TRADE OF

Industrial Insulation

PHASE 2

Module 3

Substructures, Advanced Cold Work and Cladding

UNIT: 4

Cold Work Cladding – Fabrication & Application

Produced by

SOLAS

An tSeirbhís Oideachais Leanúnaigh agus Scileanna
Further Education and Training Authority

In cooperation with subject matter expert:

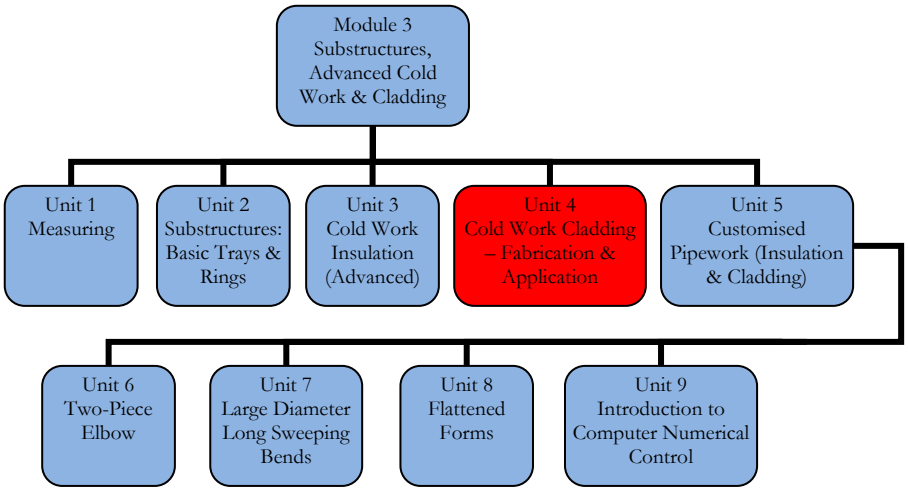
Michael Kelly

Table of Contents

Unit Objective

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

- Measure a pre-insulated pipe for cladding.
- Develop cladding patterns for measured piping.
- Fabricate cladding without fixing holes or screws.
- Fit cladding to insulated pipe using steel banding.
- Maintain vapour barrier integrity.



Introduction

An insulation system is made up of a number of different components – the insulation, the securement method, a vapour barrier and the outside cladding. Many considerations must be taken into account before designing and installing an insulation system. It is vitally important that the works specification is studied in detail so as to install the correct materials to deal with the environment in which the insulation and cladding system will be operating.

1.0 Materials and Job Sequencing

Key Learning Points

- Material requirements and job sequencing, works specification. Measurement of the pre-insulated pipe
- Allowances for pre-insulated pipe-work cladding
- Improvised swaging without screws
- Application of cladding to pre-insulated pipe

1.1 Material Requirements and Job Planning

It is very important that a job is well planned and executed so as not to waste valuable time and materials unnecessarily. Planning a job successfully is done in a number of ways, for example:

Having a drawing and insulation specification prior to starting the job. These documents will give such details as system design and layout, pipe and fitting sizes, and in the case of the specification, general requirements such as insulation types, forms and thicknesses, surface preparation requirements, job design/positioning, installation methods, supports, fasteners etc.

If a drawing is not available it is very important to measure the job carefully noting any obstructions or obstacles in the system that may cause problems later on. A quick working drawing or sketch can be produced to aid understanding and help workers with the manufacturing and fitting of the insulation and cladding system.

A detailed working drawing with measurements can be used for estimating the quantity of materials required prior to the job or contract starting.

When the job has been measured and planned, it is very important that all necessary tools and equipment are at hand and that the required amount of labour or manpower is available to complete the contract.

Good job planning and organisation will cut down on wasted time and materials thus improving the overall profit of the job.

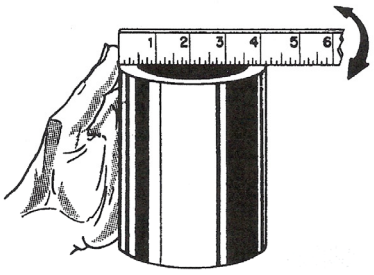
Refer to module 3 – Unit 1 – Measuring.

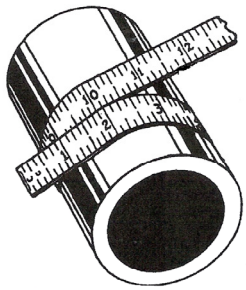
1.2 Measurement of a Pre-Insulated Pipe Using a Measuring Tape

The measuring tape is a handy tool for measuring the circumference and diameter of both insulated and non-insulated pipes. A small 2 metre tape is ideal as the blade of the tape is both narrow and very flexible allowing for a more accurate measurement around the pipe.

- Mark a position or starting point on the pipe or cylinder usually at the top of the pipe.

