

# DESIGN AND FABRICATION OF SKIVING AND BURNISHING TOOL

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**Abstract** - Skiving machines cut material in slices. This is similar to the procedure of cutting or laminating leather and laminates. The process is employed rather than rolling the material to shape when the material is not to be work hardened, or must not shed metal later which generally occur in cold rolling processes. Tighter tolerance can be achieved with the help of skiving. Generally, plain cutting tool is used while machining on a lathe. Skiving usually precedes burnishing. It is carried out in automatic lathes. Burnishing is a finishing operation, by which surface finish dimensional accuracy, work hardening can be improved, without the removal of metal. Mostly, ductile or malleable material can be burnished. This is a metal forming process.

**Key Words:** Skiving, rolling, tolerance, burnishing, hardening.

## 1. INTRODUCTION

The skiving are often applied to a wide range of applications and materials. In leather, skiving knives used to trim the thickness of the leather, usually around the edges, to thin the material and create it easier to work with. In metal working, skiving used to take away a thin dimension of material or to cut thin slices in an existing material, such as heat sinks where a large amount of surface area is required relative to the volume of the piece of metal.

Skiving are also used to gear cutting, where internal gears are skived with a rotary cutter (rather than shaped or broached) in a process analogous to the hobbing of external gears. There are many forms of burnishing processes. The common methods are roller burnishing and ball burnishing. In each case, a burnishing tool runs against the work piece and plastically deforms its surface. In some instances of the latter case it rubs, in the former it generally rotates and rolls. The work piece may be at an ambient temperature, or heated to reduce the forces and wear on the tool. The tool is hardened and coated with special materials to extend its life.

## 2. LITERATURE REVIEW

From the papers "Combination Skiving and Burnishing for cylinder Bores " and " Tool and manufacturing engineers handbook" by the authors Derek Korn and Backerjian, the basic principle and the working of burnishing process has been understood and the burnishing process on a lathe has been implemented using roller burnisher.

The selection of materials for the tool was referred from the Journal Manufacture and Materials - Materials for Cutting Tools by Dr David J Griev.

The working and operations of automatic lathe has been studied from the papers "Textbook of Elements of Mechanical Engineering" by Murthy, S. Trymbaka and "Hints & Tips for Using a Lathe" by George Wilson.

The fabrication and specification of the tool was referred from "Production Technology" by HMT tools.

## 3. WORKING OF SKIVING AND BURNISHING

### 3.1 SKIVING ON A LATHE

Shafts can be skived with a HSS skiving tool with zero back rake or rake angle and 12.5° front clearance. The skiving tool is placed at the bottom of the work piece and the shaft is rotated in the reverse direction for better removal of the material. No coolant is used while skiving since very little amount of heat is generated.

The cutting speed depends on the material of the work piece and it varies from 300-700 rpm.

Tool material: High Speed Steel.



Fig -1: SKIVING ON A LATHE

### 3.2 BURNISHING ON A LATHE

Roller burnishing is used for finishing with the help of a lathe. Metals that work must be at lower hardness. The depth of surface hardness by roller burnishing ranges from 0.1 to 0.7 mm.

The quality of the obtained surface finish in roller burnishing depends on the work piece hardness, ductility of the work piece and the material of the burnishing tool.

Hardness of the work piece must be lower than the tool. High hardness work piece can also be rolled, but the tool life becomes shorter.



Fig -2: BURNISHING ON A LATHE

#### 4. MATERIAL SELECTION

Table -1: TOOL AND MATERIAL

TOOL	MATERIAL
SKIVING	HSS M42
BURNISHING ROLLER	HSS D2
BURNISHING BODY	EN8 CARBON STEEL

##### 4.1 M42 SUPER HIGH SPEED STEEL

M42 super high speed steel is a cobalt high speed steel with a composition designed for high hardness and superior hot hardness. These properties make the steel an excellent choice for machining high-strength and pre-hardened steels, high-hardness alloys, and the difficult-to-machine, nonferrous super alloys used in the aerospace, oil, and power generation industries.

