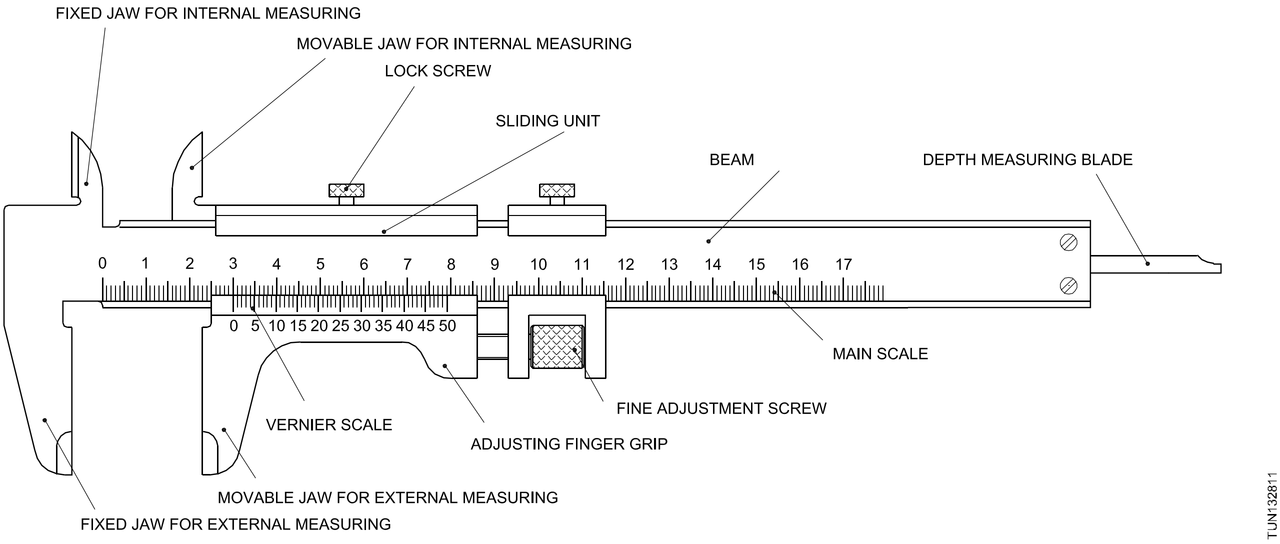
Vernier caliper - Its construction, principle, graduation

Objectives : At the end of this lesson you shall be able to
- **list out the parts of a vernier calliper**
- **state the constructional features of the vernier calliper**
- **state its functional features**
- **read a measurement.**

One of the precision instruments having the principle of vernier applied to it is the vernier caliper. It is known as a vernier caliper because of its application to take outside, inside and depth measurements. Its accuracy is 0.02 mm.

Fig 1



Parts of a vernier caliper

A universal vernier caliper consists of a:

- Beam
- Fixed jaw for external measurements
- Movable jaw for external measurements
- Movable jaw for internal measurements
- Blade for depth measurement
- Main scale
- Vernier scale
- Fine adjustment screw
- Set of locking screws.

All parts are made out nickel-chromium steel or invested heat-treated and ground. They are machined to a high accuracy. They are stabilized to avoid distortion due to temperature variations.

Constructional features

The beam is the main part and the main scale graduations are marked on it. The markings are in millimeters and every tenth line is drawn a little longer and brighter than the other graduations and numbered as 1,2,3 ….

To the left of the beam the fixed jaws for external and internal measurements are fixed as integral parts., The vernier unit slides over the beam.

At the bottom face of the beam a keyway-like groove is machined for its full length, permitting the blade to slide in the groove.

At the bottom right hand end, a unit is fixed serving as a support for the blade when it slides in the groove.

The vernier unit has got the vernier graduations marked on it. The movable jaws for both external and internal measurements are integral with this.

The fixed and movable jaws are knife-edged to have better accuracy during measurement. When the fixed and movable jaws are made to contact each other, the zero of the vernier scale coincides with the zero of the main scale.

At this position in the blade will be in line with the right hand edge of the beam.

When the vernier scale unit slides over the beam, the movable jaws of both the measurements as well as the blade advance to make the reading.

To slide the vernier unit, the thumb lever is pressed and pulled or pushed according to the direction of movement of the vernier unit.

Sizes

Vernier calipers are available in sizes of 150 mm, 200 mm, 900 mm and 1200 mm. The selection of the size depends on the measurements to be taken. Vernier calipers are precision instruments, and extreme care should be taken while handling them.

Never use a vernier caliper for any purpose other than measuring.

Vernier calipers should be used only to measure machined or filed surfaces.

They should never be mixed with any other tools.

Clean the instrument after use, and store it in a box.

Graduations and reading of vernier calipers

Objectives: At the end of this lesson you shall be able to
- **determine the least count of vernier calipers**
- **state how graduations are made on vernier calipers with 0.02mm least count**
- **read vernier caliper measurements.**

Vernier calipers

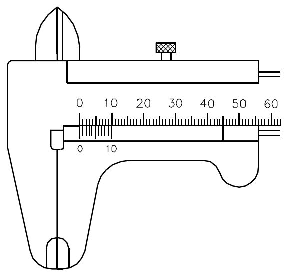
Vernier calipers are available with different accuracies. The selection of the vernier caliper depends on the accuracy needed and the size of the job to be measured.

This accuracy/least count is determined by the graduations of the main scale and vernier scale divisions.

Determining least count of vernier calipers

In the vernier caliper shown in Fig 1, the main scale divisions (9mm) are divided into 10 equal parts in the vernier scale.

Fig 1



i.e.	One main scale division (MSD)	=	1 mm
	One vernier scale division? (VSD)	=	9/10 mm
	Least count is 1 mm - 9/10 mm	=	1/10 mm
	The difference between one MSD and one VSD	=	0.1 mm

Example

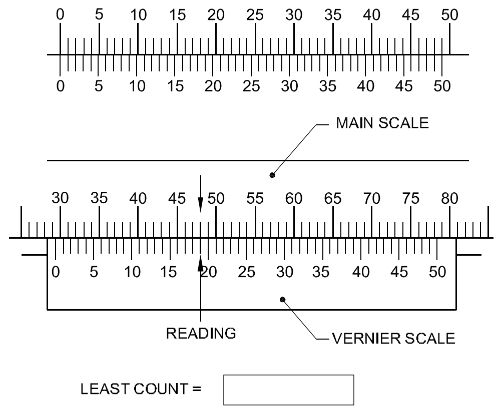
Calculate the least count of the vernier given in Fig 2.

