POLITEKNIK MALAYSIA
MELAKA

WORKSHOP TECHNOLOGY

DJJ 10033

E-BOOK

WORKSHOP TECHNOLOGY

CHAPTER 2 DRILLING

WORKSHOP TECHNOLOGY- DRILLING

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PREFACE

I would like to express my sincere gratitude to Politeknik Melaka for their invaluable support and guidance during the creation of this e-book on drill presses. The knowledge and resources provided by the institution have greatly contributed to the development of this comprehensive guide.

I extend my heartfelt appreciation to the Mechanical Department members and staff of Politeknik Melaka for their unwavering commitment to academic excellence. Their expertise and dedication in imparting knowledge and skills in the field of engineering and technology have been instrumental in shaping the content of this e-book.

Finally, I extend my deepest appreciation to all individuals who have directly or indirectly contributed to the creation of this e-book on drill presses. Your unwavering support, expertise, and encouragement have been indispensable in bringing this project to fruition.

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ABSTRACT

This e-book on drilling, created for the subject Workshop Technology (DJJ 10033), serves as a comprehensive guide for students studying in the field of workshop technology and related disciplines. The purpose of this e-book is to provide a detailed understanding of drilling processes, techniques, and equipment used in various i ndustrial and workshop settings.

The content of the e-book covers a wide range of topics related to drilling, including the fundamentals of drilling operations, types of drilling machines, drill bits, drilling techniques, safety considerations, and practical applications.

Throughout the e-book, emphasis is placed on the importance of safety precautions, proper machine setup, an d correct drilling techniques to minimize risks and ensure optimal results. The content is structured in a logical a nd organized manner, allowing readers to progress from the basics of drilling to more advanced concepts and applications.

TABLE OF CONTENT

COURSE LEARNING OUTCOMES

Students should be able to:

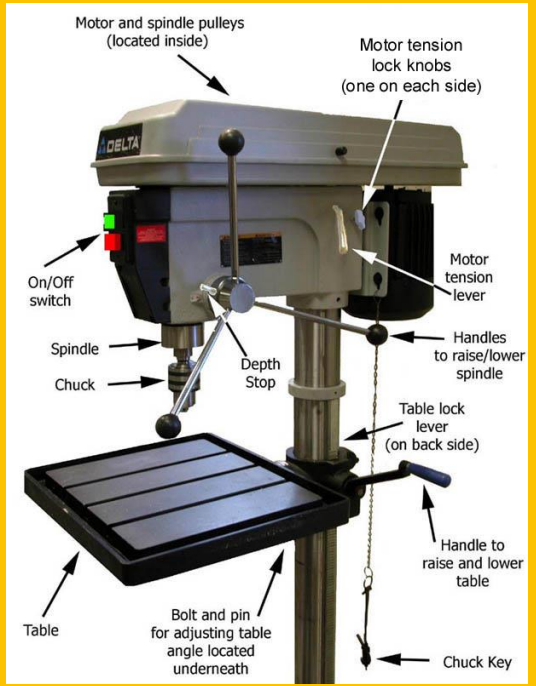
CLO1 : Apply the knowledge of basic mechanical components and equipment, hand tools and measuring equipment in workshop technology

CLO2 : Apply standard practice in operating mechanical tools and component

DRILLING- Introduction

Defination :

Making a circular hole in a workpiece using a revolving cutter known as a **DRILL** is call drilling.



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DRILLING - Introduction

Drill press function

A drill press, also known as a pedestal drill, is a stationary power tool used for drilling precise holes in various materials.

