TTE TRAINING LIMITED

Phase 1 Fabrication

Carousel 2

GENERAL TEMPORARY REPAIRS

GENERAL TEMPORARY REPAIRS

At the end of this module, the trainee will be able to safely effect temporary repairs on a variety of equipment using various methods and techniques.

It may be necessary under certain conditions to carry out a temporary repair on a piece of machinery or equipment, when a replacement or permanent repair cannot be achieved.

A temporary repair may have to be carried out to prevent a dangerous condition from occurring.

It is important that the decision to make a temporary repair must be taken by the Supervisor or Engineer and it must be carried out safely to company procedures.

JUBILEE CLIPS

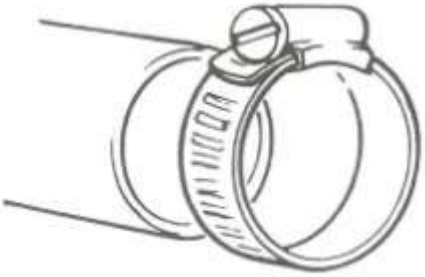
A Jubilee Clip is a simple and easy method of securing hoses and sheaths to mechanical fittings.

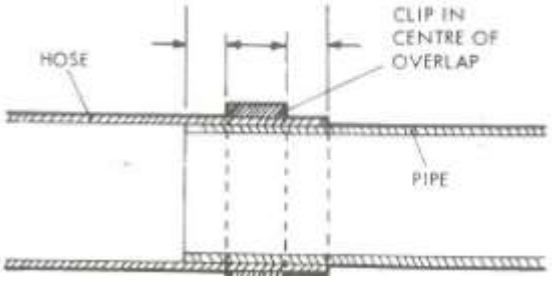
Such applications as drain hoses, air hoses, temporary water connections, radiator hoses and simple wrappings can be achieved using jubilee clips.

The clip comprises of a band which is long enough to cover the circumference of the item being clipped.

The tightening arrangement of the clip is by a wormed drive which is fixed to one end of the band and is tightened by worm gripping on a pressed “thread” along the “loose” end of the strap.

The clip is operated by turning the worm drive with a screwdriver or special clipdrive. This in turn engages the thread and pulls the band or strap. Jubilee clips are manufactured in mild steel with a zinc plated finish, or in 18/8 stainless steel.





WRAP AND SEAL TECHNIQUES

Wrap and seal techniques are a quick simple manner of a temporary repair on a leaking or fractured pipe or vessel to achieve a leak tight seal until a permanent repair or replacement can be carried out under controlled conditions.

These techniques are normally carried out to maintain a safe environment until the item can be repaired permanently.

This type of repair is not carried out on items working at high pressures or temperatures.

As the heading suggests it is a method of wrapping the pipe or vessel, and fitting a clamp or other device to secure the wrapping and maintaining a seal.

1. A simple example is a repair on a leaking duct. A sheet of metal can be rolled or formed to cover the problem area. Rubber or a coat of mastic can be laid prior to fitting the cover to form a seal.

The cover is then fitted but requires to be fixed firmly into position.

This can be done by a number of means depending on the circumstances under which the repair is being carried out. Simply by using “jubilee” clips is one method. Banding by laying and tightening a larger steel strap around the repair or fixing by using pop rivets, or self tapping screws.

2. If a pipe has become pitted or cracked a more elaborate but yet simple device may be fitted, in the form of a manufactured sleeve.

   The sleeve consists of an inner seal which is normally rubber or plastic, which is wrapped around the damaged area over which is placed outer reinforcement made from metal, to give mechanical strength and support.

   Finally, a clamp is fitted which tightens up the aforementioned parts against the pipe and achieves the seal. This type of repair is conventionally used as an emergency repair aimed at controlling a leak until the system can be properly run down to enable a permanent repair to be carried out.

   This method is not for the use on high temperature or high pressure pipework.

3. Wrapping and sealing may not just be applied to stop product leaking out but can be used also to stop substances from attacking externally. This is simply by wrapping the item with a protective coat, such as denso take, which is a material tape coated with a weather or chemical proof compound which is self adhering. The tape is wound around an item and overlapped on each wind ensuring a good contact and seal is made.

   Some examples of when denso tape is used:

   To form a temporary weather protection on electrical components.

   To wrap pipework or steelwork to keep out external corrosion attack.

THE USE OF AHDESIVES IN INDUSTRY

INTRODUCTION

Almost everything that is made by industry has component pieces, which have to be fixed together. Often mechanical connections are chosen, such as screws, bolts, rivets or spotwelds. Under certain conditions adhesive bonding could be used;- a joining technique that is well proven. It is capable of replacing or supplementing conventional methods and has its own special advantages.

This section sets out to show how joints should be designed and prepared in order to use a range of bonding adhesives.

Man has used adhesives or glues throughout history. The ancient Egyptian attached veneers to furniture with glue, today we use adhesives for bonding bones and arteries to building roads.

Early glues were all natural substances, nowadays we use synthetic resins and polymers.

Adhesives are used extensively in the production of electronics, cars, aircraft and being used more in mechanical engineering and civil engineering applications.

When we bond components together the first thoroughly wets the surface and fills the gaps between. Then it solidifies. When solidification is completed the bond can withstand the stresses of use.

The strongest adhesives solidify through chemical reaction and have a pronounced affinity for the joint surfaces. Adhesive bonding is sometimes called chemical joining to contrast it with mechanical joining.

ADVANTAGES OF ADHESIVE BONDING

a) The bond is continuous. On loading there is more uniform distribution of stresses over the bonded area.

b) The bonded joint, being continuous, produces a stiffer structure.

c) The weight of the structure can be decreased while maintaining stiffness.

d) Adhesives give a smooth appearance to designs, there are no protruding fasteners such as screws or rivets.

e) The bonded structure is safer owing to fewer and less severe concentrations of stresses.

f) Adhesive bonding does not need high temperatures. Heat sensitive materials prone to distortion can be suitably bonded.

g) Complex assemblies that cannot be joined in any other way are feasible with adhesives.

h) Adhesives can join different materials.

i) The continuous bond forms a seal which can be leak proof and less prone to corrosion.

j) Can provide an electrically insulating barrier.

k) Has good damping properties for reducing sound and vibration.

l) Adhesives can simply assembly procedures.

LIMITATIONS OF ADHESIVE BONDING

Adhesives are drawn from the class of materials known as “polymers”, “plastics”, or “synthetic resins”.

a) They have the limitations of that class, they are not as strong as metals.

b) With increasing temperature the bond strength decreases, and the strain properties of the adhesives move from elastic to plastic. Usually in the temperature range 70°C - 180°C.

c) The resistance of bonded joints to the in-service environment. Possible exposure to solvents etc. must be considered when selecting the type of adhesive.

d) With most adhesives maximum strength is not gained instantly, therefore, the assembled joint must be supported while curing takes place.

e) A badly made joint is often impossible to correct.

f) Bonded structures are not easily dismantled for in-service repair.

