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# DIES AND MOULDS MAKER



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## LEARNER GUIDE

National Vocational Certificate Level 2

Version 1 - July, 2019



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**Document Version**

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## Introduction

Welcome to your Learner's Guide for the Dies and molds maker level 2. It will help you complete the training and go on with further study or go straight into employment.

The Dies and molds maker level 2 training is to engage young people with a program of development that will provide them with the knowledge, skills and understanding to start their career in Pakistan. This qualification will not only build the capacity of existing workers of manufacturing engineering sector but also support the youth to acquire skills best fit in manufacturing industry.

The main elements of your learner's guide are:

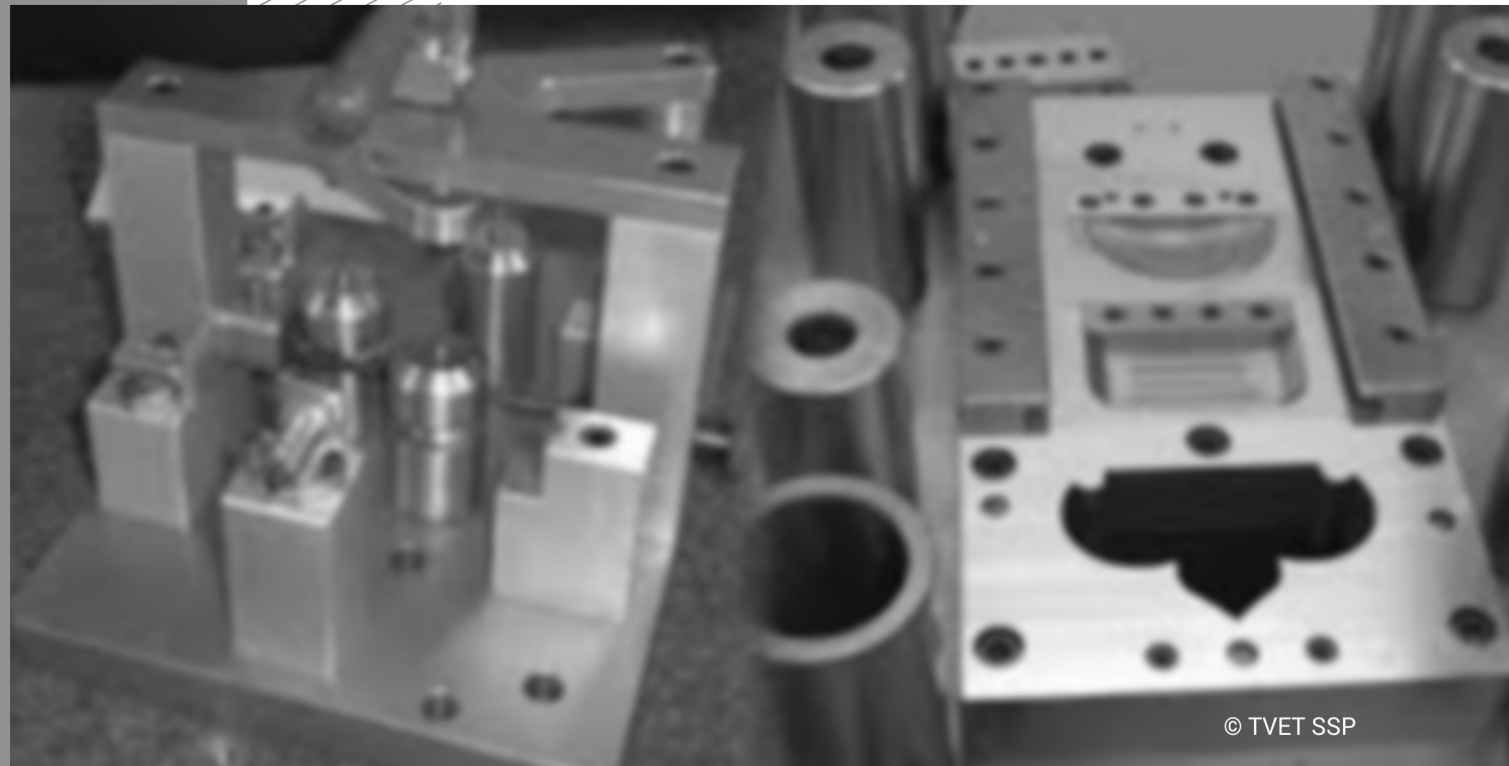
- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively
- **Modules:**
  - The modules form the sections in your learner's guide
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes:**
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your learner's guide with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require to achieve learning outcomes stated in the curriculum
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules:**
  - This contains the summary of the modules that make up your learner's guide
- **Frequently asked questions:**
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.
- **Multiple choice questions for self-test:**
  - These are provided as an exercise at the end of your learner's guide to help you in preparing for your assessment.

## Frequently Asked Question

<p><b>1. What is Competency Based Training (CBT) and how is it different from currently offered trainings in institutes?</b></p>	<p>Competency-based training (CBT) is an approach to vocational education and training that places emphasis on what a person can do in the workplace as a result of completing a program of training. Compared to conventional programs, the competency based training is not primarily content based; it rather focuses on the competence requirement of the envisaged job role. The whole qualification refers to certain industry standard criterion and is modularized in nature rather than being course oriented.</p>
<p><b>2. What is the passing criterion for CBT certificate?</b></p>	<p>You shall be required to be declared “Competent” in the summative assessment to attain the certificate.</p>
<p><b>3. How can I progress in my educational career after attaining this certificate?</b></p>	<p>You shall be eligible to take admission in the National Vocational Certificate Level-3 in Dies and mould maker. You shall be able to progress further to National Vocational Certificate Level-4 in Dies and mould maker, and take admission in a level-5, DAE or equivalent course. In certain case, you may be required to attain an equivalence certificate from The Inter Board Committee of Chairmen (IBCC).</p>
<p><b>4. What is the importance of this certificate in National and International job market?</b></p>	<p>This certificate is based on the nationally standardized and notified competency standards by National Vocational and Technical Training Commission (NAVTTTC). These standards are also recognized worldwide as all the standards are coded using international methodology and are accessible to the employers worldwide through NAVTTTC website.</p>
<p><b>5. Which jobs can I get after attaining this certificate? Are there job for this certificate in public sector as well?</b></p>	<p>You shall be able to take up jobs in the manufacturing and dies and mould making Industries as a mould maker for the production of plastic parts, sheet metal parts and house hold goods.</p>
<p><b>6. What are possible career progressions in industry after attaining this certificate?</b></p>	<p>You shall be able to progress up to the level of shop supervisor after attaining sufficient experience, knowledge and skills during the job. Attaining additional relevant qualifications may aid your career advancement to even higher levels.</p>
<p><b>7. Is this certificate recognized by any competent authority</b></p>	<p>This certificate is based on the nationally standardized and notified</p>

<b>in Pakistan?</b>	competency standards by National Vocational and Technical Training Commission (NAVTTTC). The official certificates shall be awarded by the relevant certificate awarding body.
<b>8. Is on-the-job training mandatory for this certificate? If yes, what is the duration of on-the-job training?</b>	On-the-job training is not a requirement for final / summative assessment of this certificate. However, taking up on-the-job training after or during the course work may add your chances to get a job afterwards.
<b>9. What is the examination / assessment system in this program?</b>	Competency based assessments are organized by training institutes during the course which serve the purpose of assessing the progress and preparedness of each student. Final / summative assessments are organized by the relevant qualification awarding bodies at the end of the certificate program. You shall be required to be declared "Competent" in the summative assessment to attain the certificate.
<b>10. Does this certificate enable me to work as freelancer?</b>	You can start your small business as a Dies and mould maker. You may need additional skills on entrepreneurship to support your initiative.

# DIES AND MOULDS MAKER



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Module-1

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## Modules

### Module 1: Maintain Personal Health, Hygiene and Safety

**Objective of the module:** This Competency Standard identifies the competencies required to protect/apply occupational Safety, Health and Environment at workplace according to the industry's approved guidelines, procedures and interpret environmental rules/regulations. Trainee will be expected to identify and use Personal Protective Equipment (PPE) according to the work place requirements. The underpinning knowledge regarding Observe Occupational Safety and Health (OSH) will be sufficient to provide the basis for the job at workplace.

**Duration: Hrs**

**Theory: Hrs**

**Practical: Hrs**

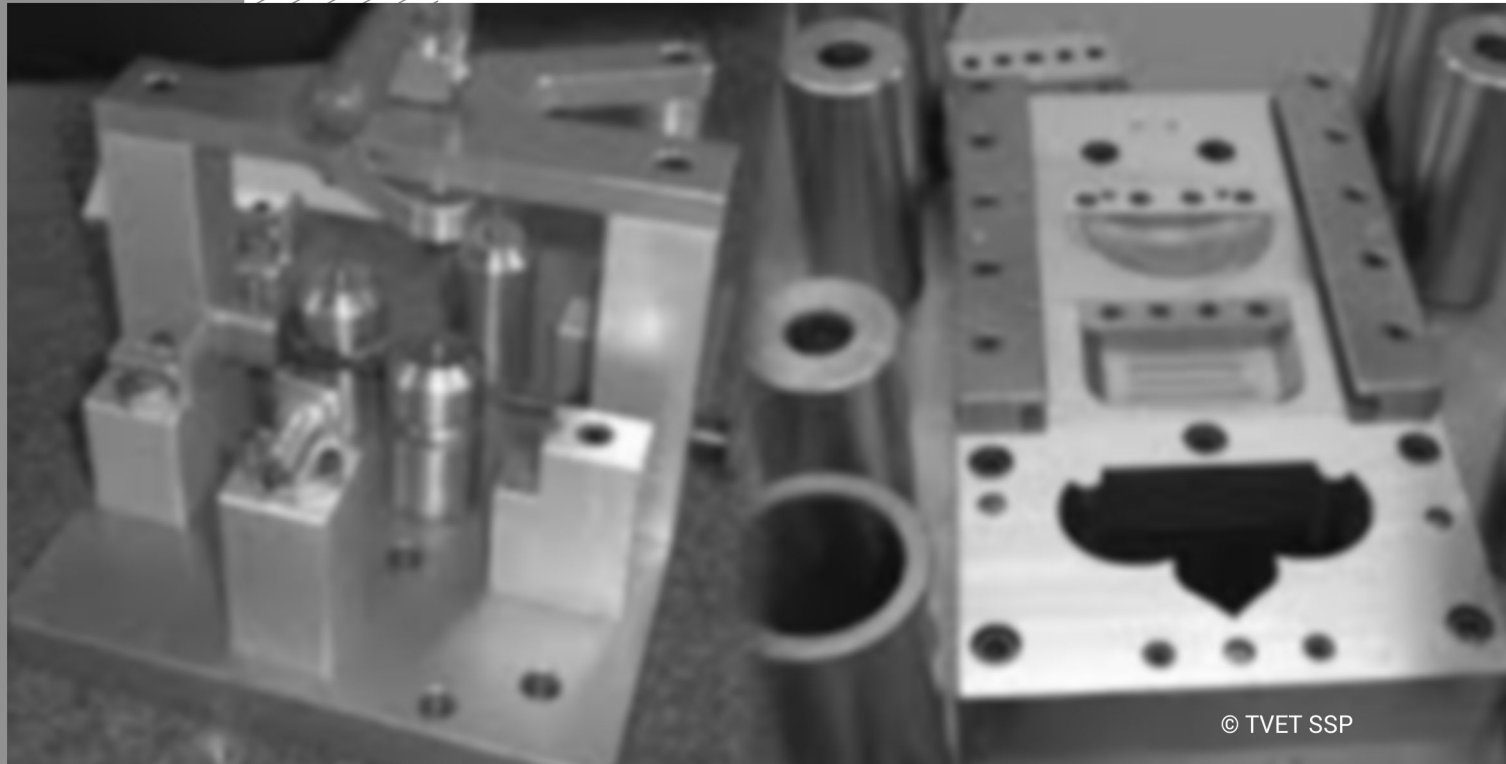
Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> Identify hazards at workplace	<p><b>The trainee will be able to:</b></p> <p>Interpret work processes and procedures correctly to identify risk to Health, hygiene and safety at workplace</p> <p>Recognize processes, tools, equipment and consumable materials that have the potential to cause harm</p> <p>Prepare report of the identified risk to Health, hygiene and safety</p>	<p>General machine shop hazards.</p> <p><b>Hazards:</b> Slippery path ways, poor lightening, and fire hazard etc.</p> <p>Hazard associated to the machine i.e. electric shock, flying particles, sharp edges, etc.</p> <p>Hazard related to material handling i.e. back bone pain, muscular pain / pull, sharp edges of material, more weight etc.</p> <p>Chemical hazards from fumes of solvents, acids, gases etc.</p> <p>Knowledge of risk assessment</p>	
<b>LU2:</b> Apply personal protective and safety equipment (PPE)	<p><b>The trainee will be able to:</b></p> <p>Select personal protective equipment in terms of type and quantity according to work orders.</p>	<p>PPEs for electrical equipment:            Leather gloves, safety shoes, insulated tools</p> <p>PPEs for machine i.e. safety shoes, apron, goggle etc.</p>	



Learning Unit	Learning Outcomes	Learning Elements	Materials Required
	<p>Wear, adjust, and maintain personal protective equipment to ensure correct fit and optimum protection in compliance with company procedures.</p> <p>Ensure personal protective equipment is cleaned and stored in proper place.</p>	<p>PPEs for general machine shop i.e. coverall, safety shoes, hard cap, goggle etc.</p>	
<p><b>LU3:</b> Observe occupational safety and health (OSH)</p>	<p><b>The trainee will be able to:</b></p> <p>Maintain cleanliness and hygiene as per organizational policy</p> <p>Comply with Health, hygiene and safety precautions before starting work</p> <p>Follow organizational Health, hygiene and safety guidelines during work</p> <p>Deal with resolvable problems according to prescribed procedures</p> <p>Report un resolvable problems to immediate supervisor</p> <p>Place the tools equipment etc. at their prescribed place after</p>	<p>Advantages of maintaining cleanliness at workplace</p> <p>Knowledge of safety signs</p> <p><b>Signs:</b> warning, prohibition, mandatory, fire and safe condition.</p> <p>Knowledge Risk assessment and reporting a hazard</p> <p>Knowledge of house keeping</p>	

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
	completion of work		
<p><b>LU4:</b> Dispose of hazardous waste/materials</p>	<p><b>The trainee will be able to:</b></p> <p>Identify hazardous waste/ drug materials which needs to be disposed off</p> <p>Collect hazardous or non-hazardous waste carefully from the designated area as per approved procedure</p> <p>Use proper disposal hazardous containers for dispose-off hazardous waste as per procedure</p> <p>Take necessary precautions like putting masks and gloves while disposing hazardous waste/ materials as per standard operating procedure</p>	<p>Knowledge of dealing with hazardous waste.</p> <p><b>Waste:</b> acids, oils, metal chips, sharp objects etc.</p> <p>Knowledge of handling wastes.</p>	

# DIES AND MOULDS MAKER



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Module-2

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## Module 2: 071500966 Perform Bench Work

**Objective of the module:** This competency standard covers the skills and knowledge required to perform bench work operations including sawing, filing, drilling, tapping, reaming, countersinking, counter boring, polishing & grinding.

**Duration:** Hrs      **Theory:** Hrs      **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> Perform sawing	<p><b>The trainee will be able to:</b></p> <p>Select appropriate blade according to the material and set in hacksaw frame</p> <p>Select appropriate marking tool and mark the job as per drawing</p> <p>Select appropriate clamping device and clamp the work piece</p> <p>Perform sawing as per standard procedures</p> <p>Verify the final job with the given drawing</p>	<p>Types of hacksaw frames:</p> <ul style="list-style-type: none"> <li>• Fixed</li> <li>• adjustable</li> </ul> <p>Types of hacksaw blades i.e.</p> <ul style="list-style-type: none"> <li>• Rigid</li> <li>• Flexible</li> </ul> <p>TPI of hacksaw blades i.e.</p> <ul style="list-style-type: none"> <li>• 14 TPI</li> <li>• 18 TPI</li> <li>• 24 TPI</li> <li>• 32 TPI</li> </ul> <p>Measuring and marking tools:</p> <p><b>Measuring tools:</b> steel rule, measuring tape, Vernier caliper,</p> <p><b>Marking tools:</b> marking ink, try square, scriber, punches, divider, hammer</p> <p>Workpiece clamping device:</p> <p><b>Devices:</b> Bench vice, Machine vice, V-blocks, C-clamps, Toggle clamps etc.</p> <p>Standard procedure for Sawing i.e. gesture, griping,</p>	MS flat bar Hack saw frames Hacksaw blade Steel rule Measuring tape Vernier caliper Marking ink Try square Scriber Punches divider hammer

		stroking etc.  Interpretation of drawing.	
<b>LU2: Perform filing</b>	<b>The trainee will be able to:</b> Select appropriate file type according to the material & profile Select appropriate marking tool and mark the job as per drawing Select appropriate clamping device and clamp the work piece Perform filing as per standard procedures Verify the final job with the given drawing	Classification of files: <ul style="list-style-type: none"> <li>• Cross section</li> <li>• Length</li> <li>• Cut</li> <li>• Coarseness</li> </ul> Workpiece clamping device: <b>Devices:</b> Bench vice, Machine vice, V-blocks, C-clamps, Toggle clamps etc. Standard procedure for filing i.e. gesture, griping, stroking etc.	MS flat bar Files of different shapes, size, cut and coarseness Bench vice Machine vice C-clamp V-blocks Toggle clamps
<b>LU3: Perform drilling</b>	<b>The trainee will be able to:</b> Select appropriate drilling bit according to the material Select appropriate marking tool and mark the job as per drawing Select appropriate clamping device and clamp the work piece Set the machine RPM according to the drill size and	Types of drill machines i.e. bench type, pillar type, column type, radial type etc. Major functional parts of a drill machine. <b>Parts:</b> machine head, work table, speed pulley, feed lever, spindle etc. Identify Types of metal i.e. Ferrous and non-ferrous. Types of drill bits: straight shank and taper shank. Cutting speed of common engineering materials. <b>Materials:</b> aluminum, mild steels, cast iron, carbon steels, copper, brass etc. Calculation method for RPM.	MS flat bar Straight and taper shank drill bits Material sample for aluminum, mild steel, cast iron, carbon steel, copper, brass Bench type drill machine Rose bit

	<p>work piece material</p> <p>Perform drilling as per standard procedures</p> <p>Perform post drilling operations</p> <p>Verify the final job with the given drawing</p>	<p>Steps to perform drilling.</p> <p>Post drilling operations i.e. chamfering, bur removing etc.</p>	
<p><b>LU4:</b></p> <p>Perform hand taping</p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate tap according to the job specification</p> <p>Select appropriate marking tool and mark the job as per drawing</p> <p>Select appropriate clamping device and clamp the work piece</p> <p>Perform drilling to produce hole according to tap size</p> <p>Perform taping as per job specification</p> <p>Verify the final job with given drawing</p>	<p>Types of taping: machine taping and hand taping</p> <p>Utility of tapes:</p> <ul style="list-style-type: none"> <li>• Internal threading</li> <li>• Cleaning threads</li> <li>• Maintenance of threads</li> </ul> <p><b>Marking tools:</b> marking ink, try square, scribe, punches, divider, hammer</p> <p><b>Clamping Devices:</b> Bench vice, Machine vice, V-blocks, C-clamps, Toggle clamps etc.</p> <p>Process steps for hand taping.</p>	<p>MS flat bar</p> <p>HSS drill bit</p> <p>Hand Tape set</p> <p>Machine tape</p> <p>Tape handle</p>
<p><b>LU5:</b></p> <p>Perform hand reaming</p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate reamer according to the job specification</p> <p>Select appropriate marking tool and mark the job as per drawing</p> <p>Select appropriate clamping</p>	<p>Types of reamers i.e.</p> <ul style="list-style-type: none"> <li>• Machine reamer</li> <li>• Hand reamer</li> </ul> <p><b>Marking tools:</b> marking ink, try square, scribe, punches, divider, hammer</p> <p><b>Clamping Devices:</b> Bench vice, Machine vice, V-blocks, C-clamps, Toggle clamps etc.</p>	<p>MS flat bar</p> <p>HSS drill bit</p> <p>Hand reamer Machine reamer</p> <p>Reamer handle</p>

	<p>device and clamp the work piece</p> <p>Perform drilling to produce hole according to the size of reamer</p> <p>Perform reaming as per job specification</p> <p>Verify the final job with given drawing</p>	<p>Purpose of reamers:</p> <ul style="list-style-type: none"> <li>• Size as per tolerance</li> <li>• Roundness of holes</li> <li>• Surface finish of holes</li> </ul> <p>Process steps for hand or machine reaming</p> <p>Knowledge of tolerances and fits.</p>	
<p><b>LU6:</b></p> <p><b>Perform counter boring</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate counter boring tool according to the drawing</p> <p>Select appropriate marking tool and mark the job as per drawing</p> <p>Select appropriate clamping device and clamp the work piece</p> <p>Perform drilling operation as per drawing</p> <p>Set the machine RPM according to the bore size and work piece material</p> <p>Perform counter boring as per standard procedures</p> <p>Perform post drilling operations</p> <p>Verify the final job with the given drawing</p>	<p>Purpose of counter bore</p> <p><b>Marking tools:</b> marking ink, try square, scribe, punches, divider, hammer</p> <p><b>Clamping Devices:</b> Bench vice, Machine vice, V-blocks, C-clamps, Toggle clamps etc.</p> <p>Process steps for counter boring</p> <p>Calculation method for RPM.</p> <p>Steps to perform drilling.</p> <p>Post drilling operations i.e. chamfering, bur removing etc.</p>	<p>MS flat bar</p> <p>HSS drill bit</p> <p>Counter bore of different sizes</p>

<p><b>LU7:</b> <b>Perform counter sinking</b></p>	<p><b>The trainee will be able to:</b>          Select appropriate counter sinking tool according to the drawing          Select appropriate marking tool and mark the job as per drawing          Select appropriate clamping device and clamp the work piece          Perform drilling operation as per drawing          Set the machine RPM according to the counter sink size and work piece material          Perform counter sinking as per standard procedures          Verify the final job with the given drawing</p>	<p>Purpose of counter sink          Process steps for counter sinking            Calculation method for RPM.          Steps to perform drilling.          Post drilling operations i.e. chamfering, bur removing etc.</p>	<p>MS flat bar          Drill bit          Counter sink of different sizes</p>
<p><b>LU8:</b> <b>Perform polishing</b></p>	<p><b>The trainee will be able to:</b>          Select appropriate polishing aid as per specification          Prepare the surface for polishing          Perform polishing as per required standards          Perform post polishing operations          Verify the final job with the given drawing</p>	<p>Concept of surface finish: radii, peeks etc.          Polishing aids:</p> <ul style="list-style-type: none"> <li>• Emery cloth</li> <li>• Oil stones</li> <li>• Polishing abrasive</li> <li>• Polishing paste</li> <li>• Pin grinding wheels</li> <li>• Rotary burs</li> </ul> <p>Knowledge of post polishing methods</p>	<p>Hardened carbon steel bar          Emery clothes rough to fine grades          Oil stones          Polishing abrasive          Polishing paste          Pin grinding wheel          Rotary burs          Pin grinder</p>



<p><b>LU9:</b> <b>Perform hand grinding</b></p>	<p><b>The trainee will be able to:</b> Select appropriate hand grinder &amp; grinding wheel / disk as per job specifications Mount the grinding wheel / disk as per standard procedure Perform grinding as per standard procedures</p>	<p>Knowledge of hand grinders / pin grinders machines and types of wheels / disc. Method of mounting disc / wheel / rotary bur on hand grinder. Knowledge of safe operating procedure for portable grinder.</p>	<p>Hand grinder Grinding disc dia 4" Pin grinder Pin grinding wheels</p>
<p><b>LU10:</b> <b>Demonstrate safe working conditions and housekeeping</b></p>	<p><b>The trainee will be able to:</b> Select &amp; use appropriate PPEs Maintain cleanliness at workplace Practice safe storage of tools &amp; equipment Prepare checklist of daily housekeeping activities</p>	<p>Importance of using PPEs PPEs: goggle, face shield, gas mask, apron, safety shoes, cotton gloves, leather gloves, hard cape etc. Importance of housekeeping and safe storage of tools and equipment Importance of making check list</p>	<p>General machine shop PPEs</p>

## Examples and illustrations

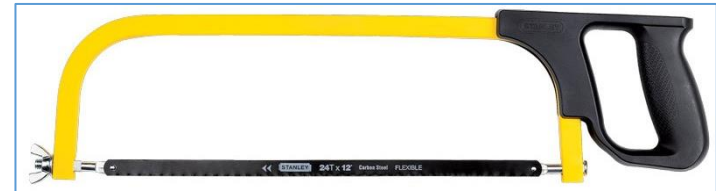
### Types of hacksaw frames:

For more details please visit: [http://www.technologystudent.com/equip\\_flash/hacksw1.html](http://www.technologystudent.com/equip_flash/hacksw1.html)

There are two types of Hacksaw frames, a fixed and an adjustable.

- Fixed

A fixed frame is one in which the length of frame is immovable. The fixed frame can only take one particular length of blade and does not have the option to alter the length unlike adjustable frame. Fixed frame is more rigid than adjustable frame.



- Adjustable

An adjustable frame is one in which the length of frame is movable. Adjustable frame can take different lengths of blade. Usually this frame has a screw tensioning feature which allows the user to tension the blade to its optimum performance level. Adjustable frame is less rigid than fixed frame.



### Types of hacksaw blades:

For more details please visit: <https://www.hunker.com/12611744/the-best-hacksaw-blades-to-cut-steel>

And [http://www.ijirset.com/upload/june/7\\_MATERIAL.pdf](http://www.ijirset.com/upload/june/7_MATERIAL.pdf)

There are two types of hacksaw blades, rigid and flexible. In both cases the teeth on the blade face away from the handle towards the front of the hacksaw.

- Rigid

This type of blade is the hard blade which has been hardened throughout. This increase in hardness makes the blade brittle. There is more efficient cutting with this blade but due to its brittleness, it tends to break more easily.



- Flexible

The second type of blade is the flexible blade which has hardened teeth but the remainder of the body remains soft. The blade, as a result, is more flexible and breaks less easily. It is an ideal blade for the workshop as it will take rougher treatment.



## TPI of hacksaw blades:

TPI is defined as teeth per inch of hacksaw.

If the TPI is higher, the gap between teeth is smaller and the teeth are shorter. It produces a finer cut that removes less material but creates less resistance.

If the TPI is lower, the gap between teeth is larger and the teeth are longer. It produces more aggressive cut with each saw stroke to improve cutting efficiency.

A hacksaw blade is available in 4 TPI configurations to cut metal, wood, and plastic.

- 14 TPI

A 14 TPI blade is the best option for cutting through the thickest of materials.

