Stiffness Measurements on the Trendsetter VLF

Products

- Trendsetter® VLF
- Trendsetter® VLF Autoloader

Background

Stiffness measurements are used to locate a component that is sensitive to vibration. Basically, you push on the object to be measured with a known force and measure the deflection. A force gauge is used to measure the force and a dial gauge with a magnetic stand is used to measure the deflection. The stiffness is expressed in N/µm (Newtons per micron).

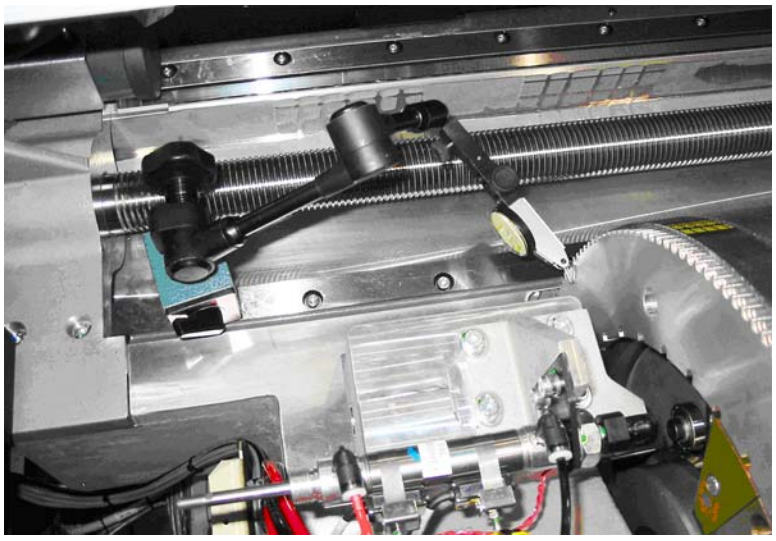
Tools required

- Force gauges – Wagner Instruments FDK 60 and FDK 20 (60 lbf and 20 lbf respectively)
- Dial gauge – 0-200 µm deflection
- Magnetic stand - Mitutoyo

Drum stiffness measurement

Measuring the drum stiffness will verify that the drum pre-load is set properly.

1. Mount the magnetic stand on the carriage rail. Adjust the arm and dial gauge so that it is touching the drum and adjusts 100 microns beyond that.



2. Remove the gauge backlash by pushing on the end of the drum by hand with a force of about 20 kg. Release the drum and see if the indicator on the dial gauge returns to the same position. Repeat the pushing and releasing of the drum until the dial gauge consistently returns to the same position.

3. Use the FDK 60 force gauge and push on the drum with a force of about 20 kg. Watch the dial gauge and note the deflection of the drum. The force gauge will hold the highest force used. Note the force used to produce the deflection. Repeat the measurement to ensure that you get a consistent reading each time.



4. If the drum is at the correct stiffness, it should not move more than 6 microns with a force of 20 kg applied.
5. Calculate the drum stiffness as follows:

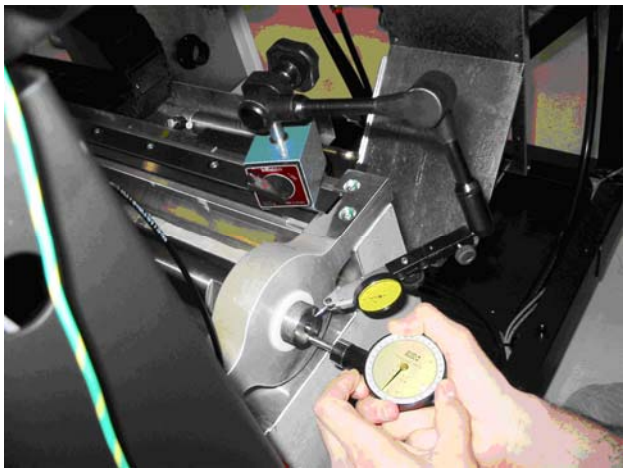
$$\frac{Force(kgf)\times 10}{Deflection(\mu m)} = stiffness(N/\mu m)$$

The drum stiffness should be about 35-40 N/µm.

Ballscrew shaft stiffness measurement

The ballscrew shaft stiffness measurement is done at the home end of the device—opposite the pulley. The ballscrew pre-load washers are at the motor/pulley end of the ballscrew shaft.

1. Set up the dial gauge to measure the ballscrew shaft deflection.



2. Remove the gauge backlash by pushing on the end of the ballscrew shaft with a force of about 20 kg. Release the shaft and see if the indicator on the dial gauge returns to the same position. Repeat the pushing and releasing on the shaft until the dial gauge consistently returns to the same position.
3. Push on the ballscrew shaft with a force of about 20 kg and note the deflection on the dial gauge. The deflection should be no more than 6 microns.
4. Calculate the ballscrew shaft stiffness as follows:

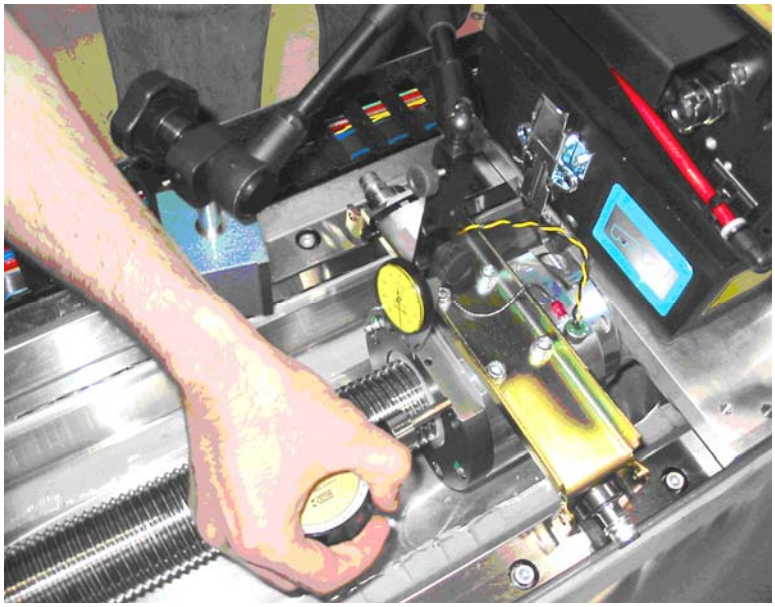
$$\frac{Force(kgf)\times 10}{Deflection(\mu m)} = stiffness(N/\mu m)$$

The minimum stiffness of the ballscrew shaft is 30-40 N/µm, but it is typically higher than that.

Ballscrew nut stiffness measurement

This measurement checks the stiffness of the ballscrew nut to the carriage rails. The ballscrew nut measurement is influenced by the stiffness of the ballscrew shaft measured in the last section. If the ballscrew shaft stiffness is within specification, then proceed with this test.

1. Set up the dial gauge to measure the ballscrew nut deflection (not the carriage).



2. Remove the gauge backlash by pushing on the ballscrew nut with a force of about 20 kg. Release the nut and see if the indicator on the dial gauge returns to the same position. Repeat the pushing and releasing on the nut until the dial gauge consistently returns to the same position.
3. Use the force gauge and push on the ballscrew nut with a force of about 20 kg. The nut should not move more than 10 microns.
4. Calculate the ballscrew nut stiffness as follows:

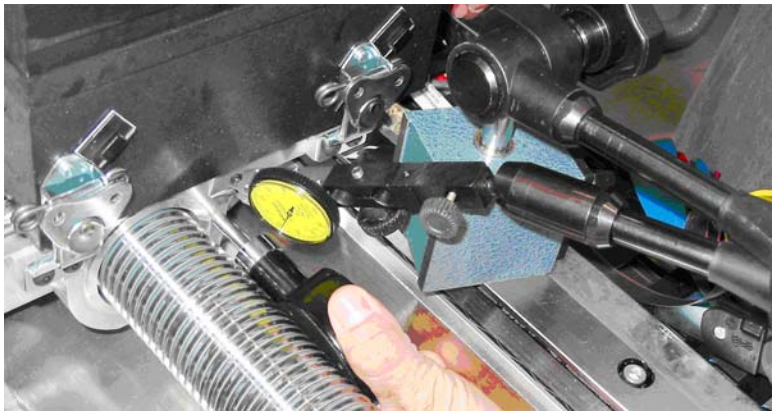
$$\frac{Force(kgf)\times 10}{Deflection(\mu m)} = stiffness(N/\mu m)$$

The ballscrew nut stiffness should be about 20-25 N/µm.

Carriage stiffness measurement

This measurement checks the stiffness of the carriage relative to the carriage rails. Use the lower range force gauge for this measurement—the FDK 20 gauge.

1. Set up the dial gauge to measure the carriage stiffness.



2. Remove the gauge backlash by pushing on the carriage with a force of about 20 kg. Release the carriage and see if the indicator on the dial gauge returns to the same position. Repeat the pushing and releasing on the carriage until the dial gauge consistently returns to the same position.
3. Push on the carriage close to the location of the dial gauge until you read 6 µm deflection on the gauge. The carriage should not move more than about 6 microns.
4. Read the applied force on the force gauge, and calculate the stiffness:

$$\frac{Force(kgf)\times 10}{Deflection(\mu m)} = stiffness(N/\mu m)$$

The carriage stiffness should be about 8-10 N/µm.

Head stiffness measurement

This measurement checks that the head is mounted securely to the carriage.

1. Set up the dial gauge near the center of gravity of the head (touching solid metal, not sheet metal which is prone to local deflection).



2. Remove the gauge backlash by pushing on the head with a force of about 20 kg. Release the head and see if the indicator on the dial gauge returns to the same position. Repeat the pushing and releasing on the head until the dial gauge consistently returns to the same position.
3. Push on the head close to the location of the dial gauge until you read 6 µm deflection on the gauge. The head should not move more than 6 microns.
4. Read the applied force on the force gauge, and calculate the stiffness:

$$\frac{Force(kgf)\times 10}{Deflection(\mu m)} = stiffness(N/\mu m)$$

The head stiffness should be about 4.5 N/µm or more.

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