It consists of

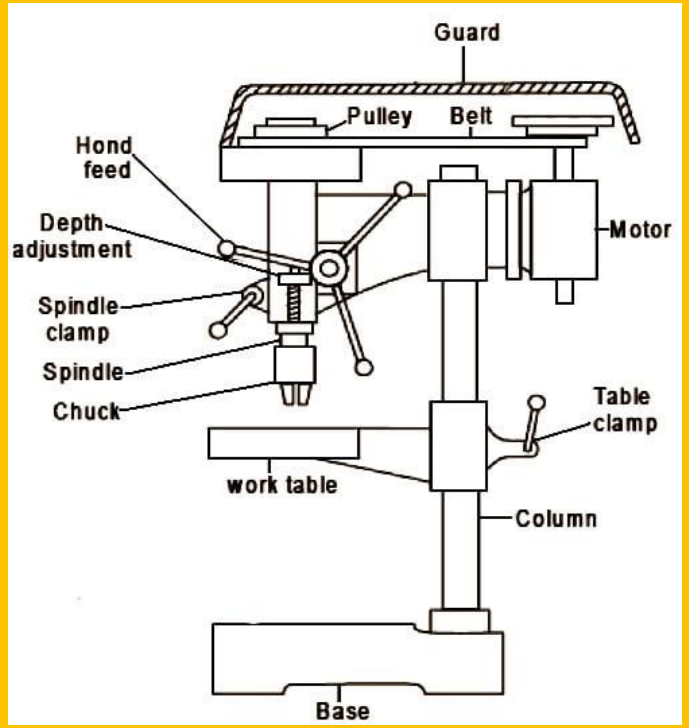
i) a base

ii) a column or pillar

iii) a worktable

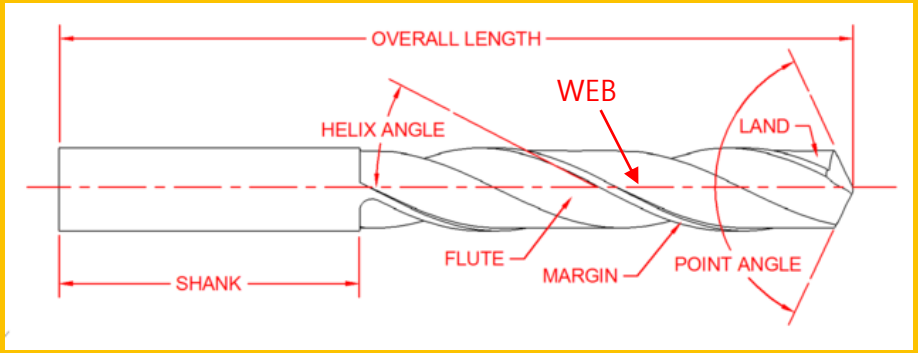
iv) a drill head

v) a spindle or chuck.



DRILLING- TWIST DRILL

A twist drill is a common type of drill bit use d in drill presses, hand drills, and other drilling machines. It is named after its helical or twisted flutes, which are designed to efficiently remove material during drilling.



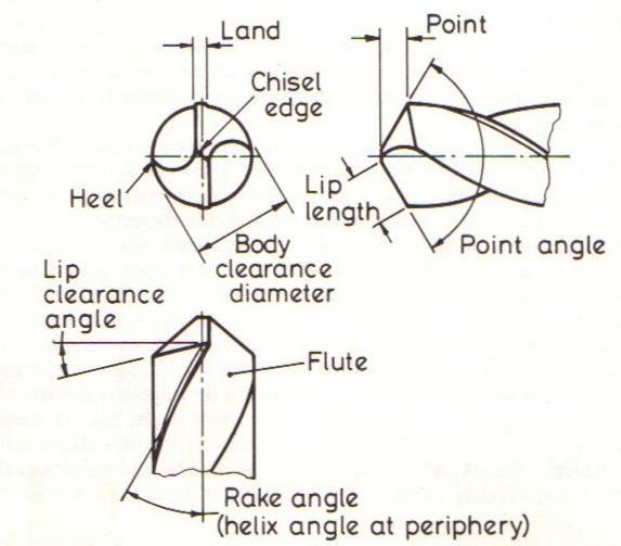
FLUTES – In order to create cutting lips, enable chip removal, and allow cutting fluid to reach the cutting lips, helical or straight grooves were cut or created into the drill's body.

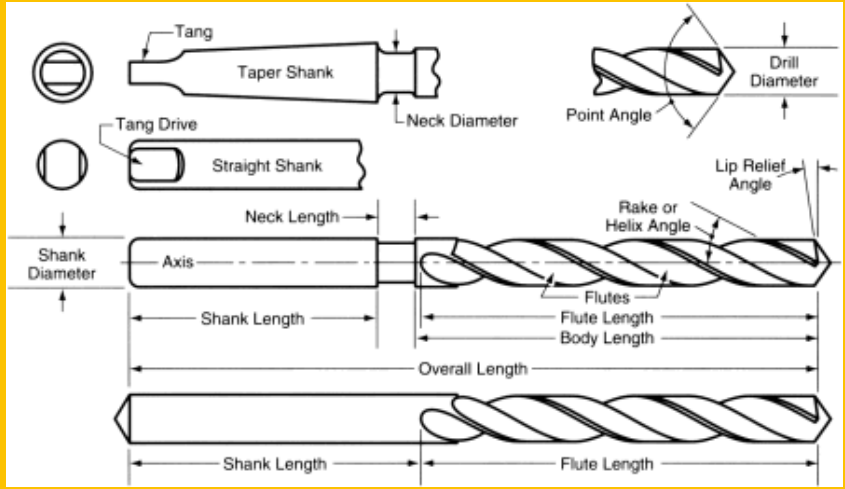
POINT – The cutting end of a drill, made up of the ends of the lands and the web. In form it resembles a cone, but departs from a true cone to furnish clearance behind the cutting lips.