MODERN ADHESIVE – TYPES AND CHARACTERISTICS

Classified as thermo setting or thermo-plastic.

Thermo setting adhesives require heat or air to cure the bonding.

Thermo-plastic adhesives solidify by a chemical reaction.

KEY TYPES OF ADHESIVES

ANAEROBICS

Anaerobic adhesives harden when in contact with metal and air is excluded, e.g. a screw in a thread, it is used to fill the non matting surfaces, giving a full faced joint, securing the threads and forming a seal. Also used in sealing close fitting machinings to prevent 'slip'. Examples: "THREADLOCK" and "BEARING FIT".

CYANODCRYLATES

A special type of acrylic, cyanoacrylte adhesives cure through reaction with moisture held on the surfaces;- to be bonded they need close-fitting joints. Usually solidify in seconds and are suited to small plastic parts and to rubber. Care must be taken so as not to come into contact with eyes or skin. Cyandacrylates can be obtained in a range of viscosities. Highly viscous to penetrate grain structures low viscosity to enable application to vertical surfaces.

Care must be taken to avoid contact with the eyes and skin.

TOUGHENED ACRYLICS

A modified type of acrylic, fast curing and offer fast curing and high strength with toughness. Supplied as two parts (resin and catalyst). They are usually applied by separate applications:- Resin to one surface, catalyst to the other. They tolerate minimal surface preparation and bond weld to a wide range of materials.

EPOXIES

Epoxy adhesives consist of an epoxy resin plus a hardener. They allow great versatility in formulation due to the different resins and hardeners. They form an extremely durable bond with most materials.

Available in one-part, two-part and film form.

POLYURETHANES

Polyurethane adhesives are usually two-part and fast curing. Resistant to impact. Useful for bonding glass reinforced plastics.

MODIFIED PHENOLICS

The first adhesive for metals. They have a long history for high strength metal, metal-wood. Used for bonding metal to brake linings. They require heat and pressure for the curling process.

HOT MELT ADHESIVES

Related to one of the oldest forms of adhesives, sealing wax. Today's industrial hot melts are based on modern polymers, normally used for the fast assembly of structures designed for light loading.

PLASTICSOLS

Modified PVC dispersions which require heat to harden. The resultant joints are often resilient and tough.

RUBBER ADHESIVES

Based on solutions or latexes, rubber adhesives solidify through loss of solvent or water medium. Not suitable for sustained loading.

POLYVINYL ACETATES (PVA'S)

Vinyl acetate is the principal constituent of the PVA emulsion adhesives.

Suited to bonding porous materials such as paper or wood and general packaging work.

SINGLE COMPONENT PRESSURE SENSITIVE ADHESIVES

Usually solvent based, dry to a tacky surface brought together under pressure to give a permanent bond. Easy to apply. Can bond materials such as foam rubber, polyurethane, PVC, leather rubber wood etc. Does not take heavy loading.

Example: EVO-STIC

SOLVENT BASED ACRYLIC ADHESIVE

Produce rapid chemical attack on the surface of plastics. The plastics are joined together and the adhesive cures by evaporation, e.g. Tensol, durapipe cement.

METHOD

When using adhesives to bond materials, it is important that the mating faces are suitably prepared.

The design of the joint must allow maximum contact to achieve the strongest results.

Bonded joints may be subject to one or a number of stresses: See diagram (1)

Tension
Compression

Shear
Cleavage
Peel

A bonded joint needs to be designed so that the leading stresses will be directed along the lines of the adhesives greatest strengths.

Basic bonded joints between sheet materials. See diagram (2).

SURFACE PREPARATION

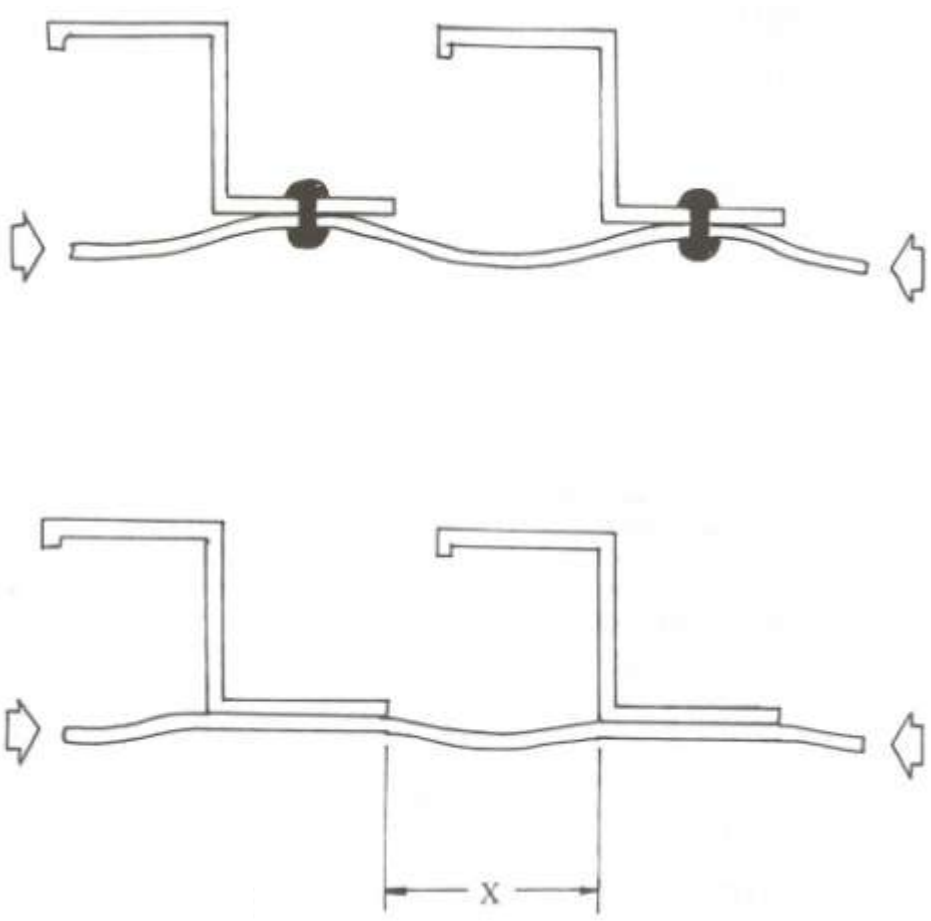
The surfaces to be adhered must be prepared in the manner specified for a particular adhesive. For example:

Chemical or solvent cleaning
Degreasing
Removal of dust particles
Etching of surfaces
Priming

SAFETY

Many adhesives and solvents are flammable or toxic so care must be taken in the use, storage and disposal of such materials.

Ensure adequate ventilation or fume extraction.
Wear correct protective clothing.
Work in a safe manner.
Store in a cupboard or storeroom away from direct sunlight and label highly flammable.
Do not expose to naked flames.
Smoking should be prohibited.
Reduce risk of spillage or leaks.
Waste should be disposed of in a correct manner.



