Application Note

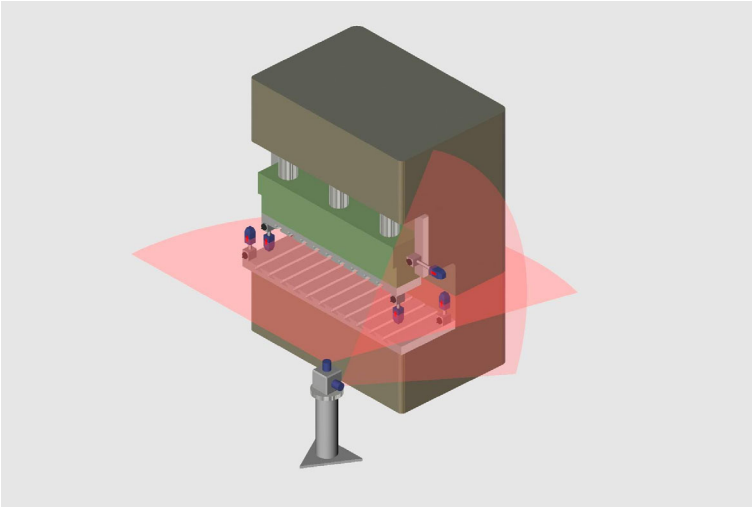
Injection Molding Machines

System Recommendations

- **L-733 Injection Molding Machine Laser**

How the Alignment System Works

To measure an injection-molding machine with the L-733, 5 reference points are needed. 3 points are chosen on the fixed platen and 1 each on 2 tie bars, usually on the lower tie bars at a point closest to the platens. The laser is positioned beside or inside the machine on an instrument stand. One of the vertical laser planes is bucked-in[1] to 3 reference points on the fixed platen. Next, the horizontal laser plane is bucked-in to 1 tie bars by placing 1 target on each tie bar. To measure the machine's geometry, the targets that were zeroed to the reference points are used to measure the deviation of a measuring point from the reference point.



Measuring Parallelism of Platens

To measure platen-to-platen parallelism, a target is placed on the opposing or moveable platen and zeroed on one corner. Next, the 3 other corners are measured for deviation from the first corner. The deviation, if any, is a measure of the parallelism of the platens since the laser plane was aligned to the fixed platen. Since the laser measurement updates in real time, the target can be left on the platen while it is being aligned. If all four corners read zero, then the two platens are parallel. The same method could also be used to check the parallelism of the molds to the platens.

Measuring Tie-Bar Squareness

Since the L-733 is comparable to 3 100-foot (30.5 meter) long surface plates, each perpendicular up to 1 arc second (like a ceiling and two walls), measuring squareness of the tie bars of even the largest injection molding machines and presses is a simple task.

The process starts by setting up the laser to 5 points as described above. To measure the squareness of the 2 lower tie bars to the fixed platen in the vertical direction, a target would be zeroed at a point on each tie bar closest to the fixed platen. Since the vertical laser plane has been bucked in to the fixed platen, the horizontal plane is perpendicular to the fixed platen. After zeroing the target, it is traversed along the tie bar. A *plus (+)* reading indicates the tie bar is sloping "up hill" relative to the platen; a *minus* (-) reading means it is sloping "downhill". A bubble level on the target base keeps the target at top-dead center of the (round) tie bar.

To measure "horizontal" squareness of the same tie bar, the target can then be placed on the tie bar horizontally (a bubble level on the target base keeps the target at “top-dead” center) and zeroed to the 3rd (vertical) laser plane. As the target is moved along the tie bar horizontally, any deviation from the zero point is a measure of horizontal squareness of the tie bar.

The same method is used to measure the squareness of all four tie bars; however, it usually takes 2 setups to measure all the tie bars for squareness.

See a more detailed procedure below.

