CNC Milling Machine Spindle Runout Verification

1.0 Maintenance Objective & Frequency

The objective of this procedure is to verify and correct spindle runout on a CNC milling machine to ensure concentric rotation of the cutting tool, prevent excessive tool wear, and maintain part dimensional accuracy. This PM is performed monthly or every 500 operating hours, whichever comes first, or immediately if a quality issue is suspected.

2.0 Lockout/Tagout (LOTO) & Safety

- Electrical Isolation: Disconnect main power to the machine at the disconnect switch and apply a personal lock and tag.
- Pneumatic Isolation: Close the main air supply valve and bleed any residual pressure from the tool changer and spindle air blast lines.
- Hydraulic Isolation: If equipped with a hydraulic counterbalance or clamping system, isolate and depressurize the hydraulic unit.
- Mandatory PPE: Safety glasses with side shields, cut-resistant gloves, and steel-toed boots.

3.0 Required Tools, Parts & Lubricants

- 0.0001 inch (0.002 mm) resolution dial indicator with magnetic base
- Precision ground test bar (ISO 30/40/50 taper as per machine spindle)
- Clean lint-free wipes (Kimwipes or equivalent)
- Isopropyl alcohol (99%) in a spray bottle
- Torque wrench (range 10-50 Nm) with appropriate spindle drawbar adapter
- Spindle cleaning tool (taper brush or plastic scouring pad)

4.0 Step-by-Step Maintenance Procedure

1. Perform LOTO as per Section 2.0. Verify zero energy state by attempting to start the spindle (machine should not power on).
2. Clean the spindle taper thoroughly using the spindle cleaning tool and isopropyl alcohol. Wipe dry with a lint-free wipe. Inspect for nicks, burrs, or discoloration.
3. Insert the precision ground test bar into the spindle taper. Ensure it is fully seated. Do not use the drawbar yet.
4. Engage the spindle drawbar using the torque wrench. Torque to the OEM specification (typically 35 Nm for ISO 40, 45 Nm for ISO 50). Record the torque value.
5. Mount the dial indicator on the magnetic base and attach it to the machine table or a rigid fixture. Position the indicator plunger perpendicular to the test bar surface, approximately 100 mm from the spindle nose.
6. Zero the dial indicator. Rotate the spindle by hand (or using jog mode at low RPM if LOTO is removed) through one full revolution. Observe the maximum and minimum readings. Calculate the total indicated runout (TIR) as the difference.

7. If TIR exceeds 0.0005 inches (0.013 mm) at 100 mm from the nose, the spindle bearings or taper may be worn. Proceed to step 8. If within spec, skip to step 10.

8. Remove the test bar. Re-clean the spindle taper and inspect for debris or damage. Re-install the test bar and repeat the measurement. If runout remains high, the spindle requires bearing replacement or taper regrinding. Document and escalate.

9. If runout is acceptable, remove the test bar. Clean the spindle taper again with isopropyl alcohol and a lint-free wipe. Apply a light film of spindle oil (ISO VG 10) to the taper if recommended by OEM.

10. Remove LOTO tags and locks. Restore power and air supply. Perform a warm-up cycle: run spindle at 1000 RPM for 5 minutes, then 3000 RPM for 5 minutes.

5.0 Verification & Return to Service

1. After warm-up, repeat the runout measurement (steps 5-6) with the spindle at operating temperature. TIR must remain within 0.0005 inches (0.013 mm).

2. Install a known good cutting tool (e.g., a new end mill) and perform a test cut on a scrap piece of aluminum or mild steel at typical feed and speed. Check surface finish and dimensional accuracy with a micrometer.

3. Verify that the tool changer operates smoothly and that the tool is seated correctly in the spindle after each change.

4. Record the runout readings, torque value, and any corrective actions taken in the maintenance log within ServiceGrid. Sign off on the PM work order.

5. Return the machine to production. Monitor the first three parts for quality compliance.