft ★	1
42	3200330	Key	1
43	2760350	Bearing	1
45	480671	Seal	1
46	320210	Base	2
47	1322640	Washer	4
48	850250	Screw	4
77	1579	Flange (F7)	1
77	1584	Flange (F8)	1
78	1200430	Screw	4
	AR64516	Oil	2

Oil Capacity - 9.81 oz

Legend

For ❍ RCV2G25E	For ● RCV3G25E	For ◆ RCV2G25D
For ■ RCV25G27D	For ⌑ RCV3G25D	For ★ RCV35G25

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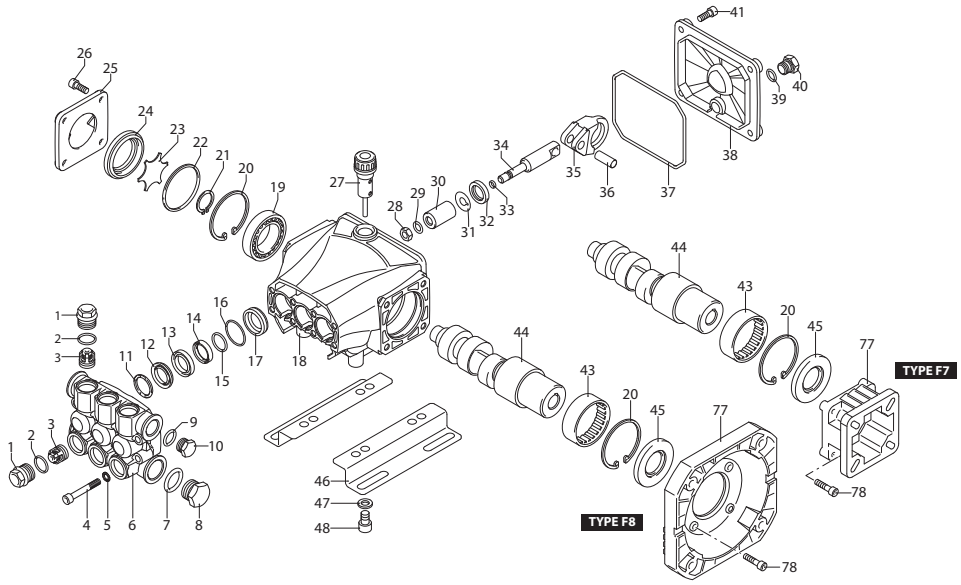
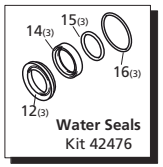
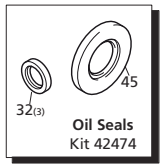
Plunger Pumps

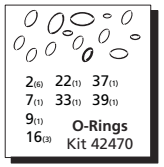
RCV 3400 RPM



Repair Kits







Operating Instructions and Parts Manual RC Series Pumps

Plunger Pumps

Installation (continued)

BELT DRIVE SYSTEMS


Figure 10

1. Mount the pump securely to the base plate. (See Figure 10) For new installation a mounting rail kit is required, refer to parts breakdown.
2. Install the pump pulley on the crankshaft. It should be as far onto the shaft as possible.
3. Align the pulleys so they are in line. (See Figure 11)


Figure 11

4. Use a belt tension gauge to assure proper tension (too much tension can cause bearing failure or damage the belts as well as cause other problems). (See Figure 12)


Figure 12

5. Installation complete.

Maintenance

SERVICING THE VALVES

The inlet and discharge valves in this series pumps are all the same. The valves are located under the six 21mm hex plugs. The inlet valves are located on the lower row and the discharge valves are located on the top row of the pump head.

Tools required: 21mm socket, ratchet, needle nose pliers, mechanics pick and torque wrench.

VALVE REMOVAL


Figure 13

1. Remove the valve cap. (See Figure 13)
2. Inspect the valve cap O-ring for any damage, replace if necessary.
3. Use the needle nose pliers to remove the valve. (See Figure 14)


Figure 14

4. Use a small probe to move the poppet up and down to assure that the valve is functioning properly and that no debris is stuck in the valve.
5. Inspect the valve seat o-ring for any damage, replace if necessary.

VALVE ASSEMBLY


Figure 15

1. Insert the valve assembly squarely into the port push it squarely into position with a small deep well socket and extension until fully seated. (See Figure 15)
2. Install the valve cap and torque to the proper specification. (See Figure 16) (See Table D or parts breakdown)


Figure 16

SERVICING THE PACKINGS/SEALS

To access the water seals for inspection or replacement, you will first need to remove the head of the pump.

