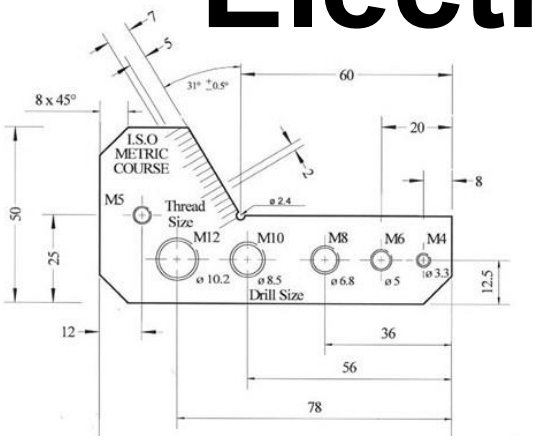
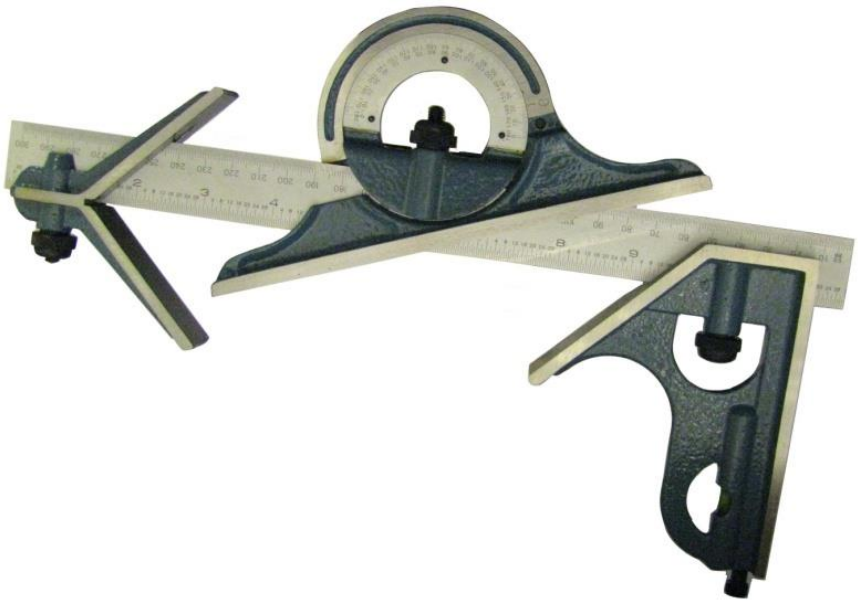
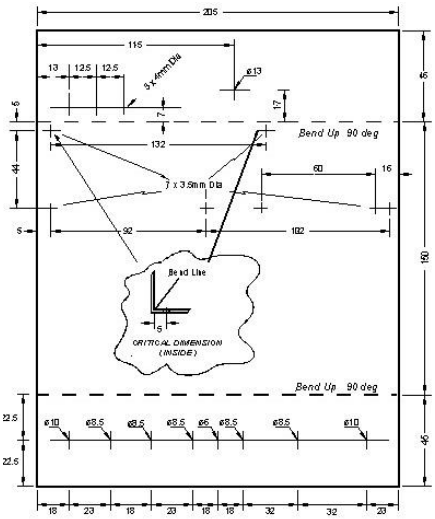
Electrotechnology Workshop Practices





Electrician UEE



Student: _____

Group/Class: _____

Lecturer: _____

The workbook contains activities that address aspects of the following Units of Competence.

WA Subject Index Number (SIN)		Title
		Fabricate, assemble and dismantle utilities industry components

NOTE:

To successfully complete this unit of competency, students will need to successfully complete the practical and theory exercises as directed by the lecturer.

Mechanical Drawings

Mechanical drawing interpretation and sketching encompassing:

- drawing standards and conventions used in drawings of mechanical components as specified in AS1100
- basic abbreviations and symbols used in drawing of mechanical components
- interpretation of mechanical drawings commonly used in the electrotechnology industry (orthogonal projection, third angle - detail and assembly drawings, pictorial views)
- laying out a drawing of mechanical components using engineering drawing convention.
- freehand drawings of mechanical components showing all information needed for its manufacture/fabrication

CONTENTS

1. GENERAL WORKSHOP SAFETY RULES

1. Keep workshop neat and tidy at all times.

2. Safety glasses must be worn at all times.

3. Safety work boots must be worn at all times.

4. Keep floor clean and clear of material scraps and litter

5. Do not remove safety guards from any tools or equipment.

6. Use tools and machines only for their intended purpose.

7. At all times seek instruction before using an unfamiliar piece of equipment.

8. Do not distract attention of another person when he/she is operating equipment.

9. Tie back long hair, avoid loose fitting clothes.

10. Remove rings and other jewellery that can be caught in moving parts.

11. Turn machine off if it produces an unfamiliar vibration or noise.

12. Report all hazards, unsafe conditions and work practices to your supervisor.

2. PERSONAL SAFETY RULES

1 Do not indulge in horseplay or practical jokes in any work area.

2 Do not carry sharp edged or pointed tools in your pockets.

3 Pay attention to what you are doing and have patience as you work.

4 Wear gloves and goggles and hearing protection as required.

5 Do not wear rings or jewellery when working with mechanical or electrical equipment.

6 When working with rotating machinery, secure loose clothing and tie up long hair.

WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORKBOOTS AT ALL TIMES.

ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY

3. HAND TOOL SAFETY RULES

1. Keep tools clean and in proper working order.

2. Do not use pliers, wrenches and screwdrivers as a hammer.

3. Do not use long nose pliers as a wrench.

4. Wear safety glasses or goggles where there is the possibility of flying debris.

5. Always put a handle on a file before use.

6. Be especially careful when using cutting blades; keep other hand and body parts clear of cutting blade.

7. Be sure that hammer heads and screwdriver blades are fastened tightly on their handles.

8. Extreme care must be taken when using a soldering iron or gun, they can burn and cause fires.

9. Where possible, pull on a wrench do not push it.

10. Reduce hand pressure on hacksaw before cut is complete.

11. Take care in using pliers, diagonal cutters as they can pinch and cut hand.

12. Place work piece on a table or in a bench vice when using most hand tolls as a slip of the tool in use can cause injury.

4. POWER TOOL SAFETY RULES

1. Keep all power tools clean and in proper working order

2. Make sure that power cords are not cracked or frayed.

3. Do not remove safety guards under any circumstances.

4. Do not use power tools with wet hands and or feet.

5. Always wear safety glasses or goggles when using power tools.

6. When drilling, fasten work piece securely.

7. When drilling use a sharp drill bit, let the bit do the work do not force.

8. Turn off all power tools when you have finished working with them.

WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORKBOOTS AT ALL TIMES.

ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY

5. WORKSHOP PROCEDURES

It is mandatory within the confines of this workshop area that all personnel comply with the following procedures

1. Refrain from conduct unbecoming such as horseplay, running, throwing, singing, shouting, the use of abusive and foul language, displays of temper and belligerence.
2. Be punctual and make themselves available for class activities at the designated start time.
3. Eye protection must be worn at all times.
4. Enclosed type safety footwear (steel cap boots) must be worn at all times.
5. Hearing protection (earplugs/earmuffs) must be worn when operating power tools.
6. Wear suitable protective clothing such as shirt, long trousers, jeans or overalls whilst in the workshop. Loose fitting clothes, robes, shorts are not considered suitable attire.
7. Wear hand protecting gloves when handling bulk quantities of metal stock.
8. All cuts, abrasions or such like injuries sustained in the workshop must be reported to the instructor.
9. Confine long or shoulder length hair with either a cap or hair net, otherwise have it tied back neatly and secured behind the head.
10. At the end of the class all tools and equipment shall be packed away, all scrap metal off cuts and swarf on benches and machines shall be cleared away and deposited in bins provided.
11. Work place is to be swept and cleaned down to the approval of the instructor

WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORK BOOTS AT ALL TIMES.

ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY

6. EXERCISE - WHS

The following exercise covers some of the WHS principles and practices that you should be aware of while in the workshop.

WHS exercise (on following pages) completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

SPOT THE HAZARD(S) AT THE WORKBENCH

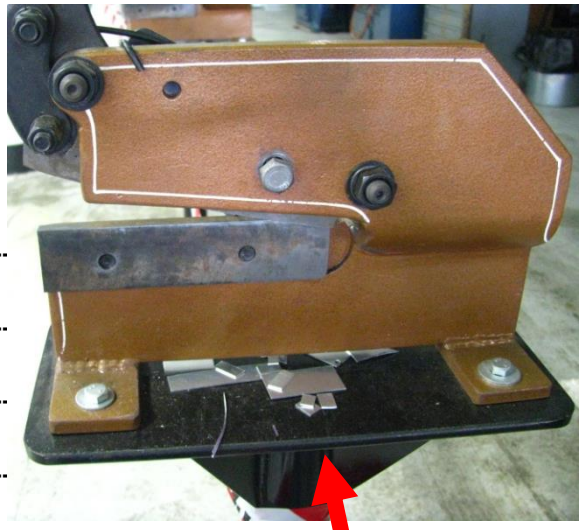
List the hazard(s)

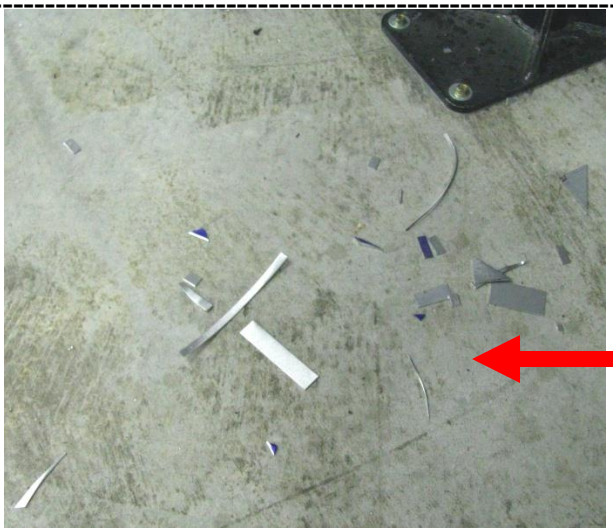
What is the remedy?

AT THE HAND LEVER SHEARS

What is the hazard?

What is the remedy?

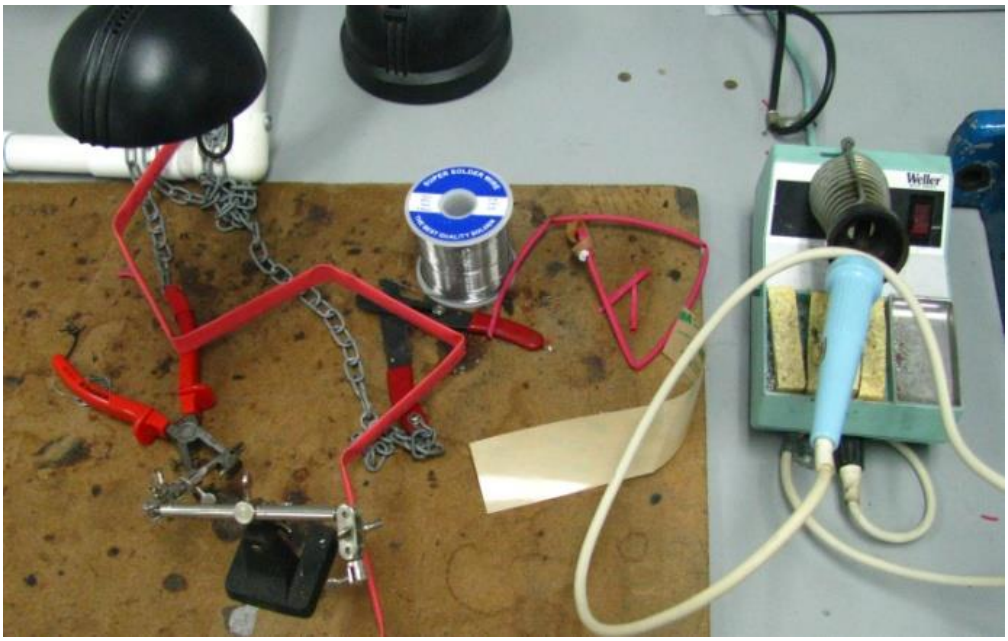




AT THE SOLDERING BENCH

List the hazard(s)

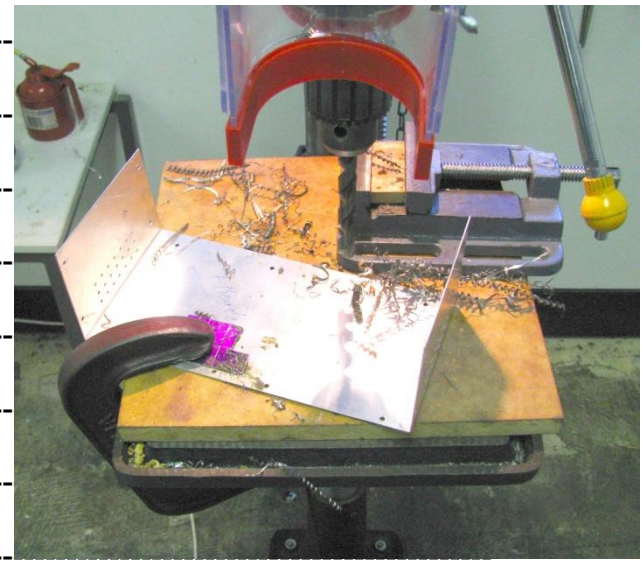
What is the remedy?



AT THE DRILL PRESS

List the Hazards

What solutions can be used?



WHS AND THE WORKSHOP

Are there any other ‘concerns’ in the workshop that you can find?
Please list them below and provide a rating for them.

---

7. TOOL TRAYS

Tool Trays exercise (on following page) completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

Contents List

- Scriber
- Try Square
- Callipers (odd leg or jenny)
- Steel Rule (300mm)
- Adjustable Spanner (150mm)
- Centre Punch
- Adjustable Spanner (100mm)
- Compound pliers (150mm)
- Screwdriver (#2 Phillips Head)
- Warding File (250mm)

A TOTAL OF 10 ITEMS

The tool trays will be issued by your lecturer at the beginning of every workshop session and must be returned to him on finishing.

All tools must be laid out in the tray on their outline this makes the checking process quick and easy. Untidy trays will not be accepted.

You will find it useful to get into the habit of returning tools to their correct position immediately after use, it will save you time looking for misplaced tools.

Do not allow other students to use your tools as you are responsible for any tools that go missing.

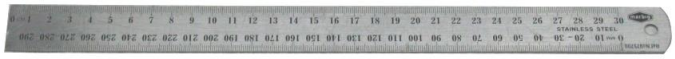
You will note that there is a selection of tools on the shadow boards located around the room. These must all be returned to their correct position at the end of the class.

Bags should be left at the front of the room.

WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORKBOOTS AT ALL TIMES.

ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY

8. EXERCISE - TOOL TRAYS

Item	What is it? What is it for?	Picture
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

9. DRAWING BASICS

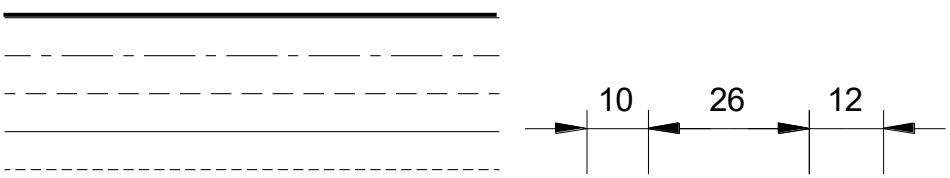
To be able to sketch or draw an item that you may need to make, or copy a component that you require, there are some basic drawing essentials that you need to use to enable a satisfactory result.

Drawing is a technical language much like any language that is used today. It has rules that help us to understand what is being shown to us or what is required to be manufactured (what you, or what you want someone else to manufacture), in accordance with AS1100 which includes standard drawing sheet sizes (such as A0, A1, A2, A3, A4 and their borders), scales used, line types, notations, tolerance, text, projections, hatching, surface finish, in fact everything required to standardise drawings.

Some of these rules are shown below to help you to understand this new language.

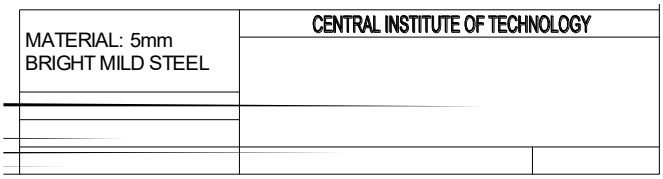
First of all, there are some basic lines that you need to know…

a. Outline
b. Centre line
c. Bend line
d. Dimension line(s)
e. Hidden line



Secondly there is a TITLE BLOCK (that has at least) the following…

a. DESCRIPTION (What it is)
b. DATE:
c. DRN: (drawing originator / draftsperson)
d. SCALE:
e. DWG NO: (Unique drawing identifier)



Thirdly, in addition to the above there may also be additional NOTATIONS such as…

NOTES: (any other) eg.

a. Parts listing
b. Material list
c. Machining tolerances
d. Change of scale

NOTES:

ALL MEASUREMENTS IN mm
MARKED FROM CENTRE LINE
BREAK ALL SHARP EDGES
HOLES 3mm UON
0.8mm ZINCANNEAL SHEET
NTS

DETAIL A-A
SCALE 50:1

Abbreviations, symbols and pictorial views are used to ensure that an accurate representation of the object is provided to the maker of the product.

In every (engineering) drawing that has been or will be drafted, these basic points should be/are present. However, some of the symbols used will differ according to the engineering discipline whether it is mechanical, civil, structural, electrical, hydraulic, electronic, reticulation etc.

2-dimensional multi-view drawings are used for 3 dimensional objects. These are usually in 3rd angle projection. Detail drawings are used for complex objects and assembly drawings are used to show how the whole items is made up of the sum of the parts. To enable a draftsperson to undertake these drawings, it may be your responsibility to sketch the object(s) and provide suitable measurements to enable the satisfactory replication of the object.

Type of line (mm)	Line thickness			Application
	A0	A1	A2 A3 A4	
Continuous—thick	0.7	0.5	0.35	Visible outlines Border lines
Continuous—thin	0.35	0.25	0.18	Fictitious outlines Imaginary intersection of surfaces Dimension lines, projection lines, intersection lines and leaders Hatching Outlines of revolved sections Adjacent parts and tooling Fold and tangent bend lines Short centre lines
Continuous—thin, freehand or ruled with zig-zag	0.35	0.25	0.18	Indication of repeated detail Break lines (other than on an axis)
Dashed—medium	0.50	0.35	0.25	Hidden outlines
Chain—thin	0.35	0.25	0.18	Centre lines Pitch lines Alternative position of moving part Path lines for indicating movement Features in front of a cutting plane Developed views Material to be removed
Chain—thick at ends and at change of direction, thin elsewhere	0.7 0.35	0.5 0.25	0.35 0.18	Cutting planes
Chain—thick	0.7	0.5	0.35	Indication of surfaces to meet special requirements

Figure 4.7 | Types of lines and their thickness requirements

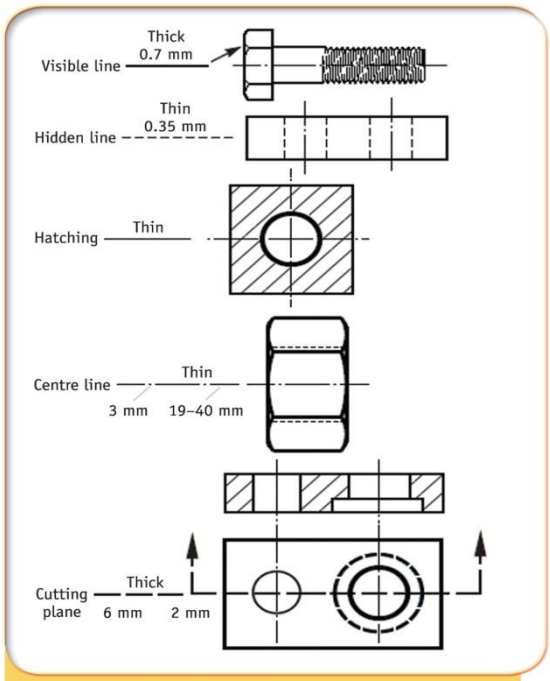


Figure 4.8 | Drawings showing various line types

SCALES

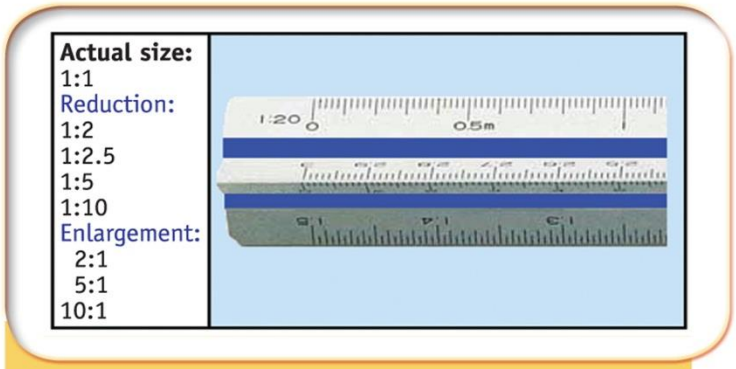


Figure 4.16 | Metric scales

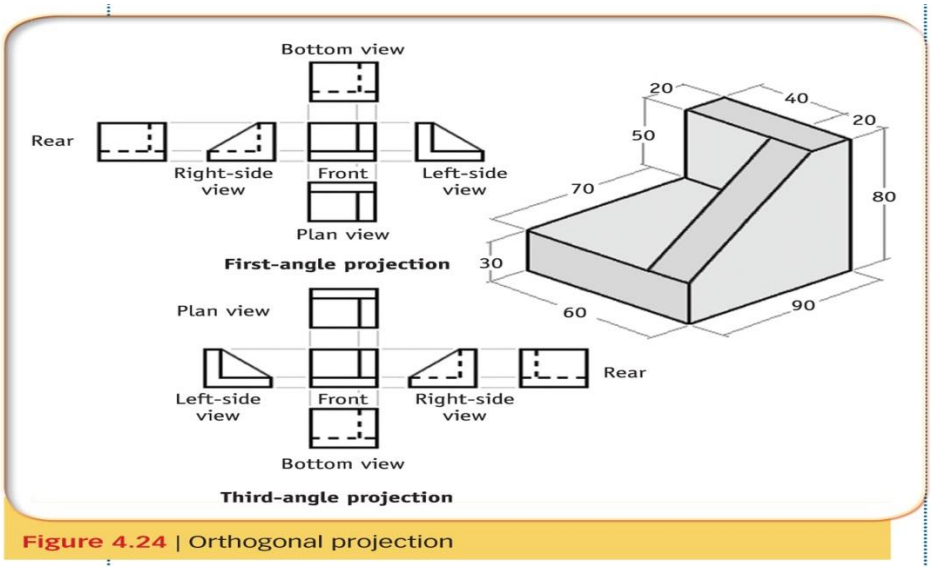


Figure 4.24 | Orthogonal projection

Your exercise is to answer the following questions and finish the drawings supplied.

EXERCISE - DRAWING BASICS (1)

From the drawing on the following page and from the notes supplied, answer the following questions….

Describe an outline and what it is used for_____

_____

Describe a centre line and what it is used for_____

_____

Describe a dimension line and what it is used for_____

_____

Describe a bend line and what it is used for_____

_____

What essential (basic) information does the title block contain <u>and why is it included</u>?

What is it?_____

When was it drawn?_____

Who was the draftsman?_____

What is the drawing number? (identifier)_____

What is the scale of the drawing?_____

What additional NOTES are supplied? And what do they mean?

a

b

c

d

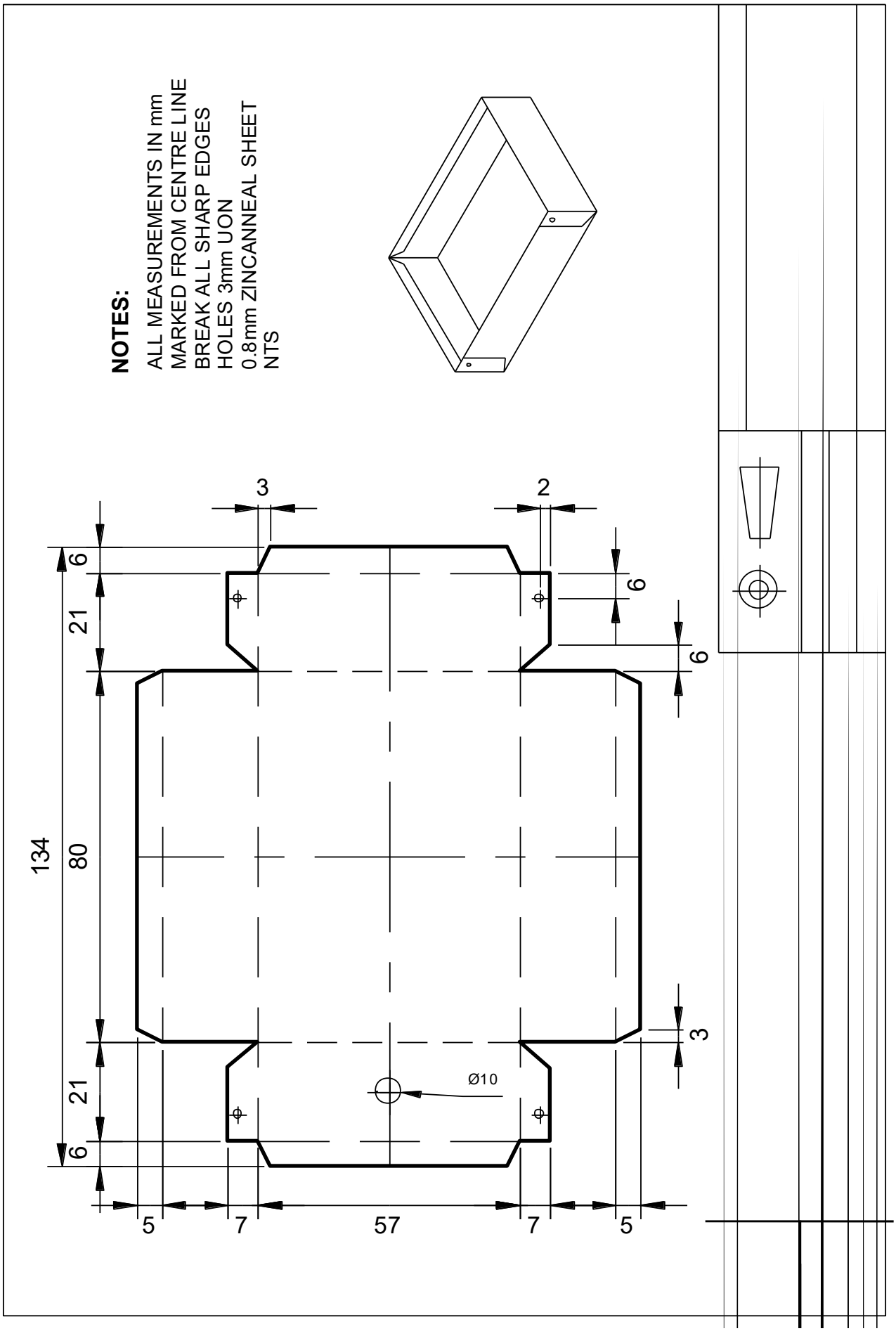
e

f

What is this symbol ∅ ?

What is the symbol in the title block (top left)?

What is the type of pictorial view displayed?



On the following page sketch (to scale) the orthographic representation of the tray and

provide basic key dimensions

Drawing Basics exercise completed:

Satisfactory	
Unsatisfactory	

10. MEASURING AND MARKING OUT

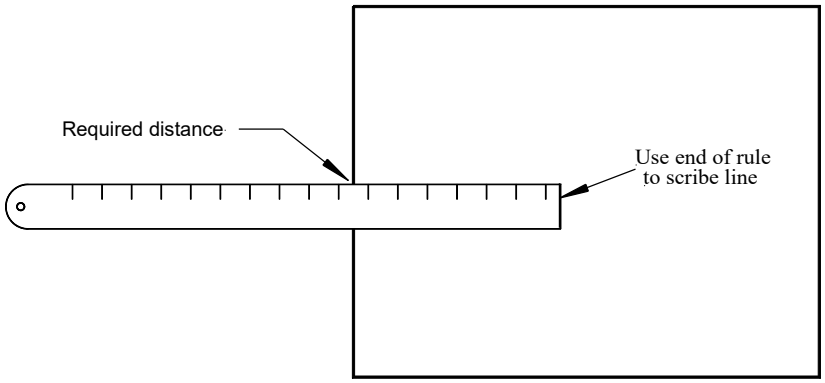
Marking out aims to reproduce an image of the job on the material with lines marked accurately in the correct position and intersecting at the correct angles (usually 90 deg or “square”), to achieve this we have a collection of tools and instruments available.

1. Steel Rule
2. Scriber
3. Try square or Engineers square
4. Centre punch
5. Dividers
6. Odd leg callipers or Jenny callipers
7. Mark out Fluid or layout stain

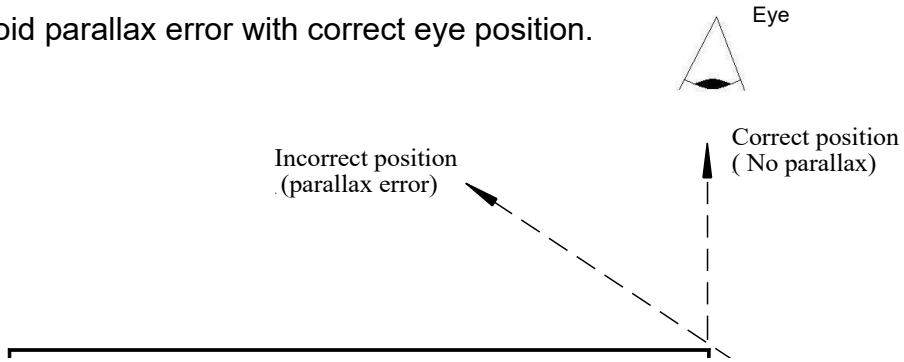
STEEL RULER.