- Position the start of the tape on this point and holding the tape tightly, proceed to wrap the tape around the pipe section until you return back to the starting point again.
- Take note of the measurement at this point as this is the circumference of the pipe.





- This process can also be used for an insulated pipe.
- When calculating the cladding for the insulated pipe add 15mm to the circumference measurement as this will make it easier to fit the cladding around the insulated pipe. The allowance for the longitudinal joint must also be added to the circumference measurement.

1.3 Allowances for Pre-Insulated Pipe-Work Cladding

The lap Joint

The lap joint is a longitudinal joint which runs the full length of the pipe section. It is extra material which is added to both ends of the circumference when developing the pipe. When the pipe section is rolled into shape this extra material allows for an overlap (where the rolled metal slides in over itself) which can be fixed in position by rivets or screws.

It is important that the correct amount of material is allowed on the pattern for the lap joint, not enough material will make it very difficult to join the pipe together once rolled, and too much material will make joint bulge and difficult to flatten. It is also important to note that the material allowance for the lap joint may differ depending on whether the pipe section being manufactured is covering rigid or non-rigid insulation as there will be very little flexibility in a rigid insulation section. Generally an allowance of between 15 and 25 mm is added to both ends of the pattern for the lap joint, however always refer back to the drawings for clarification.

Male and Female Swaging

The male and female swage is the method used for joining two lengths of cladding pipe together. The ends of the pipe have an internal swage or an external swage depending on the sequence of manufacturing. When the two sections of pipe are assembled together the male swage sits neatly into the female swage forming an interlocking joint. An allowance of material usually 3 to 5mm must be added to the length of the pipe to allow for each swage.

1.4 Installation of Pipe Cladding to a Pre-Insulated Pipe

The process of installing pipe cladding over an insulated pipe takes patience and a keen eye for detail. The apprentice must develop a professional attitude towards the overall finish and presentation of the job from the start as any mistake or oversight will be seen by the customer. The following procedure should be followed when installing a section of pipe cladding:

- Check the pipe insulation to make sure there are no rips or tears in the outer foil covering or vapour barrier.
- Decide on a starting point for the installation of the cladding. This may be from a vessel or flange.
- Try in so far as reasonably possible to keep the joints hidden and out or view. This will add to the overall appearance of the job.
- When installing a round pipe section, the cylindrical pipe will have to be pulled apart to fit over the insulated pipe, so it is important that the cladding pipe is not damaged.
- Make sure that when you are fitting the cladding pipe over the insulated pipe that you do not tear the insulation of protective foil covering.
- Temporarily fix the cladding pipe in place using self tapping screws. Install the next section of pipe or fitting in place by fitting the male swage of one section into the female section of the other fitting. Secure in place using the self tapping screws ensuring that the joint is tight and free from movement.
- Check your measurements as you install each section so as to avoid a problem at the end of the overall installation. As each section is installed measurements can creep thus increasing the overall length, and make it difficult to install the final pieces.
- When the installation is complete make sure there are no finger or hand marks on the job, wipe the cladding with a soft clean cloth to remove such marks.

1.5 Improvised Swaging Without Screws

Refer to section 1.2 above – male and female swaging.

Refer to module 1 – unit 7 – section 2.0.

2.0 Fabrication and Installation of Cladding Pipe Work

Key Learning Points

- Pattern development of measured pipe-work
- Fitting techniques without screws
- Use of banding for cladding retention

2.1 Pattern Development of Measured Pipe Work

Refer to module 2 – Geometry and pattern development.

2.2 Fitting Techniques without Screws

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.

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.

2.3 Use of Banding for Cladding Retention

Banding and Using a "Band-It" 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.

3.0 Maintaining the Integrity of a Cladding system

Key Learning Points

- Weather sealing – vapour barrier integrity
- Design and use of simple moving joints

3.1 Vapour Barrier Integrity

A vapour barrier must be used over the insulation on all plant operating at temperatures below the ambient air. The vapour barrier should be applied such that it is continuous and gives protection to the whole surface of the insulation which it covers. It should not be pierced or otherwise damaged. Means of load distribution must be provided at points of support as necessary. He material selected for use s a vapour barrier must be compatible with the thermal insulation which it is to protect.

Typical examples of vapour barriers are:

- Wet applied systems such as solvent based polymers, vinyl emulsions and bitumen emulsions with or without elastomeric latex. Frequently, these are reinforced with cotton scrim or glass mesh fibres.
- Elastomer sheets with all joints overlapped and continuously vapour sealed. Good at accommodating movement due to contraction.
- Polyvinyl chloride, polyethylene, polyisobutylene (PIB) or other suitable plastic tape or sheet. Used for wrapping small irregular shaped areas or where are coloured decorative finish is required.
- Epoxy and polyester resins. Used to provide a multi-purpose barrier to water vapour, weather and chemicals.
- Reinforced aluminium foils, building sheet or plastic film with all joints adequately overlapped and continuously vapour sealed.

