

# NVE/F506 Pump

## Owner's Record

Date of Purchase: \_\_\_\_\_

Purchased from: \_\_\_\_\_

Serial Number: \_\_\_\_\_



# NVE

National Vacuum Equipment, Inc.

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# INTRODUCTION

## General Information



## About National Vacuum Equipment

***Congratulations!*** You now own a quality vacuum/pressure pump proudly manufactured in the U.S.A. by National Vacuum Equipment, Inc. You have not only acquired a superior piece of equipment from a qualified dealer, you have hired a team of vacuum experts. We stand ready to work with your dealer to answer your questions and provide you with the information necessary to keep your equipment in peak working condition.

*Thank you for using National Vacuum Equipment.*

## Our Mission

NVE is dedicated to the manufacture and wholesale distribution of quality vacuum system products at a reasonable price and delivered on a timely basis. NVE is a “one-stop shop” for manufacturers and distributors of vacuum equipment.

## Our History

National Vacuum Equipment, Inc. was founded in 1980 by Bruce Luoma. NVE started as a retailer of vacuum pumps. Soon after it started, NVE secured the rights to exclusive distribution of the Battioni vacuum pumps in North America. This allowed NVE to evolve into its current status as a wholesale supplier.

To reach the goal of becoming a full service supplier of vacuum system components, NVE began fabrication its own line of componentry, purchased and developed its own line of vacuum pumps, and began purchasing for resale various valves and accessories.

Today, NVE has full service machine, fabrication and powder-coating shops complete with CNC-controlled production equipment designed for close tolerance work. Our staff is highly trained and are committed to quality from start to finish.

# LIMITED WARRANTY

NVE/F506 Pump

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## Warranty

**National Vacuum Equipment, Inc.**

**Guarantees that the product it provides is free of manufacturer's defects, including materials and workmanship. Properly installed and maintained product is warranted for a period of one (1) year subject to the following conditions:**

1. A properly completed warranty registration card must be received by us within 30 days of sale to end user for pump sales to be considered warrantable. All pumps received for warranty consideration must retain the original NVE serial number tag.
2. The one (1) year period shall begin the day the product is shipped from our warehouse, unless we are provided with an authentic copy of the original resale invoice, in which case the one (1) year period shall begin at such invoice date.
3. The covered product must be used in an application for which it was intended. We do not recommend our product for particular uses or applications.
4. Vane breakage, or damage caused by vane breakage, is not warrantable.
5. Damage caused by improper use or lack of proper maintenance is not warrantable.
6. Manufacturer's liability under this or any other warranty, whether express or implied, is limited to repair of or, at the manufacturer's option, replacement of parts which are shown to have been defective when shipped

7. Manufacturer's liability shall not be enforceable for any product until National Vacuum Equipment, Inc. has been paid in full for such product.

8. Except to the extent expressly stated herein, manufacturer's liability for incidental and consequential damage is hereby excluded to the full extent permitted by law.

9. Manufacturer's liability as stated herein cannot be altered except in writing signed by an officer of National Vacuum Equipment, Inc.

10. Certain products provided by National Vacuum Equipment, Inc. are covered by their respective manufacturer's warranties (e.g., engines used in the NVE engine drive packages). These products are not covered by the National Vacuum Equipment, Inc. Manufacturer's Warranty.

11. Final assemblers responsibility. NVE goes to great lengths to ensure the quality and proper functionality of the products it supplies. Many products we supply are purchased for resale or are impossible or impractical to test prior to the installation of the item in a vacuum system. It is therefore the responsibility of the final assembler to thoroughly test the vacuum system and components supplied to the assembler by NVE prior to the delivery of the final product to the end user.

Any items found to be defective after delivery to the end user that should have been discovered prior to delivery will qualify replacement of the defective part only with absolutely no compensation for outside labor or travel expenses. Any subsequent damage to other components caused by the defective part will be the sole responsibility of the assembler.

# WARRANTY PROCEDURES

**Should a potential warranty situation arise, the following Procedures must be followed:**

- Contact your dealer or NVE immediately upon the occurrence of the event and within the warranty period.
- Customer must receive a return goods authorization (RGA) before returning product.
- All serial-numbered products must retain the NVE serial number tag to be qualified for warranty.
- Product must be returned to NVE intact for inspection before warranty will be honored.
- Product must be returned to NVE freight prepaid in the most economical way.
- Credit will be issued for material found to be defective upon our inspection, based upon prices at the time of purchase.





# NVE/F506 Pump

## Model-Specific Information



## Application

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Designed for extended operation

- The NVE/F506 is a severe duty vacuum pump, designed to be used in liquid waste pumping systems where extended operation is desired.
- This pump incorporates a ballast air and fan cooling system with full length cowling to provide superior cooling and allowing for extended operation.

## Pump Specifications

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RPM		Pressure (PSI)				Free Flow	Vacuum (in Hg)					
		20	15	10	5		0	6	12	15	18	21
1150	Hp	43	36	27	25	18	21	23	24	25	25	29
	CFM	431	438	447	457	506	470	453	440	438	425	351
1000	Hp	38	32	24	20	15	18	20	21	22	23	25
	CFM	375	381	389	398	452	409	394	390	381	370	306
800	Hp	32	25	19	15	13	14	16	17	18	19	21
	CFM	319	324	331	342	385	348	333	331	324	315	242

**Recommended R.P.M.**

## System Requirements

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### High Quality Components

- The NVE/F506 is a high performance vacuum pump and requires compatible, high quality components.

