

For Further Information Contact

Heason Technologies Group Ltd
Tel: +44(0)1403 755800
Fax: +44(0)1403 755810
Email: sales@heason.com



Freephone 0800 374903 www.heason.com

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Application Note 3

Rotary Application of Nanomotion Motors

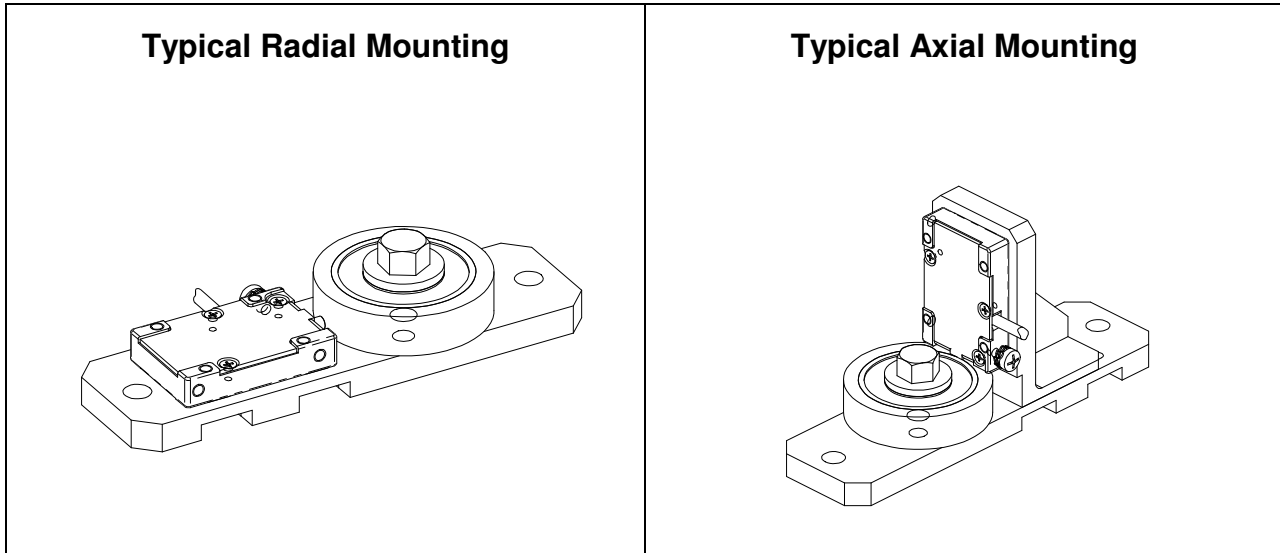
Introduction

Typical Nanomotion user manuals and installation guides refer mainly to the linear application of the motors. Therefore, detailed instructions for preparations and practical considerations for linear applications can be found within Nanomotion installation guides.

This application note is designed to focus on assisting the user to prepare and build a rotary application utilizing Nanomotion motors.

General

There are two options for using Nanomotion motors within rotary applications: radial or axial. Radial mounting refers to the motor tip running on the circumference/outside diameter of a ceramic ring. Axial mounting refers to the motor tip running on the flat face of a ring or disk.



In general, while performance is comparable, axial mounting is more forgiving of concentricity errors in the bearing structure and the finger tip maintains a flat contact pattern. Mounting in a radial manner will cause the finger tip to take a slightly curved shape during the conditioning process.



This document will refer to the considerations of each option and to the advantages inherent in each of them.

For optimal motor and system performance, it is recommended to use the ceramic drive rings and disks provided by Nanomotion. These drive rings and disks have been specifically designed to work with Nanomotion motors for maximum system performance. The ceramic disks are designed for use in axial applications, and the ceramic rings may be provided for either radial or axial applications.

Nanomotion offers a wide variety of standard ceramic rings and disks, as defined in the product catalog. In addition to the standard rings and disks, custom sizes are available upon request.

Considerations in Mounting Nanomotion Motors Radially and Axially

Bearing Selection

Bearing selection and mounting is critical to the level of intended performance and life. Nanomotion motors will exert a normal force into the ceramic plate that is 5 times greater than the driving force. Additionally, the acceleration force of the motor can reach 2 to 3 times the normal force. Based on this is important to select a bearing that has (or can be) preloaded.

