

# NVE

National Vacuum Equipment



## Owner's Manual

### 304 Challenger Rotary Vane Pump



800-253-5500

| natvac.com

# 304 CHALLENGER

## Owner's Record

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

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

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

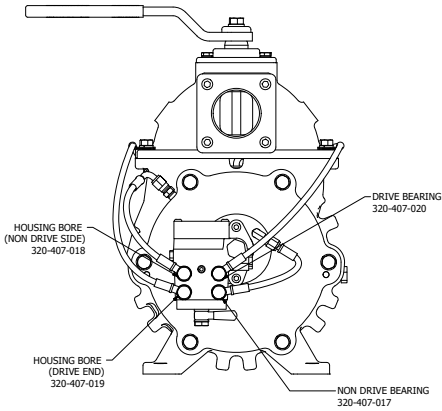
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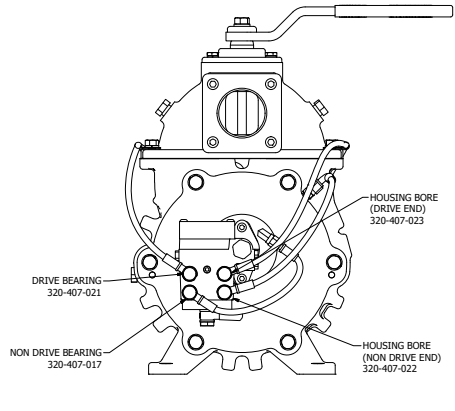
# IMPORTANT INFORMATION FOR INSTALLING PUMP

## 304 CHALLENGER SERIES PUMPS AERIAL VIEW

**SHADED AREAS MUST BE KEPT CLEAR FOR SERVICING THE FILTERS &  
CHECKING VANES**



**Clockwise  
Rotation**



**Counter - Clockwise  
Rotation**

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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 putting your trust in National Vacuum Equipment.

### Our Mission

We are dedicated to the production and wholesale distribution of quality vacuum system products at a reasonable price, on a timely basis. We are a “one-stop shop” for manufacturers and distributors of vacuum equipment.

### Our History

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

To reach the goal of becoming a full service supplier of vacuum system components, the Company began fabrication of 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. The company has a highly trained staff, all of whom are dedicated to quality.

# LIMITED WARRANTY

## 304 Challenger



## Warranty

### National Vacuum Equipment, Inc.

Guarantees that the product it provides is free of manufacturer's defects, including materials and workmanship. When properly installed and maintained this product is warranted for a period of two (2) 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 two (2) 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 two (2) 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 insure 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.
12. NVE is not responsible for pump coupling tightness or alignment. Customer needs to inspect periodically to ensure proper alignment and to check tightness of set screws.

Any items found to be defective after delivery to the end user that should have been discovered prior to delivery will qualify for 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 materials authorization (RMA) form from NVE before returning product.
- All serial-numbered products must retain the original 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.

The maximum allowable operating vacuum will vary depending on R.P.M., ambient temperature, altitude and time running. The basic principle to keep in mind is - faster R.P.M., higher air temperature and longer run time all equal more heat in pump. When installing an NVE 304 pump we recommend a normal R.P.M. of 1200-1400. Other speeds are ok as long as exhaust gas temperatures read on the supplied thermometer do not exceed 380 degrees F.

Weights and measurements are for reference only.



# 304 CHALLENGER

## Model-Specific Information



### Application

- Duty cycle will vary depending on several factors, such as altitude, RPM & ambient temperature.

### Pump Specifications

| AIR COOLED 304 CHALLENGER SPECIFICATIONS |         |       |       |
|--|---------|-------|-------|
| AIR FLOW - FREE AIR                      | 210 CFM |       |       |
| MAXIMUM INTERMITTENT VACUUM              | 27" HG  |       |       |
| MAXIMUM INTERMITTENT PRESSURE            | 20 PSI  |       |       |
| OPERATING RANGE - RPM                    | 1200    | 1300  | 1400  |
| HP REQUIRED @ FULL VACUUM                | 8.35    | 9.24  | 10.16 |
| HP REQUIRED @ 10 PSI                     | 10.08   | 11.14 | 12.24 |
| PORTING SIZE (optional 1-1/2")           | 2"      |       |       |
| SHAFT SIZE (1/4" Key)                    | 1 1/4"  |       |       |

## System Requirements

### Shutoffs

- We recommend a primary shut-off, secondary shut-off, and an oil catch muffler be installed on the system.

