INSTRUCTION MANUAL

EB SERIES MANIPULATOR MANUAL

Version 2

SERIAL # _____

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EB Series Manipulator Instruction Manual
Version 2.0

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Preface

Congratulations! You have purchased a precision vacuum positioning device from Thermionics. 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 Thermionics encourage your comments and suggestions on this manual.

Product Description

Inclusively: EB (x-y-z); EBT (z only); EBXY (x-y stage only; EBXYB (with bellows).

The EB series precision manipulators are a family of large ID bore manipulators (2" to 6") of sufficient mechanical strength to handle significant customer payloads. The X and Y stages are located at the bottom of the manipulator, making wide guide rod separation and proper bearing separation. The Z drive incorporates large diameter (0.75 and 1" OD) guide rods, intermittent support where required, and "5 sided box" bracing. This design approach creates an especially rigid overall framework. Three lead screw Z drive is available for extra support of the traveling stage.

The EB Series instruments have an 80# equipment payload for vertical operation. This rating is increased to 200# for units with the "three lead screw" option. For applications which need different payloads and/or other operational orientations, please consult the factory. See "installation" section below for complete payload considerations.

Unpacking

EB manipulators are shipped in custom boxes or wood crates with custom foam- in-place packing. We have found this the only system to provide adequate protection for shipment. The foam is separated approximately halfway inside the crate with thin plastic. The manipulator is sealed in polyethylene plastic to protect the unit from possible contamination from small particles of shipping foam, as well as from the shipping environment. The bellows assembly is shipped in place protected by a cardboard or thick paper wrap and plastic wrap about the bellows. This wrap should be left in place for as long as practical as physical protection in the mounting process. UHV surfaces are protected via UHV grade clean aluminum foil along with physical protection such as cap plugs. Normally exposed areas that have lubricant applied are also covered to keep lubricants from migrating on to the inside of the bags. We strongly recommend the packing crate with packing be saved for possible future shipment or equipment storage.

Installation

The manipulator can be installed straight from the crate. Care should be exercised to protect the knife edge seal surface on the mounting flange. The EB Manipulators can be installed with two different procedures outlined further in this section.

WARNING

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

Do not confuse adjusting screws with attachment screws. Each linear bearing is individually adjustable via an adjustment set screws clamping each bearing. Refer to the adjustment section before changing the setting on the adjustment screws.

***THIS IS IMPORTANT ***

CONSIDERATIONS:

EB manipulators are not light instruments. When mounted in the horizontal position, they can generate large cantilever or torque loads to the customers mounting flange or frame. The manipulators may include several features to allow the customer to reasonably provide adequate mechanical support.

DO NOT ASSUME YOUR MOUNTING FLANGE CAN CARRY THE LOAD ALONE
Have someone competent in mechanical engineering principles determine the nature and extent of support needed to safely mount this manipulator to your equipment.

/LP:

The /LP Series lifting package is a custom designed lifting system to allow the user to safely and conveniently handle their instrument. The package is unique to each application. Normally it consists of stainless steel eye bolts / brackets mounted to the manipulator assembly to allow overhead crane handling of the package. A set of attached handles may also be included.

PRECAUTIONS:

It is important the following precautions be followed. SEVERE SAFETY HAZARDS WILL BE CREATED IF THESE PRECAUTIONS ARE NOT FOLLOWED

DANGER Do not lift this instrument above or over people.

DO NOT ALLOW STRAPS CABLES OR CHAINS TO BE IN CONTACT WITH DELICATE PROTRUSIONS MOUNTED TO THE INSTRUMENT WHILE LIFTING OPERATIONS ARE ACTIVE.

The /LP is designed for short term transport or lifting only. Do not use it for long term support or for working on the instrument while suspended without first consulting the factory.

INSTALLATION AND USE:

Attach your sling assembly. Take special care to use all lift points specified. Verify each connection is secure.

Slowly bring tension on your sling and align so as not to have twists or pull inappropriately on the instrument. Begin to observe and verify that an even level lift is being achieved. Lower and re-adjust as needed.

Initially lift only a short distance (less than 1 inch) and verify stability and position.

Proceed to transport unit to new location.

DANGER:

Again, DO NOT TRANSPORT OR LIFT THIS INSTRUMENT OVER PEOPLE.

Once securely positioned on to your chamber, slacken the sling and remove each attachment point. We suggest securing the sling so as not to accidentally damage the instrument inadvertently when removing from the area.