- 18 TPI

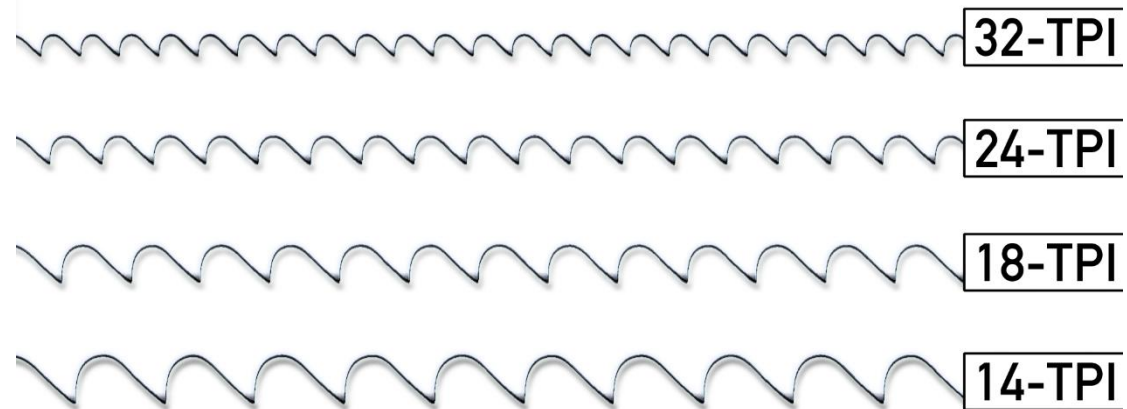
An 18 TPI blade is suitable for thick materials, but can also cut smaller diameter material when a 14-TPI blades starts to provide too much resistance. An 18-TPI blade is also suitable for cutting PVC tubing.

- 24 TPI

A 24 TPI blade comes standard with the purchase of a hacksaw. It offers the most range. The tooth count is medium (not too small nor too large).

- 32 TPI

A 32 TPI blade is the ideal choice for fine cuts and thin materials.



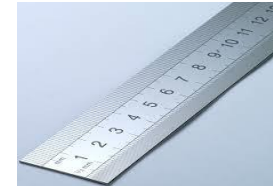
### Measuring and marking tools:

For more details please visit: <http://weldinginst.yolasite.com/resources/Measuring%20&%20Marking.pdf>

Also visit : <https://www.marineinsight.com/tech/different-types-of-mechanical-measuring-tools-and-gauges-used-on-ships/>

### Measuring tools:

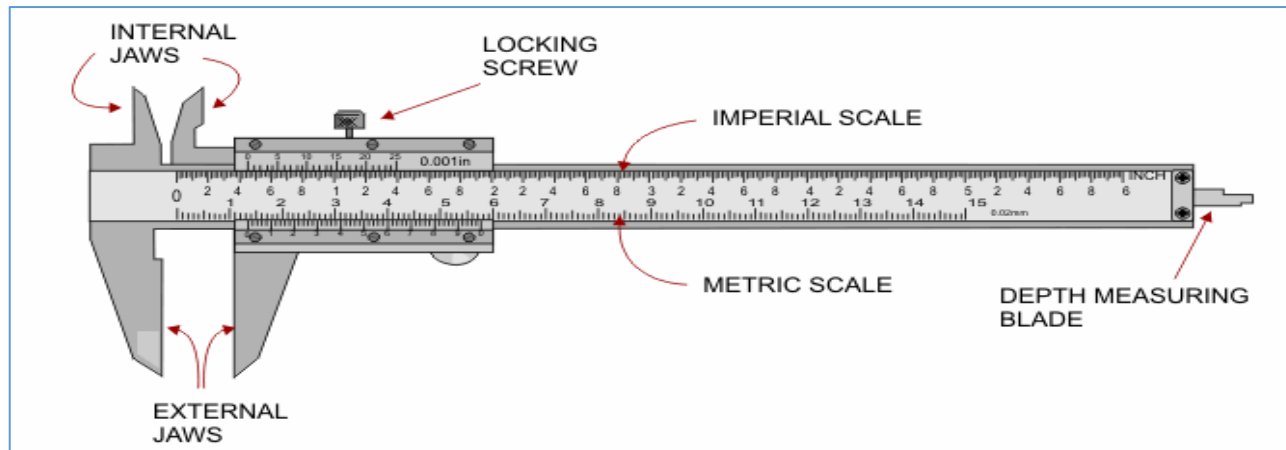
Steel rule: The steel rule is frequently used in workshops for measuring components of limited accuracy quickly. The quickness and ease with which it can be used, coupled with its low cost, makes it a popular and widely used measuring device.



Measuring tape: A measuring tape is a flexible form of ruler. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. Its flexibility allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners.

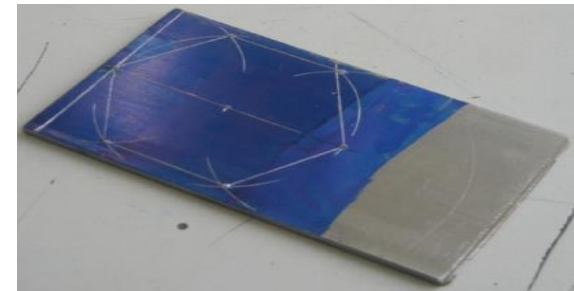


Vernier caliper: The most common instrument used for precise measurement is the Vernier caliper. This instrument is capable of external, internal, step and depth measurements and available in a range of measuring capacities from 150 mm to 1000 mm.

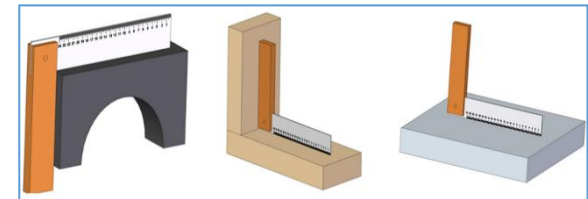


**Marking tools:**

Marking ink: Use of marking ink is the simplest method used for marking purposes. It is used to make the marking visible on a metal surface which otherwise could not be seen properly.



Try square: It consists of a stock and blade made from hardened steel and ground on all faces and edges to give a high degree of accuracy in straightness, parallelism and squareness. It is available in a variety of blade lengths.



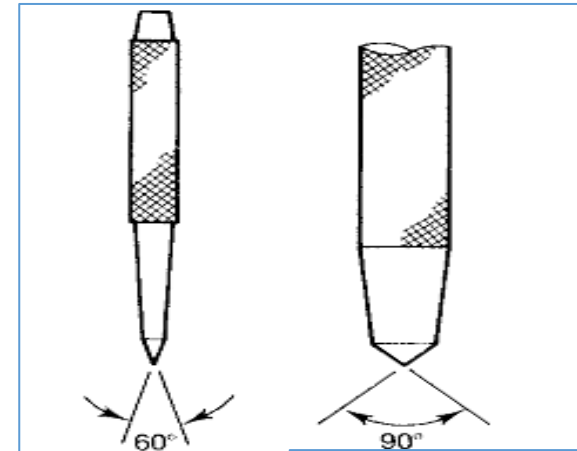
Scriber: This is the basic marking tool. It consists of a handle with a sharp point. The pointed end is made from hardened steel so that it will stay sharp in use. Scribers usually have one straight end and one hooked end.



Punches: There are two types of punches, dot punch and center punch.

Dot punch has a relatively fine point of about  $60^\circ$  or less and is used for locating the legs of such instruments as dividers and trammels. Dot punch is used for 'preserving' scribed line. For this purpose small dots or 'pop' marks are made along a straight line.

Center punch is heavier than a dot punch and has a point (usually  $90^\circ$  or greater). It is used to make a heavy indentation suitable for locating the point of a twist drill.



Divider: Divider is used to mark circular lines or arcs on metals. The legs of divider are sharpened so that they act as scribes. One leg can then be placed in the dimple created by a center punch and the other leg pivoted so that it scribes a line on the work piece's surface, thus forming an arc or circle.



Hammer: Hammers are important tools and must be used correctly and safely. Their main uses are tapping marking tools, riveting, chiseling, and driving things into position.



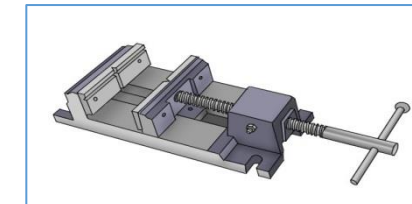
## Workpiece clamping device:

For more details please visit: [http://nemes.org/Shaper%20Books/Shaper\\_Work\\_Delmar/Work%20Holding%20Devices\\_Description%20of.pdf](http://nemes.org/Shaper%20Books/Shaper_Work_Delmar/Work%20Holding%20Devices_Description%20of.pdf)

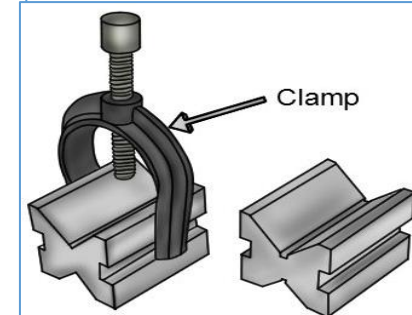
Bench vice: Bench vise is bolted onto the top surface of a workbench, with the face of the fixed jaws just forward of its front edge. Their purpose is to hold the object with grip and thereby work on the object.



Machine vice: A machine vice is a clamping device used to hold a workpiece securely when operating a machine tool, such as a drill press or milling machine. It is mounted to the table of a machine tool instead of a workbench. It relieves the user's hands from holding the workpiece when drilling, milling, or completing similar tasks.



V-blocks: A vee block (or V-block) is a square or rectangular precision made block used to securely hold a cylindrical workpiece on a milling machine or drill press. They are called vee blocks because they have at least one centrally located v-shaped groove upon which parts are positioned. The groove is parallel to both the sides and base of the block so that parts are correctly centered and ready to be machined. They are supplied with clamps so that parts can be fastened firmly to the vee blocks.



C-clamps: A C-clamp is a type of clamp device typically used to hold a wood or metal workpiece. These clamps are called "C" clamps because of their C-shaped frame. These clamps are typically made of steel or cast iron, though smaller clamps may be made of pot metal.





**Toggle clamps:** A toggle clamp has a single clamping plate and is designed to hold a workpiece down on a work surface, such as a bench top. The clamp is fixed, as it is permanently bolted to the work surface. The clamp uses a fast action mechanism, meaning it can be engaged or released in one quick movement. The clamp can be used for both light and heavy duty applications. It is commonly used to hold workpieces in woodworking tasks, such as sawing and drilling.



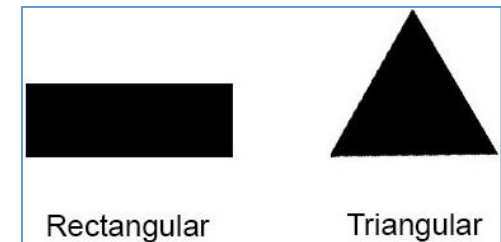
**Classification of files:**

For more details please visit: <https://images-na.ssl-images-amazon.com/images/I/81h0ZOhIOXL.pdf>

Also visit: <http://mytutorialworld.com/home/subjects/mechanical/manufacturing-process/hand-tools/file-tool/types-of-file-tool/>

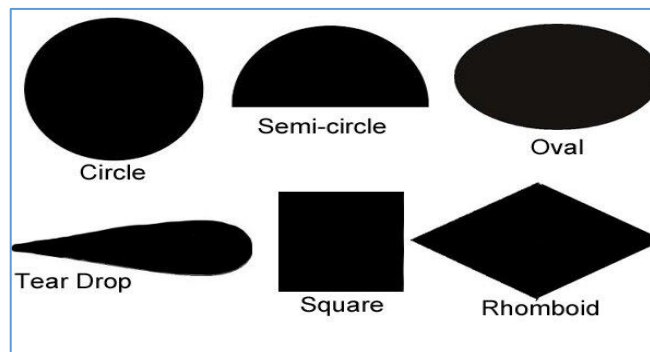
Cross section:

The cross section of a file is the shape you would get if you cut the file in half width ways. Files are produced in a variety of different cross-sectional shapes. The most common cross sections are rectangles and triangles. This is because rectangular files are extremely versatile and can be used for a wide range of different applications, and triangular files are excellent sharpening tools.



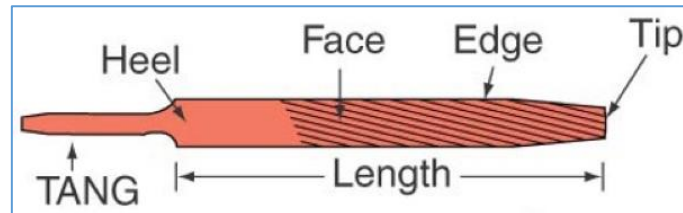
Other cross-sectional shapes include circular, semi-circular, oval, tear drop, square and rhomboid (diamond-shaped).

The cross-sectional shapes of each of these files lend themselves well to a different set of tasks. For example, half round files, with their semi-circular section, are ideal for filing inside pipes, creating semi-circular grooves and finishing concave and convex surfaces.



Length:

Length of file can be seen from the following figure



A file's length is measured from the base of its heel to the end of its tip. The tang or handle is not included when determining the length.

Cut:

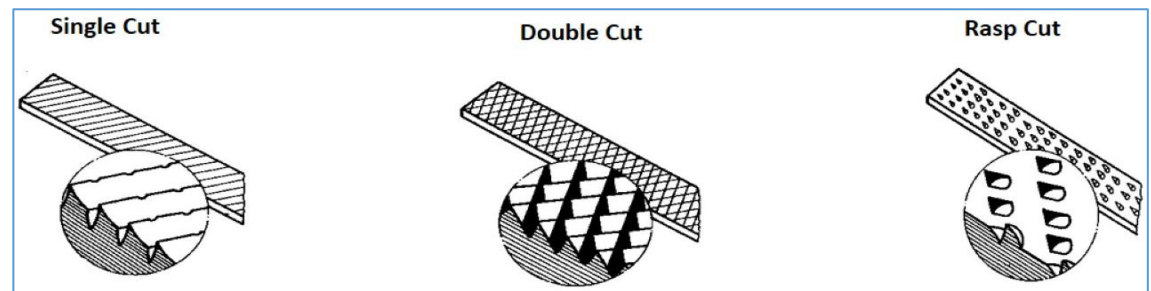
Files can be divided into three types as per the cut. These types are single cut, double cut and rasp cut.

Single cut: A single cut file has one set of teeth. It is used to file soft metals.

Double cut: A double cut file has two sets of teeth. It is used to file hard metals.

Rasp cut: A rasp cut file has distinct, individually cut teeth. It is used to file wood or rubber tube..

Some files are single cut on one face and double cut or even smooth on the other face.



### **Coarseness:**

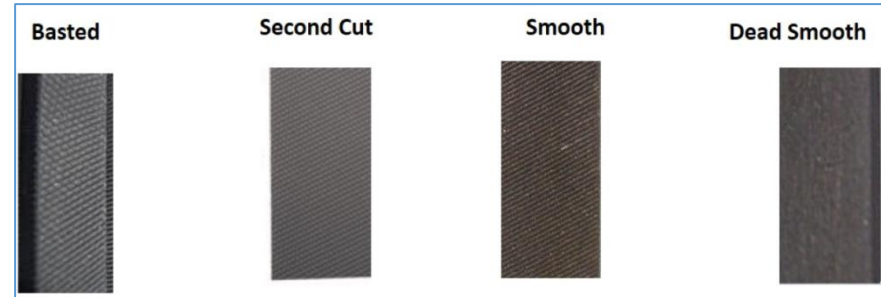
Files can be divided into four types as per the coarseness. These types are bastard, second cut, smooth and dead smooth files.

Bastard file: It is used for rough filing of an object.

Second cut file: It is used for semi finishing the object.

Smooth file: It is used for finishing purposes.

Dead smooth file: It is used for extreme finishing/finalization of the object.



### **Standard procedure for filing i.e. gesture, griping, stroking etc.**

Filing is an industrial art. It's not just rubbing the file back and forth. Every stroke should count and move you one step closer to a smooth, polished finish without gouges or abrasion marks.

There are three elemental filing techniques.

Straight filing is pushing the file lengthwise down the workpiece in a straight or slightly diagonal position. The cutting stroke is the push stroke. Done correctly, the return stroke shouldn't touch the workpiece. Straight filing can deliver maximum material removal or smooth final finish. Sometimes, the shape of the material can make straight filing difficult or awkward.

Draw filing is another popular filing method. This involves holding the file at both the tang and the point, and pulling it across the workpiece towards you. Like straight filing, draw filing can provide maximum material removal or a smooth finish.

The third technique is lathe filing and, just as its name implies, is the process of stroking the file against a workpiece that is revolving in a lathe. This can be useful when truing a workpiece or for removing material. As with any application involving your hands and face, and revolving tools, lathe filing requires with much care and attention.

### **Types of drill machines:**

For more details please visit: <https://www.theengineerspost.com/types-of-drilling-machine/>

#### **Bench type:**

The simplest type of drilling machine is the bench drilling machine. It is used for drilling holes through materials including a range of woods, plastics and metals. It is normally bolted to a bench so that it cannot be pushed over and that larger pieces of material can be drilled safely. Generally these machines have the chuck mounted directly onto the spindle nose. Variation in spindle speed is achieved by altering the belt position on the stepped pulleys.

The feed is operated by hand through a rack-and-pinion mechanism. This type of feed mechanism enables the operator to 'feel' the progress of the drill through the material being cut so that the operator can adjust the feed rate to suit the cutting conditions. This type of machine drill is used for drilling light weight pieces of material.

#### **Pillar type:**

A typical pillar drilling machine is an enlarged and more powerful version of the bench type drill machine. It is floor mounted and much more ruggedly constructed. The spindle is driven by a more powerful motor, and speed changing is accomplished through a gearbox instead of belt changing. Sensitive rack-and-pinion feed is provided for setting up and starting the drill.

Power feed is provided for the actual drilling operation. The feed rate can also be changed through an auxiliary gearbox. The spindle is always bored with a Morse taper to accept taper shank tooling as well as a drill chuck.



### Radial type:

A Radial drilling machine is a type of drill machine in which the boring head is mounted to slide along a spiral arm. It can be pivoted, raised, or brought on a vertical pole down to adjust the position of the drill over the workpiece. The machine has a vertical column mounted on a large base and is used for medium to large workpieces.

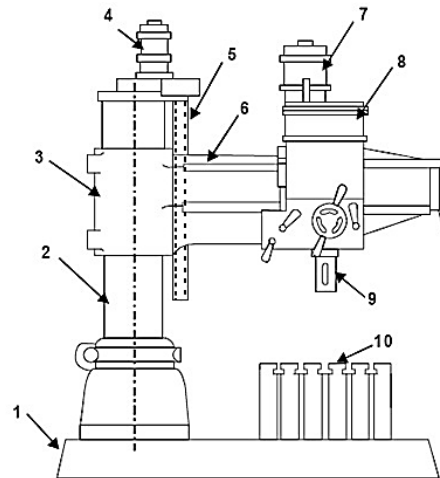
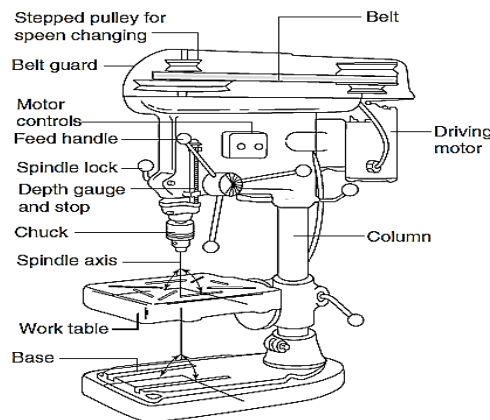
The column is supported by a radial arm which can be raised or lowered to accommodate workpieces of different height. This arm can swing horizontally to any position around the column over the work. There is also a drill head mechanism in the machine. It is provided for rotating the spindle and feeding the drill and is mounted on the radial arm. They can be moved horizontally to and fro from the column and clamped at any desired position. These three movements when combined together in a radial drilling machine permit the drill to be located at any desired position.



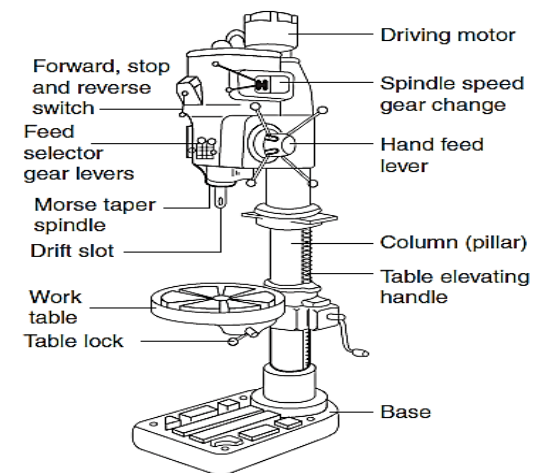
### Major functional parts of a drill machine

For more details please visit: <https://www.educationdiscussion.com/types-of-drilling-machines/>

The figures below show different functional parts of bench, pillar and radial drill machines.



- PARTS OF RADIAL DRILL:**
1. Base
  2. Column
  3. Radial arm
  4. Motor for elevating screw
  5. elevating screw
  6. Guide ways
  7. Motor for driving spindle
  8. Drill head
  9. Drill spindle
  10. Table



### Identify Types of metal i.e. Ferrous and non-ferrous

For more details please visit: <https://www.metalsupermarkets.com/the-difference-between-ferrous-and-non-ferrous-metal/>

Also visit: <http://www.me.nchu.edu.tw/lab/CIM/www/courses/Manufacturing%20Processes/Ch06-Metals-Wiley.pdf>

**Ferrous Metals:** Ferrous Metals mostly contain Iron. They have small amounts of other metals or elements added, to give the required properties. Ferrous Metals are magnetic and give little resistance to corrosion. Some examples of the ferrous metals we deal with:

- Carbon Steel
- Cast Iron

Non Ferrous Metals: Non-Ferrous Metals do not contain Iron, are not magnetic and are usually more resistant to corrosion than ferrous metals.

Some examples of Non-Ferrous Metals we deal with are:

- Aluminum & Aluminum Alloys
- Copper
- Brass
- Lead
- Zinc
- Stainless Steel
- Electrical Cable

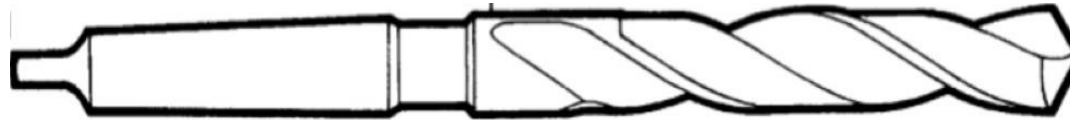
### Types of drill bits:

There are two types of drill bits: straight shank and taper shank.

Straight shank: These drill bits are made from high speed steel (HSS). They have parallel shanks and are held in a drill chuck. The size of the drill bit is normally engraved on the shank. The size range can go up to approximately 13 mm diameter.



Taper shank: Morse taper shank (taper shank) drill bits are used for accurate location and positive drive. These drill bits range from 10 mm to 50 mm diameter size. The size of the morse taper depends on the size of the drill. There are eight sizes of morse taper made, numbered from 0 to 7. Size numbers 1, 2 and 3 are most common.



### Cutting speed of common engineering materials

**Materials:** aluminum, mild steels, cast iron, carbon steels, copper, brass etc.

Following table shows the cutting speed of different materials.

Material being drilled	Cutting speed (m/min)
Aluminum	70–100
Brass	35–50
Cast iron (grey)	25–40
Steel (mild)	30–40
Steel (medium carbon)	20–30
Steel (alloy – high tensile)	5–8

Note: For roughing lower range and for finishing higher range will be used

## Calculation method for RPM.

Following formula is used to calculate RPM for drilling operation:

$$n = \frac{V \times 1000}{\pi \times d}$$

Where;

n = Spindle speed in revolution per minute (RPM)

v = linear Cutting speed of material in meter / minute (For HSS tools)

$\pi \times d$  = Circumference of the drill bit to change linear cutting speed of material into revolutions.

$\pi = 3.14$

d = Diameter of the drill

1000 = is to change the meter into millimeter according to the drill Diameter

## Steps to perform drilling and post cleaning operations

When drilling following procedure should be followed:

1. Remove scale from the surface of work piece using tip of file and maintain the flatness.
2. Mark the position of holes on the workpiece.
3. Center punch all the centers of holes
4. Calculate RPM using formula given above
5. Pilot Drill (dia. 3 to 5 mm) all the holes locations
6. Chamfer all the holes from both sides
7. Drill holes of required size on the pilot drills using correct drill bit sizes
8. Finish the holes by removing burr (spot facing tool can be used)



## Types of tapping:

Tapping is the process of cutting a thread inside a hole so that a cap screw or bolt can be threaded into the hole. Also, it is used to make thread on nuts. Tapping can be done both with machines and by hand.

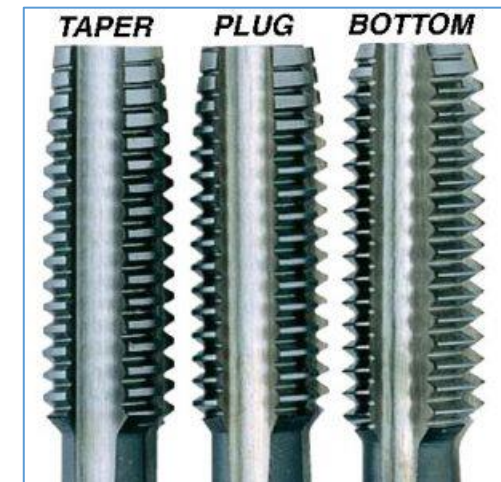
### Hand Tapping:

Hand tapping, as the name suggests, is the process of tapping (producing threads) manually. A tap and die is used to cut internal and external threads respectively. Hand taps come in three basic configurations -Taper, Plug and Bottoming.

Taper taps have the first 7 to 10 threads at the tip ground flatter than the main body of the tap to enable easy starting of the threads in the hole. Sometimes called a starter tap, taper taps can be used to start the thread in a blind hole for another tap to finish or used to cut threads all the way on a through hole.

Plug taps are like taper taps in that they have tapered threads at the starting end of the tap, the difference is there are fewer of them, usually the first 3 to 5 threads, so you get to cut a full thread sooner. Although not as easy to start as a taper tap, they can be used to start a thread.

Bottoming taps have no ground threads at the starting end and are generally used after, and in conjunction with a taper or plug tap. Bottom taps can cut threads to the bottom of blind holes although they do not do well at starting threads.



Hand threading dies are generally of two types. Round dies are designed to fit in a T-handle while Hex Die Nuts can be used with regular hand tools (Wrenches and sockets). Round dies are usually the choice for cutting new threads whereas hex die nuts are commonly used as a chaser to repair existing threads. Round dies also require a holder/handle to use them, whereas hex die nuts do not.

### Machine Tapping:

Machine tapping is faster, and generally more accurate because human error is eliminated. This is done using a machine such as a lathe, radial drilling machine, vertical milling machines etc.



Although in general machine tapping is more accurate, tapping operations have traditionally been very tricky to execute due to frequent tap breakage and inconsistent quality of tapping. Common reasons for tap breakage are:

- Tap-related problems (Wearing of tap, use of tap with improper tap geometry, use of non-standard or inferior quality taps)
- Clogging with chips
- Misalignment between tap and hole
- Over- or under-feeding the tap, causing breakage in tension or compression
- Use of improper and/or insufficient cutting lubricant
- Absence of a torque limiting feature
- Improper spindle speed.

In order to overcome these problems, special tool holders are required to minimize the chances of tap breakage during tapping.

### **Utility of taps:**

Internal threading:

Internal threading is done by using a tool called a tap in a hole drilled to a specific diameter for the thread size and pitch you want to cut. External threads, such as for bolts and studs, are made by using a tool called a die, which is applied to a specific diameter of rod for the size and pitch of the threads you want to cut.

### **Cleaning threads:**

Taps are also used to clean and finish the threads in a hole. For this purpose bottoming taps are used as described above.

Maintenance of threads:

A tap can also be used for the maintenance of damaged threads.