X = Unstiffened area

Fig. 1

Stiffening effect – bonding and riveted compared

The diagram shows how a joint may be designed to take advantage of the stiffening effect of bonding.

Adhesives form a continuous bond between the join surfaces. Rivets and spot welds pin the surfaces together only at localised points. Bonded structures are consequently much stiffer and loading may be increased (by up to 30 – 100%) before buckling occurs.

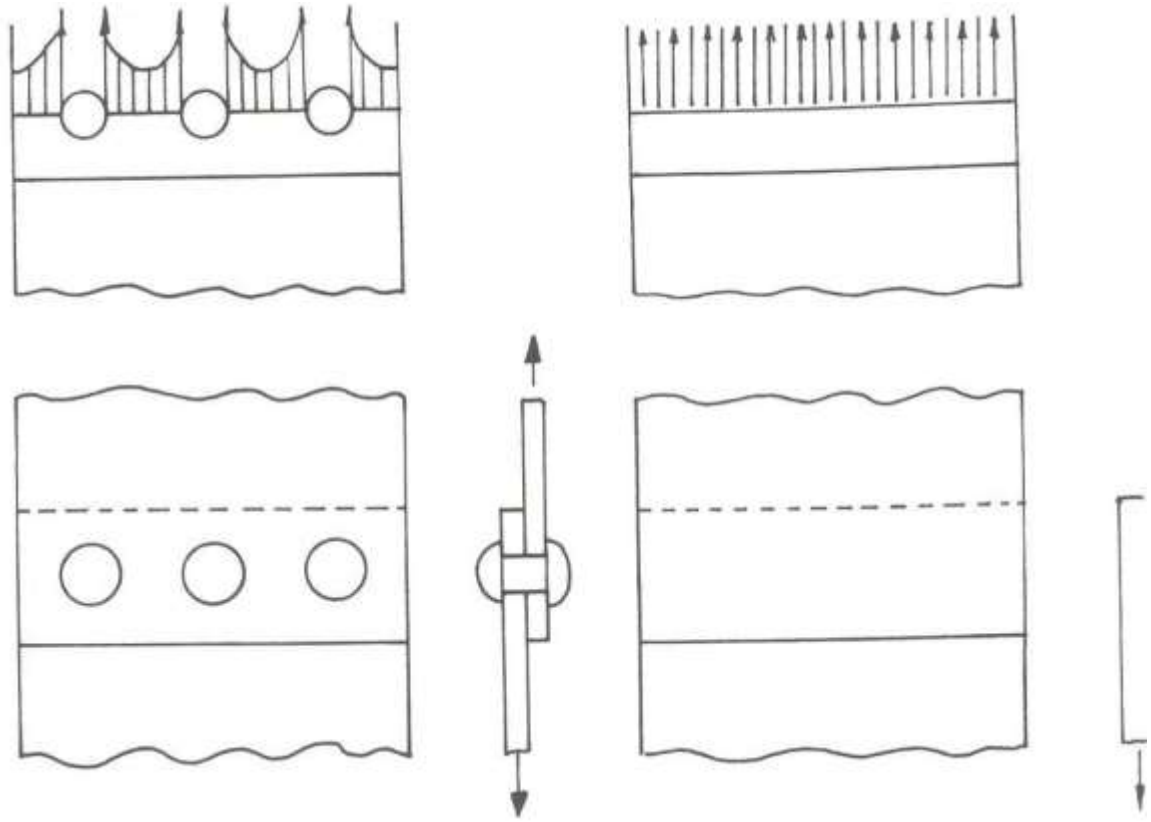


Fig. 2

Stress Distribution in loaded joints

The riveted joint on the left is highly stressed in the vicinity of the rivets. Failure tends to initiate in these areas of peak stress. A similar distribution of stress occurs with spot welds and bolts.

The bonded joint on the right is uniformly stressed. A continuous welded joint is likewise uniformly stressed but the metal in the heated zone will have undergone a change in strength.