Reading vernier measurements

Vernier calipers are available with different graduations and least counts. For reading measurements with a vernier caliper the least count should be determined first. (The least count of calipers is sometimes marked on the vernier slide).

The figure above shows the graduations of a common type of vernier caliper with a least count of 0.02 mm. In this, 50 divisions of the vernier scale occupy 49 divisions (49 mm) on the main scale.

Fig 2



i.e One main scale division (MSD) = 1mm

One Vernier scale division? (VSD) = 49/50 mm

Least count = 1 MSD - 1 VSD

= 1mm - 49/50

= 50 - 49/50 = 1/50 = 0.02 mm

Example for vernier caliper (Fig 3)

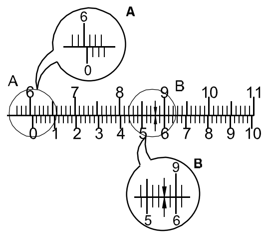
Main scale reading 60 mm.

The vernier division coinciding with the main scale is the 28th division. Value = 28 x 0.02

= 0.56 mm

Reading = 60+0.56 = 60.56mm

Fig 3



Classroom Exercise

In figures 3, 4, 5, 6 and 7, 49 main scale divisions are divided into 50 equal parts on the vernier scale. Value of-one M.S.D. is 1 mm.

Fig 4

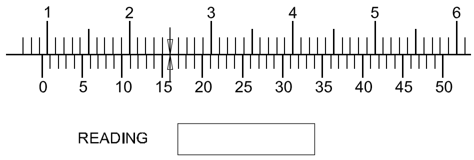


Fig 5

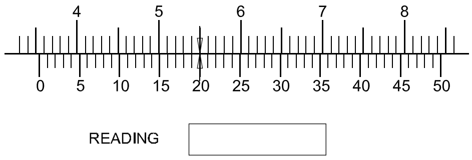


Fig 6

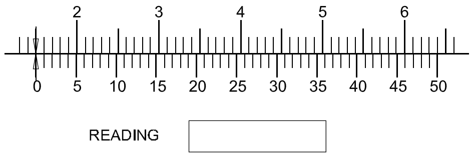
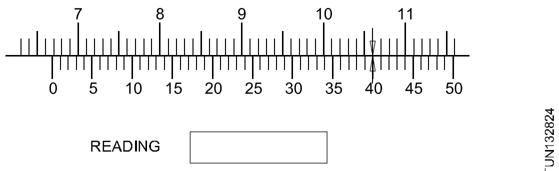


Fig 7



1 Calculate the least count.

2 Record the reading of each, figure in the space pro-vided.

Disadvantages

Accuracy of reading depends on the skill of the operator.

Loses its accuracy by constant usage as slackness in the sliding unit develops.

Cannot be used to measure components having devia-tions less than ± 0.02 mm.

Possibility of parallax error during noting down the coinciding line may cause the reading of the measurement to be wrong.

To read a measurement

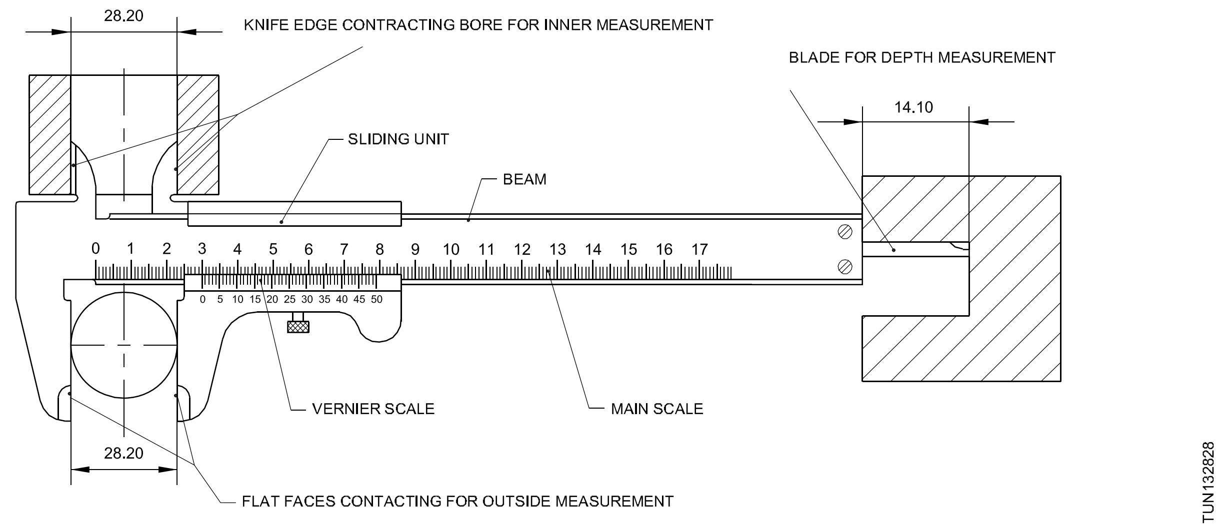
Note the number of graduations on the main scale passed by the zero of the vernier. This gives the full mm.

