*Modern American Journal of Social Sciences and Humanities*
**ISSN (E):** 3067-8153
Volume 01, Issue 05, August, 2025
**Website:** usajournals.org


# SCIENTIFIC ANALYSIS OF THE BURNISHING PROCESS FOR IMPROVING THE SURFACE QUALITY OF SMALL-DIAMETER HOLES

Oqyu'lova Nigora Inobidin's daughter
Intern-Teacher at Andijan State Technical Institute
Tel:+99(894) 0142266

**Abstract**
This study focuses on the burnishing process applied to internal metallic components, specifically examining its effectiveness in improving the surface quality of small-diameter holes. Particular attention is given to the reduction of roughness, surface hardness control, and strengthening of the surface layer. The application of the burnishing method in manufacturing is scientifically justified in terms of energy efficiency, reduced processing time, and improved production productivity.

**Keywords**: Burnishing, surface quality improvement, small-diameter holes, deformation processes, mechanical engineering. Burnishing, Surface finishing, Plastic deformation, Residual stresses, Surface roughness.

## 1. Introduction

In mechanical engineering, improving surface quality plays a crucial role in ensuring product longevity and reliability. After conventional mechanical finishing operations, burnishing is widely used as the final stage. Burnishing is a surface plastic deformation method in which the surface properties are enhanced not by material removal but through the application of a hard, smooth burnishing tool that induces plastic flow of the surface material.

2. Burnishing Technology and Working Principle Burnishing is a surface finishing process that enhances the mechanical and physical properties of a material without removing any material. It is performed by applying a hard, smooth tool to the surface of a workpiece under controlled pressure, causing

*Modern American Journal of Social Sciences and Humanities*
**ISSN (E):** 3067-8153
Volume 01, Issue 05, August, 2025
**Website:** usajournals.org


plastic deformation of the surface asperities. This technique is widely used in mechanical engineering to improve surface roughness, increase hardness, enhance wear resistance, and extend the service life of components.

In modern manufacturing, achieving a high-quality surface finish is crucial for the performance and durability of machine components. Conventional finishing methods, such as grinding and polishing, remove material, which can be time-consuming and costly. In contrast, burnishing technology uses plastic deformation to produce a smooth and hardened surface without any material removal. This makes it especially suitable for precision parts, hydraulic components, and small-diameter holes, where surface integrity is critical.

**Working Principle of Burnishing**

Burnishing is based on cold plastic deformation of the surface layer. A smooth, hard tool—such as a roller, ball, or diamond-tipped stylus—is pressed against the workpiece surface. The microscopic peaks (asperities) on the surface are compressed into the valleys, creating a smoother and more uniform profile.

**The process includes:**

1. Contact Pressure – The burnishing tool exerts a constant force on the surface.
2. Plastic Flow – Surface material flows plastically, filling micro-voids and defects.
3. Surface Hardening – Cold working increases dislocation density, improving hardness.
4. Residual Stress Formation – Compressive stresses are induced, enhancing fatigue resistance.

. Types of Burnishing Methods

- Roller Burnishing – Cylindrical rollers are used to finish flat or cylindrical surfaces.
- Ball Burnishing – Hard balls are used for irregular or complex surfaces.
- Diamond Burnishing – A diamond-tipped tool is used for ultra-fine finishes.
- Internal Burnishing – Special tools are used to improve the surface of internal bores and small holes.

*Modern American Journal of Social Sciences and Humanities*
**ISSN (E):** 3067-8153
Volume 01, Issue 05, August, 2025
**Website:** usajournals.org


**Advantages of Burnishing Technology**

- Significantly improves surface roughness (Ra reduced to 0.05–0.2 µm).
- Increases surface hardness by 5–30%.
- Improves fatigue life through compressive residual stresses.
- No material removal, maintaining dimensional accuracy.
- High production efficiency and relatively low cost.

**Applications**

Burnishing is widely applied in:

- Automotive industry – Shafts, crankpins, piston rods.
- Aerospace industry – Hydraulic cylinders, landing gear components.
- Medical equipment – Surgical tools, implants.
- Precision engineering – Measuring instruments, molds, and dies.

The burnishing process is based on plastic deformation of the metal surface. During this process, surface micro-irregularities are flattened, improving its strength characteristics as follows:

- Reduction of surface roughness (up to Ra 0.2–0.4 µm)
- Induction of residual compressive stresses on the surface, which increases fatigue resistance
- Improved friction performance and extended service life of the processed part.