There are two main things to remember:

A. Use the end of the rule to mark off distances (only one source of error)



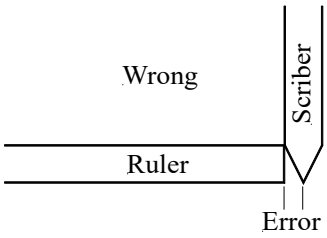
B. Avoid parallax error with correct eye position.

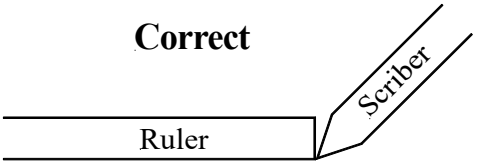


The rules we use have two scales…Imperial (inches) and metric (millimetres). When using the rule be clear in your mind which scale you should be using and which one you have in front of you

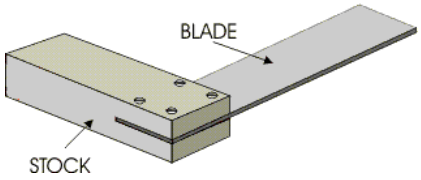
SCRIBER.

Use the end of the rule to mark off distances
Hold or angle scriber correctly to avoid errors





ENGINEERS SQUARE



The engineers square (or try square) is composed of two parts, the stock and the blade. They are usually made from bright mild steel with the blade being hardened and tempered so that it resists damage.

A typical use of an engineer's square, is to mark out material for cutting/shaping.
The engineers square is pushed against a straight side of the material.

A scriber is then used to scratch a line onto the surface of the metal. Sometimes engineers blue (a dye/ink) is wiped onto the surface first so that the scratched line can be seen easily. The material is then cut down to this straight line.

CENTRE PUNCH.

Used to locate the centre of a hole and to give drill bit an accurate start. The tiny indentation "captures" the point of the drill bit and ensures a start at the correct place.
If a centre punch is not used the drill point tends to wander before starting the cut this causes inaccuracy, especially with smaller drill sizes.

Hold the punch at an angle to the job to allow a better view of the point as it is applied to the centre mark on your material, when in position raise to vertical and tap gently with a hammer. Check that the indent is in the correct position, if not you can be corrected by setting the punch at an angle and tap across in the desired direction.

All punching must be done on the round steel plates provided, not directly on the bench.

DIVIDERS

Engineer's version of the compass' needs a centre punch indentation at the centre for accuracy. Use the wing nut to adjust radius and operate one handed from the apex

JENNY CALIPERS.

Also known as "Odd Leg Callipers"
Used to mark out lines parallel to an edge of a sheet, this can save considerable marking and measuring but requires careful handling to avoid mistakes.

CALIPERS

Inside: Used for measuring inside diameter of a hole in an object, such as pipe.

Outside: Used for measuring the outside diameter of an object such as Conduit.

Straight: Used for transferring measurements from a drawing to a measuring device or for scribing an arc or circle.

MARKING OUT STAIN.

Also known as Marking Blue" or "Layout Stain".

It is used to enhance contrast on metal surfaces as scriber marks are easily seen (silver on a dark blue background).

The stain will give trouble if surface is excessively oily or greasy but can be removed using methylated spirits provided.

Ensure surface is clean prior to application of Marking Out Stain

Apply using "Kimwipes" tissues provided.

CAUTION:
Flammable liquid and Permanent Staining

11. EXERCISE – MARKING OUT

Marking out exercise completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

Purpose: To measure/calculate dimensions from a technical drawing and mark out a shape on sheet metal

Equipment required:

300mm steel rule
150mm spring dividers
150mm engineer's square
150mm scriber
100mm centre punch
150mm odd-leg calipers
Combination set with protractor head
Marking Blue
0.5 mm sheet mild steel or similar (about 110 x 70mm)

Procedure

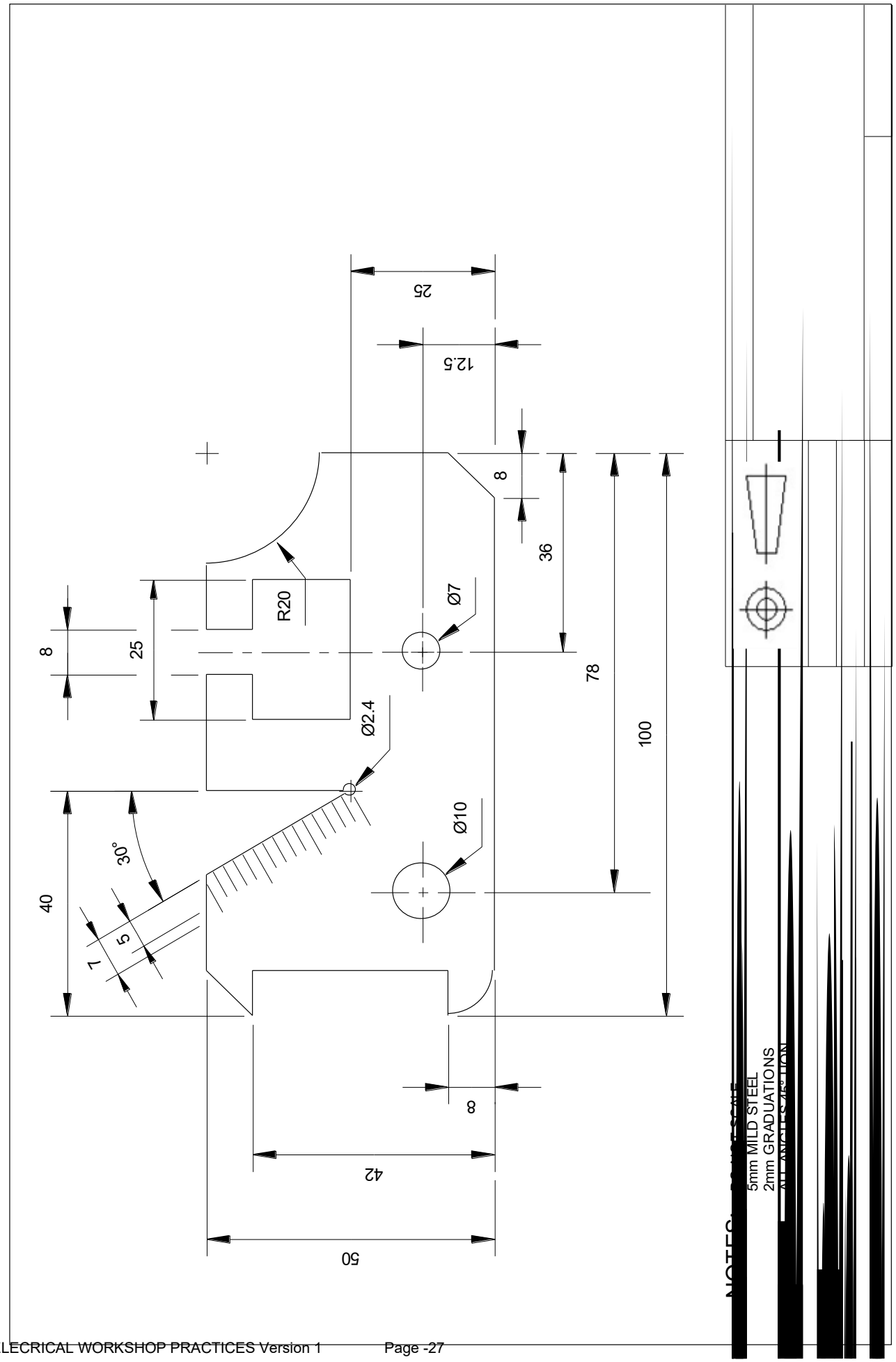
1. Examine the technical drawing attached on the following page. Note that some of the dimensions are given but others are not, however there should be sufficient information to manufacture the drawn item. The drawing may be used in conjunction with additional notes.
2. Answer the questions on the following page (to the drawing)
3. Calculate the dimensions (not given) and mark them on the drawing
4. Apply a thin film of marking blue to the work piece and allow it to dry.

NOTE: Use only the designated area to complete this exercise as this material will make a mess if not used with care

5. Mark out the shape of the work piece on the metal sheet. Start by constructing a horizontal and vertical datum line. All dimensions must be within 0.5mm.

NOTE: When scribing lines, always carry the line through for at least 2mm at each end so that each corner is an intersection of two lines rather than junction of two end points

6. Submit your work piece to your Lecturer for comment and assessment.
7. Return all of the equipment to its proper place


25
12.5
8
36
78
100
R20
Ø7
8
25
Ø2.4
Ø10
30°
40
5
1
8
42
50
5mm MILD STEEL
2mm GRADUATIONS

EXERCISE MARKING OUT Questions

a) What are the overall dimensions of the model?

WIDTH_____

HEIGHT_____

b) What are the diameters of the two holes?

LEFT_____

RIGHT_____

c) What is the width and depth of the rectangular cut out in the model?

WIDTH_____

DEPTH_____

d) What is the width and depth of the cut out on the left-hand side of the model?

WIDTH_____

DEPTH_____

e) What is the distance from the ***centre*** of the left hole to the ***centre*** of the entry to the rectangular cut out in the model? (c)

DISTANCE_____

f) What is the importance of the 'NOTES:' on a drawing?

ANSWER

_____

_____

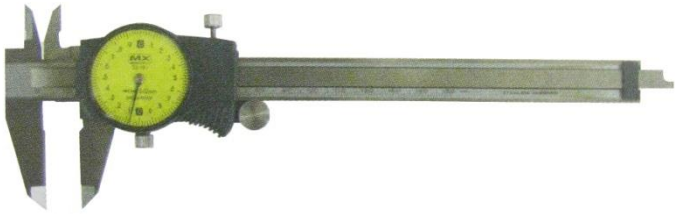
_____

_____

12. **MEASURING TOOLS**

THE VERNIER CALIPER

DIAL, DIGITAL and VERNIER Calipers



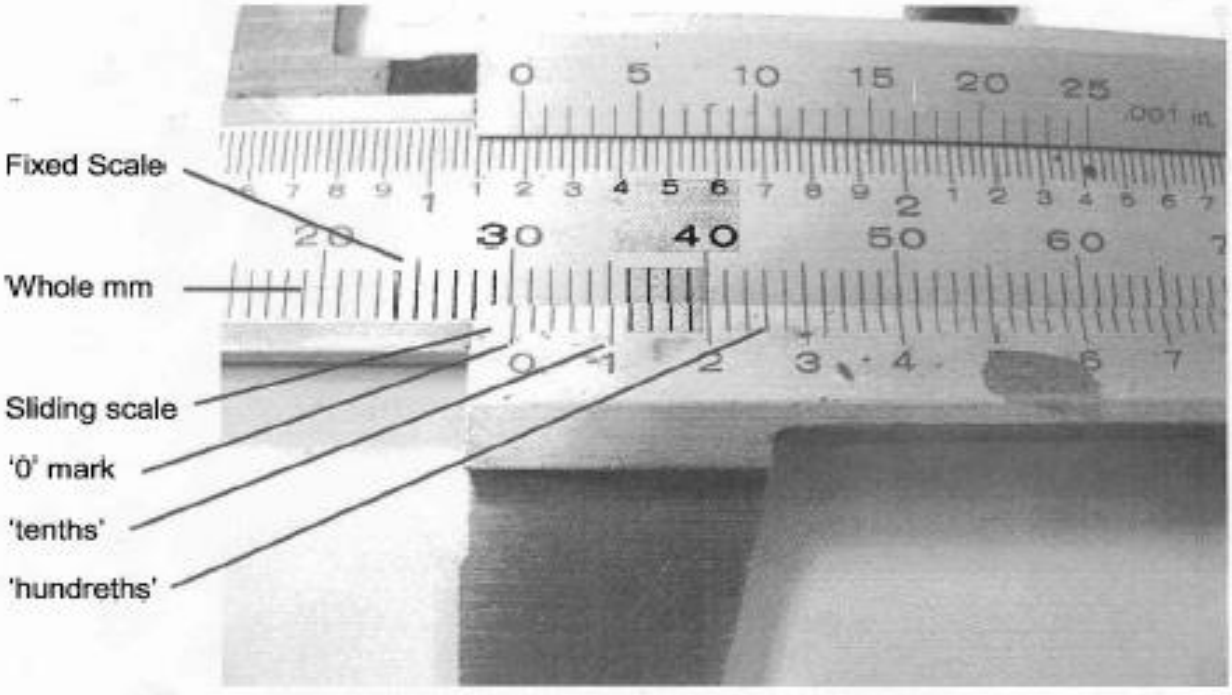
The three types shown can all measure

INSIDE, OUTSIDE and DEPTH.

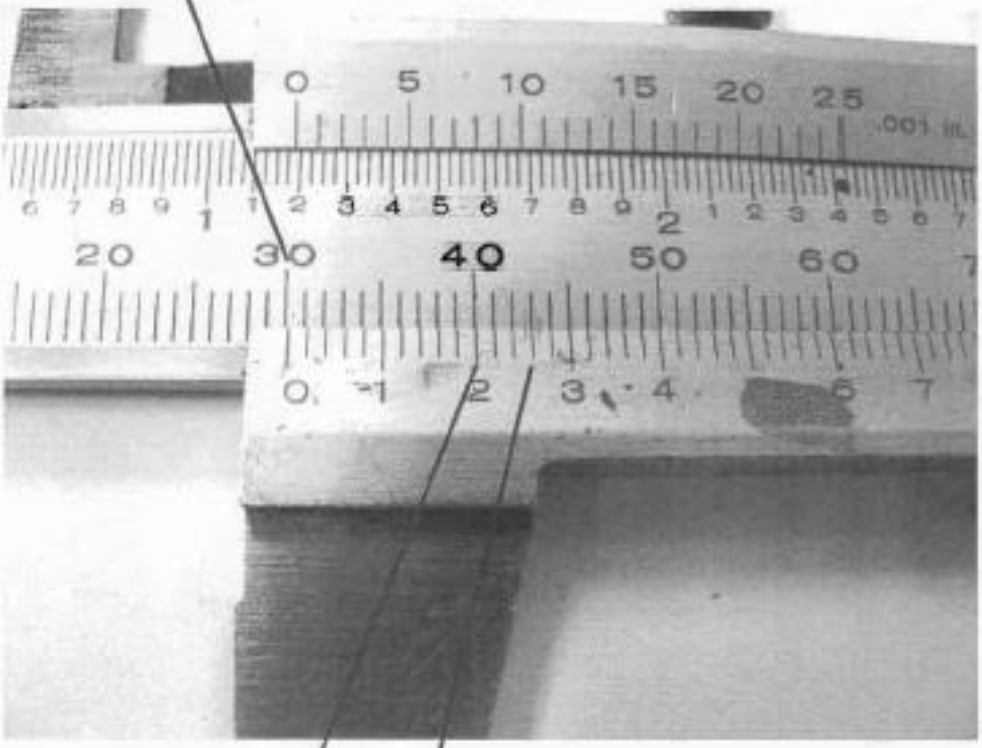
There are 3 parts to reading the vernier calculator.