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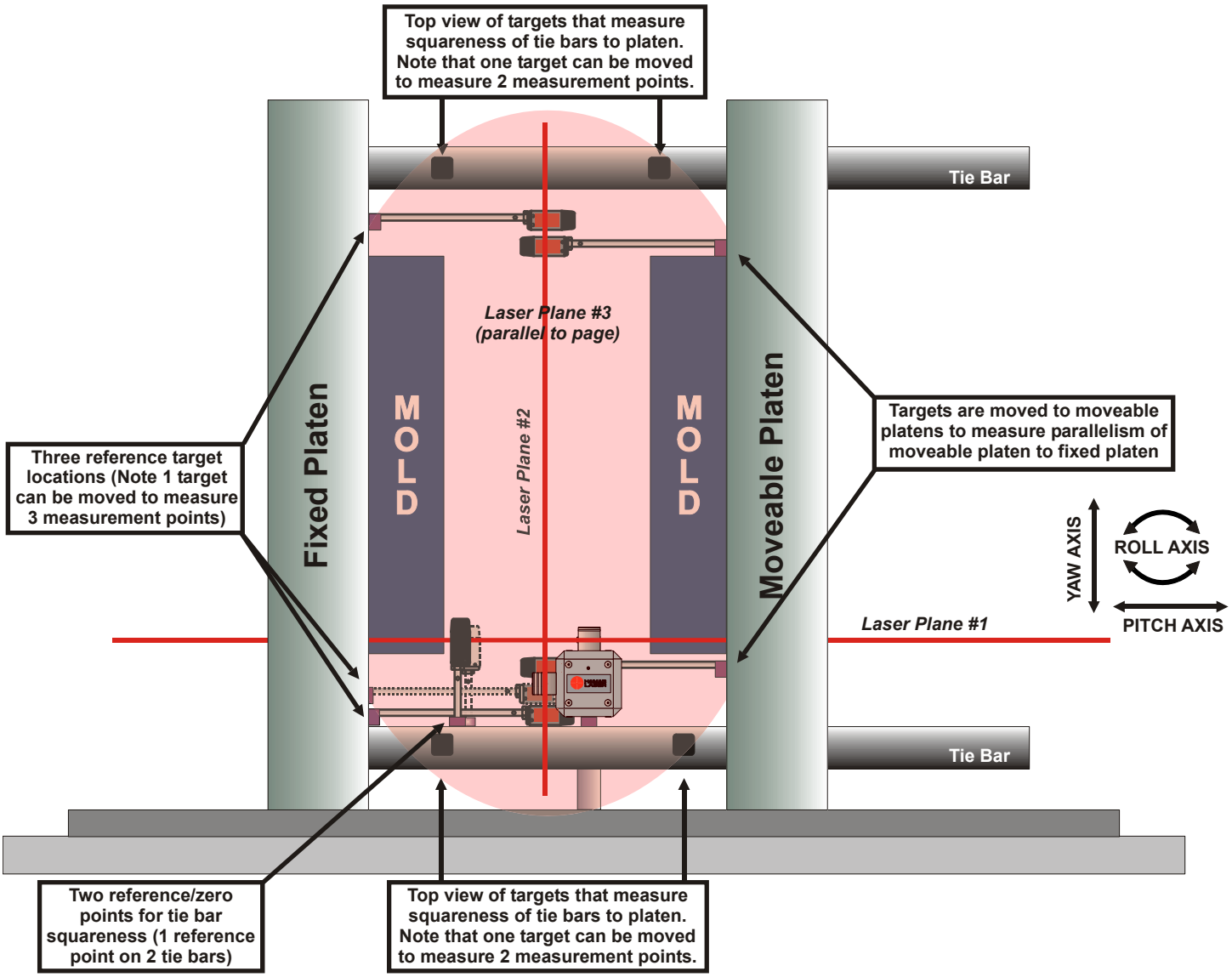
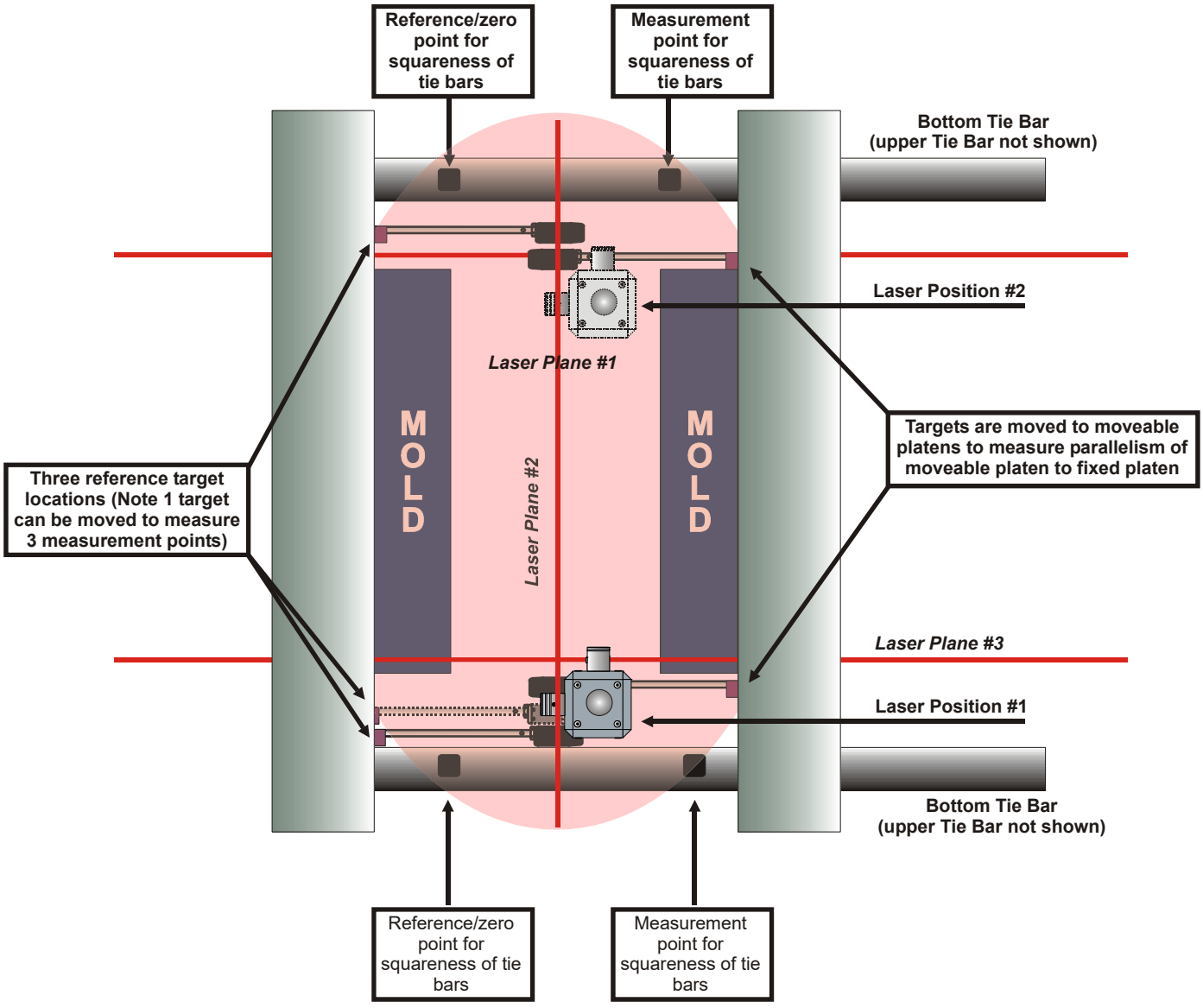
[1] **BUCK-IN—**Adjusting a laser plane or line to be parallel to the surface being measured (a table top, a surface plate, or a way surface). Three points are required to buck-in a laser plane to a reference surface. Two points are needed to buck-in a straight-line laser to a reference line (i.e., centerline).