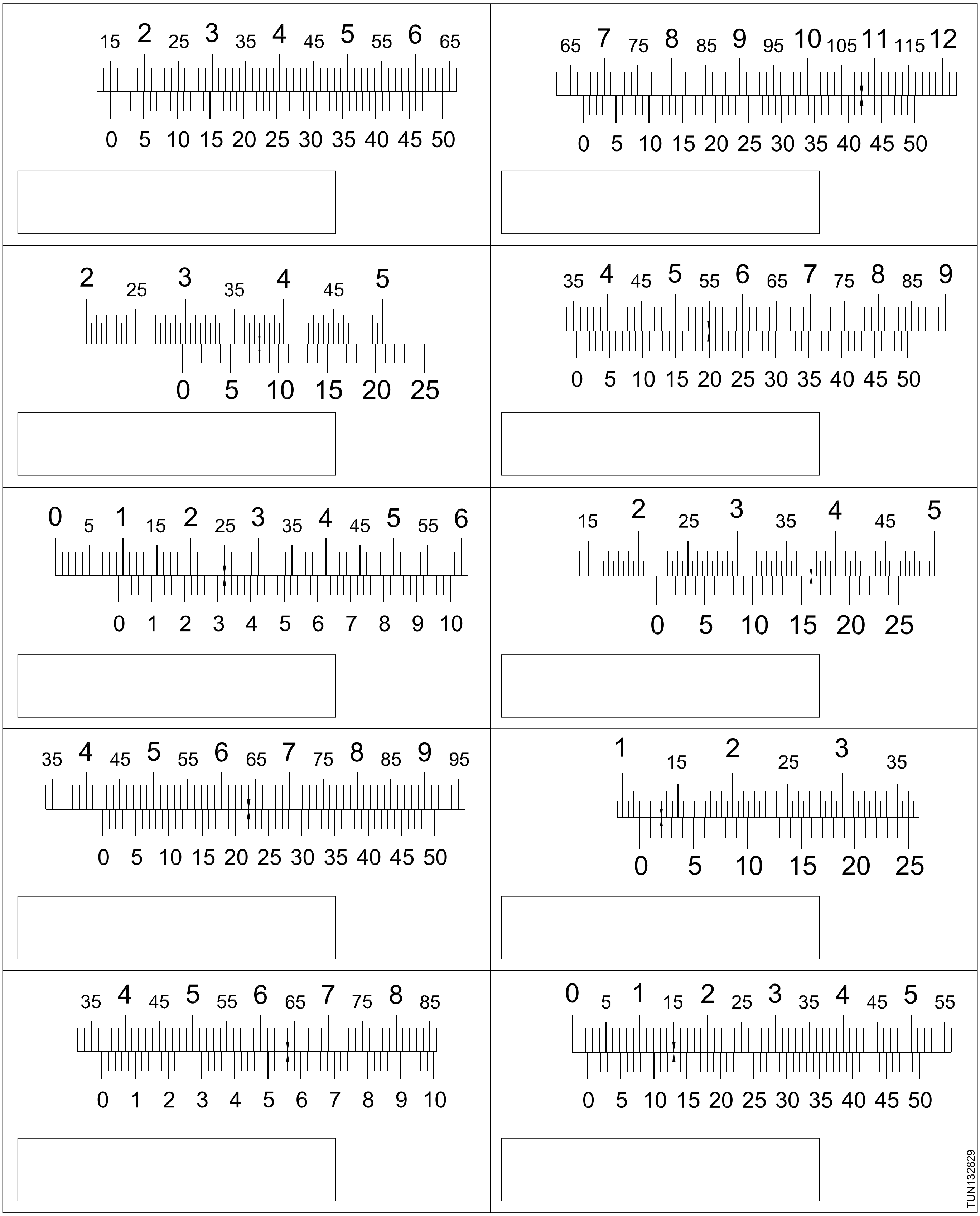
Note which of the vernier scale division coincides with any one line on the main scale.

Multiply this number with the least count.

Add the multiplied value to the main scale reading.

Fig 8




15 2 25 3 35 4 45 5 55 6 65
0 5 10 15 20 25 30 35 40 45 50
65 7 75 8 85 9 95 10 105 11 115 12
0 5 10 15 20 25 30 35 40 45 50
2 25 3 35 4 45 5
0 5 10 15 20 25
35 4 45 5 55 6 65 7 75 8 85 9
0 5 10 15 20 25 30 35 40 45 50
0 5 1 15 2 25 3 35 4 45 5 55 6
0 1 2 3 4 5 6 7 8 9 10
15 2 25 3 35 4 45 5
0 5 10 15 20 25
35 4 45 5 55 6 65 7 75 8 85 9 95
0 5 10 15 20 25 30 35 40 45 50
1 15 2 25 3 35
0 5 10 15 20 25
35 4 45 5 55 6 65 7 75 8 85
0 1 2 3 4 5 6 7 8 9 10
0 5 1 15 2 25 3 35 4 45 5 55
0 5 10 15 20 25 30 35 40 45 50
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Digital vernier caliper

Objectives: At the end of this lesson you shall be able to
- **state the uses of digital caliper**
- **name the parts of a digital caliper**
- **brief the zero setting of a digital caliper.**

The digital caliper (sometime incorrectly called the digital vernier caliper) is a precision instrument than can be used to measure internal and external distance accurately to 0.01mm, The digital vernier caliper is shown in Fig 1. The distance or the measurements are read from LED drawing. The parts of digital calipers are similar to the ordinary vernier caliper except the digital display and few other parts. The parts are indicated in Fig 1.

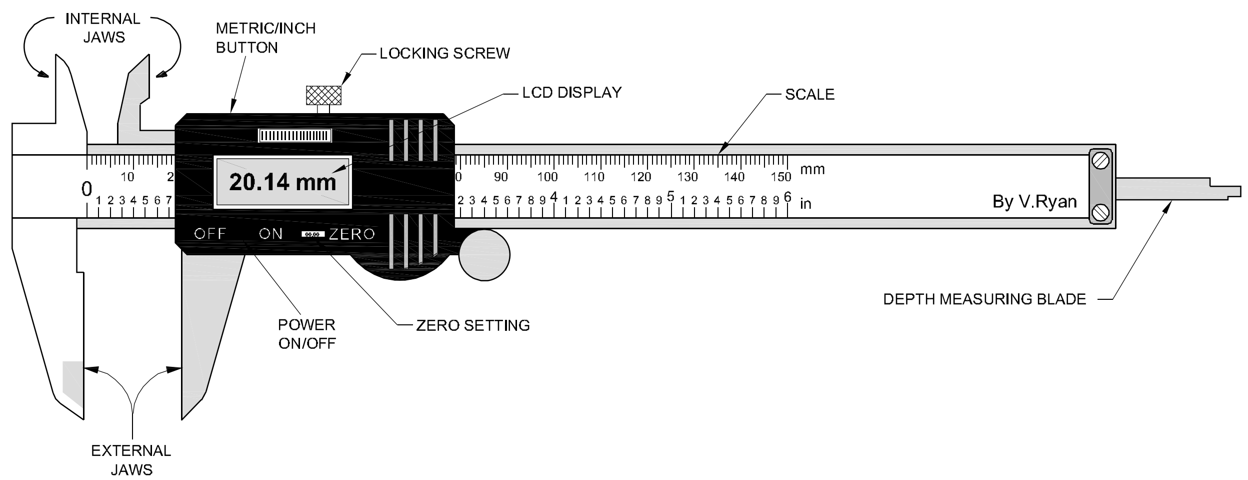
Earlier versions of the type of measuring instrument had to read by looking carefully at the inch or metric scale and there was a need for very good eye sight in order to read the small sliding scale. Manually operated vernier caliper are remain popular because they are much cheaper than the digital version.

The digital caliper requires a small battery whereas the manual version does not need any power source.The digital calipers are easier to use as the measurement is clearly display and also, by pressing inch/mm button the distance can be read as metric or inch.

The display is turned on with the ON/OFF button. before measuring, the zero setting to be done, by bringing the external jaws together until they touch each other and then press the zero button. Now the digital caliper is ready to use.

Always set zero position when turning on the display for the first time.