- Whole millimetres
- Tenths of millimetres
- Hundredths of millimetres

The illustration below shows a dual scale vernier (mm and inches) The top scale is in inches and the lower scale is in mm.



Firstly you will need to read the whole millimetres (all completely whole millimetres). This is read from the '0' point on the lower sliding scale, either the number that directly corresponds to the 0 mark or the whole number directly to the LEFT of the 0 mark. 30mm as shown below.



Secondly you need to read the tenths from the sliding scale, the 'whole number from the sliding scale (0 to 9) that is closest to the right of a whole number on the fixed scale (directly above the sliding scale). From the above picture, you will see that the closest on the right of a whole mm is '2' (This is in fact 2 tenths of a mm or 0.2mm).

Finally we need to read the hundredths scale, the markings between the whole numbers on the sliding scale. From the above picture looking at the section of the sliding scale that is next to the '2 tenths' ie between 2 tenths and 3 tenths), is shown to be the third mark which is 6 one hundredths (as the markings are 0.02mm ea refer to the vernier). Therefore it is 0.06mm.

Last task is to add all these up...

	30.00
	0.2
+	0.06
=	30.26mm

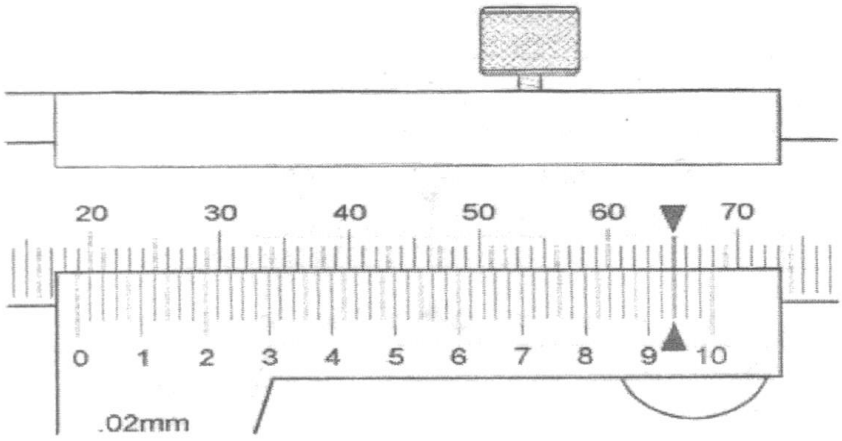
13. EXERCISE MEASURING (VERNIER)

(THEORY and PRAC) Measuring exercise completed: (Pages 26 and 27)

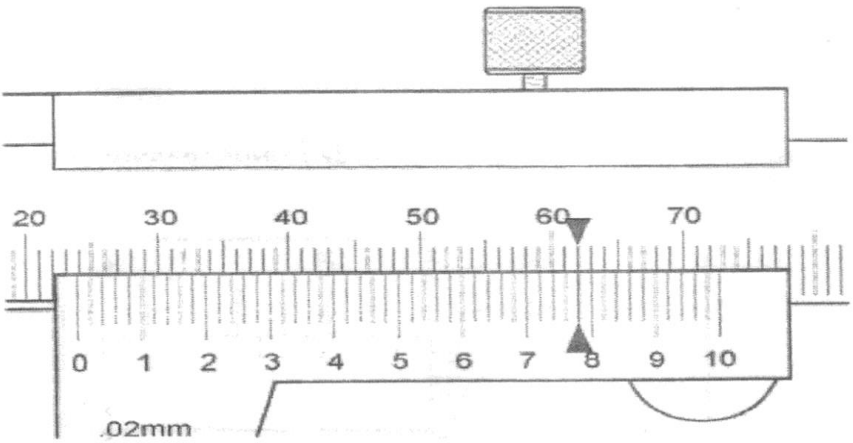
Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

THEORY



a) 18.94mm
b) 17.94mm
c) 64.94mm
d) 65.94mm

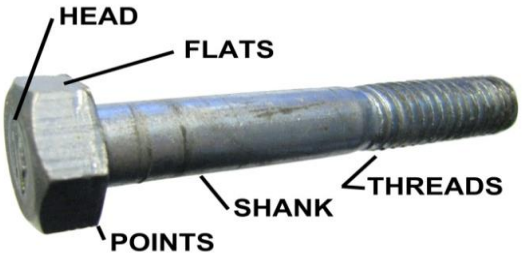


a) 23.78mm
b) 22.62mm
c) 62.78mm
d) 61.78mm

EXERCISE MEASURING (PRACTICAL)

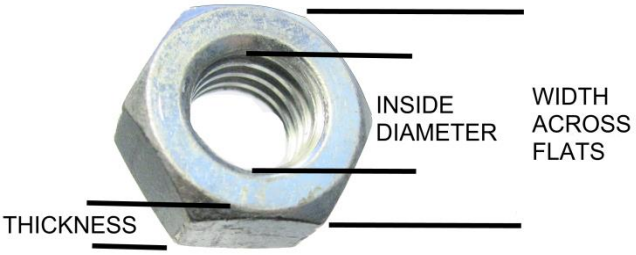
BOLT DIMENSIONS

1. DIAMETER of shank _____
2. Width across FLATS_____
3. Distance across POINTS _____
4. LENGTH (under head) _____
5. THICKNESS of HEAD_____



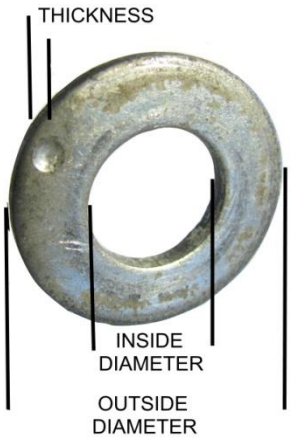
NUT DIMENSIONS

6. WIDTH across FLATS_____
7. Inside DIAMETER _____
8. THICKNESS_____



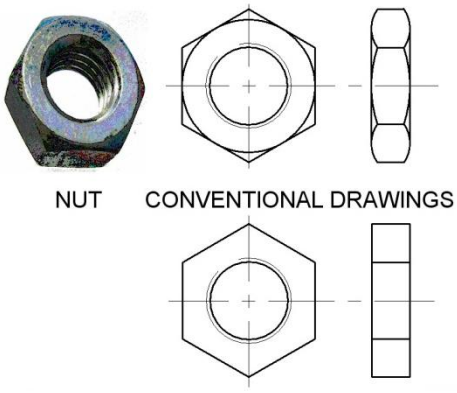
WASHER

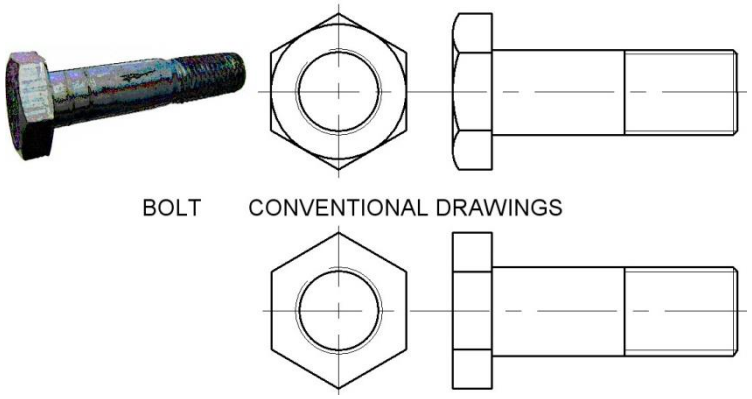
9. Outside DIAMETER_____
10. Inside DIAMETER _____
11. THICKNESS_____



Drawing Basics

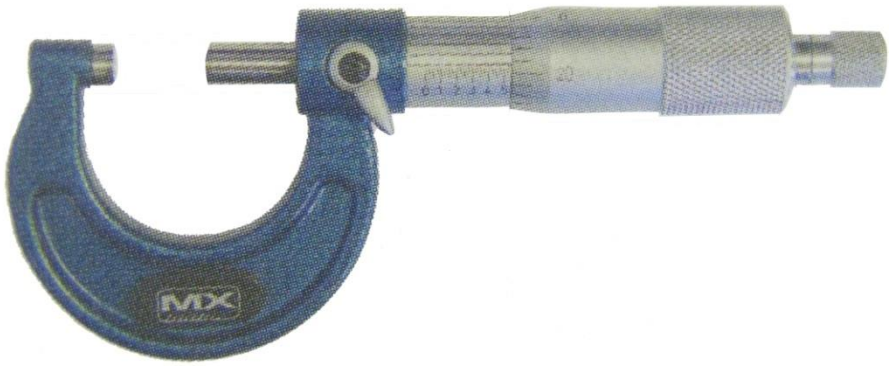
It is not economical or beneficial to draw the actual threads of a bolt or a nut. Instead there is a standardised drawing convention to make the representation. This is as shown below. NOTE: the use of thicker and thin lines.





14. **MICROMETER**

The MICROMETER is another precision measuring tool that is used in engineering.



It works in a similar manner to the VERNIER CALIPER having a slide rule for measuring distances.

The Micrometer is shown is suitable for measuring OUTSIDE diameters very accurately.

Other versions allow very accurate measurement of INSIDE diameters (not shown) or a bore gauge may be used in conjunction with the OUTSIDE MICROMETER.

DEPTH MICROMETERS are also available (shown below).

Typically, these measure accurately to 0.01mm (one hundredth of a millimeter) in contrast to the VERNIER which measures reasonably to 0.02mm (two hundredths of a millimeter)

However, like all tools, these are only as good as the person who uses them.

Due the design limitations (the range of the thimble screw mechanism), generally micrometers are in set sizes in 25mm steps (1”) although micrometers with interchangeable anvils can measure a range of 100mm.

Digital micrometers are also available (not shown)

These vary in accuracy but can measure accurately down to 0.001mm (one thousandth of a mm)

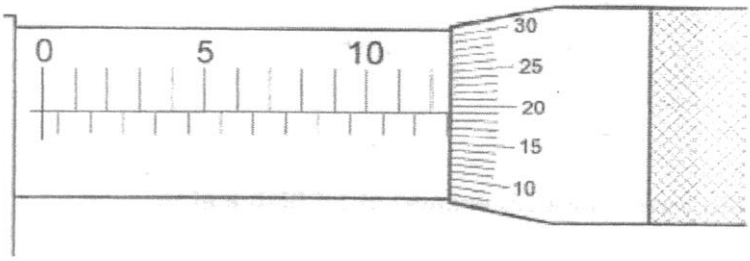
15. EXERCISE - MICROMETER READING

Select the correct answer for the following measurements shown.

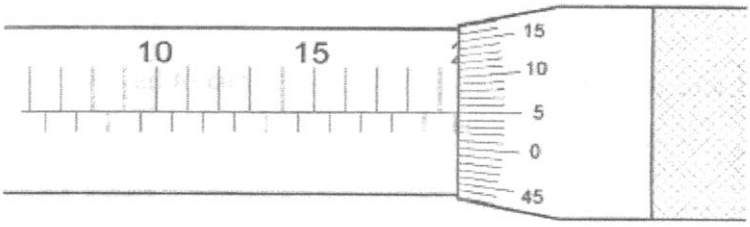
EXERCISE MICROMETER READING

Satisfactory	
Unsatisfactory	

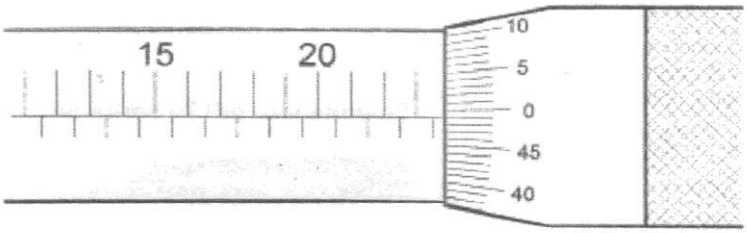
Lecturer signature: _____Date_____



a) 12.69mm
b) 12.519mm
c) 10.2519mm
d) 10.219mm



a) 19.55mm
b) 19.05mm
c) 15.55mm
d) 15.95mm



a) 23.99mm
b) 23.49mm
c) 20.749mm
d) 20.399mm

16. DRILL PRESS

DRILL SPEED

For any given material the tip speed of a cutting tool has a correct value for best results.
For steel this is l00m/min.ie the outer corner of the drill cutting edge should be moving at that speed for optimum results. Thus, for different diameter drill bits, the rotation rate will have to be changed to suit. Smaller bits should have faster speeds.

For our purposes:

3mm or less =	Fastest speed on press.
3mm to 6mm =	Medium speed on press.
6mm to 13mm =	Slowest speed on press.

If speed is set too slow (ie for a small bit) you will find that a high feed pressure is needed to force the bit through the material. These risks breaking the bit and/or displacing the hole. Increase the speed as required.

If the speed is set too fast (for a larger bit) the drill bit will make a lot of noise (chatter and squeal). The hole will not be round, and you risk the job catching and becoming a razor-edged propeller.

BELT CHANGING

To change speed on belt driven drill presses you will need to change the belts over.
Before changing belts always unplug the drillpress power cord to prevent an inadvertent start.

There are two ends to a belt.
One is the motor or driven end. The other is the drill or driven end.

For a high speed, the pulley at the motor end is bigger. Smaller is slower. Remember: Motor end bigger speed higher.

It is easier when changing belts to slip the belt partly onto the smaller pulley on the sheaf, then rotate the pulley **(by hand).** The other end will then be loose enough to slip over the larger pulley.

CLAMPING.

For all jobs you will need some form of clamping or locating arrangement.
This can be:

1. Pliers
(Note the tape to protect the work piece)

Your battery clamp model is an example
of the size model that uses a pair of pliers.

2. Drill Vice.
(Handheld for small items only!)

3. G Clamp. (Clamp work piece to worktable)
(Used with a small block of wood to prevent
damage to the work piece)

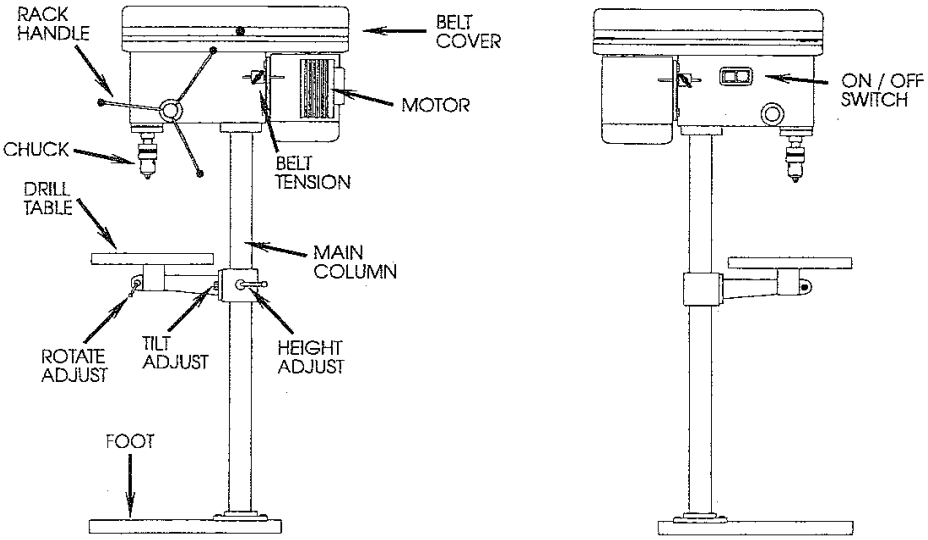
4. OR a DRILL VICE bolted to the table for larger items.

