<u>Objective</u>: Familiarize with subtractive machining operations

A. SAFETY PRECAUTIONS

a. Always wear Eye Protection
a. Remove any adjusting key or wrench before turning the power tool on.
b. Dress properly. Do not wear loose clothing or jewelry. Keep your hair, clothing and gloves away from moving parts.

B. REPORT WRITING

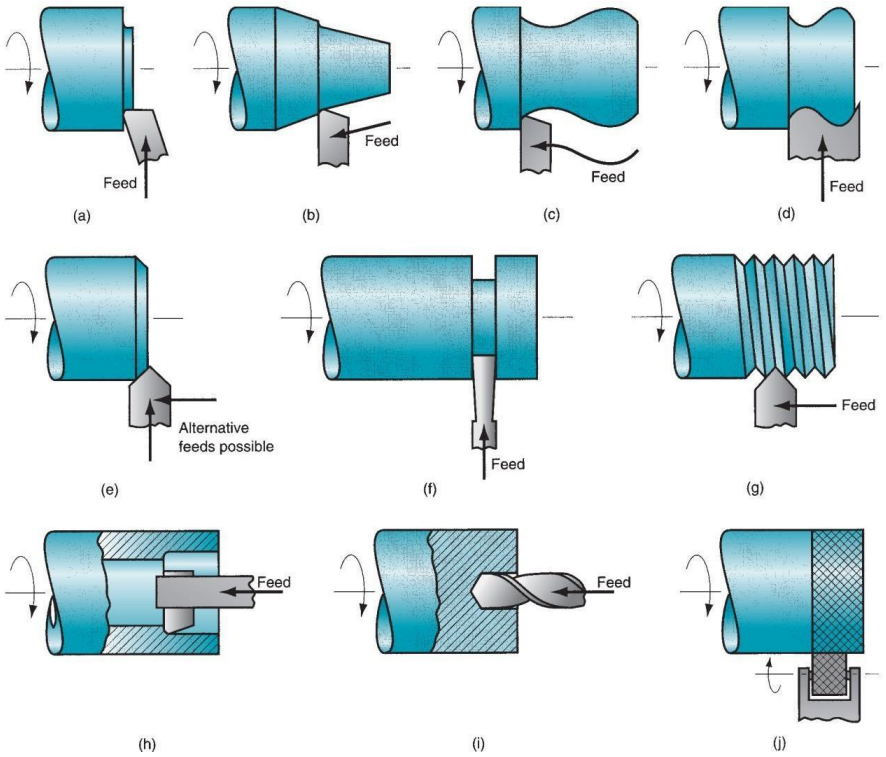
1. Each student will submit a **hand-written** report in the lab itself with the **name, and roll no.** on the first page of the report. Each student will write two different reports for (i) Lathe and (ii) Drilling/Dremel. Each student will be provided with one blank A4 sheet for the same: Use front-side for Lathe and back-side of the same sheet for Drilling/Dremel.

The report must include answers to the following questions:

1. Type/Name of machine which you have worked on [Lathe, Drilling, Dremel].
2. Write the sequence of operations for each specimen from the raw material to the finished stage.
3. Write down the necessary calculations for (i) Material Removal Rate (MRR) and Taper Angle for Lathe and (ii) MRR and Machining Time for Drilling

INTRODUCTION TO LATHE PRACTICES

Turning and associated process like facing, taper turning are machining processes in which a single-point tool removes material from the surface of a rotating workpiece. The tool is fed linearly in a direction parallel or at certain angle to the axis of rotation to generate a cylindrical/conical geometry on a **lathe machine**.