POINT ANGLE – the angle between the lips, which was projected onto a plane that was both parallel to the drill axis and to the cutting lips.

WEB -The central portion of the body that joins the lands. The extreme end of the web forms the chisel e dge on a two-flute drill.

DRILLING





LIPS – The cutting edges of a two flute drill extending from the chisel edqe to the periphery.

SHANK – The part of the drill that is used for holding and operating it.

TANG - A taper shank's flattened end that is d esigned to go into a socket's drive slot

Identifying twist drill sizes

There are four systems for identifying twist drill sizes.

1.Fractional

- The Fractional Drill sizes range from 1/64 inch to 1 inch and over.

2.Number

- Numerical drill sizes, corresponding to wire gauge (the larger the number, the smaller the drill). Example: Starting with a # 80 drill and a # 1 drill.

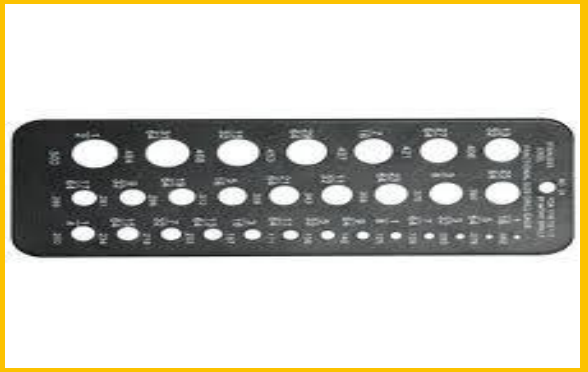
3.Letter

- Drill size designed by letter range from letter “A” (measures .234 inch) to letter “Z” (measures .431 inch).

4.Metric

- The metric sizes range from 0.4mm (measures .015 inch) to 50mm (measures 1.968 inch).

Measuring size of drill



1.Drill Bit Gauge:

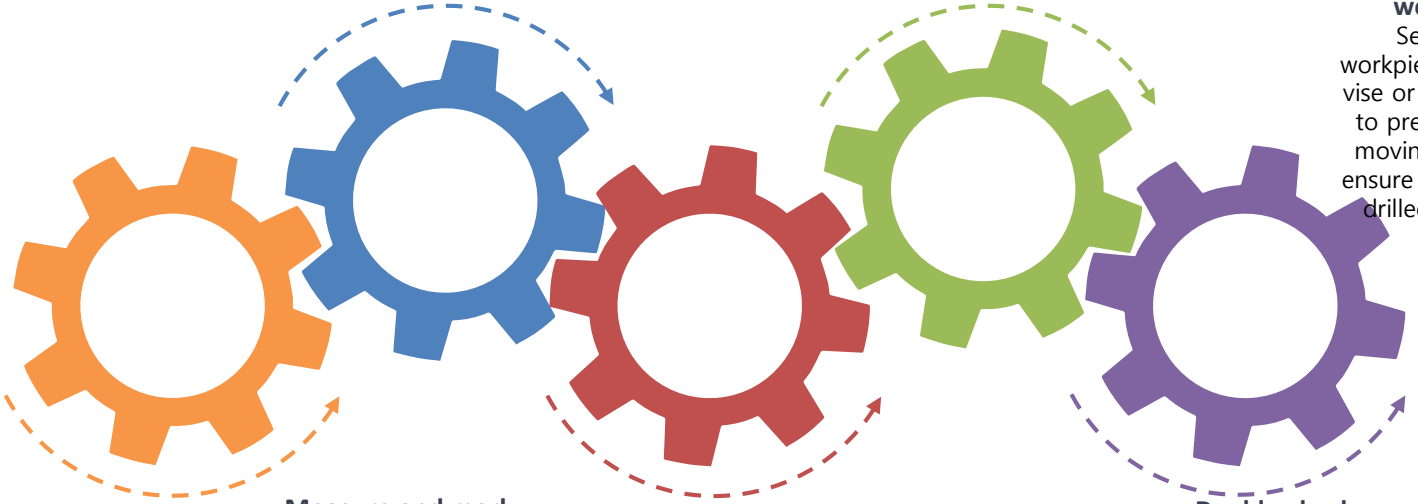
- Obtain a drill bit gauge, which is a tool specifically designed for measuring drill bit sizes.
- The gauge will typically have a series of holes or slots labeled with di fferent drill bit sizes.
- Insert the shank of the drill bit into the holes/slots on the gauge until y ou find the one that matches or closely corresponds to the size of your drill bit.
- The labeled size on the hole/slot will indicate the diameter of the drill bit.