## Process steps for hand tapping

Following steps will be followed during hand tapping:

1. In order for taps and dies to cut, they must be harder than the materials they are cutting. This additional hardness also makes them brittle, meaning, they can be easily broken. It is always preferable to use a proper T-handle for taps rather than a wrench or locking pliers. Using a T-Handle keeps the force applied over the center of the tap or die, maintaining proper symmetry
2. Lubricate the cutting threads. Lubrication can reduce friction binding and aid in chip removal. You can use a specialty tapping fluid, a light machine oil, a little WD-40
3. Turn the T-handle in the direction of cutting and keep rotating it slowly and gradually. Take the required time and do not go fast as the risk of breaking the tap becomes higher. Once the first full teeth begin cutting, the metal being removed may be a long strip, called a swarf, or chips. At this point, turn the tap slowly in reverse until you hear, or feel a 'click' of the chip breaking away from the material being cut. The vast majority of tap breakage can be avoided by making sure you break the chips
4. Keep going this way up to the full length of the threads. Now turn the tap in reverse to bring it out of the hole in similar fashion.
5. Clean and finish the threads

## Types of reamers:

A reamer is a type of rotary cutting tool used in metalworking. Precision reamers are designed to enlarge the size of a previously formed hole by a small amount but with a high degree of accuracy. The process of enlarging the hole is called reaming.

There are two types of reamers: machine and hand reamers.

### Hand reamers:

A hand reamer is intended for manual reaming and is typically equipped with a handle. It is designed with a longer taper or lead in at the front than a machine reamer to compensate for the difficulty of starting a hole by hand power. It also allows the reamer to start straight and reduces the risk of breakage.



### Machine reamers:

Machine reamers have a small lead in and spiral flutes have an advantage of clearing the swarf automatically. The reamer and the work piece are pre-aligned, removing the risk of the reamer going off course. The constant force of the machine ensures that the cutting starts immediately.



The purpose of reaming is as follows:

1. It maintains the size of the hole as per the tolerance given
2. Correct use of reamer ensures that the roundness of hole is preserved
3. Reamers are used for surface finishing of holes

### Knowledge of tolerances and fits

For more details please visit: [http://site.iugaza.edu.ps/aabuzarifa/files/METRO20152\\_CH52.pdf](http://site.iugaza.edu.ps/aabuzarifa/files/METRO20152_CH52.pdf)

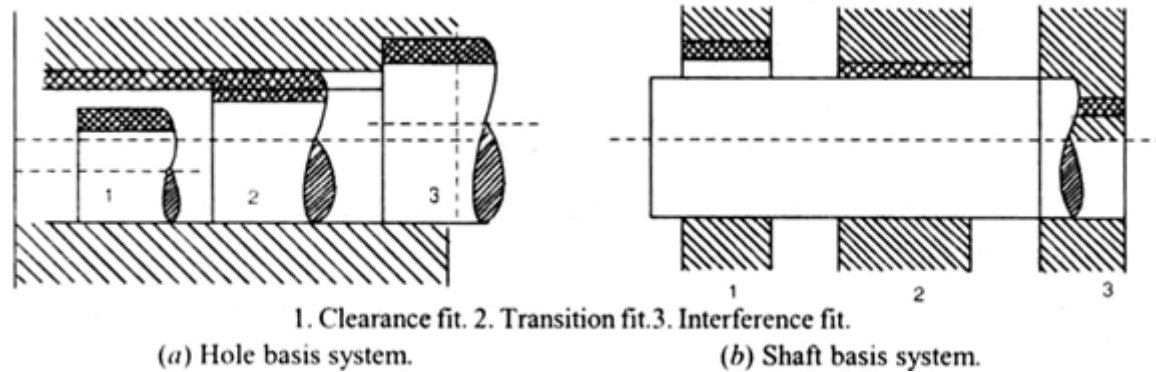
**Tolerance:** The term tolerance refers to the difference between the upper (maximum) limit and lower (minimum) limit of a dimension. In other words, tolerance is the maximum permissible variation in a dimension.

**Fits:** The term fits refers to the degree of tightness or looseness between two mating parts. There are three categories of fits:

**Clearance fit:** A fit that always provides a clearance (gap) between the hole and shaft when assembled is known as clearance fit. In clearance fit, the minimum size of the hole is either greater than or equal to (in extreme case) the maximum size of the shaft so that the shaft can rotate or slide as per the purpose of the assembled members.

**Interference fit:** In interference fit, the maximum size of the hole is either smaller or equal to (in extreme case) the minimum size of the shaft. In this fit, the shaft and the hole members are intended to be attached permanently, so that they can be used as a solid component

**Transition fit:** A fit which may provide either a clearance or interference between the shaft and hole when assembled depending on the actual sizes of the shaft and hole is known as Transition fit.

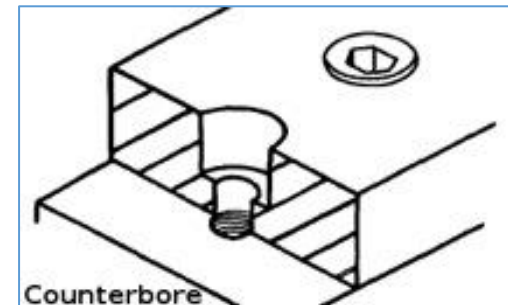


### Purpose of counter boring:

Counter boring creates a flat-bottom cavity that matches the shape of the underside of a bolt or screw. This allows the head of the screw or bolt, often used with a washer, and its flat underside to rest totally within the counter bore.

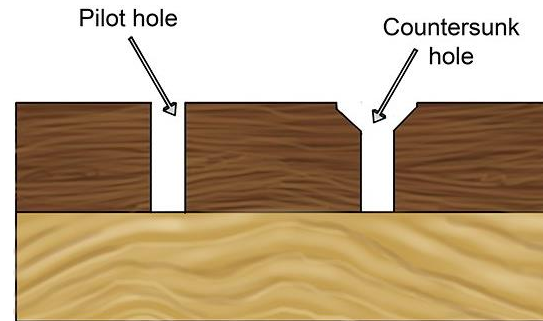
### Process steps for counter boring

1. Remove scale from the surface of work piece
2. Mark the position of hole on the workpiece.
3. Center punch the center of hole
4. Calculate RPM using formula
5. Pilot Drill (dia. 3 to 5 mm)
6. Chamfer the hole
7. Drill hole of required size on the pilot drill
8. Use counter bore drill to produce a counter bore hole
9. Finish the hole by removing burr (spot facing tool can be used)



## Purpose of counter sinking

Counter sinking creates a conical cavity that matches the angled shape of the underside of a flathead screw. A person needs to countersink a hole when working with countersunk screws. Countersinking a pilot hole allows a countersunk screw to sit flush with the surface of the material, giving work a neat finish.



## Process steps for counter sinking

1. Remove scale from the surface of work piece
2. Mark the position of hole on the workpiece.
3. Center punch the center of hole
4. Calculate RPM using formula
5. Pilot Drill (dia. 3 to 5 mm)
6. Chamfer the hole
7. Drill hole of required size on the pilot drill
8. Use counter sunk drill to produce a counter sunk hole
9. Finish the hole by removing burr (spot facing tool can be used)

## Concept of surface finish:

Surface finish of parts can significantly affect their friction, wear, fatigue, corrosion, tightness of contact joints, positioning accuracy, etc. Surface finish is important factor for manufacturing process monitoring and quality control inspection.

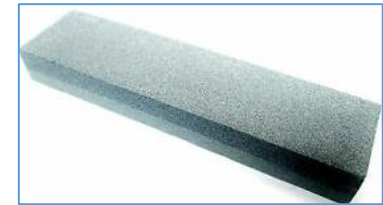
## Polishing aids:

For more details please visit: <https://www.uddeholm.com/files/polishing-english.pdf>

**Emery cloth:** Emery cloth is a strip of dense fabric that has small metallic or synthetic particles bonded to it with glues and adhesives. It's best used to smooth metal surfaces.



**Oil stones:** Oil Stones are traditional sharpening stones. They are long wearing and are available in a variety of sizes and grits.



**Polishing abrasive:** Abrasive polishing is a mechanical process to remove excess materials from the wafer surface by letting abrasives cut into the surface to be polished.



**Polishing paste:** The composite polishing paste is comprised of smooth polishing cream with submicron aluminum oxide abrasive particles to provide a long-lasting, brilliant shine on both anterior and posterior restorations.



**Pin grinding wheels:** These are made of natural or synthetic abrasive minerals bonded together in a matrix to form a wheel. Grinding wheels provide an efficient way to shape and finish metals and other materials.

**Rotary burrs:** Rotary Burrs are used for cutting, shaping, grinding and for the removal of sharp edges, burrs and excess material (deburring)



### **Post polishing Methods:**

Metal should be cleaned properly after polishing. All the fine particles that might appear on the metal surface should be removed. Wire brush can be used for this purpose.

### **Knowledge of hand grinders / pin grinders machines and types of wheels / disc.**

Hand grinder, also known as angle grinder or disc grinder, is a handheld power tool used for grinding (abrasive cutting) and polishing. They can be powered by an electric motor, petrol engine or compressed air. They typically have an adjustable guard and a side-handle for two-handed operation.





Grinding wheels / discs are widely used in grinding machines. These wheels are expendable wheels composing of an abrasive compound. These grinding wheels are formed out of an aluminum disc or solid steel by way of attaching the particles to the exterior surface.

Types of grinding wheels:

### 1. Straight grinding wheel

Straight wheel are the most common mode of wheel that is found on pedestal or bench grinders. This is the one widely used for centerless & cylindrical surface grinding operations.



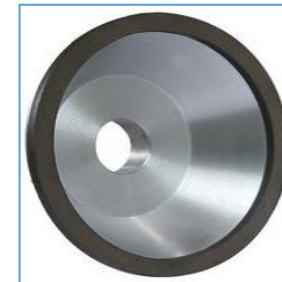
### 2. Cylindrical grinding wheel

A cylinder wheel has no center mounting support but has a long & wide surface. Their width is up to 12" and is used purely in horizontal or vertical spindle grinders.



### 3. Tapered grinding wheel

Tapered Grinding wheel is a straight wheel that tapers externally towards the midpoint of the wheel. As this fact is stronger than straight wheels, it accepts advanced lateral loads.



### 4. Straight cup wheel

Straight cup wheels forms an option for cup wheels in cutter and tool grinder

## 5. Dish cup wheel

This is used primarily in jig grinding and cutter grinding. It is a very thin cup-style grinding wheel which permits grinding in crevices and slot.

## 6. Saucer grinding wheels

Saucer grinding wheel is an exceptional grinding profile used for grinding twist drills and milling cutters.



## 7. Diamond grinding wheels

In diamond wheels industrial diamonds remain bonded to the edge. This is used to grind hard materials like concrete, gemstones & carbide tips.



### Method of mounting disc / wheel / rotary bur on hand grinder

Following steps will be used to mount a disc/wheel on grinder:

1. With the grinder unplugged, turn the grinder upside down so that you are looking at the position where grinding wheel and the locking apparatus will be placed
2. Nest the inner flange against the underside of the disc. Set the inner flange and disc onto the grinder's shaft
3. Place the lock nut on the grinder's shaft and hand-tighten it
4. Press the shaft lock button located on the top of the grinder. Because the grinder is being held upside down, this button will be facing down towards the ground. Spin the shaft until it locks into place
5. Use your lock nut wrench to tighten the lock nut onto the grinder shaft and disc. Turn the lock nut wrench clockwise until the disc is secured

## **Knowledge of safe operating procedure for portable grinder**

### **Preparation of working:**

- Remove flammable materials from the work area
- Ensure work area is clean.
- Keep the power cord away from the grinding wheel and the material being ground
- Secure work with clamps or a vice to free both hands to operate the tool

### **Personal Protective Equipment (PPE):**

- Wear safety glasses or goggles, face protection to protect against flying particles
- Gloves – Caution: Wear snug fitting gloves to avoid snagging on abrasive wheel or wire brush
- Apron, metatarsal safety boots, and respiratory protection may also be required depending on the work being performed
- Do not wear jewelry or other items that could become entangled in moving parts
- Avoid wearing loose clothing or secure loose clothing
- Tuck or secure long hair

### **Switch Grinder “ON”:**

- Stand to one side and switch on grinder
- Ensure the grinder operates smoothly and does not vibrate. If you notice any unusual vibrations or noises, STOP. Re-inspect the grinder and fix the problem immediately

### **Grinding:**

- Use both hands to maintain hold of the grinder
- Allow grinder to reach full rpm before grinding
- Position yourself to avoid overbalancing
- When grinding avoid placing excessive pressure on abrasive wheels
- Do not grind objects on sides of grinding wheels
- Materials may become hot when grinding – use gloves when necessary
- Clean and service grinders according to manufacturers' recommendations
- Ensure the floor around the work area is clean

- Do not use wheels that are cracked or those that excessively vibrate
- Do not operate grinder on wet floors





**Switch Grinder “OFF”:**





- Switch off grinder when done
- Wait until the wheel has stopped turning before placing the grinder on the working surface
- Unplug the power cord from the power supply
- Clean area and dispose of grinder particles

**Importance of using PPEs**

PPE is equipment that will protect workers against health or safety risks on the job. The purpose is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels.

**PPEs:**

Name & Usage	Picture of PPE	Name & Usage	Picture of PPE
Safety goggles – used to protect eyes from flying particles (chips, sparks etc.)		Safety shoes – used to protect feet from spatters of welding and impact of other falling objects	
Face shield - used to protect face from welding sparks, radiations, arc and spatters		Face mask – used to protect from inhaling fumes, dangerous gases etc.	

<p>Hard cap – used to protect the head from injury due to falling objects</p>		<p>Leather Apron – used to protect welder’s body from welding spark and spatters</p>	
<p>Leather gloves – used to protect hands during welding</p>		<p>Cotton gloves – used to protect hands from sharp edges of sheets and plates</p>	

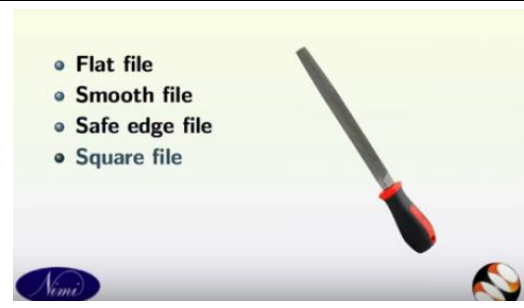
**Importance of housekeeping and safe storage of tools and equipment**

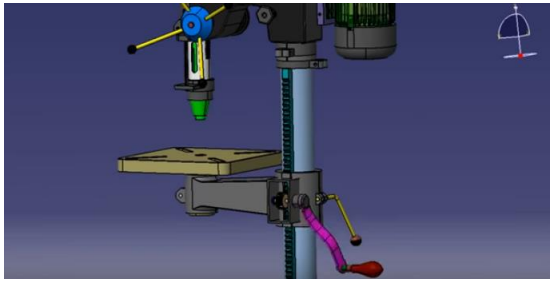
The main function of housekeeping is to ensure cleanliness, comfort, convenience, privacy, health and hygiene in a safe environment. It includes keeping work areas neat and orderly. All the tools and equipment must be stored properly.

**Importance of making check list**

It ensures you get your daily, weekly and monthly tasks done on time, helps you keep track of projects on deadline and ensures you're organized throughout the day.

**VIDEOS:**

 <ul style="list-style-type: none"><li>• Flat file</li><li>• Smooth file</li><li>• Safe edge file</li><li>• Square file</li></ul>	<p>Filing a work piece - English</p> <p><a href="https://www.youtube.com/watch?v=BM8gZuLr0CE">https://www.youtube.com/watch?v=BM8gZuLr0CE</a></p>
 <p>Make:</p>	<p>Skillbuilder: 5 Tips for Using Files</p> <p><a href="https://www.youtube.com/watch?v=32FUysj-Lu4">https://www.youtube.com/watch?v=32FUysj-Lu4</a></p>
 <p>power supply</p> <p>Feed unit</p> <p>drill tool &amp; holder</p> <p>worktable</p> <p>base frame</p>	<p>Drilling Machine   Construction ,Parts , Working , Animation</p> <p><a href="https://www.youtube.com/watch?v=OX3qYmcE3hQ">https://www.youtube.com/watch?v=OX3qYmcE3hQ</a></p>



catia tutorial for beginners pt1. Vertical drill press machine simulation

[https://www.youtube.com/watch?v=h\\_bTrQas4bc](https://www.youtube.com/watch?v=h_bTrQas4bc)



HTO - How to Drill Thick Steel | Iron Wolf Industrial

<https://www.youtube.com/watch?v=Z2fNS4nkP-c>



How to Hand Sharpen a Twist Drill

<https://www.youtube.com/watch?v=y0SQkzScQk0>



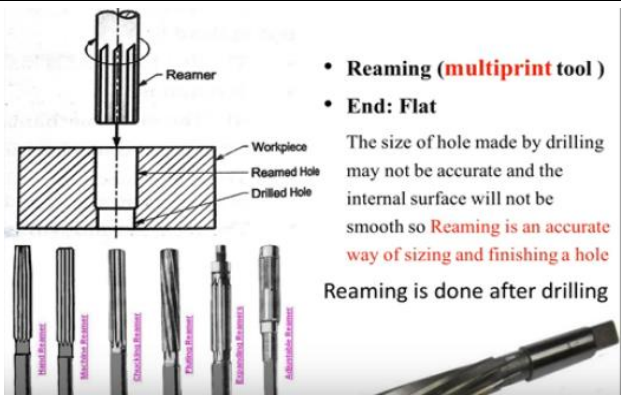
How to tap steel | tapping steel | ultimatehandyman

<https://www.youtube.com/watch?v=veO270DcKXE>



Cutting an External Thread using Die & Die Stock

<https://www.youtube.com/watch?v=gVcwjjBAT4Q>



- Reaming (**multi-point tool**)

- End: Flat

The size of hole made by drilling may not be accurate and the internal surface will not be smooth so Reaming is an accurate way of sizing and finishing a hole

Reaming is done after drilling

BME 4.2 DRILLING MACHINE AND OPERATIONS

<https://www.youtube.com/watch?v=wWsFob0bV38>



# DIES AND MOULDS MAKER



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Module-3

LEARNER GUIDE

National Vocational Certificate Level 2

Version 1 - July, 2019

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### Module 3: 071500967 Perform Lathe Operations

**Objective of the module:** This competency standard covers the skills and knowledge required to perform different processes on lathe machines including Facing, turning, parting, threading, knurling, and drilling.

**Duration:** Hrs                      **Theory:** Hrs                      **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> Set tool and lathe machine	<b>The trainee will be able to:</b> Identify & select machine. Manage the required measuring equipment  Set machine & other attachments if required.  Select proper tool according to job specifications.  Clamp the tool as per standard procedures.  Set machine parameters Follow relevant safety procedures.	Knowledge of the types of lathe machine: <b>Types:</b> Bench lathe, Speed lathe, Engine lathe, Tool room lathe, Turret lathe, Automatic lathe, Special purpose lathe  Knowledge of Major functional parts of a lathe machine. <b>Parts:</b> machine bed, Head stock, speed changing lever, tailstock, lead screw etc.  Know the use of precision measuring tools: <b>Tools:</b> Vernier caliper, external micrometer, internal micrometer etc.  Know types of cutting tools. <b>Cutting tools:</b> HSS, carbide tips, carbide inserts  Knowledge of tools clamping methods Method of setting machine parameters i.e. speed, feed etc.	Tool room lathe Vernier caliper External Micro meter Internal micrometer HSS tool bit Carbide tips Carbide inserts
<b>LU2:</b> <b>Perform workpiece setting</b>	<b>The trainee will be able to:</b> Prepare work piece for machining operations Clamp the work pieces as per standard procedures	Workpiece clamping devices: <b>Devices:</b> concentric chuck, four jaws chuck, face plate and tail stock, collets.  Use of dial indicators i.e. Dial indicator, lever gauge, magnetic stand.	MS shaft Concentric chuck Four jaws chuck Face plate Lathe machine tail stock

	Dial the work piece & ensure final clamping	Methods of workpiece clamping i.e. three jaw chuck, four jaw chuck, between centers, use of face plate etc. Methods of using dial indicators	collet Dial indicator Lever gauge Magnetic stand
<b>LU3: Perform facing</b>	<b>The trainee will be able to:</b> Select appropriate tool for facing  Clamp the tool in tool post & set in required angle Set machine parameter as per job specifications  Dial the work piece & ensure final clamping  Carry out machining operation for facing as per standard procedure	Tool angles and their application for different materials. <b>Angles:</b> rack angle, clearance angle, wedge angle, face clearance etc. Knowledge of tool post and carriage. RPM calculating and setting on machine. Understand speed and feed rate.	MS shaft HSS tool bit
<b>LU4: Perform turning</b>	<b>The trainee will be able to:</b> Select appropriate tool for turning  Clamp the tool in tool post & set in required angle  Set machine parameter as per job specifications  Dial the work piece & ensure final clamping	Knowledge of turning Tool angles and their application for different materials. <b>Angles:</b> rack angle, clearance angle, wedge angle, face clearance etc. Knowledge of tool post and carriage. RPM calculating and setting on machine. Understand speed and feed rate.	HSS tool bit MS shaft External micro meter

	Carry out machining operation for turning as per standard procedure		
<b>LU5: Perform thread cutting</b>	<p><b>The trainee will be able to:</b> Select &amp; prepare appropriate tool for thread cutting</p> <p>Clamp &amp; set the tool in tool post</p> <p>Set machine parameters as per job specifications</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for thread cutting as per standard procedure</p>	<p>Types of threads. <b>Types:</b> metric, British, square, acme, buttress etc. Method of clamping tool for thread cutting. Thread cutting parameters: lead screw, gear train, feed rate etc. Safe operating procedures for lathe machine</p>	<p>MS shaft Thread samples Thread cutting tool HSS Thread pitch gauge</p>
<b>LU6: Perform parting</b>	<p><b>The trainee will be able to:</b> Select appropriate tool for parting</p> <p>Clamp &amp; set the tool in tool post.</p> <p>Set machine parameter as per job specifications Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for parting as per standard procedure</p>	<p>Know the tools for Straight parting and Parting with contours Method of clamping on parting tool Setting machine parameter i.e. workpiece rpm. Safe procedures for parting</p>	<p>HSS Parting tool MS shaft Vernier caliper</p>

<p><b>LU7:</b> <b>Perform drilling / boring</b></p>	<p><b>The trainee will be able to:</b> Select appropriate tool for drilling / boring as per drawing</p> <p>Set machine parameter as per job specifications</p> <p>Clamp drill bit in drill chuck Perform drilling to produce appropriate hole size for boring</p> <p>Clamp the boring tool in the tool post.</p> <p>Carry out machining operation for Boring as per standard procedure</p>	<p>Knowledge of Boring tools and boring bars for lathe machine.</p> <p>Setting of workpiece rpm</p> <p>Method of using drill chuck in a lathe machine</p> <p>Clamping method of boring tools</p> <p>Knowledge of Drilling steps: center drill, pilot drill, final drill etc.</p>	<p>MS shaft HSS boring tool Boring bar Internal micrometer</p>
<p><b>LU8:</b> <b>Perform knurling</b></p>	<p><b>The trainee will be able to:</b> Select appropriate tool for knurling</p> <p>Clamp the tool in tool post.</p> <p>Set machine parameter as per job specifications</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for Knurling as per standard procedure</p>	<p>Types of knurling tools i.e. straight and diamond knurling.</p> <p>Method of clamping knurling tools</p> <p>Workpiece rpm for knurling</p> <p>Use of dial indicators</p> <p>Safe procedure of knurling</p>	<p>MS shaft Straight Knurling tool Diamond knurling tool</p>

<p><b>LU9:</b> <b>Perform final inspection</b></p>	<p><b>The trainee will be able to:</b> Prepare the work piece for inspection</p> <p>Visually Inspect the work piece</p> <p>Manage the required measuring tools</p> <p>Perform the required inspection as per drawing</p>	<p>Knowledge of tolerance i.e. upper limits and lower limits, basic hole and shaft system</p> <p>Knowledge of inspection tools.</p> <p><b>Tools:</b> Ring gauge, plug gauge, thread pitch gauge, internal micrometer, external micrometer, Checking parallelism</p>	<p>Prepared lathe machine job</p> <p>Ring gauge</p> <p>Plug gauge</p> <p>Thread pitch gauge</p> <p>Internal and external micrometer</p> <p>Dial indicator with magnetic stand</p>
<p><b>LU10:</b> <b>Demonstrate safe working practice &amp; housekeeping</b></p>	<p><b>The trainee will be able to:</b> Select &amp; use appropriate PPEs.</p> <p>Maintain cleanliness at the workplace</p> <p>Ensure relevant safety procedure for lathe operations</p>	<p>Benefits of good house keeping</p> <p>Health and safety relevant to lathe machine</p>	<p>Cleaning cloth / cotton rages</p> <p>Lubricant oil</p>

## Examples and illustrations

### Knowledge of the types of lathe machine:

For more details please visit: <http://engineering.myindialist.com/2014/types-of-lathes/#.XXH0RS4zbiU>

#### Bench lathe:

Lathe mounted on a workbench.

Lathe - machine tool for shaping metal or wood; the workpiece turns about a horizontal axis against a fixed tool.



#### Speed lathe:

It is a power lathe with a rapidly revolving spindle. It is used for turning small objects and for polishing purposes. It does not have power feed. The tool is fed and actuated by hand. These lathes may be of bench type or they may have the supporting legs cast and fitted to the bed. These are usually used for wood turning.

#### Engine lathe:

An engine lathe is a type of machinery, shaped horizontally, and it is often used to cut metal. The metal is turned, and the machine uses special cutting tools to create the desired shape. Primary features of an engine lathe are gears, a stepped pulley to operate spindle speeds, tailstock, and a carriage. The gears work to power the transport, which cushions the cutting tools. A tailstock will support hole-drilling within the spindle. Shaping tools can be manually operated or driven with gears. A conventional engine lathe will also include a compound rest and cross-slide for angular and cross cutting.



### Tool room lathe:

A tool room lathe is generally a high precision lathe having a gearbox in the headstock offering an extended range of thread pitches and feeds. It is used for making precision components in the tool room.



### Turret lathe:

The turret lathe is a form of metalworking lathe that is used for repetitive production of duplicate parts. It evolved from earlier lathes with the addition of the turret, which is a tool holder that allows multiple cutting operations to be performed, each with a different cutting tool, in easy, rapid succession, with no need for the operator to perform set-up tasks in between, such as installing or uninstalling tools, nor to control the tool path.



### Automatic lathe:

An automatic lathe is a lathe (usually a metalworking lathe) whose actions are controlled automatically. All movements of cutting tools, their sequence of operations, applications, feeding of raw material, and parting off, unloading of finished parts are all done on machine. Only operation required to be done manually is loading of bar stock/individual casting/forged blocks.



### Special purpose lathe:

As the name implies, these lathes are used for special purposes such as heavy-duty production of identical parts. In addition, these lathes also perform specific functions that cannot be performed by the standard lathes.





## Knowledge of Major functional parts of a lathe machine

For more details please visit: <https://www.theengineerspost.com/types-of-lathe-machines/>

### Machine bed:

The bed is a robust base that connects to the headstock and permits the carriage and tailstock to be moved parallel with the axis of the spindle.



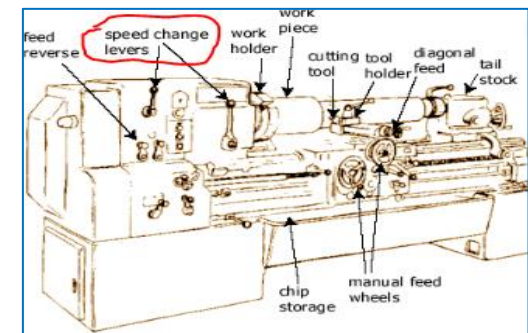
### Headstock:

The headstock is clamped on left-hand end of bed. It houses the spindle, speed change mechanism and change gears.