In a preloaded condition, the bearing should yield a stiffness of 50N/μm. Acceptable bearing designs are:

- Precision crossed roller rotary bearings
- Duplex angular contact bearings (different contact angles will yield different stiffness values)
- Dual deep groove radial ball bearings

In the bearing selection process, attention should be paid to the stiffness in the direction of the motor's normal force as well as the load. If the motor force will overcome the preload or stiffness of the bearing, vibration will be introduced into the system

Radial Application Considerations

Radial applications refer to the radial mounting of a motor against the bearing and shaft. This type of mounting is applicable for single tip or dual tip motors, where there is only one column of ceramic tips. Four tips and eight tip motors have two columns of tips, and therefore are not suitable for radial mounting. Radial use of Nanomotion motors is recommended only for limited duty cycle systems and for a limited angle of rotation.

As is the case with all Nanomotion motors, multiple motors can be used. In so doing, the motors must be evenly spread along the circumference to reduce the dynamic load on the bearing and increase the balance.



For this type of application, the main consideration is the concentricity of rotation and the concentric alignment to the bearing OD. Most of the rings are supplied with a concentricity of 20μ between the outer and inner diameters. After the bonding of the ring, the total run-out measured on the ring perimeter should be less than 40μ for optimal performance of the motor and for minimal wear of the ring.

Bonding of the ring to the shaft or bearing should be performed by applying a small amount of anaerobic adhesive, such as Loctite 638 or compatible to the inner diameter of the ring before sliding it on the shaft. It is also optional to use a smaller diameter shaft, in which case an interface plate should be mounted between the shaft and the ceramic disk.

Attention should be paid to the mounting of the motor so that the motor tip(s) are pointed radially to the rotary axis. The motor tip(s) are not positioned in the center of the motor, please refer to the motor interface layout for further information about dimensions.

In mounting the motor, consideration must be taken to insure a 1.8mm gap between the motor and the ring surface. This gap can be maintained by using the spacer supplied with the motor, and placing it close to the motor tip from each side.

The outer diameter of the shaft should be equal to the inner diameter of the ring. The shaft diameter tolerance should be h6. The recommended shaft material is Stainless Steel

It is also recommended to place the motor in the same plane as the bearing. The ceramic ring should be backed against the shaft all along the travel sector.

Axial Application Considerations

Axial applications refer to the axial mounting of the motor against the bearing and shaft. Axial mounting is suitable for all Nanomotion motors and is recommended for relatively large diameters when the delta between the radius of work of the inner tip versus the outer tip is less than 8%. The HR-1 can also operate on small radii.

For axial applications, the ring and disk bonding procedure is similar to the procedure for bonding linear alumina plates, as referred to in the installation guide of each motor (section 2.2.1). The ceramic disk should be backed to a wall thick enough to assure stiffness during the motor operation. The ceramic disk is mounted using double sided tape. Here again, multiple motors can be used. It is recommended to mount the motors symmetrically in order to reduce the dynamic load on the bearing and increase the balance.



Comparison Between Options

1. Axial mounting is preferred to optimize motor performance as the motor's tip will take a predictable shape and is less susceptible to alignment issues.
2. Radial mounting is preferred when a low profile, small foot print system is required.

Summary

Nanomotion motors have been implemented in many successful rotary applications. Using sound design practices and proper component selection is essential to its implementation and performance. Using Nanomotion motors helps to maintain a low profile and compact construction by eliminating the worm gear set, shaft coupling and rotary motor.

Contact Information:

Nanomotion Ltd. Headquarters

Nanomotion Ltd.

PO Box 223

Yokneam, Israel 20692.

Tel: +972-4-9590862

Fax: +972-4-9590995.

Web site: www.nanomotion.com

Email: nano@nanomotion.com

Nanomotion Inc. (US) Headquarters

Nanomotion Inc

1 Comac Loop, Ste. 14B2

Ronkonkoma, NY 11779

Tel: (800)821-6266

Fax: (631)585-1947

Web site: www.nanomotion.com

Email: nanous@nanomotion.com