2. With a micrometers

(taken measurements across the margin of the drill)

DRILLING

STEPS OF MARKING OUT BEFORE DRILLING



Gather the necessary tools

Prepare the tools required for marking out, such as a ruler, measuring tape, marking gauge, center punch, and a pencil or marker suitable for marking on the workpiece material.

Measure and mark

- ✓ Use the measuring tools to measure the distances and dimensions needed for the hole placements.
- ✓ Make precise marks or notations on the workpiece surface using the pencil or marker.

Use a center punch

Once you have marked the drill hole locations, use a center punch to create small indentations or dimples at the marked spots. This helps to provide a starting point for the drill bit, ensuring accuracy during drilling. Place the center punch on each marked spot and strike it with a hammer to create the indentation.

Double-check measurements

Before proceeding with drilling, double-check your measurements and markings to ensure they are accurate and aligned properly. This step helps to minimize errors and ensures that the drilled holes will be in the correct positions.

Secure the workpiece

Secure the workpiece firmly in a vise or using clamps to prevent it from moving. Therefore ensure the holes are drilled is precise.

DRILLING

METHODS OF HOLDING A DRILL BIT

- ✓ By directly fitting in the spindle hole.
- ✓ drill sleeve
- ✓ drill socket
- ✓ drill chuck

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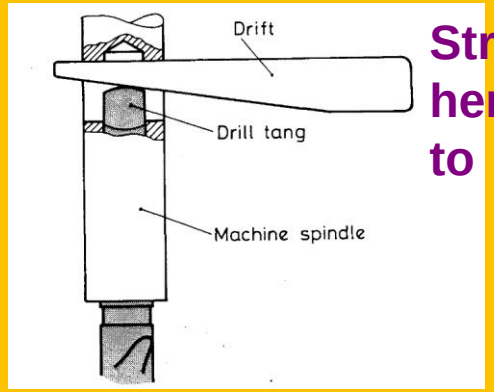
The holding device is used to hold the dri ll bit during the drilling operation. TWO main methods

1.<u>Chucks</u>

The chuck is an adjustable moving jaw m echanism mainly used for drills with straight shanks.

2. **<u>Tapered Spindles</u>**

A tapered opening is used for drills with taper shanks. The drill is locked in the spindle with friction and is remove d from the spindle by using a drift.



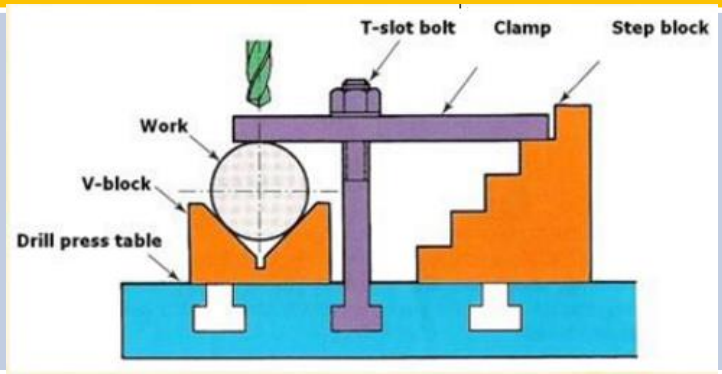
Strike here to remove

DRILLING Work holding devices

VISES

Widely used to hold the work piece during the drilling process. The vise must be bolted to the drill table to ensure a safe and proper practice.

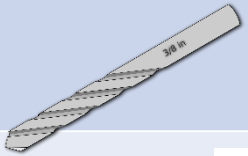
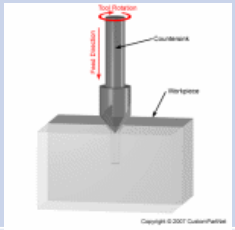
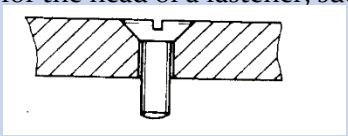
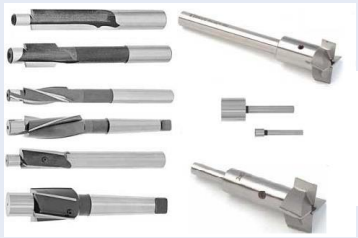
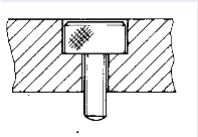
DRILLING Work holding devices