M42 exhibits good wear resistance by virtue of heat-treated hardness (68 - 70 HRC), and the high cobalt content imparts the hot hardness. As such, the cutting edges on tools made up of M42 super high speed steel are sharp and hard in heavy-duty and high-production cutting applications.

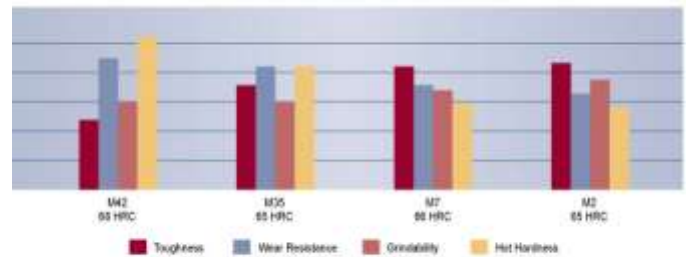


Chart -1: PROPERTIES OF M42 HSS

##### 4.2 D2 Super High Speed Steel

D2 alloy Steel is a high-carbon, high-chromium, air-hardening tool steel that characterized by a relatively attainable hardness and diverse chromium-rich alloy carbides in the microstructure. These carbides offer good resistance to wear from sliding contact.

Although other steels with improved toughness or improved wear resistance are available, D2 provides an effective combination of wear resistance and toughness, tool performance, price, and a wide variety of product forms. Also available as an Electro-Slag-Remelted (ESR) product. The remelting method improves homogeneity, refinement of carbide size, and the associated enhancements in mechanical and fatigue properties.

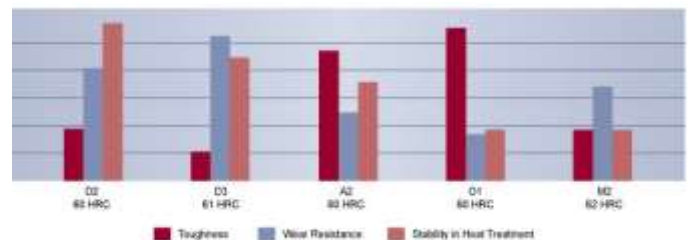


Chart -2: PROPERTIES OF D2 HSS

##### 4.3 EN8 CARBON STEEL

EN8 is medium steel usually being untreated on supply. EN8 has good tensile strength and is often used in applications such as: shafts, gears, stressed pins, studs, bolts, keys etc. EN8 is a very popular grade and is readily machinable in any condition. It is further surface-hardened to supply materials with enhanced resistance of wear, typically within the range of 50-55 HRC through induction processes. It is also available in free-machining versions, EN8DM and EN8M (212A42).

#### 5. TOOL DESIGN

2D Drawing is done in AutoCad software and 3D Modeling is done in Creo parametric software.

