MEM05 Metal and Engineering
Training Package

MEM12007D
Marking off/out structural fabrications and shapes

Learner guide
Version 1

Training and Education Support
Industry Skills Unit
Meadowbank

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Topic 1: Marking off tools and measurement devices

Objectives

At the end of this topic you will be able to;

List the measurement, squaring and marking tools in common use in metal fabrication industries:

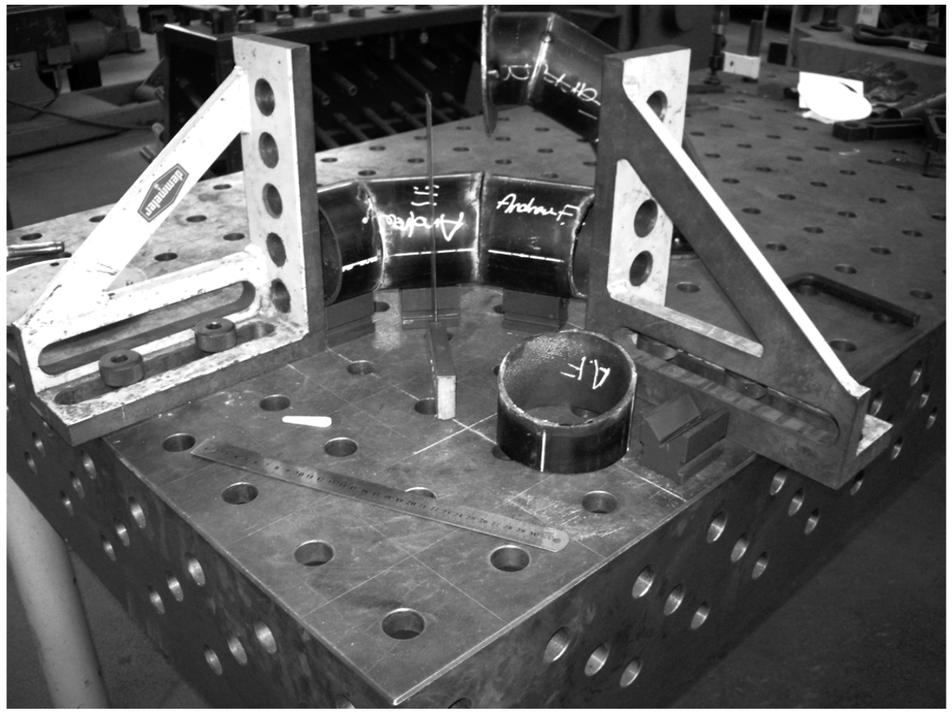
- steel rules
- tape measures
- squares
- dividers
- trammels
- marking tools
- holding devices
- special purpose measuring tools.

outline typical applications for each tool:

- measurement
- squaring
- permanent and non-permanent marking
- witness marking.

State the necessary processes for care and maintenance of measuring, squaring and marking tools:

- safety
- wear correction
- environment.



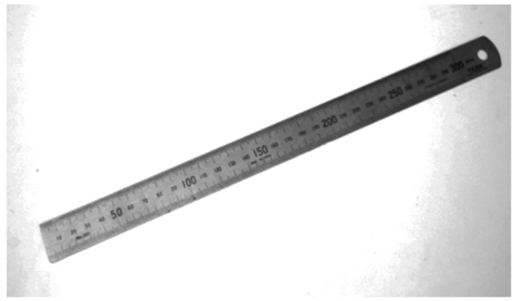
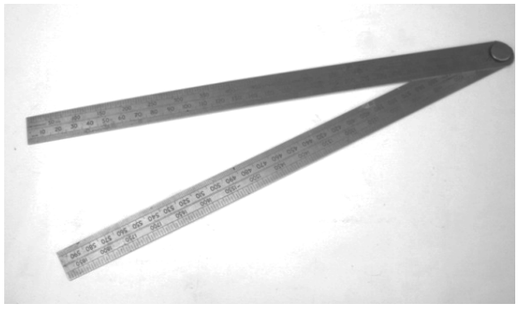
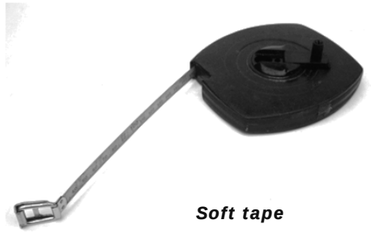
Marking/assembly table

