Congratulations! You have purchased a precision vacuum positioning device from Nor-Cal Products. This unit is capable of many years of use with minimal care and maintenance. This manual is a tool to aid you in obtaining this service. We at Nor-Cal Products encourage your comments and suggestions on this manual.

Product Description

The EM 200 series precision manipulators are a family of aluminum units which offer exceptional value per dollar. These units differ from their 100 series counterparts in the construction of the X Y Z travel stage. The 200 series utilize thick aluminum to mount the linear bearings, and feature wider spacing between all linear bearings. This allows the neck assembly to be removed, reducing the flange-to-flange distance for a given Z stroke. This change also allows more rigid micrometer mounting, simpler micrometer-stage pre-load, and simpler motor drive retrofit in the field. This series is available with 1.39” or 1.88” ID bellows. Gearbox drive is standard, but micrometer Z drive is available on the standard 2” Z stroke model at no extra cost. The EM series utilizes 0.5” OD stainless steel Z guide rods and 0.375” OD X & Y rods. The bearings are all stainless.

The EM Series instruments have a 20# equipment payload for vertical operation. For applications which need different payloads and/or other operational orientations, please consult the factory. See “installation” section below for complete payload considerations.

A full compliment of options are available... many suitable for field retrofit. This allows the unit to be modified to suit changing requirements as the role for the manipulator changes through its life. These options include tilt and an extended support shaft. Motor drive is available, both DC stepping and AC synchronous.

Unpacking

EM manipulators are shipped in custom foam-in-place packing. We have found this the only system to provide adequate protection for shipment. The foam is separated approximately half way inside the crate with thin blue plastic. The bellows assembly is shipped in place protected by a cardboard or thick paper wrap about the bellows. This wrap should be left in place until the manipulator is fully mounted. We strongly recommend the packing be saved for possible future shipment or equipment storage.

Installation

******** WARNING ********
Shipping vibration can loosen screws. The user must check to verify the screw fasteners have not backed off on the unit during shipment. This is critical for safe operation.

**********THIS IS IMPORTANT ************
The standard EM Manipulator can be installed directly from the crate. As usual, care should be exercised to protect the knife seal edge. The standard unit mounts to a 6” OD flange. (other flanges from 1.33 to 8” OD are available). Proper tightening technique should be observed whenever tightening a metal sealed flange. We recommend a small quantity of high temperature anti-seize lubricant be used on all mounting bolts. This is especially important if the unit will be subject to bake-outs.

******** WARNING ********
It is necessary, especially on long stroke manipulators, to have an axis rod or tube down the axis of the Z travel. This will keep the bellows from "springing" out when the pressure is returned to atmosphere (usually when the unit is near its most compressed mode). This function is usually satisfied by a “theta” rotation shaft or support tube. Damage to the equipment can occur if this precaution is not observed.
PAYLOAD CONSIDERATIONS
The EMT Series instruments have a 20# equipment payload for standard vertical (NOT inverted) operation. This payload is based upon the total equipment load on the traveling flange with the base flange securely attached to the customer’s chamber, providing a strong and stable mounting. The payload center of gravity must be within the diameter of the traveling flange OD (Normally 2.75”) and within 8” of the flange face.

Special models are available for special mounting and payload requirements. If your unit is such a special one, verify the unit you have is correct for the application. If not, consult the factory if your application requires:
- Payload greater than 20#
- Center of gravity beyond above limits
- Mounting orientation other than standard vertical (angled, horizontal, inverted, etc.)

Adjustments
Your EM manipulator is correctly adjusted prior to shipment. This section is included to aid the user in making changes in these settings if he so desires.

LINEAR BEARINGS: The linear bearings are not adjustable on the EM manipulators.

TRAVEL LIMIT STOP COLLARS: Some models come equipped with stop collars clamped to the guide rods or the Z axis lead screw. These stops limit travel to the specifications of the device, such that the bellows is not extended beyond its operating parameters. If a need arises to move these stops, measure their locations prior to their removal, and replace them accurately upon re-assembly. Over extension of the bellows will cause premature failure of the bellows and/or mechanical damage to the manipulator or other equipment.

MICROMETERS: Micrometer play is affected by two micrometer adjustments.

1. Micrometer thread engagement is adjustable by removing the micrometer handle and tightening or loosening a knurled nut on the barrel. This normally does not need to be adjusted in the field.

2. The micrometer to stage coupling is adjustable via the approx. 1” diameter knurled cylinder around the end of the micrometer spindle. At the end of the micrometer spindle, under the 1” dia knurled cylinder, is a small, chrome plated, dome anvil. This must be finger tight to properly load onto the cross shaft. These are properly adjusted at the factory, and should not require further adjustment. When re-installing the micrometer/micrometer block assemblies, the following procedure will assure the best alignment.