### Shutoffs

- We recommend the use of our Parts F-802C portal/portal shutoff, and our Part F-901-C, 12 gallon scrubber/secondary shutoff.

### Final Filter

- We also Require the use of a final filter. You can use our remote mounted filter (Part F-1001C).

### Hose

- Use 4" or larger hose to plumb your system. We recommend you use a hose that can withstand high temperatures such as hot tar-asphalt hose.

### Pressure Relief and Vacuum Relief Valves

- A pressure relief valve and vacuum relief valve should also be incorporated in the system.
- The pressure relief valve should be set for a maximum of 25 p.s.i. or as allowed by the tank manufacturer if lower.
- The vacuum relief valve should be set for 20" Hg.
- The relief valves should be set to where the pump operates at a maximum temperature of 350° F.

## Drive System

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- The pump should be mounted on a level, horizontal surface, secured with grade 5 or better fasteners.
- The drive system should be sized to supply the required horsepower to the pump plus a reserve to insure long life.
- Make certain that all shafts, pulleys or turning parts are properly guarded.
- Check the ratio of the drive system prior to installation to verify that the pump will be turning at the proper speed and direction.
- The pump should be set up to engage slowly to avoid initial torque damage.

## Direction of Rotation

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- The direction of rotation and RPM are marked on the front of the pump.
- The direction of rotation required by your drive system should be determined prior to ordering the pump.
- If during assembly of your unit you find you need the opposite rotation, call the factory for instructions.

## Factory Settings

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- The automatic oil pumps are set at the factory during pump testing and should require no further adjustment during pump installation.
- The pumps are adjusted to one drop every two seconds per outlet. This oil rate equals 2.7 fluid oz. per hour, or approximately 8 hrs/Gal. The tank capacity is 1 gallon.

## Adjusting Factory Oil Settings \_\_\_\_\_

The automatic oil pump is a metered piston-type pump. If you wish to adjust the pump, please follow these instructions:

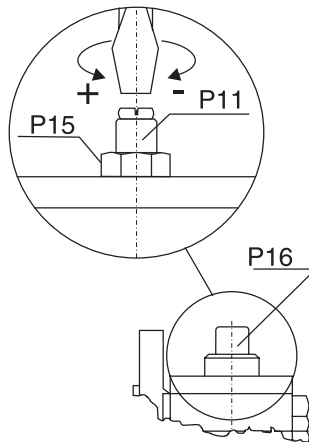
### Adjusting the Oil Rate

Oil flow is changed by adjusting the length of the stroke of the piston, located behind the oil tank .

1. To adjust the oil rate, remove cap #P16. Under this cap you will find a jam nut #P15 and adjusting screw #P11.
2. To adjust oil rate loosen jam nut and turn adjusting screw clockwise to reduce oil flow or counterclockwise to increase oil flow.
3. When making adjustments do so one turn of the screw at a time and test before making further adjustments.
4. Be careful to not turn adjusting screw too far counterclockwise as you may disengage the gears and strip them out.

### Testing Flow Rate After Adjustment

1. Observe oil drip rate by disconnecting an oil line and watching for the proper lubrication rate, in drops per minute (30).
2. Adjustments should be done gradually so as not to starve the vacuum pump of oil.
3. Each side of the oil pump must be checked and adjusted separately.



# OPERATING INSTRUCTIONS

## F506 Challenger™



## Normal Operation

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### Oil Reservoir

- Check oil reservoir daily and fill as required.
- Drain and clean periodically depending on service.
- Clean the ballast air filter with diesel fuel regularly

### Recommended RPM

- Do not operate the pump faster than the recommended rpm of 1000. 1150 RPM is for intermittent use only.
- Too low of an RPM can cause the vanes to clatter (inconsistent contact with the housing) causing wear.

### Suction Valve

- To operate the suction valve, move the handle in the appropriate direction for either vacuum or pressure; center is neutral.

### Vacuum Levels

- Do not operate your pump for extended periods of time at vacuum levels which cause the pump to exceed 375 degrees Fahrenheit exhaust gas temperature.

### Guards

Make certain all guards are in place prior to running your pump.

*Think Safety!*

## Lubrication System

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### Force Feed System

- The NVE/F506 is supplied with a force feed type lubrication system which incorporates a piston type pump and three-point oiling.

### The Drip Rate is Preset at the Factory

- The NVE/F506 is supplied with a force feed type lubrication system which incorporates a piston type pump and three-point oiling. The result is cooling of the housing and rotor with no appreciable drop in vacuum level.

## Recommended Lubricant

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- We recommend that turbine oil be used in our pumps. Turbine oil is much more resistant to breakdown due to heat than normal motor oil, thereby avoiding the problems associated with motor oil such as lacquering and excessive wear.