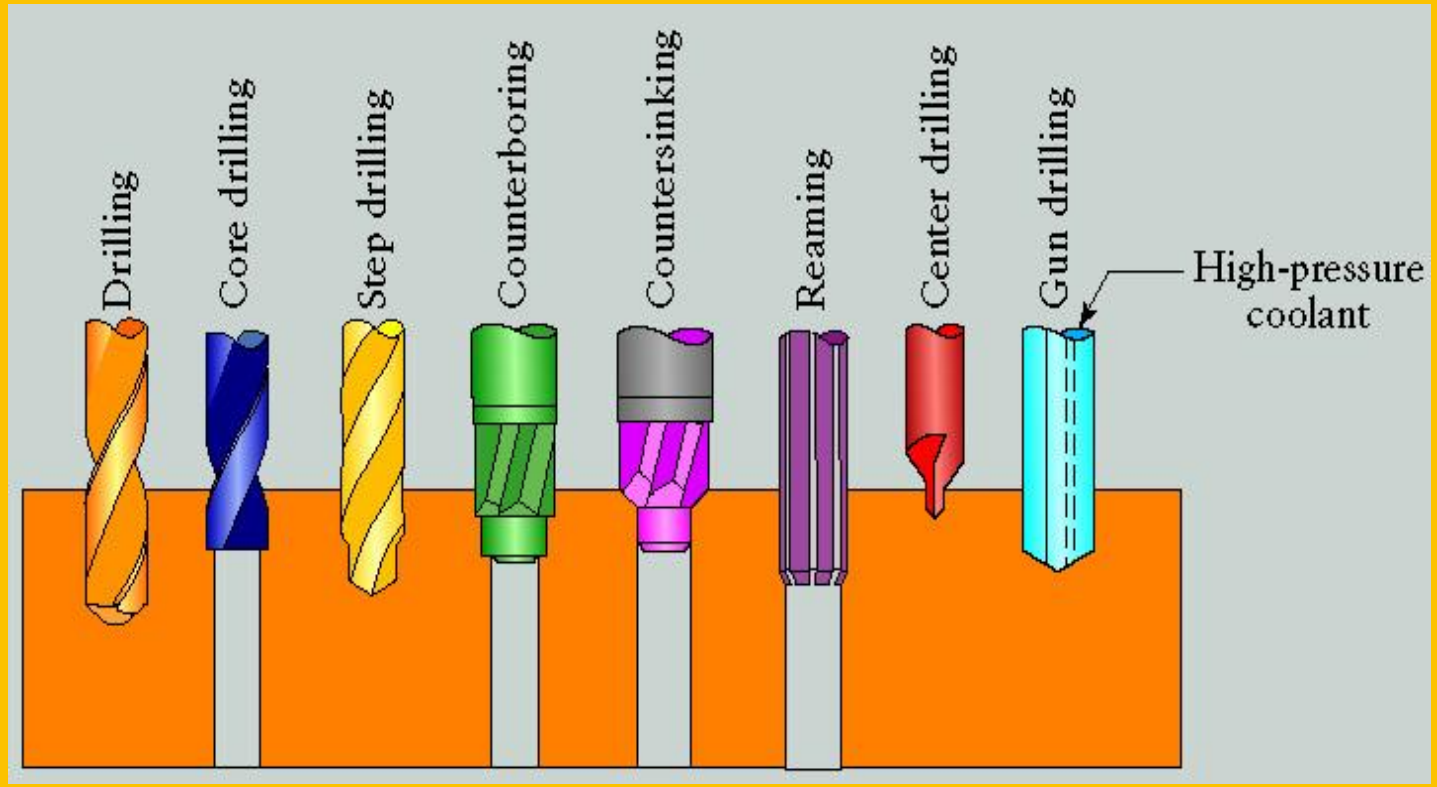
T BOLTS AND CLAMPS

The T bolts and clamps are used to hold a round work piece onto the drill press table.

TYPES OF DRILL BIT

1		**TWIST DRILL** •A twist drill bit is a metallic cylinder with helical grooves that spiral up the bit. •Drills are used in a wide variety of projects and fields, from home repair to arts to large-scale const ruction projects.
2		**COMBINATION** •These double ended drills are also called centre drills. •They are designed for drilling centre holes in the end of work pieces to be held between standard 60º centres. •Also available in bell type with 120° chamfer to protect the centre hole.
3	 	**COUNTERSINK** •A countersink tool enlarges the top portion of an existing hole to a cone-shaped opening. •Countersinking is performed after drilling to provide space for the head of a fastener, such as a scr ew, to sit flush with the workpiece surface. 
4	 	**COUNTERBORING** •A counterbore tool enlarges the top portion of an existing hole to the diameter of the tool. • Counterboring is often performed after drilling to provide space for the head of a fastener, such as a bolt, to sit flush with the workpiece surface. •The counterboring tool has a pilot on the end to guide it straight into the existing hole

Various drilling operation



DRILLING

Methods of drilling large hole

Drill a small pilot hole on the spot with a smaller bit if you will be drilling a large hole.

