TRADE OF

Industrial Insulation

PHASE 2

Module 1

Sheet Metal and Insulation Fundamentals

UNIT: 9

Metal Cladding Assembly Work

Produced by

SOLAS

An tSeirbhís Oideachais Leanúnaigh agus Scileanna
Further Education and Training Authority

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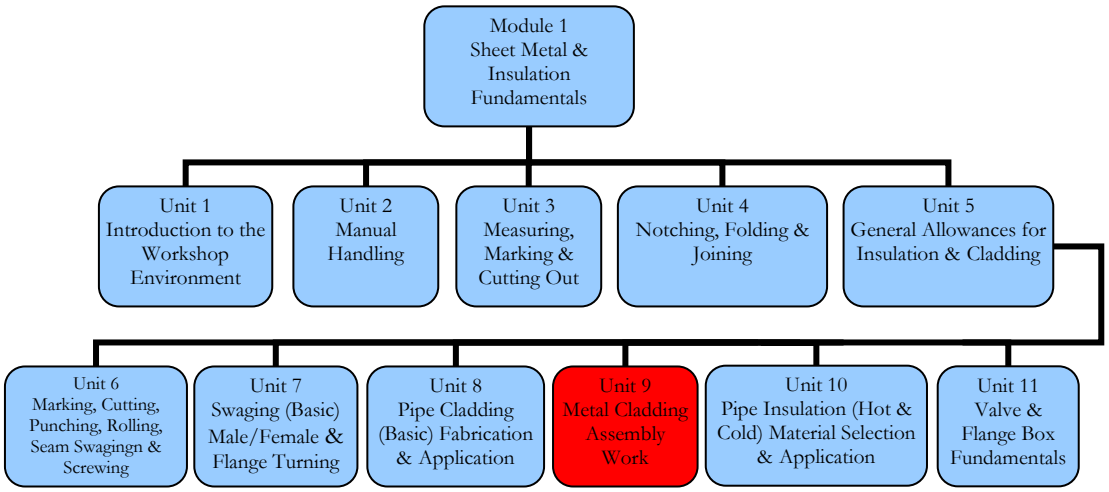
Introduction

In this unit we address the fundamentals of fabricating and assembling cladding pipe sections. Pipe sections are generally joined by either male/female interlocking swages or by crimping one end of a pipe to fit into the other pipe. It is important that the apprentice understands the need for accuracy when fabricating and assembling pipe sections, as inaccuracy can lead to a sloppy fit up of parts and a poor overall appearance to the job.



Unit Objective

By the end of this unit **each apprentice** will be able to:

- Fabricate and swage pipe cladding pieces.
- Assemble pipe cladding.
- Crimp a section of pipe cladding.
- Join two pieces of flat sheet.
- Fitting a toggle snap.
- Identify and operate tensioning tools.
- Operate a lazy tongs.
- Dress a solid rivet.

1.0 Fabricating a Section of Pipe Cladding

Key Learning Points

- Reading and interpretation of drawings.
- Calculation of joining allowances.
- Fabrication and swaging of several pieces of pipe cladding.
- Precision cutting and male/female swaging.
- Fixing hole alignment.
- Tight interlocking jointing of cladding pieces.
- Communication and information gathering.

1.1 Fabricate, Swage and Assemble Sections of Pipe Cladding

The following procedures should be followed when developing pipe sections for cladding. It is important that the apprentice spends time reading and understanding the drawing before commencing the pattern development. Communicate with other workers who may be working on the project as well. If a drawing cannot be fully understood or if there are doubts as to some aspects of the drawing, it is important that the correct information is sought before commencing the project.

1. Calculate the overall width of the pattern.
2. Diameter of the pipe = 175mm
3. Calculate the circumference of the pipe = diameter x π = 175mm x 3.14 = 549.5mm
4. Add lap or joining allowances of 30mm (15mm both ends of the pattern)
5. The total width of the pattern = 549.5mm + 30mm = 579.5mm

Note: The lap allowance may vary to 40mm overall.

6. Cut the patterns using the guillotine.
7. Mark the position of the holes using a scratch gauge, tape and steel rule.
8. Punch the holes in the pattern using a 3.3mm die in the multi punch machine.
9. Swage the longitudinal seam on the pattern using the swaging machine.
10. Pre-set and roll the pattern to the required diameter using the hand operated slip bending rolls or the power bending rolls.
11. Assemble the pipe using 4.2mm diameter x 13mm long self tapping screws.
12. Swage each end of the pipes – one end with a male swage and the other end with a female swage.

