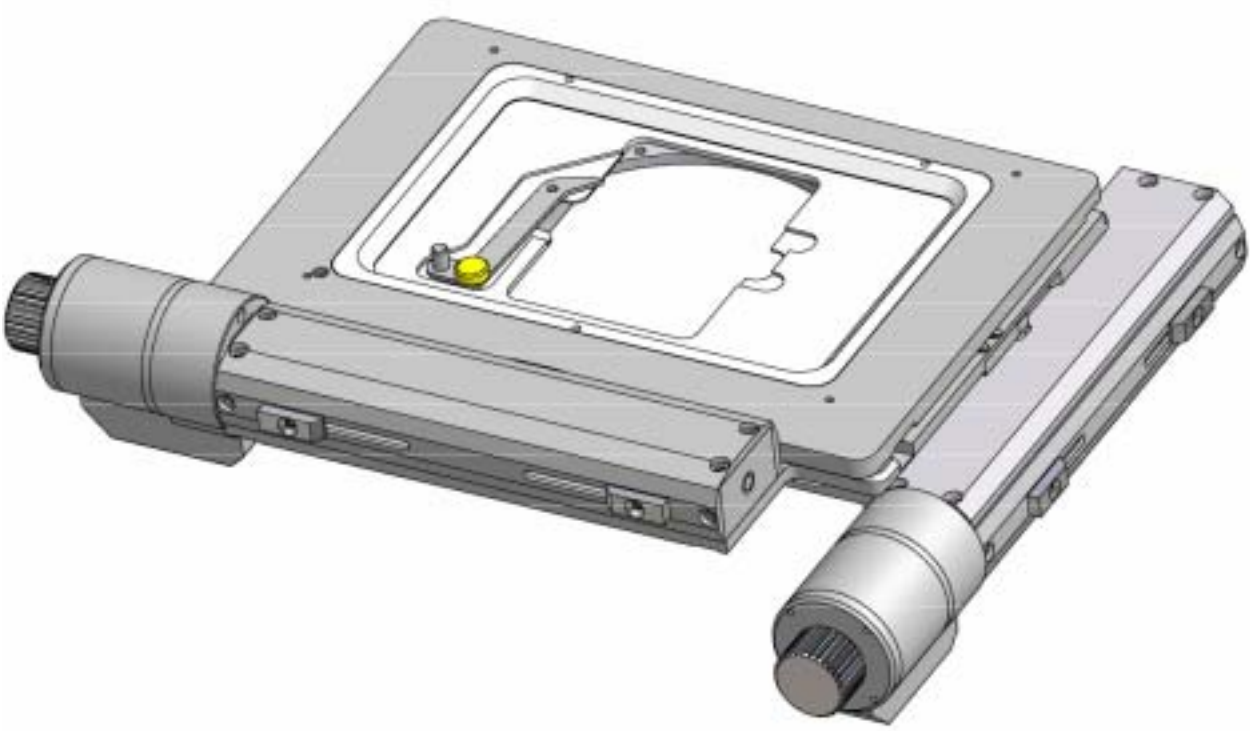
LEP Motorized XY Stage
Users Guide



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Contents

1.0 Overview

LEP XY stages are carefully designed and assembled for high accuracy and performance. The stage will retain its performance characteristics for many years with minimal maintenance. This guide outlines the recommended operation, installation, maintenance and troubleshooting procedures.

Stages by nature are a compromise of many parameters. To achieve high performance in a certain specification other parameters will be affected. For example speed will often be reduced when resolution increases, accuracy and straightness are affected by the physical size of the stage. Practice and experience allow us to build stages that 'cheat' these compromises and provide truly high performance positioning instrumentation.

2.0 Theory

All LEP stages are driven by a conventional motor which turns a leadscrew which translates the rotation to linear motion. The motor type can be either a stepper motor or a DC servo motor, the basic principles are the same for each. The motor is coupled to the leadscrew shaft directly without any mechanical reduction. The leadscrew has a specified pitch which is defined as the distance the stage will move for one complete turn of the leadscrew shaft. The motor resolution therefore converts to stage position resolution by taking the ratio between the pitch and the motor resolution. For example if the stage has a 1mm pitch leadscrew and is driven by a motor with 10,000 steps per revolution, the stage resolution will be 1mm divided by 10,000 or 0.0001mm (0.1um).