A. Cutting Parameters for Material Removal Rate

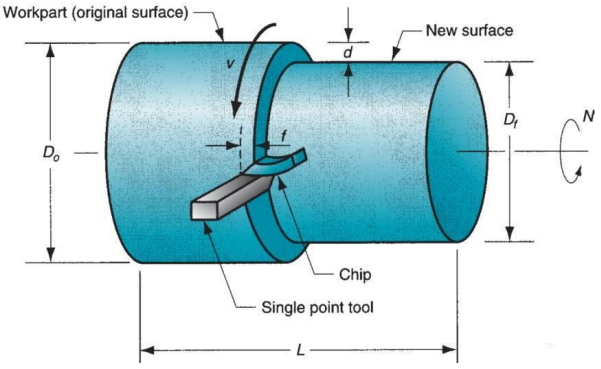
Spindle speed: N (rpm)

Cutting velocity: V (mm/s)

Feed: f (mm/rev)

Feed rate: f_r (mm/s)

Depth of Cut: d (mm)



B. Equations

$V = \pi DN / 60$ **1**

$f_r = fN/60$ **2**

Material Removal Rate (MRR) = Vfd (mm^3/s) **3**

Taper angle = $\tan^{-1}((d1-d2)/(2*L))$ **4**

C. Instruction for calculating Material Removal Rate

1. Ask the operator for the spindle speed (N, rpm) during the particular operation.
2. Measure the diameter (D) of given workpiece.
3. Calculate the velocity (V) from equation 1.
4. Ask the operator to provide the information about Feed (f) & feed Rate (f_r) during particular operation.
5. Calculate the feed (f) using feed rate (f_r) if not already provided by the operator using equation 2.
6. Measure the depth of cut (d) for particular operation.
7. Calculate the MRR from Equation 3.

D. Instruction for calculating Taper Angle

1. Measure the smaller (d2) diameter, larger diameter (d1), and length (L) of taper.
2. Calculate the taper angle from equation 4.

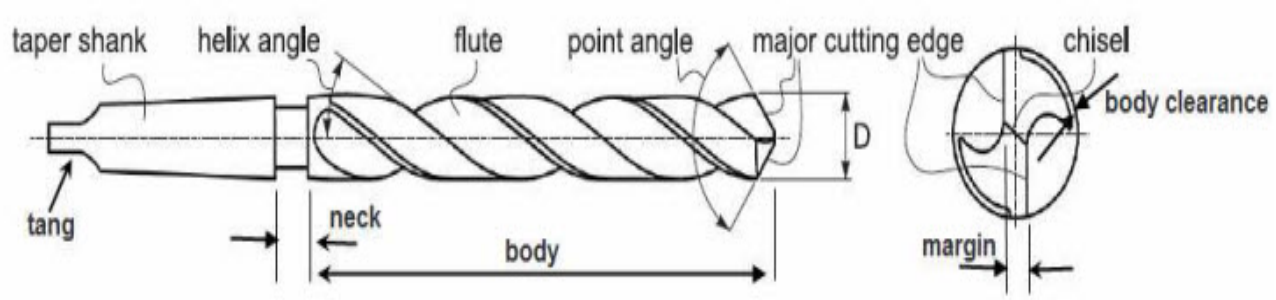
From Operator: N, fr,

Measure: D, d, d1, d2, L

Calculate: V, f, MRR, taper angle

INTRODUCTION TO DRILLING

Drilling is a process of producing round holes in a solid material or enlarging existing holes with the use of multi-tooth cutting tools called drills or drill bits. Various cutting tools are available for drilling, but the most common is the twist drill.



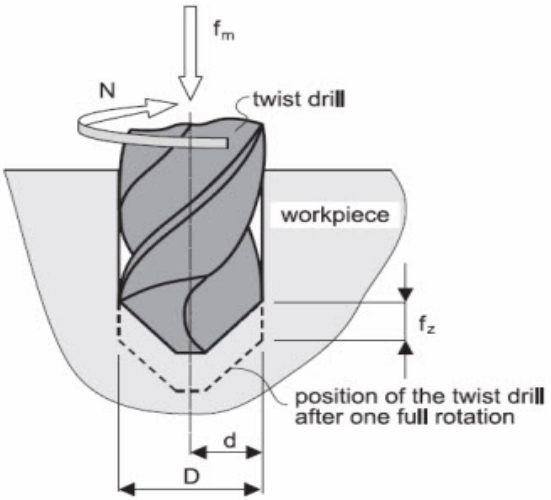
A. Cutting Parameters

Spindle Speed: N (rpm)