Side View (Without Removing Mold)

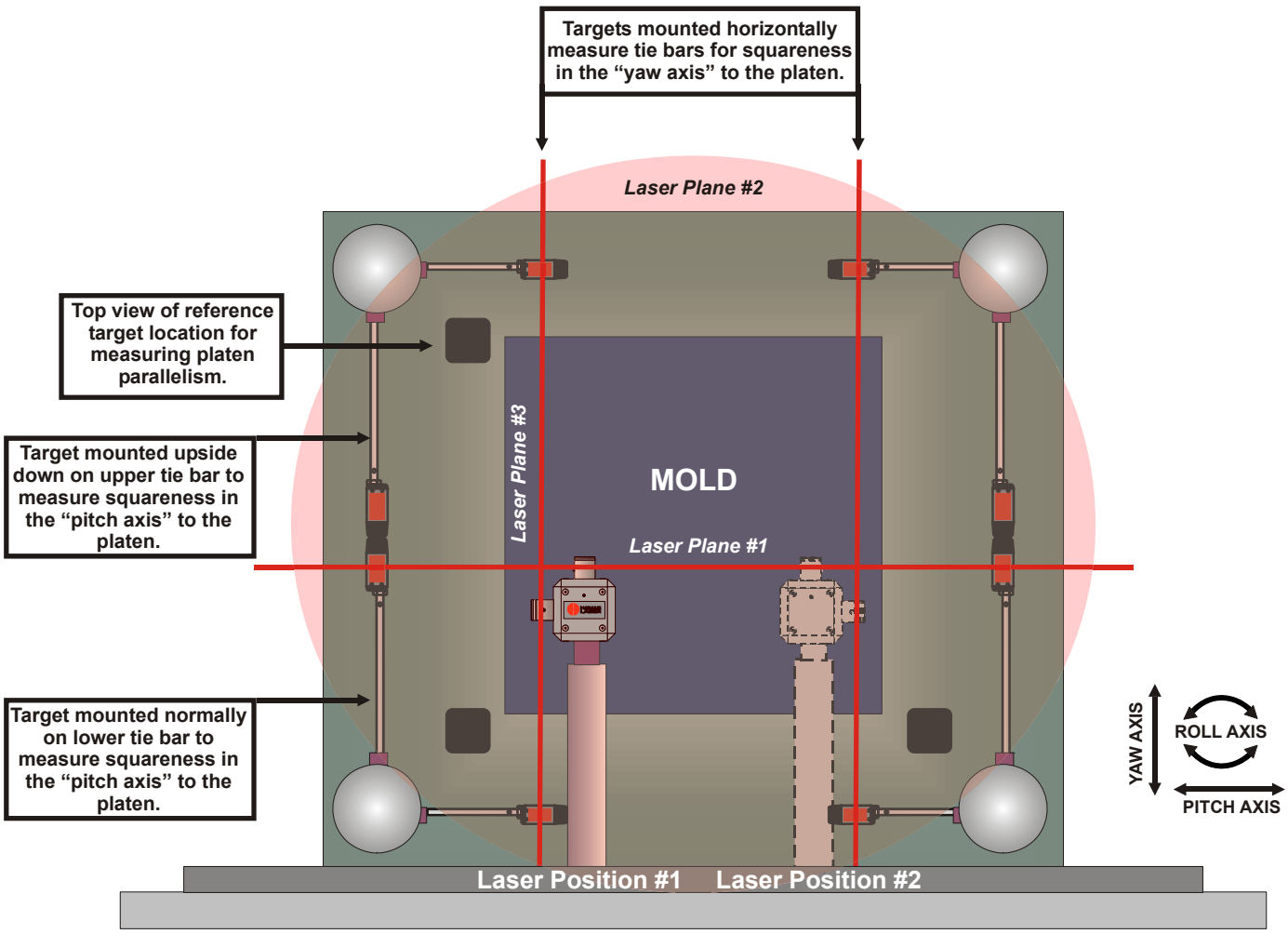
Please note that while this looks like a complex setup, it is the *machine* that makes the setup look difficult. The total time to set up the laser and reference it to the machine should be 13-25 minutes, including the time to take it out of the box. The total time to completely measure the machine for parallelism of the platens and squareness of the tie bars is 35-55 minutes (see timeline below).



