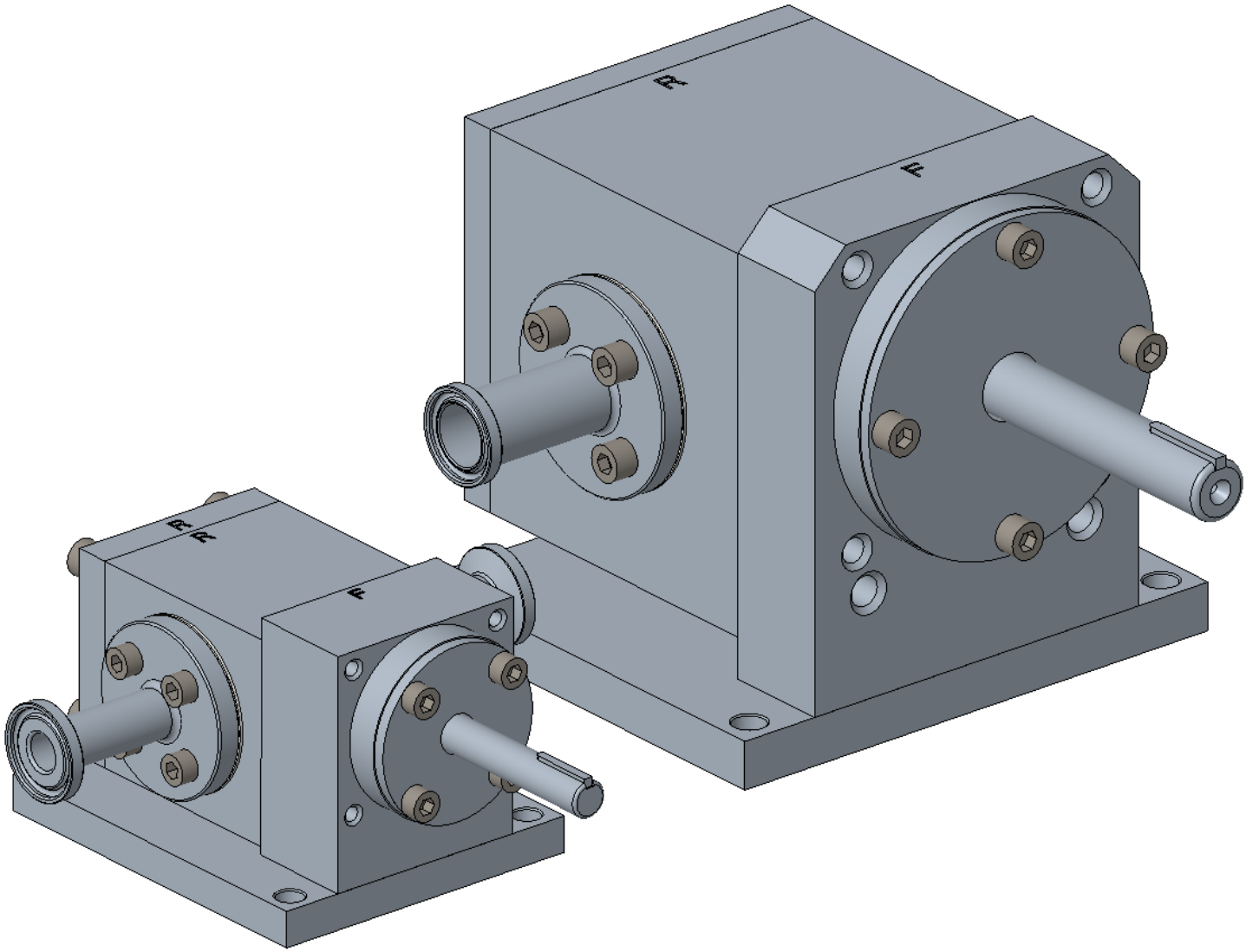
Operation & Maintenance Manual

Instructions for Disassembly, Cleaning, Inspection, and Assembly of Northern® NPC Pumps



Small Frame Models: NPC-.5, NPC-1, NPC-3
Large Frame Models: NPC-5, NPC-10, NPC-15

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Introduction

The Northern® NPC Series was born as a result of the Slot Die Coating industry's need for a precise and pulse fee metering pump. Special gear design, combined with easy adaptability to flow changes, allow coating systems to deliver consistent coating thickness over a variety of mediums. This pump can be disassembled and cleaned in a matter of minutes, with a few simple hand tools.

Cautionary Statements

Note: Failure to heed these cautionary statements may result I personal injury and/or damage to equipment.

1. Disable and lock-out the drive system before any work is done to maintain or remove the pump.
2. Fully depressurize the entire system.
3. Close the valve closest to the pump in both the suction and discharge pipe.
4. Wear protective eyewear.
5. When handling corrosive, caustic, toxic, or hazardous liquids, wear protective clothing to prevent contact with skin.
6. Wear protective footwear such as safety shoes.
7. When handling liquids with toxic vapors, wear a properly rated breathing mask.
8. Work area must be properly ventilated.
9. Work area must be properly grounded.
10. Do not work alone.
11. Clean up any spilled liquid immediately.