### Speed changing lever

It is used to change the gear settings in the headstock. It usually have two to three levers.



### Tailstock:

Tailstock is usually used to apply support to the longitudinal rotary axis of a workpiece being machined.



### Lead screw:

The basic function of the lead screw is to move the turret by a précised increment for every rotation of the screw. As a result of this it allows the machine to generate threads in a work piece and helps in generating precise length and diameter dimensions, and also to maintain a constant rate of metal removal.



### Know the use of precision measuring tools

For more details please visit: <https://www.brighthubengineering.com/hvac/63905-precision-measuring-instruments/>

Vernier caliper:



External micrometer



Internal micrometer etc.



### Know types of cutting tools

For more details please visit: <https://www.educationdiscussion.com/lathe-cutting-tools/>

### HSS

The simplest and most common is high speed steel (HSS) tool bits. These tool bits typically come as square bars, and are then hand ground on the pedestal grinder.



### Carbide tips

These tools feature a steel body, with a carbide tip brazed onto the end.



### Carbide inserts

Carbide inserts are replaceable and usually indexable bits of cemented carbide used in machining steels, cast iron, high temperature alloys, and nonferrous materials. Carbide inserts allow faster machining and leave better finishes on metal parts.



## Knowledge of tools clamping methods

For more details please visit: [http://www.fayoum.edu.eg/stfsys/stfFiles//243//2378//04\)%20Manufacturing%20Processes%201.pdf](http://www.fayoum.edu.eg/stfsys/stfFiles//243//2378//04)%20Manufacturing%20Processes%201.pdf)

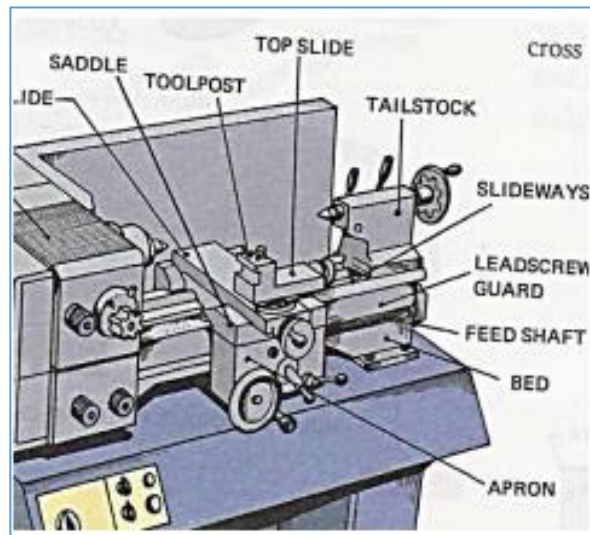
**Saddle:** It is an H shaped casting slides over the outer set of the guide ways and serves as the base for the cross slide.

**Cross Slide:** It is mounted on the saddle and enables the movement of the cutting tool laterally across the lathe bed by means of cross-feed hand wheel. It also serves as the support for a compound rest.

**Compound Rest:** It is mounted on the top of the cross slide and supports the tool post. It can be swiveled to any angle in the horizontal plane to facilitate the taper turning and threading operations. It is moved manually by the compound rest feed handle independent of the lathe cross feed.

**Apron:** It is mounted at the front of the saddle beneath it and houses the carriage and the cross slide mechanisms. The apron hand wheels moves the carriage assembly manually by means of the rack and the pinion gears.

**Tool Post:** It is mounted in the T slot of the compound rest. The tool post clamps the tool holder in the proper positions for machining operations. It is fitted on top slide and carries the cutting tool or the cutting tool holder. It can adjust the height on some types. It can carry 4 different tool holders.



## Quick change tool post (QCTP)



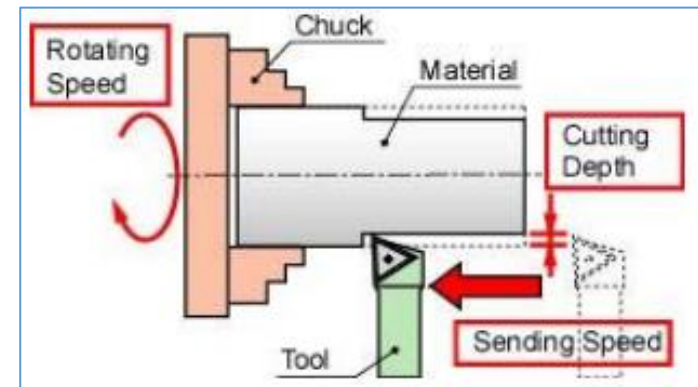
### Method of setting machine parameters i.e. speed, feed etc.

For more details please visit: <http://www.ghunt.com/2015/10/cutting-speed-and-feed-on-lathe-machine.html>

**Rotating Speed (Spindle speed):** It expresses with the number of rotations (rpm) of the chuck of a lathe. When the rotating speed is high, processing speed becomes quick, and a processing surface is finely finished. However, since a little operation mistakes may lead to the serious accident.

**Cutting speed:** The rate of metal removal is from the metal surface, in length, during the machining per unit time. The unit for cutting speed is m/minute. The depth of cut, the feed rate and the cutting speed are dependent of the hardness of the cutting tool material and the hardness of the cutting material.

**Feed:** The distance travels by the tool toward the work piece during one rotation of part. Cutting speed and feed determines the surface finish, power requirements, and material removal rate.



Material Being Machined	Feed (mm/rev)	Cutting Speed (m/min)
Aluminium	0.2-1.0	70-100
Brass	0.2-1.5	60-90
Cast iron	0.15-0.7	18-25
Mild Steel	0.2-1.0	30-38
Medium Carbon Steel	0.15-0.7	21-30
Alloy Steel	0.08-0.3	12-20

The primary factor in choosing feed and speed is the material to be cut. However, one should also consider material of the tool, rigidity of the work piece, size and condition of the lathe, and depth of cut.

### Workpiece clamping devices

**Concentric chuck:** A chuck is a specialized type of clamp used to hold an object with radial symmetry. In lathes it holds the rotating workpiece. On a lathe the chuck is mounted on the spindle which rotates within the headstock.

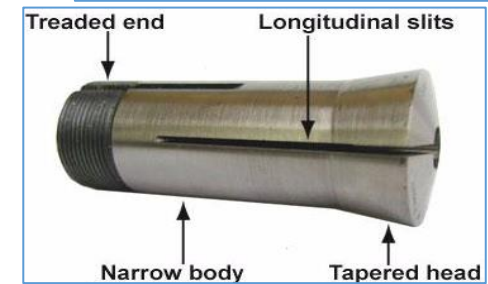


**Four jaws chuck:** The four jaw independent chuck has four jaws each of which can be adjusted independently by a chance wrench. They are used to hold round, square, hexagonal, and irregular-shaped workpieces. The jaws can be reversed to hold work by the inside diameter.

**Face plate:** It is a circular metal (usually cast iron) plate which fixes to the end of the lathe spindle. The workpiece is then clamped to the faceplate typically using t-nuts in slots in the faceplate or less commonly threaded holes in the faceplate itself.



**Collets:** It is a subtype of chuck that forms a collar around an object to be held and exerts a strong clamping force on the object when it is tightened.



### Use of dial indicators

**Dial indicator:** Dial indicators are typically used to measure deck clearances, crankshaft thrust and straightness, lifter travel and other measurements that involve the distance between two surfaces or small amounts of component travel.



**Lever gauge:** It is a type of dial indicator. It has lever type contact as opposed to dial indicator which has plunger type contact.



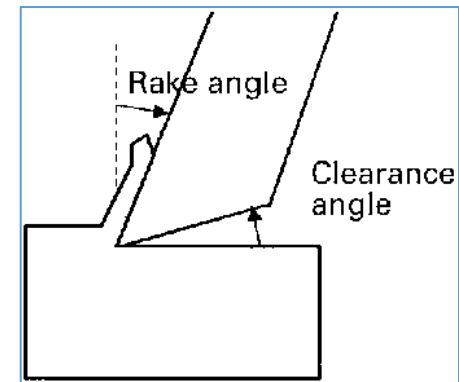
**Magnetic stand:** It is a magnetic fixture based on a magnet that can effectively be turned "on" and "off" at will. The magnet, when it is rotated or pressed, acts as the ON/OFF switch for the magnetic base. ... When the poles of the magnet are lined up with the aluminum spacer, the magnet is OFF. When the magnet is rotated so the poles line up with the ferrous plates, the magnet is ON.



### Tool angles and their application for different materials

For more details please visit: <https://www.theengineerspost.com/lathe-cutting-tools/>

**Rake angle:** The rake angle is the angle of the surface of a cutting tool tip over which the removed chips flow. The rake angle is the angle between the front or cutting face of the tool and a line perpendicular to the workpiece.



**Clearance angle:** It is the angle between machined surface and the flank surface.

**Wedge angle:** It is defined as the cutting tool angle. The sum of rack angle, clearance angle and wedge angle is 90 degrees.

### Knowledge of tool post and carriage

A lathe tool post is a machine tool that spins a block of material when abrasive, cutting, or deformation tools are applied to the block.





Carriage moves on the outer ways. It is used for mounting and moving most the cutting tools. It provides a good support to damp the vibration.

### RPM calculating and setting on machine

The basic equation used to calculate the proper RPM for machining is as follows:

$$\text{RPM} = (\text{cutting speed} \times 12) / (\pi \times \text{diameter})$$

Where the cutting speed is in feet/min and the diameter is in inches.

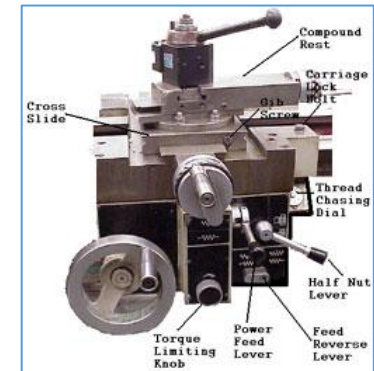
This can be approximated as:

$$\text{RPM} = (3.82 \times \text{cutting speed}) / \text{diameter}$$

In order to use the equation, four pieces of information are required:

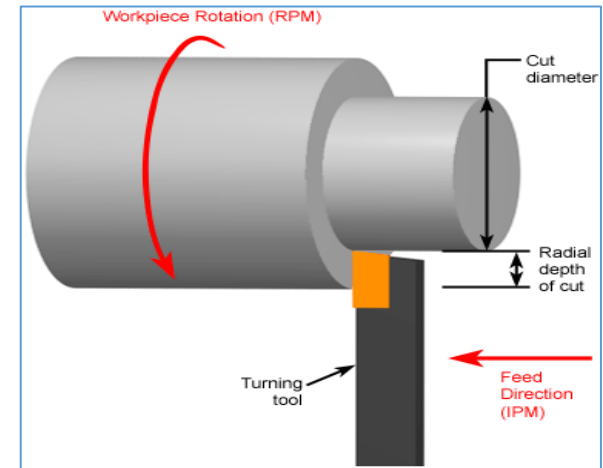
1. The workpiece material (steel, cast iron, brass, etc.).
2. The tool material (High Speed Steel, carbide, or ceramic).
3. The type of machining operation to be performed (drilling, milling, turning, etc.).
4. The diameter of the tool or the diameter of the part feature to be machined.

The first three pieces of information allow the machinist to look up the proper cutting speed from a table in Machinery's Handbook or other reference source. The fourth piece of information, the diameter, is the largest diameter that the tool "sees", i.e. the diameter of the tool (for drilling and milling) or the diameter of the workpiece feature being machined (turning or boring).



## Knowledge of turning

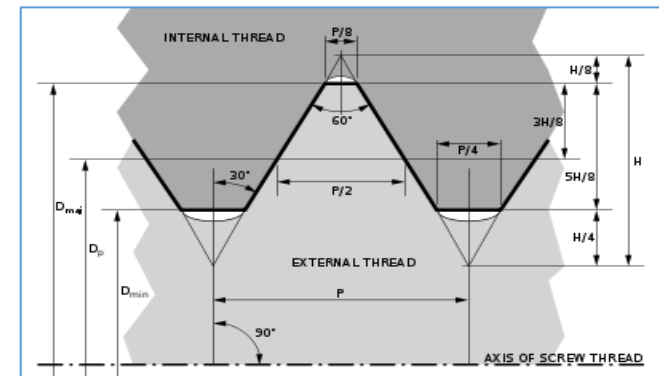
Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or lathe, workpiece, fixture, and cutting tool. The workpiece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and allowed to rotate at high speeds. The cutter is typically a single-point cutting tool that is also secured in the machine, although some operations make use of multi-point tools. The cutting tool feeds into the rotating workpiece and cuts away material in the form of small chips to create the desired shape.



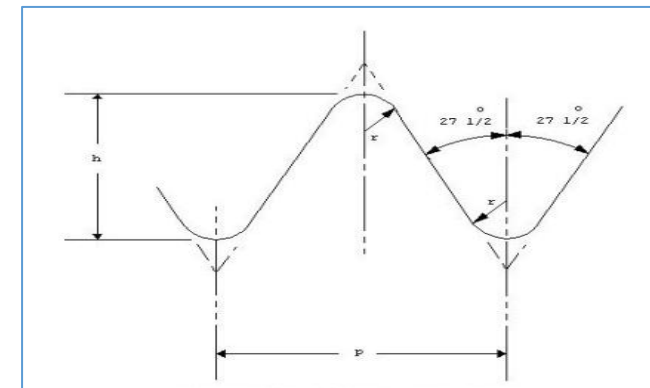
## Types of threads

For more details please visit: <https://www.theengineerspost.com/screw-thread-terminology-types-of-screw-threads/>

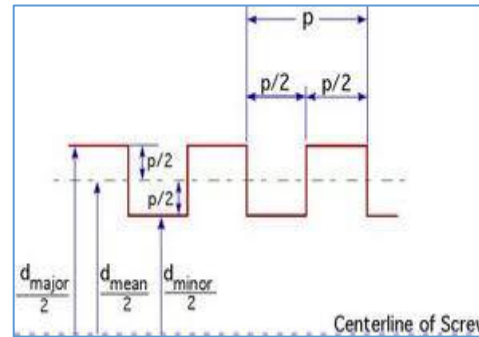
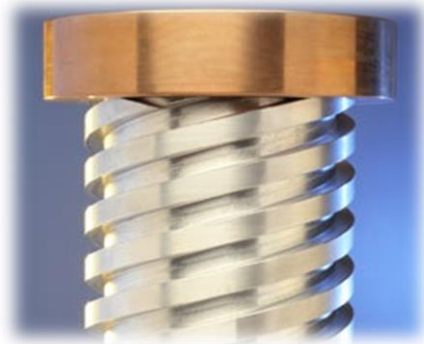
**Metric threads:** The metric screw threads are the world-wide most commonly used type of general purpose screw thread. Metric threads consist of a symmetric V-shaped thread. In the plane of the thread axis, the flanks of the V have an angle of  $60^\circ$  to each other. The outermost  $1/8$  and the innermost  $1/4$  of the height  $H$  of the V-shape are cut off from the profile. Each thread is characterized by its major diameter  $D$  and its pitch  $P$ .



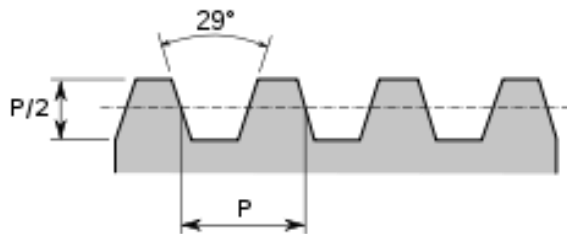
**British threads:** British threads also consist of a V-shaped thread. In the plane of the thread axis, the flanks of the V have an angle of  $55^\circ$  to each other.  $1/6$  of the outermost and innermost of the height  $h$  of the V-shape is cut off from the profile. The threads are rounded equally at crests and roots by circular arcs ending tangentially with the flanks



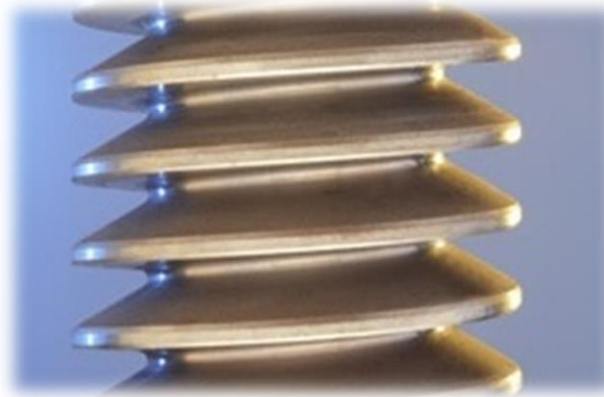
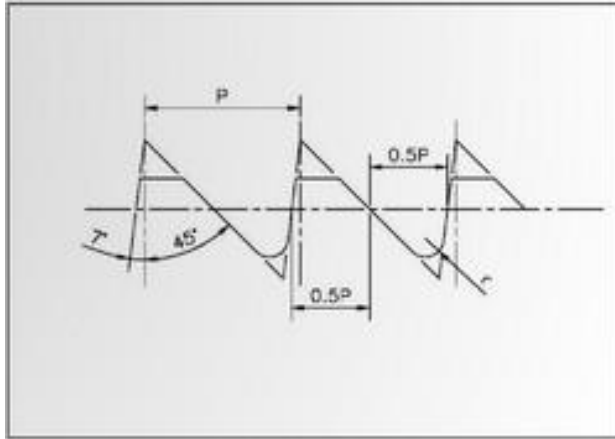
**Square threads:** The square thread is the most efficient conventional power screw form. It gets its name from the square cross-section of the thread. It is the most difficult form to machine. The crests are at 90° angles from the flanks. Due to the lack of a thread angle there is no radial pressure, or bursting pressure on the nut. This also increases the nut life.



**Acme threads:** The Acme thread form has a 29° thread angle with a thread height half of the pitch. The apex and valley are flat. The tooth shape has a wider base which means it is stronger (thus the screw can carry a greater load) than a similarly sized square thread.



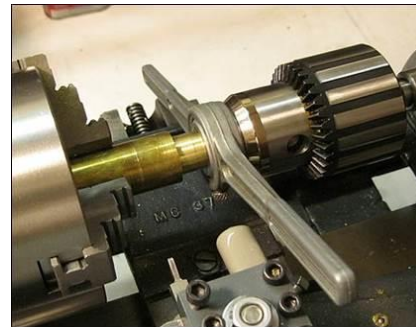
- **Buttress threads:** The buttress thread form refers to two different thread profiles. One is a type of lead screw and the other is a type of hydraulic sealing thread form. The lead screw type is often used in machinery and the sealing type is often used in oil fields.



### Method of clamping tool for thread cutting

Using a tap handle is the most common method of tapping on the lathe. The workpiece is clamped in the lathe chuck, a spring loaded center (for smaller taps) or a dead center (for larger taps) is clamped in the tailstock, and the tap is held and rotated using a tap handle

Using a die handle is a common method of external thread cutting on the lathe. The workpiece is clamped in the lathe chuck, and the threading die is held and rotated using a die handle.



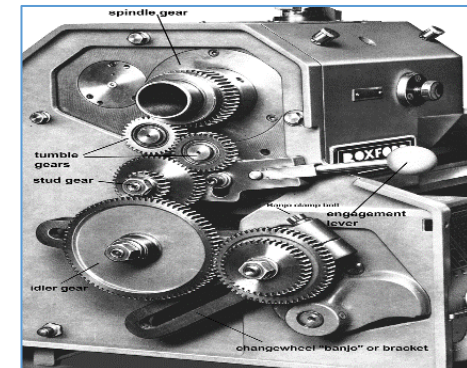
### Thread cutting parameters:

For more details please visit: <https://www.educationdiscussion.com/thread-cutting-operation-on-lathe-machine-powerpoint-presentation/> also visit : <http://www2.mae.ufl.edu/designlab/Advanced%20Manufacturing/Lathe%20Threading/Threading%20on%20Lathe.htm>

Lead screw: The basic function of the lead screw is to move the turret by a précised increment for every rotation of the screw. As a result of this it allows the machine to generate threads in a work piece



Gear train: It is a set of gears that drive the lead screw



Feed rate

In threading, the feed rate must correspond precisely to the pitch of the thread. In the case of a pitch of 8 threads per inch (tpi), the tool has to travel at a feed rate of 8 revolutions per inch. The feed rate in thread turning is 10 times greater than conventional turning. And the corresponding cutting forces at the tip of the threading insert can range from 100 to 1,000 times greater.

## Safe operating procedure for Lathe Machine

For more details please visit: [https://www.ccohs.ca/oshanswers/safety\\_haz/metalworking/lathes.html](https://www.ccohs.ca/oshanswers/safety_haz/metalworking/lathes.html) also visit: <https://mechanicalengineering.com/safety-precautions-lathe-machine/>

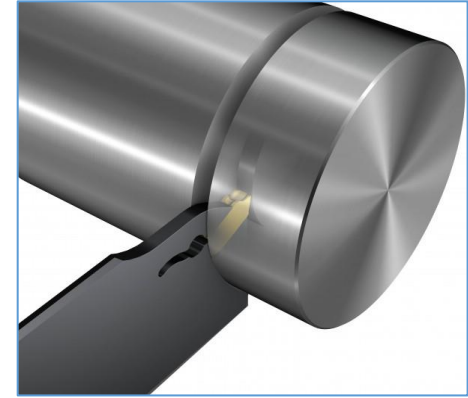
- All stock must be properly secured in the lathe chuck or mounted prior to the machining process taking place. Use the correct sized clamp or vise for the stock being machined.
- Turn the chuck or faceplate by hand to ensure there is no binding or danger of the work striking any part of the lathe.
- Check to ensure the cutting tool will not run into the chuck or lathe dog. If possible, feed away from the chuck or dogs.
- Before starting the lathe, ensure the spindle work has the cup center embedded; tail, stock and tool rests are securely clamped; and there is proper clearance for the rotating stock.
- Prior to starting the lathe, ensure that small diameter stock does not project too far from the chuck without support from the tail stock center.
- When using wood, do not mount a split work piece or one containing knots.
- When roughing stock, do not force the tool in the work piece or take too big a cut.
- The operator must always be aware of the direction and speed of the carriage or cross-feed prior to engaging the automatic feed.
- Never leave the key in the chuck. Do not let go of the key until it is free of the chuck and secured in its proper holding place.
- Select turning speed carefully. Large diameter stock must be turned at a very low speed. Always use the lowest speed to rough out the stock prior to final machining.
- The correct speed and feed for the specific material and cutting tool must be used. Stop the machine before making adjustments or measurements.
- Do not remove metal or wood chips from the table or stock by hand. Use a brush or other tool to properly remove chips or shavings from the table or stock.
- Never attempt to run the chuck on or off the spindle head by engaging the power.
- Do not stop the rotation of the chuck by reversing the power to the lathe unless tapping holes.
- Do not leave tools, bits or excess pieces of stock on the lathe bed.
- All belts and pulleys must be guarded. If frayed belts or pulleys are observed, the lathe must be taken out of service and the belts or pulleys replaced.
- Stop the machine immediately if odd noise or excessive vibration occurs.
- Only properly sharpened drill bits and cutting tools in good condition should be used. Dull drill bits and chipped or broken cutting tools must be removed from service.
- When an operator has finished working on the lathe, and before leaving the lathe for any reason, the power must be shut off and the machine must come to a complete stop.
- When an operator observes an unsafe condition with the lathe or stock being worked, the operator must report it immediately to the designated person and the lathe shall be taken out of service until the problem has been corrected.

## Tools for Straight parting and Parting with contours

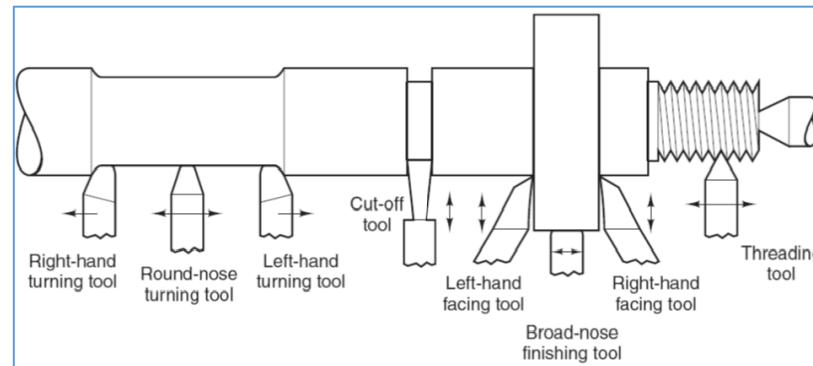
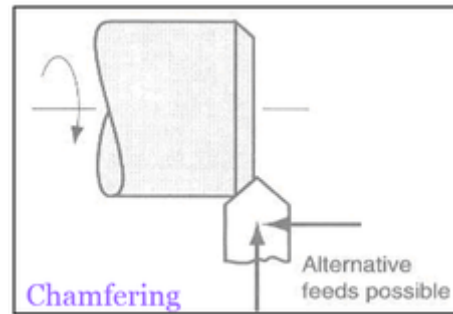
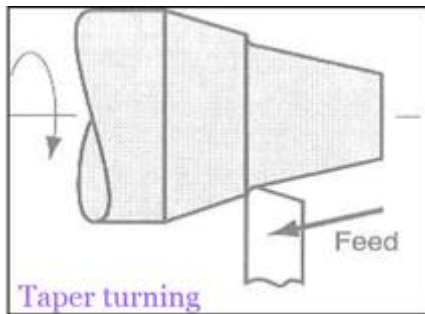
For more details please visit: <https://www.theengineerspost.com/lathe-cutting-tools/>

Parting uses a blade-like cutting tool plunged directly into the workpiece to cut off the workpiece at a specific length. It is normally used to remove the finished end of a workpiece from the bar stock that is clamped in the chuck.

Straight parting tools is a narrow-bladed tool used in turning or planing or for cutting a piece in two



Parting with contour requires special tools for making the required contour. Some of the tools are shown below:



### Method of clamping on parting tool

A parting and cut off tool holder is used to hold the parting tool which is attached on the headstock of lathe machine.



### Knowledge of Boring tools and boring bars for lathe machine

For more details please visit:

<http://www2.mae.ufl.edu/designlab/Advanced%20Manufacturing/Lathe%20Boring/Boring%20on%20Lath e.htm>

In machining, boring is the process of enlarging a hole that has already been drilled (or cast) by means of a single-point cutting tool.

Special boring tools are used for boring purpose. A set of tools is shown below:



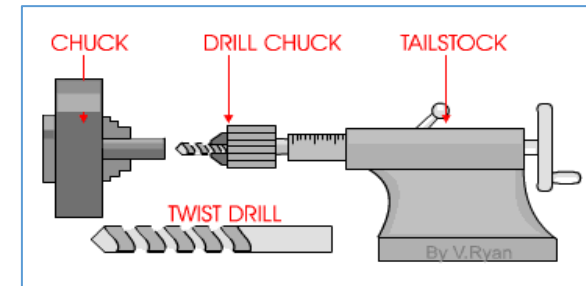
The boring bar is used on a metal lathe, a machine tool that spins a part while moving a cutting tool to remove material from the part, to enlarge the inside diameter of a work piece and, potentially, to cut that dimension to a tight tolerance.