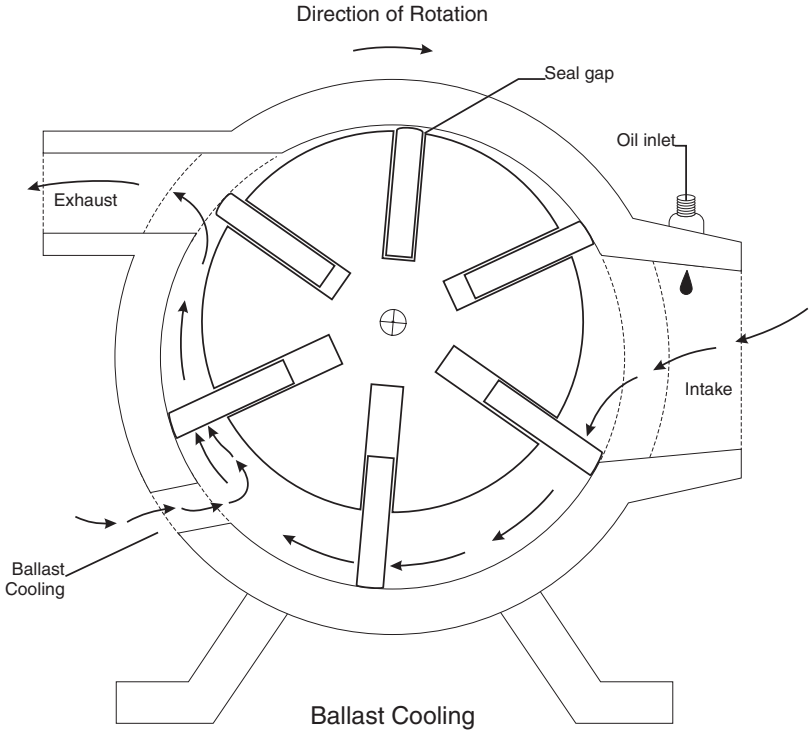
Acceptable oils include:

1. Penzoi Penzabell 68 T.O.
2. Shell Turbo 68
3. Mobil D.T.E. Heavy - Medium
4. Texaco Regal R & O 68
5. \* NVE ISO 68 Oil

\* NVE ISO 68 Oil is our recommended pump oil for the Challenger series vacuum pumps. Challenger Vacuum Pump Oil is sold by the case, six-1 gallon containers of oil per case.

# Ballast Cooling

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- Ballast cooling of a vacuum pump is accomplished by introducing atmospheric air into the exhaust side of the pump housing. The ballast inlet is located at a point where the affected pump cell is no longer in contact with the intake port.
- The result is cooling of the housing and rotor with no appreciable drop in vacuum level.

## Maintenance

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### Washing

- Periodically wash the mud and dirt off of your pump. The NVE/F506 is an air cooled pump. It must be clean to allow heat to radiate from it. Regularly clean and inspect the ballast air filter. Also drain and clean the oil tank as necessary.

### Flushing

We recommend periodic flushing of your pump. To do this:

1. Connect the hose to the flush valve located on the side of the inlet port.
2. Put the end of the hose in a one pint container of diesel fuel. Start your pump and run as slow as possible.
3. With the 4-way valve in the vacuum position, open the flush valve and monitor the diesel flow to your pump.
4. When the diesel fuel is gone, switch the 4-way valve to neutral and run the pump for 2 minutes.
5. Speed the pump up to normal RPM, switch the 4-way valve to vacuum.
6. Remove the hose and close the valve.
7. Properly dispose of used oil and flushing fluid.

### Checking Vane Wear

We recommend checking vane wear at least every 12 months.

- A new vane is flush with the outside diameter of the rotor.
- Remove the plug from the vane check port, insert a rod to rotor O.D., rotate rotor until the rod falls into one of the vane slots. If the rod falls more than a 1/4" into any of the 6 vane slots, it's time to replace the vanes.
- Vanes should be replaced in sets and it is always a good idea to have an extra set of vanes on hand for emergencies.



## Cold Weather Operation \_\_\_\_\_

### **Confirm pump is not frozen**

- Prior to engaging the pump, turn by hand to confirm it is not frozen.

### **In pump is frozen, thaw it.**

- If the pump is frozen, thaw it out by heating the bottom of the pump with a torch or move the truck into a heated building.

### **Avoid freezing problems**

- You can avoid freezing problems by putting a small amount of diesel fuel into the pump at the end of the day.

# TROUBLESHOOTING

## F506 Challenger™



### Pump overheats \_\_\_\_\_

- No oil in pump
- Oil adjustment set too lean
- RPM too fast
- Prolonged operation at excessive vacuum or pressure levels,
- Pump is dirty
- Ballast filter is clogged or dirty.

### Pump uses too much oil \_\_\_\_\_

- Oil pump set too rich
- Leaving pump under vacuum between jobs
- Product running through pump

### Pump doesn't turn \_\_\_\_\_

- Broken vane or bearing
- Pump is frozen
- Problem in the drive train

## No vacuum

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- Suction valve is in neutral
- Worn seals or vanes
- Pump is not turning fast enough
- Check valve or suction valve is clogged
- Leak in the tank or fittings
- Collapsed hose between the pump and shutoffs
- Ballast filter clogged

## System Troubleshooting

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### Locating the source of the trouble

If you notice a decrease in pump performance, start troubleshooting at the pump.

- Remove the suction and discharge hoses at the pump
- Start the pump and run it in vacuum only at its normal rpm
- Check the vacuum level at the pump inlet. The F/506 Challenger in new condition will develop 27-28" hg.
- If the pump checks out OK, check the vacuum level at the secondary, then the primary shutoff. Keep working your way back until you find the problem.