Removal from Installation

1. Turn off and lock out the drive mechanism.
2. If the reservoir is pressurized, fully depressurize it.
3. Close the valve in the suction and discharge lines closest to the pump.
4. Position a pan or other liquid collecting device under the pump to collect the liquid that will drain from the pump, as well as from the suction and discharge lines, when these are disconnected from the pump.
5. Disconnect the suction and discharge lines at the union or flange closest to the pump. Position the removed lines so that liquid is not spilled.
6. Remove the suction and discharge port adapters from the pump. Remove the adapter gaskets.
7. Remove the Cap Screws from either the C-Face Adapter or Foot Mount that secures the pump mounting flange. Hold the pump to prevent it from falling.
8. Remove the pump from its mounting by pulling it straight out. The shaft coupling is a jaw type coupling and should separate when the pump is pulled straight out.
9. Loosen the setscrew in the coupling hub on the pump's drive shaft and remove it. If it does not slide off easily, use a puller to remove it. Do not drive it off with a hammer or force it off with a pry bar.
10. Clean up any spilled liquid.
11. Recycle or dispose of spilled liquid as approved by owner's regulations.

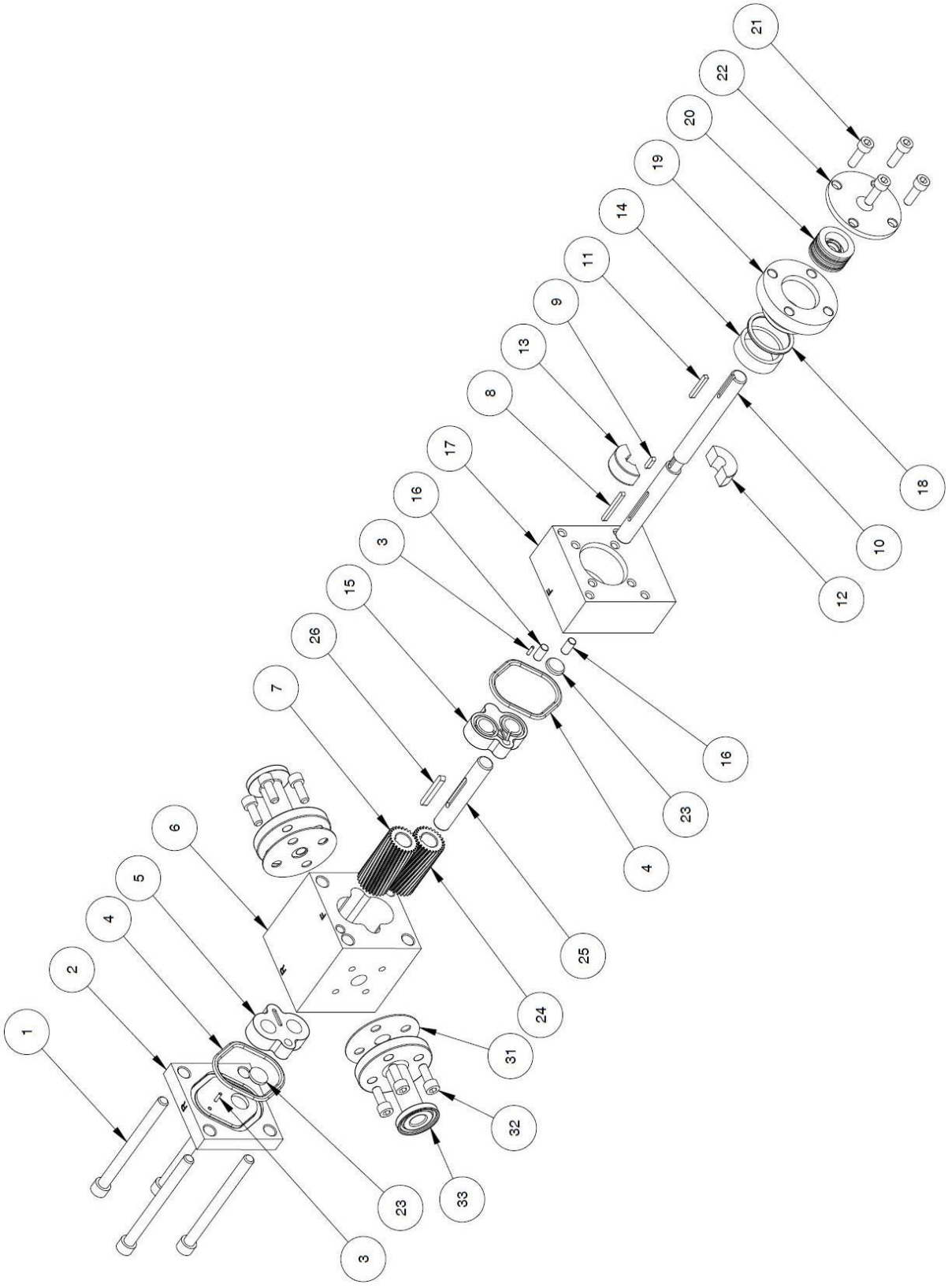

Figure 1: Exploded View