13. Assemble the pipes by interlocking the male and female swages. The joints should be tight and free from rattle

1.2 Male and Female Swages

Refer to module 1 – unit 7 – section 2.

1.3 Rolling Cylindrical Pipes

Refer to module 1 – unit 6 – section 3.

2.0 Operating a Slip Bending Rolls

The slip bending rolls is an easy machine to operate, however a lot of experience is required to manufacture well-formed jobs. Pre-setting of the pattern or job is very important as it determines how accurate the finished pipe will be with regard to its shape and roundness.

Key Learning Points

- Power crimping using the power swager.
- Flush jointing swager set up using the power swager.
- Correct use and applications of various screwdrivers.

2.1 Procedure for Rolling Cylindrical Shapes

1. Raise or lower the bottom front roll by adjusting the two front knurled adjustment screws so the sheet can be inserted(this arrangement or design may differ from machine to machine). It is important to note that if the sheet has a swaged edge, the rolls must be far enough apart so the swage will not be flattened.
2. Set the rear roll by means of the two knurled adjustment screws at the back of the machine. To make a large diameter, the rear roll must be lowered, and to make a small diameter the rear roll must be raised.
3. Insert the sheet between the rolls from the front of the machine.
4. Start rolling the sheet between the rolls by turning the operating handle.
5. Holding the operating handle firmly with the right hand , raise the sheet with the left hand to from the starting edge.
6. Turn the operating handle until the sheet is partly through the rolls, changing the left hand from the front edge of the sheet to the upper edge of the sheet.
7. Roll the remainder of the sheet through the machine.

Note: If the curvature is not small enough, bring the sheet back to its starting position by turning the operating handle in the opposite direction, raise the rear roll slightly, and roll the sheet through the rolls again. Repeat this procedure until the required curvature is achieved.

8. Raise the upper roll and remove the job.

2.2 Universal Combination Rotary Machine

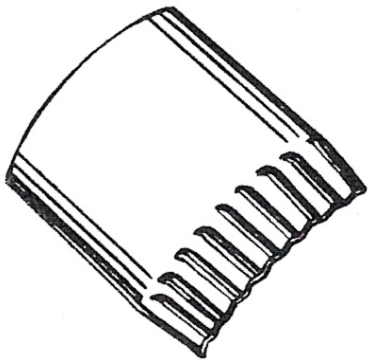
The universal combination rotary machine (also known as a swaging machine) has interchangeable rolls and gauges for many types of operations such as swaging, wiring, joggling, jennying and crimping. It is a simple machine to operate but to produce a good swage or other type of edge requires skill as well as care and attention.

Refer to Module 1 – unit 7 – section 2.

2.3 Crimping an Edge on a Cylindrical Piece of Pipe Cladding

Crimping corrugates sheet metal and, at the same time contracts it. When the end of a pipe is crimped, the diameter is made smaller. This method of crimping eliminates the need for laying out a large and a small end on the same section of pipe and thus makes the connecting of sections of pipe easier.

Crimping is a simple operation on the swaging machine. Care must be taken to not over tighten the rolls on the swaging machine as this will result in the pipe diameter been reduced too much. A pipe that has been over crimped will be a sloppy or loose fit when it is joined to another pipe or fitting.



Crimping.

2.4 Procedure for Crimping a Pipe Section

1. Raise the upper roll on the swaging machine by turning the crank screw.
2. Loosen the wing screw, set the gauge with a rule to the desired width of crimp and tighten the wing screw to secure.
3. Place the edge to be crimped between the rolls and against the gauge.
4. Lower the upper roll to produce the depth of the crimp desired by turning the crank screw with the right hand.
5. (Hold the work piece in a horizontal position against the gauge with the left hand. Turn the operating handle with the right hand, allowing the work piece to move freely between the thumb and the fingers of the left hand.
6. Raise the upper roll and remove the work piece.

Notes: When crimping, the work piece must touch the gauge at all times.

For jobs with riveted seams, start the crimping alongside the seam and finish without crossing the seam .Crossing the seam would damage the rolls.

Caution should be taken at all times to ensure that fingers and loose clothing are kept away from the crimping rolls.