PAYLOAD CONSIDERATIONS:

The EB Series instruments have an 80# equipment payload for vertical operation. (Note: NOT inverted mounting!) This payload is based upon the total load on the traveling flange with the base flange securely attached to the customers chamber, providing a strong and stable mounting. The payload center of gravity must be within the diameter of the traveling flange OD (Normally 6") and within 12" of the traveling flange face.

The equipment payload rating is increased to 200# for those units with the "three lead screw" option.

Please consult the factory if your application requires:

- Payload greater than 80#; (200# on 3 lead screw units)
- Center of gravity beyond above limits
- Mounting orientation other than standard vertical (i.e., angled, horizontal, inverted, etc.).

The EB Manipulators can be installed with two different procedures:

A:

This procedure should be used wherever possible:

If clearance holes are used on your configuration, care must be used not to damage the bellows assembly with a wrench handle. We recommend anti-seize compound be utilized on the bolt threads, especially when repeated high temperature bakeouts are anticipated. Avoid migration of anti-seize compounds onto UHV surfaces. As with all UHV flanges, proper tightening procedures should be observed. The base flange may be tapped or come with clearance holes, depending on configuration.

IT IS IMPERATIVE BOLTS OF EXCESSIVE LENGTH ARE NOT USED TO MOUNT THE BASE FLANGE ON SOME MODELS.

Permanent damage to the bellows assembly could otherwise result. Similar care is necessary in mounting the payload to the traveling flange with some manipulator flange/bellows configurations.

B:

Consult the factory about your application before using this procedure

The EB Series manipulators can also be mounted in a two-step process. This

procedure should be used only when the direct mounting is not practical. This procedure is especially helpful when large diameter bellows with extended necks and flange clearance holes are specified. This procedure allows the bellows assembly to be mounted independently first, without the drive stages.

We strongly advise you consult the factory about your application before using this procedure

1. BELLOWS ASSEMBLY REMOVAL

The bellows assembly is held by its flanges in the traveling and base stages with 0.375" dia. SHCS. The manipulator should be placed on a clear work surface, and the Z drive adjusted to approximately one-half travel. With the bellows protector wrapping loosely in position, the 0.375" screws should be removed from the flanges. The traveling stage may need to be adjusted to allow access through the Z stage back wall. The X & Y Stages will need to be driven to their extremes, one at a time to gain access to the screws in the base on some models. These procedures may require removing the bellows protector. Once these SCHSs are removed from the flanges, the bellows/flange assembly can slide along the Z axis, out of the driving stages.

2. BELLOWS ASSEMBLY MOUNTING

The bellows assembly can be mounted to the chamber as any UHV flange. Care on bolt lengths should be observed, especially on tapped flanges on minimum flange-to-flange units. The rotatable flange should not be mounted to the chamber but rather left for the traveling stage. If a particular manipulator orientation is required, note the tapped hole orientation prior to manipulator disassembly, and match that placement to the desired one upon mounting the flange.

3. MANIPULATOR RE-ASSEMBLY

Once the bellows assembly is mounted to the chamber, the drive stages can be lowered onto the bellows assembly. The tolerances are close, and this operation may require more than one person to carefully lower the drive stages around the bellows. 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 6" OD flange both in orientation and axial position to align the tapped holes with the SHCSs.

EB manipulators are capable of horizontal operation only when ordered in that manner from the factory. The Horizontal mounting package includes (depending on the particular model) oversized guide rods, large micrometers, large limit stop, large diameter mounting flange (e.g., 10" OD),

counterbalance springs, support stands/framework. Many standard models can be retrofitted, if required. The factory should be consulted on such operational changes in the field.

HMP:
Assembly and dis assembly of the spring sets is difficult and not recommended unless absolutely necessary. Significant amounts of energy are stored in these assemblies. This can harm the unsuspecting user.

The HMP springs mounted into the instrument can be baked under our bake-out guidelines.

IT IS MANDATORY THE SPRING ASSEMBLIES COUNTER THE GRAVITATIONAL FORCES AND VICE VERSA. THE MICROMETER ASSEMBLY IS NOT SUITABLE TO CARRY THE ENTIRE WEIGHT OF THE SYSTEM IN THE HORIZONTAL POSITION. ALWAYS BLOCK AND UNLOAD THE VERTICAL DRIVE IF YOU WISH TO CHANGE ORIENTATION OF THE MANIPULATOR.