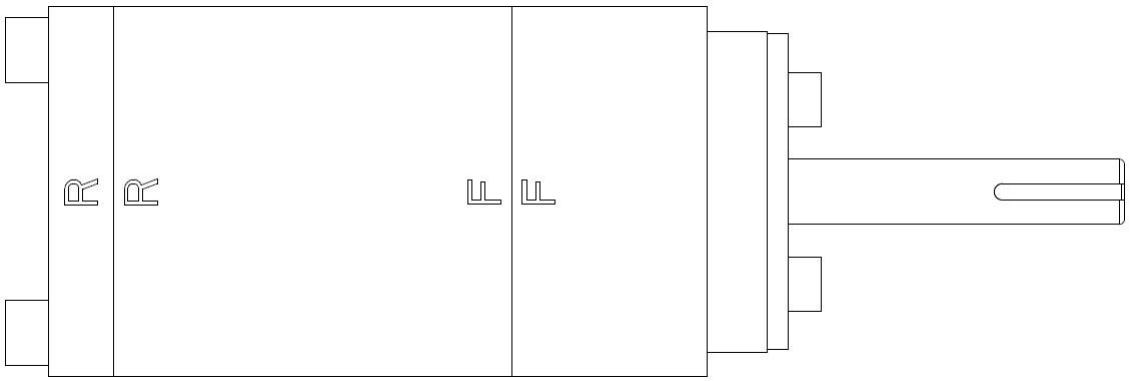

Figure 2: Top View of Pump

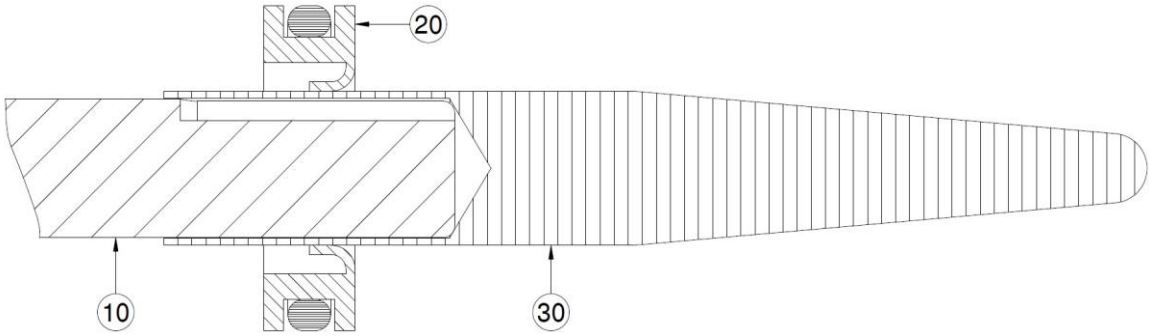

Figure 3: Lip Seal Installation with Tool

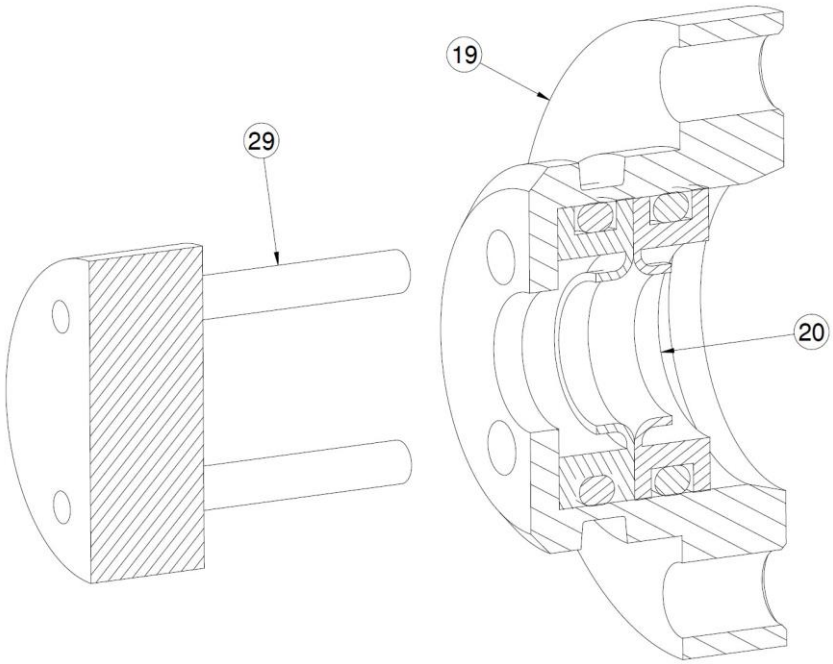

Figure 4: Seal Removal Tool and Lip Seal Orientation

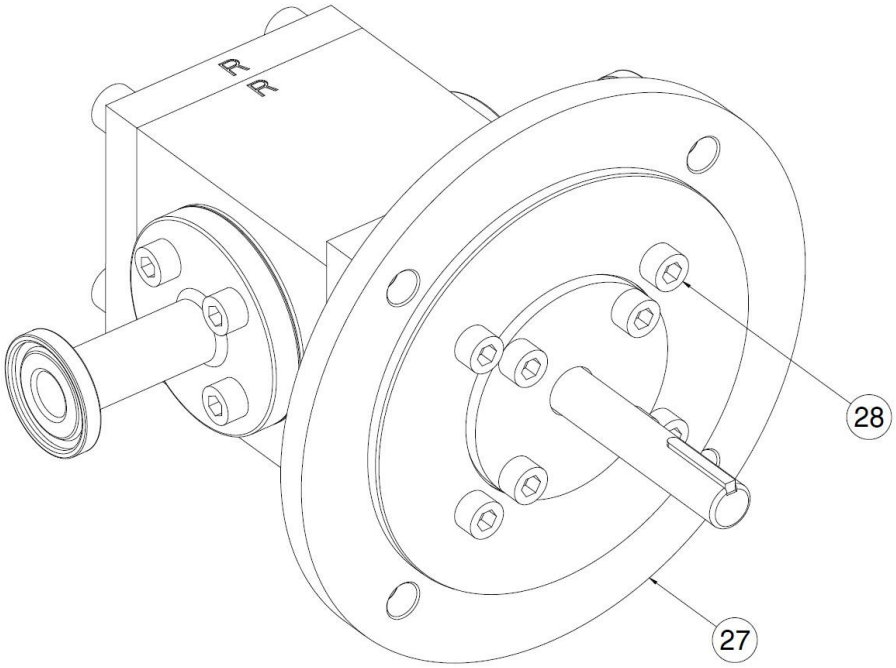

Figure 5: C-Face Adapter and Hardware

Cap Screw (28) Torque Specs: Small Frame: 12 in-lbs
Large Frame: 30 in-lbs

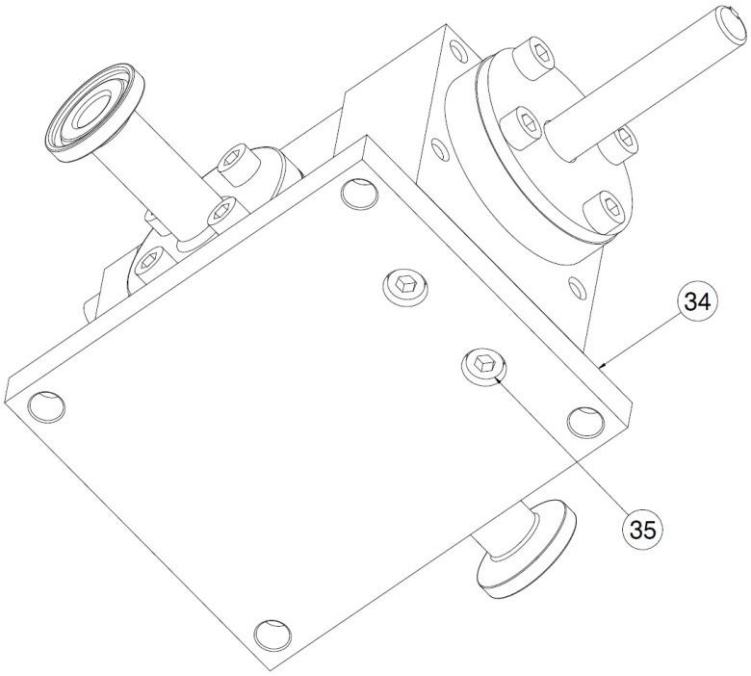

Figure 6: Foot Mount and Hardware

Cap Screw (35) Torque Specs: Small Frame: 12 in-lbs
Large Frame: 60 in-lbs

Disassembly

Note: All item numbers in the disassembly steps reference Figure 1 unless otherwise noted.
Steps follow the NPC Repair Video found at www.northern-pump.com or the QR code in the header.

1. Position pump to catch any liquid that may be released from the pump during disassembly. Remove the End Key (11) from the Drive Shaft (10). Check the Drive Shaft for burrs in the coupling area. Remove all burrs.
2. Remove Cap Screws (21) and remove the Mounting Flange (22).
3. Remove Cap Screws (1) and remove the Rear End Plate (2).
4. Remove Cylinder (6) from assembly. If residual fluid is present in the pump preventing the Cylinder from sliding freely, it is important to push the Bearing Inserts and Gears through the Cylinder housing as it is removed. Just pulling on the housing can cause the Gear Keys to damage the Front Bearing Insert (15). Dowel Pins (16) will be found in either the Cylinder (6) or Seal Adapter Plate (17). Be careful to not lose them.
