

# INSTRUCTION MANUAL

RNN SERIES

DIFFERENTIALLY PUMPED ROTARY SEALS

Version 2.3

SERIAL # \_\_\_\_\_

03.2024 231 B Otto Street - Port Townsend, WA 98368 - (360) 385 - 7707

#### **1.0 INTRODUCTION**

- Product Description 1.1
- 1.2 Construction
  1.3 Leaks/Pressure Bursts
- Receiving, Inspection and Unpacking 1.4

#### 2.0 INSTALLATION

- Orientation and Load 2.1
- Fastening/Gaskets 2.2
- 2.3 Bolt Sizes/Lubrication
- 2.4 Pump Requirements and Orientation
- 2.5 Pump type & Speed Requirement
- 2.6 **Pump Connections**
- 2.7 **Optimal Differential Pumping**

#### **3.0 OPERATION**

- 3.1 Pumping Sequence
- 3.2 Rotation
- 3.3 Torque
- 3.4 Vernier

#### 4.0 BAKEOUT

#### **5.0 MAINTENANCE**

- 5.1 Field Disassembly Procedure
- 5.2 Platform Performance Testing
- 5.3 Lubrication
- 5.4 Motorized & Fine Adjust Operation

#### 6.0 PACKING FOR SHIPMENT OR STORAGE

#### 7.0 PARTS AND SERVICE

- 7.1 Parts
- 7.2 RNN Factory Overhaul

#### **8.0 ACCESSORIES**

#### APPENDIX

- **RNN** Assembly Drawing A.
- B. Document Control and Approval

## 1.0 INTRODUCTION

### 1.1 PRODUCT DESCRIPTION

The RNN SERIES of differentially pumped rotating seals are ultra-high vacuum compatible devices. When properly installed and pumped, systems have achieved base pressures of less than 2 x10 -11 Torr. They may be used in any vacuum system where rotational motion is desired.

#### 1.2 CONSTRUCTION

The metal components exposed to vacuum are type 304 stainless steel. There are two pumping chambers, isolated by three spring loaded Teflon-graphite seals. The chambers are pumped through the 1.33" mini-ConFlat type flanged ports. The internal sealing surfaces are specially prepared by a proprietary manufacturing process.

Linear and lateral alignments are maintained by a series of special bearing assemblies. The bearings are made of hardened carbon steel.

#### WARNING

These bearings will corrode. Do not allow moisture to condense on or in the unit. Do not allow LN2 to chill the unit. If the internal probe is a cryogenic unit, consider mounting heating units to protect the seal. Whenever the unit is exposed to moisture, it must be dis- assembled, cleaned and re-lubricated.

#### 1.3 LEAKS/PRESSURE BURSTS

<u>THIS DEVICE IS A CONTROLLED LEAK</u>. When properly installed and with suitable differential pumping, this RNN seal will show an effective leak rate of between 1 x 10-9 and 8 x 10-9 std. cc He/sec. Pressure bursts will be observed as it is rotated. This is normal. When correctly pumping on both pumping ports, the typical observed pressure burst will be 0.5 to 1.0 decade., with a system base pressure of 2 x 10 -(10) Torr. Typical system base pressure recovery times range from 15 to 50 seconds, depending upon the system pump speed. The recovery time may vary depending upon the system condition and pumps used. A correctly installed and pumped platform will not indicate a leak when bag checked for 30 seconds with He, with a mass spectrograph leak detector with a leak sensitivity to 5 x 10-10 std. cc /sec He.

#### **CAUTION**

Please read and follow the instructions to ensure the seal will provide years of service.

#### 1.4 RECEIVING, INSPECTION AND UNPACKING

Most RNN platforms are shipped with custom foam-in-place packing. We have found this to be the best system to provide protection for shipment. The foam is separated approximately halfway inside the carton with thin plastic. The unit is also double bagged in polyethylene. This is necessary to assure no packing material or foreign matter is able to contaminate the unit in transit.

Upon arrival of the shipment, inspect the outside of the box(s) for damage such as crushed corners and tears which would indicate the parcel was mishandled in shipping. If damage is noted, immediately notify the shipping company of the damage and that there may be hidden damage.

Unpack the equipment and check the contents to be sure everything shown on the packing list is identified and located. Optional equipment may be attached to the main assembly. If something later on is found missing it is difficult to establish responsibility.

Give particular attention to small parts such as cables and/or spare gaskets as they can be overlooked in the unpacking process and are then difficult to locate during the installation process.

It is always good to save the packing material until the equipment is fully installed. Should anything be missing, the original packing can be checked.

#### WARNING

DO NOT THREAD THE STUDS INTO ROTATING FLANGE MORE THAN 1.25" DEEP. SEE "FASTNENINGS" SECTION, below.

#### WARNING

Do not lift the RNN by the external pumping manifolds (rings of 1/2" OD tubing about the RNN). Damage will occur to the unit.

## 2.0 INSTALLATION

The RNN is shipped clean and ready to install. Remove the protective polyethylene bags. Prior to shipment, the RNN is leak checked. A certificate indicating the leak rate is included with the RNN.