3.0 Specifications

There are many ways to describe XY stage performance specifications. Some specifications are ambiguous and misleading or simply misinterpreted. LEP makes an effort to define specifications in a classical sense and accurately as possible. The following is a description of the specifications that LEP publishes and their respective definitions.

Accuracy: Stage accuracy is defined as the maximum error observed when the stage is asked to move a specific distance. For example if the stage is commanded to move 100mm, and the stated accuracy is 2um, the stage is guaranteed by this specification to travel no more that 100.002mm or less than 99.998mm. This figure is sometimes represented as +/- the accuracy figure.

Repeatability: The ability for the stage to move from one point to another and back to the first is defined as the repeatability. Similar to the accuracy specification, the value is expressed as the maximum observed error. Again, the number is published as some value or +/- that value.

Straightness: When the stage moves one axis it is expected to move in a perfectly straight line, the deviation from this straight line is the straightness specification. The value is expressed in one of two ways. First, similar to the accuracy and repeatability specifications, the number can represent the maximum error. The alternate method is to publish the value as at function of distance.

Flatness: Stage flatness is the same as stage straightness except that it occurs in the Z axis perpendicular to the plane defined by the X and Y axes of the stage.

Resolution: The stage resolution is the minimum increment that the stage can move. The mathematical resolution is clearly defined from the leadscrew pitch and the motor resolution. In reality the physical minimum resolution is not a simple calculation, but should be measured. The resolution is presented as an absolute distance.

Orthogonality: With an XY stage it is assumed that the axes are exactly perpendicular, as with the other specifications perfection is unusual. The specification is given as a angular deviation from the normal perpendicular. Usually the number is given in units of seconds of arc. Keep in mind that this is the only specification that deals with both the X and Y axis together.

4.0 Installation

LEP stages are designed to fit most conventional microscopes. The major brands including Zeiss, Leitz (Leica), Nikon, Olympus and Reichert all have specific adapters (for upright microscopes) or specific stages (for inverted microscopes) designed to fit the microscope manufacturer. In most cases simply mounting the stage with the specified screws is all that is required. In some cases additional hardware is need.

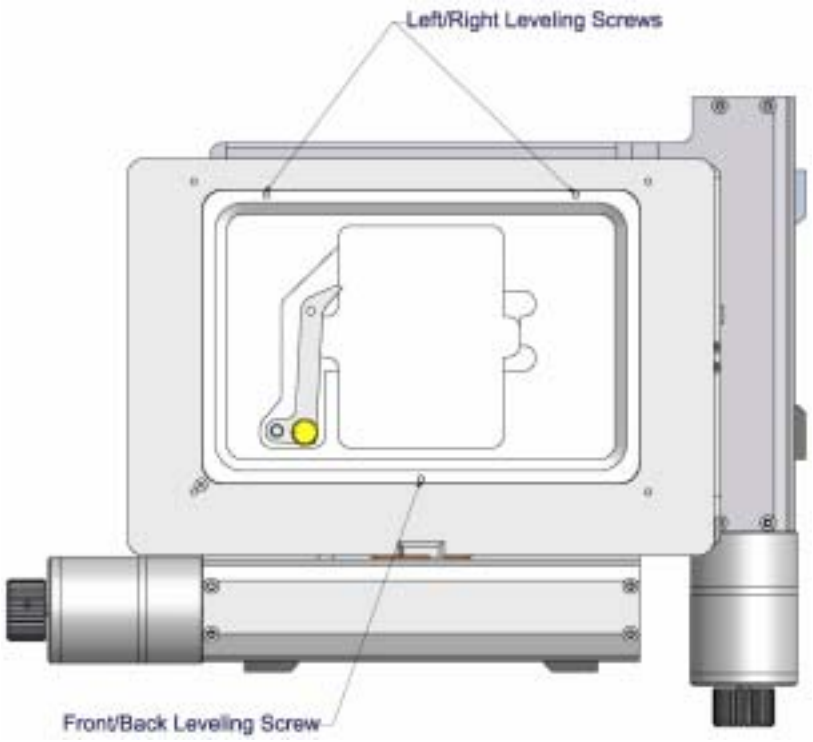
It is good practice to place a precision washer at each mounting point (in the case where screws are used). This will ensure that the stage is not affected by differences in flatness between the bottom plate of the stage and the mount on the microscope.