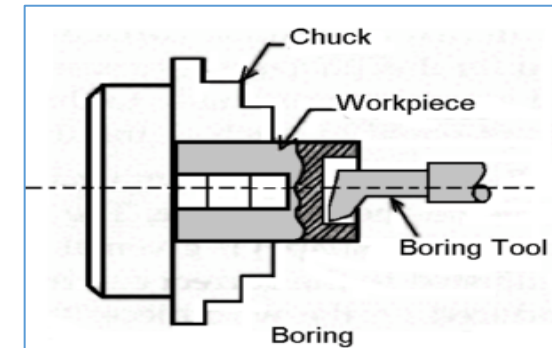
### Method of using drill chuck in a lathe machine

On a lathe the chuck is mounted on the spindle which rotates within the headstock. For drilling purposes an additional chuck is mounted on the non-rotating tailstock. The drill is held in the tailstock and the drilling operation is carried out by advancing the drill in the workpiece by rotating the handle of the tail stock.



### Clamping method of boring tools

Boring tools are held in the designed tool holder which are mounted/clamped on the tailstock. Boring operation is carried out by advancing the boring tool by rotating the handle of the tailstock.



### Knowledge of drilling steps

**Center drill:** It is a process of starting a hole in drilling. Center drill bits are used in metalworking to provide a starting hole for a larger sized drill bit or to make a conical indentation in the end of a workpiece in which to mount a lathe center.

**Pilot drill:** A pilot hole is a small hole drilled into a piece of construction material. Drilling a pilot hole the same size as the mandrel bit can help keep it under control and it is important to keep the bit parallel to the surface.

**Final drill:** A final drill is the process of drilling and finishing a hole of required size. First a pilot drill is done on the workpiece. Final drill is to enlarge or finish the already done pilot drill.

## Knurling

For more details please visit: <http://www.technologystudent.com/equip1/knurl1.htm>

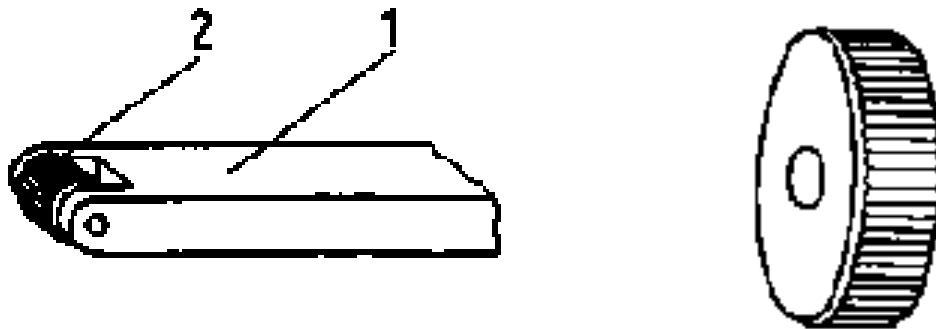
Knurling is a process of impressing a diamond shaped or straight line pattern into the surface of a workpiece by using specially shaped hardened metal wheels to improve its appearance and to provide a better gripping surface.

### Types of knurling tools

By the knurling technique the outer surface of the parts is formed by means of a single-wheel or double-wheel knurling holder. The tools are toothed steel wheels (or rolls or knurls) pressing the pattern into the surface.

#### Straight knurling tools:

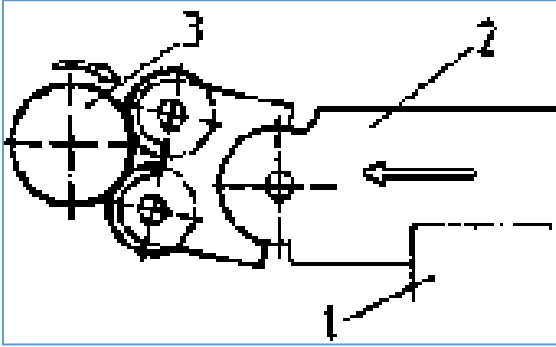
Straight knurling holders are solid and have one wheel. The wheel should run with a little clearance in the borehole as well as in the holder. Straight knurlings are produced by means of straight or hollow knurling wheels (mostly cylindrical) with one wheel only in the knurling holder.



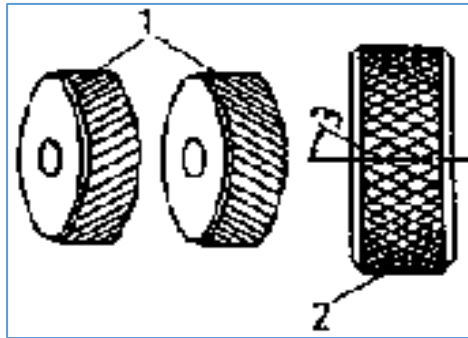
Where 1 is knurling holder and 2 is knurling wheel.

#### Diamond knurling tools:

The diamond knurling holder, the head of which is tiltable, holds two wheels. Diamond knurling holders have a special matching edge bearing which must fit well at the upper edge of the tool slide when clamping so as to prevent the holder from being forced away during the operation.



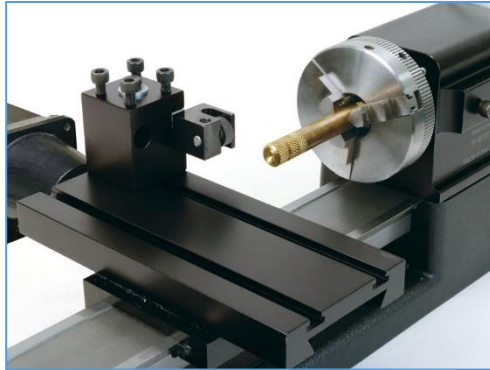
Where 1 is matching edge, 2 is knurling tool and 3 is workpiece.



Here 1 is pair of knurling wheel, 2 is knurled position and 3 is degrees and 3 is degrees ( $30^\circ$ ).

## Method of clamping knurling tools

Knurling tools are clamped in the specially designed knurling holders which are mounted on the tool post.



## Workpiece rpm for knurling

Knurling is often performed at the same speeds used for turning operations when using high speed steel tool bits. But to prevent seizing of the rolls on the pin, a maximum surface speed of about 150 SFPM (Feet/Min) or 50 m/min is recommended. A longer knurl life and improved appearance can be achieved by slowing down the spindle to about 50 SFPM (15 m/min) for harder steels and stainless.

## Use of dial indicators

Dial indicators are used to check whether the workpiece rotates in a smooth fashion. It is also used to know the depth of embossing during knurling process.

## Safe procedure of knurling

Never stop the carriage while the tool is in contact with the work and the work is still revolving as this will cause wear rings on the work surface. Check the operation to ensure that the knurling tool is not forcing the work from the center hole. Keep the work and knurling tool well-oiled during the operation. Never allow a brush or rag to come between the rollers and the work or the knurl will be ruined.

## Knowledge of tolerance

The term tolerance refers to the difference between the upper (maximum) limit and lower (minimum) limit of a dimension. In other words, tolerance is the maximum permissible variation in a dimension.

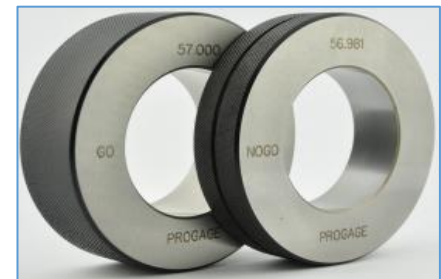
Upper limits and lower limits: Upper limit is the maximum or greatest permissible size of a feature whereas lower limit is the minimum or smallest permissible size of a feature.

Basic hole and shaft system: If the lower limit size or minimum size of hole is equal to the basic size then that type of hole is known as basic hole for a given assembly of hole and shaft. If the upper limit size or maximum size of the shaft is equal to the basic size then that type of hole is known as Basic Shaft for a given shaft and hole assembly.

## Knowledge of inspection tools

For more details please visit: <http://www.yourarticlelibrary.com/metrology/main-types-of-limit-gauges-with-diagram-metrology/95226> also visit: [https://www.mitutoyo.com/wp-content/uploads/2013/04/E11003\\_2\\_QuickGuide.pdf](https://www.mitutoyo.com/wp-content/uploads/2013/04/E11003_2_QuickGuide.pdf)

**Ring gauge:** A ring gauge, or ring gage, is a cylindrical ring of a thermally stable material, often steel, whose inside diameter is finished to gauge tolerance and is used for checking the external diameter of a cylindrical object.



**Plug gauge:** Plug gauges are commonly used in the inspection of several product lines as a result of their ease of use. A plug gauge assesses the conformity of objects to the prescribed specifications. A typical plug gauge resembles a rod whose ends are carefully fashioned so that one end is the upper limit while the other end is the lower limit.

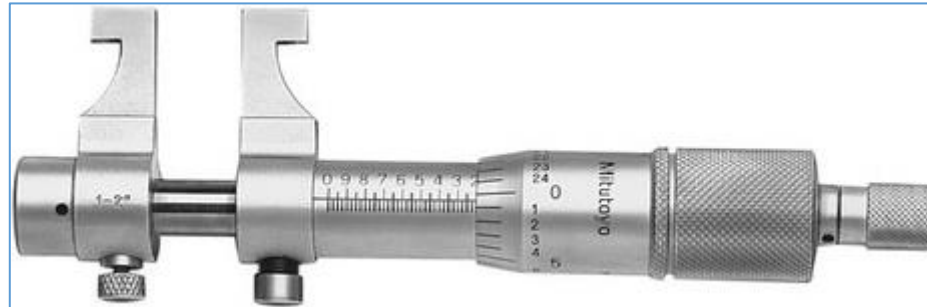


The left end is marked green and is the go-end, while the right end is marked red and is the no-go end. The go-end should fit into the component under test and the no-go end should not fit into the said component for the component to meet specifications.



**Thread pitch gauge:** A thread pitch gauge is used to measure the pitch or lead of a screw thread.

**Internal micrometer:** It is a precision instrument for measuring the inside dimension of an object, such as the diameter of a hole or the width of a groove



**External micrometer:** It is used to measure external surfaces of shafts, blocks, spheres and various common shapes.



**Checking parallelism:** Take the measurement of the opposing sides. Determining parallelism means finding that two opposing sides of an object, which are supposed to be parallel, are consistently far apart at all positions. To test this, one needs to measure the distance between the two surfaces at multiple positions.

## **Benefits of good house keeping**

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping incidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous products (e.g. dusts, vapours)
- better control of tools and materials, including inventory and supplies
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale
- improved productivity (tools and materials will be easy to find)

## **Health and safety relevant to lathe machine**

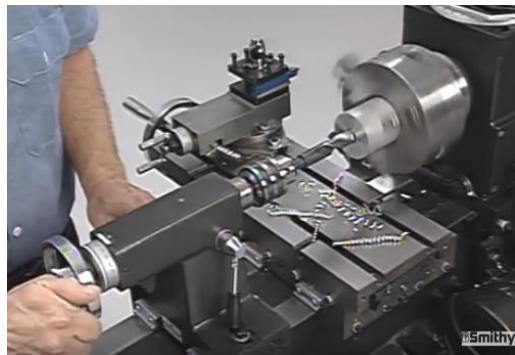
- Make sure that all gear and belt guards are in place.
- Never leave a chuck wrench in a chuck.
- Keep your hands off chuck rims when a lathe is in operation.
- Do not attempt to screw the chuck onto the lathe spindle with the power on, as it may get cross-threaded and cause injury. Stop the machine, place a board under the chuck, and then screw on by hand.
- Steady rests should be properly adjusted to conform to the material being worked on.
- When filing work in a lathe, always face the head stock and chuck.
- See that tail stock, tool holder, and work are properly clamped before turning on power.
- Never attempt to adjust a tool while the lathe is running.
- Never apply a wrench to revolving work or parts.
- Always use a brush to remove chips; never your hands.
- When possible, use pipe sleeves to cover work protruding from the end of the lathe.
- Before removing your work from the lathe, remove the tool bit.

**VIDEOS:**



Essential Machining Skills: Working with a Lathe, Part One

<https://www.youtube.com/watch?v=Za0t2Rfjewg>



Best Practices for Metal Lathe Turning - SMITHY GRANITE 3-in-1 Combo

<https://www.youtube.com/watch?v=H0AyVUfI8-k>



Another Thread Cutting Video?!

[https://www.youtube.com/watch?v=Lb\\_BURLuI70](https://www.youtube.com/watch?v=Lb_BURLuI70)





## Knurling

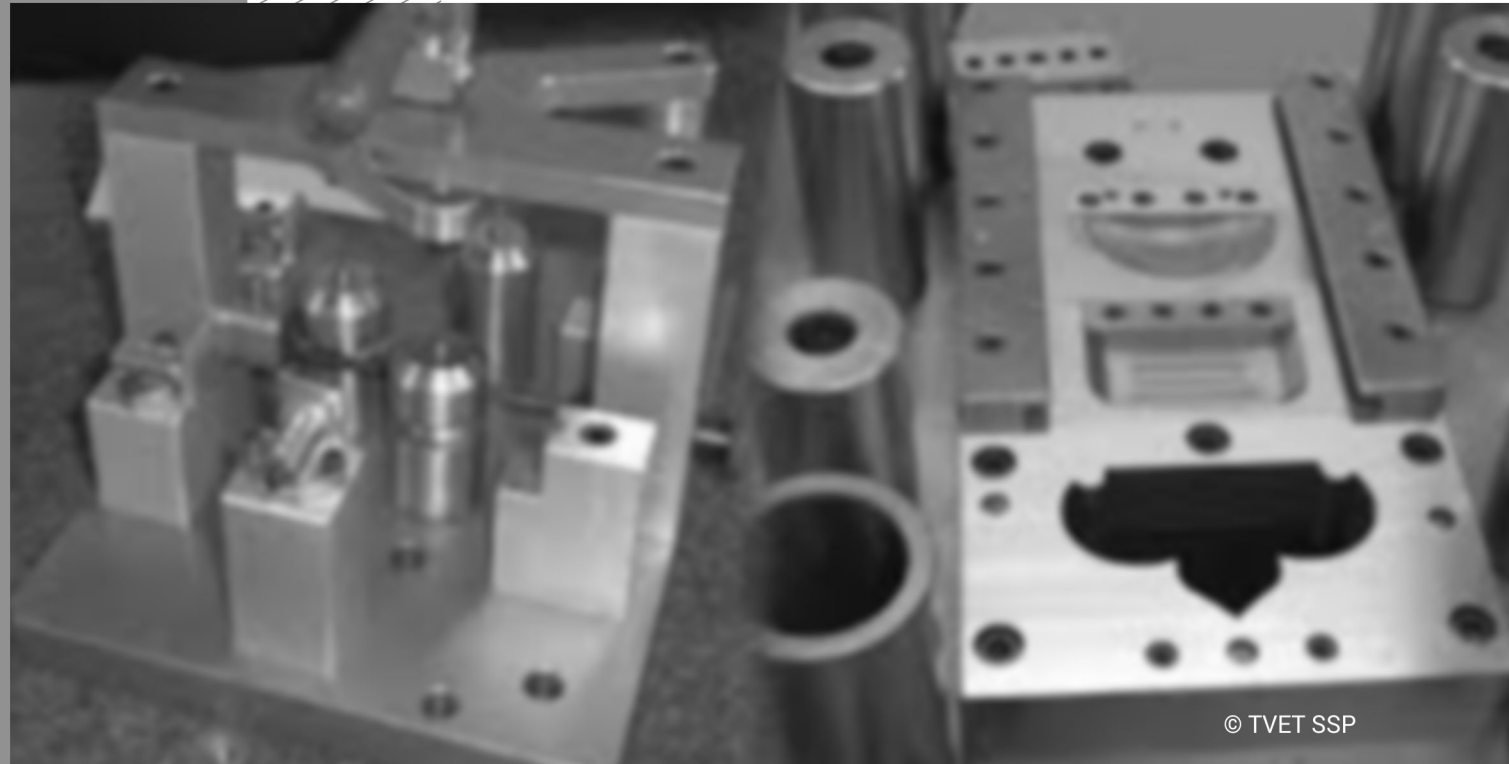
[https://www.youtube.com/watch?v=\\_0o8vd6UUeY](https://www.youtube.com/watch?v=_0o8vd6UUeY)



## Bouton 704, Tournage

<https://www.youtube.com/watch?v=SgOdqA06txg>

# DIES AND MOULDS MAKER



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Module-4

LEARNER GUIDE

National Vocational Certificate Level 2

Version 1 - July, 2019

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<p><b>LU2:</b> <b>Perform workpiece setting</b></p>	<p><b>The trainee will be able to:</b> Interpret drawing and arrange the material for milling operation according to the job requirement</p> <p>Prepare work piece for machining operations</p> <p>Check and verify the dimension of raw material according to drawing.</p> <p>Identify &amp; select appropriate clamping device</p> <p>Clamp the workpiece as per standard procedure</p>	<p>Interpret different drawing views. <b>Views:</b> Isometric, orthographic Preparing bill of material (BOM) from drawing i.e. finish size, raw material with machining allowance etc. Knowledge of clamping devices for milling. <b>Devices:</b> machine vice, step clamps, parallel blocks etc.</p> <p>Health and safety relevant to milling machine / shop.</p>	<p>Machining drawing MS plate Machine vice Step clamps Parallel blocks</p>
<p><b>LU3:</b> <b>Perform pocketing</b></p>	<p><b>The trainee will be able to:</b> Select appropriate tool &amp; clamping device as per job specifications</p> <p>Mount the tool as per standard procedures</p> <p>Set machine parameters as per job specifications</p> <p>Select appropriate clamping</p>	<p>Knowledge of milling machine axis travelling. Knowledge of producing pockets using milling machine. Know the effect of milling direction i.e. conventional and climb milling. Workpiece dialing devices i.e. dial indicator, lever gauge etc.</p>	<p>MS plate Milling cutter Dial indicator with magnetic stand Lever gauge Machine vice Step clamps Parallel blocks Vernier caliper Cutting fluid</p>

	<p>device/method for work piece.</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for pocketing as per standard procedure</p>		
<p><b>LU4:</b></p> <p><b>Perform contouring</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate tool &amp; clamping device as per job specifications</p> <p>Mount the tool as per standard procedures</p> <p>Set machine parameters as per job specifications</p> <p>Select appropriate clamping device/method for work piece.</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for contouring as per standard procedure</p>	<p>Knowledge of contouring tools i.e. ball nose, single lip V tool, grooving tool, radius tool etc.</p>	<p>MS plate</p> <p>Contouring tools</p>

<p><b>LU5:</b> <b>Perform drilling / boring</b></p>	<p><b>The trainee will be able to:</b> Select appropriate tool &amp; clamping device as per job specifications</p> <p>Mount the tool as per standard procedures</p> <p>Set machine parameters as per job specifications</p> <p>Select appropriate clamping device/method for work piece.</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for drilling/boring as per standard procedure</p>	<p>Knowledge of boring tools i.e. boring head, boring bars etc.</p> <p>Method of mounting tool on a boring bar</p> <p>Calculating and setting of boring bar rpm</p> <p>Work piece clamping devices for milling i.e. machine vice, step clamps, toggle clamps etc.</p> <p>Safe procedure sequence for boring.</p>	<p>MS plate Drill bits Boring head Boring bar HSS tool bit</p>
<p><b>LU6:</b> <b>Perform reaming</b></p>	<p><b>The trainee will be able to:</b> Select appropriate tool &amp; clamping device as per job specifications</p> <p>Mount the tool as per standard procedures</p> <p>Set machine parameter as per job specifications</p>	<p>Purpose of using reamers.</p> <p><b>Purpose:</b> roundness, size to tolerance, surface finish etc.</p> <p>Tool mounting devices i.e. drill chuck, collets etc.</p> <p>Setting rpm for reamer</p> <p>Knowledge of using machine reaming i.e. step for reaming.</p> <p><b>Steps:</b> marking. Center drilling, pilot drilling, drilling, chamfering, reaming.</p>	<p>MS plate Dial indicator with stand Drill bits Rose bit Cutting fluid Reamer Plug gauge</p>

	<p>Select appropriate clamping device/method for work piece.</p> <p>Dial the work piece &amp; ensure final clamping</p> <p>Carry out machining operation for reaming as per standard procedure</p>		
<p><b>LU7:</b> <b>Perform indexing</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate tool &amp; clamping device as per job specifications</p> <p>Mount the tool as per standard procedures</p> <p>Set machine parameters as per job specifications</p> <p>Select and mount appropriate indexing head on machine table</p> <p>Select appropriate clamping device/method for work piece.</p> <p>Dial the work piece &amp; ensure final clamping</p>	<p>Use of indexing head i.e. producing polygon shapes, gears etc.</p> <p>Knowledge of types of milling cutters. Types: end mill, shell end mill, face mill etc.</p> <p>Methods of tool clamping i.e. collet, arbor etc.</p> <p>Dialing methods for indexing</p> <p>Know essential parts of indexing head to perform calculation for indexing i.e. indexing plate, worm wheel, formula, interpretation of answer etc.</p> <p>Safe procedure sequence for indexing</p>	<p>MS plate or disc</p> <p>Indexing head</p> <p>Dial indicator with stand</p> <p>Milling cutter</p> <p>Cutting fluid</p> <p>Vernier caliper</p>

	<p>Perform calculations &amp; select appropriate disc for indexing</p> <p>Carry out machining operation for indexing as per standard procedure</p>		
<p><b>LU8:</b> <b>Perform final inspection</b></p>	<p><b>The trainee will be able to:</b></p> <p>Prepare the work piece for inspection</p> <p>Visually Inspect the work piece</p> <p>Manage the required measuring tools</p> <p>Perform the required inspection as per drawing</p>	<p>Post milling operations: bur removing, chamfering, cleaning etc.</p> <p>Use of datum to measure different places. <b>Datum:</b> edge datum, surface datum. Point datum, line datum etc.</p>	<p>Workpiece prepared on a milling machine</p> <p>Inspection tools</p>
<p><b>LU9:</b> <b>Demonstrate safe working practice &amp; housekeeping</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select &amp; use appropriate PPEs.</p> <p>Maintain cleanliness at the workplace</p> <p>Ensure relevant safety procedure for milling operations</p>	<p>Potential hazard associated with milling operations</p> <p>PPEs for a milling machine</p> <p>Maintaining housekeeping on a milling machine</p>	<p>PPEs</p> <p>Tool cabinet</p> <p>Milling tools</p>



## Examples and illustrations

### Set tool and milling machine

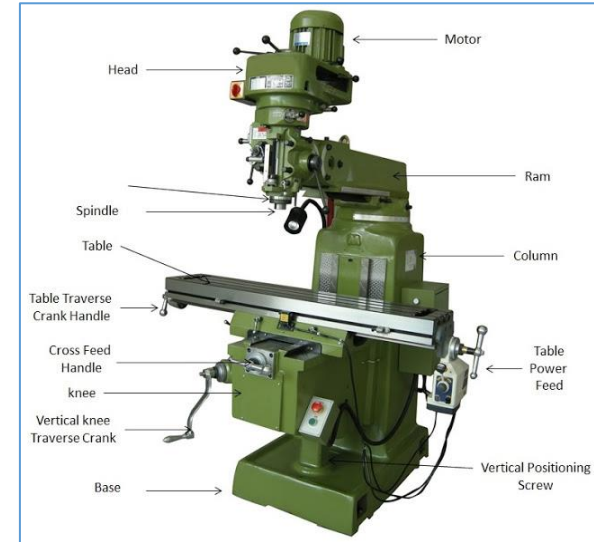
#### Types of milling machines

For more details please visit:

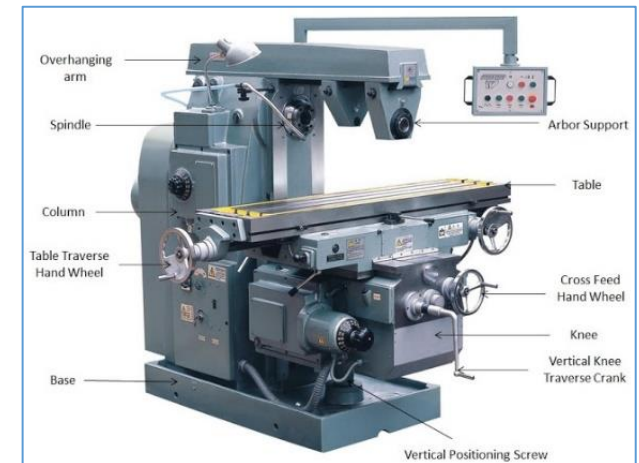
[http://mcehassan.ac.in/departement/auto/files/AU504\\_Manufacturing\\_Process\\_II/Unit\\_V.pdf](http://mcehassan.ac.in/departement/auto/files/AU504_Manufacturing_Process_II/Unit_V.pdf)

Milling is a process performed with a machine in which the cutters rotate to remove the material from the work piece present in the direction of the angle with the tool axis. With the help of the milling machines one can perform many operations and functions starting from small objects to large ones. There are two types of milling machines:

**Vertical:** In this machine, the spindle axis is aligned in vertical direction. The base of vertical milling machines is made up of cast iron as it has higher compressive strength. The screw jack is attached to the base and it moves in vertical direction. The drawback of vertical milling machine is that it has a low efficiency.

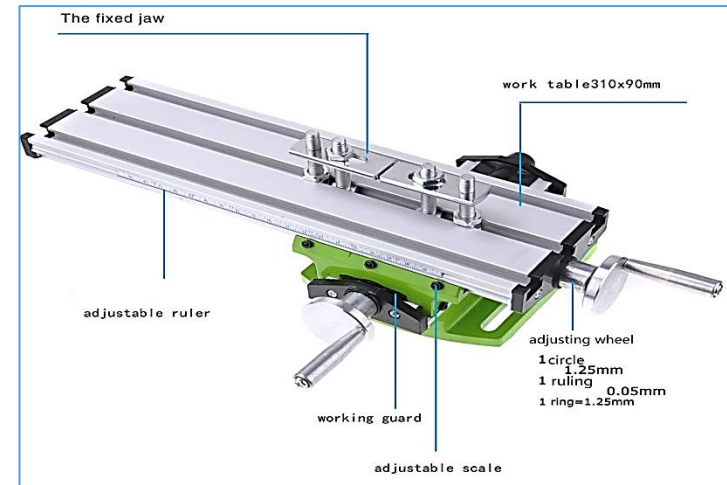


**Horizontal:** The base of horizontal milling machine is made up of grey cast iron. In this machine, an arbor is used and it is inserted in spindle nose. The gear arrangement is inside the column. Above the column there is an overhanging arm. An arbor is supported by yoke and arbor support. An arbor is chosen according to the internal diameter of the cutter. Arbor and spindle both are different. Arbor is an extension and is fitted inside spindle and it transfers the rotational motion of spindle to the cutter. This type of machine gives us an excellent finishing and the cutting chips are removed easily.