## **Making a Vacuum Tester**

1. Procure a flange to mount on your four-way valve, a short 4" pipe nipple, a 4" pipe cap and a vacuum gage.
2. Drill and tap a 1/4" N.P.T. thread in the pipe cap.
3. Assemble the flange, nipple, pipe cap and vacuum gage.
4. Remove a flange from the 4-way valve on your pump.
5. Start the pump and confirm the location you have chosen to test from is at vacuum.
6. Using the existing O-ring, fasten the testing flange to your pump.
7. Start your pump and read the vacuum level on the gauge.

# PUMP REBUILDING

## F506 Challenger™

Please read these instructions completely before attempting repair.

There are two types of pump repair—vane replacement and total rebuilding.

### Vane Replacement



1. Clean off the exterior of the pump, drain and remove oil tank, clean the inside if necessary.



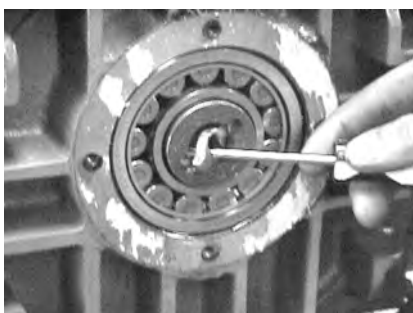
2. On the oil tank end, loosen the shroud by removing the button head cap screw on the top of the shroud that attaches it to the endplate.



3. Remove the oil lines from the oil pump mount that go under the pump shroud.



4. Remove the four hex head bolts that attach the oil pump mount to the vacuum pump and remove oil pump and pump mount assembly.



5. Remove the oil pump drive key from the end of the rotor.



6. Remove the six hex head screws that hold the end plate in place and pull the end plate off. It may be necessary to push off the end plate using bolts (as jack screws) in the two tapped holes provided.



7. Inspect vanes, bearings and seals and replace as necessary. A new vane is flush with the outside diameter of the rotor. If they are worn more than 1/4" they should be replaced. We recommend replacing vanes in sets. If the ends of the vanes are chipped or delaminated they should be replaced. The seals should be soft and pliable. The bearing should turn smoothly.

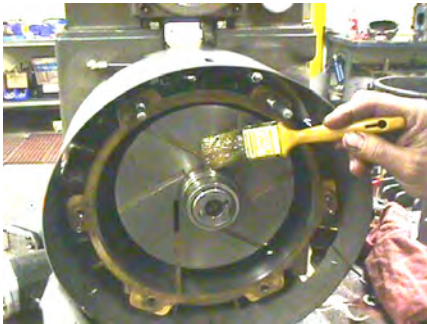


8. Coat the vanes with oil and install the vanes in the rotor. Ensure that the vanes are properly installed, the angle of the vane should match the outside of the rotor and not extend past the O.D. of the rotor.

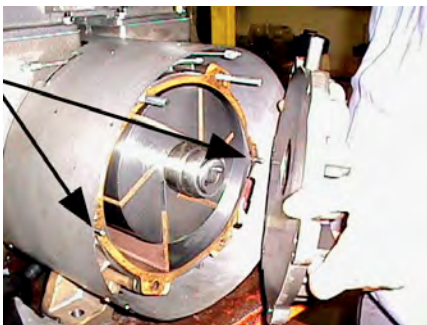




9. Locate two 3/8-16 x 2-1/2 Lg. studs and insert them into the bolt holes on either side of the endplate



10. Lubricate seal sleeve and install the same number of endplate gaskets as were removed.



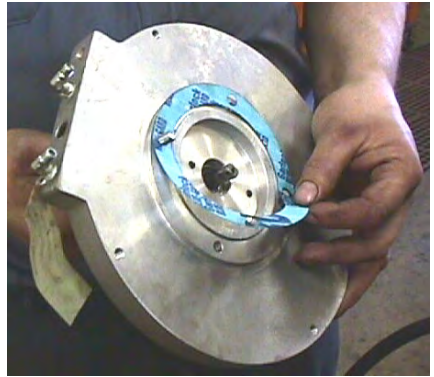
11. Align the endplate onto the dowel pins and bolt into place. Tighten endplate bolts to 35-40 ft. lbs of torque



12. Reinstall the oil pump drive key and oil tank mount oil pump assembly. Inspect oil pump drive key for wear.



13. Clean the gasket surfaces on the endplate and oil tank mount. Install a new gasket if required.



14. Line up the oil pump drive key and the oil pump shaft prior to tightening the assembly to the pump.





15. Connect the oil line to the oil pump mount assembly from the front of the pump.
16. Reinstall the oil tank and fill the pump with oil. The pump is now ready to run. At this point the pump should turn freely by hand.



17. Start the pump at a slow R.P.M. and allow to run for a few minutes until the oil fills the oil lines and can get to the bearings.

The pump is now ready to go to work.

# COMPLETE PUMP REBUILD



1. Follow steps 1- 6 in the vane replacement instructions.
2. Remove the vanes from the pump.



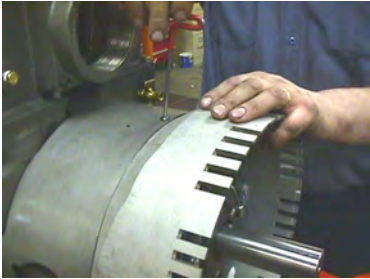
3. Place a cushion under the rotor to prevent damage when the front endplate is unbolted, because the rotor will drop.



