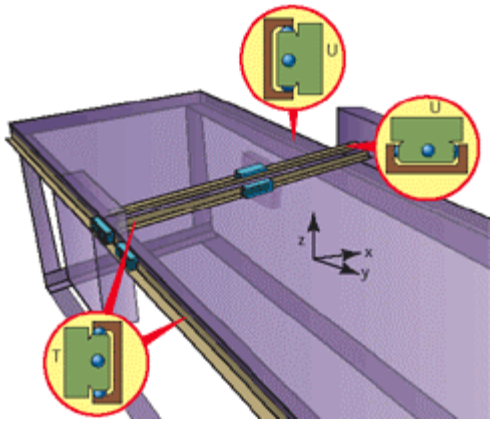
Straightening out motion

For cutting, slicing, and printing applications, it's important to keep motion precise. But tables never have perfect geometry. That's why a different approach correcting machine strokes with forgiving bearings is more effective and economical.

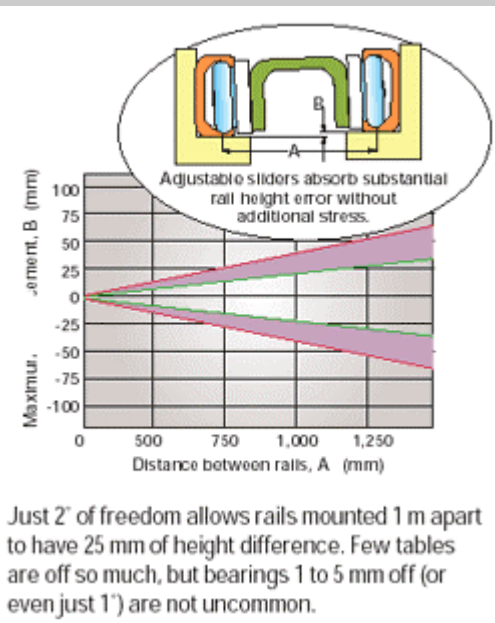
Linear bearings reduce the friction of straight movements. But here the sliders are put to another clever use: They adjust to and absorb the forces resulting from misalignment.

Say one rail of a 10-ft.-long table is assembled several millimeters lower than the one opposite. With most bearings, any misalignment becomes additional load. The mounting surface is rigid. Bearings are rigid. There is no freedom; the bearings are pulled in opposite directions at once. What happens? In most cases, the bearings bind.

On the other hand, adjustable sliders assemble into the system at an angle to conform to the table's imperfect geometry while still taking their share of radial load or moment. Similarly, if one rail of a table is skewed laterally a few degrees, adjustable sliders can be mounted at an angle to allow linear strokes without binding or increased friction. These bearings come in pairs of hardened C-shaped channels: The first has flat races and allows lateral freedom while the second holds the bearings on one side, allowing a rotational freedom on the other. When used together, this system allows up to ±2° of rotational and 4 mm of lateral freedom. This means that the rails can be mounted to nonmachined surfaces out of parallel by up to 4°.



This machine cuts shapes from metal plates with a plasma arc. The long *Y* axis includes forgiving T+U sliders that correct rail misplacements.



Just 2° of freedom allows rails mounted 1 m apart to have 25 mm of height difference. Few tables are off so much, but bearings 1 to 5 mm off (or even just 1°) are not uncommon.

One alternative for increasing precision is to construct a table with maximum parallelism. While this approach is most obvious, geometry is never perfect — especially on multiple axes — and trying to make it so is costly. Plus, building perfectly square tables becomes harder and more expensive as size increases. (Many plasma and other cutting tables exceed 4 by 10 ft.) Another option is to oversize ball or leadscrews and their motors to power through the axial loads from misalignment. While “plowing through” sticking points works, it requires larger, costlier components that degrade efficiency.