2.5 Screwdrivers

Refer to module 1 – unit 3 – section 1

3.0 Operation of a Lazy Tongs and Hand Pop Riveting Tool

Key Learning Points

- Application and use of a lazy thongs riveting tool.
- Application and use of a hand pop riveting tool.
- Area and volume calculations for rivet conversion.
- Types of solid rivets materials and forms.

Pop rivets are extensively used in place of solid rivets for the assembly of light fabrications and are particularly useful for the assembly of ductwork, or other articles where access is restricted to one side of the work only.

The riveting operation is performed by one operator using a special riveting tool, no rivet sets or hold ups been required.

Pop rivets are tubular in form, with either domed or countersunk heads. A mandrel runs through the rivet, the mandrel heads being slightly larger than the inside diameter of the rivet. Just under the head, the mandrel is weakened to provide a breaking point.

The rivet is formed by pulling the mandrel through the rivet using a riveting tool. As the mandrel is pulled through, the head is drawn into the rivet, expanding it outwards. Further pulling by the riveting tool increases the tension on the mandrel and finally the mandrel snaps at the weakened portion, allowing it to be drawn from the rivet.

3.1 Using the Lazy Tongs for Pop Riveting

The lazy tongs are used for the larger diameter rivets, where sufficient working space is available to permit operation of the tool. The construction of the tool permits a moderate pressure on the handle to provide3 a strong pulling force on the rivet mandrel.

Safety

Before use, check that the lazy tongs are in good order. Pay particular attention to the condition and security of the pins linking the levers. Failure of a pin can throw the levers out of alignment with danger of the arms and body being nipped.

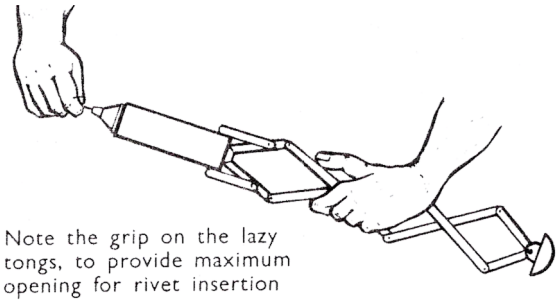
Always check before using the lazy tongs that the correct collet and nosepiece is fitted as the lazy thongs will not grip the mandrel if the wrong size collet is fitted.

Always make sure that there is no old mandrel in the barrel. A rivet will not enter the collet if an old mandrel has not been removed.

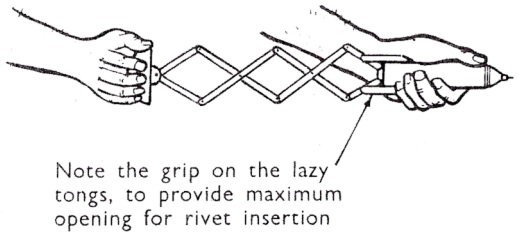
Make sure to wear the appropriate ppe when using the lazy thongs especially your eye protection as the mandrel can sometimes fly out of the tongs when broken.

Operation

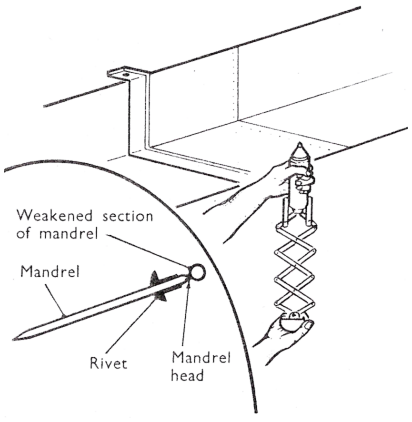
1. Open the lazy thongs fully, hold open as shown against light spring pressure exerted by the tool. Insert the rivet , push until rivet rests against nosepiece.



2. Change grip to barrel and with the other hand close the lazy thongs until resistance is felt. Do not close any more, otherwise the head of the rivet will start to form and the rivet will not enter the hole.



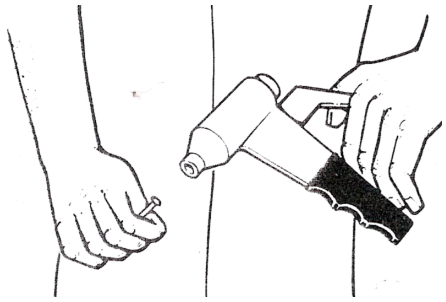
3. Insert the rivet in the previously drilled hole. Maintain the lazy thongs square to the sheet surface. Apply upward pressure on the handle. Continue upward pressure until the mandrel snaps at the weak section. Withdraw the lazy thongs. Open the lazy thongs fully to eject the used mandrel and fit a new rivet.