NOTE: The total spring force is custom assembled to match your expected load. This is done to unload the micrometer and allow less than approximately 10 lbs. of force on the micrometer spindle. If your load changes appreciably in application, please consult the factory. It may be necessary to adjust your spring system.

WARNING: *Large bellows device*

Manipulators under vacuum will exert considerable force on micrometers when moved more than .25" off center. Excess wear may occur if cycled many times in extreme ranges. Be watchful of wear and play in this situation. PLEASE consult the factory with any questions.

Adjustments

Your EB manipulator is correctly adjusted prior to shipment. This section is included to aid the user in making changes in these settings if needed.

LINEAR BEARINGS:
All the linear bearings (ball bushings) are adjustable on the EB manipulators. A limited amount of preload is allowed by the bearing manufacturer, but care should be used to minimize the preload to what is necessary for the application. Excessive pre-load will cause rough operation and shorten the useful life of the components. The linear bearings are properly adjusted before the manipulator leaves the factory. To make this adjustment in the field requires feeling the load on each bearing under motion independently. This usually requires disassembly of the stages and removal of the drive system involved.

CROSS ROLLER BEARINGS:
All the linear cross roller style bearings are adjustable on the XY stage portion. Care should be used to minimize the pre-load to what is necessary for the application. Excessive pre-load will cause rough operation and shorten the useful life of the components. The linear bearings are properly adjusted before the unit leaves the factory. To make this adjustment in the field requires feeling the load on each bearing under motion, and adjusting the bearing race uniformly.

NOTE: Care is taken during factory assembly that parallelism is observed, adjusted and achieved on all of the cross roller bearing sets via surface indicator measurements. Some specific models require this to be done precisely in order to function properly.

TRAVEL LIMIT STOP COLLARS/SCREWS:
Some models come equipped with stop screws attached to the Z Back or 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 or compressed beyond its operating parameters. If a need arises to move these stops, replace them accurately upon re-assembly. Over extension or compression of the bellows will cause premature failure of the bellows and/or mechanical damage to the manipulator or other equipment.

MICROMETERS:
The micrometer to stage coupling is adjustable via the 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, hardened

and plated, dome anvil where the tip of the micrometer makes contact. These are properly adjusted at the factory and should not require further adjustment.

Micrometer play is adjustable by removing the micrometer barrel and tightening or loosening a knurled nut on the body. *This is only needed if the micrometer threads become worn, and should not be tampered with otherwise*

Z DRIVE:

The two main bearings in the gearbox assembly are preloaded at assembly via the main drive gear, shims, and held via roll pin. The worm wheel is locked into place by the main set screw in tangent with the acme drive screw, which creates a 'sandwich' with a thrust bearing/radial bearing set. The worm drive gear set is adjusted by positioning the upper gearbox housing before locking down the two 5/16-18 SHCS mounting bolts. A slight force toward engagement is usually best to minimize gear binding while minimizing backlash. If smooth Z drive cranking is not obtained under load, this placement should be repeated.

This alignment is set at the factory and should not be disturbed unless necessary.

Anti-backlash Z drive (optional) incorporates two lead nuts with independent locks. The lower nut should be permanently locked into place. The upper nut should be rotated until all axial play is removed and locked via set screw. Perimeter holes are drilled in the upper nut assemblies to aid in this procedure.

Lubrication

All bearings, gears, gearboxes, and lead screws are lubricated with Thermionics 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 ***

Z drive:
Additional lubricant must be added to the lead screw as the use and operating 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 failure scenario, 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 (in excess of 0.010”) is detected, consult the factory for suitable service/repair.

Main drive gear set located inside the worm gear housing can require relubrication depending on loads and time of use.

X Y drive:
Manipulators under vacuum will exert considerable force on micrometers and or drive mechanisms when moved more than .25" off center. Excess wear may occur if cycled many times in extreme ranges. Be watchful of wear and play in this situation.
Re-lubrication of threads as well as spindle shafts is on an ‘as needed’ basis.

All other drive components including bearings and bushings should not require more than the factory has applied during initial assembly.

*** 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 300° C.
This material may give off toxic gases 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 EB Manipulator can be baked with standard UHV bakeout procedures fully assembled with certain considerations.

SEE SAFETY WARNINGS UNDER "LUBRICATION".