(*This will help ensure that the hole will be straight when you use the larger bit.)*

Pilot hole will allow you to centre the tip of the larger diameter tool and then accurately drill your final size hole.

This often keeps the larger tool from jumping all over the surface when it first touches the material.

DRILLING

CUTTING SPEED & DIFFERENT MATERIAL

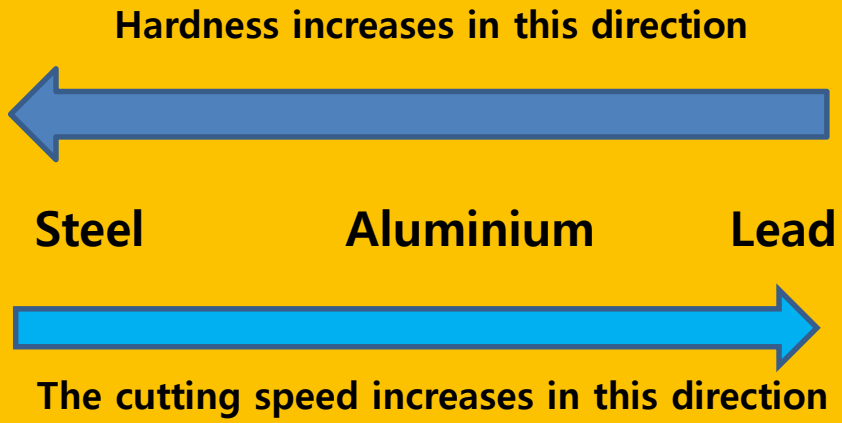
Cutting speed is the speed at the outside edge of the tool as it is cutting the work piece. Cutting speed depe nds on

- The type of material being cut
- The type of cutting tool being used.
- The strength or firmness of the workpiece is held in the machine.
- Use of cutting fluid

DRILLING

Cutting speed and different materials

- Hardness is the ability of the material to resist being scratched.
- The cutting speed is inversely related to the work material hardness.



DRILLING

Cutting speed and different materials

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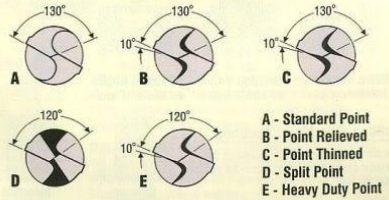
DRILL POINT GEOMETRY FOR VARIOUS MATERIALS

Drill Point Styles



A - Standard Point
B - Point Relieved
C - Point Thinned
D - Split Point
E - Heavy Duty Point

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SPEEDS & FEEDS FOR HIGH SPEED STEEL TWIST DRILLS

Drill Diameter (mm)	Drill Diameter (inch)	Work Material: Stainless Steel	Tool Steel	Cast Iron	Malleable Iron	Medium Carbon Steel	Free Cutting Steel	Alum. Brass	Wood Plastic
		Cutting Speed : Metres per minute							
		12	18	24	27	30	43	61	91
		Cutting Speed : Feet per minute							
		40	60	80	90	100	140	200	300
		Spindle Speed RPM							
1.5	1/16	2445	3667	4889	5500	6112	8556	12223	18335
2.5	3/32	1620	2445	3259	3667	4074	5704	8149	12223
3	1/8	1222	1833	2445	2750	3056	4278	6112	9167
4	5/32	978	1467	1956	2200	2445	3422	4889	7334
5	3/16	815	1222	1630	1833	2037	2852	4074	6112
6	1/4	654	982	1309	1473	1637	2292	3274	4911
7	9/32	543	815	1086	1222	1358	1901	2716	4074
8	5/16	489	733	978	1100	1222	1711	2445	3667
9	11/32	448	672	896	1008	1120	1568	2241	3361
10	3/8	407	611	815	917	1019	1426	2037	3056
11	7/16	349	524	698	786	873	1222	1746	2619
13	1/2	306	458	611	688	764	1070	1528	2292
14	9/16	272	407	543	611	679	951	1358	2037
16	5/8	244	367	489	550	611	856	1222	1833
18	23/32	222	333	444	500	556	778	1111	1667
19	3/4	204	306	407	458	509	713	1019	1528
20	25/32	189	224	378	425	473	662	946	1419
22	7/8	175	262	349	393	437	611	873	1310
25	1	153	229	306	344	382	535	764	1146
28	1 1/8	136	204	272	306	340	475	679	1019
32	1 1/4	122	183	244	275	306	428	611	917
35	1 3/8	111	167	222	250	278	389	556	833
38	1 1/2	102	153	204	229	255	357	509	764
41	1 5/8	94	141	188	212	235	329	470	705
44	1 3/4	87	131	175	196	218	306	437	655
47	1 7/8	81	122	163	183	204	285	407	611
50	2	76	115	153	172	191	267	382	573
57	2 1/4	68	102	136	153	170	238	340	509
63	2 1/2	61	92	122	138	153	214	306	458
70	2 3/4	56	83	111	125	139	194	278	417
76	3	51	76	102	115	127	178	255	382

