FLATNESS vs. LEVELNESS
USING A LASER TO MEASURE THE TWO

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FLAT

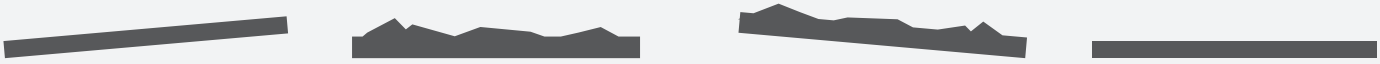
WHAT IS FLAT?
Flat is a surface that does not have curves, peaks and valleys as you travel along it. Essentially, a smooth plane.

WHY FLAT?
A flat mounting base can prevent or minimize distortion of the machine frame, known as a soft foot problem. Flatness is also good for checking settling of equipment or degradation of the base. Being out of flat can also induce machine tool quality problems.

LEVEL

WHAT IS LEVEL?
Level is a horizontal surface that is perpendicular to the earth's gravity. In other words, having a slope of zero with respect to the horizon.

WHY LEVEL?
Starting with a level machine prevents damage during operation. A level baseplate can help keep the oil level equal between bearings. Being out of level can cause drainage issues. Levelness helps with mating two surfaces to each other (such as flanges). Levelness helps to minimize extra work by ensuring all surfaces are parallel to each other.



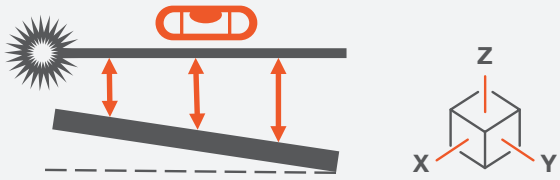
Flat, not Level | Level, not Flat | Not Level, not Flat | Level and Flat

NOTE: Both should be checked before installing a new machine onto a baseplate.

HOW TO SELECT THE CORRECT REFERENCE AND SET-UP FOR YOUR APPLICATION

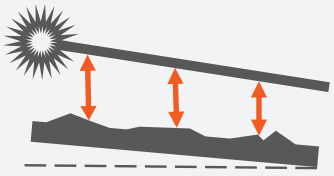
Using a level plane as reference.

This entails adjusting the laser emitter using its **high precision levels** in the X and Y directions. If necessary, also in the Z-axis to establish a plumb laser beam (plumbness means aligned to gravity). This will determine how the surface is aligned with respect to the earth and is mostly used as a reference for installing new machines or reinstalling them after repair.



Using a parallel plane as reference.

This entails adjusting the laser emitter in the X and Y directions until it creates a laser plane that is parallel to the surface through **three reference points**. This helps determine if foot pads are coplanar, or if the baseplate or machine frame is twisted/distorted. Typically used as reference for field inspections and corrections that require minor adjustments.



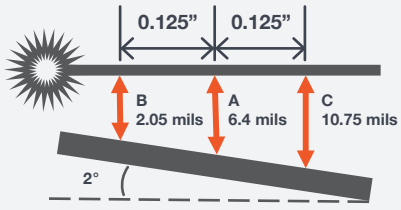
MEASURING BOTH FLAT AND LEVEL WITH LEVEL AS A REFERENCE

Typically a quicker setup, as it only requires leveling the laser emitter within the parameters of the device to measure the surface. However, there is an inherent built-in error when measuring flatness using level as a reference. In the example below this error is **4.35 mils**.

For example, a compressor frame can be as much as 2 degrees off level and be within specification. Let's assume we measure at a given point **(A)**, reading 6.4 mils. When measuring for a second time the detector is placed 1/8″ off from the original position, and for a third time another 1/8″ off from the original location.

Degrees to mils/inch: 1° = 17.4 mils/inch
2° = 34.8 mils/inch

EXAMPLE:



Error at 2 degrees:
34.8 mils/in × 0.125 in
Error = 4.35 mils

Measurements at points B and C:
B: 6.4 mils - 4.35 mils = 2.05
C: 6.4 mils + 4.35 mils = 10.75

As shown above, when the surface is not level, bucking-in your laser to be parallel to the surface helps establish repeatable flatness measurements and increases accuracy.

Keep it running.

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