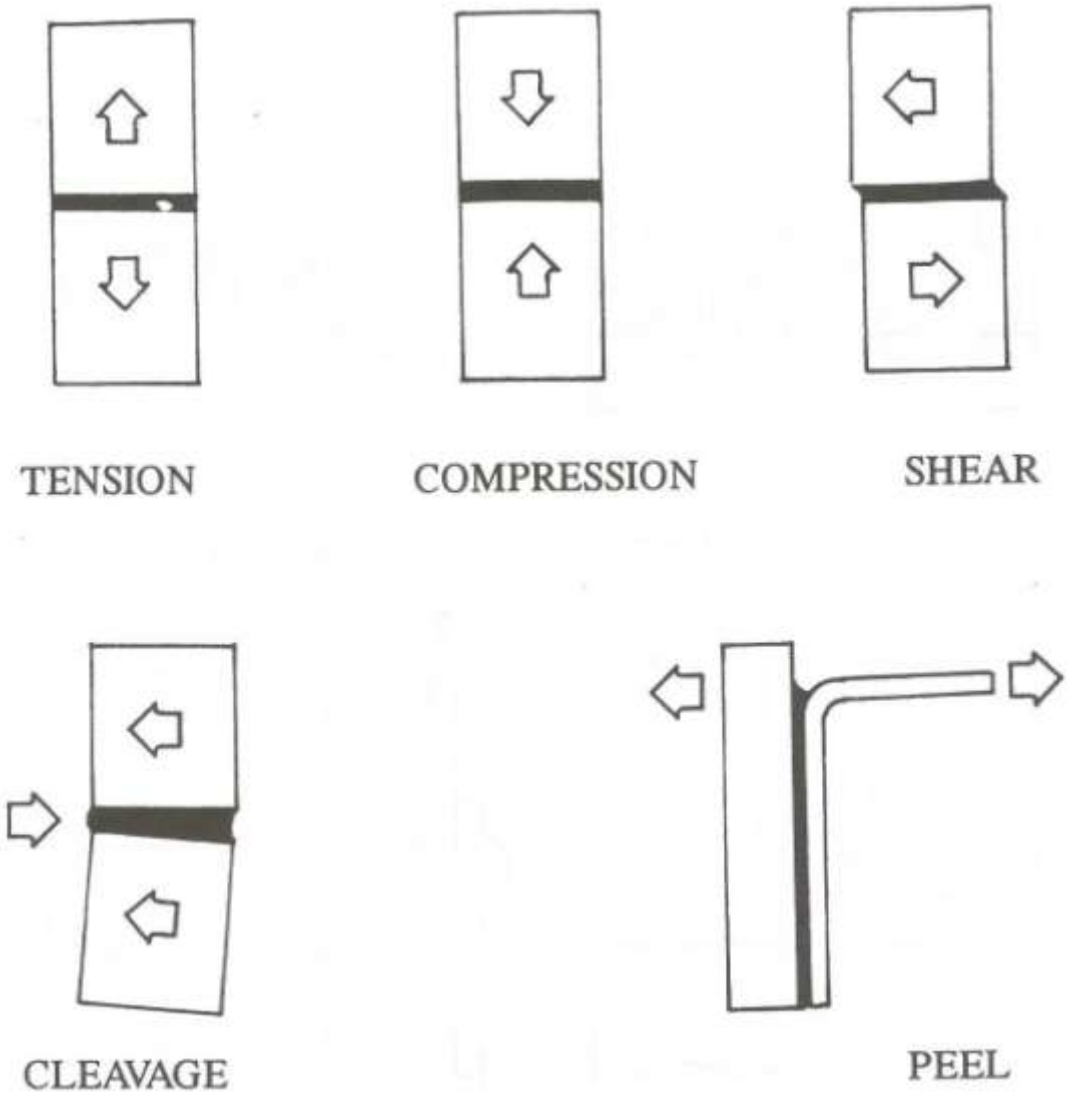


Fig. 3

Loading Conditions

A bonded joint can be loaded in five basic ways (shown in the diagram). Cleave and peel are the most taxing; they concentrate the applied force into a single line of high stress. In practice a bonded structure has to sustain a combination of forces. For maximum strength, cleavage and peel stresses should be as far as possible designed out of the joints.

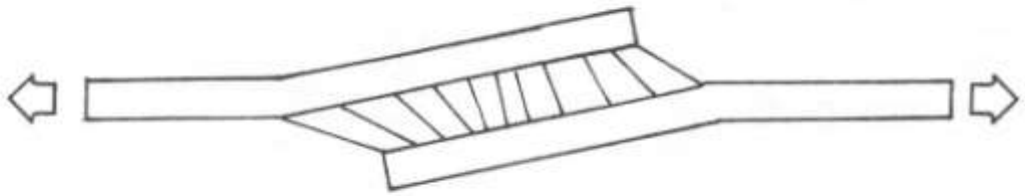


Fig. 4

Simple lap shear joint

On loading, the adhesive and the adherend react to the applied force. At the adhesive-adherend interface the force resolves into a shear component along the plane of the interface and a peel component at right angles to it. These stresses are at a maximum at the edges of the bond where they may cause high levels of strain and twisting, as in the joint depicted.

Fig. 5
Basic bonded joints between sheet metals

The basic types of bonded joints are shown diagrammatically. In practical structures two or more basic types may be used in combination – and the relative dimensions (and areas of fay-ing* surface) of the joints may vary from those shown in the diagrams.

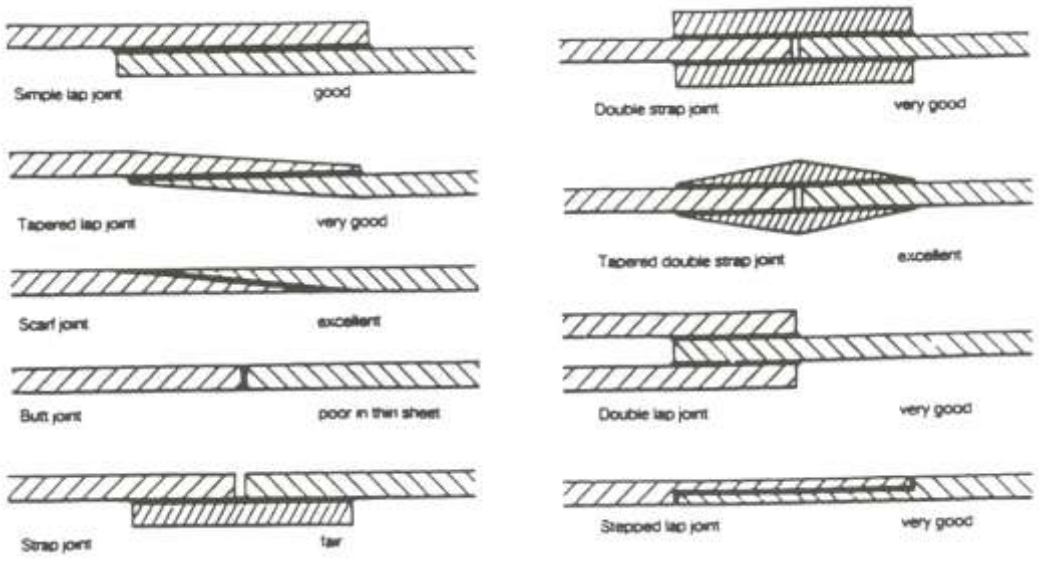
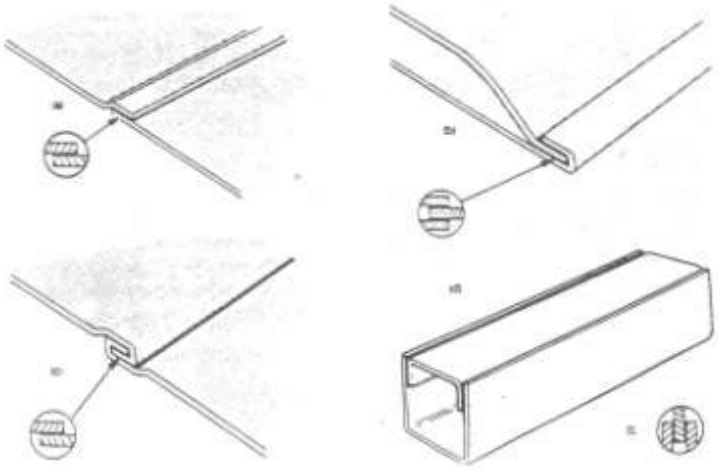


Fig. 6
Practical bonded joints between sheet metals

Certain metals, especially mild steel, are easily bent or folded to form advantageous joints. (a) Shows a development from the simple lap joint: a toggled point. (b) and (c) show further developments. The final fold is made after application of the adhesive.

Closed box structures (d) from formed sheet metal are easily produced using this folding and bonding technique to join the edges.

* Faying surface: that part of a surface which is specially prepared for bonding or is already bonded.



POP RIVETS

Pop Rivets are extensively used in place of solid rivets for the assembly of light fabrication work in thin sheet where access is restricted to one side of the work only.

Pop Rivets are easy to install; reasonably cheap in cost.

The disadvantages of using pop rivets are that they do not form a leak tight seal and under certain conditions and stresses may fracture or work loose.

The riveting operation is carried out by one person using a special riveting tool, with no requirement for hold ups or rivet sets.

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

The riveting action is achieved by pulling the mandrel through the rivet using a special rivet gun. As the mandrel is pulled through, the head is drawn into the rivet causing it to expand outwards.

Further pulling increases the tension on the mandrel and finally it snaps at the weakened portion when the rivet is tight, allowing it to be withdrawn from the rivet.

There are two types of riveting gun or tool:

1) Lazy Tongs
2) Plier Type Guns

1) Lazy Tongs are used for larger diameter rivets, where sufficient space is available to permit operation.

2) Plier type guns are suitable where space is limited, and used on smaller sized rivets. This is mainly due to the reduced amount of leverage the gun offers.

USE OR RIVETING TOOLS

1) Check equipment before use.