NOTE:
Larger holes are a greater grab and spinning hazard.
Large holes require more secure clamping arrangements.

DRILL PRESS RULES

1. **Always wear eye protection.**
2. **Long Hair must be tied back or a hairnet must be worn.**
3. Always unplug drill from mains power when changing the belts,
4. Always secure your job.
5. **Never** expose the belt when the drill is operating.
6. Always ensure that there is a piece of scrap wood (12mm at least) under your model to protect the drill table. Chipboard or plywood is best.
7. Always remove the drill bit from the chuck and replace it in its correct location in the drill stand.
8. **Never** have more than one bit out at once.
9. **Never walk away from the drill and leave a bit in the chuck.**

Safety glasses must be worn at all times in the Workshop. A **face mask** is available to be worn if an unusual amount of swarf is being produced.

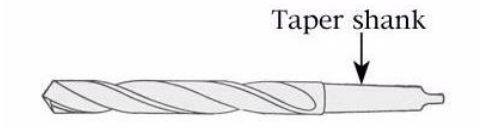


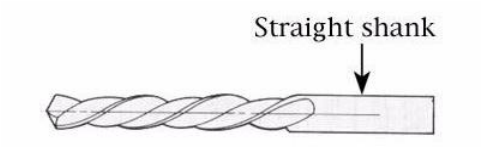
WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORKBOOTS AT ALL TIMES.

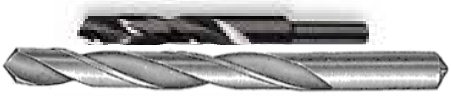
ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY

17. DRILL BITS

Drill bits come in a range of sizes and types. The common ones are shown on the following pages







Bradley Point

Jobber drill bit

TWIST DRILLS

Twist drills (drill bits) are probably the most common drilling tools used by the tradesmen with either a hand or electric drill. The front edges cut the material and the spirals along the length remove the debris from the hole and tend to keep the bit straight.

They can be used on timber, metal, plastics and similar materials. Most twist bits are made from either:

- 'High speed steel' (HSS), these are suitable for drilling most types of material, when drilling metal, the HSS stands up to the high temperatures.
- 'Carbon steel', these bits are specially ground for drilling wood and should not be used for drilling metals, they tend to be more brittle, less flexible than HSS bits.

Twist drills are usually available in sizes 0.8-12 mm plus. Special care is required when using the smallest sizes since these bits are thin and brittle. Always hold the drill square to the work and apply only light pressure when drilling.

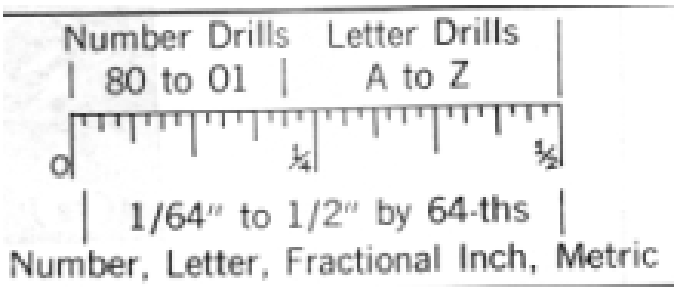
MASONARY DRILLS

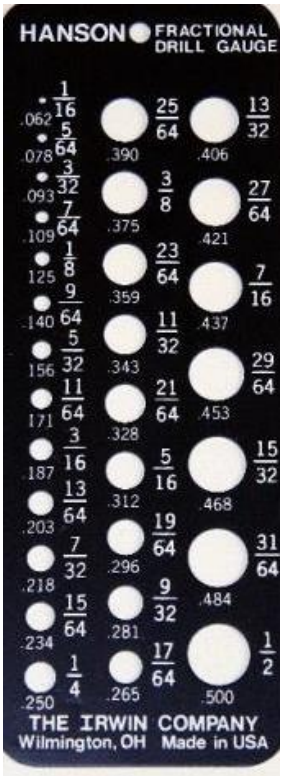
As the name suggests, these are designed for drilling into brick, block, stone, quarry tiles or concrete. The cutting tip is often made from tungsten carbide bonded to a spiraled steel shaft.

Some masonry drills are described as 'durium tipped', this term refers to a highly durable silicon bronze alloy used instead of tungsten as the cutting point.

Masonry drills are usually used in a power drill, although they can be used with a lot of effort in a hand brace. Most masonry bits can be used with a hammer action power drill but always check as the action is quite punishing on the bit and cheaper bits have been known to shatter when subjected to the pounding. Always use a slow rotational speed for drilling into harder materials to avoid overheating the tip and frequently withdraw the bit to remove dust.

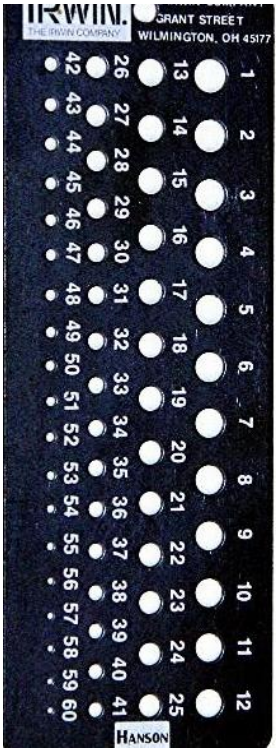
TWIST DRILL SIZES – GAUGES





Fractional Sizes

Metric Sizes



Number Sizes

Sharpening Drill Bits

Unfortunately, drill bits do not maintain their sharpness and therefore their ability to safely and quickly drill a hole in a given material will be greatly affected. It is therefore very important to keep drill bits in good condition ready for use.

There are a number of ways to maintain the sharpness of a drill bit, ranging from purchasing multiple sets of 'jobber' drill bits (usually small diameter bits that are used frequently) though to using a number of commercially available drill bit dressers (sharpeners) through to using a bench grinder with a suitable grinding wheel.

Each method of sharpening has advantages and disadvantages.

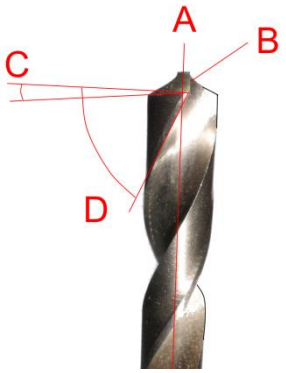
Advantages / *Disadvantages*	**Method**
Cheaper multiple purchase Always sharp Spare available when broken Portable *Can run out of bits* *Carrying more bits* *More expensive than single drill bit*	Multiple Jobber Drills 
Able to 'touch up' drill tips Cheap to purchase Portable *Cheap construction uses stone wheel* *Care required to maintain geometry* *Requires drill to power sharpener* *Awkward*	Drill sharpening attachments Very Cheap ($20 - $50) 
Able to 'touch up' or regrind drill bits Cheap to purchase Self-powered *Not as portable (240V)* *Only one point angle* *Some stone wheels* *Cheap construction*	Drill bit sharpening machine (cheap~$50 -100) 
Regrind drill bits of different types Multiple tip geometry Accurate refinishing Diamond wheel and self-powered *Not as portable (240V)* *Expensive purchase*	Drill bit sharpening machine (expensive ~$400+) 
Regrind drill bits of different types Multiple tip geometry possible Accurate refinishing possible *Not as portable (240V)* *Requires different grinding wheels* ***YOU HAVE TO GRIND***	Bench / Pedestal Grinder 

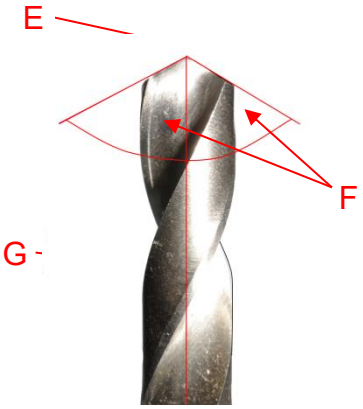
Sharpening Drill Bits Exercise

Inspect a drill bit (have a good look at a new or properly sharpened bit)

1. You must know what you are doing to successfully sharpen a drill bit. The geometry of a drill bit is very complex. Some terms you will encounter include… Identify these from the picture(s) below.

- point angle,
- cutting angle(s),
- rake angle,
- lip,
- clearance angle,
- axis,
- flank…



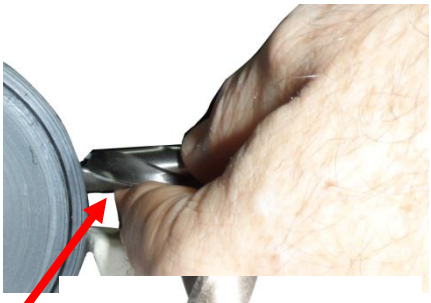


2. Wear suitable protective clothing and PPE…What will you be using? (and why)

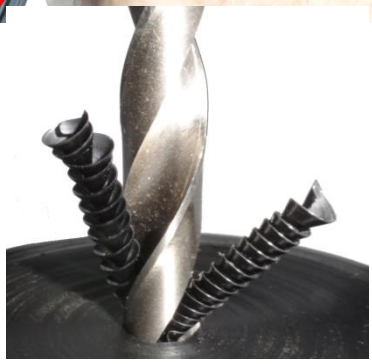
3. All drill bit angles should all be equal…(one side to the other, not all the same)
Cutting angle is_____(general angle)
Clearance angle is_____

4. With a good drill bit, place against the edge of a desk/bench and practice rolling the bit down and away to the left…taking care to follow the angle of the drill bit using your left hand to control the movement.

5. Once this movement is mastered, go to the drill press and using suitable PPE and under supervision of the lecturer, gently touch up the edge of a drill bit.



Remember: Support the bit ~1/4 from leading edge and rest on the grinder rest with the cutting edge horizontal and parallel to the wheel (~60°).
DO NOT PUSH YOUR FINGERS INTO THE WHEEL!



6. The angles then need to be checked with a drill bit gauge and if all is satisfactory, a test hole can be drilled in the material provided. Two evenly formed chips should form if sharpened correctly.

18. HAND LEVER SHEARS

Typical hand lever shears

The hand lever shears is used to cut sheet metal and bar stock within the capability of the machine with a cutting blade length of 150mm (typically up to 4mm thick (flat) and 9.5mm diameter bar (in cutter provided not with main blade)).

The hand lever shears are used to cut out two of the models(the Battery Clamp and the Metal Tray) that are made in this unit of competency.

SAFETY PRECAUTIONS.

- One machine, one operator
- Keep hands and fingers away from the cutting blades of the machine.
- Remove the locking bolt before attempting to cut your work piece
- Replace the locking bolt leaving the guillotine to return to your bench at the completion of your cutting.
- Never leave the handle in the horizontal position, return to the vertical position to help reduce hazards (walking into handle).
- Always clean up your waste (off cuts) before leaving the machine.

19. MANUAL PANBRAKE

Typical Panbrake-folder

The hand operated panbrake-folder (bending machine) is used to *only* bend sheet metal within the capability of the machine which is typically 1mm thickness.

It is called a Panbrake-Folder as it is used for making 'pans' or boxes (trays) of different dimensions.

The bending machine is used for the Battery Clamp, The Metal Tray and the Trainer Chassis model

SAFETY PRECAUTIONS.

- One machine, one operator
- Keep hands and fingers away from the finger clamps of the machine.
- Do not attempt to hold your work piece when bending. Always clamp your work.
- Leave the bending handle hanging down (vertically) from the machine.
- Do not attempt to bend rod or bar stock as this will permanently damage the machine
- Leave the machine in clean working order at the completion of your work.

20. EXERCISE - BATTERY CLAMP

Purpose: To mark out, cut, drill and bend piece of 0.8mm thick Zincanneal sheet and bend to shape using the Drill press, Guillotine and the Bending Machine

Method

1. Cut a strip of material 20mm wide
2. Examine the drawing and cut a sufficient length for the clamp
3. The piece of metal could be slightly curled at the corners. Using a hammer GENTLY tap it flat on the round piece of plate on your workbench. Use a file to de burr the edges and round off the corners.
4. Go to the fluid staining bench and carefully coat both sides of the metal with the blue layout stain
5. Return to your work area and mark out the two lines and the hole position. Centre punch the hole position (use circular plate to rest on)
6. Drill the hole 3.5mm diameter
7. De burr the hole using the small chamfering tool
8. Bend the clamp to shape using the manual bending machine
9. Check your clamp dimensions against the drawing.
10. Submit clamp to your lecturer for checking …..

Test

- The clamp must hold a 9V battery securely but with no damage to the battery case (Will be tested on a flat surface e.g. whiteboard)

- If the clamp is not a good fit it will be discarded and you will have to do another **Do not flatten and re bend**

11. Modify your dimensions or methods to obtain the desired result

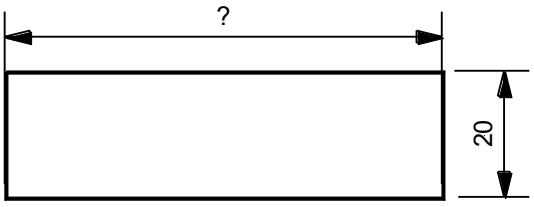
    Note: The clamp requires bends in two opposite directions; the two lines must be on opposite sides of the blank

Criteria for success	**S or NYS**
1. Edges chamfered and de burred	
2. All bends are 90 degrees	
3. No more than 0.5mm under the foot of the clamp	
4. Clamp must hold a 9V battery on the whiteboard or similar surface against gravity	
5. Finished dimensions +/- 0.5mm	

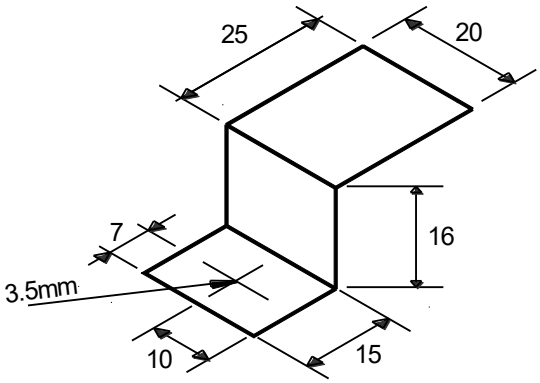
Lecturer signature: _____Date_____

WHILE IN THE WORKSHOP YOU MUST WEAR YOUR SAFETY GLASSES AND SAFETY WORKBOOTS AT ALL TIMES.

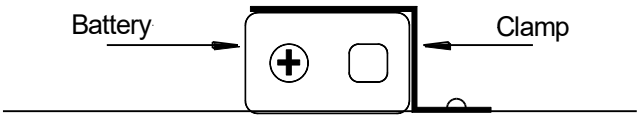
ALL INJURIES MUST BE REPORTED TO YOUR LECTURER IMMEDIATELY



Blank Material



Clamp



All Dimensions in Millimetres

DRAWN BY S BUTLER	TAFE WA central	BATTERY CLAMP	
DATE 2/7/2009		NOT TO SCALE	DRG No. 1 OF 3

21. EXERCISE BRACKETS

BRACKETS completed: (Pages 25 and 26)

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

Two types of brackets are shown below.