5. Remove the O-Ring (4) from the Rear End Plate.
6. Remove the Driven Gear (24) and Driven Shaft (25) from the Front Bearing Insert (15).
7. Remove the Drive Gear (7) from the Drive Shaft (10). Then remove the Drive Gear Key (8) from the Drive Shaft (10).
8. Remove the Rear Bearing Insert (5). This may have already been removed.
9. Remove the Front Bearing Insert (15).
10. Locate and remove Dowel Pins (3) from End Plate and Seal Adapter. They are very easy to lose, so put them in a safe place.
11. Remove O-Ring (4) from the Seal Adapter Plate (17).
12. Remove the Seal Housing (19) and Drive Shaft (10) from the Seal Adapter Plate (17) by pushing on the gear end of Drive Shaft (10) while holding Seal Adapter Plate (17).
13. Remove the Outer Ring (14) from the Thrust Washer (12, 13) on the Drive Shaft (10).
14. Remove the two halves of the Thrust Washer (12, 13) from the Drive Shaft (10).
15. Remove the Thrust Washer Drive Key (9) from the Drive Shaft (10).
16. Remove the Seal Housing (19) from the Drive Shaft (10).
17. Press the Drive Shaft Seals (20) from the Seal Housing (19) by inserting the pins of the Seal Removal Tool (29) through the holes in end of the Seal Housing (19), Figure 4.
18. Remove O-Ring (18) from the Seal Housing (19).