4. From the drive end, remove the four screws that attach the fan cover to the shroud.



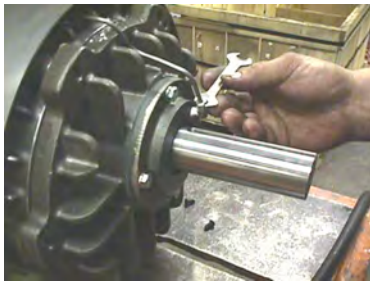
Remove the fan by loosening the clamping bolt and spreading the clamping collar with a screw driver or chisel.



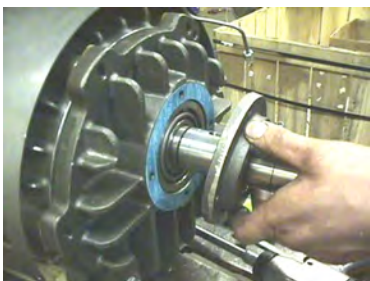
5. Remove the three button head screws that attach the steel shroud to the aluminum shroud.



6. Remove the four bolts attaching the aluminum shroud to the endplate and remove the shroud.



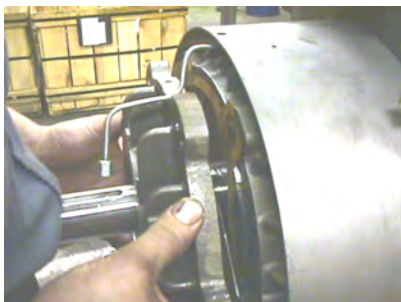
7. Remove the oil line to the drive end bearing.



8. Remove the bearing cover.



9. Remove the two remaining bolts attaching the endplate to the housing.  
Support the rotor shaft prior to loosening the last bolt.  
Slide the rotor out.



10. Remove the front endplate by sliding it off the end of the shaft.

Put an identifying mark on the endplate so as to not confuse it with the rear.  
Count the number of gaskets.



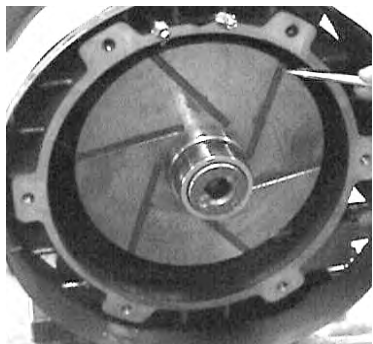
11. Clean the rotor, rotor slots and housing and inspect for wear or damage also check the seal sleeves for grooves.

If the housing needs to be bored or honed, remove only as much material as is necessary to give a smooth clean bore.

The maximum overbore we recommend is .060 inch. A new housing has a bore of 10.000 inches.

If you bore or hone the housing, remove the 4-way valve assembly and internal check valve prior to machining.

If the housing is bored, the top seal gap must be reset and the dowel pins can not be used.



12. Inspect vanes, bearings and seals and replace as necessary.

A new vane is flush with the outside diameter of the rotor.

If they are worn more than 1/4" they should be replaced.

We recommend replacing vanes in sets.

If the ends of the vanes are chipped or delaminated they should be replaced.

The seals should be soft and pliable.

The bearing should turn smoothly.



13. Locate the replacement seals and install them in the end-plates with the seals positioned back to back.

Replace the seals in the bearing cover with the seals back to back or springs to the outside and lubricate.



14. Lubricate and install the bearings in the endplates.

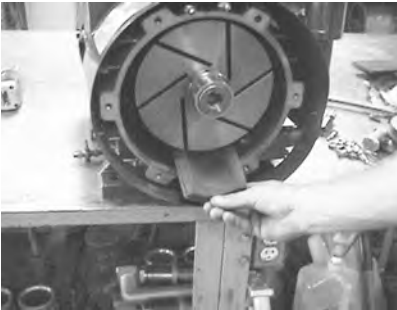
15. Locate two pieces of threaded rod 3/8-16 thd. to use as guides and screw them into the two top holes in the housing.



Locate the gasket and slide it on the threaded rods and pins.

Do not use any gasket sealer.

16. Lubricate the housing bore.



17. Lubricate seal sleeve and slide the proper endplate on the input end of the rotor.

Install the endplate and slide rotor-endplate assembly into the pump housing.

Slide the cushion material (used during disassembly) under the rotor on the opposite end to gain leverage during assembly of endplate to housing.



18. Lift the rotor-endplate assembly and slide over the 3/8 inch threaded guides and pins and install the endplate bolts.

Tighten the bolts sufficiently to make contact between the endplate and the housing.



19. Coat vanes with oil and install the vanes in the rotor. The vanes should slide freely in the vane slots.
20. Locate the correct number of gaskets and install them on the rear endplate.

Do not use any gasket sealer.



21. Lubricate seal sleeve and install the endplate on the end of the rotor.





22. When the endplate is close enough to the housing, install the endplate bolts.

Lift the endplate-rotor assembly to allow proper alignment of the bolts, pins and bolt holes and start the bolts into the housing.

Tighten endplate bolts to the point where the endplate just touches the housing. If the pump has been bored.

23. Use a prybar and a block of wood, lift the endplate to make certain the seal gap is properly set.

Tighten the endplate bolts to 35–40 ft. lb. of torque. Tighten both endplates in this manner.