On the left is an ‘in-house’ manufactured one that may be used for shelf brackets or for reinforcing the corners of table etc. It is made from 0.8mm zincanneal.

The one on the right is a purchased item used for securing conduit (fix and connect). It is made from flat bar of suitable width and thickness.

The aim of this exercise is to develop your hand skills in the event that you have limited tools to complete a task.

INSTRUCTIONS

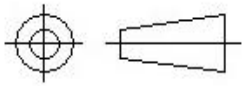
7. Measure and sketch your bracket on the following page. (Orthogonal and pictorial). You will need to provide enough information to recreate the brackets.

8. Make the bracket(s) using workshop tools at your disposal (within the limitations of the unit).

9. Use a limited number of hand tools to replicate the first bracket.

These brackets may be used in the FIX and SECURE exercise later in the unit.

NOTES:



	CENTRAL INSTITUTE OF TECHNOLOGY	
DRN:		
DATE:		
SCALE: AS SHOWN	DWG NO: FSB1	REV:0

22. RIVETS

UNDERSTANDING RIVET FASTENERS

Riveting or fastening, as a craft, was practiced long before the ancient pyramids were built. It is a simple and relatively inexpensive method, used to secure items such as fabrics, leather, wood and metal together, to form a composite piece of work. There are only two general categories of fastening operations, used in industry today, Solid and Hollow metal rivets.

Solid Metal Riveting

This type of fastening is generally confined to small production runs requiring relatively high mechanical strength and a tolerance for low aesthetic appearance of the finished model. The rivets for this type of application are available in Aluminium, Brass, Copper, Nickel Copper (Monel), Stainless Steel and Steel (zinc plated or galvanised) and are made up from solid drawn metal rod or wire stock. The common variety of solid rivets employed in this operation, are Tinner's, Flat Head, Round Head and Counter Sunk Rivets.

Tinners

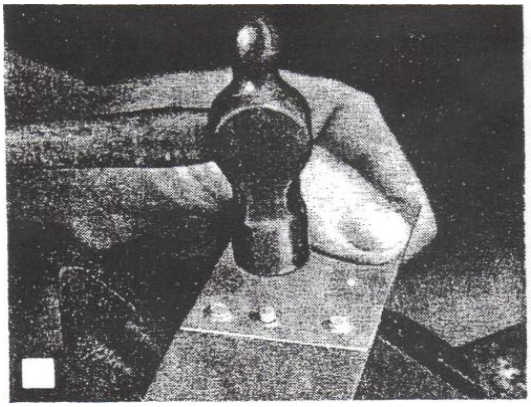
Flat Head

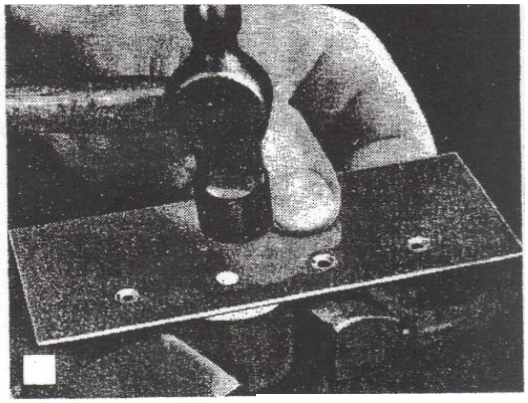
Round Head

Countersunk

Solid Metal Rivet Upsetting - Manual Operation

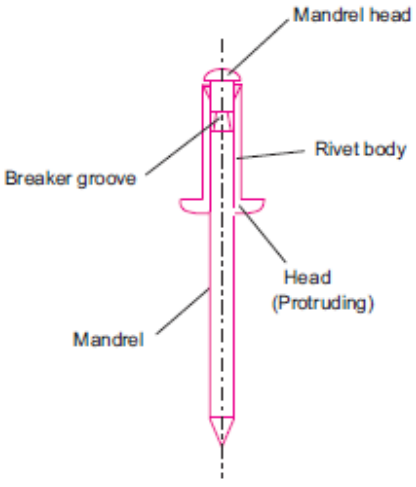
The solid metal rivet is capable of being upset, within the work piece with either a hammer and swaging tool or a ball peen hammer and stake or plate to back-up the head of the rivet during the swaging or hammering operation.
The main problem with this type of riveting is the time required to achieve a satisfactory result in both strength and appearance.

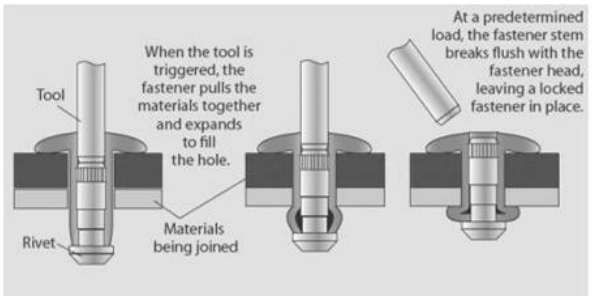




Hollow or Tubular Metal Fasteners.

They are often referred to by their trade name, Pop, Ajax , or Cherry Blind Rivets
Hollow or tubular rivets utilize a steel stem (mandrel) to provide the compression riveting action which provides low to medium strength mechanical bonding. As compared with equivalent diameter solid metal rivets.
This type of fastening is also used for low production runs, and the finish and ease in which it is accomplished, is superior to that of solid metal riveting.





Hollow Rivet Head Formation

The rivet is available with the following head formations:

SEALED **TRUSS** **COUNTERSUNK** **LARGE FLANGE** **HEAD GROOVED**

Hollow Rivet Body Strength

The body strength of the rivet is from weakest – Aluminium, to the strongest - Stainless Steel. The appropriate type of rivet can be determined with the help of the following recommendations.

Hollow Rivet Material Codes

The rivets are available in a variety of coded metal compositions as shown in table below

RIVET CODE	RIVET MATERIAL
A	Aluminium
S	Steel (zinc plated)
M	Nickel Copper Alloy
ST	Stainless Steel
C	Copper

Hollow Rivet Size (Diameter)

They are available in a range of sizes, and each require a specific drill size as shown in the table below.

Diameter Code	Rivet Diameter	Drill Hole Size
3	2.4mm (3/32)	2.5mm
4	3.2mm (1/8)	3.3mm
5	4.0mm (5/32)	4.1mm
6	4.8mm (3/16)	4.9mm
8	6.4mm (1/4)	6.5mm

Hollow Rivet Grip Range

This ranges from 1.6 to 34.9mm. The material thickness of the items, being fastened, should be within the Grip Range of the selected rivet. Grip Codes indicate general workshop compression ranges.

GRIP	GRIP RANGE		GRIP	GRIP RANGE	
CODE	IMPERIAL	METRIC	CODE	IMPERIAL	METRIC
1	Up to 1/16	Up to 1.6mm	8	3/8 – 1/2	9.5mm – 12.7mm
2	1/16 – 1/8	1.6mm – 3.2mm	10	1/2- 5/8	12.7mm – 15.9mm
3	1/8 – 3/16	3.2mm – 4.8mm	12	5/8 – 3/4	15.9mm – 19mm
4	3/16 – 1/4	4.8mm – 6.4mm	14	3/4 - 7/8	19mm – 22.2mm
5	1/4 - 5/16	6.4mm – 7.9mm	16	7/8/2001	22.2mm 25.4mm
6	5/16 – 3/8	7.9mm – 9.5mm	20	1 – 1 3/8	25.4mm – 34.9mm

Hollow Rivet Material Compatibility

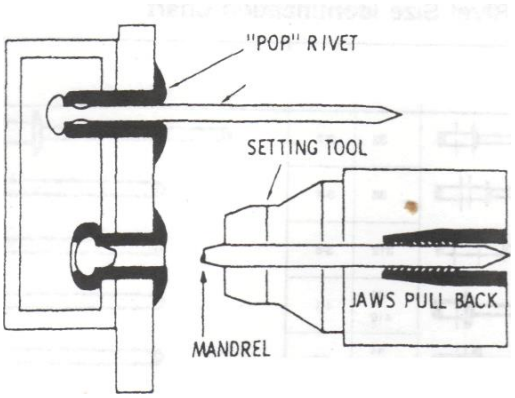
It is important to note, that although this type of fastening is inexpensive, precautions need to be taken to ensure that dissimilar metals are not employed, as galvanic reactions between the metal and rivet, may cause the joint to ultimately fail.

	MATERIAL				
RIVET	ALUM	AL/AZ COATED STEEL	ZINC COATED STEEL	ST STEEL	COPPER
ALUMINIUM			?	NO	NO
STEEL Z/P	NO			NO	NO
NICKEL COPPER	NO	NO	NO		
ST. STEEL	?	?	?		
COPPER	NO	NO	NO		

	Compatible
NO	Must not be in contact
?	Compatible in mild environments Painting both metals would reduce reaction

Hollow Rivet Fastening / Upsetting - Manual Operation

In the operation of fastening or upsetting the rivet, the protruding steel stem or mandrel within the rivet body, is inserted into the nozzle of the pliers like tool. The action of squeezing the handles together draws the mandrel stem head through the body of the rivet, expanding the tubular shell. This compresses the material in which the rivet has been inserted, between the rivet head and the expanded shell of the protruding rivet. At the rivet's designed compression force, the head of the steel mandrel separates from its stem making the familiar pop or snap sound, signaling the completion of the riveting action and it has been upset.



Hollow Rivet Fastening - Automatic Machine Operated

Automatic machine operated riveting methods are used on large scale production runs, where great importance is placed upon the ease, presentation and the speed of the action. A further advantage being, that the tool used, is air operated, allowing for a large number of riveting actions to be made, with minimal fatigue to the operator.
Automatic machines carry the rivets in a cartridge type container, reducing the rivet reloading time after each upsetting operation.

Semi-automatic rivet machine (left)

Hand rivet gun(above)pneumatic rivet gun (as used in picture above)

23. SOLAR PANEL METAL TRAY

The metal tray may be made in a number of sizes depending upon the intended purpose of the tray. The dimensional variations shown below allow for some suggested purposes.
Note: Available resources may not allow the manufacture of all the sizes shown.

TRAY	PURPOSE	NOMINAL DIMENSIONS
1	Overall metal sheet dimension	
2	Inner tray dimension	
3	Side height dimensions	

Criteria for success	S or NYS
Dimensions suitable for tray	
Material sizes suitable for job	
Tools required suitable for project	
Procedure suitable for project	
Completed model fit for purpose	

Lecturer signature: _____Date_____

Manufacturing Procedure (Steps)

_____

_____

_____

_____

_____

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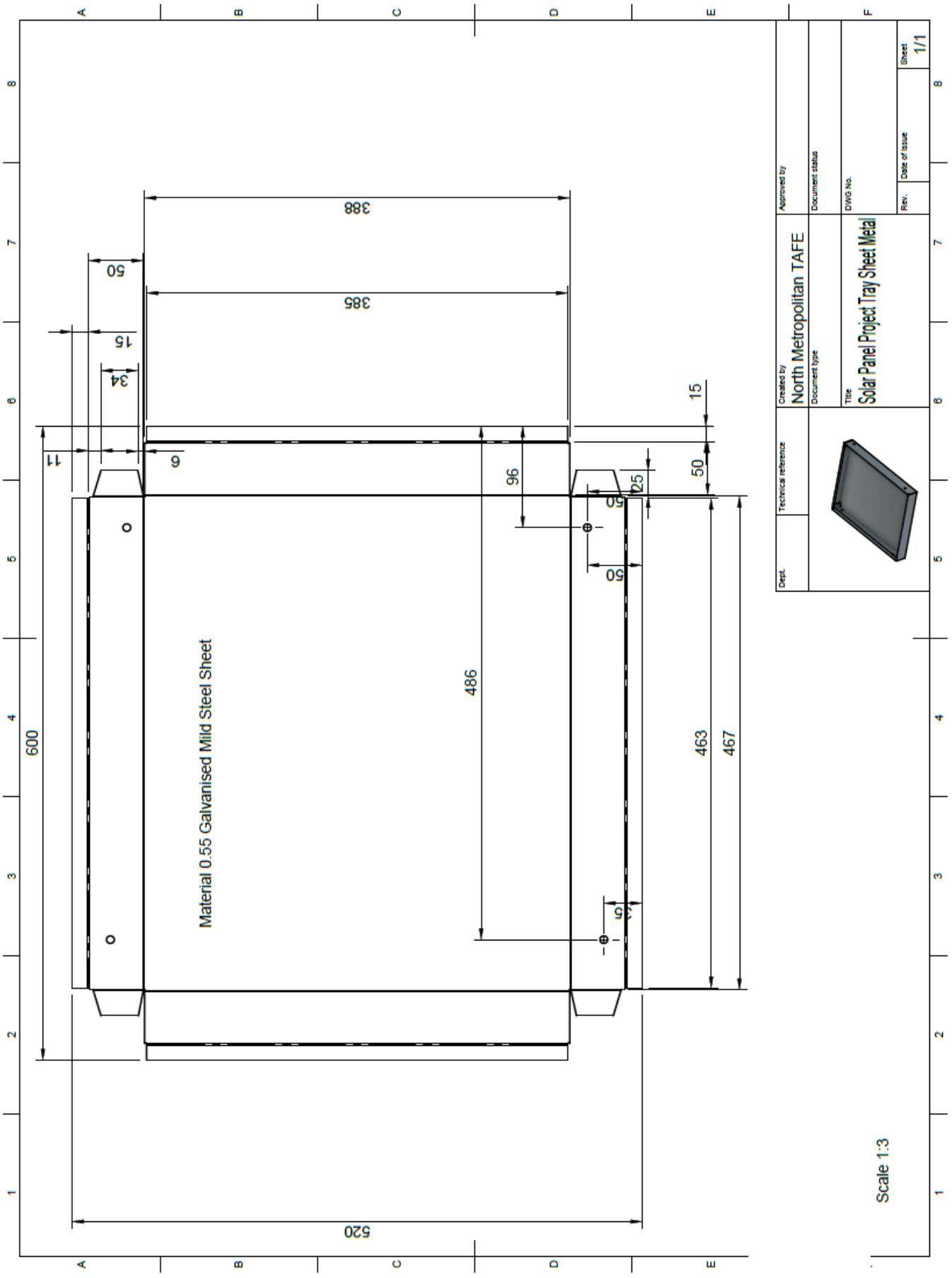

388
385
50
15
34
11
6
96
25
50
50
50
15
600
486
463
467
Material 0.55 Galvanised Mild Steel Sheet
520
Scale 1:3
Created by
North Metropolitan TAFE
Approved by
Document status
Document type
DWG No.
Title
Solar Panel Project Tray Sheet Metal
Rev.
Date of issue
Sheet
1/1
Dept.
Technical reference

EXERCISE - TRAY

Dimension the drawing on the following page so that it will be fit for purpose. (Refer to the table for the trainer size note: allow extra for fittings).