Tools required: 5mm hex socket, ratchet, (2) long screwdrivers, reversible pliers, mechanics pick and torque wrench.

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Plunger Pumps

Service Pumps (continued)

DISASSEMBLY

1. First remove the eight 5mm head bolts.
2. Place the screwdrivers as shown between the head and crankcase of the pump, lifting one up and the other down. The head should start to lift off of the plungers. (See Figure 17)


Figure 17

3. When you remove the head you may notice that some of the water seals have stayed on the plungers and some in the head. To remove the seals from the plungers simple turn the assemblies and pull off. (See Figure 18)


Figure 18

4. If the seal assemblies are in the head use the reversible pliers to grab the seal retainer on the outside ring, twist the retainer in either direction (this is done to free the retainer O-ring which is stuck to the manifold) and lift out. (See Figure 19)


Figure 19

5. With your finger pull out the brass intermediate guide ring.
6. With your finger pull the high-pressure seal and head ring out of the head. (See Figure 20)


Figure 20

7. The low-pressure seal is located in the brass seal retainer. Using the mechanics pick, go in between the seal and retainer and pull the seal straight out. (See Figure 21)


Figure 21

8. Remove the seal retainer O-ring with the mechanics pick. (See Figure 22)

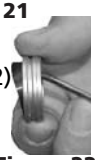


Figure 22

ASSEMBLY

1. Install the plastic head ring into the head (the flat side is on the bottom).
2. Install the high-pressure seal. Place the seal so the open "V" portion is toward the head ring. You need to place the seal at an angle and pull and push to work the seal into position with your fingers (do not use any tools you may damage the seal). Make sure the seal is totally seated against the head ring. (See Figure 23)


Figure 23

3. Place the brass intermediate ring squarely over the high-pressure seal
4. Install the low-pressure seals into the rear piston guide. Make sure the brown scrapper ring is in place on the backside of the seal (NOTE: Care must be taken so the ring does not fall out during assembly). The scrapper side of the seal goes into the piston guide. Push the seal down until fully seated. You should be looking at the open side of the seal. (See Figure 24)


Figure 24

Pos.	Code	Description	Qty.
1	3200110	Plug (216 in/lbs)	6
2	120690	O-Ring	6
3	2769050	Complete valve (92 in/lbs)	6
4	800410	Screw	8
5	1381550	Washer	8
6	3200020	Head	1
7	180101	O-Ring	1
8	820361	Plug (354 in/lbs)	1
9	740290	O-Ring	1
10	1980740	Plug (221 in/lbs)	1
11	1780140	Ring	3
12	1780720	Gasket	3
13	3200130	Piston guide	3
14	3200142	Gasket	3
15	3200260	Ring	3
16	770260	O-Ring	3
17	3200120	Piston guide	3
18	3200010	Pump body	1
19	1780490	Bearing	1
20	1260790	Snap ring	2
21	1780550	Snap ring	1
22	395081	O-Ring	1
23	3200090	Disc	1
24	3200080	Oil indicator	1
25	3200070	Cover	1
26	1200430	Screw (92 in/lbs)	8
27	880130	Oil cap	1
28	1260110	Nut (106 in/lbs)	3
29	1260100	Washer	3
30	1260210	Piston guide	3
31	1260091	Spacer	3
32	1260460	Seal	3
33	480480	O-Ring	3
34	3200060	Piston guide	3
35	3200040	Conrod	3
36	1780050	Conrod pin	3
37	2760280	O-Ring	1
38	3200030	Rear cover	1