Fig 1



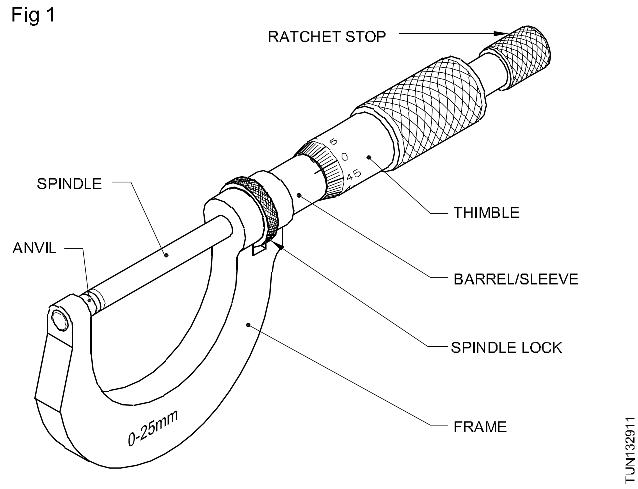
Outside Micrometers, parts, principle and digital Micrometer

Objectives : At the end of this lesson you shall be able to
- **list the parts of an outside micrometer**
- **state the functions of the main parts of an outside micrometer.**

A micrometer is a precision instrument used to measure a job, generally within an accuracy of 0.01 mm.

Micrometers used to take the outside measurements are known as outside micrometers. (Fig 1)

Fig 1



The parts of a micrometer are listed here.

Frame

The frame is made of drop-forged steel or malleable cast iron. All other parts of the micrometer are attached to this.

Barrel/Sleeve

The barrel or sleeve is fixed to the frame. The datum line and graduations are marked on this.

Thimble

On the bevelled surface of the thimble also, the graduation is marked. The spindle is attached to this.

Spindle

One end of the spindle is the measuring face. The other end is threaded and passes through a nut. The threaded mechanism allows for the forward and backward movement of the spindle.

Anvil

The anvil is one of the measuring faces which is fitted on the micrometer frame. It is made of alloy steel and finished to a perfectly flat surface.

Spindle lock nut

The spindle lock nut is used to lock the spindle at a desired position.

Ratchet stop

The ratchet stop ensures a uniform pressure between the measuring surfaces.

Graduations of metric outside micrometer

Objectives : At the end of this lesson you shall be able to
- **state the principle of a micrometer**
- **determine the least count of an outside micrometer.**

Working principle

The micrometer works on the principle of screw and nut. The longitudinal movement of the spindle during one rotation is equal to the pitch of the screw. The movement of the spindle to the distance of the pitch or its fractions can be accurately measured on the barrel and thimble.

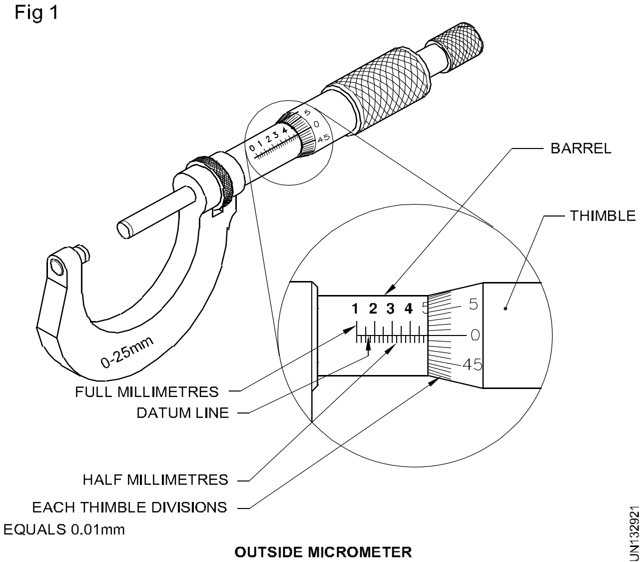
Graduations (Fig 1)

In metric micrometers the pitch of the spindle thread is 0.5 mm.

Thereby, in one rotation of the thimble, the spindle advances by 0.5 mm.

On the barrel a 25 mm long datum line is marked. This line is further graduated to millimetres and half millimetres (i.e. 1 mm & 0.5 mm). The graduations are numbered as 0, 5, 10, 15, 20 & 25 mm.

Fig 1



OUTSIDE MICROMETER

The circumference of the bevel edge of the thimble is graduated into 50 divisions and marked 0-5-10-15 .... 45-50 in a clockwise direction.

The distance moved by the spindle during one rotation of the thimble is 0.5 mm.

Movement of one division of the thimble = 0.5 x 1/50

= 0.01 mm

Accuracy or least count of a metric outside micrometer is 0.01mm.

Reading dimensions with an outside micrometers

Objectives: At the end of this lesson you shall be able to
- **select the required range of a micrometer**
- **read micrometer measurements.**

Ranges of outside micrometer

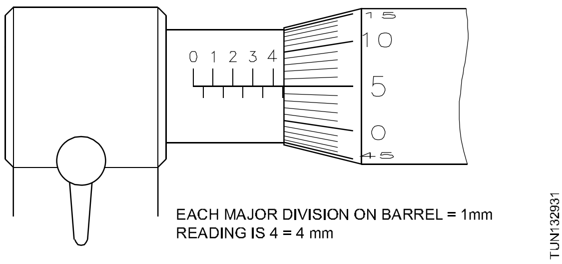
Outside micrometers are available in ranges of 0 to 25 mm, 25 to 50 mm, 50 to 75 mm, 75 to 100 mm, 100 to 125 mm and 125 to 150 mm.

For all ranges of micrometers, the graduations marked on the barrel is only 0-25 mm. (Fig 1)

Method of reading

Read on the barrel scale the number of whole millimeters that are completely visible from the bevel edge of the thimble. It reads 4 mm. (Fig 1)

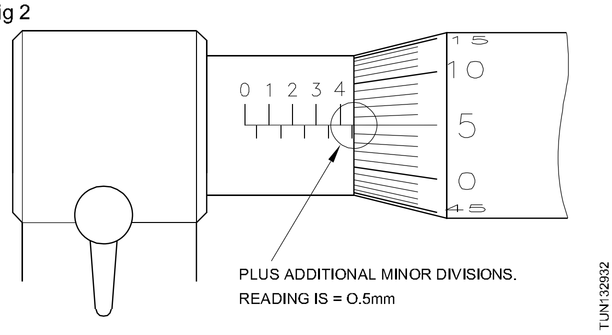
Fig 1



Add to this any half millimeters that are completely visible from the bevel edge of the thimble.