3.2 Using a Pop Rivet Tool

Riveting in a confined space requires the use of a plier type riveting gun. These are unsuitable for larger type rivets, due to the reduced amount of leverage available.

1. Use your fingers to open fully against light spring pressure.
2. Insert the rivet.
3. Transfer your fingers to grip the body.



4. Insert the rivet in the previously drilled hole.
5. Close rivet by squeezing the operating handle until the mandrel snaps.
6. Continue the operation as for the lazy thongs.

Safety

Used mandrels should be collected in an old box. An accumulation of loose mandrels provides a dangerous footing, especially on scaffolding platforms.

3.3 Rivets

Refer to module 1- unit 4 – section 4.

4.0 Dressing a Solid Rivet Using a Snap Set

The "snap" set is a companion of tools supplied in pairs. They consist of a rivet "set" and a rivet "snap". They can be identified by the rivet size which is usually stamped on the body and the hemispherical cavity at the forming end.

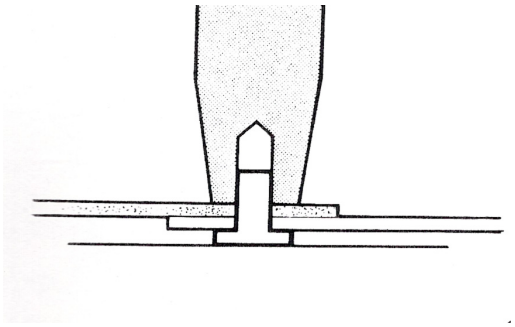
Key Learning Points

- Use of rivet set and bolster set for solid riveting.

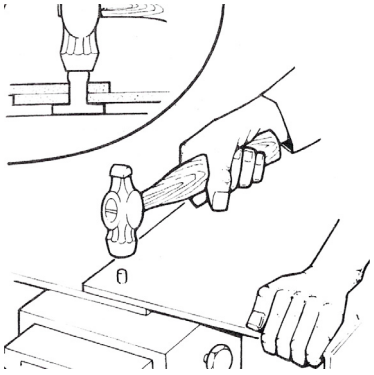
4.1 The Rivet Set

The following procedure should be used when operating a rivet set.

1. Ensure that the correct size set is been used, normally the rivet diameter is stamped on the body of the set.
2. Make sure that the set hole is clear. The hole is a clearance fit on the rivet diameter and deep enough to accommodate the rivet.
3. That the set is free from splits and mushrooming of the head.
4. Place the set over the rivet and strike one or two sharp blows, too much hammering may mark or deform the work piece. It is important to use a standard 12oz. or 16oz. ball or cross pane hammer ensuring that the face is clean and un-chipped and that the head is securely fixed.

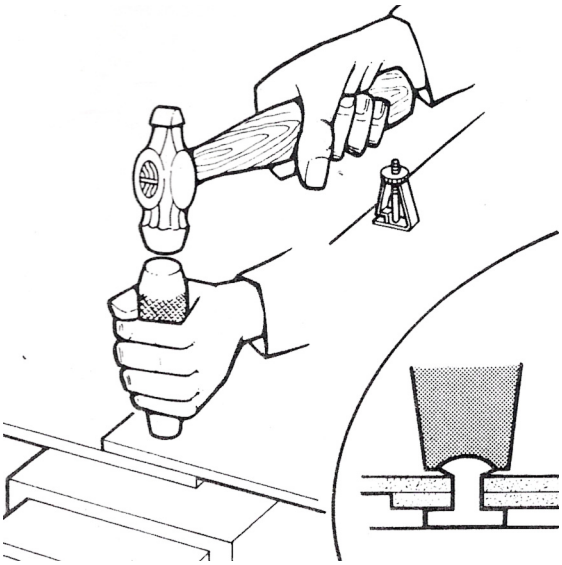


5. Strike the rivet set squarely with the hammer face to swell the rivet in the hole and partly form the head. Two or three sharp blows are all that is required.