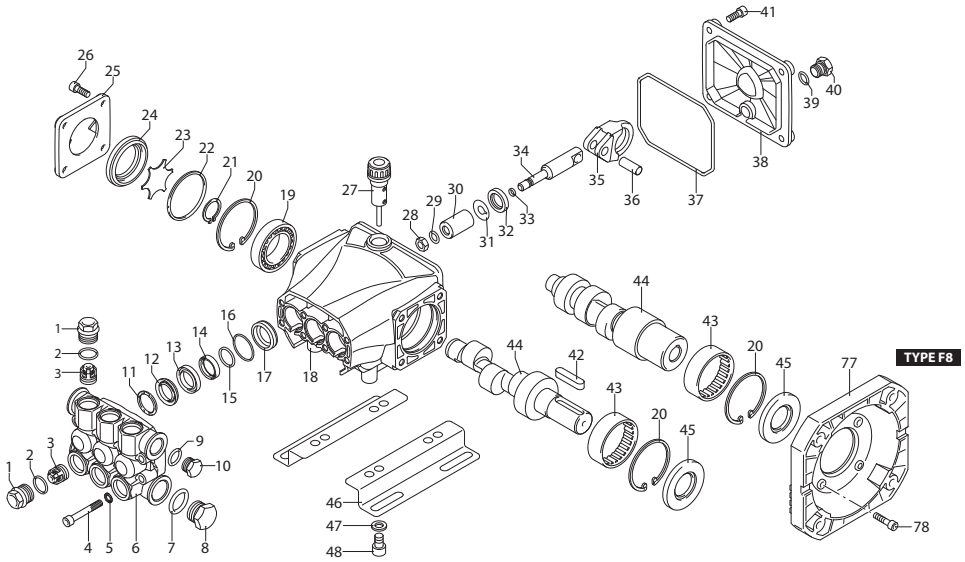
Pos.	Code	Description	Qty.
39	820510	O-Ring	1
40	880581	Plug	1
41	3200220	Screw	4
44	3200330	Crankshaft - Solid Shaft ❍	1
44	3200310	Crankshaft - Solid Shaft ●	1
44	3200290	Crankshaft - Solid Shaft ◆	1
44	3201190	Crankshaft - Hollow Shaft ■	1
44	3200180	Crankshaft - Hollow Shaft ⌑	1
44	3200830	Crankshaft - Hollow Shaft ★	1
42	3200330	Key	1
43	2760350	Bearing	1
45	1260750	Seal	1
45	480671	Seal	1
46	320210	Base	2
47	1322640	Washer	4
48	850250	Screw	4
77	1584	Flange (F8)	1
78	1200430	Screw	4
	AR64516	Oil	2

Oil Capacity - 9.81 oz

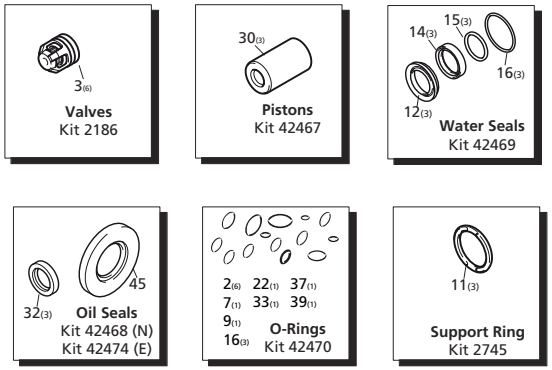
Legend		
For ❍ RCA25G25	For ● RCA3G25	For ◆ RCA35G25
For ■ RCA2G25	For ⌑ RCA3G25	For ★ RCA35G16

Plunger Pumps

RCA 1750 RPM



Repair Kits



Operating Instructions and Parts Manual RC Series Pumps

Plunger Pumps

Service Pumps (continued)

5. Install the retainer O-ring.
6. Squarely seat the retainer into the head and push with even pressure until it snaps into position. (See Figure 25)


Figure 25

SERVICING THE PLUNGERS

If the plungers are not damaged they do not need any servicing.

Tools required: 13mm socket, ratchet, mechanics pick, taper blade gasket scraper, thread sealant and torque wrench.

NOTE: Be very careful when working with the plungers, they are made from ceramic which is brittle and can be damaged.

Any time you remove a plunger it is recommended you replace the slinger washer, O-ring and top plunger washer. The washers are a cushion for the ceramic plunger and compress when first used and the O-ring will take a set to create a seal and usually will not spring back to its original shape. By not replacing these parts you run the risk of breaking a plunger or having a water leak.

DISASSEMBLY

1. Remove the plunger retainer nut. (See Figure 26)
2. Insert the gasket scraper between the copper washer and plunger to remove the washer. (See Figure 27)


Figure 26


Figure 27

3. Twist and pull the plunger off the plunger rod. (See Figure 28)
4. Remove the plunger rod O-ring seal with the mechanics pick.
5. Remove the brass slinger. At this point clean any thread locker that is left on the plunger rod and retaining nut threads.