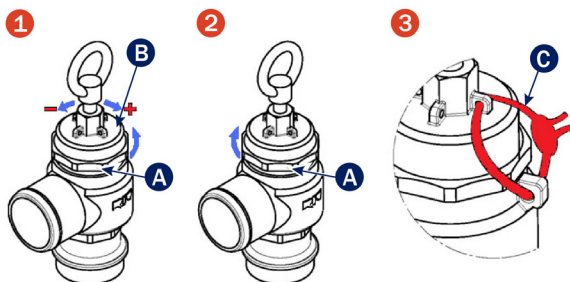
### Hose

- Use 2" or larger hose to plumb your system. We recommend you use a hose that can withstand high temperatures and pressures such as hot tar-asphalt hose.

### Pressure and Vacuum Relief Valves

- Properly adjusted pressure relief and vacuum relief valves should also be incorporated in the system between the secondary shutoff and the pump.
- The relief valves should be set to where the pump operates at a maximum temperature of 375 degrees Fahrenheit and to tank manufacturers specifications.

# Pressure and Vacuum Relief Valve Setting Instructions



## Pressure Relief Valve

Picture 1.

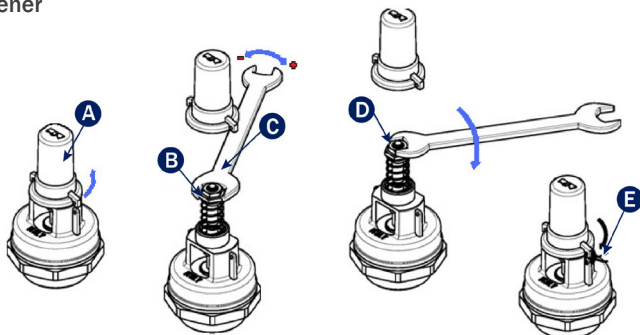
1. Unscrew the lock nut "A"
2. Turn the spring-tightener "B"

Picture 2.

1. Once obtained the desired pressure, screw down the lock nut "A"

Picture 3.

1. Fix the setting, using the rings "C" Situated on the body and on the spring tightener



## Vacuum Relief Valve

1. Remove the protection cap "A"
2. Turn the spring-tighter "B", through a spanner "C", clockwise to increase the pressure, counter-clockwise to reduce the pressure
3. Once obtained the desired pressure, screw down the lock nut "D"
4. Screw down the protection cap and fix it using the rings "E" situated on the valve body and on the cap

## Drive System

- The pump should be mounted on a level, horizontal surface, secured with Grade 8 fasteners.
- The drive system should be sized to supply the required horsepower to the pump plus a reserve to insure long life.
- The power take off (PTO) must be slowly engaged or it will damage the pump and drive components.
- Immediate engagement at working rpm for any rotating equipment will cause failure or premature wear. It is the responsibility of the installer and user to ensure the vacuum pump or blower is not being over torqued at start up.
- 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.

| 304 HORSEPOWER REQUIREMENTS AND FLOW DATA |     |                |    |    |    |           |                |    |    |    |    |    |      |
|---|-----|----------------|----|----|----|-----------|----------------|----|----|----|----|----|------|
| RPM                                       |     | PRESSURE (PSI) |    |    |    | FREE FLOW | VACUUM (IN HG) |    |    |    |    |    |      |
|   |     | 20             | 15 | 10 | 5  | 0         | 5              | 10 | 15 | 20 | 25 | 27 | FULL |
| 1100                                      | HP  | 14             | 12 | 9  | 7  | 5         | 5              | 5  | 6  | 7  | 7  | 7  | 8    |
|   | CFM |                |    |    |    | 169       |                |    |    |    |    |    |      |
| 1250                                      | HP  | 17             | 14 | 11 | 9  | 6         | 6              | 6  | 7  | 8  | 8  | 9  | 9    |
|   | CFM |                |    |    |    | 186       |                |    |    |    |    |    |      |
| 1400                                      | HP  | 18             | 16 | 13 | 10 | 7         | 8              | 8  | 9  | 9  | 10 | 10 | 10   |
|   | CFM |                |    |    |    | 210       |                |    |    |    |    |    |      |