Recommended Feeds for Various Drill Diameters

Diameter of Drill (mm)	Diameter of Drill (inch)	Feed per Revolution (mm)	Feed per Revolution (inch)
3	1/8	.02 - .10	.001 - .003
6	1/4	.05 - .15	.002 - .006
13	1/2	.10 - .25	.004 - .010
25	1	.20 - 40	.007 - .015
> 25	> 1	.40 - .65	.015 - .025

Note : The information on this page is intended as a general guide only. Figures will vary with grades of material used.

It is best to start with a moderate speed and feed, increasing either one, or both, after observing the cutting action and condition of the drill bit.

DEFINITIONS AND CALCULATION

	Symbols	Equation
Cutting Speed *Peripheral speed of drill* *Unit- meter/minute*	V	$V = \frac{\pi DN}{1000}$

$V = Cutting\ speed$
$\pi = The\ circular\ constant$
$D = Diameter$
$N = spindle\ speed\ (rpm)$

TUTORIALS

1. Calculate the ideal spindle speed in revolutions per minute to drill a hole with a diameter of 15 mm on a piece of mild steel with durable drill . Cutting speed used is 30 meters per minute .
2. Calculate the ideal spindle speed in revolutions per minute to drill a hole with a diameter of 35 mm on a piece of mild steel with a cutting speed of 25 meters per minute . Drill bit used is a kind of durable ste el .
3. Calculate the time for a specific drilling job for a hole with 10mm d iameters and 40mm depth. The spindle speed is 425 rpm and the fee d rate 0.2 mm/rev.

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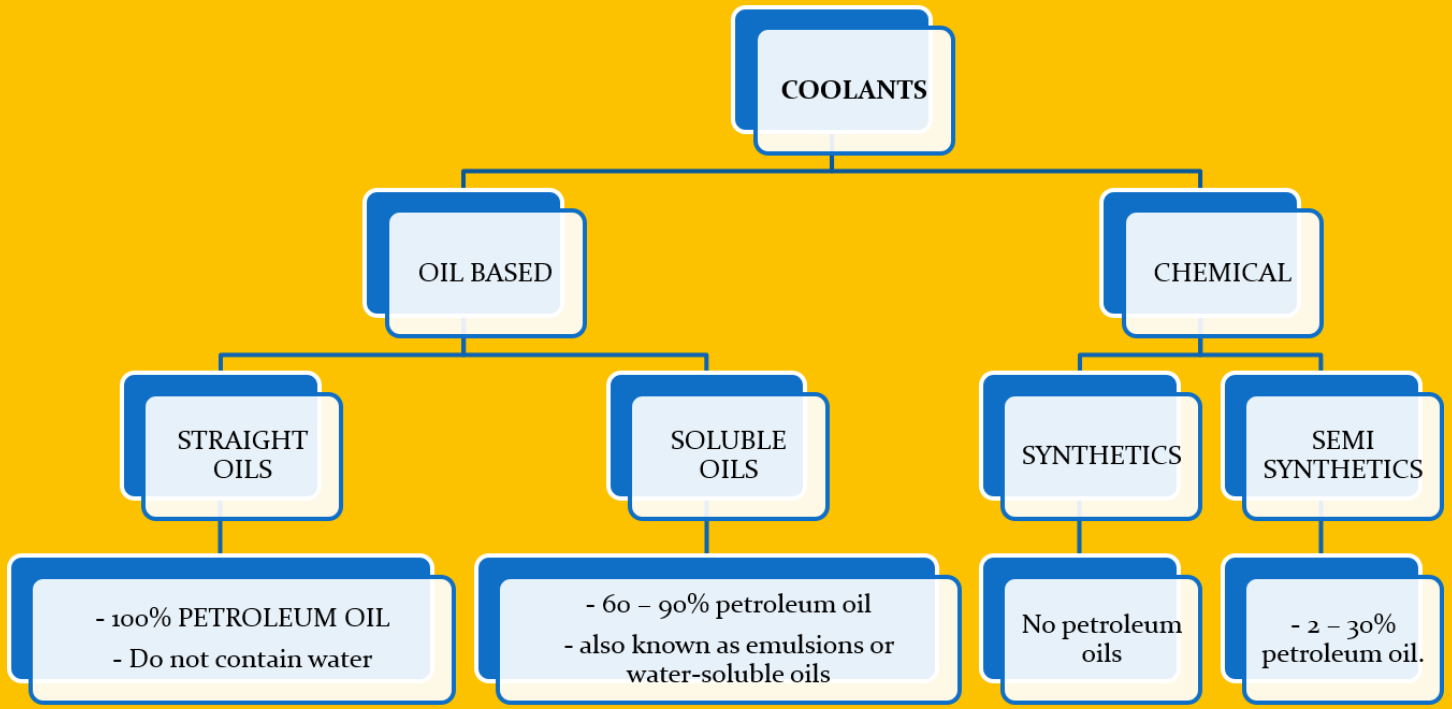
COOLANT

Cutting fluids or coolants greatly increase the life of drill bits, taps, lathe and milling cutters as well as saw blades.