2) Ensure correct nozzle is fitted.

3) With tool fully open make sure that there is no old mandrel remaining in the barrel.

4) Insert rivet until head rests against the nozzle.

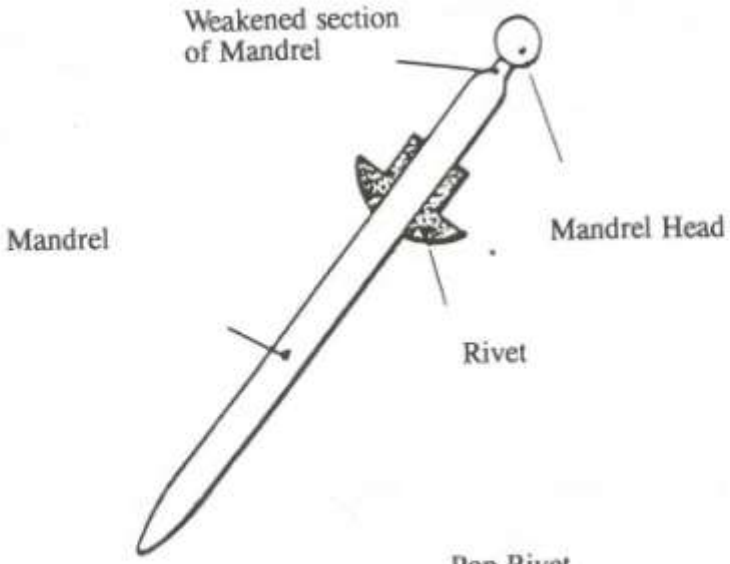
5) Tighten grip until resistance is felt.

6) Insert rivet into pre-drilled hole.

7) Apply pressure to handle (ensure fingers are clear of levers).

8) When levers are closed, repeat until mandrel “snaps”.

9) Dispose of old mandrel.


Weakened section
of Mandrel
Mandrel
Mandrel Head
Rivet

Pop Rivet


Weak part
of mandrel

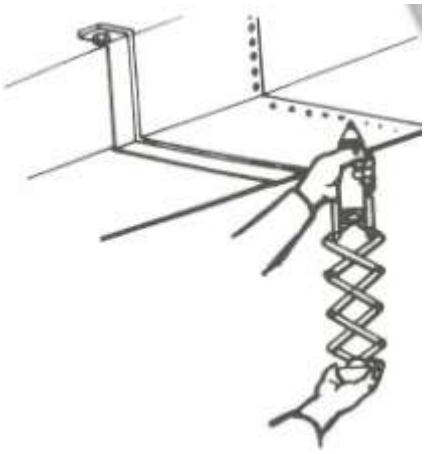

Head broken off

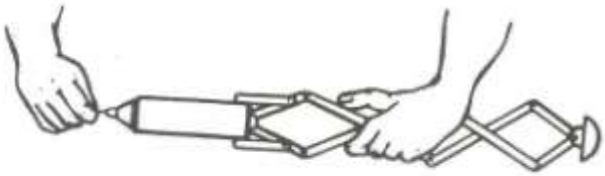
Safety

Before use, check the lazy tongs are in good order.

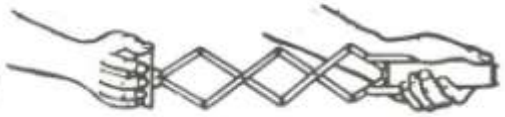
Pay particular attention to the condition and security of the pins linking the levers.

Failure of a pin can throw the levers out of alignment with danger of the arms or body being nipped.

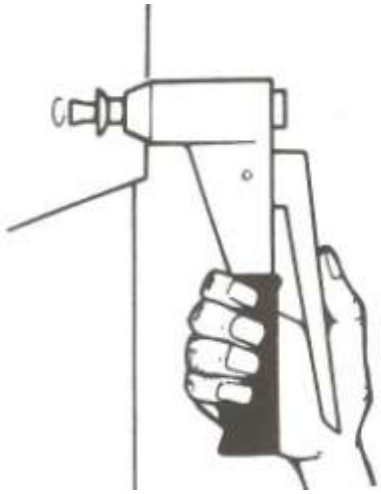


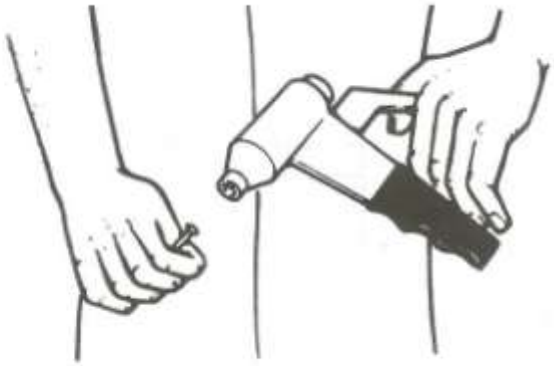


Note the grip on the tongs, to provide provide maximum opening for the rivet insertion. insertion.



Note the grip on the lazy tongs, to maximum opening for the rivet





Safety

Used mandrels should be removed from the workshop floor as they provide a dangerous footing and create a safety hazard.

“METALOCK” COLD REPAIRS TO CASTINGS

Metalock is a method of repairing machinery in iron, steel and aluminium, which has been fractured or cracked.

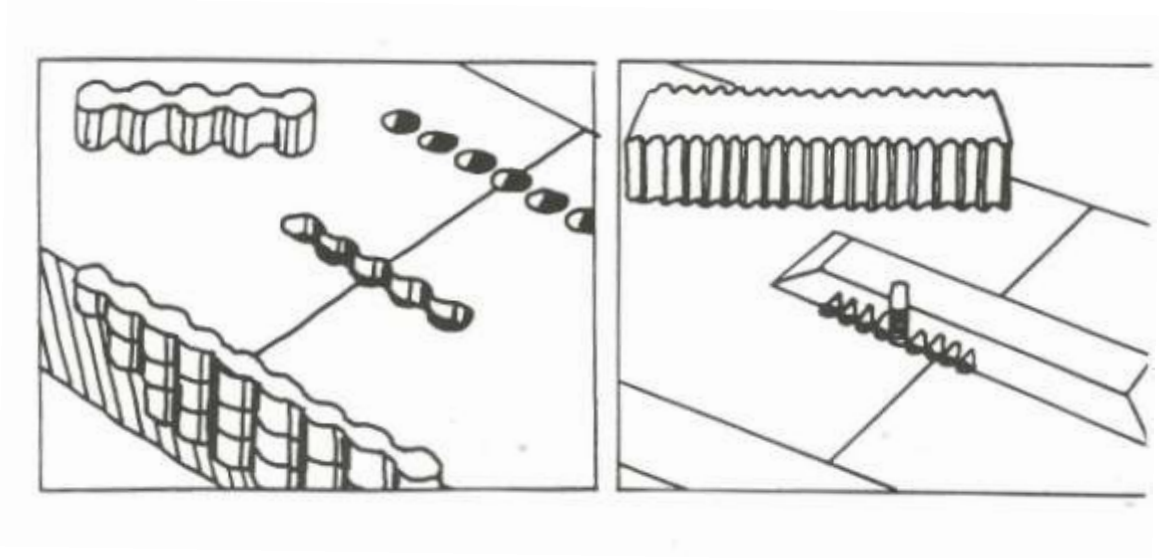
The repair consists of peening into prepared apertures, layers of metalock keys. The keys formed into multi dumbbell shape from special alloys, and being highly ductile can be peened into a metal-to-metal condition and become almost integral with the parent metal of the component under repair.