\* Ambient temperature, altitude, and a variety of other factors will affect the values listed in this table

## Direction of Rotation

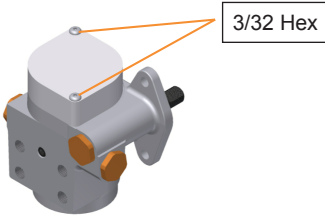
- The direction of rotation required by your drive system should be determined prior to ordering the pump.

## Factory Settings

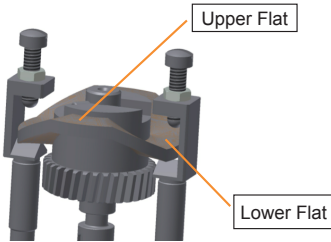
- The automatic lubrication pumps are set at the factory during pump testing and should require no further adjustment during pump installation. The oil pump is easily adjustable from 5-24 ounces per hour. The 304 should consume between 7 and 9 oz/hr of oil at 1250 RPM.
- It is the responsibility of the installer to ensure proper vacuum and pressure settings and RPM.

# Oil Pump Flow Rate Adjustment Procedures

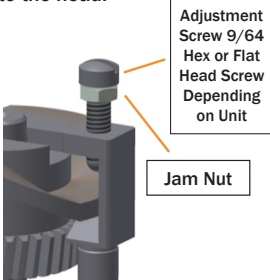
1. Remove oil pump cap (3/32 hex).  
Ensure o-ring stays intact.



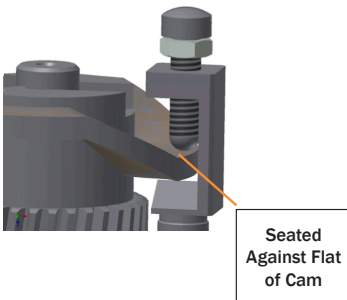
2. Move cam so adjustment screws are resting on lower flats



3. Hold adjustment screw (9/64 hex or flat head screw) while loosening jam nut 1/4" wrench). Spin jam nut all the way up to the head.



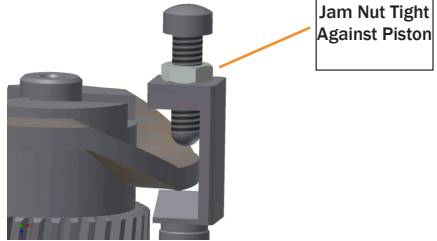
4. Tighten adjustment screw (CW) until it seats on the cam. (Do not force!)



5. Back the screw off the desired amount of turns (CCW) - 8 turns if operated at 1250 RPM

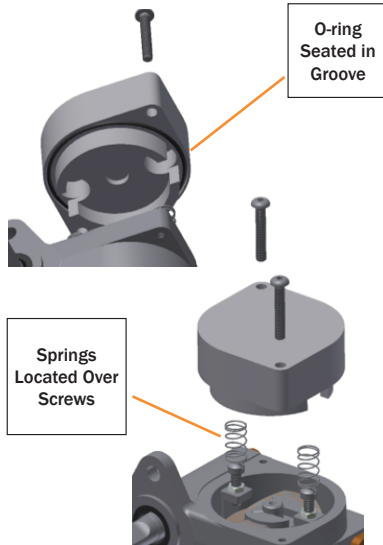
*Tip: More turns out equals less oil flow.  
Fewer turns out equals more oil flow.*

6. Retighten jam nut while holding adjustment screw.



7. Repeat process for other adjustment screw.

8. Reassemble cover onto pump assuring o-ring does not fall out of groove, and springs are located over adjustment screws



# Adjusting Factory Oil Settings Continued

## NVE 4 Port Oil Pump Adjustment Rate Chart Tested at 1100 RPM

| Turns From Bottom | Ounces Per Hour |
|-------------------|-----------------|
| 7.5               | 6               |
| 7.25              | 7               |
| 7                 | 8               |
| 6.75              | 9               |
| 6.5               | 10              |
| 6                 | 11              |
| 5.5               | 12              |
| 5                 | 13              |
| 4.75              | 14              |
| 4.5               | 15              |
| 4.25              | 16              |

# OPERATING INSTRUCTIONS

## 304 Challenger



### Oil Reservoir

- Check oil reservoir daily and fill as required.
- Drain and clean periodically depending on use.