- to cool the tool
- to cool the work piece
- reduce friction at the sliding contacts,
- prevent or reduce the adhesion of chip on the contact edges
- to flush chips away.

COOLANT

The most common machine coolants used today belong to one of two categories based on their oil content:



COOLANT

BENEFITS OF USING CUTTING FLUID	
Improve part productivity.	✓ The use of cutting fluids reduces friction and heat. ✓ The removal of the heat prevents the work piece from expanding during the machining operation, which would cause size variation as well as damage to the material's microstructure.
Reduce tooling cost.	✓ Proper use of cutting fluids increases tool life, which reduces the tooling costs. ✓ Increased tool life also reduces tool changes and downtime which decreases labour costs.
Increase Cutting Speeds and Feeds	✓ Cutting tools reduce friction and heating a machining operation. ✓ This allows high speeds and feeds to be used to achieve optimal cutting conditions
Improved Surface Finishes	✓ Effective use of cutting fluids helps remove the chips. ✓ This prevents the chip from being caught between the tool and work piece where it causes scratches and a poor surface finish
Reduces Bacterial Growth	✓ Bacteria can drastically affect cutting oils. Bacteria growth can turn a cutting fluid rancid. ✓ Additives in coolants help reduce the effects of bacteria, but it is important that pure water is used for coolant mixing.
Rust and Corrosion Prevention	✓ Cutting fluids should protect the tooling, machine, and work piece against rust and corrosion. ✓ Cutting fluids should leave a small residual film that remains after the water has evaporated.

Machine & Drill Bit Maintenance

Clean machine → Remove chips using brush → T-slots, grooves, spindle sleeves, belts, pulley should be clean. → Lightly oiled machine

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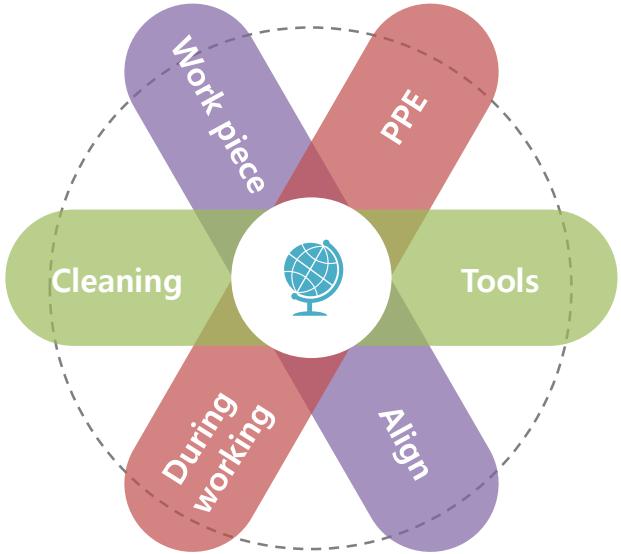
SAFETY DURING DRILLING

Work piece
Do not support the work piece by hand – use work holding device.

Cleaning
Use brush to clean the chip

During working
No adjustments while the machine is operating



PPE
Avoid loose clothing and protect the eyes.

Tools
Never place tools on the drilling table

Align
Ensure for the cutting tools running straight before starting the operation.

SAFETY DURING DRILLING

Why the workpiece is needed to clamp securely?

Workpiece	• Workpiece will loose from holding device.
Hole	• Hole drilled become large • Will not meet specification
Drill bit	• Drill bit will be broken
Waste	• Material & drill bit • Time to replace the new material and drill bit

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SOP FOR DRILLING

1. Turn power ON from wall breaker.
2. Clamp workpiece!
3. Inspect cutting tool for any damage
4. Insert the cutting tool into the chuck and tighten it with chuck key.
6. Switch ON drill press, use centre drill & lubrication.
7. Replace the centering tool with the drill bit and drill out the hole.
8. Once all holes have been drill out take the drill bit out of the chuck.
9. Turn the power off at the wall breaker.
10. Clean up the area of any debris, and lubricant.

SOP
Standard Operating Procedures

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