Top View


Reference/zero point for squareness of tie bars
Measurement point for squareness of tie bars
Bottom Tie Bar (upper Tie Bar not shown)
Laser Position #2
Laser Plane #1
MOLD
MOLD
Laser Plane #2
Targets are moved to moveable platens to measure parallelism of moveable platen to fixed platen
Three reference target locations (Note 1 target can be moved to measure 3 measurement points)
Laser Plane #3
Laser Position #1
Bottom Tie Bar (upper Tie Bar not shown)
Reference/zero point for squareness of tie bars
Measurement point for squareness of tie bars

Front View of Platen



Procedure	Timeline (minutes)
1. Set the laser on an instrument stand either outside the machine or inside the machine as shown (Laser Position #1). Position the laser so the laser plane (LP) #1 is at a sufficient height to allow measurement of the upper tie bars for squareness. Ensure that there is sufficient room between the lower left tie bar and LP#3—75 mm to 300+ mm is the correct range.	5-10
2. Place a single-axis target (A-1519-2.4ZB) in the lower left corner of the platen and zero. Mark the spot for reference purposes, and then move this target to the upper left side of the platen. Place a second target on the *same* point in the lower left corner of the platen and zero the display.	3-5
3. Adjust the pitch axis of the L-733/743 until the same reading appears on *both* targets. This means the laser is now parallel to these two points (shown on left side of the *Front View*). Re-zero both targets.	1-2
4. Move one of the two targets (without changing the zero point) to the lower right side of the platen. Adjust the yaw axis until the target at this location reads zero. Re-measure the other points to ensure that they all read zero. The laser plane is now parallel to the fixed platen.	
5. Mount a target on the lower left tie bar and level using the built-in level vial on the target base. This keeps the target at top dead center. Adjust the target height until it reads LP #1. Zero the target and mark the reference point. Move the target the lower right tie bar. Repeat this procedure with a second target, placing it on the same reference point on the lower left tie bar where the first target was zeroed.	3-6
6. Adjust LP#1 using the roll axis in the laser base until both targets read the same number, making the laser plane parallel to the two lower tie bars.	1-2
7. Now the laser is ready to measure parallelism and squareness of two of the four tie bars. *Note: Skip Steps 5 and 6 if tie-bar squareness is not desired.*	
8. To measure platen parallelism, assuming the moveable platen is within 1 meter of the fixed platen, place a target in one corner of the moveable platen. Add or remove rods from the targets so that the length of the target height allows it to read the laser plane. Zero the target (see *Side View*).	1-2
9. Move the target to the other three corners and note the readings. Any deviation from zero is a measurement of out-of-parallel condition of the moveable platen to the fixed platen. Since the readings are live, the target (or targets) can be left on the platen while it is being adjusted to bring it into alignment.	1
10. Since all three laser planes are perpendicular to each other, the laser is also now set up to start measuring tie-bar squareness. Note that the laser cannot measure all four tie bars for squareness with one setup (see Steps 16 and 17).	
11. To measure squareness of the lower tie bar to the platen in the pitch axis, (as defined by looking into the end of the tie bar) use the target that set up LP#1 (which should still be reading zero). Move the target the other end of the tie bar, where its reading will indicate the squareness. If it reads zero, then it's square to the platen. If not, then the amount shown on the readout is how much either the platen or the tie bar needs to move to bring it into specification. Again, the reading is live, so the target can be left in place while the adjustments are being made.	1-2
12. Move the target along the tie bar in small increments to measure the tie bar for straightness. Note the readings as the target is moved.	
13. To measure the tie-bar squareness in the yaw axis (as defined by looking into the end of the tie bar), set up a target at the 3 o'clock position on the tie bar (see *Front View*). The level on the target base can be moved to the side of the base to keep it at top dead center.	1-3
14. Adjust the target until it picks up LP#3 and zero the target. As in Step 11, move the target to the other end of the tie bar to measure the squareness. If the reading not zero, it is not square. At the same time, the upper tie bar can be measured for squareness in the same yaw axis with the same setup.	1-3
15. The upper tie bar squareness in the pitch axis can be measured by turning the target up side down, picking up LP#1 and following Step 11. This also measures the parallelism of the upper tie bar to the lower tie bar in the pitch axis. Similarly, the upper and lower tie bars can be measured for parallelism in the yaw axis by using LP#3.	2-4
16. To measure the two right-hand tie bars, move the laser to Position #2 and repeat Steps 1-6 to make the laser planes parallel to the same reference.	5-10
17. Repeat Steps 11-15 to measure the squareness of the two right-hand tie bars.	3-5