Do not run uncontrolled bakeouts or bakeouts approaching 200°C.

It is not necessary to remove the X Y micrometers prior to standard bakeout. For high temperature bake-out, or repeated bake-outs of long duration, we do recommend micrometer removal.

The Z drive gearbox should be locked in place during bakeout.

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

Other attached peripheral equipment must be investigated individually as to suitability for bake-out.

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

See safety warnings under "Lubrication".

Do not run uncontrolled bakeouts or bakeouts approaching 300°C

BAKEOUT:
The design of the EB series 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.

MICROMETER REMOVAL:

1. Position both X & Y micrometers at mid travel. Blocking the stage from motion may be needed to protect any internal workings.

2. The pre-load coupling to the stage removes by simply un-threading the knurled collar. The same Check under "Adjustments" for correct instructions for re assembly 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 before bakeout.

After baking and cool-down, re-attach micrometers.

NOTE: Micrometer re-installation
When re-installing the micrometer/ micrometer bloc 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 axes of your manipulator can be motorized. Retrofit kits are available for field installation. When purchased without a controller the wiring comes un-terminated. It is the customer's responsibility to be sure the wiring is properly strain-relieved mechanically. Please consult the factory for further information.

ALL MOTORS AND LIMIT SWITCHES/ POSITION INDICATORS MUST BE REMOVED BEFORE BAKEOUT.

REMOVAL 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 and coupler can be pulled away from the mount.

X Y STANDARD MICROMETERS:

The standard micrometer motor drive package utilizes an open gear and gear cylinder configuration that is Thermionics' design. This allows the micrometer to move axially while the motor remains in position on one axis, and, oppositely on the other axis, the motor moves axially while the micrometer stays in place.

This design allows simple removal of the motor for bake out. There is no need to center the axes prior to removal. Remove the two bolts that are 90 degrees from the motor shaft axis, holding the motor mount, and remove the mount and motor together.

For reference only:

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. 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 holding the barrel and slide it into the micrometer handle in order to remove the socket head mounting screws. Remove each micrometer.

Re-installing the micrometer/ micrometer block assemblies:

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.

X Y DIRECT MOTOR DRIVE:

This style of drive incorporates a fine thread drive screw directly mounted on to the motor.

Center the axes prior to removal. Remove the associated screws for the motor and the drive nut plate. Reverse procedure for assembly, being careful that the solid coupled parts re-align.

X Y BALL SCREW DRIVE:

The X & Y Drive units are removed as assemblies. Center the axes prior to removal. Realize that the force of vacuum will hold the stages from moving off center.

First the drive ball nut should be turned out of the aluminum connecting cylinder. This coupling should only finger tight. Due to the large pitch differential, it will be necessary to turn the motor by hand during this operation. Once this is accomplished and the stage is floating free, the two 1/4" socket head cap screws that hold the motor mount plate to the motor mount standoff can be removed. Remove and save the spacer collar from inside the aluminum connecting cylinder.

WARNING: Care must be exercised not to allow the ball nut to spin off the ball shaft. All the drive ball bearings will be released if this occurs. We recommend taping the assembly together until time to re-assemble.

The X & Y ball drive are adjustable via set screws in the clamp mounted to one side of the ball nut. This should be adjusted as to give smooth operation without allowing any lash.

LIMIT SWITCHES:

The limit switches are mounted in removable assemblies. Simply remove the two associated mounting screws and remove the plate (typically the Z scale).

On the X & Y limit switch assembly, note the switch orientation. Loosen the screw in the clamp that is just below the switch pod. Slide the switch pod off the “joystick” actuator and mount. Be sure to re-align the two mating halves of the assembly carefully during re-assembly. Care should be used in re-

assembly to not over-spread the switch actuators while the assembly is lowered into position.

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 and COLOR CODE - Limit switches and Position indicators:

LIMIT SWITCHES:

Common ---------- Yellow
Normally closed ---- Green
Normally open ------ Red

ENCODERS:

See individual encoder documentation for specific wiring.

ZERO POSITION CONNECTIONS:

SIGNAL	SENSOR WIRE COLOR
Detector Ground	Green
Detector Output	Blue
Detector Vcc	White
Anode (3.3 V)	Red
Ground	Black

.

LED POSITION INDICATORS: (CLI870W)

Pin #
1 Red
2 Yellow
3 Green
4 Black

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. www.thermionics.com