### Recommended RPM

- 1000 - 1400 RPM.
- 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!**

## **Recommended Lubricant**

- 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.
- NVE ISO 150 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.

# Maintenance

## Washing

- Periodically wash the mud and dirt off of your pump as it must be clean to allow the fins to dissipate heat properly.

## 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 container with 4-5 ounces of diesel fuel. Start your pump and run as slow as possible.
3. With the suction valve in the vacuum position, monitor the diesel flow to your pump.
4. When the diesel fuel is gone, switch the suction valve to neutral and run the pump for 2 minutes.
5. Speed the pump up to normal RPM, switch the suction valve to vacuum.
6. Close the valve and remove the hose.
7. Drain oil catch muffler and properly dispose of used oil and flushing fluid.

## Checking Vane Wear

- We recommend checking vane wear, at a minimum, 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 outside diameter, 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 4 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.



## Maintenance Continued

- If equipped with a filter, check filter regularly.
- Clean filter with compressed air or a cleaning solution.  
The filter is made of stainless steel, please keep that in mind when choosing your cleaning solution.
- Before reinserting the filter into the housing, lube the inside end of the filter that will fit over the lip in the bottom of the housing.

*Properly apply lube here on the inside lip of the filter...*

*...before reinserting here.*



## Cold Weather Operation

### **Prior to engaging pump.**

- Confirm pump is not frozen.

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

- If the pump is frozen, thaw it out by moving 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

## NVE 304 Vacuum Pump



---

### Problem: Pump overheats

#### Causes:

- No oil in pump
- Oil adjustment set too lean
- RPM too fast
- Prolonged operation at excessive vacuum or pressure levels
- Pump is dirty
- Inlet filter is clogged (if equipped)

### Problem: Pump uses too much oil

#### Causes:

- Oil pump set too rich
- Leaving pump under vacuum between jobs

### Problem: Pump doesn't turn

#### Causes:

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

## **Problem: No vacuum**

### **Causes:**

- 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
- Inlet filter clogged (if equipped)