19. The Rear End Plate (2) and the Seal Adapter Plate (17) each have a PTFE Thrust Disk (23) pressed into a recess. Removing the Thrust Disk (23) will also destroy it. Remove it only if you are going to replace it. It can be removed by driving a small screwdriver or small punch into it and prying it out of the recess.

Clean-up

Clean all parts of the pump in accordance with the owner's cleaning procedures. Take all appropriate precautions to prevent damage to the parts of the pump during the cleaning process. All parts of the pump may be heated to 200°C (392°F).

Inspection

Visually inspect all parts for obvious problems: scratches on surfaces that mate with seals, cracks, upset metal, burrs, or other serious wear that will affect how parts mate together. Correct problem or replace part as necessary.

- Front and Rear Bearing Inserts (5, 15):
    - It is important to inspect the shaft bearing bores. Oversize bores will allow the gears to contact the cylinder bores causing damage. Shaft bearing bores max size:
        - Small Frame NPC .379" ID
        - Large Frame NPC .629" ID
    - No nicks, burrs, scratches, or other defects are allowable on the exterior surfaces that mate with the cylinder, rear end plate, or seal adapter plate. The surface that mates with the meshing gears is a critical surface for maintaining pump efficiency. Depending on the application some wear may be tolerable. This surface should be free of dents, grooves, and scratches.
- Drive Shaft (10):
    - No nicks or burrs allowed on the edges of the keyways.
    - No scratches, pits, or other surface defects are allowed on the lip seal area.
    - In the thrust washer area, no burrs or upset material is allowed on the shoulders that support the thrust washer.
    - In the coupling area, no burrs or upset material is allowed on the surface of the drive shaft that mates with the coupling.
    - Bearing areas of the shaft must be free of surface defects and smooth. To prevent the gears from contacting the cylinder bore the minimum shaft diameter is:
        - Small Frame NPC .3745" OD
        - Large Frame NPC .6225" OD
- Driven Shaft (25):
    - No nicks or burrs are allowed on the edges of the keyway.
    - Bearing areas of the shaft must be free of surface defects and smooth. To prevent the gears from contacting the cylinder bore the minimum shaft diameter is:
        - Small Frame NPC .3745" OD
        - Large Frame NPC .6225" OD
- Cylinder (6):
    - Visually inspect the gear bores for any sign that the gear has contacted the surface. If so, pump performance may be affected. Depending on the application some wear may be tolerable.
    - No major nicks, scratches, or grooves are allowed on the end surfaces.

- Gears (7, 24):
  - No nicks, scratches, grooves, or other defects are allowed on the outside diameter and sides of the gear.
  - Visually inspect the gear teeth. The surfaces of the gear teeth must be smooth and free of obvious wear or damage.
- Thrust Washer (12, 13):
  - No nicks, scratches, burrs, or other defects are allowed.
  - Visually inspect the keyway. No deformation of the keyway is allowed.
- Shaft Seals (20):
  - Visually inspect the edge of the lip for signs of wear, cuts, or tears. Replace if any defect is present.
  - Inspect the lip for flexibility. It must be firm and pliable. When deformed, the lip must return to its original shape.
  - Visually inspect the O-Ring. Cuts, scratches, tears, or permanent deformation of the O-Ring is not allowed. Either replace the O-Ring or replace the entire seal if any defect is present.
- O-rings (4, 18):
  - No nicks, scratches, cuts, tears, or permanent deformation are allowed.
  - The O-Rings must be firm and pliable. Replace if necessary.

Assembly

Note: All factory supplied fasteners are coated with a dry film lubricant or Kolsterise hardened. If fasteners are replaced with uncoated/unhardened non-OEM fasteners, a suitable anti-seize compound must be used.

1. Install Dowel Pins (16) into Seal Adapter Plate (17).
2. Install the Thrust Washer Drive Key (9) into the Drive Shaft (10) keyway.
3. Assemble each half of the Thrust Washer (12, 13) on the Drive Shaft (10). Note: Only one half of the Thrust Washer has a keyway.
4. Slide the Thrust Washer Retaining Ring (14) over the Thrust Washer (12, 13).
5. Install the O-Ring (18) into the groove on the Seal Housing (19) pilot diameter.
6. Install the O-Ring (4) into the groove in the Seal Adapter Plate (17) and the Rear End Plate (2).
7. Install the Drive Shaft (10) and Thrust Washer (12, 13, 14) assembly into the Seal Adapter Plate (17). The coupling end of the Drive Shaft (10) must be on the side of the Seal Adapter Plate (17) where the Seal Housing (19) will be installed.
8. Install the Bearing Insert Dowel Pin (3) into the Seal Adapter Plate (17).
9. Install the Front Bearing Insert (15) over the Drive Shaft (10) until it engages the Bearing Insert Dowel Pin (3). Note: The Front Bearing Insert has no groove on the side that fits against the end of the gears.
10. Install the Drive Gear Key (8) into the Drive Shaft (10) keyway. Note: The keyway in the Drive Shaft (10) is not the same width as the keyway in the Driven Shaft (25). The Drive Shaft (10) has a narrower keyway than the keyway in the Driven Shaft (25).
11. Slide the Drive Gear (7) onto the Drive Shaft (10). Note: Each gear has different size keyway. Use the gear with the keyway that fits the key in the Drive Shaft (10).