24. At this point you should be able to turn the pump by hand. If the rotor does not turn easily the bearings may have to be “set” by hitting the O.D. with a bearing driver.

25. Lubricate the seal surface on the rotor and reinstall the front bearing cover.



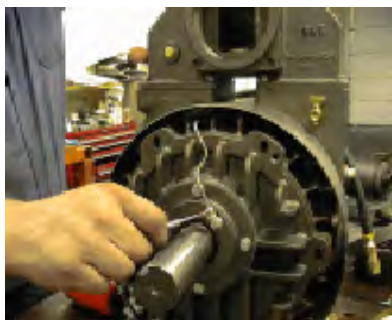
Coat the gasket with a harding gasket sealer.



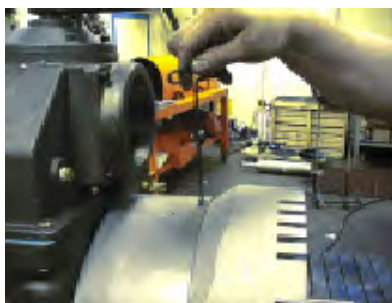
26. Reinstall the oil pump drive key and oil tank mount-oil pump assembly.

27. Be sure to line up the oil pump drive key and the oil pump shaft prior to tightening the assembly to the pump.

Use gasket between the assembly and the endplate.



28. Reassemble to oil line to the front endplate.



29. Attach the steel shroud to the shroud support and aluminum shroud using the button head screws.



30. Connect the oil line to the oil pump mount assembly from the front of the pump.



31. Slide the fan on the input shaft.  
Tighten the clamping bolt in the hub.

Make sure there is sufficient clearance to mount the fan cover and allow clearance for the oil line when positioning the fan assembly.



32. Reassemble the fan cover to the fan shroud.



33. Remove the Ballast filter, Inspect for dirt or damage. clean as required or replace the filter.



34. Reinstall the oil tank and fill the pump with oil.

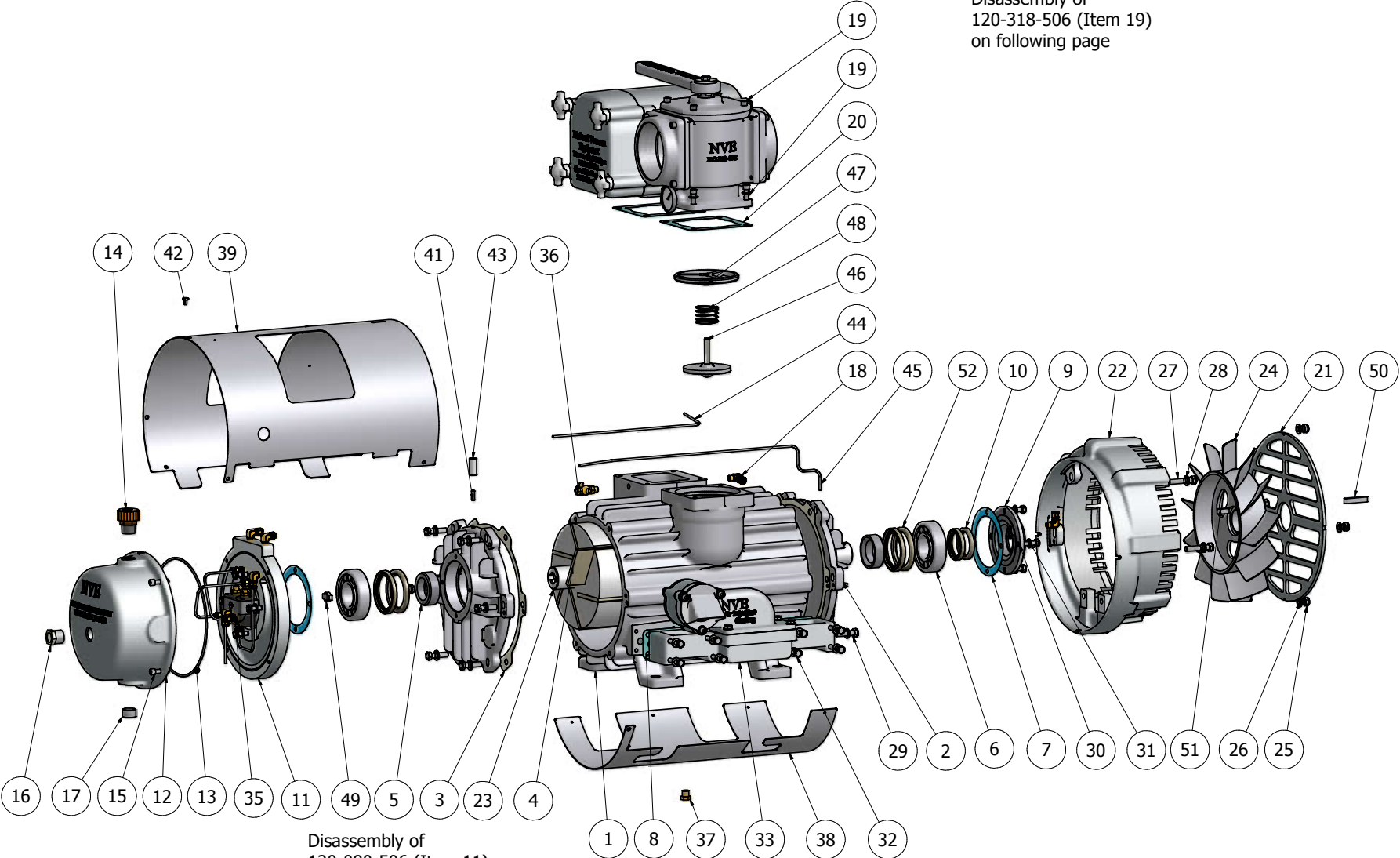
The pump is now ready to run.