   1. Install and snug the two 1/4-20 SHCS. Back each screw off 1/8 to 1/4 turn.
   2. Assemble knurled collar/bearing at end of micrometer spindle into receiver on guide rod. Tighten firmly finger tight. This will align the micrometer assembly.
   3. Tighten the two 1/4-20 SHCS. Back off the knurled adjustment collar to a light tension, without axial play. Test operation for smoothness.

Z DRIVE: The two main bearings in the gearbox assembly are pre-loaded at assembly via the main drive gear. This is locked into place by the main setscrew in shear. Shimming should be used if adjustment is ever required. The spiral drive gear set is adjusted by positioning of the upper gearbox housing before locking down the two 1/4-20 SHCS mounting bolts. A slight force toward engagement is usually best to minimize gear cogging. If smooth Z drive cranking is not obtained under load, this placement should be repeated. This alignment should not be disturbed unless necessary.

BELLOWS ASSEMBLY REMOVAL: The bellows assembly is held by its flanges in the traveling and base stages. The base is held by socket button head bolts. Four socket head cap screws (SHCS) installed at 45 degrees to the X & Y axis hold the top flange. The manipulator should be placed on a clear work surface, and the Z drive adjusted to approximately one half travel. With a bellows protector wrapping in position about the bellows, the base bolts can be removed, leaving one installed loosely for control. The SHCSs should then be un-threaded from the flange. The X & Y Stages may need to be moved to gain access to the pins. The bellows/flange assembly then can slide along the Z axis, out of the driving stages.

RE-ASSEMBLY: One must be careful not to over flex the bellows during re-assembly. This is especially true of the longer stroke units. When re-fitting the top flange to the X-Y stage, the SHCSs should be securely tightened into place. One must position the 2.75” OD flange both in orientation and axial position to align these screws. THEY MUST CORRECTLY ENGAGE THE TAPERED HOLES IN THE FLANGE PERIMETER.

Information in this manual is subject to change without notice.
Lubrication

All exterior bearings, micrometers, gears, gearboxes, and lead screws are lubricated with GHT-2 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.

***********WARNING***********

Additional lubricant must be added to the lead screw as the use and environment requires. The standard lifting mechanism is a bronze acme thread on a burnished steel acme lead screw. This is a sliding contact, requiring lubrication. Equipment overloading, heavy use, high temperature bakeouts, environmental conditions, etc. can and will remove the lubricant from this interface. THIS WILL CAUSE PREMATURE WEAR. If this is continued to an extreme, the nut will fail and allow the stage to suddenly drop. THIS SITUATION IS DANGEROUS TO EQUIPMENT AND PERSONNEL AND MUST BE AVOIDED. Inspect this mechanism and relubricate as needed. The mechanism should have 0.002" to 0.006" vertical (axial) backlash maximum. If more is detected, consult the factory for suitable repair.

************** WARNING *************

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

Avoid inhalation of decomposition products formed above 300C.
This material may give off toxic gasses at elevated temperatures.

Bakeout procedure

We recommend limiting the temperature of the device (and the lubricant) to a maximum bakeout temperature of 200 C. Bakeouts of long duration (12 hours or more) should be limited to lower temperatures. We recommend 180 C maximum for long bakeouts.

Our bakeout temperatures are conservative. We find they lead to long service life and high reliability. Tear-down and re-lubrication is held to a minimum. Operation outside these parameters cannot be guaranteed.

SUMMARY:

The EM Manipulator can be baked with standard UHV bakeout procedures.

See safety warnings under “Lubrication”.
DO NOT RUN UNCONTROLLED BAKEOUTS OR BAKEOUTS OVER 200 C

It is not necessary to remove the micrometers (on specials only, if any) prior to standard bakeout. For high temperature bake-out, or repeated bake-outs of long duration, we do recommend micrometer removal.

All motors and limit switches/position indicators must be removed during bakeout.

We recommend limiting the temperature of the lubricant and the bakeout temperature to 200 C or less.

See safety warnings under “Lubrication”.

Do not run uncontrolled bakeouts or bakeouts approaching 300 C

MICROMETER REMOVAL: The micrometers should be removed prior to long term bakeout.

1. Position both X & Y micrometers at mid travel.
2. The pre-load coupling to the stage removes by simply un-threading the knurled collar. The same procedure is used on both X & Y axis micrometers. Check under “Adjustments” for correct instructions for reassembly after bakeout.
3. The micrometers are bolted to the frames with two 1/4-20 SHCS each. On large drum mics, it may be necessary to loosen a set screw and slide the inner drum into the micrometer handle in order to remove the socket head mounting screws. Remove each micrometer.