Marking-off tools and measurement devices

Boilermakers and metal fabricators will use a variety of hand tools and measuring devices when marking structural sections to shape and dimension.

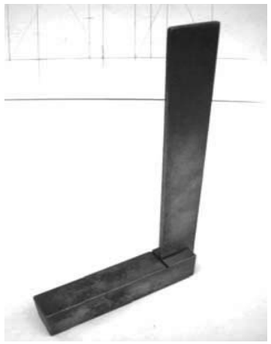
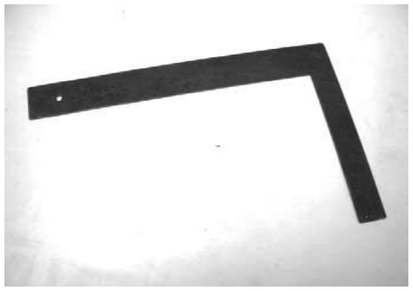
The following table contains a list and brief description of marking off, squaring and measurement tools common to most areas of structural fabrication.

Measurement tools

Steel rule 	For accurate measurement over the length of the rule. Metal fabricators would typically use this measurement tool to; • measure small metal parts to size • mark centre lines and hole locations.
Folding steel rule (Line of cord rule) 	For accurate measurement over the length of the rule, transfer of angles. Metal fabricators would typically use this measurement tool to; • measure small to medium metal parts to size • construct angles to size and transfer to structural sections.
Tape measures  ***Metal blade tape***  ***Soft tape***	For measurement over long distances. Metal fabricators would typically use this measurement tool to; • measure larger metal plates and sections to size • lay out dimensions when constructing or erecting structural sections • Soft tapes are normally used for measuring distances over 8 meters.

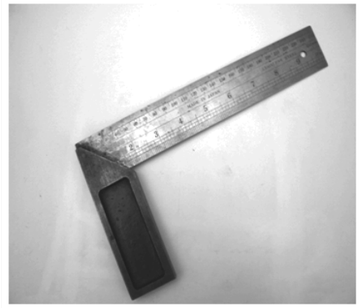
Additional student notes:

Squaring tools

Block square (Engineers square) 	For marking square lines off plate edges and marking around rolled steel sections. Metal fabricators would typically use this squaring tool to; • square off small structural sections prior to assembly • transfer lines around structural sections prior to thermal or mechanical cutting.
Plate square 	For marking square lines off plate edges or existing lines. Metal fabricators would typically use this squaring tool to; • construct square lines during marking off layouts • square off larger structural sections • check sections for square during assembly.
Combination set 	For accurate angle construction Metal fabricators would typically use this measurement tool to; • construct angles on structural sections • locate centre lines along pipes and circular hollow sections • Mark the backgauge on angles

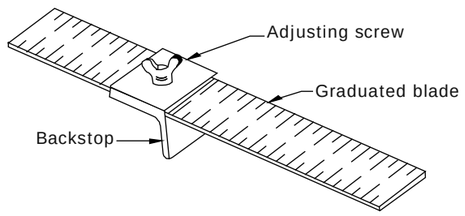
Bevel square 	For transferring angles. Metal fabricators would typically use this marking tool to; • transfer angles to structural sections • duplicate angles • check constructed angles during assembly.