Feed: f (mm/rev)

Length of hole: L (mm)

Diameter of drill: D (mm)



B. Equation

$$MRR = (\pi D^2/4) * f * N$$

$$Time = L / (f * N)$$

C. Instructions for calculating MRR

1. Ask the operator the spindle speed (N, rpm) during the particular operation.
2. Measure the diameter of the hole drilled (mm) or ask the operator for diameter of the drill (mm).
3. Ask the operator for feed (mm/rev) during the particular operation.
4. Use the MRR equation provided to calculate the MRR (mm^3/min)

D. Instructions for calculating Total Time

1. Ask the operator the spindle speed (N, rpm) during the particular operation.
2. Measure the Length of the hole drilled (L, mm).
3. Ask the operator for feed (mm/rev) or during the particular operation.
4. Use the Time equation provided to calculate the Time (min)

From Operator**:** N, f

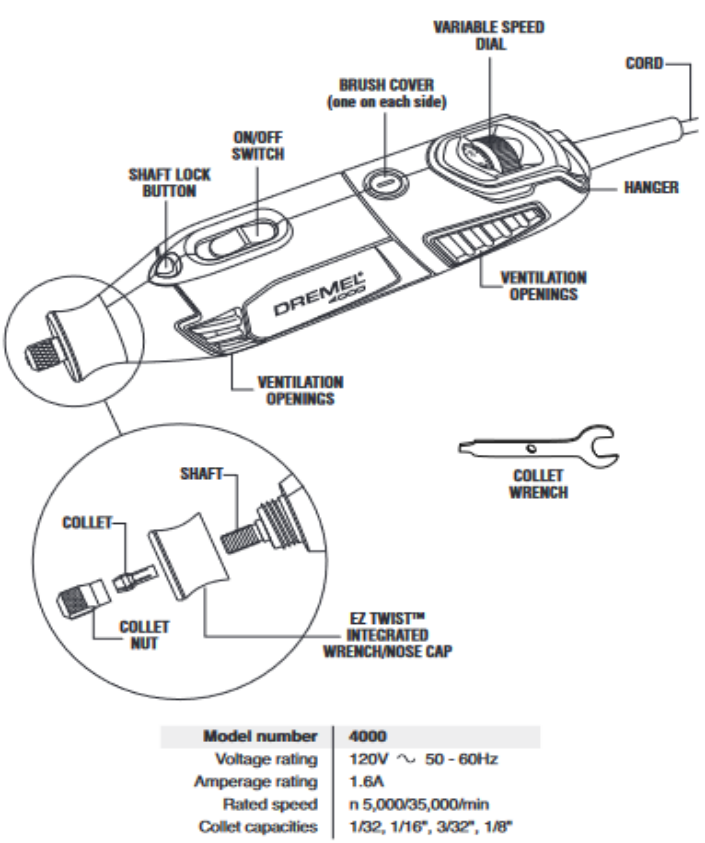
Measure**:** D, L

Calculate**:** MRR, Time

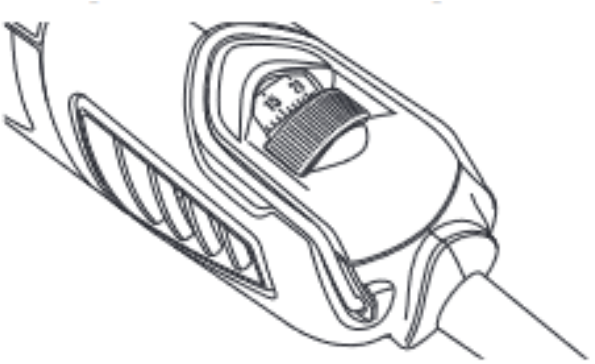
INTRODUCTION TO DREMEL

Dremel is a post-processing tool mainly used for Dimensioning holes and Micro-finishing (Sanding, Cutting, Finishing, Polishing and Roughing)

Model 4000 High Speed Rotary Tool



Model number	4000
Voltage rating	120V ∿ 50 - 60Hz
Amperage rating	1.6A
Rated speed	n 5,000/35,000/min
Collet capacities	1/32, 1/16", 3/32", 1/8"



Settings for Approximate Revolutions.