You will need to allow approximately 5mm clearance front and back and only an additional 5mm clearance for the width and height of the trainer if choosing option 3.

Draw in the centre lines and bend lines.

Finished dimensions

Length:_____

Width:_____

Height:_____

Size of Material required for the project

Length:_____

Width:_____

Thickness_____

Material:_____

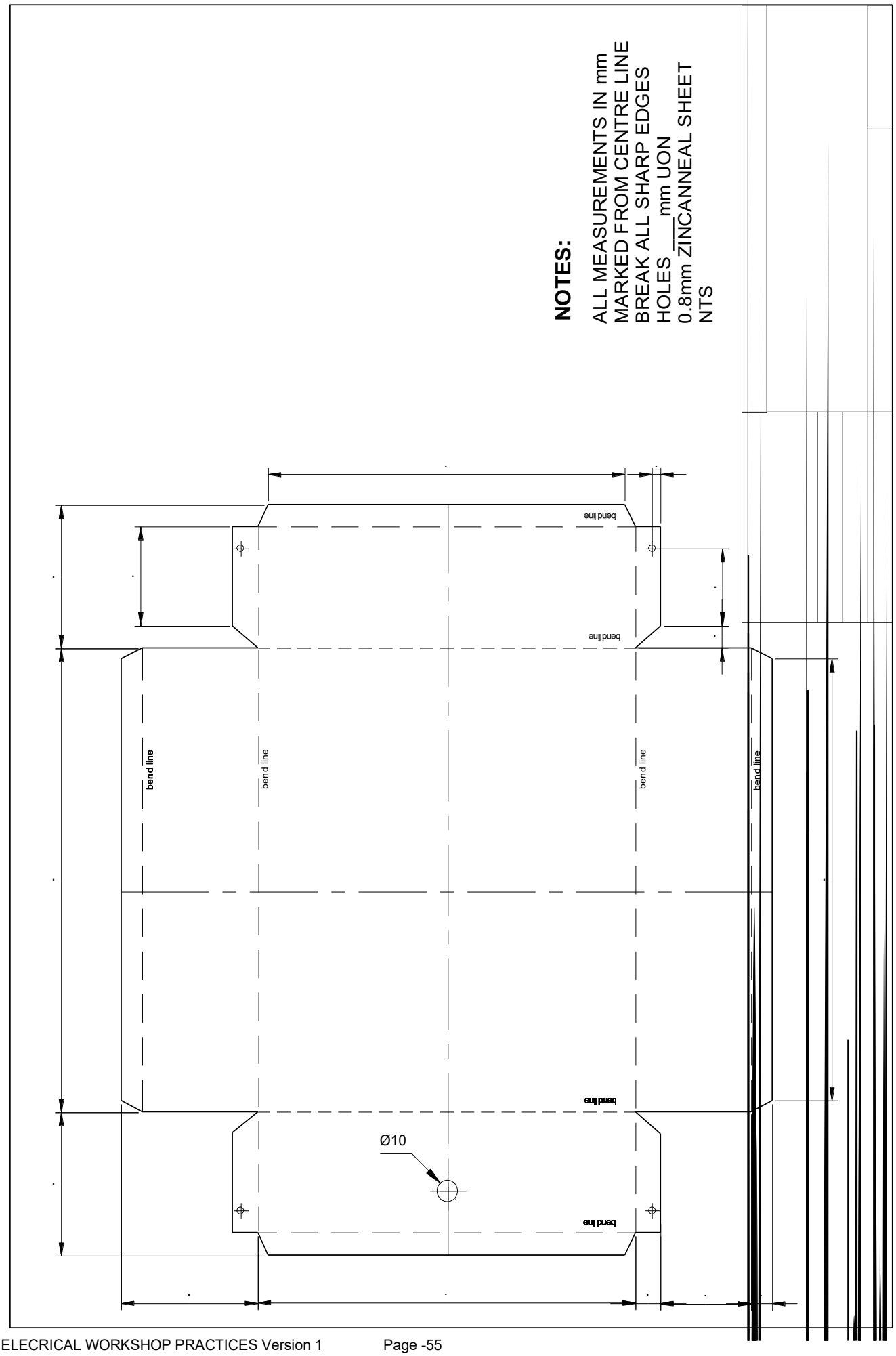
Equipment list (required tools, hand and machine)

From tool tray

- _____
- _____
- _____
- _____
- _____
- _____
- _____

Other Tools/Equipment

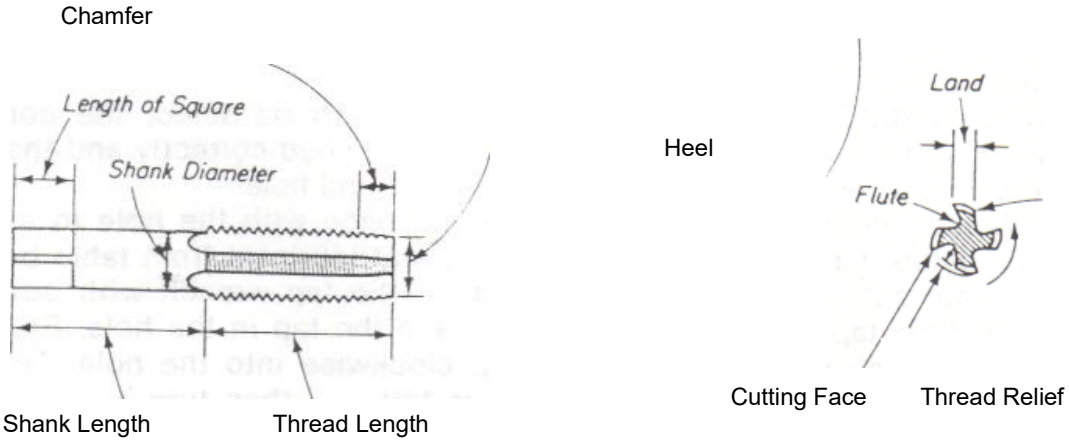
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____


NOTES:
ALL MEASUREMENTS IN mm
MARKED FROM CENTRE LINE
BREAK ALL SHARP EDGES
HOLES ___mm UON
0.8mm ZINCANNEAL SHEET
NTS
bend line
bend line
bend line
bend line
bend line
bend line
bend line
Ø10

24. TAPS AND DIES

Taps and dies are used to cut threads in metal, plastics or hard rubber. The taps are used for cutting internal threads, and the dies are used to cut external threads

TAPS



The **square end** is used to turn the tap with either a straight or T-handled tap wrench.

The shank is a smooth, rounded section which is immediately behind the threaded section.

The body **(threaded)** section contains four **flutes** which have threads cut into their upper edges
they have a hollow section near the center to permit metal shavings to fall away from the cutting edges.

The **chamfer** is the non-threaded end of the tap. It allows the tap to be positioned squarely in the metal to be threaded without engaging the threads of the tap

T Wrench

Adjustable straight wrench

Taper tap: Similar to a plug tap but has a more pronounced taper to the cutting edges. This feature gives the taper tap a very gradual cutting action that is less aggressive than that of the plug tap. A taper tap is most often used when the material to be tapped is difficult to work (e.g., alloy steel)

Intermediate or **plug tap**: The tap illustrated in the middle of the image has tapered cutting edges, which assist in aligning and starting the tap into an untapped hole. Plug taps are the most commonly used type of tap.

Bottoming tap: The tap illustrated in the bottom of the image has a continuous cutting edge with no taper. This feature enables a bottoming tap to cut threads to the bottom of a blind hole. A bottoming tap is never used to cut threads in an unthreaded hole, as the cutting edges lack the taper required to successfully start into such a hole

How to use a tap

1. From the tapping drill charts select the correct drill size.

2. Ensure the drill is sharpened correctly and that the drill cuts a clean, straight and round hole.

3. Clamp the work in a vice with the hole in an upright position.

4. Select tap (3) and secure in tap wrench

5. Apply cutting oil to the tap and the hole

6. Grasp the tap wrench with both hands close to the tap place the tap in the hole. Fig.1

7. Press and start to turn tap clockwise into the hole.

8. Make sure tap is square with surface of work at all times.
Turn tap forward until resistance is felt then turn the tap back a quarter-turn to break the ‘chip’

Note:
Once the thread is started properly, the tap will draw itself into the work and downward pressure is no longer needed. Grasp the wrench by both handles and with a slow steady movement, continue turning tap into the hole, turning back when increased resistance is felt to allow the chips to break. A tightly wedged tap will easily break so never force the tap.
Using too much pressure or letting the tap get out of line will also break the tap.

Lubricants — Taps & Die

Material	Lubricant
Steel	Neatsfoot Oil or Sulphur Base Oil
Stainless Steel	Neatsfoot Oil or Sulphur Base Oil
Brass and Copper	Kerosene and Lard Oil
Cast Iron	Kerosene or Soluble Oil
Aluminium	Kerosene and Light Mineral Oil
Plastics	Soap Solution

TAP DRILL SIZE TABLE

Imperial Tap & drill bit size table

Tap	Fractional Drill Bit	Number Drill Bit	Letter Drill Bit
0-80	3/64	-	-
1-64	-	53	-
2-56	-	50	-
3-48	-	47	-
4-40	3/32	43	-
5-40	-	38	-
6-32	7/64	36	-
8-32	-	29	-
10-24	5/32	25	-
10-32	5/32	21	-
12-24	11/64	16	-
1/4-20	13/64	7	-
1/4-28	7/32	3	-
5/16-18	17/64	-	F
5/16-24	-	-	I
3/8-16	5/16	-	-
3/8-24	21/64	-	Q
7/16-14	23/64	-	U
7/16-20	25/64	-	-
1/2-13	27/64	-	-
1/2-20	29/64	-	-
9/16-12	31/64	-	-
9/16-18	33/64	-	-
5/8-11	17/32	-	-
5/8-18	37/64	-	-
3/4-10	21/32	-	-
3/4-16	11/16	-	-
Drill sizes are for 75% depth of thread.			

Metric Tap & drill bit size table

Tap	Metric Drill	Imperial Drill
3 mm x 0.5	2.5 mm	-
4 mm x 0.7	3.4 mm	-
5 mm x 0.8	4.3 mm	-
6 mm x 1.0	5.2 mm	-
7 mm x 1.0	6.1 mm	15/64
8 mm x 1.25	6.9 mm	17/64
8 mm x 1.0	7.1 mm	-
10 mm x 1.5	8.7 mm	-
10 mm x 1.25	8.8 mm	11/32
10 mm x 1.0	9.1 mm	-
12 mm x 1.75	10.5 mm	-
12 mm x 1.5	10.7 mm	27/64
14 mm x 2.0	12.2 mm	-
14 mm x 1.5	12.7 mm	1/2
16 mm x 2.0	14.2 mm	35/64
16 mm x 1.5	14.7 mm	-
Drill sizes are for 75% depth of thread.		

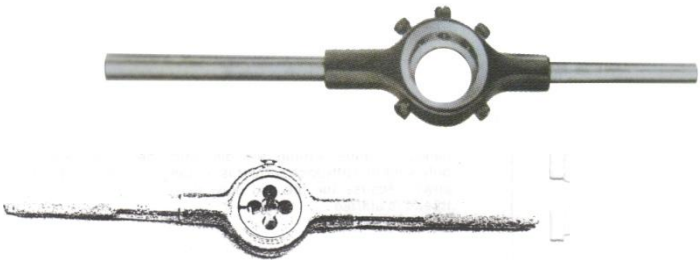
CARE OF TAPS

1. Do not attempt to sharpen taps
2. Keep cutting edges lightly oiled
3. Wipe excess oil and metal shavings from tap and tap wrench
4. Store taps in a case or wrap individually in cloths to protect cutting surfaces

DIES

Rethreading dies (die nuts) are used to restore bruised (rounded) or rusty threads on screws and bolts. The rethreading die is hexagonal in shape and may be turned with a socket, box, open-end, or any other wrench that will fit. They are available in American Coarse and Fine Threads. Rethreading dies are available in a variety of sizes and are usually assembled in sets with a case

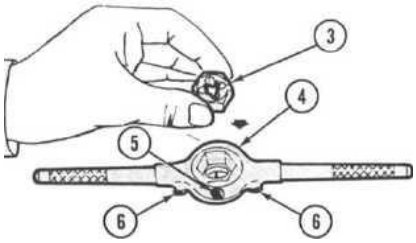
DIE



DIE STOCK

DIE NUT

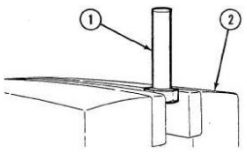
How to use a die



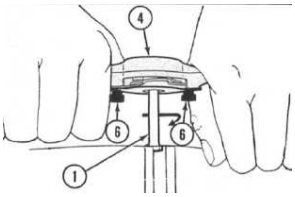
1. Assemble die (3) and diestock (4). Tighten setscrew (5). Loosen the two thumbscrews (6) to adjust diestock (4).

2. After assembling die to diestock, make sure setscrew is tight. Die could fall out of diestock causing damage to die

3. Grind or file a small bevel on the edge of the rod or pipe to be threaded; this makes starting the die easier.



4. Fasten the work in a vice, either vertically or horizontally, depending on the length of the piece



5. Apply cutting oil (7) to the die and to the work

6. Grasp the die holder with both hands near the die and place the starting side of the die over the end of the rod or pipe.

7. Press down firmly on the work and at the same time slowly turn the die clockwise . . . backing up when resistance is felt just as you do with a tap. Be sure the die goes on squarely.

8. After the thread is started, grasp the die holder by both handles, Fig. 2 and, with a steady forward and back movement, continue turning the die onto the work, advancing only slightly with each turn.
   It is no longer necessary to press down because the die will draw itself onto the work when thread is started.

9. Turn the diestock one turn forward and one-quarter turn backward. Repeat this procedure until desired thread length has been cut.

10. Carefully back the diestock off the threads by turning in a counterclockwise direction

11. Clean threads with a clean rag and check with a screw pitch gage before using

12. Disassemble die and diestock by loosening setscrew. Wipe clean with a rag.

Thread charts are a readily available guide for cutting threads and preparing the internal or external diameters of the materials to be threaded.

Imperial Thread Chart (Threads per inch)

Size	Major Dia "	Major Dia mm	BSF 55°	BSCY 60°	Brass 55°	BSW 55°	UNC 60°	UNF 60°	BA 47.5°
0G	0.0600	1.524						80	
1/16	0.0625	1.588				60			
10BA	0.0669	1.699							72.6
1G	0.0730	1.854					64	72	
9BA	0.0748	1.900							65.1
5/64	0.0781	1.984				56			
9/16	0.5625	14.288	16	20/26	26	12	12	18	
5/8	0.6250	15.875	14	20/26	26	11	11	18	
11/16	0.6875	17.463	14		26	11			
3/4	0.7500	19.050	12	20/26	26	10	10	16	
13/16	0.8125	20.638							
7/8	0.8750	22.225	11	20/24	26	9	9	14	
15/16	0.9375	23.813							
1	1.0000	25.400	10	24	26	8	8	12*	

* **Note:** UNF is the same as ANF and SAE except at 1" dia where ANF and SAE are 14 tpi.

