

# Ball screw pre-tensioning

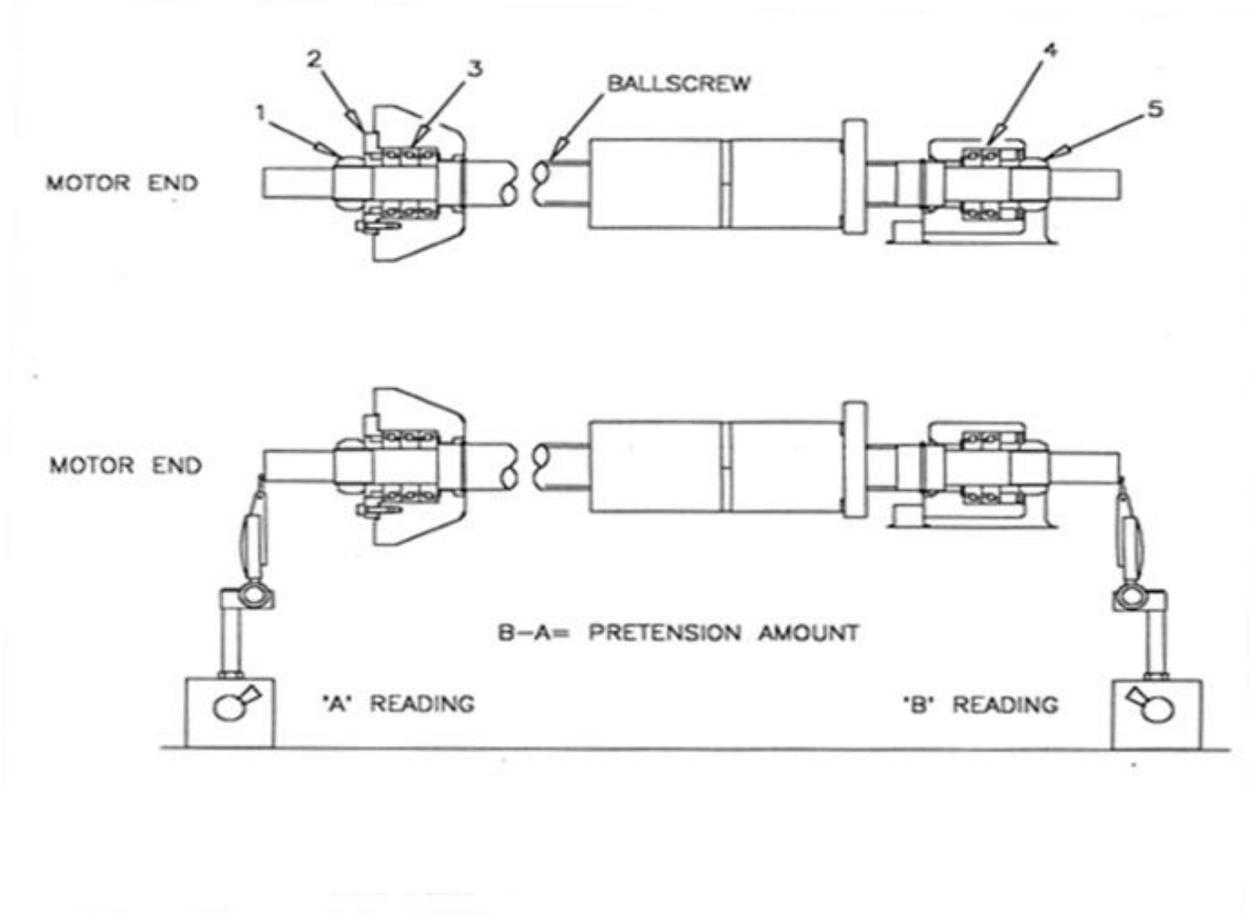
On most modern Machine Tools, the ball screw on the X, Y, and Z axis is pre-tensioned or "stretched" when installed to minimize changes in axis positioning due to "thermal growth" of the screw from ambient to normal operating temperature. When the axes are moved, heat is generated by the recirculating balls in the ball nut. The ballscrew is therefore subject to "GROWTH" or thermal length deformation, by the coefficient of thermal expansion for steel of 6.5 parts per million per degree Fahrenheit (11.7 ppm/° Celsius)

The average temperature rise of a cold ball screw is 5.4 to 7.2° Fahrenheit (3 to 4° Celsius). Pre-tensioning places a cold ballscrew in a state of tensile stress. This stress decreases or normalizes as the screw expands toward its normal operating temperature, minimizing axis position deviation. During normal operation, tension may become relaxed, causing possible end play and positioning error; requiring re-tensioning of the ballscrew.

$$.0016'' \text{ (pretension)} = 40'' \text{ (Travel)} \times 6^\circ\text{F (Temp Rise)} \times .0000065 \text{ (PPM /}^\circ\text{ Fahrenheit)}$$

$$(.041\text{mm (pretension)}) = 1000 \text{ mm (Travel)} \times 3.5^\circ\text{C (Temp Rise)} \times .0000117 \text{ (PPM /}^\circ\text{ Celsius)}$$

If the ball screw preload (tension) has been relaxed for any reason, follow this general procedure for re-tensioning the ball screw preload.



## PRE-TENSION PROCEDURE

1. Mount the ball screw.
2. Install the ballscrew support (TAC) bearings on the ball screw [3 & 4] in the proper orientation.
  - Assemble retainer nuts both ends leaving trailing end (opposite motor) loose.
3. Tighten the bearing retainer nut [2] on the motor end of the ballscrew, to fully seat the bearings [3].
4. Rotate the ball screw by hand, check and retighten the retainer nut [2] and tighten lock nut [1]
5. Tighten nut [5] (opposite motor end) to seat TAC bearings [4] into the bore.
6. Loosen nut [5] and run it back in, just to touch.
7. Place an indicator on each end of the ball screw and set to the indicators to 0 (zero).
8. Be sure to load the indicators at about mid-range, to insure a good reading.
9. Tighten nut [5] until the indicator equals the pretension amount for that axis.
  - Tension amount usually supplied by machine builder
  - If unavailable it is recommended to measure temperature rise and calculate proper amount of preload
10. Some pull thru will occur  $B - A = \text{PRELOAD AMOUNT}$ .
11. When proper pretension has been achieved, tighten the lock nut to secure the ends.
12. Mount the servo motor and coupling.
13. Check the axis reference points and reset if necessary.
14. Final Laser Calibration of machine positioning required.

We have many years of HANDS-ON experience with ballscrew removal,