Other squares used in metal fabrication include;

Try square 	Similar uses as the block square. As well as marking right angles, try squares have a 45° edge, used for marking and checking mitre corners.
Combination square 	Squaring component of the combination set. As well as 90° and 45° marking and checking, this square can also be used as a back gauge during marking off and fabrication assembly.

Marking tools

Angle or back gauge



For accurately locating gauge lines to position items or hole centres.
Metal fabricators would typically use this marking tool to;

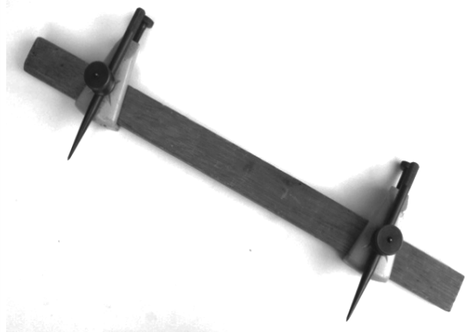
- mark out a series of similar hole locations on structural sections
- assist assembly of attachments during fabrication.

Dividers

For drawing arcs and circles.
Metal fabricators would typically use this marking tool to;

- geometrically construct angles
- step out hole locations on flanges
- transfer dimensions on structural sections
- mark out small to medium circles for thermal cutting.

Trammels



For constructing large arcs and circles.
Metal fabricators would typically use this marking tool to;

- mark out large circles and arcs, and dividing lines and angles
- geometrically construct angles
- transfer measurements and angles on structural sections.

String line

For producing soft chalk lines over medium to long distances
Metal fabricators would typically use this marking tool to;

- mark out locations for structural sections
- plumb structural sections during construction.

Scriber

For accurately marking thin permanent lines on metal sections.

Metal fabricators would typically use this marking tool to;

- mark out hole locations, and mark the positions of attachments to structural sections.

Engineers chalk

Sharpened to a chisel point to mark thin non-permanent lines.

Metal fabricators would typically use this marking chalk to;

- mark visible, heat-resistant lines on structural steel sections for cutting, forming or location of hole centres.

Ball pein hammer 	General hand hammer used by metal fabricators and boilermakers when marking off Metal fabricators would typically use this hand tool together with the centre punch to; • mark hole centres • permanently mark witness marks on lines • mark lines to assist accurate thermal cutting.
Centre punch 	Used for permanently marking line locations, hole centres for drilling or punching, and marking a shape for thermal cutting Hand-held and hand-operated spring loaded prick punches are also available, and are useful for marking centres when using dividers and trammel centres.

Metal fabricators will also use measurement and marking tools specific to the type of work being fabricated. Other tools not listed might include customised measuring devices such as;

- scribing back-gauges
- pipe profile markers
- pipe-to-flange squares.

Jigs and fixtures can also serve as measurement devices for repetitive fabrication work. Such devices can allow repetitive work to be completed by semi-skilled workers, allowing the tradesperson to complete more skilled tasks.

Commercially produced high quality workbenches used in fabrication can be set up using fixtures and devices for accurate measurement of distances and angles.

Other hand tools used for marking off

	Holding devices such as magnets and spring clamps. Metal fabricators would typically use this tools to; • hold tape measures accurately in place when marking dimensions on longer structural sections such as universal beams and columns • hold brackets and other components in place during fabrication assembly.

Measurement tools are calibrated to close tolerances, and good quality measurement tools are often expensive to purchase. To ensure long-lasting reliability and accuracy of measurement and marking off tools, they should be used with care and stored appropriately.
For example;

- correctly store measurement equipment and squaring tools to avoid damage from other hand tools
- take care to avoid damage from thermal cutting, welding and environmental factors such as wet weather when using measuring tools
- check marking tools for wear; scribers and centre-punches will occasionally require sharpening to their correct angles; hammer handles need to be secured properly to hammer heads; tape, square and rule blades occasionally require light oiling to avoid surface corrosion appearing
- by looking after your tools, to the manufacturers recommendations, they will provide you with accurate measuring devices for many years to come.