For motorized models, see under “Motorized operation” for removal instructions for bakeout. All motors and limit switches/position indicators must be removed during bakeout.

4. The Z drive gearbox should be locked in place prior to bakeout.

The design of the manipulator allows room around the bellows for thermal insulation, making possible greater bellows temperatures while not exceeding our recommendations. Under no condition should heater tapes be used directly on a welded bellows. An electrical short would not only create a safety hazard, but possibly destroy the vacuum integrity of the thin bellows wall.

5. After bake and cool-down, re-attach micrometers.

NOTE: Micrometer re-installation

When re-installing the micrometer/micrometer block assemblies, the following procedure will assure the best alignment.

a. Install and snug the two 1/4-20 SHCS. Back each screw off 1/8 to 1/4 turn.

b. Assemble knurled collar/bearing at end of micrometer spindle into receiver on guide rod. Tighten firmly finger tight. This will align the micrometer assembly.

c. Tighten the two 1/4-20 SHCS. Back off the knurled adjustment collar to a light tension, without axial play. Test operation for smoothness.
Motorized operation

All axis of your manipulator can be motorized. Retrofit kits are available for field installation. Please consult the factory for further information. All motors and limit switches/position indicators must be removed before bakeout.

REMOVE AND ADJUSTMENT PROCEDURES

Z drive:
The Z drive motor is removed by first releasing the clamp screw on the drive shaft. This screw is accessed through a hole in the aluminum spacer between the motor mounting flange and the gearbox. Once this coupling is released, the four socket head screws holding the motor can be removed and then the motor.

X & Y Drive:
Micrometer Drive:
Motor removal is simple. Loosen the clamp coupling to the motor shaft. Loosen the two clamp bolts holding the motor mount plate to the extended 3/8” shafts and slide the motor plate/motor assembly off. Remove the micrometer as per instructions under “bakeout”.

Limit Switches:
The limit switches are mounted in removable assemblies. Simply remove the two associated mounting screws and remove the plate.

On the X & Y limit switch assembly, note proper switch orientation. un-clamp the switch pod,. Slide the switch pod up off the “joystick” actuator. It may be necessary to spread the switch actuators while re-assembling the switch pod.

Position indicators:
Position indicators may be removed with limit switch mounting plates or individually as required. Care should be used upon re-assembly to dress the wires as not to interfere with stage motion.

WIRING COLOR CODE.....Limit switches and Position indicators

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LED Position Indicators: CLI870W

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We at Nor-Cal Products 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.
Appendix II - Limited Warranty and Intellectual Property Coverage

Products manufactured by Nor-Cal Products, Inc. (hereinafter referred to as "Nor-Cal") are warranted against defects in material and workmanship for a period of twelve (12) months from the date of shipment from Nor-Cal to the buyer. Any modification to the product by the buyer or their agent voids this warranty. Liability under this warranty is expressly, limited to replacement or repair (at Nor-Cal’s option) of defective parts. Nor-Cal may at any time discharge its warranty as to any of it products by refunding the purchase price and taking back the products. This warranty applies only to parts manufactured, and labor provided, by Nor-Cal under valid warranty claims received by Nor-Cal within the applicable warranty period and shall be subject to the terms and conditions hereof. Expendable items such as tubes, heaters, sources, bellows, etc., by their nature may not function for one year; if such items fail to give reasonable service for a reasonable period of time, as determined solely by Nor-Cal, they will be repaired or replaced by Nor-Cal at its election. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Nor-Cal, are due or traceable to defects in original materials or workmanship. Malfunctions caused by abuse or neglect of the equipment are expressly not covered by this warranty. Nor-Cal expressly disclaims responsibility for any loss or damage caused by the use of its products other than in accordance with proper operating and safety procedures. Reasonable care must be taken by the user to avoid hazards. In-warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the parts that have been repaired or replaced. After expiration of the applicable warranty period, the buyer shall be charged at Nor-Cal’s then current prices for parts and labor plus transportation. Except as stated herein, Nor-Cal makes no warranty, expressed or implied (either in fact or by operation of law), statutory or otherwise: and, except as stated herein, Nor-Cal shall have no liability for special or consequential damages of any kind or from any cause arising out of the sale, installation, or use of any of its products. Statements made by any person, including representatives of Nor-Cal, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Nor-Cal unless reduced to writing and approved by an officer of Nor-Cal. Merchandise may be returned at the sole discretion of Nor-Cal Products, but not more than 60 days after shipment. A fee may be charged for restocking the item. An RMA number must be obtained from Nor-Cal before returning any merchandise.

Intellectual Property Coverage

The products described in this manual are covered under U.S. Patents. Additional patents may be pending.