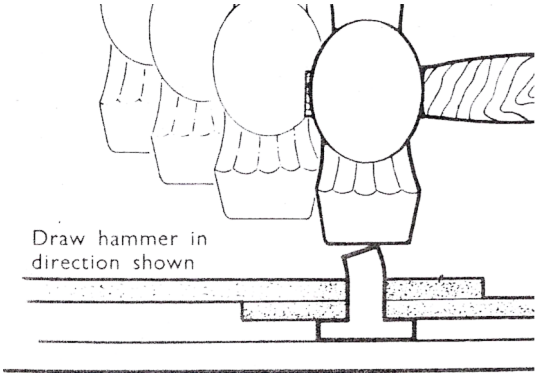
4.2 The Rivet Snap

1. Place the rivet snap over the partly formed head and strike with the hammer.
2. Lift the snap between blows to see how the rivet is forming. It is important to note that a good rivet is hemispherical in shape. The edge of the hemisphere being just clear of the sheet surface, and if viewed from the side, should be formed evenly over the rivet center.

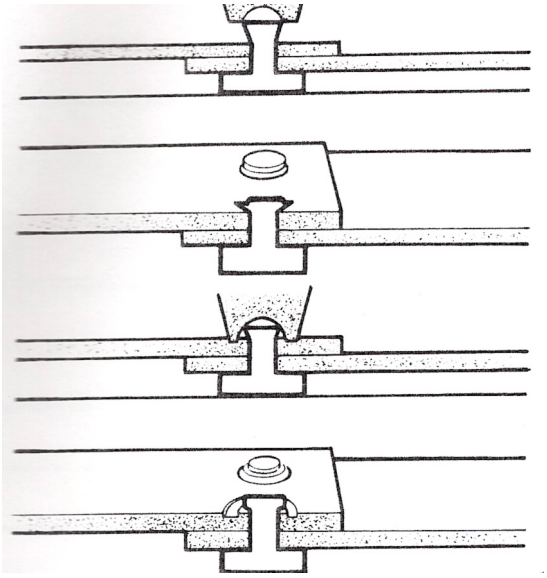


4.3 Rivet Faults and Causes

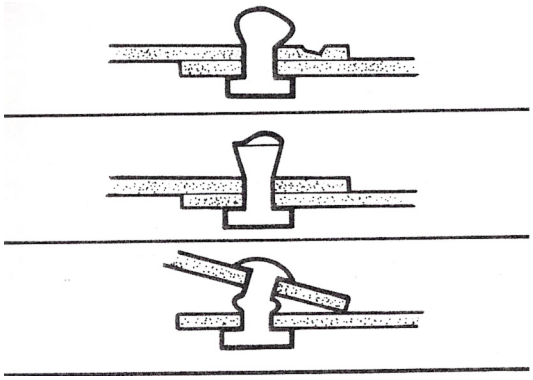
1. Failure to strike the rivet squarely when forming the head. If the rivet is not forming squarely, it should be struck with a drawing motion in the direction required.



2. Flattening the head too much when forming, will result in ringing of the rivet and a full head not being shaped. Ringing will also occur if the rivet is too long.
3. Using rivets which are too short, or a snap which is too big may result in damage to the work piece. Short rivets will also result in a weak head being formed. Surface damage can be caused by care-less use of the set.



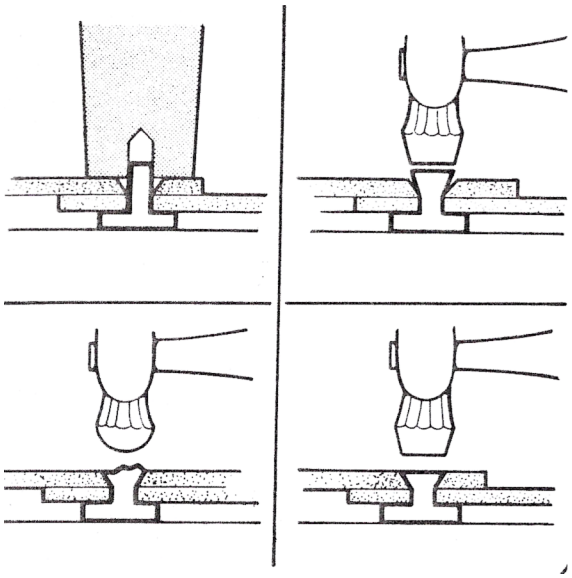
4. Careless application of the snap head will result in deformed heads i.e. head drawn to one side, rivet partly ringed and failure to set the plates properly may result in a warped joint and a deformed rivet.