Once the stage is installed on to the microscope, the stage should be connected to the controller and power applied. Using the joystick, slowly move the stage to the limits of travel to ensure that there are no obstructions. Special attention should be paid to check the clearance between the stage and the back of the microscope throat.

Now a specimen should be placed on the stage and focused. The stage should focus high enough so that there is adequate over travel above the focus range, travel should also be adequate so that it can be lowered to remove the specimen or change lenses.

If the stage is being used in a transmitted light application the condenser should be easily focusable, again with ample over travel for normal usage.

Each stage has a means of leveling the insert. It may necessary to adjust this level to maintain focus over the travel range. The leveling is accomplished with three setscrews located on the edge of the insert.



First check the left-right flatness along the X axis as close to the left-right leveling screws as possible. Moving the stage left and right adjust the screws so that the focus does not change. This should be done using the objective lens that you will most frequently use. The higher the magnification used the better the flatness.

With the left-right level adjusted, the front-back level is adjusted by turning the single screw in the front **only**.

Attempting to make the focus perfectly flat over the entire travel range is nearly impossible. A good rule of thumb is to try and make the focus between a quarter and a half turn of the fine focus knob.

Keep in mind that the flatness is specimen dependent; the stage can only be as flat as your specimen.

5.0 Maintenance

All LEP stages are lubricated at the factory with stable synthetic grease. Normally the leadscrews and guides should be cleaned and re-lubricated every year to maintain nominal performance. Heavy use, such as semiconductor wafer inspection, requires more frequent maintenance after 1000 hours of use.

The specified grease is LEP P/N 61-ME00093 for the leadscrews and 61-ME00092 for the linear guide bearings. These greases are suitable for clean-room applications.

Leadscrew lubrication requires removal of the leadscrew covers. The leadscrew should be wiped clean with a lint-free cloth and new lubricant applied. Work the stage to the limits of travel, while cleaning the leadscrew. This procedure is repeated until the old grease is removed. This process purges grease from the inside of the follower nut. The process should be done on both the X and Y axis leadscrews.

The linear guide bearings are a bit simpler. Move the stage to the extremes of travel to expose the bearings guides as much as possible, wipe clean and relubricate. Repeat the process for the opposite direction of travel. Only a thin film of grease is required, too much excess grease will get messy and cause too much foreign material to attach to the bearing guide.

Procedure:

1. Remove leadscrew covers from stage. It may be necessary to dismount the stage from the microscope.
2. The bearings and leadscrew are cleaned and lubricated according to the following procedure:
3. Use a lint-free cloth to clean the old grease from the bearing rail. Note if there are any fine metal shavings in the old grease, this could be a sign of potential failure.
4. Apply a thin coat of grease to the entire length of the bearing or leadscrew. Use only P/N 61-ME00092 grease for the leadscrews and P/N 61-ME00093 for all other bearings.
5. Run the bearing or leadscrew back and forth a few times to work the fresh grease into the bearing mechanism. It may be helpful to use the joystick to move the axis under power. To make sure that the joystick is not disabled disconnect the computer and/or terminal connectors from the rear of the MAC controllers.
6. Using the cloth remove the grease again and regrease as in step 3. If the removed grease was not clean and/or was showed signs of particulate contamination repeat from step 2 as many times as necessary.
7. Move the stage from end to end to check the function of the limit switches and the mechanical stops.
8. Replace the leadscrew covers. Re-mount the stage to the microscope and check for level as described above.

If metal shavings were present note it in the service record. This could be an indication that the bearing or leadscrew may need to be replaced in the near future.

Ludl Electronic Products designs and manufactures a wide range of automation accessories for microscopes and instrumentation.

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