Be certain no foreign residue or particles adhere to the device or the sealing flange knife edges. As a precaution, it is recommended the flanges be wiped with a lint free cloth prior to installation.

#### WARNING:

Shipping vibration can loosen screws. The user must check to verify the external screw fasteners have not backed off on the unit.

#### IMPORTANT

#### <u>WARNING</u>

NEVER ALLOW THE TWO PUMPING PORTS LOCATED ON THE PERIMETER TO REMAIN UNCOVERED. This device is sensitive to foreign matter entering the sealing system. The seal effectiveness and useful life are affected by the cleanliness of its environment.

Particles can migrate through the pumping ports, contaminating the chambers, and this can cause seal failure.

At all times, do one of the following:

1) Connect the ports to suitable pumps

2) Cover the ports with the plastic caps provided (always remove during

bakeout and replace with materials which will not melt)

3) Cover with clean foil or other suitable material.

#### 2.1 ORIENTATION and LOAD

The RNN will accommodate up to a 50 lb. load in a vertical orientation. Consult the factory for loads greater than 50 lbs., inverted position, and/or horizontal cantilever operation.

#### 2.2 FASTENING/GASKETS

Install the RNN on your chamber/manipulator/instrument as you would any other wire seal flange. Use standard, 0.080" thick, flat copper gaskets. Recommended bolt sizes are in the table below. These recommended bolt lengths are for standard thickness ConFlat type flanges.

**TOP FLANGE** (rotating, with worm wheel)

The bolt should extend 0.6" to 1.25" into the RNN when the wire seal is fully compressed. This distance is measured from the flange surface that is tapped.

BOTTOM FLANGE (non-rotating, with pump outs) The bolt should extend 0.54" to 0.66" into the RNN when the wire seal is fully compressed. This distance is measured from the flange surface that is tapped. DO NOT EXCEED THESE DISTANCES!

Use an anti-seize lubricant to minimize the chance of galling the threads.

## PUMP REQUIREMENTS AND ORIENTATION

#### PUMPING PORTS/STAGES

There are two ports for pumping the RNN. They are located about the circumference and are terminated with mini (1.33") ConFlat flanges.

The ports are etched with the labels "Ist stage" and "2nd stage". The markings are found on the mini flange perimeters. Remove the protective caps if you have not done so already.

#### HOWEVER, NEVER ALLOW THE TWO PUMPING PORTS LOCATED ON THE PERIMETER TO REMAIN UNCOVERED, PARTICULATE CONTAMINATION MAY OCCUR, CAUSING SEAL FAILURE.

The 1st stage port is for the roughing chamber, the 2nd stage port is for the high vacuum chamber, of the RNN.

#### PUMP TYPE AND SPEED REQUIREMENTS

CONNECT A ROUGHING PUMP to the FIRST STAGE PORT FLANGE. The roughing system must have a pumping speed of 2.5 cfm or greater AT THE PORT FLANGE and be capable of achieving a vacuum base pressure of at least 10 microns, MEASURED AT THE RNN PUMPING PORT FLANGE. The platform should be protected from back streaming oil or other contaminants.

CONNECT A HIGH VACUUM PUMP to the SECOND STAGE PORT FLANGE. The high vacuum system should have a pumping speed of 11 l/s or greater AT THE PORT FLANGE and be capable of achieving a vacuum base pressure of at least 5 x 10 -(8) Torr, MEASURED AT THE RNN PUMPING PORT FLANGE. A smaller pump may be used (i.e., 2 l/s), but you may find this inadequate over the lifetime of the seal set. If a smaller pump is used, the same vacuum MUST be achieved.

Care must be taken to ensure that significant pump speed losses due to conductance restrictions do not occur by using long lengths of small diameter tubing to connect suitable pumps.

#### USING ONE PUMP STAGE ONLY

IF YOU WISH TO USE ONLY ONE PUMP STAGE, CAP THE FIRST STAGE AND CONNECT THE PUMP TO THE 2ND STAGE PORT.

Using one pump or no pump on the RNN will cause the system base pressure to degrade and limit the ultimate system base pressure. In addition, system recovery time from the pressure burst observed during RNN rotation will increase. The effective leak exhibited by the RNN will significantly increase.

## **OPERATION**

#### PUMPING SEQUENCE

The user has the option of roughing and then starting the high vacuum pumps for the RNN, and then roughing and starting main system high vacuum pumps, or vice versa.

In our experience, we have found it easier to achieve crossover pressures in the main system if the RNN pumps are started first.

RNN expected pressures: First stage: 1 to 10 microns Second stage: 10<sup>-6</sup> to 10<sup>-8</sup> Torr

#### ROTATION

The RNN may be rotated continuously in either direction, the direction of rotation may be reversed at any time.

THIS DEVICE IS A CONTROLLED LEAK. Pressure bursts may be observed as it is rotated, this is normal. When pumping on both pumping ports, the typical pressure burst observed, with a system base pressure of 2 x 10 -(10) Torr, will be 0.5 to 1.0 decade. Typical system base pressure recovery times range from 15 to 50 seconds. The recovery time may vary depending upon the system condition and pumps used.