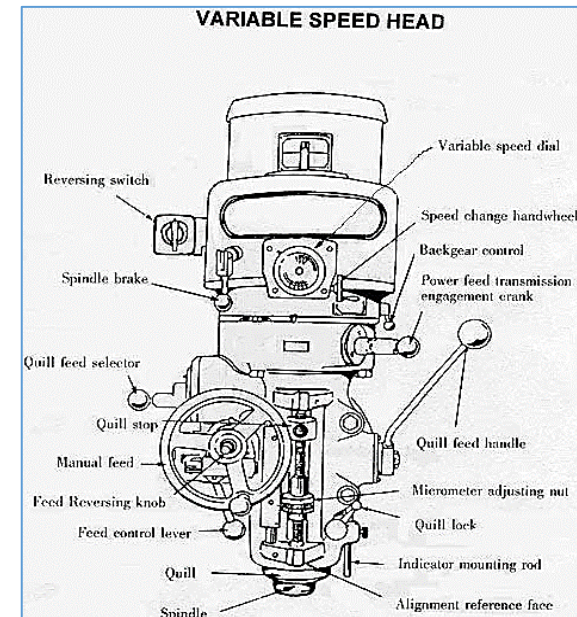


## Major functional parts of a milling machine

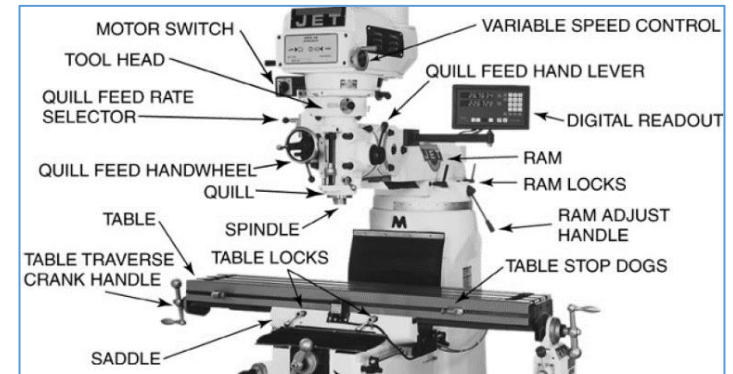
**Machine bed:** Machine bed or table is a rectangular casting which is present on the top of the saddle. It is used to hold the work or work holding devices. It contains several T-slots for holding the work and work holding devices (i.e. jigs and fixtures). The table can be operated by hand or by power. To move the table by hand, engage and turn the longitudinal hand crank. To move it through power, engage the longitudinal direction feed control lever.



**Head:** Milling machine head has arrangement of cutting holder device. Modern vertical milling machines are designed so the entire head can also swivel to permit working on angular surfaces



Speed control lever: It is common for milling machines to have a power feed on one or more axes. Normally, a forward/reverse lever and speed control knob is provided to control the power feed. A power feed can produce a better surface finish than manual feeding because it is smoother.



Bed travel: It is the speed at which the bed of milling machine travels.

### Knowledge of tool clamping devices

For more details please visit: <http://uhv.cheme.cmu.edu/procedures/machining/ch8.pdf>

**Collets:** A collet is a form of a sleeve bushing for reducing the size of the hole in the milling machine spindle so that small shank tools can be fitted into large spindle recesses. They are made in several forms, similar to drilling machine sockets and sleeves, except that their tapers are not alike.



**Long and short arbors:** Arbor is a cutting tool holder accessory used in milling machine to clamp the cutting tool.

Short arbor (Style A in figure) has a cylindrical pilot on the end opposite the shank. The pilot is used to support the free end of the arbor. Short arbors are used mostly on small milling machines, but they are also used on larger machines when a long arbor support cannot be used because of a small-diameter cutter or interference between the arbor support and the workpiece.

Long arbors (Style B in figure) are supported by one or more bearing collars and arbor supports. Long arbors are used to produce rigid setups in heavy-duty milling operations.



## Knowledge of RPM setting, auto feed rate

The formula to calculate RPM is as under:

$$\text{Speed (RPM)} = \text{SFM} * 3.82 / D$$

Where SFM is surface feet per minute of the material being cut

D is tool diameter

The formula to calculate feed rate is as under:

$$\text{Feed (IPM)} = \text{RPM} \times \text{FPT} \times Z$$

Where FPT is feed per tooth. This is the size of chip that each tooth of the cutter takes

Z is the number of teeth on the cutter

## Knowledge of milling cutters types

For more details please visit:

[http://mcehassan.ac.in/departement/auto/files/AU504\\_Manufacturing\\_Process\\_II/Unit\\_V.pdf](http://mcehassan.ac.in/departement/auto/files/AU504_Manufacturing_Process_II/Unit_V.pdf)

**End mill:** A finishing end mill has one square end and the outside diameter is smooth for creating smooth surface finishes. They come in a variety of helix angles and numbers of flutes. They are mainly used for side milling operations.



**Shell end mill:** A shell mill is any of various milling cutters (typically a face mill or end mill) whose construction takes a modular form, with the shank (arbor) made separately from the body of the cutter, which is called a "shell" and attaches to the shank/arbor via any of several standardized joining methods.

**Face mill:** Face mills are primarily used for milling a face on the surface of a plate or bar. They are predominantly used to cut with the ends of the cutter rather than their sides. The term "face" refers to the creation of a flat face on the workpiece.



**Profile cutters:** Profile milling is a common milling operation. Round inserts and concepts with radius are milling cutters used for roughing and semi-roughing while ball nose end mills are milling cutters used for finishing and super-finishing.



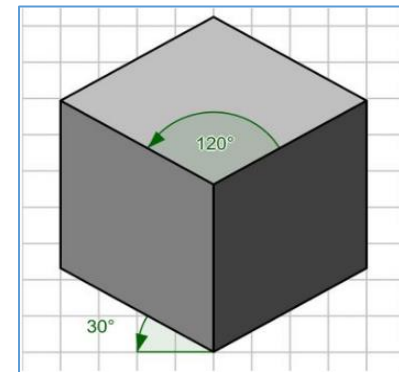
### Know the use and types of cutting fluid

The primary function of cutting fluid is temperature control through cooling and lubrication. Application of cutting fluid also improves the quality of the workpiece by continually removing metal fines and cuttings from the tool and cutting zone.

There are generally three types of liquids: mineral, semi-synthetic, and synthetic. Semi-synthetic and synthetic cutting fluids represent attempts to combine the best properties of oil with the best properties of water by suspending emulsified oil in a water base.

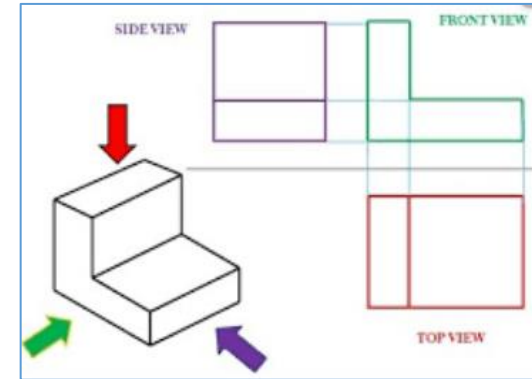
### Interpret different drawing views

**Isometric:** An isometric drawing is a type of 3D drawing that is set out using 30-degree angles. In an isometric drawing, the object appears as if it is being viewed from above from one corner, with the axes being set out from this corner point. Isometric drawings begin with one vertical line along which two points are defined. Any lines set out from these points should be constructed at an angle of 30 degrees.



**Orthographic:** An orthographic drawing represents a three-dimensional object using several two-dimensional views of the object. It is also known as an orthographic projection.

Typically, an orthographic projection drawing consists of three different views: a front view, a top view, and a side view. Occasionally, more views are used for clarity. The side view is usually the right side, but if the left side is used, it is noted in the drawing. They are used to show an object from every angle to help manufacturers plan production.



### Preparing bill of material (BOM) from drawing

Bill of materials contains a check list of materials, items, processes, vendors and consumptions used in preparing the product. It is a master list of every physical item required to create finished Product. It is also used to prepare actual cost of the product.

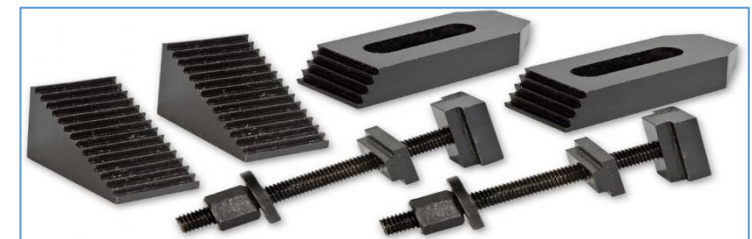
### Knowledge of clamping devices for milling

**Machine vice:** A milling machine vice is a clamping tool that is primarily designed to be used on a milling machine due to its strong construction. Milling places greater pressure on a workpiece as the cutter rotates along the material, as opposed to drilling, where the drill bit rotates directly into it.



Step clamps:

**Parallel blocks:** Parallels are used in machining operations, be it milling, drilling, turning or sometimes grinding. Parallels of different sizes can be used to support a workpiece that doesn't have a 'flat' surface underneath,



**Toggle Clamps:** The quick action toggle clamps are ideal for industrial applications requiring high clamping forces and repetitiveness of movements to lock components quickly and safely.



### Health and safety relevant to milling machine / shop

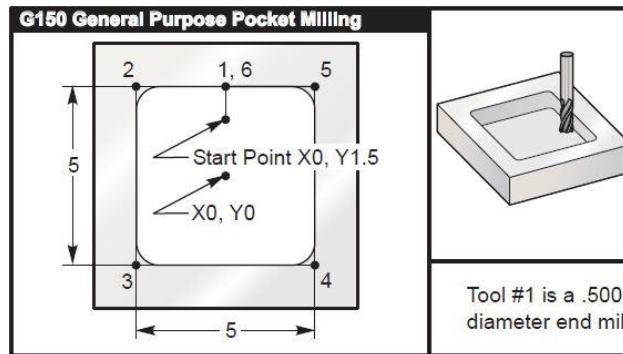
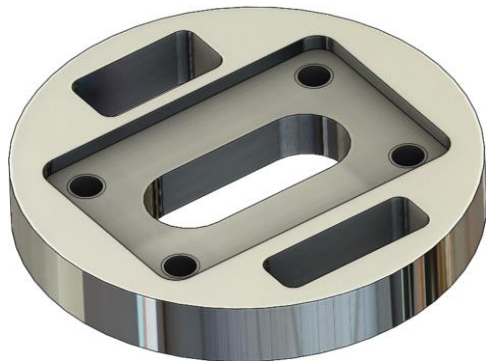
- Move table as far as possible from cutter while setting up work to avoid injuring your hands
- Keep hands, brushes and rags away from the revolving milling cutter
- Use a vacuum, brush or rake to remove cuttings only after the cutters have stopped moving
- Keep cutters sharpened correctly and in good condition

### Knowledge of milling machine axis travelling

The part is moved very accurately by means of a table that can be controlled in two directions (X-axis = left/right and Y-axis=in/out). The third axis is provided by a vertical spindle (Z-axis) that moves up and down. On a 5-axis machining center, the cutting tool moves across the X, Y and Z linear axes as well as rotates on the A and B axes to approach the workpiece from any direction.

### Knowledge of producing pockets using milling machine

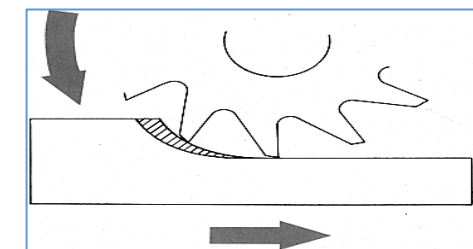
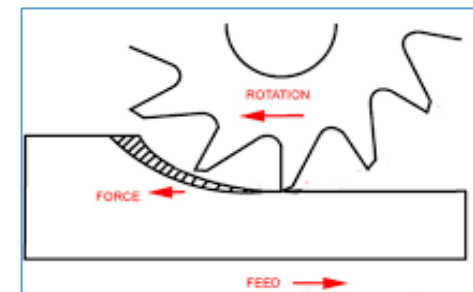
Pocket milling has been regarded as one of the most widely used operations in machining. It is extensively used in aerospace and shipyard industries. In pocket milling the material inside an arbitrarily closed boundary on a flat surface of a work piece is removed to a fixed depth.



### Know the effect of milling direction

**Conventional milling:** In Conventional milling the cutter rotates against the direction of the feed. Conventional milling is the traditional approach when cutting because the backlash, or the play between the lead screw and the nut in the machine table is eliminated.

**Climb milling:** During Climb milling the cutter rotates with the feed. Climb Milling is generally the best way to machine parts today since it reduces the load from the cutting edge, leaves a better surface finish, and improves tool life.





## Workpiece dialing devices

**Dial indicator:** A dial indicator is a precision tool used to measure minute amounts of deflection between two surfaces. When tramping a dial indicator attached to the chuck is used to determine the orientation of the mill head to the mill table. The same wrench used to tighten and loosen the quill can be used to adjust the various bolts on the mill head.



**Lever gauge:** It is used for determining the relative position of the inner and outer centers of the workpiece and the center of the machine tool spindle.



## Knowledge of contouring tools

**Ball nose:** Ball end mills, also known as ball nose end mills, are used for milling contoured surfaces, slotting and pocketing. A ball end mill is constructed of a round cutting edge and used in the machining of dies and molds.



**Single lip V tool:** It is a special shaped tool used for contouring.



**Grooving tool:** Grooving tool is usually a carbide insert mounted in a special tool holder, similar to any other tool. Designs of grooving inserts vary, from a single tip, to an insert with multiple tips.



**Radius tool:**



### Knowledge of boring tools

**Boring head:** The offset boring head is an attachment that fits the milling machine spindle and permits most drilled holes to have a better finish and greater diameter accuracy. Offset boring head are used to create large hole when tolerance do not allow for a drill bit or do not have a large enough drill or reamer.



**Boring bars:** The boring bar is a machine tool that spins into a part while moving a cutting tool to remove material from the part, to enlarge the inside diameter of a work piece and, potentially, to cut that dimension to a tight tolerance.



### Calculating and setting of boring bar rpm

Formula for calculation of boring bar rpm will remain the same as described earlier.

$$\text{RPM} = \text{SFM} * 3.82 / D$$

Where SFM is surface feet per minute of the material being cut

D is the boring tool diameter

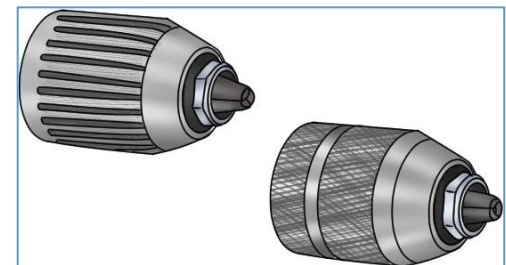
### Purpose of using reamers

Purpose: roundness, size to tolerance, surface finish etc.

Reaming is a mechanical process that creates precision holes, typically after drilling, by rotating a precision cutting tool into a hole sized slightly under the diameter of the reaming tool. The main advantage of reaming is the high tolerance of the resulting hole and smooth internal surfaces.

### Tool mounting devices

**Drill chuck:** A drill chuck is a specialized type of clamp used to hold an object with radial symmetry (eg. reamer). In drills and mills it holds the rotating tool whereas in lathes it holds the rotating workpiece. The body of the chuck positions and guides the movement of the jaws as they are brought together or separated. The sleeve, or shell as it is also called, rotates around the chuck's body.



**Collets:** A collet is a subtype of chuck that forms a collar around an object to be held and exerts a strong clamping force on the object when it is tightened, usually by means of a tapered outer collar. It may be used to hold a workpiece or a tool.



### Knowledge of using machine reaming

#### Steps for reaming:

**Marking:** Mark the position of holes on the workpiece  
**Center drilling:** Center drill at the marked position using center drill bit.

**Pilot drilling:** Pilot drill at the center drilled hole using a small size drill bit

**Drilling:** Drill the required size of hole using actual size drill bit

**Chamfering:** Chamfer the drilled hole from both sides

**Reaming:** Use reamer to finish the hole

#### Use of indexing head

For more details please visit:

[http://mcehassan.ac.in/department/auto/files/AU504\\_Manufacturing\\_Process\\_II/Unit\\_V.pdf](http://mcehassan.ac.in/department/auto/files/AU504_Manufacturing_Process_II/Unit_V.pdf)

Producing polygon shapes and gears: Indexing is the process of evenly dividing the circumference of a circular work piece into equally spaced divisions, such as in cutting gear teeth, cutting splines, milling grooves in reamers and taps, and spacing holes on a circle. The index head of the indexing fixture is used for this purpose.



#### Dialing methods for indexing

A dial-indexing machine is an automated system consisting of multiple workstations that process work parts attached to fixtures around the periphery of a circular worktable, and the table is indexed (rotated in fixed angular amounts) to position the parts at the stations.

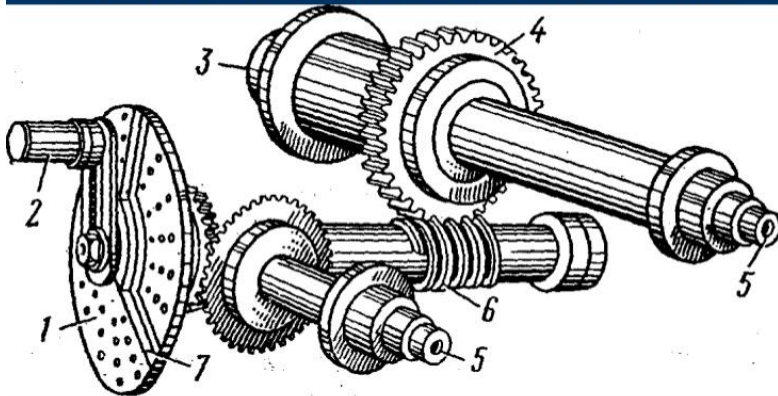
## Know essential parts of indexing head to perform calculation for indexing

**Indexing plate:** It is a graduated circular plate or one with circular rows of holes differently spaced that is used in machines (as for graduating circles or cutting gear teeth)



**Worm wheel:** A worm and wheel is used anywhere where you need a very large reduction in speed. The worm is typically driven and the wheel then turns very slowly. Examples of where we used them in industry: Driving ash conveyors for packaged boilers.

### The construction of the index head



1-index plate; 2-index crank; 3-spindle;  
4-worm wheel ( $z=40$ ); 5-necks to receive pick-off  
gears; 6-worm ( $k=1$ ); 7-sector arm.

**Formula:** There are different indexing methods which use some formulas for calculation.

In simple indexing method, index crank movement is calculated by:

$$\text{Index crank movement} = 40 / N$$

Where N is the number of division required on the work

In direct indexing method, to find the index movement find the total number of holes in the direct index plate by the number of divisions required in the work

$$\text{Number of holes to be removed} = 24 / N$$

Where N is the number of division required on the work

In angular indexing method

$$\text{Index crank movement} = \text{angular displacement of work, in degrees} / 9$$

## **Post milling operations**

**Burr removing:** Burr formation is one of the most common and undesirable phenomenon occurring in machining operations which reduces assembly and machined part quality. To remove burrs a secondary operation known as deburring is required for post-processing and edge finishing operations.

**Chamfering:** By making chamfers, material edges can not only be relieved of sharp burrs, scale and slag deposits but it also improves the visual properties of a workpiece and due to the high accuracy of it, it also simplifies the subsequent joining of several parts to form welded structures.

A chamfer mill, or a chamfer cutter, is one of the most common tools used by machinists daily. A chamfer mill eliminates sharp edges leaving a sloped surface or a chamfer instead.

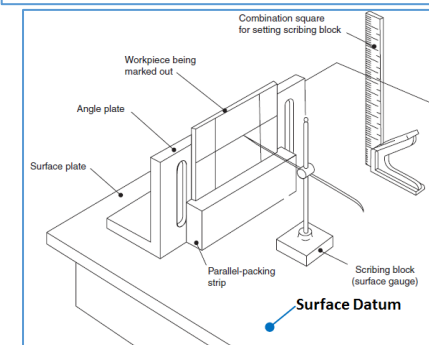
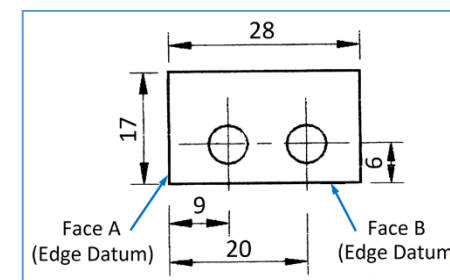
**Cleaning:** Cleaning is the process of removing unwanted substances, such as dirt, infectious agents, oil, grease, metal burrs etc. from an object or environment. Cleaning occurs in many different contexts, and uses many different methods.

### Use of datum to measure different places

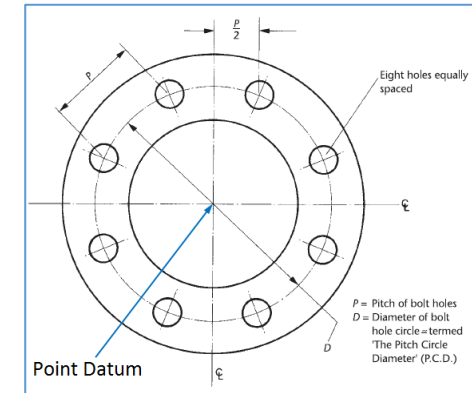
A datum is a reference from which measurements are taken. Types of datum are:

**Edge datum:** This is also known as a *service edge*. It is a physical surface from which dimensions can be taken. This is the most widely used datum for measuring and marking. Usually two edges are prepared at right angles to each other. They are also referred to as *mutually perpendicular* datum edges. These two edges ensure that the distances marked out from them are also at right-angles to each other.

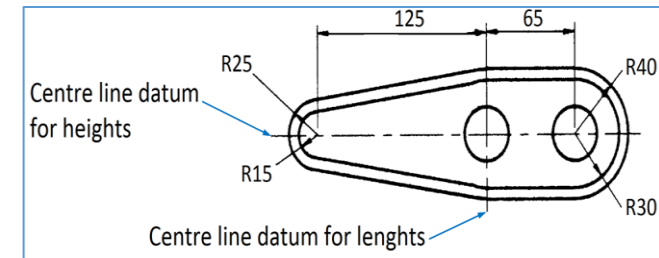
**Surface datum:** This can be the working surface of a surface plate or a marking out table. It provides a common datum to support the work and the measuring and marking out equipment.



**Point datum:** This is a single point from which dimensions can be taken when measuring and marking out. For example, the center point of a pitch circle.



**Line datum:** This is a single line from which or along which dimensions are taken when measuring and marking out. It is frequently the center line of a symmetrical component.



### Potential hazard associated with milling operations

Milling machines and computer-numerical-controlled (CNC) mills use moving cutters and/or move stock materials to cut shapes materials such as metal, wood or plastic. Mills cut away material using rotating blades, and can throw or eject dust and chips at high speed. Flying chips present an eye injury hazard. Fine dust can be a respiratory hazard. Mills can also be very loud, presenting a threat to hearing as well as drowning out voices, phones, and alarms. Rotating machinery presents a serious hazard, as gloves, clothing, jewelry or loose hair can be caught and body parts drawn into the running machine. Mills have guards to prevent some exposure, and some are completely enclosed when running.






## **PPEs for a milling machine**

Safety glasses to protect eyes from particles and debris, hearing protection (if necessary) and other PPE as needed.

## **Maintaining housekeeping on a milling machine**

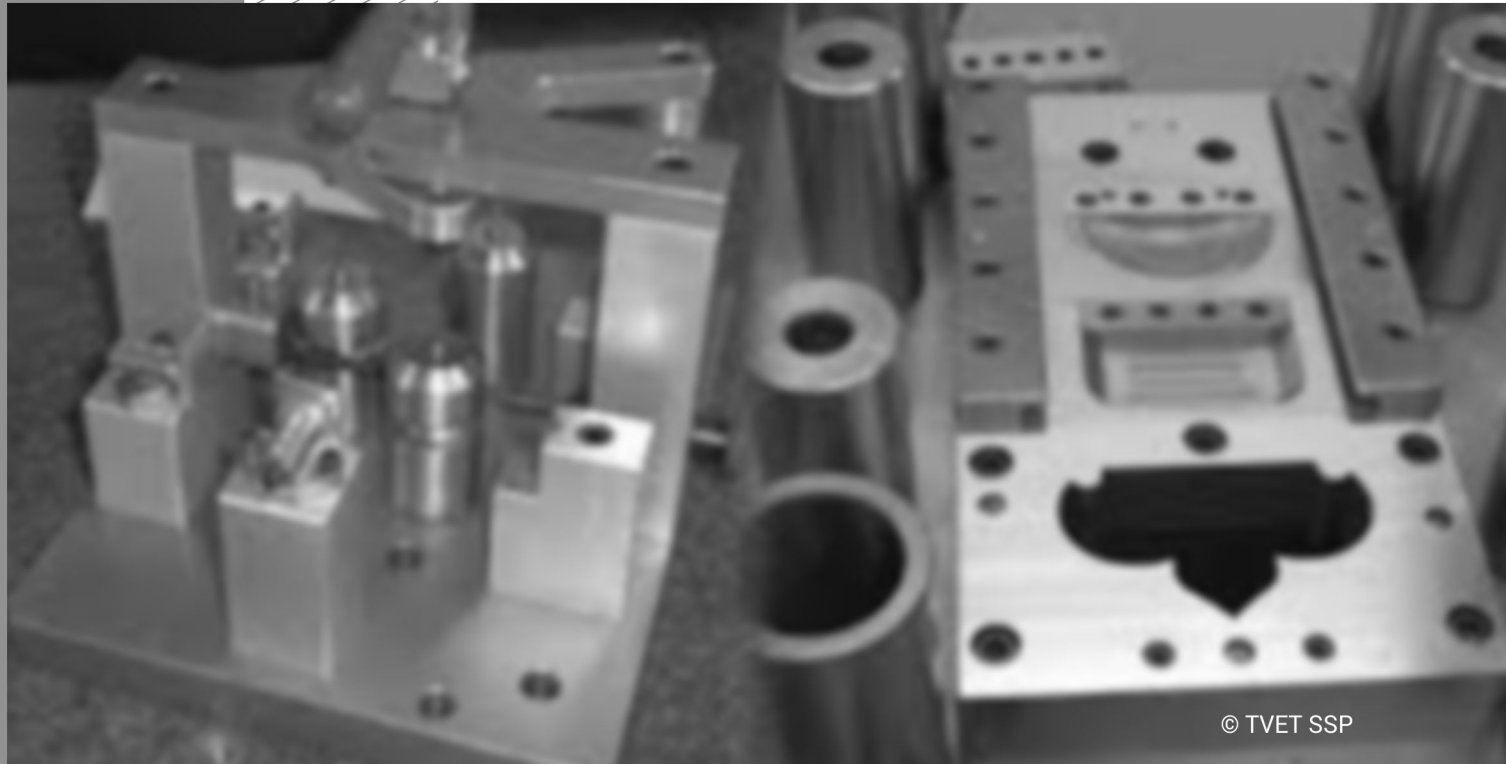
- Keep working surface clear of scraps, tools and materials.
- Remove cutting tools from spindle when cleaning the machine.
- Keep floor around the milling machine free of oil and grease.
- Use lifting equipment when appropriate to move heavy work to or from milling machines
- Place all the tools and equipment properly at a safe place

**Videos:**

	<p>Manual Mill Tutorial</p> <p><a href="https://www.youtube.com/watch?v=5ZkP5RW41rg">https://www.youtube.com/watch?v=5ZkP5RW41rg</a></p>
	<p>Climb Milling vs. Conventional Milling</p> <p><a href="https://www.youtube.com/watch?v=galm5_6SUcM">https://www.youtube.com/watch?v=galm5_6SUcM</a></p>
	<p>Tom's Tips &amp; Tricks #3 - Plunge Milling</p> <p><a href="https://www.youtube.com/watch?v=SSY-0hrWIho">https://www.youtube.com/watch?v=SSY-0hrWIho</a></p>

<p style="text-align: center;"><b>UP MILLING</b></p> 	<p><b>MILLING MACHINE OPERATIONS   Milling Processes</b></p> <p><a href="https://www.youtube.com/watch?v=2jc3HkrHh9s">https://www.youtube.com/watch?v=2jc3HkrHh9s</a></p>
	<p><b>SHOP TIPS #198 Gear Cutting on the Bridgeport Mill Plain Indexing Method tubalcaín</b></p> <p><a href="https://www.youtube.com/watch?v=3wd8wE_VxPo">https://www.youtube.com/watch?v=3wd8wE_VxPo</a></p>
	<p><b>Simple (Plain) Indexing</b></p> <p><a href="https://www.youtube.com/watch?v=MRA6d0fPqgl">https://www.youtube.com/watch?v=MRA6d0fPqgl</a></p>

# DIES AND MOULDS MAKER



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Module-5

LEARNER GUIDE

National Vocational Certificate Level 2

Version 1 - July, 2019

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## Module 5: 071500969 Perform Grinding Operations

**Objective of the module:** The standard defines the competencies in accordance with approved procedures. Student able to perform different type of grinding, which includes Surface, Cylindrical & Tool & Cutter Grinders. Able to use with all safety requirements. Understand pinning knowledge will be sufficient to provide the basic work.