12. Carefully slide the Cylinder (6) over the Drive Gear (7) and Front Bearing Insert (15) and engage the Dowel Pins (16) in the Seal Adapter Plate (17). Note: The top of the Seal Adapter Plate (17) has an "F" stamped into it. The top of the Cylinder (6) has an "F" stamped into it. The Cylinder (6) is correctly installed on to the Seal Adapter Plate (17) when the two "F's" are adjacent to each other. See Figure 2.

13. Install the Driven Gear Key (26) into Driven Shaft (25) keyway. Note: The keyway in the Driven Shaft (25) is wider than the keyway in the Drive Shaft (10).

14. Slide the Driven Gear (24) on the Driven Shaft (25). Carefully install the assembly into the Cylinder (6) and into the bearing bore of the Front Bearing Insert (15).

15. Slide the Rear Bearing Insert (5) over the Drive Shaft (10) and Driven Shaft (25). Note: The Rear Bearing Insert has a relief groove on the side that fits against the end of the gears. This groove will be on the discharge side of the pump. The hole for the Bearing Insert Dowel Pin (3) will be next to the Drive Shaft (10).

16. Install the Bearing Insert Dowel Pin (3) into the Rear End Plate (2).

17. Install the Rear End Plate (2). Note: The top of the End Plate (2) has an "R" stamped into it. The top of the Cylinder (6) has an "R" stamped into it. The End Plate (2) is correctly installed on to the Cylinder (6) when the two "R's" are adjacent to each other. See Figure 2. Make sure the Bearing Insert Dowel Pin (3) aligns with the hole in the Rear Bearing Insert (5).

18. Install Cap Screws (1) and tighten snugly. DO NOT OVER TIGHTEN.
    a. Small Frame NPC: 30 in-lbs
    b. Large Frame NPC: 100 in-lbs

19. Install Seal Housing (19) into Seal Adapter Plate (17). Note: A light coat of lubricant will aid the installation of the Seal Housing.

20. The pump Drive Shaft (10) must rotate freely. If it does not, disassemble pump, determine the cause of the binding problem, correct it, and reassemble the pump.

21. Place the Seal Assembly Tool (30) over the Drive Shaft, see Figure 3. Slide the inner Lip Seal (20) over the Drive Shaft (10), the lip of this seal MUST be turned toward the pump body, see Figure 4. Press it into the Seal Housing (19). A light coat of lubricant on the O-Ring will aid the assembly of the Lip Seal (20) into the Seal Housing (19).

22. Slide the outer Lip Seal (20) over the Drive Shaft (10) and press it into the Seal Housing (19). The lip of this seal must be turned away from the pump body, see Figure 4. A light coat of lubricant on the O-Ring will aid the assembly of the Lip Seal (20) into the Seal Housing (19).

23. Install the Seal Retainer Plate (22) with the shouldered side toward the Lip Seals (20).

24. Install the Cap Screws (21) and tighten snugly. DO NOT OVER TIGHTEN.
    a. Small Frame NPC: 12 in-lbs
    b. Large Frame NPC: 30 in-lbs

Installation

1. Install the C-Face Adapter (27) or Foot Mount (34), see Figures 5 and 6.

2. Install the Drive Shaft End Key into the keyway.

3. Install the coupling hub on to the Drive Shaft (10). The coupling hub must slide freely on the Drive Shaft. If it does not, locate the problem, correct it, and re-install the coupling hub. The coupling hub is normally positioned so that the end of the drive shaft is flush with the solid part of the coupling hub. Tighten the set screw over the drive shaft key snugly, DO NOT OVERTIGHTEN.

4. Install the pump on to the equipment mounting bracket. The drive shaft coupling hub must slide freely into its mating coupling hub.

5. Check the coupling hub alignment and adjust if necessary. Poor coupling alignment can cause excessive wear to the pump internals.

6. Install the suction and discharge port adapters (33) to the pump. A Teflon® gasket (31) is used to seal each adapter to the pump body. Install the cap screws (32) and tighten snuggly. DO NOT OVERTIGHTEN.
    a. Small Frame NPC: 12 in-lbs
    b. Large Frame NPC: 30 in-lbs

7. Connect the suction and discharge lines to the port adapters.

8. Open the suction and discharge valves.

9. Operate the pump at a moderate speed until the pump has been primed and air is purged from the pump.

Lubrication and Preventative Maintenance

- The pump is fully lubricated by the pumped liquid. It is capable of being run dry for short periods. However, dry running for extended periods must be avoided.

- It is recommended that a very small amount of a liquid compatible with the liquid to be pumped be put into the pump at startup. This will lubricate the pump during the startup period and make the pump much easier to prime.

- There is no preventative maintenance routine to follow for this pump as there are no manual adjustments or other actions required for normal operation.

- It is required that the coupling be a slip fit on the pump shaft. Do not force the coupling and shaft together.

- When attaching the suction and discharge lines to the pump adapters, make sure that the attached lines mate with the pump adapters naturally without being forced into position. Do not expect the pump to accept significant forces from the attached suction and discharge lines.