Metalock keys are manufactured in a variety of sizes, their selection depending on the nature and depth of fracture, size of component and stresses involved.

The high tensile strength of the metalock keys ensures the return of a large percentage if not 100% of the original lost strength.

Some of the advantages of the “metalock” process are that it dampens and absorbs compression stresses, provides a good expansion joint for castings such as cylinder liners or vessels subject to thermal stresses; distributes the tensional load away from fatigue points, can cope with pressures of up to 5,000 1bs. P.S.I.

It also maintains alignment of original surfaces, since lack of heat produces no distortion, and the vast majority of repairs can be done in situ, with consequent saving of time with little or no dismantling.



STEP BY STEP PROCESS

1) The fracture is positioned, realigned and firmly held together by special fixtures and clamps.

2) By the use of jigs, groups of holes are drilled across the line of fracture to the total depth of the casting.

3) The metalock key is a multi dumbbell shaped section of highly ductile alloy. The size and length being selected to suit the type of fracture.

4) The holes are then joined by the use of pneumatic chisels to conform to the shape of the metalock keys.

5) Individual layers of keys are inserted in the apertures and peened into a metal to metal condition which becomes almost integral with the parent metal.

6) Holes are then drilled along the line of the fracture, then tapped.

7) Fill the tapped holes with studs.

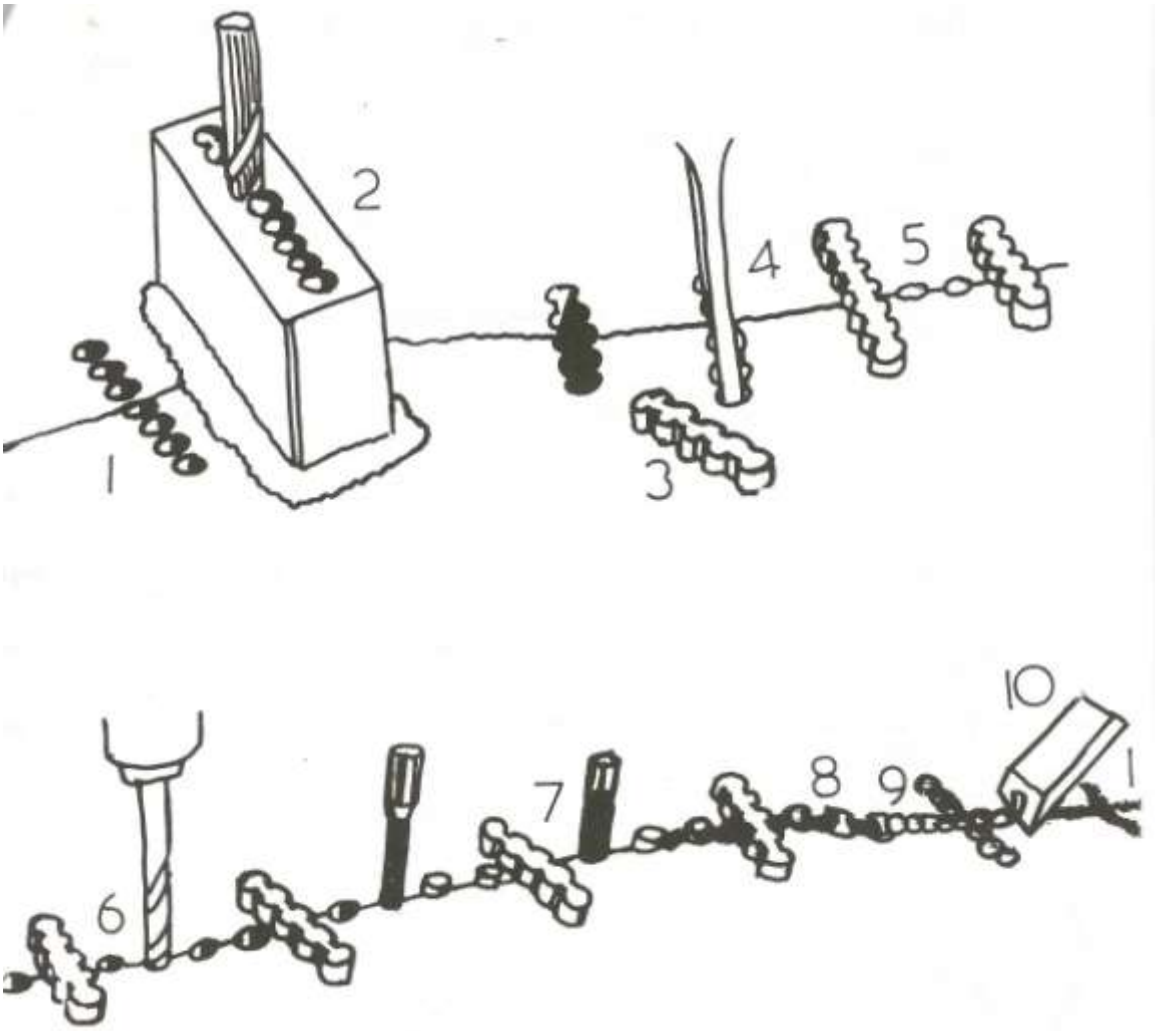
8) Each stud biting into its predecessor, resulting in a pressure tight joint.

9) The studs are then run down till the heads shear.

10) The remaining rough metal being removed by pneumatic chisels.

11) The whole repair is ground flush.

12) A final coat of paint is applied..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THREAD REPAIRS USING "HELICOIL" TYPE BUSHES

Screw threads in castings, cylinder heads, valve bodies and similar items, occasionally become damaged, stripped or worn.

There are a number of methods of repairing a thread such as drilling and re-tapping to a larger size therefore using larger bolts. Spot welding of bolts, but these methods have their limitations.

A much more effective method is to replace the damaged thread returning it to its original specification.

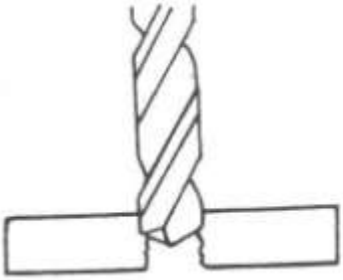
This is done by drilling out the damaged thread and re-tapping it to a specific size. A bush or "Helicoil" which is a precision formed coil of diamond section stainless steel wire is inserted into the hole.

Using a special tooth the bush is fitted and held firmly in position by radial pressure against the flanks of the tapped hole.