## **System Troubleshooting Locating the source of the trouble**

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

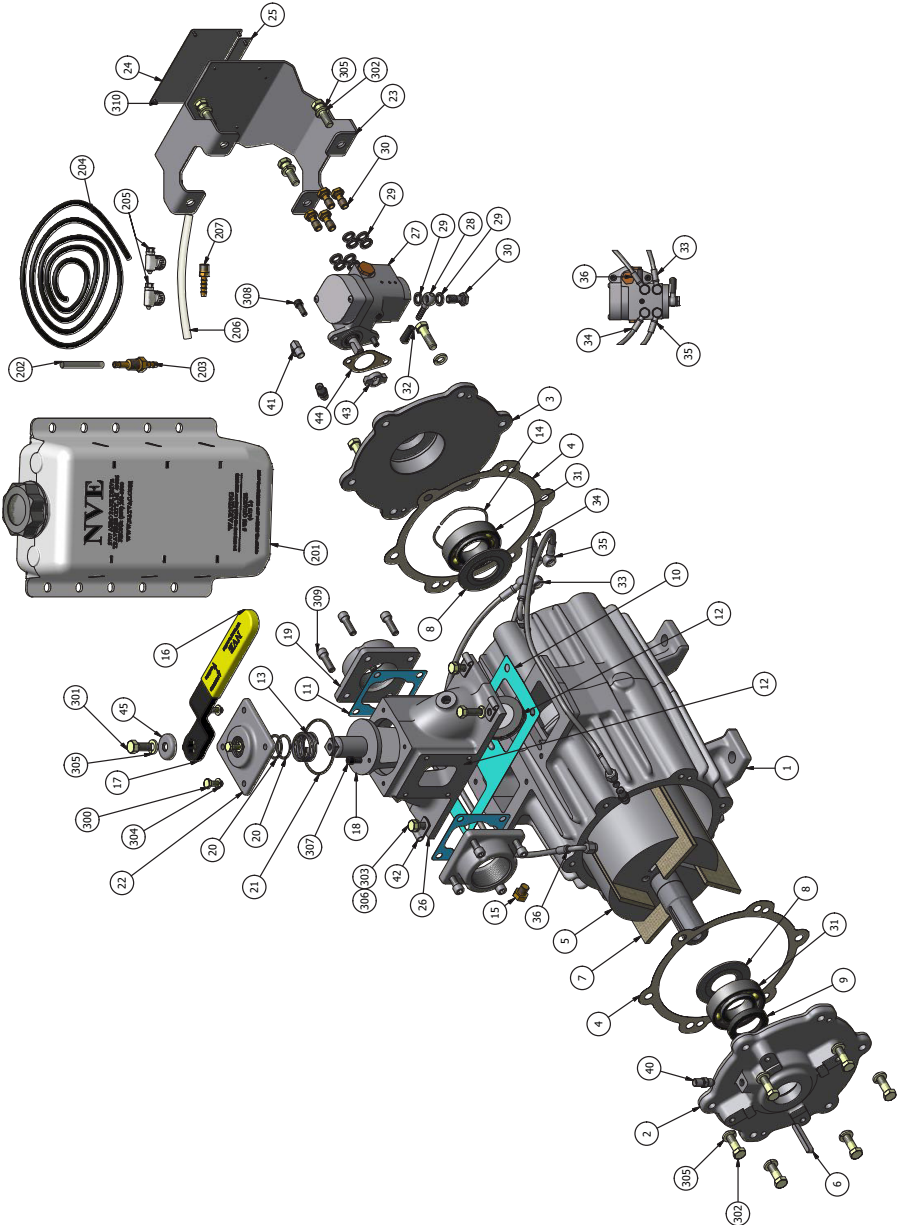
- Remove the suction and discharge hoses at the pump.
- Start the pump and run it in vacuum mode at its recommended RPM.
- Check the vacuum level at the pump inlet. The 304 Challenger in new condition will develop 27" Hg.
- If the pump checks out okay, check the vacuum level at the secondary, then the primary shutoff. Keep working your way back until you find the problem.

**For rebuild instructions please visit our website at [www.natvac.com](http://www.natvac.com) or call us at 800-253-5500.**

## Making a vacuum tester

1. Procure a flange to mount on your 4-way valve, a short 2" pipe nipple, a 2" pipe cap and a vacuum gauge.
2. Drill and tap a 1/4" NPT thread in the pipe cap.
3. Assemble the flange, nipple, pipe cap and vacuum gauge.
4. Remove a flange from the four-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.