Trouble Shooting Guide

Problem	Solution
Pump will not fit on mounting bracket	Check for burrs and nicks around the mounting bracket bore and the pilot diameter on the pump mounting flange. Remove as required.
Key will not fit into keyway in drive shaft	Check for burrs and nicks in the keyway and on the key. Remove as required. Measure width of key and keyway, if an interference fit is found, reduce the width of the key.
Motor shaft turns but pump shaft does not	Verify that the coupling has been properly installed with the correct key in each hub, the correct insert spider, and that the gap in the coupling hubs are properly engaged.
Pump will not prime	Check for air leaks in the suction line. Check for correct rotation of the pump shaft -- CW when facing the shaft end of the pump. "Wet" the internals of the pump with the liquid to be pumped to provide a liquid seal in the pumping chamber. Make sure that all suction and discharge line valves are open. Make sure that the suction and discharge lines are free of obstructions.
Pump requires too much torque	Make sure that the viscosity of the liquid being pumped is not abnormally high. Check for binding of the pump shaft
Pumped liquid has entrained air	Check for air leaks in suction line. Check for air leaks in the shaft seal.
Flow rate is too low	Make sure that the viscosity of the liquid being pumped is not abnormally low. Make sure that the discharge pressure is not abnormally high. Make sure that there are no air leaks in the suction line. Verify that the rotational speed is correct. Disassemble pump and verify that the internal clearances are within specification.