When the operating temperature of the equipment cycles above and below the temperature of the ambient air, it will be necessary to design a vapour barrier/ breather system.

Refer to module 3 – unit 3 – section 3.0 – Vapour barriers.

Adhesives and Sealants

Multi-purpose adhesives and sealants are available for bonding of hard insulating foams like polystyrene, phenolic and polyisocyanurate. Adhesives are available in an aerosol can, container or bulk form. When the adhesive is fully dried, it is designed to provide strength greater than the internal strength of most polystyrene foams.

Handling/Application Information

- Read and fully understand the manufacturer's data sheets before using these products.
- For best results, all surfaces to be bonded must be clean, dry and free from dirt, dust, oil, loose paint, grease etc.
- The temperature of the adhesive/sealant and the surface to be bonded should be between 16-27°C as temperatures outside this range may affect the bonding range and sprayability of the substance.
- Once the adhesive/sealant as been applied, allow the substance to dry until tacky then apply the insulation to the surface. Apply sufficient pressure to ensure intimate contact between the insulation and the surface being insulated.
- Excess adhesive/sealant should be removed using a cloth and a solvent substance. When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions of use.

3.2 Effects of Thermal Movement on Insulation and Cladding

The effects of thermal movement on an insulation system should be designed into the "system" from the very start. Whether the insulation is to cover very hot or very cold pipe-work or equipment, allowance must be made for expansion or contraction so as to avoid future problems within the "system".

The design of hot service insulation expansion joints and insulation supports are quite important. With pipe-work for example expanding so many millimetres per metre, and the insulation contracting at its own rate per metre, the total rate of expansion and contraction over a long length could be substantial.

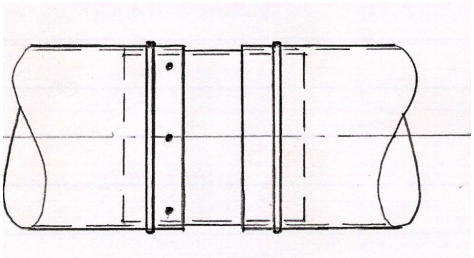
In cold insulation design, contraction joints are just as important as expansion joints are in hot insulation. As the system will have a low operating temperature, the pipe-work will contract so much per metre of length and depending upon the type of insulation being used, this will contract at its own rate as well.

This all adds up to a situation whereby if expansion and contracting joints are not built into the "system" from the design stage, thermal movement will result in possible tearing of the insulation and finishing materials.

3.3 Moving Joints

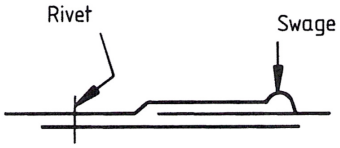
It is an accepted rule of physics that material, when subjected to a change of temperature, will expand or contract directly related to the temperature. Pipe-work is therefore subject to the same principle. There are a number of factors which must be taken into account when dealing with thermal expansion and contraction in a pipe-work system, the amount of temperature change, the overall length of pipe on which the calculations are to be based and the materials co-efficient of expansion. Moving joints and supports systems are an extremely important part of any cladding system as they allow the materials to expand and contract without damage to the pipe-work or cladding system.

Typical examples of moving joints are:



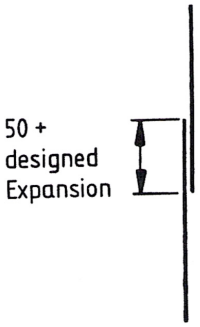
Flush Joint

Refer to module 1 – unit 6 – Marking, cutting, punching, rolling, seam



swaging and screwing to fabricate a flush joint.

Expansion joint (horizontal)



Expansion joint (vertical)

3.4 Joint Weathering

Joints should be arranged when fitted to shed water, as water is the number one enemy of an insulation system. If water gets into a joint it can wet the insulation but over time it can cause major problems by way of corrosion to pipe-work etc. under the insulation. This can be a very costly problem if it is not rectified in time.

Summary

Insulation is rarely installed as a standalone item. Instead, insulation material is part of a system that includes the insulation, the securement, a vapour barrier and in the case of low temperature applications, an outer layer of finishing material such as metal cladding.

Each component plays an important part in the overall function of the system. The insulation material itself is the primary barrier to the flow of energy, while the securement holds the insulation in place. The function of the vapour barrier is to prevent the passage of moisture into the insulation. The most multi-functional component in the insulation system is the outer covering or cladding. Generally metal cladding is used to cover the insulation system. Care should be taken when installing cladding so as to leave a clean , professional job on completion.

An tSeirbhís Oideachais Leanúnaigh agus Scileanna
Further Education and Training Authority

Castleforbes House
Castleforbes Road
Dublin 1