# NVE 304 Challenger | Parts Diagram



# NVE 304 Challenger Series - Parts List

| ITEM | QTY | PART NUMBER                    | DESCRIPTION                                       |
|------|-----|--------------------------------|---|
| 1    | 1   | 120-001-001                    | HOUSING 304                                       |
| 2    | 1   | 120-003-006                    | ENDPLATE 304 DRIVE                                |
| 3    | 1   | 120-003-007                    | ENDPLATE 304 NON-DRIVE                            |
| 4    | 2   | 120-004-304                    | GASKET ENDPLATE 304                               |
| 5    | 1   | 120-005-003-D<br>120-005-003-S | ROTOR 304 CW<br>ROTOR 304 CCW                     |
| 6    | 1   | 120-006-184                    | KEwY .25" X .25" X 1.875"                         |
| 7    | 4   | 120-007-304                    | VANE 304  |
| 8    | 2   | 120-009-002                    | BEARING SPACER 304                                |
| 9    | 1   | 120-018-002                    | SEAL, 35 X 52 X 7 DOUBLE LIP                      |
| 10   | 1   | 120-039-001                    | GASKET MANIFOLD 304                               |
| 11   | 2   | 120-039-002                    | GASKET INTAKE MANIFOLD 304                        |
| 12   | 1   | 120-041-003                    | SWING CHECK 304                                   |
| 13   | 1   | 120-045-003                    | SPRING 4-WAY 304                                  |
| 14   | 1   | 120-045-004                    | SPRING WAVE BEARING 304                           |
| 15   | 1   | 120-058                        | PLUG BRASS HEX HEAD 1/8" NPT                      |
| 16   | 1   | 120-060-005                    | GRIP 3/8" HANDLE W/ LOGO                          |
| 17   | 1   | 120-060-006                    | HANDLE 3/8"                                       |
| 18   | 1   | 120-062-003                    | PLUG 304 MACHINED                                 |
| 19   | 2   | 120-063-304                    | FLANGE 4-WAY 2" NPT                               |
| 20   | 2   | 120-064-025                    | O-RING 2-120 VITON                                |
| 21   | 1   | 120-064-026                    | O-RING 2-144 VITON                                |
| 22   | 1   | 120-065-003                    | TOWER 304 MACHINED                                |
| 23   | 1   | 120-079-010                    | GUARD NVE OIL PUMP 304 W/ TAG MOUNT               |
| 24   | 1   | 120-105-304                    | NAME PLATE SS, 304                                |
| 25   | 1   | 120-107-001                    | SERIAL TAG SS                                     |
| 26   | 1   | 120-320-004                    | MANIFOLD 304 MACHINED                             |
| 27   | 1   | 123-000-004                    | OIL PUMP 4 PORT BIDIRECTIONAL                     |
| 28   | 1   | 123-408-017                    | BANJO ADAPTER TO 0.250" HB                        |
| 29   | 10  | 123-013-001                    | WASHER 3/8" SEALING NBR                           |
| 30   | 5   | 123-408-014                    | BANJO BOLT 1/8" BSPP                              |
| 31   | 2   | 310-AM55                       | BEARING 6207                                      |
| 32   | 1   | 320-083-011                    | CAP OIL PUMP FEED LINE FITTING                    |
| 33   | 1   | 320-407-017                    | OIL LINE -3 SST FEMALE JIC TO BANJO 8.5" (MAKE)   |
| 34   | 1   | 320-407-018                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 8.75" (MAKE)  |
| 35   | 1   | 320-407-019                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 20.25" (MAKE) |
| 36   | 1   | 320-407-020                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 23.75" (MAKE) |
| 37   | 1   | 320-407-021                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 22.75" (MAKE) |
| 38   | 1   | 320-407-022                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 11" (MAKE)    |
| 39   | 1   | 320-407-023                    | OIL LINE -3 SST 90 DEG JIC TO BANJO 22.25"        |
| 40   | 3   | 320-408-016                    | FITTING STR -3 MJIC X 1/8 MNPT                    |
| 41   | 1   | 320-408-017                    | FITTING ELBOW -3 MJIC X 1/8 MNPT                  |
| 42   | 4   | 320-409-003                    | P-CLIP, OIL LINE 1/4" X 5/16                      |

## NVE 304 Challenger Series - Parts Continued

| ITEM | QTY  | PART NUMBER               | DESCRIPTION                             |
|------|------|---------------------------|---|
| 43   | 1    | 320-LF8                   | DRIVE TAB                               |
| 44   | 1    | 320-R31                   | GASKET, OIL PUMP                        |
| 45   | 1    | 412-020-001               | WASHER, CUP 4-WAY                       |
| 201  | 1    | 320-082-001               | OIL TANK, 5QT, W/ LOGO                  |
| 202  | 1    | 320-083-009               | OIL TANK FILTER, 100 MESH               |
| 203  | 1    | 320-083-010 W/HB          | FILTER FITTING, OIL TANK 1/4 NPT        |
| 204  | 5 FT | 320-407-003               | OIL LINE, BLK 1/4" ID 30R7              |
| 205  | 2    | 416-025-1WC               | CLAMP, WORM, 1/4" DIA                   |
| 206  | 6 IN | 320-R102                  | OIL LINE, 3/8" X 1/4" ID X 6" LG        |
| 207  | 1    | 310-LP5                   | HOSE BARB, 1/4" X 1/8" NPT STRAIGHT     |
| 300  | 4    | HHCS - 1/4-20 UNC X 0.75  | HEX HEAD CAP SCREW - 1/4-20 UNC X 0.75  |
| 301  | 1    | HHCS - 3/8-16 UNC X 0.75  | HEX HEAD CAP SCREW - 3/8-16 UNC X 0.75  |
| 302  | 12   | HHCS - 3/8-16 UNC X 1.25  | HEX HEAD CAP SCREW - 3/8-16 UNC X 1.25  |
| 303  | 4    | HHCS - 5/16-18 UNC x 1.00 | HEX HEAD CAP SCREW - 5/16-18 UNC x 1.00 |
| 304  | 4    | LW - 1/4                  | LOCK WASHER, 1/4"                       |
| 305  | 13   | LW - 3/8                  | LOCK WASHER, 3/8"                       |
| 306  | 4    | LW - 5/16                 | LOCK WASHER, 5/16"                      |
| 307  | 1    | SHCS - 1/4-20 UNC X 0.50  | SHCS - 1/4-20 UNC X 0.50                |
| 308  | 2    | SHCS - 1/4-20 UNC X 0.75  | SOCKET HEAD CAP SCREW 1/4" - 20 X 3/4"  |
| 309  | 8    | SHCS - 5/16-18 UNC X 1    | SHCS - 5/16-18 UNC X 1                  |
| 310  | 6    | RVT 3/32 D X 1/4L SS      | BLIND RIVET, 3/32 DIA X 1/4 GRIP, SS    |