Figure 28

ASSEMBLY

1. Install the brass slinger washer.
2. Install the plunger rod O-ring. Place a light film of oil on the O-ring.
3. Install the plunger by pushing straight down and twisting slightly in either direction. Make sure you fully seat the plunger. (See Figure 29)


Figure 29

4. Install the small copper washer on top of the plunger and place a small quantity of thread sealant in the thread. Install the plunger nut and tighten to the required torque. (See Figure 30) (See Table D or parts breakdown)


Figure 30

PUMP HEAD TO DRIVE END INSTALLATION

1. Turn the crankshaft to align the plungers as shown. (See Figure 31)


Figure 31

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Plunger Pumps

Service Pumps (continued)

2. Place the head evenly onto the plungers and push it until it makes contact with the drive end of the pump. (See Figure 32)

Figure 32

3. Torque the head bolt as shown in the tightening sequence diagram. (See Figure 33 & 34) (See Table D or parts breakdown)

Figure 33

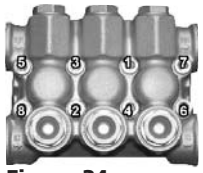

Figure 34

OIL CHANGE

Change oil after first 50 hours of use. Then every 500 hours. Refer to parts breakdown for oil type.

WINTER OR LONG TIME STORAGE

1. Drain all of the water out of the pump.
2. Run a 50% solution of a RV or non-toxic/biodegradable antifreeze through the pump.
3. Flush the pump with fresh water before the next use.
4. In freezing conditions failure to do this may cause internal pump damage.
5. For long periods of storage in non-freezing areas the solution will keep the seals and O-rings lubricated.

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1	3200110	Plug (216 in/lbs)	6
2	120690	O-Ring	6
3	2769050	Complete valve (92 in/lbs)	6
4	800410	Screw	8
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10	1980740	Plug (221 in/lbs)	1
11	1780140	Ring	3
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14	3200142	Gasket	3
15	3200260	Ring	3
16	770260	O-Ring	3
17	3200120	Piston guide	3
18	3200010	Pump body	1
19	1780490	Bearing	1
20	1260790	Snap ring	2
21	1780550	Snap ring	1
22	395081	O-Ring	1
23	3200090	Disc	1
24	3200080	Oil indicator	1
25	3200070	Cover	1
26	1200430	Screw (92 in/lbs)	8
27	880130	Oil cap	1
28	1260110	Nut (106 in/lbs)	3
29	1260100	Washer	3
30	1260210	Piston guide	3
31	1260091	Spacer	3
32	1260460	Seal	3
33	480480	O-Ring	3
34	3200060	Piston guide	3
35	3200040	Conrod	3
36	1780050	Conrod pin	3
37	2760280	O-Ring	1
38	3200030	Rear cover	1

Pos.	Code	Description	Qty.
39	820510	O-Ring	1
40	880581	Plug	1
41	3200220	Screw	4
44	3200290	Crankshaft ❍	1
44	3200270	Crankshaft ❒	1
42	3200330	Key	1
43	2760350	Bearing	1
45	1260750	Seal	1
46	320210	Base	2
47	1322640	Washer	4
48	850250	Screw	4
	AR64516	Oil	2

Oil Capacity - 9.81 oz

Legend	
For ❍	For ❒
RC11.17	RC13.17

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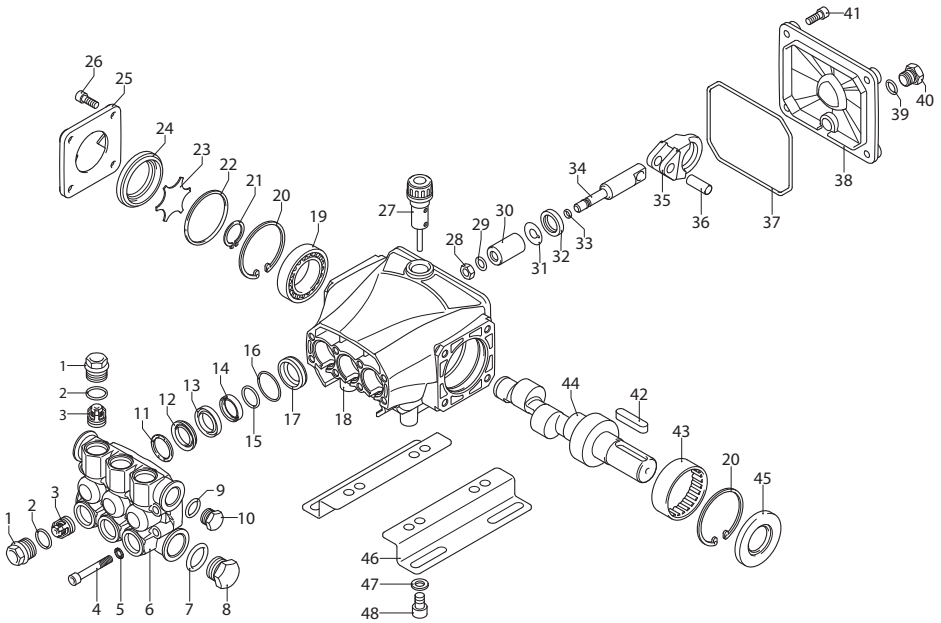
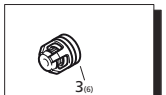
RC 1450 RPM