The figure reads 1/2 = 0.5 mm.(Fig 2)

Fig 2



Add the thimble reading to the two earlier readings.

The figure shows the 5th division of the thimble is coinciding with the index line of the sleeve. Therefore the reading of the thimble is 5x0.01 mm = 0.05 mm. (Fig 3)

The total reading of the micrometer.

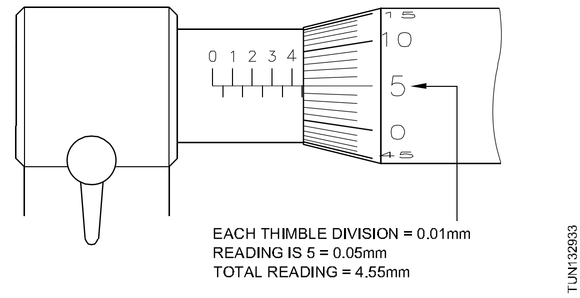
a 4.00 mm

b 0.50 mm

c 0.05 mm

Total reading 4.55 mm (Fig 3)

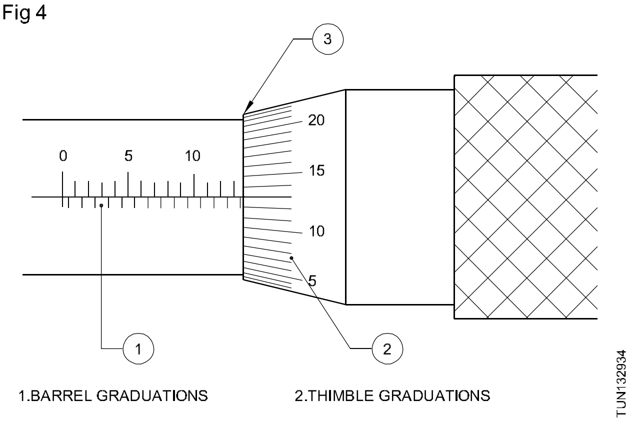
Fig 3



Reading micrometer measurements

How to read a measurement with an outside micrometer? (Fig 4)

Fig 4



First note the minimum range of the outside micrometer. While measuring with a 50 to 75 mm micrometer, note it as 50 mm.

Then read the barrel graduations. Read the value of the visible lines on the left of the thimble edge.

13.00 mm

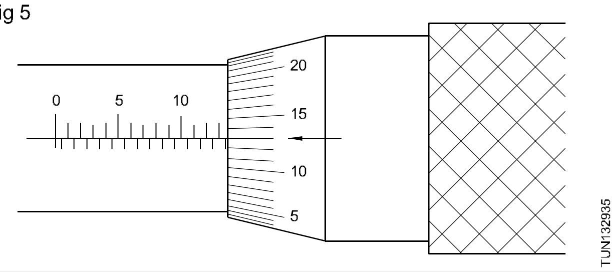
+ 00.50 mm

13.50 mm

Next read the thimble graduations.

Read the thimble graduations in line with the barrel datum line, 13th div. (Fig 5)

Fig 5



Multiply this value with 0.01 mm (least count).

13 x 0.01 mm = 0.13 mm.

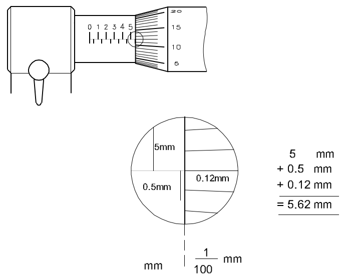
Add

Minimum range	50.00 mm
Barrel reading	13.50 mm
Thimble reading	00.13 mm
Total	63.63 mm

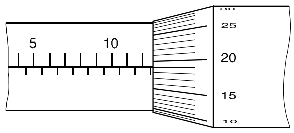
The micrometer reading is 63.63 mm.

Some examples of metric micrometer readings and their solution

i 5.00 mm
0.50 mm
0.12 mm
Total 5.62 mm

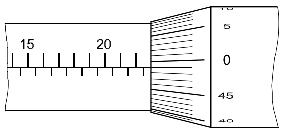


iii 12.00 mm
0.50 mm
0.19 mm
Total 12.69 mm



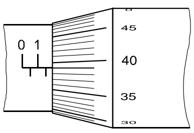
12.69mm

iiii 23.00 mm
0.50 mm
0.49 mm
Total 23.99 mm



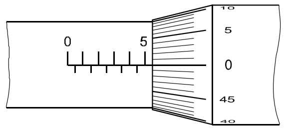
23.99mm

iv 1.00 mm
0.50 mm
0.39 mm
Total 1.89 mm



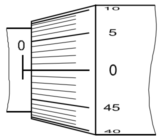
1.89mm

v 5.00
0.50 mm
0.00 mm
Total 5.50 mm



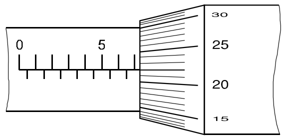
5.50 mm

vi 0.00 mm
0.50 mm
0.00 mm
Total 0.50 mm



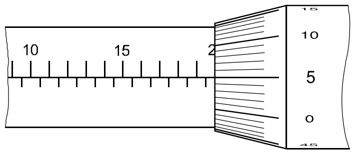
0.50 mm

vii 7.00 mm
0.00 mm
0.22 mm
Total 7.22 mm



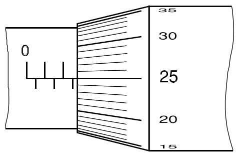
7.22 mm

viii 19.00 mm
0.50 mm
0.05 mm
Total 19.55 mm



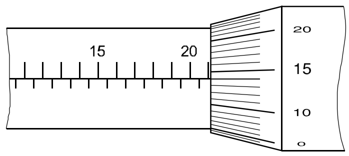
19.55 mm

ix 2.00 mm
0.50 mm
0.25 mm
Total 2.75 mm



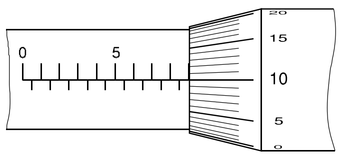
2.75 mm

x 21.00 mm
0.00 mm
0.14 mm
Total 21.14 mm



21.14 mm

xi 9.00 mm
0.00 mm
0.10 mm
Total 9.10 mm



9.10 mm

Error in micrometer

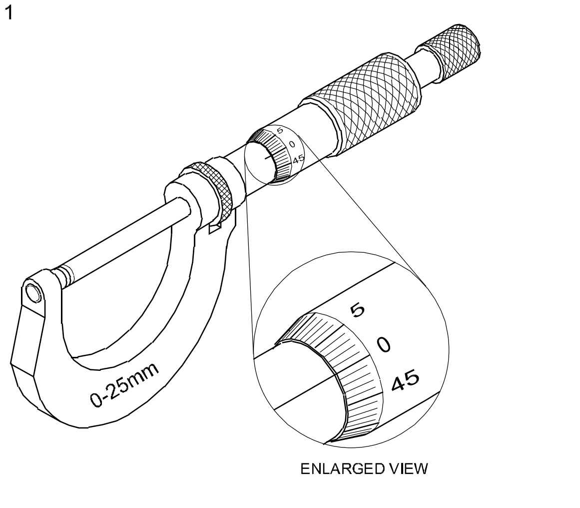
Objective: This shall help you to

- **check outside micrometer for '0' error.**

No zero error

When the measuring faces are in contact if the zero of the thimble should be coincide with the datum line No zero error (Fig 1).