Appendix

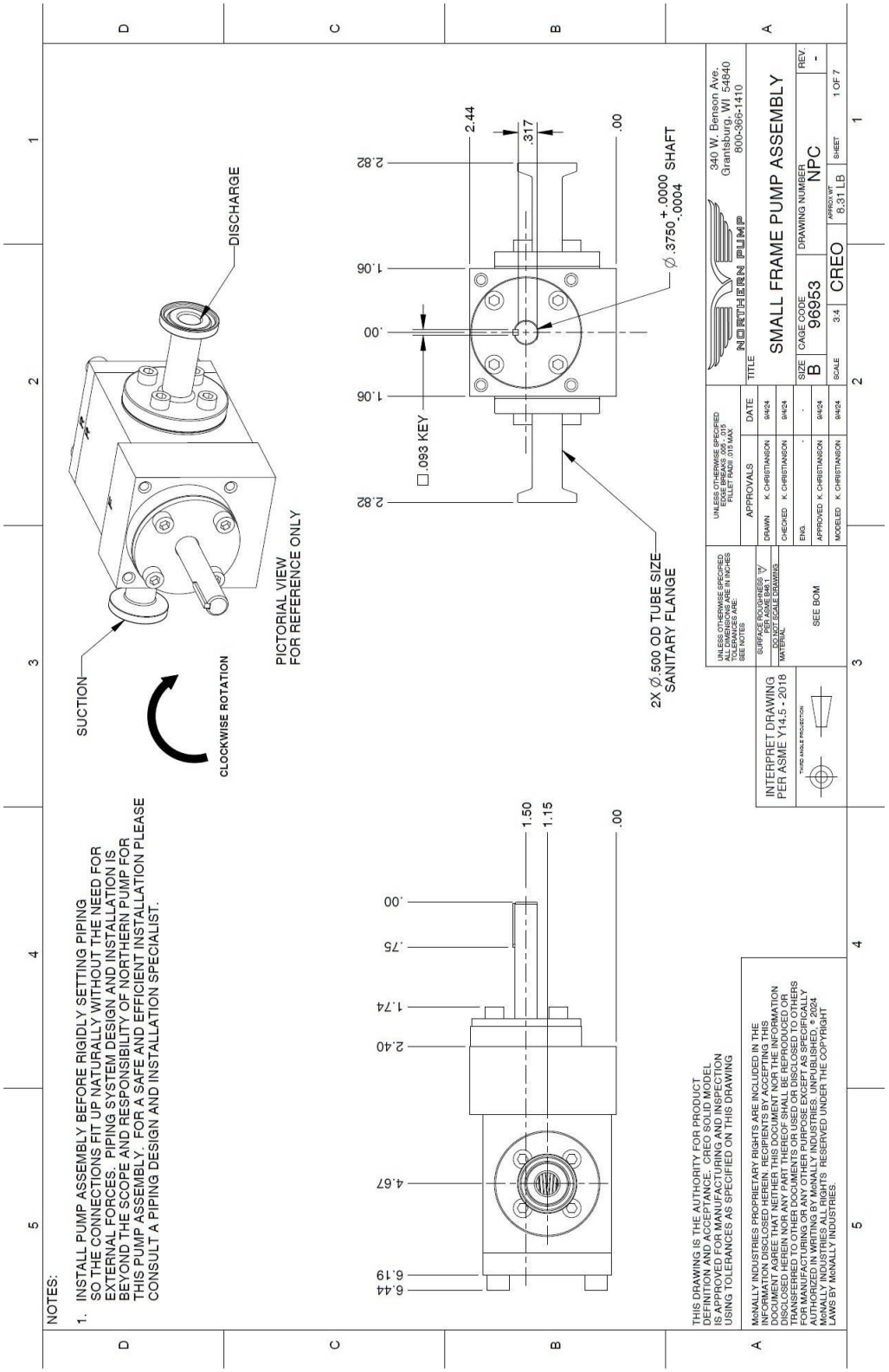

Figure 7: Small Frame Pump Assembly Drawing

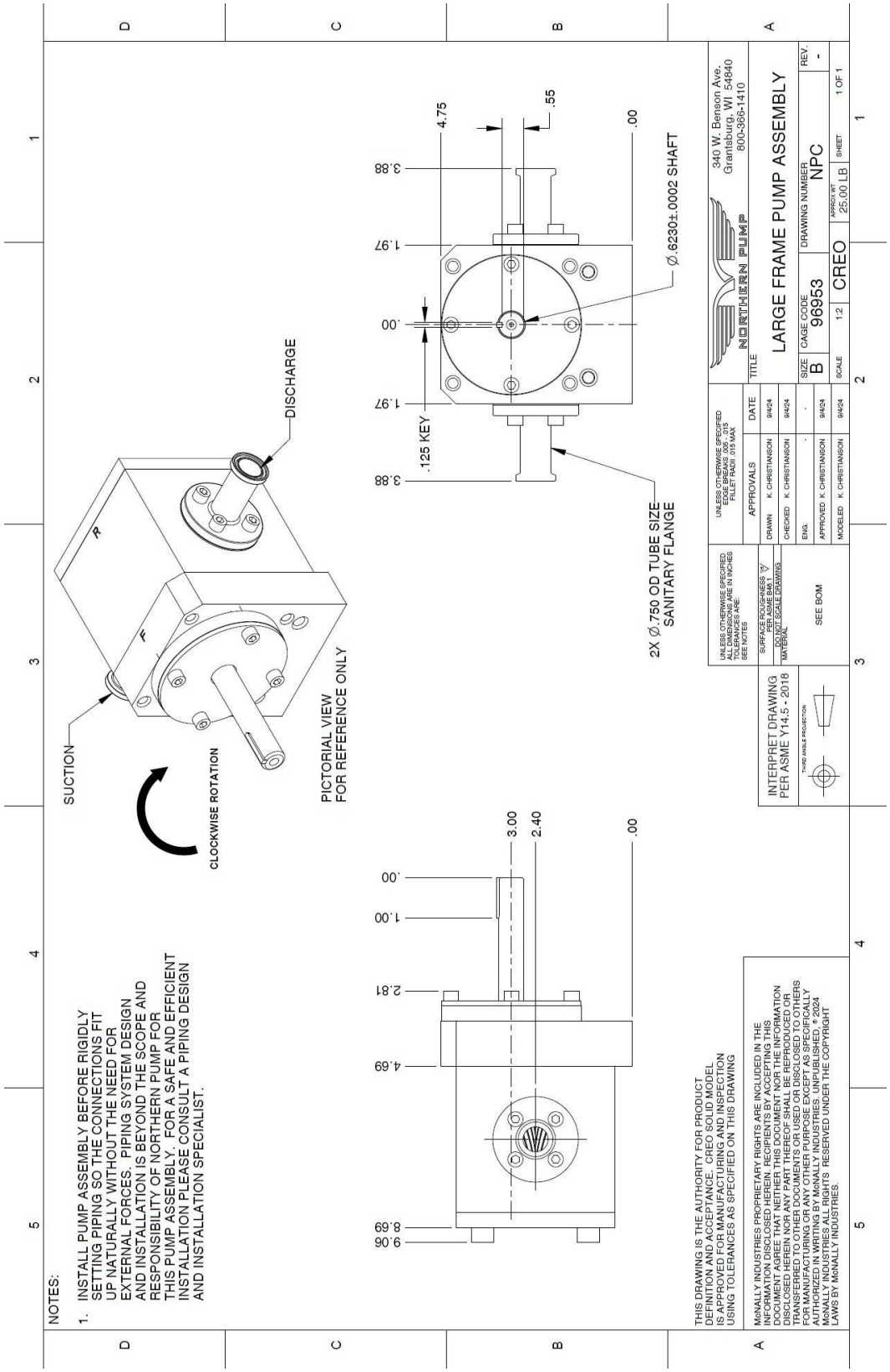

Figure 8: Large Frame Pump Assembly Drawing

PARTS LIST		
ITEM NO.	NOMENCLATURE OR DESCRIPTION	QTY.
1	CAP SCREW	4
2	REAR END PLATE	1
3	DOWEL PIN	2
4	O-RING	2
5	REAR BEARING INSERT	1
6	CYLINDER	1
7	DRIVE GEAR	1
8	DRIVE GEAR KEY	1
9	THRUST WASHER DRIVE KEY	1
10	DRIVE SHAFT	1
11	END KEY	1
12, 13	THRUST WASHER	1
14	OUTER RING	1
15	FRONT BEARING INSERT	1
16	DOWEL PINS	2
17	SEAL ADAPTER PLATE	1
18	O-RING	1
19	SEAL HOUSING	1
20	LIP SEAL	2
21	CAP SCREW	4
22	MOUNTING FLANGE	1
23	THRUST DISK	2
24	DRIVEN GEAR	1
25	DRIVEN SHAFT	1
26	DRIVEN GEAR KEY	1
27	C-FACE ADAPTER	1
28	CAP SCREW	4
29	SEAL REMOVAL TOOL	1
30	SEAL ASSEMBLY TOOL	1
31	TEFLON GASKET	2
32	CAP SCREW	8
33	PORT ADAPTERS	2
34	FOOT MOUNT	1
35	CAP SCREW	2

Figure 9: Bill of Materials