35. Start the pump at a slow R.P.M. and allow to run for a few minutes until oil can work it way to the bearings.

Allow the pump to run for a few more minutes.

# 506 Challenger™ - Fan Cooled Parts Diagram



Disassembly of  
120-318-506 (Item 19)  
on following page

Disassembly of  
120-080-506 (Item 11)  
on following page

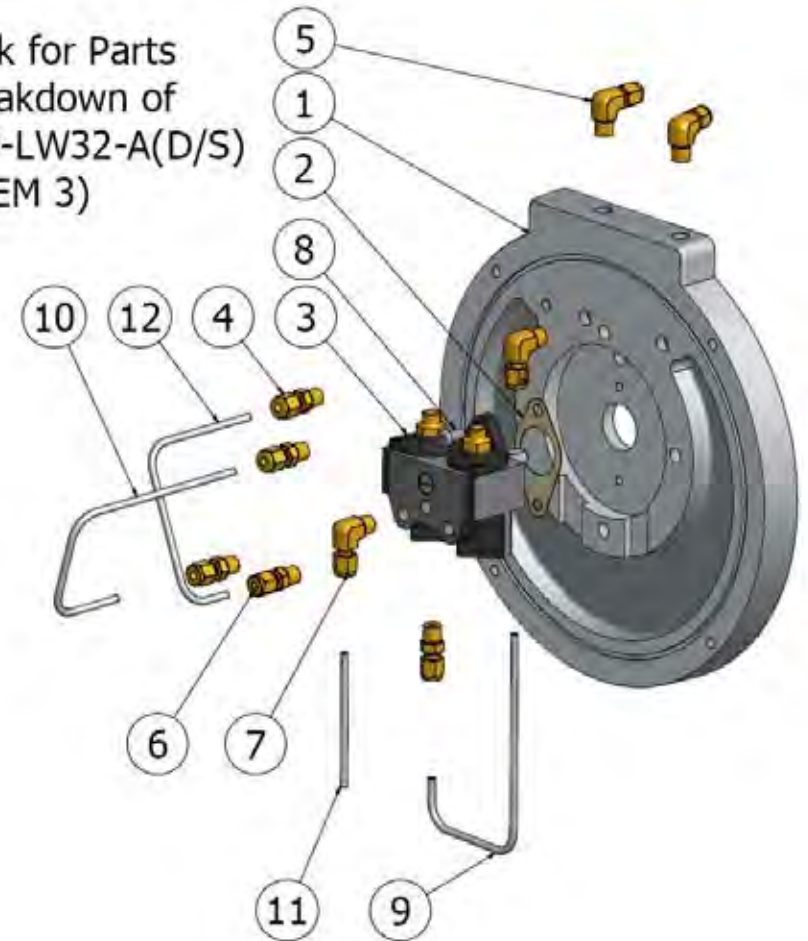
Disassembly of  
466-310 (Item 33)  
on following page

# 506 Challenger™ - Oil Tank Mounting Plate

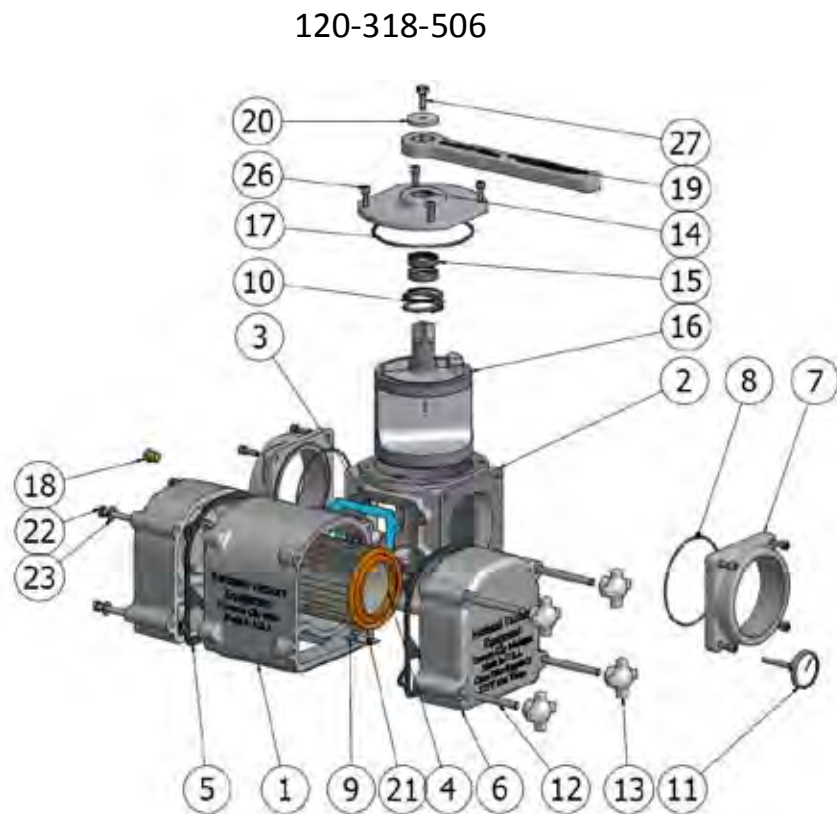
120-080-506-D (CW) & 120-080-506-S (CCW)