Fig 1



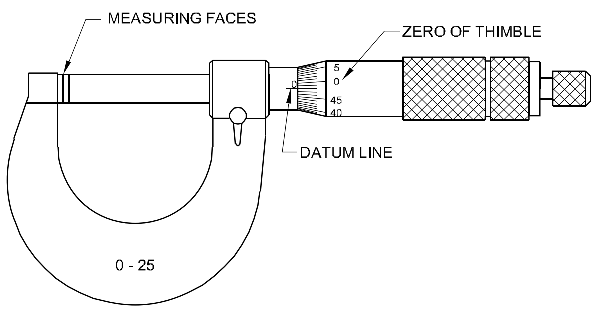
Zero error

When the measuring faces are in contact, (Fig 2) if the zero of the thimble do not coincide with the datum line (the zero of the thimble will be above or below the datum line) the micrometer is said to be with zero error. There are two types of zero error.

a) Positive error

b) Negative error

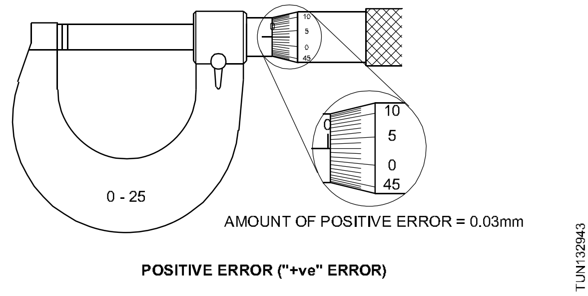
Fig 2



> **All micrometers should be checked for its zero error and the error should be noted if any before using it on checking dimensions.**
>
> **Clean measuring faces with clean cloth before checking for zero error.**

Positive error: When the anvil and spindle faces are in contact in case of a 0-25 mm micrometer or 0-1 micrometer and with a test piece inbetween the measuring faces in case of a higher range micrometer. If the zero of the thimble rest below the datum line of the sleeve the error is called as "Positive". (Fig 3)

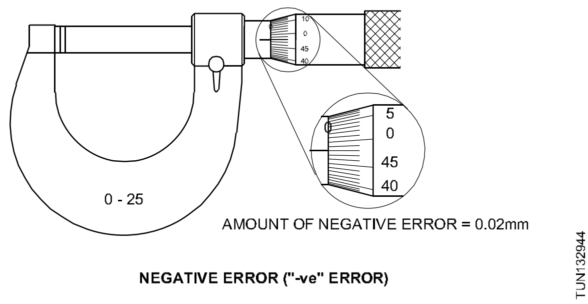
Fig 3



To get the correct reading the amount of error should be substracted from the reading dimension.

Negative error: When the anvil and spindle faces are in contact, if the zero of the thimble passes above the datum line of the sleeve, the error is called as "Negative". (Fig 4)

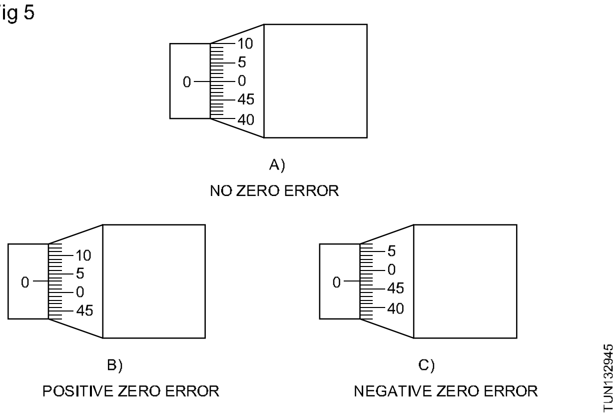
Fig 4



To get the correct reading the amount of negative error should be added to the reading dimension.

> **Caution: When you come across with micrometer having "zero error", inform your instructor and get it corrected by him. Do not try yourself to correct at this stage.**

Fig 5



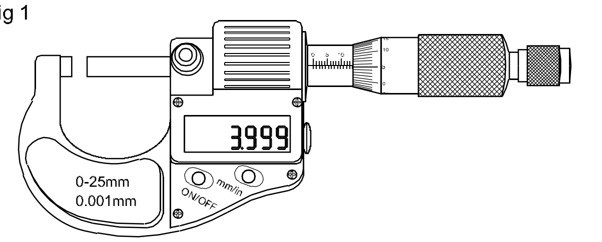
Digital micrometers

Objectives: At the end of this lesson you shall be able to
- **state the uses of digital micrometer**
- **list the parts of digital micrometer**
- **read the reading from LED display and thimble and barrel**
- **brief the maintenance, maintenance of digital micrometers.**

Digital micrometers is one of the simplest and most widely used measuring equipment in any manufacturing industry. Its simplicity and the versatile nature make Digital micrometers so popular. Different kinds of Digital micrometers available in the market.

Feature of digital micrometers (Fig 1)

Fig 1



FEATURE OF DIGITAL MICROMETERS

- LCD displays measuring data and makes direct read out with resolution of 0.001mm.
- Origin setting mm/inch conversion, swith for absolute and incremental measurement.
- Carbide tipped measuring faces.
- Ratchet ensures invariable measurement and accurate repeatable reading

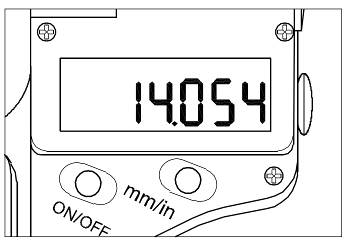
Accuracy of digital micrometers

Digital micrometers provide 10 times more precision and accuracy : 0.00005 inches or 0.001mm resolution, with 0.0001 inches or 0.001mm accuracy.

Reading of the digital micrometer

The digital micrometers are provided with high precision reading with LCD display. The reading is 14.054 mm as shown in Fig 2.