**Duration:** Hrs                      **Theory:** Hrs                      **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> <b>Set grinding machine</b>	<p><b>The trainee will be able to:</b></p> <p>Identify &amp; select grinding machine according to the job specifications</p> <p>Select appropriate grinding wheel according to the work piece material</p> <p>Mount the grinding wheel as per standard procedure</p> <p>Dress the grinding wheel as per standard procedure</p> <p>Select &amp; set coolant as per job specifications</p>	<p>Know the types of grinding machines i.e. surface grinding machine and cylindrical grinding machine</p> <p>Grinding Wheel classification codes and materials.</p> <p><b>Material:</b> aluminum oxide, silicon carbide etc.</p> <p>Standard procedure for wheel balancing, mounting and dressing</p> <p>Advantages of using coolant on grinding wheels</p>	<p>Surface grinding machine</p> <p>Cylindrical grinding machine</p> <p>Grinding wheels</p> <p>Grinding wheel balancing device</p> <p>Diamond dresser</p>
<b>LU2:</b> <b>Perform workpiece setting</b>	<p><b>The trainee will be able to:</b></p> <p>Select and use appropriate clamping device</p> <p>Prepare workpiece for</p>	<p>Clamping devices for surface grinding i.e. grinding vice, magnetic table.</p> <p>Clamping devices for cylindrical grinder.</p>	<p>MS shaft</p> <p>Grinding wheel</p> <p>Collet &amp; collet body</p>

	<p>clamping</p> <p>Clamp the work piece as per standard procedure</p> <p>Set travel length of machine bed as per workpiece</p>	<p><b>Devices:</b> collets, face plate with dog clamp, dead center, half center, revolving center etc.</p> <p>Method of using workpiece clamping devices.</p> <p>Method of setting table travel / movement</p>	<p>Faceplate with dog clamp</p> <p>Tailstock</p> <p>Dead center</p> <p>Half center</p> <p>Revolving center</p>
<p><b>LU3:</b></p> <p><b>Perform surface grinding</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select appropriate grinding wheel according to the work piece material</p> <p>Set the table travel according to the work piece.</p> <p>Maintain safe distance between work piece &amp; grinding wheel</p> <p>Apply coolant on surface grinding process</p> <p>Perform grinding as per standard procedure.</p> <p>Lubricate &amp; debur the workpiece</p> <p>Verify parallelism</p>	<p>Grinding machine operational parts i.e. magnetic table, table movement limit switches, feed drum etc.</p> <p>Grinding Wheel classification codes and materials.</p> <p><b>Material:</b> aluminum oxide, silicon carbide etc.</p> <p>Setting of safe table travel length</p> <p>Advantages of applying coolant on grinding wheels</p> <p>Safe procedure sequence to perform grinding</p> <p>Use of rust prevention techniques i.e. oiling greasing etc.</p> <p>Use of dial indicators for checking parallelism</p>	<p>Surface grinding machine</p> <p>MS plate</p> <p>Grinding wheel</p> <p>Diamond dresser</p> <p>Micro meter</p>

<p><b>LU4:</b> <b>Perform cylindrical grinding</b></p>	<p><b>The trainee will be able to:</b> Select appropriate grinding wheel according to the work piece material</p> <p>Mount the work piece in chuck or collet between centres as per Requirement.</p> <p>Set the appropriate RPM of work piece</p> <p>Set the table travel according to the work piece</p> <p>Apply coolant on cylindrical grinding process</p> <p>Perform grinding as per standard procedure</p> <p>Lubricate &amp; debur the work piece.</p> <p>Verify parallelism</p>	<p>Cylindrical grinder machine major operational parts. <b>Parts:</b> headstock, tailstock, feed, bed travel limit switch etc.</p> <p>Grinding Wheel classification codes and materials. <b>Material:</b> aluminum oxide, silicon carbide etc.</p> <p>Knowledge of work holding devices i.e. chuck, collet, between centers etc.</p> <p>Setting of safe table travel length</p> <p>Advantages of applying coolant on grinding wheels</p> <p>Safe procedure for operating cylindrical grinders</p> <p>Use of rust prevention techniques i.e. oiling greasing etc.</p> <p>Use of dial indicators for checking parallelism</p>	<p>Cylindrical grinding machine Hardened shaft Cylindrical grinder machine accessories Micro meter Lubrication oil Coolant oil</p>
<p><b>LU5:</b> <b>Perform final inspection</b></p>	<p><b>The trainee will be able to:</b> Prepare the work piece for inspection</p> <p>Visually Inspect the work piece</p>	<p>Knowledge of tolerance i.e. upper limits and lower limits, basic hole and shaft system</p> <p>Knowledge of inspection tools. <b>Tools:</b> Ring gauge, plug gauge, thread pitch gauge, internal micrometer, external micrometer,</p>	<p>Micrometer Dial indicator gauge</p>

	<p>Manage the required measuring tools</p> <p>Perform the required inspection as per drawing</p>	Checking parallelism	
<p><b>LU6:</b></p> <p><b>Demonstrate safe working practice &amp; housekeeping</b></p>	<p><b>The trainee will be able to:</b></p> <p>Select &amp; use appropriate PPEs.</p> <p>Maintain cleanliness at the workplace</p> <p>Ensure relevant safety procedure for grinding operations</p>	<p>Health and safety relevant to grinding machines</p> <p>Benefits of good house keeping</p>	<p>PPEs</p> <p>Cylindrical grinding machine with all tools and accessories</p>



## Examples and illustrations

### Know the types of grinding machines

For more details visit

<https://www.westmidlandgrinding.co.uk/grinding-machines/surface/>

[https://en.wikipedia.org/wiki/Cylindrical\\_grinder](https://en.wikipedia.org/wiki/Cylindrical_grinder)

**Surface grinding machine:** Surface grinding is an abrasive process. It involves securing the object to a device that will hold it in place (a chuck) before slowly moving the object's surface across a grinding wheel that's spinning really fast. This will generate a flat plane wherever the machine comes into contact with the object. It also gives the object an even finish.



**Cylindrical grinding machine:** The cylindrical grinder is a type of grinding machine used to shape the outside of an object. The cylindrical grinder can work on a variety of shapes, however the object must have a central axis of rotation.



### Grinding Wheel classification codes and materials

For more details visit

[http://www.sharpabrasives.com/standard\\_grinding\\_wheel\\_marking.html](http://www.sharpabrasives.com/standard_grinding_wheel_marking.html)



ABRASIVE	GRIT SIZE	GRADE SIZE		STRUCTURE		BOND	CODE SYMBOL	
	Course Medium Fine	"D" to "H"	↑ ↓	Soft	Dense	↑ ↓	B- Resinoid	
Aluminum Oxide "A"	8				1		V - Vitrified	
White Aluminum Oxide "AA"	10	2	R - Rubber					
Pink Aluminum Oxide "RA"	12	3	E - Shellac					
Mixture of Brown "A"	14	"I" to "P"	↑ ↓	Medium	4		O - Oxychlo	Letters or Numbers to Designate a Variation of bond or characteristics of the wheel
Black Silicon "C"	16			5	S - Silicate			
Green Silicon Carbide "G C"	20	6						
Aluminum Zirconium "Z"	24	7						
		8						
		9						
		10						
		11						
		12						
		13						
		14						
		Open / Porus						

**Aluminum oxide:** Grinding wheels made of aluminum oxide are the most commonly used for working with metals. There are also abrasives made of zirconia alumina, a combination of aluminum oxide and zirconium-oxide. Zirconia alumina is a heavy-duty substance that doesn't splinter, so you don't have to change the wheels as often. Aluminum oxide or zirconia alumina should be used for grinding steels and steel alloys.

**Silicon carbide:** For grinding cast iron, non-ferrous metals and non-metallic materials, select a silicon carbide grinding wheel. .

### Standard procedure for wheel balancing, mounting and dressing

For more details visit

[https://www.woodturnerscatalog.com/docs/mounting\\_balancing\\_grinding\\_wheels.pdf](https://www.woodturnerscatalog.com/docs/mounting_balancing_grinding_wheels.pdf)

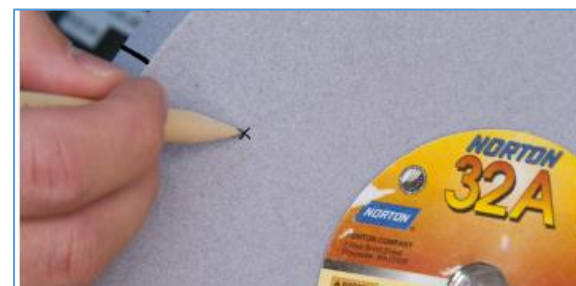
## 1. Installing / Mounting the grinding wheel

Place the grinding wheel on the grinder. It should fit tightly. If the wheel is sloppy on the arbor, simply wrap the grinder arbor with masking tape until the wheel fits snugly on the arbor. Do not install the guards at this point.



## 2. Aligning / Balancing the wheel

a). With the wheel mounted on the grinder, rotate the wheel by hand. Identify the “high point” on the right side of the wheel.



b). Remove the tightening nut and washer.

c). Place a single layer of masking tape on the paper washer on the right side of the wheel as shown. The tape should be positioned on the paper washer so that it is in line with the mark on the wheel and the center of the arbor.



d). Place a single layer of tape on the paper washer on left side of the wheel with the tape positioned opposite the tape on the right side paper washer. If done properly, the tape on opposite sides of the wheel are positioned 180 degrees from one another.

e). Reinstall the right side washer and tightening nut and tighten.

f). Rotate the wheel by hand checking for side-to-side movement. Add additional tape as needed until the wheel runs true.



### 3. Dressing the wheel

Attach the grinder guards and make sure that the wheels spin free without hitting contacting the grinder. Plug in the Grinder. Power the grinder ON. Use a diamond wheel dresser, place it flat against the rest and slowly advance the face of the dresser until it lightly touches the face of the grinding wheel. Continue to dress the wheel until all high points on the wheel have been ground down and the dresser fully engages the entire surface of the wheel. Move the wheel dresser side to side until the face of the wheel runs true.



#### Advantages of using coolant on grinding wheels

For more details visit

<https://www.canadianmetalworking.com/article/metalworking/understanding-grinding-fluid>

Fluid use is very important in the grinding process because it reduces the effects of friction, removes heat from the work zone, and increases material removal. Most important, grinding fluid increases the material removal rate without increasing the damage to the surface of the workpiece.

#### Clamping devices for surface grinding

For more details visit

<https://openoregon.pressbooks.pub/manufacturingprocesses45/chapter/chapter-5-surface-grinder/>

**Grinding vise:** The Surface Grinder is mainly used in the finishing process. It is a very precise tool which uses a stationary, abrasive, rotating wheel to shave or finish a metallic surface which is held in place by a vise. This vise, which is part of a table, or carriage is moved back and forth under the abrasive wheel.



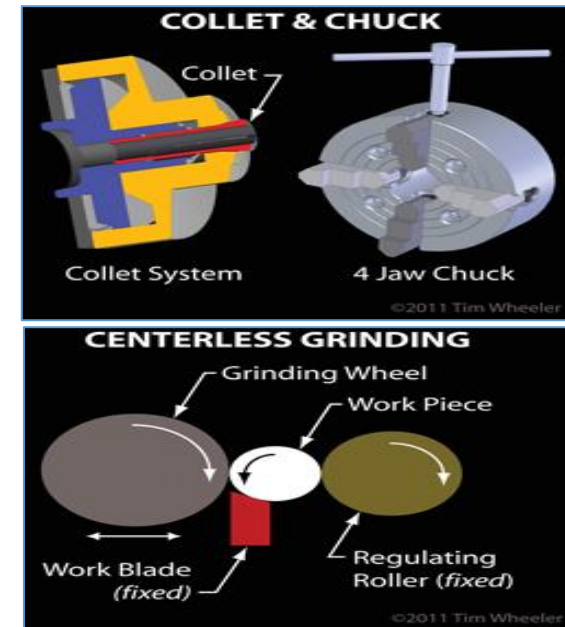
**Magnetic table:** The table of the grinder is magnetic which aids in holding the material still. These magnets can be toggled by means of a lever located in the front side of the grinder.

### Clamping devices for cylindrical grinder

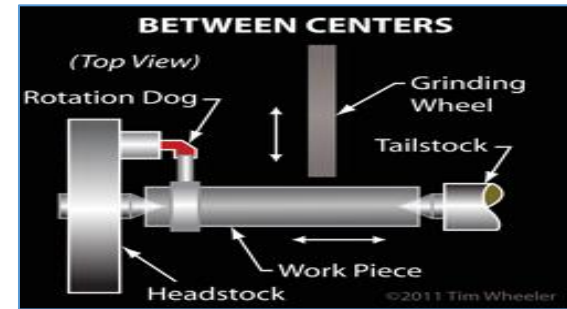
For more details visit <https://www.canadianmetalworking.com/article/metalworking/workholding--for-cylindrical--grinding>

**Collets:** Collets and chucks are used for grinding workpiece that are either too small for center points or require one end to be featured or profiled. Chuck and collet systems are dynamic work holding systems. Unlike center less and between-centers setups, where the setup is stationary, the workpiece moves with the chuck or the collet. This means in addition to any inaccuracies they suffer, the quality, wear, and balance of the drive system is critical to maintaining the overall stability of workpiece holding.

**Center less:** Center less grinding is accomplished by feeding stock between a fixed guide blade and rotating regulating roller and a rotating grinding wheel. The regulating roller controls the rotation of the part. The feed-through action is precipitated by slightly skewing the guide blade axis in relation to the regulating roller, causing the regulating roller to pull the part across the face of the grinding wheel. The workpiece is held against the guide blade and roller by gravity.



**Between centers:** The most widely used work holding method for cylindrical grinding is done between centers. The reason for its popularity is the stability of the tooling. Centers are drilled in the end of the workpiece, and hardened, precision center points position the centerline of the part in space. The workpiece centers ride, surface to surface, on the stationary head- and tailstock centers, establishing one, and unchanging centerline for the part.



**Parametric work holding:** The most recent advancement to come along is parametric work holding. It is similar to center less grinding but with some significant differences. Parametric work holding employs a regulating roller to drive the work piece and a guide blade, but the parametric method precisely locates and qualifies the guide blade and roller to the grinding wheel, and employs a tension roller that ensures solid contact of the workpiece to both. In addition, the grinding wheel moves along an additional axis, relative to the workpiece. In traditional center less grinding, only one axis is available.

**For more details visit**

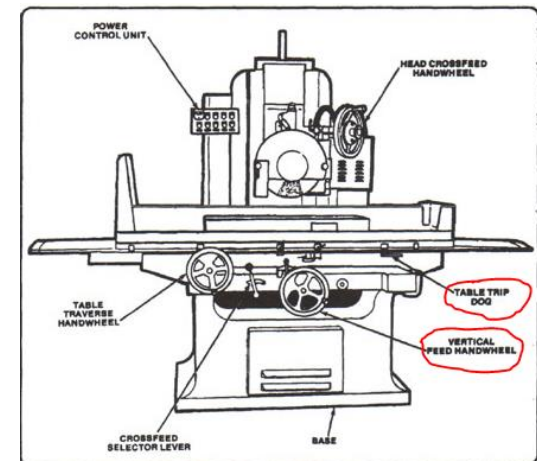
[http://www.americanmachinetools.com/how\\_to\\_use\\_a\\_surface\\_grinder.htm](http://www.americanmachinetools.com/how_to_use_a_surface_grinder.htm)

### Grinding machine operational parts

**Magnetic table:** Magnetic table: The table of the grinder is magnetic which aids in holding the material still. These magnets can be toggled by means of a lever located in the front side of the grinder.

**Table movement limit switches:** These switches are located at the bed of the grinding table and control the movement of the bed in the horizontal direction. The switch trips immediately when the movement is more than it is programmed.

**Feed drum:** It is a hand wheel on the surface grinding machine to provide the feed.



## **Setting of safe table travel length**

Table travel length is set with respect to the length of the workpiece surface on which grinding is to be done. On a Manual Surface Grinder, you will need to run the table left and right with one hand wheel while cross feeding with the other hand wheel. On an Automatic Surface Grinder, you will be able to run the table left and right automatically while cross-feeding automatically. All you need to do is set the down feed and stroke.

## **Safe procedure sequence to perform grinding**

1. Select the correct grinding wheel for the work to be ground
2. Visually inspect the wheel for any damage or cracks. If no damage is found install the wheel on your surface grinder tightening the left-hand spindle nut carefully with a spanner wrench
3. Dress / True the grinding wheel if needed
4. After the wheel is dressed and running concentric you will then be ready to gently touch off on the work (using the spark or layout fluid method). Next, set your "zero" on the down feed handle, raise the head slightly to clear work then the cross feed handle to distance the work from the grinding wheel. Next feed the grinding head down a distance not more than .005. The amount of material being removed will determine how far you can feed the cross-feed in per pass.
5. Set the parameters and start grinding the surface

Note: Wear appropriate safety glasses and other required protective equipment

## **Use of rust prevention techniques**

In metal working, fluid (coolant) such as cutting oil, grinding fluid is used. It contains several chemicals that are oil, surface active agent, extreme pressure additive, antirust agent, antifoaming agent, preservative, biocide etc. These coolants will not only keep the workpiece and cutting tool cooler and safer but also avoids the rust to be appeared on metal.

## **Use of dial indicators for checking parallelism**

Dial indicators are used on surface grinders for aligning purposes.

## Cylindrical grinder machine major operational parts

For more details visit

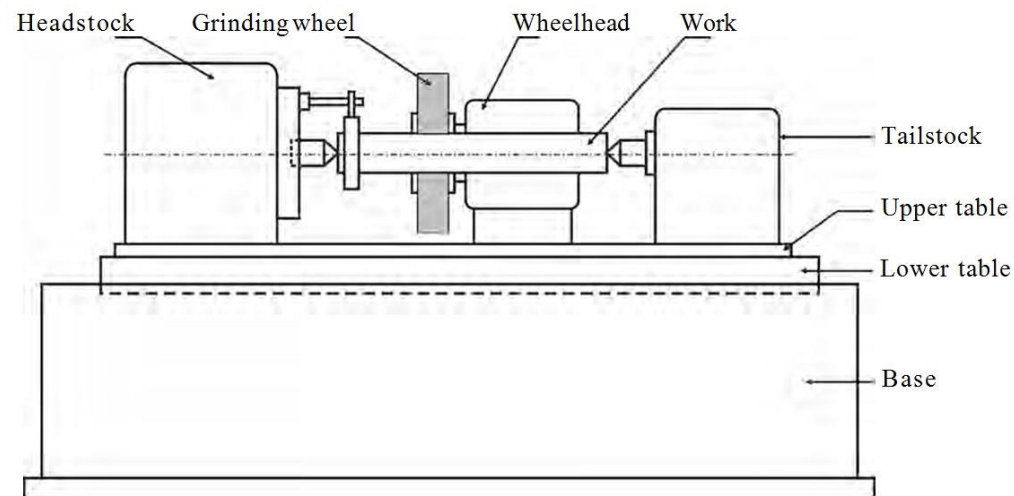
<https://www.educationdiscussion.com/cylindrical-grinding-machine/>

**Headstock:** The headstock is situated at the left side of upper table. It supports the workpiece by means of a center and drives it by means of a dog. It may hold and drive the workpiece in a chuck. The headstock of a universal grinding machine can be swiveled to any required angle.

**Tailstock:** The tailstock is situated at the right side of the table. It can be adjusted and clamped in various positions to accommodate different lengths of work pieces.

**Feed:** The feed is provided by a wheel head. Which may be moved at right angles to the table ways. It is operated by hand or by power to feed the wheel to the work. The wheel head carries a grinding wheel.

**Bed travel limit switch:** These switches are located at the bed of the grinding table and control the movement of the bed. The switch trips immediately when the movement is more than it is programmed.



Cylindrical Grinding Machine



### **Setting of safe table travel length**

Table travel length is set with respect to the length of the workpiece surface on which grinding is to be done. On a Manual Surface Grinder, you will need to run the table left and right with one hand wheel while cross feeding with the other hand wheel. On an Automatic Surface Grinder, you will be able to run the table left and right automatically while cross-feeding automatically. All you need to do is set the down feed and stroke.

### **Safe procedure for operating cylindrical grinders**

The methods used to set up stock in a cylindrical grinder are similar to the methods used to set up lathes. If you plan to grind work between centers, you will usually machine it to approximate size between centers on a lathe. Then, you will use the same center holes for the grinding setup. When you set up a workpiece to grind between centers, use the following procedures:

1. Be sure the centers in the headstock and tailstock and the center holes in the workpiece are in good condition
2. Clamp a driving dog onto the workpiece
3. Position the headstock and tailstock and set the traverse stop dogs so that when the workpiece is in place, the table will traverse (longitudinally) the proper distance to grind the surface
4. Make sure the headstock swivel, the taper table attachment, and the wheelhead swivel are set properly

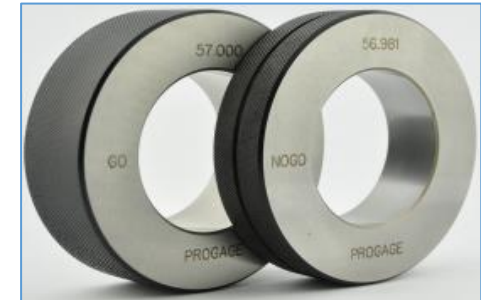
### **Knowledge of tolerance**

Upper limits and lower limits: Upper limit is the maximum or greatest permissible size of a feature whereas lower limit is the minimum or smallest permissible size of a feature.

Basic hole and shaft system: If the lower limit size or minimum size of hole is equal to the basic size then that type of hole is known as basic hole for a given assembly of hole and shaft. If the upper limit size or maximum size of the shaft is equal to the basic size then that type of hole is known as Basic Shaft for a given shaft and hole assembly.

## Knowledge of inspection tools

**Ring gauge:** A ring gauge, or ring gage, is a cylindrical ring of a thermally stable material, often steel, whose inside diameter is finished to gauge tolerance and is used for checking the external diameter of a cylindrical object.



**Plug gauge:** Plug gauges are commonly used in the inspection of several product lines as a result of their ease of use. A plug gauge assesses the conformity of objects to the prescribed specifications. A typical plug gauge resembles a rod whose ends are carefully fashioned so that one end is the upper limit while the other end is the lower limit.

The left end is marked green and is the go-end, while the right end is marked red and is the no-go end. The go-end should fit into the component under test and the no-go end should not fit into the said component for the component to meet specifications.



**Thread pitch gauge:** A thread pitch gauge is used to measure the pitch or lead of a screw thread.



**Internal micrometer:** It is a precision instrument for measuring the inside dimension of an object, such as the diameter of a hole or the width of a groove



External micrometer: It is used to measure external surfaces of shafts, blocks, spheres and various common shapes.



Checking parallelism: Take the measurement of the opposing sides. Determining parallelism means finding that two opposing sides of an object, which are supposed to be parallel, are consistently far apart at all positions. To test this, one needs to measure the distance between the two surfaces at multiple positions.

### Health and safety relevant to grinding machines

For more details visit

<http://uhv.cheme.cmu.edu/procedures/machining/ch5.pdf>

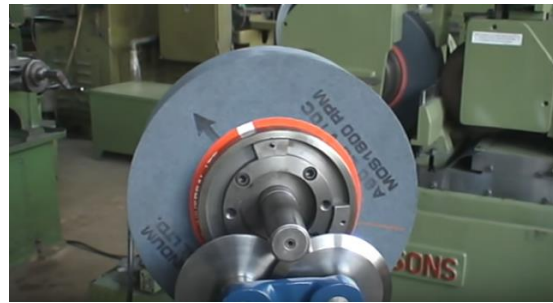
Grinding machines are used daily in a machine shop. To avoid injuries follow the safety precautions listed below:

- Wear goggles for all grinding machine operations
- Check grinding wheels for cracks before mounting
- Never operate grinding wheels at speeds in excess of the recommended speed
- Never adjust the workpiece or work mounting devices when the machine is operating
- Do not exceed recommended depth of cut for the grinding wheel or machine
- Remove workpiece from grinding wheel before turning machine off
- Use proper wheel guards on all grinding machines
- On bench grinders, adjust tool rest 1/16 to 1/8 inch from the wheel

## **Benefits of good house keeping**

- reduced handling to ease the flow of materials
- fewer tripping and slipping incidents in clutter-free and spill-free work areas
- decreased fire hazards
- lower worker exposures to hazardous products (e.g. dusts, vapours)
- better control of tools and materials, including inventory and supplies
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale
- improved productivity (tools and materials will be easy to find)

**Videos:**



**CENTERLESS GRINDING WHEEL BALANCING**

<https://www.youtube.com/watch?v=RJVn-G2nZaQ>



**Surface Grinder Basics: How to Square a Block (6 sides)**

<https://www.youtube.com/watch?v=0XkZ8SkVA2U>



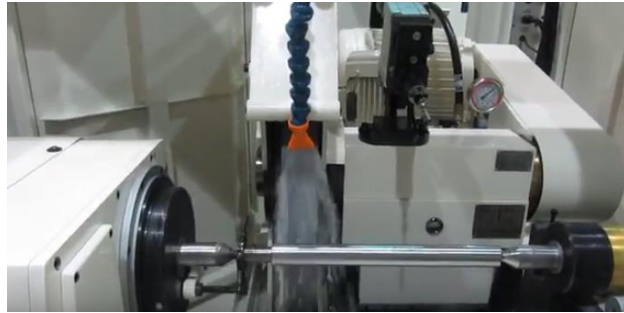
**How to Dress and Balance a Surface Grinder Wheel**

[https://www.youtube.com/watch?v=MofRhM\\_W-Vk](https://www.youtube.com/watch?v=MofRhM_W-Vk)



OD Grinder Basics- How to grind fast and accurate.

<https://www.youtube.com/watch?v=NuLjCTEZrgc>



CNC cylindrical grinder taper adjustment 2

[https://www.youtube.com/watch?v=Or7sU\\_yhddc](https://www.youtube.com/watch?v=Or7sU_yhddc)

# DIES AND MOULDS MAKER



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Module-6

LEARNER GUIDE

National Vocational Certificate Level 2

Version 1 - July, 2019

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## Module 6: Perform Basic communication skills

**Objective of the module:** This competency standard covers the skills and knowledge required to perform basic communication skills.