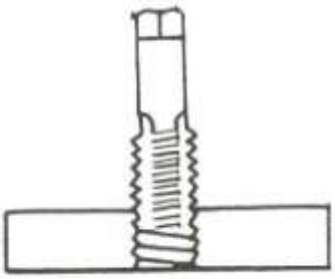
This gives a superior female thread of a high strength and surface finish returning to the original size.

The helicoil thread bushes are supplied in kits to suit a particular thread size and are not inter-changeable.

Thread repairs of this type can be carried out in cast iron, steel, copper, brass, bronze and aluminium.

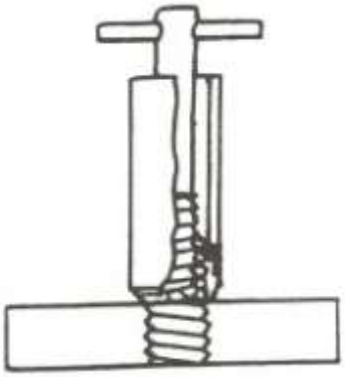


1 Drill to adequate depth with adequate drill size specified on front of kit.

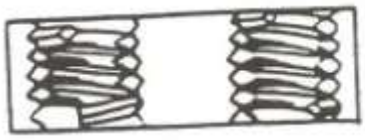


2 Tap new thread to depth.

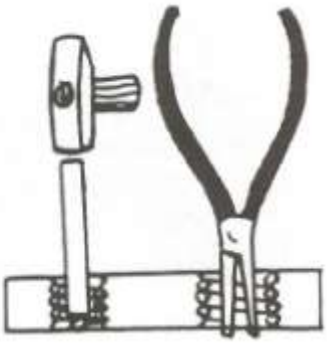
3 Screw insert onto threaded end of mandrel and engage in tool



4 Install insert by placing tool in line with tapped hold and gently rotate mandrel



5 Top of insert should be ¼ or ½ turn below square the surface when installed



6 Use punch or rod with end (no chamfer) which fits snugly into installed insert. Allow it to rest on insert tang and strike sharply with hammer. Where necessary, the tang can be removed by rapidly agitating up and down with long nosed pliers.

ON LINE LEAK SEALING

A serious leak from a pipeline in a continuous Process Plant or Refiner call for a choice between three courses of action:

1 Shut down for conventional repair

2 Leave the leak to blow.

3 Seal the leak while it is 'on line'.

On line leak sealing means no or minimal loss of production, no knock on effect on associated plants, no wastage of fuel or product because of down time.

Flanges

In the most common case of a leak from a flange the Furmanite process involves forming an injection moulding around the failed gasket. This is achieved by providing a path for the leak through special adaptors fitted to the studs or bolts, or the outer edge of the flange. The gap between the flanges is fitted with a peripheral seal. Furmanite compound is then injected through the adaptors, starting from the side opposite to the leak, into the space between the peripheral seal and the failed gasket. During injection the Furmanite compound fills all the grooves and pits in the faces of the joint. The compound used depends upon several factors but is usually thermo-setting and rapidly forms a tough, resilient mass. The repair can be treated as permanent but, like any gasket, its length of life will depend upon the extent of thermo-cycling and other factors such as the nature of the content of the line.

Valve Glands

In the case of valve glands the Furmanite compound or the valve manufacturer's recommended packing is injected into the stuffing box. Once the leak has stopped, the gland follower is backed off and the gland is fully repacked. The valve function is not impaired in any way and even automatically controlled valves are completely operable after being Furmanited.

Other Applications

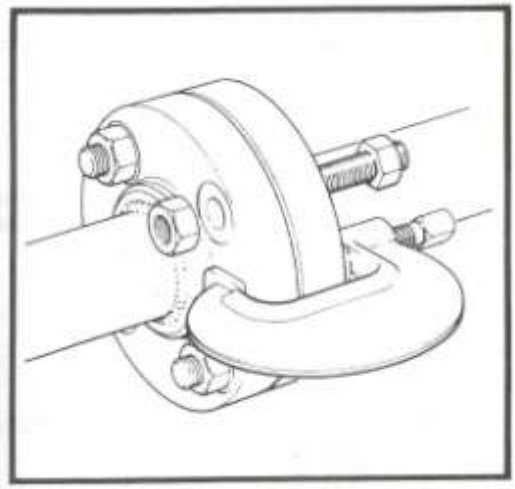
Leaks from heat exchanger joints, turbine joints, screwed couplings, pipe unions and riveted joints can all be dealt with by these methods. For a leak in the wall of a pipe or a weld a special retaining box would be designed and produced by Furmanite to fit around the leaking area. Subsequent injection of sealant stops the leak.

The process has been applied successfully in oil refineries, chemical plants, nuclear and conventional power stations and numerous other industries. On almost any pipeline leak, of steam, hydrocarbons, or gas, from sub zero to 600°C, from vacuum to 350

Kg/cm², Furmanite can keep the plant in operation, prevent waste, damage and danger and save costs.

FURMANITE

CHANGING BOLTS ON LOW PRESSURE FLANGED CONNECTIONS PRIOR TO LEAK SEALING



Furmanite maintains a standard policy of changing bolts on flanged connections operating below 40 bar (600 psi) before beginning to seal a leak under pressure. For higher pressures each case is assessed individually by a qualified engineer.

Furmanite's policy is based upon many years of experience in repairing leaks under pressure. The major consideration is always to ensure the safety of plant and personnel when working on live systems.

The condition of existing bolts is difficult to assess from external examination. They may have been subjected to erosion or caustic embitterment (stress corrosion cracking). The bolts may also have been over-tightened by maintenance personnel in an initial attempt to seal the leak.

'G' CLAMP TECHNIQUE

Bolts are changed by fitting a 'G' clamp to the flange and removing one bolt at a time. New bolts effectively upgrade the integrity of the flanged connection. Where appropriate, coated bolts can be fitted to improve resistance to corrosion.

After fitting an appropriate peripheral seal injection of sealant is either through ring adaptors or proof-tested angle nuts which remain as an integral part of the joint

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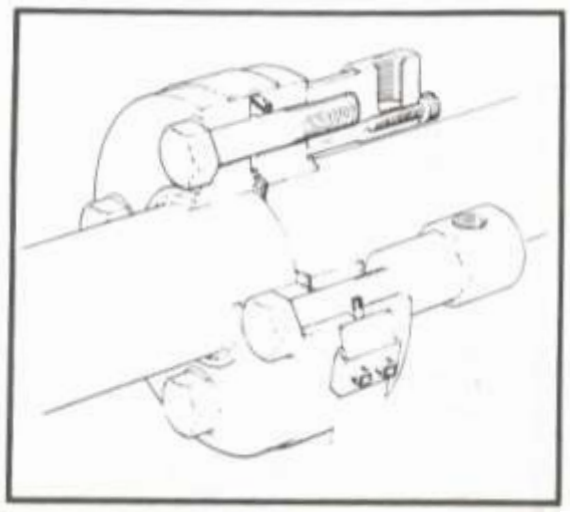
INJECTION TECHNIQUES FOR SEALING LOW PRESSURE FLANGE CONNECTIONS



During the bolt changing operation (see Technical News FK420), Furmanite technicians fit proof-tested restricted angle nuts to each bolt.