Switch Setting	Speed Range
5	5,000-7,000 RPM
*10	7,000-10,000 RPM
15	13,000-17,000 RPM
20	18,000-23,000 RPM
25	23,000-27,000 RPM
30	28,000-32,000 RPM
35	33,000-35,000 RPM

* Wire Brush Setting.

Accessories

- Collets

COLLETS

Collets are used for accommodating different shank sizes.

- Mandrel

Screw Mandrel No 401

A Mandrel is a shank with a threaded or screw head, which are required when you use polishing accessories, cutting wheels, sanding discs and polishing points. The reason mandrels are used is that sanding discs, cutting wheels and similar accessories must be replaced frequently. The mandrel is a permanent shank, allowing you to replace only the worn head when necessary, thus saving the expense of replacing the shaft each time.

- High Speed Cutters

High Speed Cutters

Available in many shapes, high speed cutters are used in carving, cutting and slotting in wood, plastics and soft metals such as aluminum, copper and brass.

- Tungsten Carbide Cutters

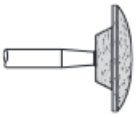
Tungsten Carbide Cutters

These are tough, long-lived cutters for use on hardened steel, fired ceramics and other very hard materials. They can be used for engraving on tools and garden equipment.

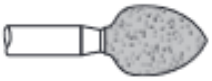
- Structured Tooth Tungsten Carbide Cutters

Fast cutting, needle-sharp teeth for greater material removal with minimum loading. Use on fiberglass, wood, plastic, epoxy and rubber.

- Aluminium Oxide and Silicon Carbide Grinding Stones



Aluminum Oxide Grinding Stones (red/brown)



Silicon Carbide Grinding Stones (blue/green)

Aluminum Oxide Grinding Stones are made of aluminum oxide and cover virtually every possible kind of grinding application. Use to remove flash from metal castings, deburring any metal after cutting, smoothing welded joints, grinding off rivets and removing rust. Silicon Carbide Grinding Stones are tougher than aluminum oxide points, these are made especially for use on hard materials such as glass and ceramics.

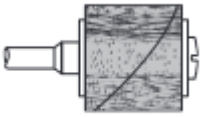
- Polishing Accessories

These include an impregnated polishing point and an impregnated polishing wheel for bringing metal surfaces to smooth finish and high luster.

- Aluminium Oxide Abrasive Wheels

Use to remove paint, deburr metal, polish stainless steel and other metals.

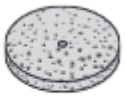
- Sanding Accessories



Sanding Accessories

Sanding discs come in fine, medium and coarse grades. They can be used for nearly any small sanding job you might have, from model making to fine furniture finishing.

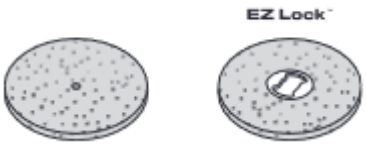
- Grinding Wheel



Grinding Wheel

Use for deburring, removing rust, and general-purpose grinding.

- Cutting Wheels



These thin discs of emery or fiberglass are used for slicing, cutting off and similar operations. Use them for cutting off frozen bolt heads and nuts, or to reslot a screw head which has become so damaged that the screwdriver won't work in it. Fine for cutting BX cable, small rods, tubing, cable and cutting rectangular holes in sheet metal.

- Brad Point Drill Bits

Titanium coated brad points stay on center and begin drilling immediately. For use on wood.

- HSS Drill Bits

HSS drill bit for use in metal and plastic.

Safety Precautions

1. Always wear eye protection.
2. Remove any adjusting key or wrench before turning the power tool on.
3. Dress properly. Do not wear loose clothing or jewelry. Keep your hair, clothing and gloves away from moving parts.
4. Prevent unintentional starting. Ensure the switch is in the off-position before connecting to power source and / or battery pack, picking up or carrying the tool.
5. Do not force the power tool. Use the correct power tool for your application.