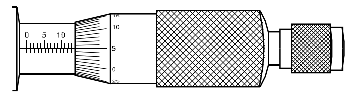
Fig 2



READING OF THE DIGITAL MICROMETERS

Reading also by reading the marks on the sleeve and the thimble. Usually, the reading from the large LCD display for the digital micrometer because the digital reading is more accurate. The reading on the sleeve and the thimble is just for reference. Read the markings on the sleeve and the thimble, firstly, read the point which the thimble stops at it on the right of the sleeve (It is 14mm here, because each line above the centre long line represents 1mm while each line below the centre long line represent 0.5mm) (Fig 3)

Fig 3



Secondly, read the markings on the thimble, It is between 5 and 6, So you need to estimate the reading. (It is 0.055mm for each line here represents 0.001mm). At last, add all the reading up : 14mm + 0.055 mm = 14.055mm. So the total reading is 14.055mm.

Maintenance of a digital micrometers

Never apply voltage (e.g. engraving with an electric pen) on any part of the Digital Micrometers for fear of damaging the circuit.

Press the ON/OFF button to shut the power when the Digital micrometers stands idle; take out the battery if it stands idle for a long time.

As for the battery, abnormal display (digit flashing or even no display) shows a flat battery. Thus you should push the battery cover as the arrow directing and then replace with a new one. Please note that the positive side must face out If the battery bought from market dosen't work well (the power may wear down because of the long-term storage or the battery's automatic discharge and etc.) Please do not hesitate to contact the supplier.

Flashing display shows dead battery. If this is the case please replace the battery at once. No displace shows poor contact of a battery or short circuit of both poles of the battery. Please check and adjust pole flakes and battery insulator cover. In case water enters the battery cover, open the cover immediately and blow the inside of the battery cover at a temperature of no more than 40^{0}C till it gets dry.

Cutting speed and feed & depth of cut, recommended speed

Objectives : At the end of this lesson you shall be able to
- **distinguish between cutting speed and feed**
- **read and select the recommended cutting speed for different materials from the chart**
- **point out the factors governing the cutting speed**
- **state the factors governing feed.**

Cutting speed (Fig 1)

The speed at which the cutting edge passes over the material, which is expressed in metres per minute is called the cutting speed. When a work of a diameter 'D' is turned in one revolution the length of portion of the work in contact with the tool is π x D. When the work is making 'n' rev/min, the length of the work in contact with the tool is π x D x n. This is converted into metres and is expressed in a formula form as

$$V = \frac{\pi DN}{1000}$$

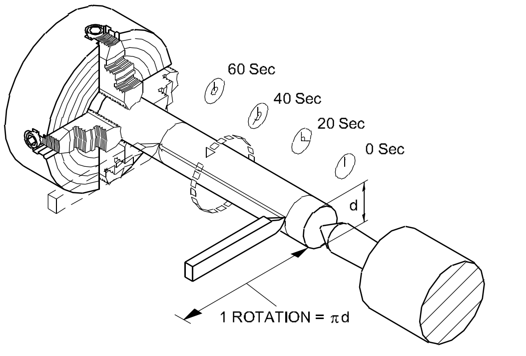
Where V = cutting speed in metre/min

π = 3.14

D = diameter of the work in mm.

N = r.p.m.

Fig 1



CUTTING SPEED FOR TURNING OPERATION

When more material is to be removed in lesser time, a higher cutting speed is needed. This makes the spindle to run faster but the life of the tool will be reduced due to more heat being developed. Recommended cutting speeds are given in a chart form which provides normal tool life under normal working conditions. As far as possible the recommended cutting speeds are to be chosen and the spindle speed calculated before performing the operation. (Fig 2)

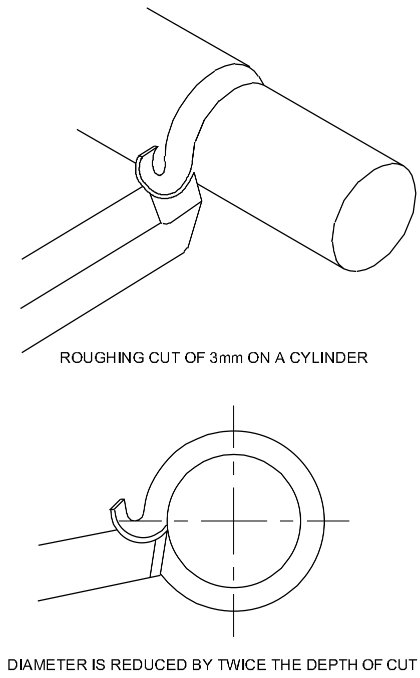
Example

Find out the rpm of the spindle for a 50 mm bar to cut at 25 m/min.

$$V = \frac{\pi DN}{1000} \qquad N = \frac{1000V}{\pi D}$$

$$\frac{1000 \times 25}{3.14 \times 50} = \frac{500}{3.14} = 159 \text{ r.p.m}$$

Fig 2



DEPTH OF CUT

Factors governing the cutting speed

Finish required

Depth of cut

Tool geometry

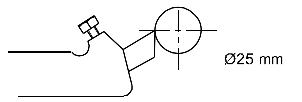
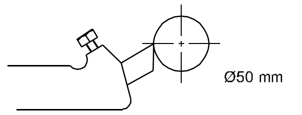
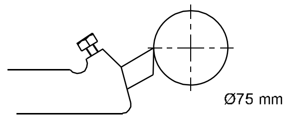
Properties and rigidity of the cutting tool and its mounting

Properties of the workpiece material

Rigidity of the workpiece

Type of cutting fluid used & Rigidity of machine tool

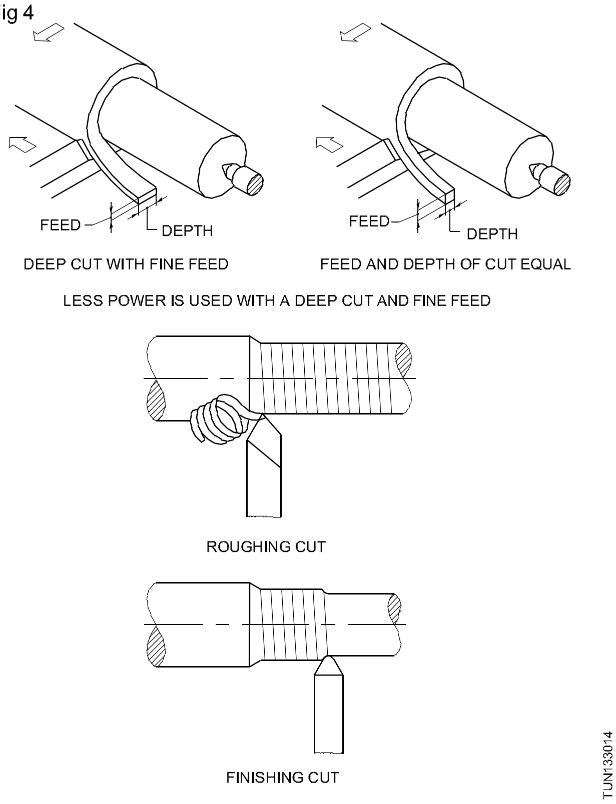
Relationship of r.p.m to the cutting speed on different diameter

