Teaching materials
Deliverable 1. Static Burnishing Analysis

MISCE project

Mechatronics for Improving and Standardizing Competences in Engineering

Competence: Mechanical systems

Workgroup: RzuT, UNICA, UCLM, UNICAS

This document corresponds to the first burnishing exercise for the competence 'Mechanical Systems'. ' Exercise 1 - Static Burnishing Analysis'

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1 Static Burnishing of a Shaft During Rotation

1.1 Objective of the Exercise

- Investigate the influence of indentation force on the depth of indentation and the surface quality of a rotating aluminium shaft.
- Compare the results for two different values of indentation force.

1.2 Task Description

1. The teacher mounts the aluminum shaft on the lathe and sets its rotational speed (*n*), ensuring a uniform rotation.
2. The indentation (burnishing) process involves statically pressing the ball indenter head (diameter $s = 3\ mm$) against the rotating shaft.
3. Perform two experiments over one full rotation of the shaft:
    a. On the HMI, select the Static option (Fig. 1, 1) to initialize the static burnishing process.
    b. Use the slider (Fig. 2, 1) to set the maximum pressing force.
    c. Enable the motor by ticking the Enable Motor checkbox (Fig. 2, 2).
    d. Use the Left and Right buttons (Fig. 2, 3) to move the burnisher head toward the aluminum shaft.
    e. When the pressing force reaches the set maximum, the servo automatically stops.

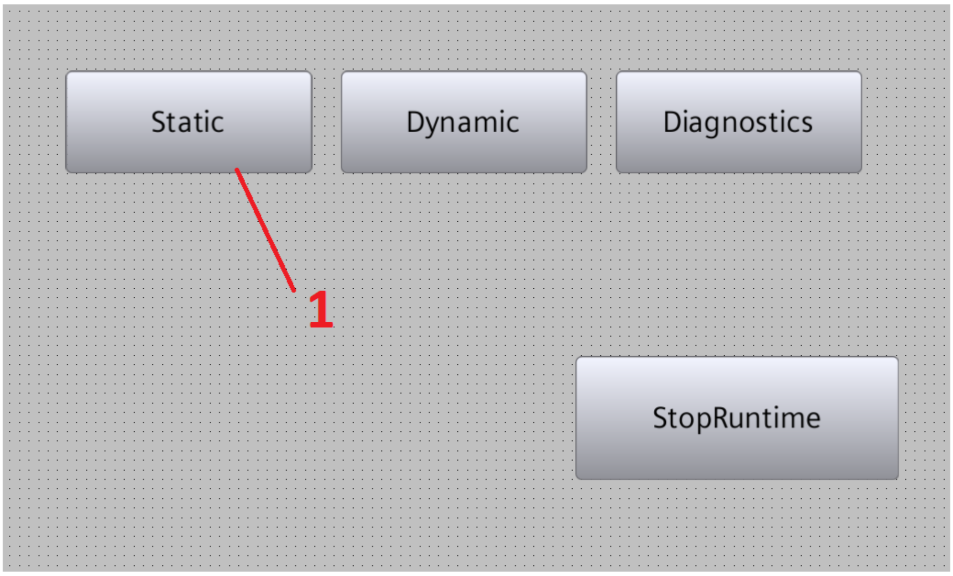

Fig. 1 Main menu

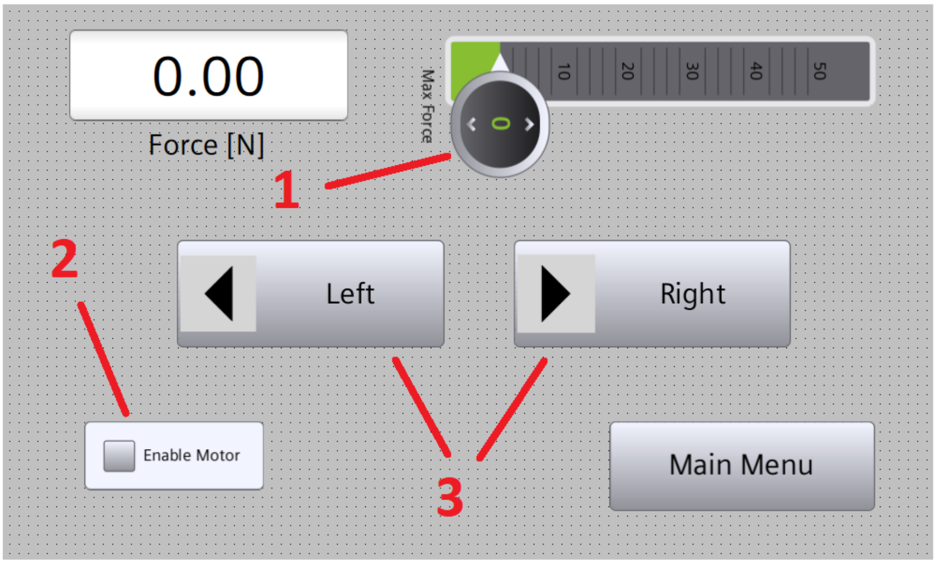

Fig. 2 Static burnishing menu

4. After completing the indentation process, the teacher will stop the lathe and retract the burnisher. Then measure:
    - The average depth of indentation (δ),
    - Surface quality (e.g., roughness) using a profilometer.
5. Carry out two cases:
    - Case 1: Indentation with force F_1,
    - Case 2: Indentation with a higher force F_2.
6. Perform calculations according to the previously presented theory:
    - Diameter of indentation:

$$d = \sqrt{\frac{0.408F}{\pi D\ \mathrm{HB}} - \left(\frac{0.204F}{\pi D\ \mathrm{HB}}\right)^2},$$

    - Depth of indentation:

$$\delta = R - \sqrt{R^2 - \left(\frac{d}{2}\right)^2}.$$

7. Based on the results of the calculations, compare the impact of forces F_1 and F_2 on the depth of indentation and surface uniformity.

1.3 Expected Results

- Comparison of results for two values of indentation force (F_1 and F_2).
- Graphs showing the relationship between indentation depth and indentation force.
- Assessment of the shaft surface quality after the indentation process.