90 Hrs

**Theory:**

15 Hrs

**Practical:**

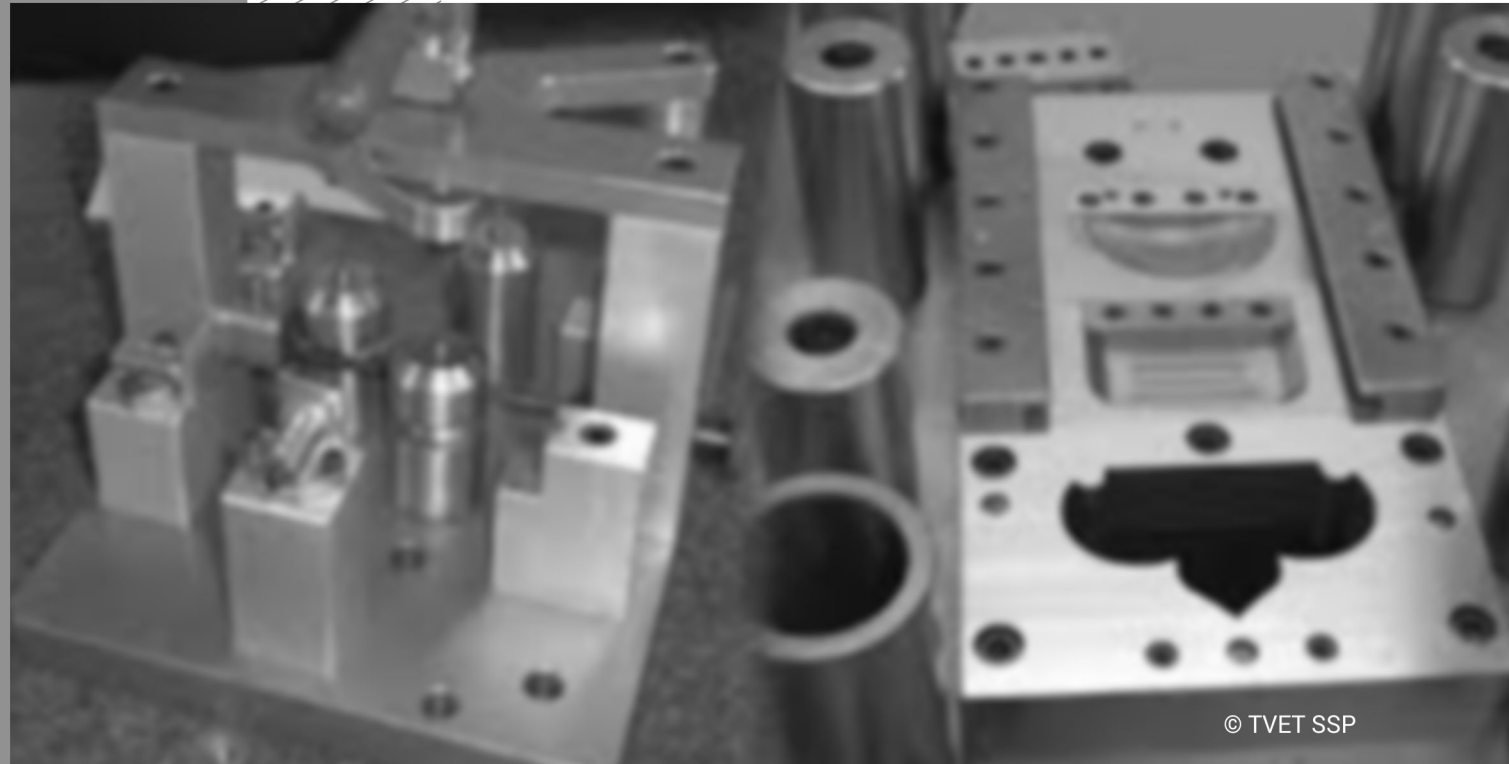
75 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> <b>Work in team</b>	<p><b>The trainee will be able to:</b></p> <p>Treat team members with respect and maintain positive relationships to achieve common organizational goals</p> <p>Listen to instructions carefully &amp; comply with those instructions</p> <p>Provide work related information to team members and identify interrelated work activities to avoid confusion</p> <p>Adopt communication skills, appropriate to work activities and organizational/medical procedures</p> <p>Identify problems and resolve them through discussion and mutual agreement</p>	<p>Difference between work groups and teams.</p> <p>Attributes of good listening</p> <p>Attributes of good communication skills</p> <p>Barriers to communications</p>	



<b>LU2: Follow Supervisor's Instructions</b>	<p><b>The trainee will be able to:</b> Carefully listen and note down the instructions of Supervisor</p> <p>Carry out the instructions of the supervisor</p> <p>Report to the supervisor as per organizational SOPs</p>	<p>What is a SOP? Attributes of SOPs.</p>	
<b>LU3: Demonstrate Basic IT skills</b>	<p><b>The trainee will be able to:</b> Create folders and files and learn major commands of operating system/windows</p> <p>Type text and use major commands such as printing, editing, creating tables and graphs etc.</p> <p>Generate office reports using appropriate computer applications</p> <p>Use internet for sending/receiving emails and connecting through social or other media</p>	<p>Basic knowledge of computer. Basic use of office applications i.e. MS word, excel and PowerPoint. Knowledge of using internet and emails.</p>	

# DIES AND MOULDS MAKER



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Module-7

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## Module 7: Dispose the waste material

**Objective of the module:** This unit involves the skills and knowledge required for disposing of Waste which can be a sanitary landfill or any other locally used method

**Duration** 90 Hrs **Theory:** 15 Hrs **Practical:** 75 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1: Characterize the final waste</b>	<p><b>The trainee will be able to:</b></p> <p>Understand the composition of waste.</p> <p>Differentiate between Waste which remain at road sides or at producers</p> <p>Identify whether separate pre-collection or collection has occurred</p>	<p>Knowledge of types of waste material i.e. recyclable or non-recyclable etc.</p>	
<b>LU2: Dispose of the final waste</b>	<p><b>The trainee will be able to:</b></p> <p>Sort the waste</p> <p>Shred the waste</p> <p>Perform the baling process</p> <p>Perform incineration (burning) or Land filling whichever is appropriate according to the type of waste.</p>	<p>Method of sorting the waste.</p> <p>Methods of disposal of waste materials.</p>	

# DIES AND MOULDS MAKER



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Module-8

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## Module 8: Demonstrate Basic Numeracy Skills

**Objective of the module:** This module covers the skills and knowledge required to apply basic Numeracy skills, Perform Measurement, Perform basic mathematical calculations and Calculate Area and Volume of aggregate

**Duration** 90 Hrs                      **Theory:** 15 Hrs                      **Practical:** 75 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
<b>LU1:</b> Apply Basic Numeracy Skill	<b>The trainee will be able to:</b> Knowledge of basic principles of addition, subtraction, multiplication and division  Apply basic principles of addition  Apply basic principles of subtraction  Apply basic principles of multiplication  Apply basic principles of division	Basic principles of calculations. i.e. BODMAS	
<b>LU2:</b> <b>Perform Measurement</b>	<b>The trainee will be able to:</b> Describe identification and working of measuring tools Collect appropriate measuring tools Identify inch foot and yard Identify millimeter, centimeter and meter	Knowledge of basic units of measurements. i.e. metric system and British system How to read a inches scale in fractions.	

<b>LU3:</b> <b>Perform Basic Mathematical Calculations</b>	<b>The trainee will be able to:</b> Knowledge of Basic measuring units and its inter conversion  Perform addition  Perform subtraction  Perform multiplication  Perform division  Perform inter conversion of Measuring units Record the results.	Conversion of basic measuring units. i.e. millimeter, centimeter, deci-meter, meter, yards, foot, inches	
<b>LU4:</b> <b>Calculate Area and Volume of aggregate</b>	<b>The trainee will be able to:</b> Describe Area and Volume of materials Calculate surface area  Calculate volume of materials	Method of calculating area of basic and composite shapes. Method of calculating volumes of objects of basic shapes	

## Module summary

Module Title and Aim	Learning Units	Timeframe of modules
<p><b>Module 1:</b> Maintain Personal Health, Hygiene and safety</p> <p><b>Aim:</b> This Competency Standard identifies the competencies required to protect/apply occupational Safety, Health and Environment at workplace according to the industry's approved guidelines, procedures and interpret environmental rules/regulations. Trainee will be expected to identify and use Personal Protective Equipment (PPE) according to the work place requirements. The underpinning knowledge regarding Observe Occupational Safety and Health (OSH) will be sufficient to provide the basis for the job at workplace.</p>	<p><b>LU1:</b> Identify Hazard at work place  <b>LU2:</b> Apply personal protective and safety equipment (PPE).  <b>LU3:</b> Observe occupational safety and health (OSH)  <b>LU4:</b> Dispose of hazardous waste/materials</p>	<p>30 Hrs</p>
<p><b>Module 2:</b> Perform Bench Work</p> <p><b>Aim:</b> This competency standard covers the skills and knowledge required to perform bench work operations including sawing, filing, drilling, taping, reaming, countersinking, counter boring, polishing &amp; grinding.</p>	<p><b>LU1:</b> Perform sawing  <b>LU2:</b> Perform filing  <b>LU3:</b> Perform drilling  <b>LU4:</b> Perform hand taping  <b>LU5:</b> Perform hand reaming  <b>LU6:</b> Perform counter boring  <b>LU7:</b> Perform counter sinking  <b>LU8:</b> Perform polishing  <b>LU9:</b> Perform hand grinding  <b>LU10:</b> Demonstrate safe working conditions &amp; housekeeping</p>	<p>100 Hrs</p>

Module Title and Aim	Learning Units	Timeframe of modules
<p><b>Module 3: Perform Lathe Operations</b></p> <p><b>Aim:</b> This competency standard covers the skills and knowledge required to perform different processes on lathe machines including Facing, turning, parting, threading, knurling, and drilling.</p>	<p><b>LU1:</b> Set tool and lathe machine  <b>LU2:</b> Perform workpiece setting  <b>LU3:</b> Perform facing  <b>LU4:</b> Perform turning  <b>LU5:</b> Perform thread cutting  <b>LU6:</b> Perform parting  <b>LU7:</b> Perform drilling / Boring  <b>LU8:</b> Perform knurling  <b>LU9:</b> Perform final inspection  <b>LU10:</b> Demonstrate safe working practice &amp; housekeeping</p>	<p>100 Hrs</p>
<p><b>Module 4: Perform Milling Operations</b></p> <p><b>Aim:</b> This competency standard covers the skills and knowledge required to perform different processes on milling machines including pocketing, contouring, reaming, indexing, and drilling/boring.</p>	<p><b>LU1:</b> Set tool and milling machine  <b>LU2:</b> Perform workpiece setting  <b>LU3:</b> Perform pocketing  <b>LU4:</b> Perform contouring  <b>LU5:</b> Perform drilling / boring  <b>LU6:</b> Perform reaming  <b>LU7:</b> Perform indexing  <b>LU8:</b> Perform final inspection  <b>LU9:</b> Demonstrate safe working practice &amp; housekeeping</p>	<p>50 Hrs</p>



Module Title and Aim	Learning Units	Timeframe of modules
<p><b>Module 5: Perform Grinding Operation</b></p> <p><b>Aim:</b> The standard defines the competencies in accordance with approved procedures. Student able to perform different type of grinding, which includes Surface, Cylindrical &amp; Tool &amp; Cutter Grinders. Able to use with all safety requirements. Understand pinning knowledge will be sufficient to provide the basic work.</p>	<p><b>LU1:</b> Set grinding machine  <b>LU2:</b> Perform work piece setting  <b>LU3:</b> Perform surface grinding  <b>LU4:</b> Perform cylindrical grinding  <b>LU5:</b> Perform final inspection  <b>LU6:</b> Demonstrate safe working practice &amp; housekeeping</p>	<p>120 Hrs</p>
<p><b>Module 6: Perform Basic Communication Skills</b></p> <p><b>Aim:</b> This competency standard covers the skills and knowledge required to perform basic communication skills</p>	<p><b>LU1:</b> Work in team  <b>LU2:</b> Follow supervisor's Instructions  <b>LU3:</b> Demonstrate basic IT skills</p>	<p>90 Hrs</p>
<p><b>Module 7: Dispose the waste Material</b></p> <p><b>Aim:</b> This unit involves the skills and knowledge required for disposing of Waste which can be a sanitary landfill or any other locally used method</p>	<p><b>LU1:</b> Characterize the final waste  <b>LU2:</b> Dispose of the final waste</p>	<p>30 Hrs</p>

Module Title and Aim	Learning Units	Timeframe of modules
<p><b>Module 8: Demonstrate basic Numeracy skills</b></p> <p><b>Aim:</b> This module covers the skills and knowledge required to apply basic Numeracy skills, Perform Measurement, Perform basic mathematical calculations and Calculate Area and Volume of aggregate</p>	<p><b>LU1:</b> Apply basic numeracy skills  <b>LU2:</b> Perform measurement  <b>LU3:</b> Perform basic mathematical calculations  <b>LU4:</b> Calculate Area and Volume of aggregate</p>	<p>30 Hrs</p>

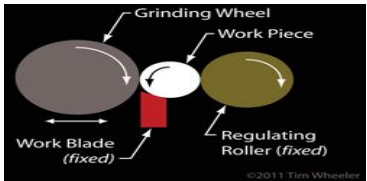
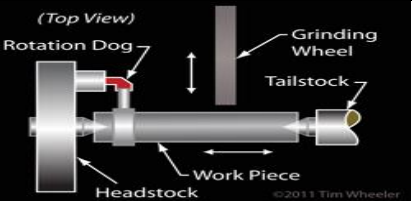
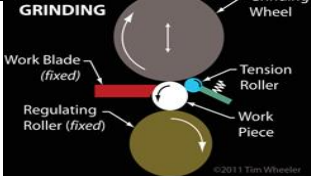
## Short Questions/Answers

Q1. How many types of hacksaw frames are there?	There are two types of hacksaw frames; fixed and adjustable.
Q2. How many TPI configurations are generally available for hacksaw blades?	There are four TPI configurations: 14 TPI, 18 TPI, 24 TPI and 32 TPI.
Q3. Why do we use marking ink on metals?	Marking ink is used to make the marking visible on a metal surface which otherwise could not be seen properly.
Q4. What is the function of a divider?	Divider is used to mark circular lines or arcs on metals.
Q5. Define V Block?	A vee block (or V-block) is a square or rectangular precision made block used to securely hold a cylindrical workpiece.
Q6. How many types of punches are used in metal working? Name them.	There are two types of punches used: dot punch and center punch
Q7. How many types of files are there as per the cut? Name them.	There are three types of files as per the cut: single cut, double cut and rasp cut
Q8. How do we measure the length of file?	A file's length is measured from the base of its heel to the end of its tip
Q9. How do we change the spindle speed in bench type drill machine?	Variation in spindle speed is achieved by altering the belt position on the stepped pulleys.
Q10. How do we change the spindle speed in pillar type drill machine?	Variation in spindle speed is achieved through a gearbox
Q11. Explain ferrous and non-ferrous metals?	Ferrous metals are those which contain iron as their major element. They are also magnetic and rust prone. Non Ferrous Metals do not contain Iron. These are not magnetic and are corrosion resistant.
Q12. How many types of drill bits are there? Name them.	There are two types of drill bits: straight shank and taper shank.
Q13. What is tapping?	Tapping is the process of cutting a thread inside a hole. Also it is used to

	make thread on nuts
Q14. How many configurations of hand taps are there? Name them.	Hand taps come in three basic configurations: Taper, Plug and Bottoming.
Q15. How many types of reamers are there? Name them.	There are two types of reamers: machine and hand reamers.
Q16. Define tolerance?	The term tolerance refers to the difference between the upper (maximum) limit and lower (minimum) limit of a dimension. In other words, tolerance is the maximum permissible variation in a dimension.
Q17. What is clearance fit?	A fit that always provides a clearance (gap) between the hole and shaft when assembled is known as clearance fit
Q18. What is the purpose of counter boring?	Counter boring creates a flat-bottom cavity that matches the shape of the underside of a bolt or screw.
Q19. What is the purpose of counter sinking?	Counter sinking creates a conical cavity that matches the angled shape of the underside of a flathead screw.
Q20. Define grinding wheels?	Grinding wheels are expendable wheels composing of an abrasive compound.
Q21. What is cylindrical grinding wheel?	A cylinder wheel is the one which has no center mounting support but has a long & wide surface
Q22. What is tapered grinding wheel?	Tapered Grinding wheel is a straight wheel that tapers externally towards the midpoint of the wheel.
Q23. What is the use of saucer grinding wheel?	Saucer grinding wheel is used for grinding twist drills and milling cutters.
Q24. What is the use of diamond grinding wheel?	This is used to grind hard materials like concrete, gemstones & carbide tips.
Q25. What is PPE?	PPE is personal protective equipment.
Q26. What is a bench lathe?	It is a type of lathe machine that is mounted on a workbench.
Q27. What is a speed lathe?	It is a power lathe with a rapidly revolving spindle used for turning small

	objects and for polishing purposes.
Q28. What is a turret lathe?	It is a type of lathe machine used for repetitive production of duplicate parts.
Q29. Define headstock?	It is a part of lathe machine that houses the spindle, speed change mechanism and change gears.
Q30. Define tailstock?	Tailstock is usually used to apply support to the longitudinal rotary axis of a workpiece being machined.
Q31. What is the function of lead screw?	The basic function of the lead screw is to move the turret by a précised increment for every rotation of the screw.
Q32. Which type of cutting tool is simplest and most common on lathe machine?	High speed steel (HSS) tool bits are the simplest and most common cutting tools on lathe machine.
Q33. What is tool post?	The tool post clamps the tool holder in the proper positions for machining operations. It is fitted on top slide and carries the cutting tool or the cutting tool holder
Q34. What is a four jaw chuck?	It is a workpiece clamping device that has four jaws used to hold round, square, hexagonal and irregular shaped workpieces.
Q35. What is a face plate?	It is a circular metal workpiece clamping device which fixes to the end of the lathe spindle. The workpiece is clamped to the faceplate using t-nuts in slots in the faceplate or threaded holes in the faceplate itself.
Q36. What is the function of dial indicator?	Dial indicators are used to measure the distance between two surfaces or small amounts of component travel.
Q37. What is a rake angle?	The rake angle is the angle between the front or cutting face of the tool and a line perpendicular to the workpiece.
Q38. What is a clearance angle?	It is the angle between machined surface and the flank surface.
Q39. What is the angle of V shaped thread in metric and british threads?	In metric threads, V has an angle of $60^{\circ}$ whereas in british threads, V has an angle of $55^{\circ}$ .
Q40. Define parting of workpiece?	Parting uses a blade-like cutting tool plunged directly into the workpiece to

	cut off the workpiece at a specific length.
Q41. Define knurling?	Knurling is a process of impressing a diamond shaped or straight line pattern into the surface of a workpiece by using specially shaped hardened metal wheels
Q42. What is ring gauge?	A ring gauge is a cylindrical ring whose inside diameter is finished to gauge tolerance and is used for checking the external diameter of a cylindrical object.
Q43. What is the function of thread pitch gauge?	A thread pitch gauge is used to measure the pitch or lead of a screw thread.
Q44. What is internal micrometer?	It is a precision instrument for measuring the inside dimension of an object
Q45. What is external micrometer?	It is used to measure external surfaces of shafts, blocks, spheres and various common shapes.
Q46. Define milling?	Milling is a process performed with a machine in which the cutters rotate to remove the material from the work piece present in the direction of the angle with the tool axis
Q47. Define milling machine bed?	Machine bed or table is a rectangular casting which is present on the top of the saddle. It is used to hold the work or work holding devices.
Q48. What is arbor?	Arbor is a cutting tool holder accessory used in milling machine to clamp the cutting tool.
Q49. Define end mill?	End mill is the milling cutter which has one square end and the outside diameter is smooth for creating smooth surface finishes.
Q50. What is the function of cutting fluid?	The primary function of cutting fluid is temperature control through cooling and lubrication.
Q51. What is the difference between conventional and climb milling?	In Conventional milling the cutter rotates against the direction of the feed whereas during Climb milling the cutter rotates with the feed.
Q52. What is the function of ball nose end mill?	Ball nose end mills are used for milling contoured surfaces, slotting and

		pocketing.
Q53. Define boring head.		Boring head is an attachment that fits the milling machine spindle and permits most drilled holes to have a better finish and greater diameter accuracy
Q54. Define boring bar.		The boring bar is a machine tool that spins into a part while moving a cutting tool to remove material from the part
Q55. Define indexing.		Indexing is the process of evenly dividing the circumference of a circular work piece into equally spaced divisions
Q56. What is a datum?		A datum is a reference from which measurements are taken.
Q57. What is edge datum?		It is a type of datum which uses a physical surface from which dimensions can be taken.
58. On a grinding disc, a classification code is written. What does the first letter of the code indicate?		The first letter of the code indicates the type of abrasive used on the wheel
Q59. Write down the type of grinding process used?		Centerless grinding is used in the given figure.
Q60. Write down the type of grinding process used?		Between centers grinding is used in the given figure.
Q61. Write down the type of grinding process used?		Perimetric grinding is used in the given figure.

## Test Yourself (Multiple Choice Questions)

### MODULE 2

- Question 1** Compare to flexible hacksaw blades the rigid blades cut material are:
- A Less efficient
  - B More efficient
  - C Equally
  - D No remarkable difference
- Question 2** For a Hacksaw Blade what does TPI stands for?
- A Teeth Per inch
  - B Thread Per Inch
  - C Tetra Pack International
  - D Transparent Product Identity



**Question 3** Which is of the following is the best option to cut with 14 TPI hacksaw blade?

- A Thin sheets
- B Thin material
- C Wood
- D Thickest material

**Question 4** What is the point angle of center punch?

- A 55°
- B 60°
- C 90°
- D 75°

**Question 5** What is the point angle of dot punch?

- A 55°
- B 60°
- C 90°
- D 75°

**Question 6** Which of the following is used to mark with divider?

A Arc, circle and radius

B Straight lines

C Angular lines

D Irregular shapes

**Question 7** V-Blocks are used to clamp?

A Long bars

B Flexible sheets

C Round bars

D Angle iron

- Question 8** :Smooth files are used for which purpose?
- A Polishing
  - B Finishing
  - C Roughing
  - D Material removing

- Question 9** The materials having Iron content are called?
- A Non- ferrous metal
  - B Ferrous metal
  - C Brass
  - D Copper

- Question 10** Copper is a \_\_\_\_\_ metal?
- A Non- ferrous metal
  - B Ferrous metal
  - C Cast
  - D rough

**Question 11** Taps are used to produce?

- A External thread
- B Finish hole
- C Internal threads
- D chamfer

**MODULE 3**

**Question 12** The simplest and most common Material for a lathe tool is?

- A High Carbon HC
- B High Speed Steel HSS
- C Brazed Tip
- D Chromium steel

**Question 13** On a lathe machine the depth of cut and feed is given through?

A Lead screw

B Carriage

C Tail stock

D spindle

**Question 14** Which of the following device on lathe machine carriage used to clamp tool?

A Chuck

B Collet

C Tool post

D Face plate

**Question 15** Which of the following object is used with dial indicators?

A Shaft

B Magnetic stand

C Tailstock

D collet

- Question 16** The surface of a cutting tool tip over which the removed chips flow is known as?
- A Rack angle
  - B Clearance angle
  - C Front clearance
  - D Back clearance

- Question 17** What is the abbreviation of RPM?
- A Revolutions Per Minute
  - B Required Per man
  - C Required Per Million
  - D Request Per Machine

**Question 18** What is the V angle of British thread?

A 55°

B 60°

C 90°

D 75°

**Question 19** What is the V angle of metric thread?

A 55°

B 60°

C 90°

D 75°

- Question 20** What is the V angle of square thread ?
- A 55°
  - B 60°
  - C 90°
  - D 75°

**MODULE 4**

- Question 21** In a Milling machine end mill cutters are usually clamped with?
- A Chuck
  - B Collet
  - C Arbors
  - D Long bar



- Question 22** In RPM calculation formula what does the D represent?
- A Dia of Collet
  - B Dia of arbors
  - C Dia of cutting tool
  - D Dia of machine spindle

- Question 23** Which of the following tool is shown in the figure?
- A End mill cutter



- B Face mill cutter
- C Shell end mill cutter
- D Profile cutter

- Question 24** The drawing showing three views of an object at 30 degree is called?
- A Square view
  - B ISO metric view
  - C Orthographic view
  - D Cabinet view

- Question 25** The drawing showing two dimensional view is known as?
- A Square view
  - B ISO metric view
  - C Orthographic view
  - D Cabinet view

- Question 26** In which type of milling operation the cutter rotates against the direction of the feed?
- A Climb milling
  - B Conventional Milling
  - C Cross milling
  - D End milling

- Question 27** In a milling operation the cutter rotates in the direction of the feed is known as?
- A Climb milling
  - B Conventional Milling
  - C Cross milling
  - D End milling

**Question 28** Reamers are used to maintain?

- A Roundness
- B Tolerance
- C Surface finish
- D All of above

**MODULE 5**

**Question 29** The machine process uses abrasives is known as?

- A Grinding
- B Reaming
- C Boring
- D Sinking

- Question 30** Which of the following material is grind with Aluminum Oxide wheel?
- A Coppers
  - B Aluminum
  - C Steel and steel alloys
  - D Cast Iron

- Question 31** In a Grinding wheel classification code "A16R5BS4" Number 16 represents?
- A Wheel size
  - B Grit size
  - C Wheel Thickness
  - D Bond thickness

- Question 32** Prior to use a grinding wheel it must be?
- A Tight
  - B Balanced
  - C Mark date
  - D Mark material

- Question 33** In a surface grinding machine the bed traveling is controlled through?
- A sensors
  - B Programmed tool
  - C Limiting switches
  - D bell

## Multiple Choice Questions Answer scheme

### MODULE 2

- Question 1** Compare to flexible hacksaw blades the rigid blades cut material? **B** More efficient
- Question 2** For a Hacksaw Blade TPI stands for? **A** Teeth Per inch
- Question 3** 14 TPI blade is best option to cut? **D** Thickest material
- Question 4** The Point angle of center punch is? **C** 90°
- Question 5** The Point angle of dot punch is? **B** 60°
- Question 6** The Divider is used to Mark? **A** Arc, circle and radius
- Question 7** V-Blocks are used to clamp? **C** Round bars
- Question 8** :Smooth files are used for? **B** Finishing
- Question 9** The Materials having Iron content are called? **B** Ferrous metal
- Question 10** Copper is a \_\_\_\_\_ metal? **A** Non- ferrous metal
- Question 11** Taps are used to Produce? **C** Internal threads

**MODULE 3**

- Question 12** The simplest and most common Material for a lathe tool is? B High Speed Steel HSS
- Question 13** On a lathe machine the depth of cut and feed is given through? B Carriage
- Question 14** The device on lathe machine carriage used to clamp tool is known as? C Tool post
- Question 15** Dial indicators are mostly used with a-----? B Magnetic stand
- Question 16** The surface of a cutting tool tip over which the removed chips flow is known as? A Rack angle
- Question 17** RPM stands for? A Revolutions Per Minute
- Question 18** The V angle for British threads is? A 55°
- Question 19** The V angle Metric threads is? B 60°
- Question 20** The angle for Square threads is? C 90°

**MODULE 3**

- Question 21** In a Milling machine end mill cutters are usually clamped with? B Collet



- Question 22** In RPM calculation formula D represents? C Dia of cutting tool
- Question 23** the tool shown in the figure is a? B Face mill cutter
- Question 24** The drawing showing three views of an object at 30 degree is called? B ISO metric view
- Question 25** The drawing showing two dimensional view is known as? C Orthographic view
- Question 26** In a milling operation the cutter rotates against the direction of the feed is known as? B Conventional Milling
- Question 27** In a milling operation the cutter rotates in the direction of the feed is known as? A Climb milling
- Question 28** Reamers are used to maintain? D All of above

## MODULE 5

- Question 29** The machine process uses abrasives is known as? A Grinding
- Question 30** Aluminum Oxide wheel are mostly used to grind? C Steel and steel alloys
- Question 31** In a Grinding wheel classification code "A16R5BS4" Number 16 represents? B Grit size
- Question 32** Prior to use a grinding wheel it must be? B Balanced
- Question 33** In a surface grinding machine the bed traveling is controlled through? C Limiting switches

