INSTRUCTION MANUAL

FB SERIES PRECISION MANIPULATORS

Version 2

SERIAL # _____

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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

The FB 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 FB 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

FB 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 bellows assembly is shipped in place protected by a cardboard or thick paper wrap about the bellows. This wrap should be left in place as long as it is practical in the mounting process. We strongly recommend the packing crate with packing be saved for possible future shipment or equipment storage.

Installation

*****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 ball bushing is individually adjustable via an adjustment screw clamping each bearing. Refer to the adjustment section before changing the setting on the adjustment screws.

*****THIS IS IMPORTANT *****

PAYLOAD CONSIDERATIONS
The FB 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 FB Manipulators can be installed with two different procedures.

1. The manipulator can be installed straight from the crate. This procedure should be used wherever possible.

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. 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. As with all UHV flanges, proper tightening procedures should be observed.

2. The FB 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 8 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 8 x 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.

FB 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.

Adjustments

Your FB 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:
All the linear bearings (ball bushings) are adjustable on the FB 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.

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:
Micrometer play is adjustable by removing the micrometer handle and tightening or loosening a knurled nut on the barrel. 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.

NOTE: Micrometer re-installation

When re-installing the micrometer/ micrometer block assemblies, the following procedure will ensure 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 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 of 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 will 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 service/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 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 FM 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 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 to a bakeout temperature of 200°C or less.

Do not run uncontrolled bakeouts or bakeouts approaching 200°.

MICROMETER REMOVAL:

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 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 during bakeout.

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

BAKEOUT:

The design of the FB 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.

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

NOTE: MICROMETER RE-INSTALLATION
When re-installing the micrometer/ micrometer block assemblies, the following procedure will ensure 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 prior to 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.

X & Y DRIVE:
The X & Y Drive units are removed as assemblies. 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 it is 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 so 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. On the X & Y limit switch assembly, care should be used in re- assembly to 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 so as not to interfere with stage motion.

WIRING COLOR CODE...Limit switches and Position indicators

Switches:

Common	Yellow
Normally closed	Green
Normally open	Red

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.

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