## Notes

[illegible]





# Vane Replacement

## Challenger Series Rotary Vane Vacuum Pumps



# VANE REPLACEMENT

## 304 Challenger

304 Repair Kits

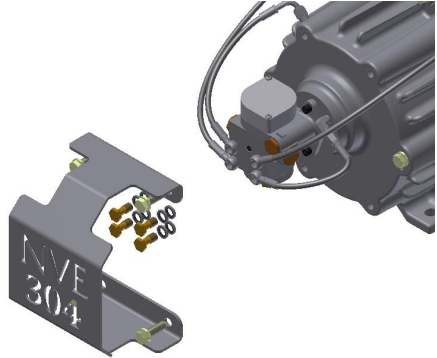
Part #115-304-0 (with Bearings)

Part #115-304-0B (without Bearings)

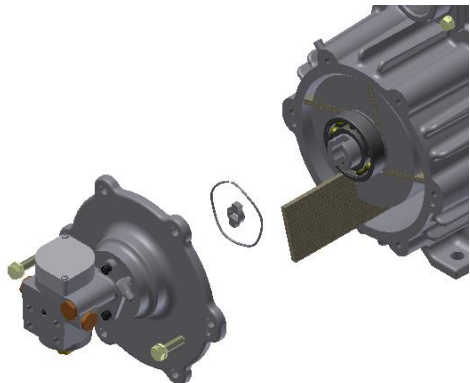


1. Remove oil pump guard by removing (4) 3/8" bolts.

2. Remove (4) banjo bolts and (8) seal washers holding the oil lines to the oil pump (note the location of the oil lines on the oil pump). *Note: Also remove the oil feed line on the bottom of the oil pump if it is still connected.*



3. Remove the remaining (2) 3/8" bolts holding the endplate to the housing. Pull the endplate off of the rotor and housing. *Note: Keep track of the oil pump drive tab that is seated in the non drive shaft of the rotor and the wave spring that is seated in the non drive endplate. The oil pump does not need to be removed from the endplate.*



4. Remove the (4) vanes. *Note: The rotor will need to be rotated so that each vane will slide out from the bottom of the rotor.*

## Vane Replacement Instructions Continued

5. Prepare each of the (4) new vanes (122-000-002) by coating them evenly with ISO 68 Turbine Oil.
6. Insert the new vanes into the rotor.
7. Replace endplate gasket (120-004-304). A thin coat of oil will help hold it in place on the housing.
8. Reinstall the non drive end plate over the rotor shaft.  
(make sure the wave spring is in the endplate and the oilpump drive tab is in the end of the rotor.)
9. Use (2) 1/4" pins to align the endplate with the housing.
10. Install the (2) 3/8" bolts (along with the brass serial tag) just above the pin locations and retighten.
11. Reattach the oil lines to the oil pump using the banjo bolts and seal washers.
12. Reinstall the oil pump guard and the remaining (4) 3/8" bolts.
13. Remove the 1/4" pins after all of the bolts have been tightened down.
14. Make sure the rotor spins freely in the housing.



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