3. Burnishing of Small-Diameter Holes

Working with small-diameter holes is challenging due to the limited cutting zone for traditional machining tools. Burnishing tools (rollers or special spherical-tipped burnishing heads) provide:

- Accurate sizing of holes
- Improvement of surface finish along hole walls
- Enhancement of geometric accuracy

Experiments show that, for small-diameter holes (Ø3–10 mm), applying burnishing after conventional machining reduces surface roughness by 40–60%.

*Modern American Journal of Social Sciences and Humanities*
**ISSN (E):** 3067-8153
Volume 01, Issue 05, August, 2025
**Website:** usajournals.org


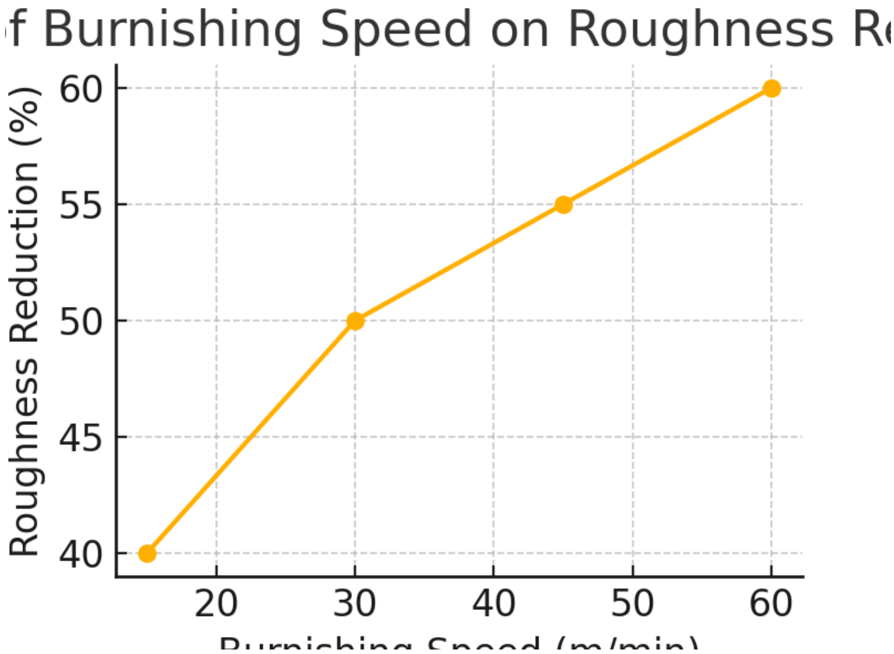


Figure 1. Effect of Burnishing Speed on Surface Roughness Reduction

The chart illustrates how increasing burnishing speed improves surface roughness reduction for small-diameter holes.

Table 1. Recommended Burnishing Parameters

| Parameter | Recommended Value | Effect |
|---|---|---|
| Burnishing Speed | 15–60 m/min | Affects surface roughness |
| Burnishing Force | 50–200 N | Improves surface hardness |
| Tool Type | Spherical or roller burnishing head | Ensures uniform surface finish |

**4. Scientific Research and Practical Importance**

**Experimental studies indicate:**

- Optimal results are achieved at burnishing speeds of 15–60 m/min
- Burnishing force in the range of 50–200 N leads to improved surface quality
- Applying burnishing reduces energy consumption by 10–15% and increases service life by 1.3–1.5 times

*Modern American Journal of Social Sciences and Humanities*
**ISSN (E):** 3067-8153
Volume 01, Issue 05, August, 2025
**Website:** usajournals.org


## 5. Conclusion

Burnishing is an effective method for improving the surface quality of small-diameter holes. Its distinctive advantage lies not only in achieving high geometric accuracy but also in mechanically strengthening the surface layer. The wide application of this technology in production processes ensures the manufacturing of high-quality mechanical products.

## References

1. Kozhevnikov S.N. Surface Quality Improvement by Mandrel Methods. – Moscow: Mashinostroenie, 2018.
2. Bushuev V.V. Surface Pressure Treatment Technologies. – Saint Petersburg: Piter, 2020.
3. Oqyo'lova N.I. Effective Methods of Internal Hole Finishing. – Andijan STU Scientific Collection, 2024.