**TORQUE** -Listed below are approximate values of required torque for rotation. **The user must keep the worm and worm wheel well lubricated**.

RNN1800/MD 35-50ft. lbs. on the worm drive

#### VERNIER

No angle scale or vernier is supplied with this unit.

#### BAKEOUT

Bakeout in normal fashion, but NEVER exceed 150 degrees C stage temperature during bakeout. Higher temperatures will damage the seals. Monitor seal temperature during bakeout.

NEVER ROTATE THE SEAL DURING BAKEOUT OR WHEN IT IS ABOVE AMBIENT TEMPERATURE. ALWAYS PUMP THE RNN THROUGH THE PORTS DURING BAKEOUT. NEVER ALLOW THE PORTS TO REMAIN UNCOVERED, PARTICULATE CONTAMINATION MAY OCCUR, CAUSING SEAL FAILURE.

#### WARNING

The lubricant in this unit has been tested to 230 C. We recommend limiting the temperature of the lubricant to 200 C or less.

The manufacturer warning states <u>"...avoid inhalation of decomposition</u> products formed above 300C." We believe this material may give off toxic gases at elevated temperatures.

#### NEVER run uncontrolled bake-outs

All motors and limit switches/ position indicators must be removed during bakeout. The motor/worm drive unit should be removed as a unit. It is attached with 3 x 1/2-20 SS hex head cap screws.

## MAINTENANCE

No regular maintenance involving dis-assembly is required for normal operation. Occasional lubrication of the fine adjust/motor drive gear, worm and bearings/bushings is required, depending on operational environment.

The platform's main bearings are hardened carbon steel, and susceptible to corrosion. Cleaning and re-lubrication may be required from time to time, depending on the operational environment.

Service requiring dis-assembly is needed if:

- A. Reduced sealing performance is observed.
- B. Greater torque is required for operation.
- C. The unit has been exposed to high humidity or cryogenic chilling (condensing) environment.

Seal wear is not normally a problem when used as designed as a positioning device. High use or continuous operation will reduce the service life of the seals.

We recommend the RNN series be returned to the factory for service involving dis-assembly. The main reason for this policy is the sensitivity of RNN units to <u>contamination</u> and <u>mechanical damage</u> of interior components and surfaces.

These units can be successfully serviced in the field if a clean work environment is available and adequate skill and care are used. The equipment warranty does not cover units which, in the sole judgment of Thermionics, may have been damaged during attempted customer repair.

#### Dis-assembly:

Remove the RNN from use and cap pumpout ports. Remove worm drive gear and motor/fine adjust unit, if mounted. Take care to note the spacers used in mounting this equipment.

Thoroughly clean all exposed surfaces with alcohol and "LINT FREE" wipes. Move unit to a clean work area. Use a clean hood or laminar flow work area if possible.

Remove angle scale and then the worm wheel.

Remove perimeter bolts/screws from the clamp ring and remove ring.

The two flanges can now be separated. Special care needs to be taken with

the bearings. Protect sealing surfaces from mechanical damage at all times.

Remove and clean all interior components. Use alcohol and "LINT FREE" wipes. Inspect **actual** seal surfaces and seals.

Clean and re-lubricate bearings with the proper lubricant.

#### Re-assembly:

Replace components, taking special care to clean sealing surfaces. Install clamp ring and lightly tighten ring. **IMPORTANT....** tighten using a balanced "star" sequence. Blank off and pump on platform (< 1 torr). Re-tighten clamp ring screws.

Re-install motor drive and rotate 20 revolutions.

Test unit.

#### PLATFORM PERFORMANCE TESTING:

1)Install platform per specifications with mass spectrograph leak detector on the UHV volume. Bag check for 30 seconds. No leak should be observed with a sensitivity of 5 x 10-10 std. cc He/sec.

2)Install platform on leak detector and pump on second stage to between 1 and 5 microns. transfer 1 atm. of He into the first pumping stage. A correctly operating platform will display a leak rate of between 1 and 8 x 10-9 std. cc He/sec, depending on wear.

3)The torque required to rotate the platform under vacuum should be less than or equal to the torque values indicated earlier in this manual.

#### <u>Lubrication</u>

The bearings are lubricated with Thermionics GHT high temperature lubricant. The user may need to add more lubricant from time to time, depending on the frequency and temperature of bakeouts and operating environment.

The seals have a temperature limit of 150 C. (See "BAKEOUT" section). This lubricant has a temperature limit of 200 C.

#### WARNING

This lubricant has been tested to 230 C. We recommend limiting the temperature of the lubricant to 200 C or less.

The manufacturer warning states <u>"... avoid inhalation of decomposition</u> products formed above 300C." We believe this material may give off toxic gases at elevated temperatures.

Do not run uncontrolled bake-outs!

We at Thermionics have a large stake in your new equipment operating up to your expectations. If you experience difficulty with this unit, or any other aspect of your endeavor where our experience might be of value, we want to hear from you. We want to be part of your success.

END