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	700-080-506	460 Oil Mounting Plate
2	1	320-R31	Gasket, Oil Pump
3	1	320-LW32-AD	Oil Pump, 3 Port (CW or CCW)
4	2	320-001	Oil Fitting (4mm x 1/8"NPT STR)
5	3	320-002	Oil Fitting (4mm x 1/8"NPT Elbow)
6	3	320-003	Oil Fitting (4mm x 1/8"BSPT STR)
7	1	320-004	Oil Fitting (4mm x 1/8"BSPT 90 Elbow)
8	2	B2-0404	Screw, SHCS 1/4" UNC x 1/2"
9	1	320-092-506-D	Oil Line, Oil Tank to Inlet
10	1	320-091-506-D	Oil Line, Oil Tank Inlet
11	1	320-090-506-D	Oil Line, Oil Tank Inlet
12	1	320-093-506	Oil Line, Oil Tank Frnt Brng

Click for Parts Breakdown of 320-LW32-A(D/S) (ITEM 3)

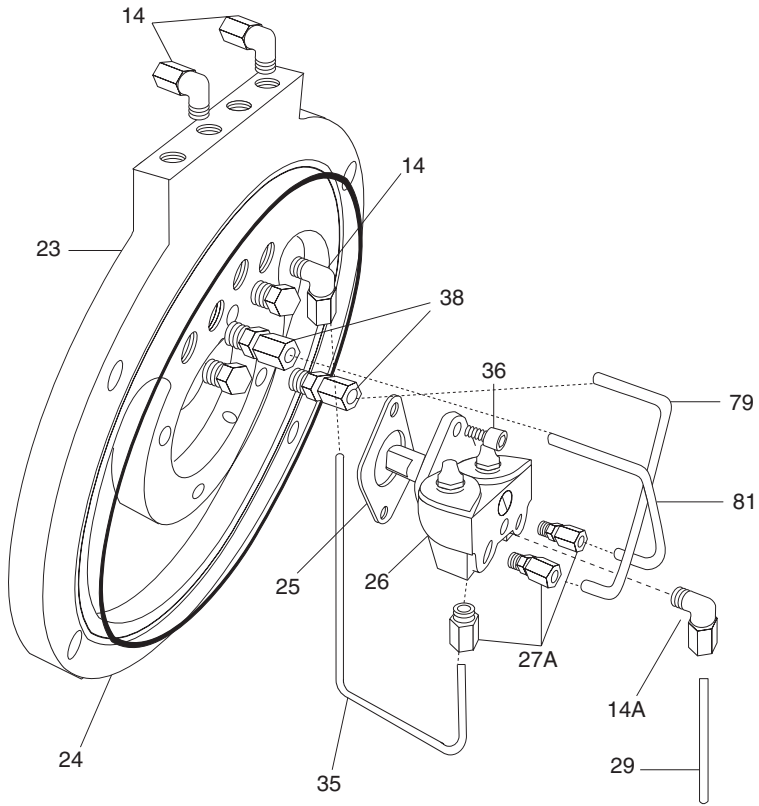


# 506 Challenger™ - 4" 4-Way Valve and Filter Assembly



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	120-309-506	Filter Housing, 4"
2	1	120-067-506	4-Way Housing, 4" w/ Filter
3	1	120-311	Gasket, Valve to Filter Hsg.
4	1	120-314	Filter Element, 4-Way
5	2	120-315	Gasket, Filter Cover
6	2	120-310	Filter Cover
7	2	120-063-506	Flange, 4" NPT
8	2	120-064-506	Oring, 2-154 Silicone
9	1	808-SCR-SS	2" Screen for Filter Housing
10	1	120-045	4-Way FV Spring (Compressed)
11	1	120-220	1/4" NPT Thermometer 400 F
12	4	120-313	Stud, 3/8-16UNC-2A x 4-3/8"
13	4	120-312	Knob, 3/8"-16UNC
14	1	120-065	Tower, 4-Way w/ Filter
15	2	120-040	4-Way Valve Seal 3" & 4" Viton
16	1	120-062-506	Plug, 4-Way w/ Filter
17	1	120-068	Oring, 2-210 Viton
18	1	120-058-506	Plug, Brass 1/8" NPT, Hex Hd.
19	1	120-060	Handle, 3" & 4" 4-way Valve
20	1	120-085	Washer, 4-way handle
21	2	B2-0403	Screw, 1/4" x 3/8" Button Head
22	4	B1-0528	Bolt, HHCS 5/16"-18UNC x 3.5"
23	4	B8-0501	5/16 Flat Washer
24	4	B1-0518	Bolt, HHCS 5/16"-18UNC x 2.25"
25	4	B8-0503	5/16 Lock Washer
26	12	B2-0507	SSCS, 5/16"-18UNC x 7/8"
27	1	B1-0608	Bolt, HHCS 3/8" x 1"

# OIL PUMP AND FITTING (Clockwise)





# OIL PUMP AND FITTING (Counter Clockwise)