4.4 Forming Countersunk Rivet Heads

Countersinking should be done using a hand drill or low speed power drill to prevent overcutting of the rivet hole in the work piece.

1. Select the appropriate rose bit or countersunk bit. Countersink the hole on the side of the work piece that requires the rivet to be flush.
2. Check the depth of the countersink. Use a countersunk head rivet of the same diameter as a guide.
3. Select a set with a base wide enough to span the countersink. Check for splits or mushrooming of the head. Use a 12oz. or 16oz. ball pane hammer.
4. Set the rivet, keeping the rivet square to the work piece.
5. Use the ball pane hammer to shape the rivet into the countersunk and then use the flat faced hammer to smoothen the rivet head.



5.0 Operating a Band-It Clamping Tool

Clamping or banding tools are used for securing various banding materials such as stainless steel, galvanised and carbon steel bands. They are used for securing insulation and cladding around pipe work, equipment, tanks and vessels. They can also be used for securing signs, traffic lights and other equipment to posts, poles and other mounting hardware.

Key Learning Points

- Toggle clip types and fitting techniques.
- Assembly and operation of "band-it" tensioning tool.
- Other tensioning tool types and applications.
- Tension and compression.

5.1 Operating Instructions – Hand Tool

1. The band can be used from a bulk roll as this eliminates waste of material. Slide the buckle on the band as shown, bringing the end of the band around the object been clamped and through the buckle again. The tension screw thread should be lubricated regularly.
2. Continue the band around the object once more and again through the buckle. Double banding develops a great deal more radial compression than single banding. Bend the end of the band under the buckle.
3. Place the band in the opening of the tool nose and the gripper block. Move it into the slot as far as possible to avoid the buckle slipping into the nose. Tighten the band clamp by turning the tension handle clockwise while holding the band gripper tight against the band.
4. Place your finger on the band at the buckle bridge while tensioning with the tool handle. When the band stops moving through the buckle stop turning the handle as the maximum pressure has been exerted by the band-it tool.
5. Roll the tool over the buckle while backing off with the tension handle throughout the rolling operation. Failure to back off with the tension handle may result in breaking the band. There is no loss of tension as the band released is used up in the bend.
6. Pull the cutting handle to cut the band.
7. Remove the tool holding the stub of the band with your finger.
8. Hammer down the buckle ears to hold down the band stub in place.

5.2 Operating Instructions – Bantam Hand Tool

(A) Pistol Grip Position

1. With the bantom tool in the pistol grip position, place the band in the tool with sufficient band in the winding mandrel.
2. With ratcheting action, tension the band until the clamp is tight. If necessary, the band may be repositioned by releasing tension with the levers.
3. Roll the tool over as far as it will go, and push forward the cutter handle. Remove the tool and tap down the ears to complete the clamp. Remove excess material from the winding mandrel.

(B) Straight or Angle Position

1. With the bantom tool in the pistol grip position, place the band in the tool with sufficient band in the winding mandrel.
2. With ratcheting action, tension the band until the clamp is tight.
3. Roll the tool over as far as it will go, and push forward the cutter handle. Remove the tool and tap down the ears to complete the clamp. Remove excess material from the winding mandrel.

5.3 Toggle Clips

Toggle clips are used in the industrial insulation industry where parts need to be held together and removed at short notice and to facilitate the repair or removal of the flange or valve underneath. They are used primarily for holding valve and flange boxes together, and generally pop riveted onto the box for secure attachment. Toggle clips are available in many different sizes and designs and are manufactured from different materials.

5.4 Tension and Compression

Tension is a force related to the stretching of an object (the opposite of compression).

Compression is the result of the subjection of a material to compressive stress.

Summary

The fabrication and assembly of metal cladding, incorporates many skills which the apprentice must develop in order to turn out a first class job. In this unit we have looked at the fabrication and swaging of metal cladding, the joining and assembly of cladding pieces and also the tools and equipment used in the workshop.

Rivets and screws are used to join cladding pieces together. The spacing of rivets and screws is an important factor to the assembly of the parts but also to the overall appearance of the job. Toggle clamps on flange and valve boxes are used to allow for easy access to parts of a piping system which require regular maintenance.

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