25. EXERCISE - ADHESIVES

ADHESIVES research exercise completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

Answer the following basics regarding adhesives…
What is it?
What can it or can't it do?
What colour is it (uncured/cured)?
What characteristics?
TOXICITY?
Anything else of interest?

1. **Araldite** also known as "Epoxy"

2. **Contact cement**

3. **Superglue** (also known as cyanoacrylate.)

4. **PVA** white woodworking glue

5. Hot melt glue

6. Silicone Silastic

SAFETY

Most adhesives are synthetic materials and may contain toxic solvents or other substances. Always keep the adhesives off your skin wherever possible and clean up carefully afterwards.

When the glue contains significant amounts of solvents ensure your work area is adequately ventilated and away from sources of ignition.

Solvents are a fire hazard

- **All of these glues clean up best when first applied.**
- **Inspect your job, work area, clothes and person after using glues of any type.**
- **Clean up immediately.**

26. EXERCISE - DRILL GAUGE.

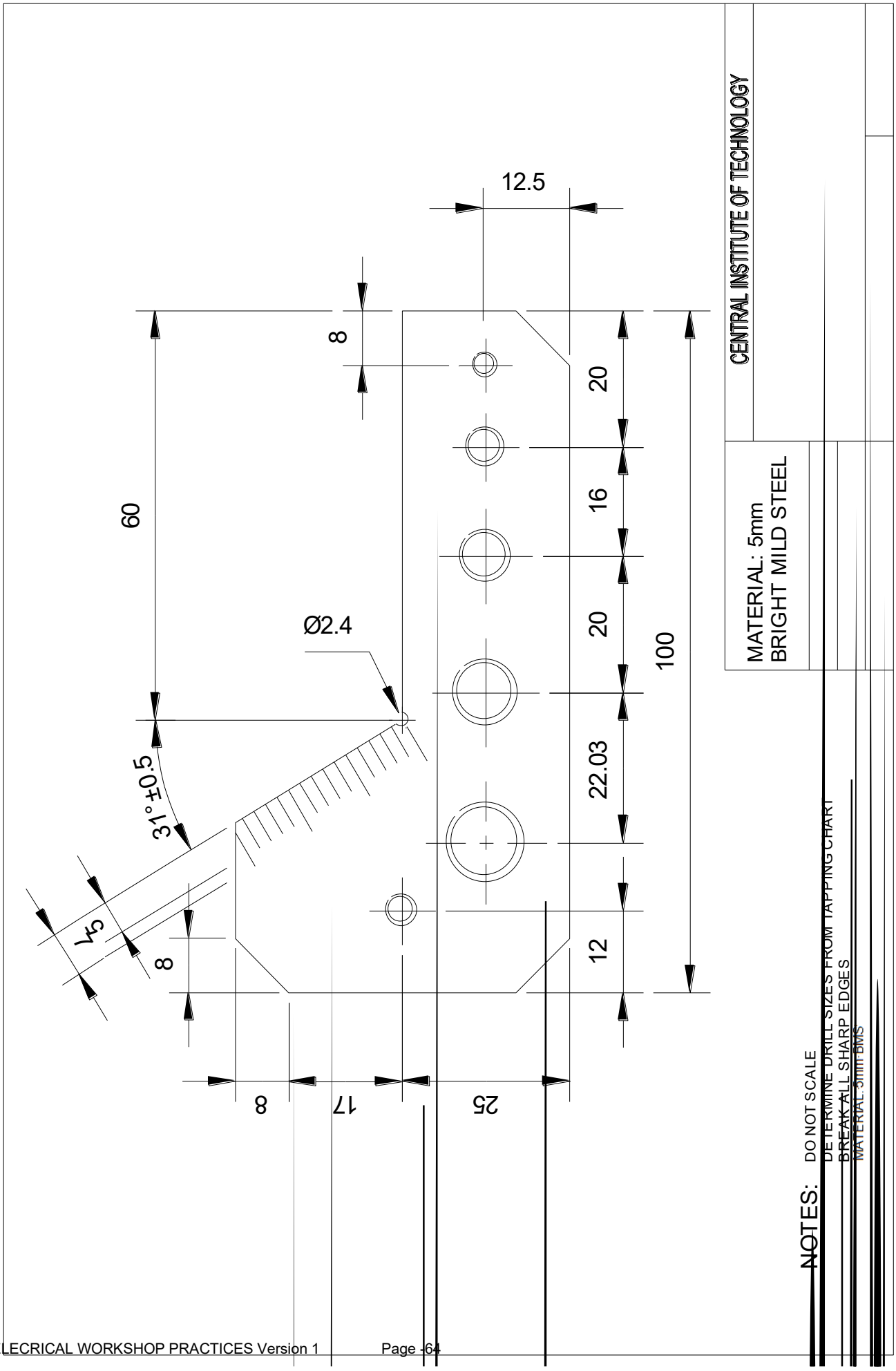
DRIL GAUGE exercise completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

1. Check the measurements on the drawing on the following page carefully and measure your length of steel to make sure it is 100mm or slightly longer.
2. Place the bar in the vice clamping its edges so that the 50 x 100mm flat area is upward and draw file the surface to clean away the black oxide, then turn over and clean the other side.
3. Place the bar in the vice, clamping the flats so the edge is upwards and draw file the edge until the rounded corners are gone. The edge should be sharp and flat. Repeat for other edge.
4. Blue both sides, square the ends by marking at each end 100mm apart then draw file the ends until you get down to the line and the metal is exactly 100mm long. Mark out the 3 corner angles on both sides of the bar.
5. Mark the centre line down the length of the bar 25mm in from the bottom edge on both sides of the bar, then mark the M5 and 2mm hole on the centre line.
6. From the bottom edge, mark a line between the centre line and the bottom edge 12.5mm up and mark all the hole centers M4, M6, M8, M10, M12.
7. Mark the angled line off from the centre line hole (2.4mm) at an angle of 31 degrees on both sides of the bar using a sliding bevel.
8. Drill all holes to each **drill size** marked on the drawing **(Not the M size),** then countersink each hole with a countersinking bit on top side only.
9. Select the correct taps and cut the thread in each hole to correct marked size. ie (M8)**.** (**NOTE: 2.4mm hole is not tapped).**
10. Carefully cut the corners off using a standard size hacksaw then draw file each corner down to its marking line.
11. Cut down the centre line with the hacksaw then down the angled line then draw file down to the marked line.
12. Mark graduations on gauge using a scriber and rule.
13. Draw file with a finishing file to polish surfaces, then use the letter stamps to mark THREAD SIZES, ISO METRIC COARSE and your name on the surface.

Alternative MARKING OUT Exercise is to make the drill gauge from zincaneal sheet.


12.5
8
20
16
20
22.03
12
100
60
Ø2.4
31°±0.5
5
8
8
17
25
CENTRAL INSTITUTE OF TECHNOLOGY
MATERIAL: 5mm
BRIGHT MILD STEEL
NOTES:
DO NOT SCALE
DETERMINE DRILL SIZES FROM TAPPING CHART
BREAK ALL SHARP EDGES
MATERIAL 5mm BMS

27. EXERCISE – JOINING TECHNIQUES

WELDING research exercise completed:

Satisfactory	
Unsatisfactory	

Lecturer signature: _____Date_____

Over the course of the previous sessions, we have covered the following JOINING TECHNIQUES…

- Riveting
- Adhesives
- Tapping (machine threads)
- Soldering (soft soldering i.e. joining wires)
- Fixing to cement products (concrete and brick)

In addition to these methods, there are other forms of JOINING TECHNIQUES (welding) including…

Electric

1. ARC WELDING (MMAW)
2. TIG welding
3. MIG welding

Gas (oxy acetylene and/or oxy propane)

4. Bronze welding (brazing)
5. Hard Soldering (silver soldering)
6. Phosbronze

It is not generally within the time constraints of this program to cover all these joining techniques as a whole course can be devoted to each of these disciplines.

Your task is a research assignment (report) that will provide some basic information on each of these processes. You will need to answer the following questions for each process…

a. Name the process.
b. What is it used for (joins what types of materials ferrous, non-ferrous, thickness etc)
c. What equipment is required for the process
d. What safety equipment is required.
e. Provide a picture of the equipment required (including PPE)
f. What are the dangers associated with each process)

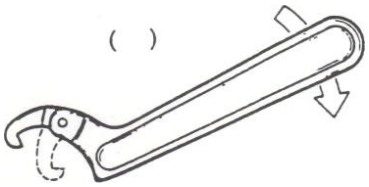
If time permits (last session), a demonstration of basic forms of welding may be carried out.

28. EXERCISE - TOOL RECOGNITION 1

Task

1. What is the tool shown? (eg spanner, pliers, snips, drill, saw etc)
2. What is it used for?…(eg measuring, marking, shaping, cutting, holding, undoing etc)

No	NAME and USE	TOOL
1.	Example… Single open-end spanner Undoing nuts/bolts	
2.		
3.		
4.		
5.		
6.		
7.		

8.		
9.		
10.		
11.		
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22.		
23.		

24.	Speed brace	
25.	Offset extension bar	
26.	Square drive (C Spanner)	
27.	Diagonal cutting/side cutting pliers	
28.	Adjustable/shifting spanner	
29.	Phillips or Pozidrive Screwdriver	
30.	Combination open end and ring spanner	

31		
32		
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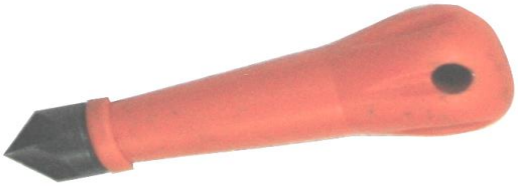
35		
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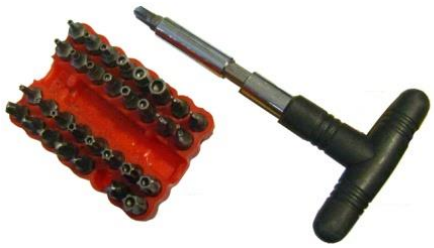
45		
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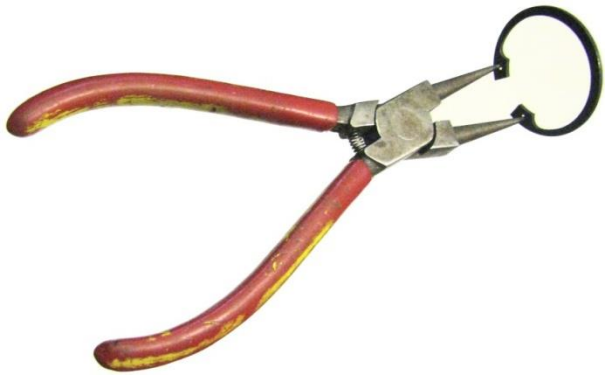
73		

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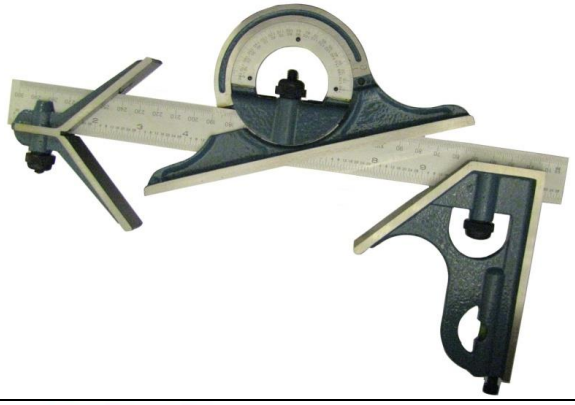
100		
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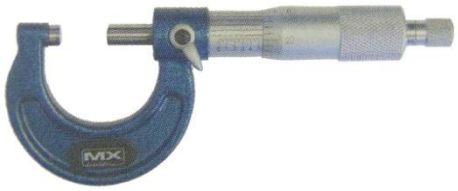
107		
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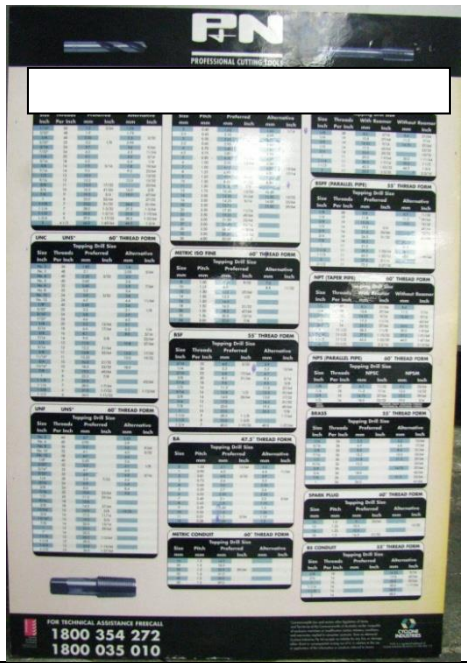
111		
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How did you go? _____/115

29. EXERCISE - WORKSHOP BASICS

1. Draw an arrow on the sketch of a hacksaw frame (below), showing the direction teeth face

2. When cutting thin material with a hacksaw, would you use a coarse or fine pitch blade? Why would you choice this blade?

_____
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3. What should you do when marking off a job to avoid losing the line when you cut and file the job?

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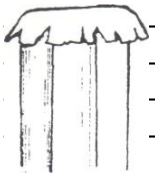
4. What is wrong with the head of this cold chisel?



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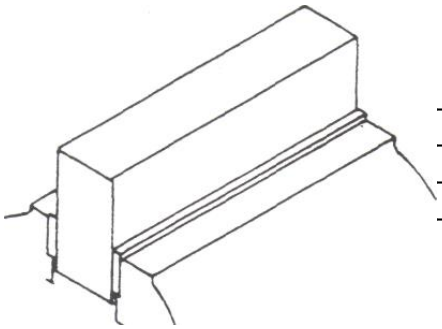
5. What is meant by crossing the cut when using a file, and why is it done? Complete the sketch below showing the file movements



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30. RECORD OF COMPLETION

REQ'd	ITEM DESCRIPTION	COMPLETION
☐	OHS (THEORY)	
☐	TOOL TRAY (THEORY)	
☐	MARKING OUT (THEORY AND PRACTICAL)	
☐	MEASURING Vernier (THEORY AND PRACTICAL)	
☐	MICROMETER READING (THEORY AND PRACTICAL)	
☐	BATTERY CLAMP (PRACTICAL)	
☐	BRACKETS (PRACTICAL)	
☐	TRAY EXERCISE (THEORY AND PRACTICAL)	
☐	ADHESIVES (ASSIGNMNET WEEK 6)	
☐	DRILL GAUGE (PRACTICAL)	
☐	JOINING TECHNIQUES (ASSIGNMENT WEEK 8)	
☐	CHASSIS (PRACTICAL)	
☐	TOOL IDENTIFICATION (THEORY)	
☐	WORKSHOP Basics (THEORY)	
☐	QUIZ (THEORY)	

NOTE:
It is your responsibility to ensure that all of the sections are marked off upon completion. This workbook is required on the final session to enable verification of work completed (assignments, quizzes, work book theory activities and practical exercises). Failure to produce this work book will ensure an undesirable result to be entered.