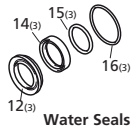


Repair Kits

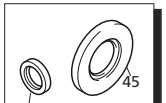


Valves
Kit 2186

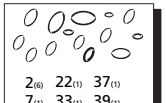
Pistons
Kit 42467



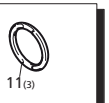
Water Seals
Kit 42469



Oil Seals
Kit 42468



O-Rings
Kit 42470



Support Ring
Kit 2745

Plunger Pumps

Notes

Troubleshooting

Symptom	Possible Cause(s)	Corrective Action
Oil leak between crankcase and pumping section	Worn rod oil seals	Replace crankcase piston rod seals
Frequent or premature failure of the packing	1 Cracked, damaged or worn plunger	1 Replace plungers
	2 Overpressure to inlet manifold	2 Reduce inlet pressure
	3 Material in the fluid being pumped	3 Install proper filtration on pump inlet plumbing
	4 Excessive pressure and/or temperature of fluid being pumped	4 Check pressures and fluid inlet temperature; be sure they are within specified range
	5 Running pump dry	5 Do not run pump without water
Pump runs but produces no flow	Pump is not primed	Flood suction then restart pump
Pump fails to prime	Air is trapped inside pump	Disconnect discharge hose from pump. Flood suction hose, restart pump and run pump until all air has been evacuated
Pump looses prime, chattering noise, pressure fluctuates	1 Air leak in suction hose or inlet	1 Remove suction line and inspect it for a loose liner or debris lodged in hose. Avoid all unnecessary bends. Do not kink hose
	2 Clogged suction strainer	2 Clean strainer
Low pressure at nozzle	1 Unloader valve is by-passing	1 Make sure unloader is adjusted property and by-pass seat is not leaking
	2 Incorrect or worn nozzle	2 Make sure nozzle is matched to the flow and pressure of the pump. If the nozzle is worn, replace
	3 Worn packing or valves	3 Replace packing or valves
Pressure gauge fluctuates	1 Valves worn or blocked by foreign bodies	1 Clean or replace valves
	2 Packing worn	2 Replace packing
Low pressure	1 Worn nozzle	1 Replace with nozzle of proper size
	2 Belt slippage	2 Tighten or replace with correct belt

Operating Instructions and Parts Manual **RC Series Pumps**

Troubleshooting (cont.)

Symptom	Possible Cause(s)	Corrective Action
Low pressure (cont.)	3 Air leak in inlet plumbing	3 Disassemble, reseal and reassemble
	4 Relief valve stuck, partially plugged or improperly adjusted valve seat worn	4 Clean and adjust relief valve; check for worn or dirty valve seats
	5 Worn packing. Abrasive in pumped in cavitation. Inadequate water	5 Install proper filter suction at inlet manifold must be limited to lifting less than 20 feet of water or 8.5 psi vacuum
	6 Worn inlet, discharge valve blocked or dirty	6 Replace inlet and discharge valve
Pump runs extremely rough, pressure very low	1 Inlet restrictions and/or air leaks.	1 Clean out foreign material
	2 Stuck inlet or discharge valve	2 Replace worn valves
Water leakage from under manifold	Worn packing or cracked plunger	Install new packing or plunger
Slight leak, oil leaking in the area of crankshaft	1 Worn crankshaft seal or improperly installed oil seal o-ring	1 Remove oil seal retainer and replace damaged 0-ring and/or seals
	2 Bad bearing	2 Replace bearing
Excessive play in the end of the crankshaft pulley	Worn main bearing from excessive tension on drive belt	Replace crankcase bearing and/or tension drive belt
Water in crankcase	1 Humid air condensing into water inside the crankcase	1 Change oil intervals
	2 Worn packing and/or cracked plunger	2 Replace packing. Replace plunger
Loud knocking noise in pump	1 Cavitation or sucking air	1 Check water supply is turned on
	2 Pulley loose on crankshaft	2 Check key and tighten set screw
	3 Broken or worn bearing	3 Replace bearing

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