### 5.1 SKIVING TOOL

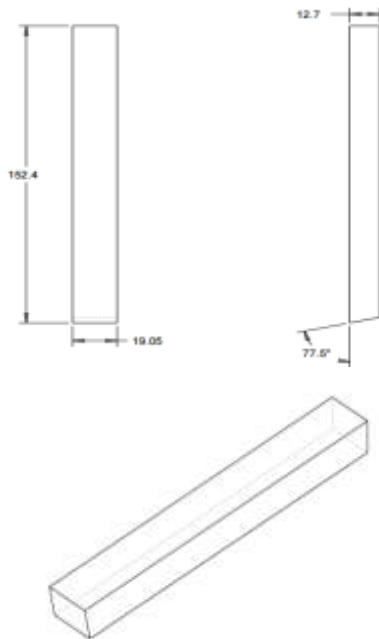


Fig -3: 2D AND 3D MODEL OF SKIVING TOOL

### 5.2 BURNISHING TOOL

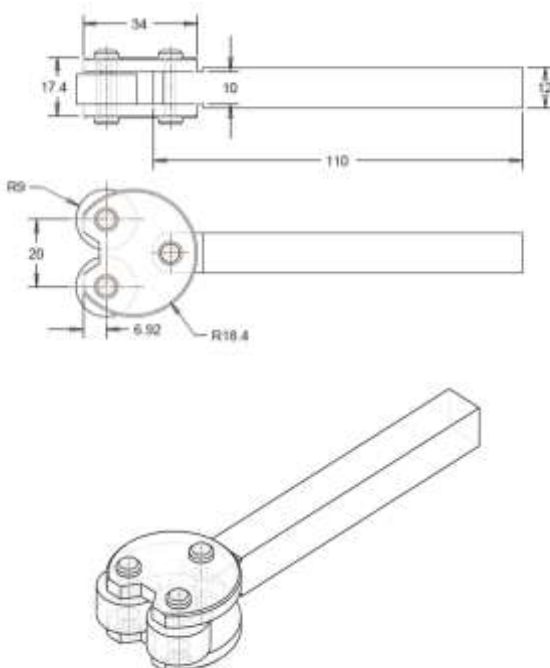


Fig -4: 2D AND 3D MODEL OF BURNISHING TOOL

## 6. DESIGN CALCULATION

Cutting speed,  $v = \pi DN / 1000$  mm/min

D = Diameter of the workpiece (mm)

N = Spindle speed (r.p.m)

$$v = 3.14 * 18 * 300 / 1000 = 16.96 \text{ mm/min}$$

The cutting force of the tool is given by the formula:

$$F = K_s * f * d * v \text{ where,}$$

P = Cutting force in kgf

Ks = Specific cutting force of the material in kgf/mm<sup>2</sup>

(63 for Aluminium)

f = rate of feed (mm/s)

d = depth of cut (mm)

v = cutting speed (mm/min)

$$F = 260 \times .06 \times .1 \times 16.96$$

$$F = 26.45 \text{ kgf}$$

## 7. FABRICATION OF THE TOOLS

### 7.1 SKIVING TOOL

Using tool and cutter grinder CNC, the metal block made of M42 HSS (152.40\*19.05\*12.7) is cut by an angle of 12.5°, so that the angle at the edge is reduced to 77.5°. Hence, the required specification of the tool is obtained using the tool and cutter grinder CNC.

### 7.2 BURNISHING TOOL

The cylindrical bar made of EN8 Carbon Steel was step turned with two different diameters on a conventional Lathe. The specimen is turned to 9 mm as per the required dimension for the roller.

The Grinding process was used to shape and sharpen the HSS tool to be used in the cutting process. It also resharpen the tool when it gets blunt and thus allows the tool to be reused to a particular extent.

Hardening is done to have a higher resistance to plastic deformation. The hardness of the material is increased to about 48-50 HRC.

Polishing and buffing are finishing processes used for smoothing surfaces of workpiece using an abrasive and a work wheel.

Milling used for machining parts to precise sizes and shapes. The burnishing tool body is milled to the required dimensions.

A metal pin passing through holes in two or more plates, to hold them together, is made with a head at one end and the other end being hammered into a head after insertion. The

body and head of the burnishing tool is riveted into a single body.

**8. PHOTOGRAPH OF FABRICATED MODEL**



**Fig -4:** FABRICATED MODEL OF TOOLS

(Skiving tool, Burnishing tool and workpiece being skived and burnished)

**9. COST ESTIMATION**

**Table -2:** ESTIMATED COST

CONTENTS	COST
RAW MATERIAL	Rs 1600/-
BURNISHING ROLLER	Rs 1100/-
BURNISHING BODY	Rs 2700/-

**10. CONCLUSION**

The tools are successfully designed and fabricated to perform skiving and burnishing efficiently and economically on a lathe. The tool material of High Speed Steel was chosen for machining the mild steel workpiece. The tool life depends on the work piece .hence for longer tool life can be obtained with lesser hardness material in case of both the processes .This project has proven to be advantageous to perform skiving and burnishing on a lathe.

**11. FUTURE SCOPE**

The Design of the tool holder can be made to specifically suit CNC Mills and easy removal of tool. The tool can be made out of Carbide Material to work with harder jobs. Gear skiving can be performed using CNC power machine for formation of gears. Burnishing can be performed on complex workpieces using CNC machine.

**REFERENCES**

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**BIOGRAPHIES**



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