Cutting speed 120m/min	Length of metal passing cutting tool in one revolution	Calculated r.p.m of spindle
	.... 78.5 mm	1528
	.... 157.0 mm	764
	.... 235.5 mm	509.5

Feed (Fig 3)

The feed of the tool is the distance it moves along the work for each revolution of the work, and it is expressed in mm/rev.

Fig 4



Factors governing feed

Tool geometry

Surface finish required on the work

Rigidity of the tool

Coolant used.

Depth of cut (Fig 3)

It is defined as the perpendicular distance measured between the machined surface (d) and the unmachined surface (D) expressed in mm.

$$\text{Depth of cut} = \frac{D - d}{2}$$

Rate of metal removal

The volume of metal removal is the volume of chip that is removed from the work in one minute, and is found by multiplying the cutting speed, feed rate and the depth of cut.

The recommended cutting speed and feed for different metals are given in the table. It can be observed that soft materials has a very high cutting speed and hard metal has a lesser cutting speed. The feed for hard material is generallt very low compare to the feed given for soft materail.

Cutting speeds and feeds for H.S.S. tools are given in Table 1

Table 1

Material being turned	Feed	Cutting speed
Aluminium	0.2 - 1.00	70 - 100
Brass (alpha) - ductile	0.2 - 1.00	50 - 80
Brass (free cutting)	0.2 - 1.5	70 - 100
Bronze (phosphor)	0.2 - 1.00	35 - 70
Cast iron (grey)	0.15 - 0.7	25 - 40
Copper	0.2 - 1.00	35 - 70
Steel (mild)	0.2 - 1.00	35 - 50
Steel (medium-carbon)	0.15 - 0.7	30 - 35
Steel (alloy high tensile)	0.08 - 0.3	5 - 10
Thermosetting plastics	0.2 - 1.00	35 - 50

Note

For super HSS tools the feeds would remain the same, but cutting speeds could be increased by 15% to 20%

A lower speed range is suitable for heavy, rough cuts.

A higher speed range is suitable for light, finishing cuts.

The feed is selected to suit the finish required and the rate of metal removal.

When carbide tools are used, 3 to 4 times higher cutting speed than that of the H.S.S. tools may be chosen.

Calculation involving cutting speed, feeds

Objectives : At the end of this lesson you shall be able to
- **determine the spindle speed for turning jobs of different materials of different diameters with different tool materials**
- **determine the turning time with the given data.**

The selection of the spindle speed is one of the factors which decides the efficiency of cutting. It depends on the size of the job, material of the job and material of the cutting tool. The formula to determine cutting speed is.

$$= \frac{\pi \times D \times N}{1000} \text{ metre/min. where D is in mm.}$$

$$N = \frac{CS \times 1000}{\pi \times D}$$

To determine the spindle speed (N)

Example 1

Calculate the spindle speed to turn a MS rod of ø40 mm. Using HSS tool data in the above problem, since the material is mild steel and tool is HSS, the recommended cutting speed from the chart is 30m/min.

ø = 40 mm

$$N = \frac{CS \times 1000}{\pi \times D}$$

$$= \frac{30 \times 1000}{\frac{22}{7} \times 40}$$

$$= \frac{30 \times 1000 \times 7}{22 \times 40}$$

$$= \frac{30 \times 25 \times 7}{22}$$

= 238.6 r.p.m.

The spindle speed should be set nearest to the calculated r.p.m., on the lower side.

Example 2

Determine the spindle speed to be set for a hard cast iron round rod of ø 40 mm using a HSS tool.

Data: The cutting speed for hard cast iron from the chart is 15 m/min.

ø = 40 mm

$$N = \frac{CS \times 1000}{\pi \times D}$$

$$= \frac{15 \times 1000}{\frac{22}{7} \times 40}$$

$$= \frac{15 \times 1000 \times 7}{22 \times 40}$$

$$= \frac{15 \times 25 \times 7}{22}$$

= 119.3 r.p.m.

The spindle speed should be set nearest to the calculated r.p.m., on the lower side.

Example 3

Calculate the spindle speed to turn a ø40 mm MS rod using a cemented carbide tool.

Data: The cutting speed recommended for-turning mild steel using a carbide tool is 92 mtr/minute.

ø of job = 40 mm

$$N = \frac{CS \times 1000}{\pi \times D}$$

$$= \frac{92 \times 1000}{\frac{22}{7} \times 40}$$

$$= \frac{92 \times 1000 \times 7}{22 \times 40}$$

$$= \frac{92 \times 25 \times 7}{22}$$

= 731.8 r.p.m.

The spindle speed should be set to the nearest calculate r.p.m.

Turning time calculation

The time factor is very important to decide the manufac turing of the component as well as to fix the incentives to the operator. If the spindle speed, feed and length of the cut are known, the time can be determined for a given

cut.If the feed is 'f' and length of cut is 'l', then the total number if revolutions the job has to make for a cut is l/f. If N is the rpm, the time required for a cut is found by

$$\text{Time to turn} = \frac{\text{Length of cut} \times \text{No.of cuts}}{\text{Feed} \times \text{r.p.m}}$$

$$T = \frac{l \times n}{f \times N}$$

where 'n' is the number of cuts and 'N' is the r.p.m.

Example 1

A mild steel of ø 40 mm and 100 mm length has to be turned to ø 30 mm in one cut for full length using a HSS tool with a feed rate of 0.2 mm/rev. Determine the turning time.

$$\text{Turning time} = \frac{l \times n}{f \times N}$$

The r.p.m. for the above is calculatedHand found out as 238.6 r.p.m.

l = 100mm

f = 0.2 mm

n = 1

N = 238.6 r.p.m.

$$\text{Time} = \frac{100 \times 1}{0.2 \times 238.6}$$

$$= \frac{100 \times 10}{2 \times 238.6}$$

$$= \frac{500}{238.6}$$

= 2.09 minutes

2 minute 5.4 seconds.