The angle nuts are specially designed for injecting sealant down the bolt clearance. Furmanite use angle nuts in preference to slotted Studs since laboratory tests have proven that the latter technique lowers the integrity of the joint System.

RESTRICTED ANGLE NUTS

Restricted angle nuts incorporate a shut-off screw as an added safety feature and remain in position so that there is no disturbance of the joint after the leak has been sealed.

After fitting the angle nuts a peripheral seal is effected using Furmanite's patented "IMPRES" packing and a stainless steel band-clamp.

Furmanite abandoned the use of wire and cable techniques as experience has shown this method requires frequent reinjections.

An alternative method of injection for low pressure leak sealing of flanges in systems up to 40 bar (600 psi) is the use of ring adaptors.

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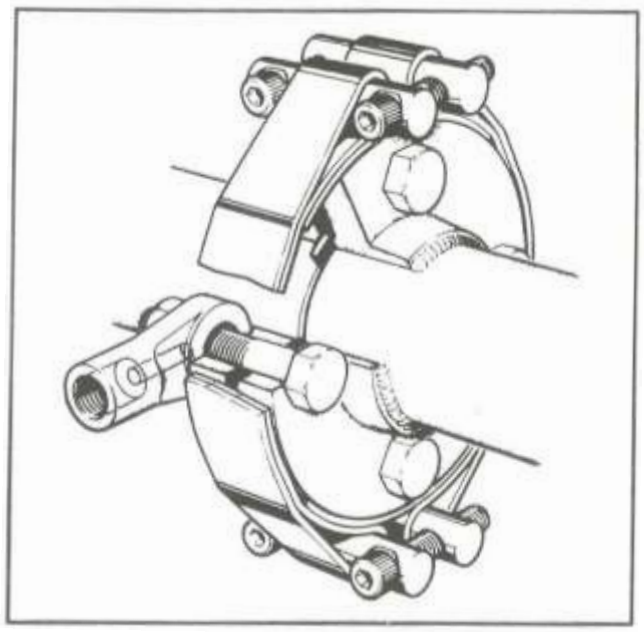
INJECTION TECHNIQUES FOR SEALING LOW-PRESSURE LEAKS



On-line leak sealing in systems pressurised up to 40 bar (600 psi) requires the sealant to be injected down to the bolt clearances in order to guarantee a positive lasting seal.

Furmanite techniques have the advantage of permitting the sequential removal and replacement of damaged and corroded bolting and progressive injection of sealant to form a sound continuous injection moulding which totally encapsulates the leak.

LUG ADAPTORS & ANLE NUTS

Lug adaptors are made to fit under the nuts, angle nuts are fitted in place of the existing nuts. After the injection of sealant they are removed and the original nuts replaced.

Lug adaptors and angle nuts are used in conjunction with one of the Furmanite methods of flange edge sealing.

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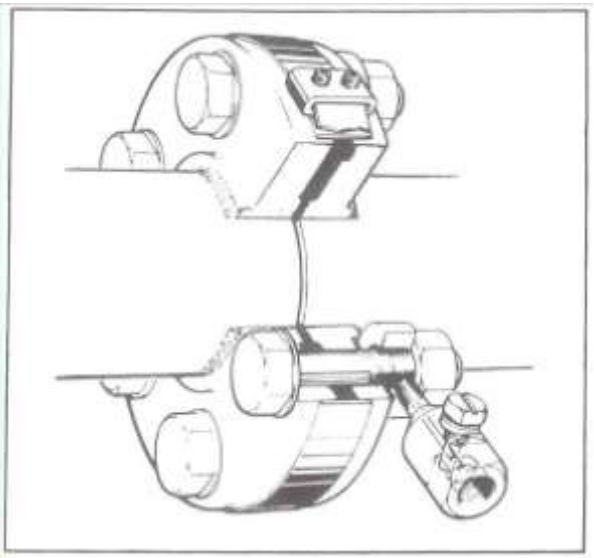
ALTERNATIVE INJECTION TECHNIQUES FOR LOW PRESSURE LEAKS



For on-line leak sealing in systems pressurised up to 40 bar (600 psi) the Ring Adaptor may be used as an alternative to the lug adaptor and angle nut.

Ring Adaptors permit injection of sealing compound down the bolt clearances without requiring subsequent removal.

RING ADAPTORS

The ring adaptor is made to fit under the flange nut, and remain in place as part of the flange assembly. It is manufactured from high grade steel or other materials to suit special requirements.

An additional advantage of the ring adaptor is that it may be installed as original equipment as illustrated. It is then instantly available for the injection of compound.

Ring adaptors are used in conjunction with one of Furmanite's methods of flange edge sealing.

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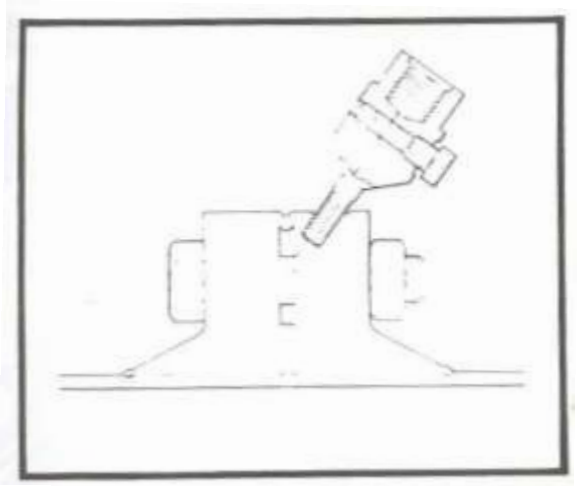
TECHNIQUES FOR SEALING HIGH PRESSURE NARROW GAP FLANGES

The sealing of leaks of high pressure super-heated steam or boiler feed water from narrow gap flanged systems requires a high level of skill and experience.

Two methods are used by Furmanite. The most economical, versatile and cost effective requires the technician to lightly peen a brass wire into the gap between the flanges. Furmanite technicians are highly trained to carry out neat light peening which does not impair the integrity of the flange bolting system.

Alternatively, if the customer prefers not to have any peening, an outside diameter clamp can be fitted. In some cases the technique would be recommended, for example, where the flange material is brittle. However, it does involve additional cost.



When sealing narrow gap high pressure flanges Furmanite recommend the direct injection of sealant into the flange gap in such a way that the compound can flow outwards to seal the gap between the flanges.

The method requires the drilling and tapping of a limited number of points in the flange periphery for the insertion of restriction adaptors. Positions are carefully selected where the flange stresses are lowest. Sealant is then injected through the restrictors and the force of the leak itself helps to fill the gap with compound.

Alternatively sealant can be injected through the clamp, however, experience has shown success depends upon the severity of the leak with this technique.

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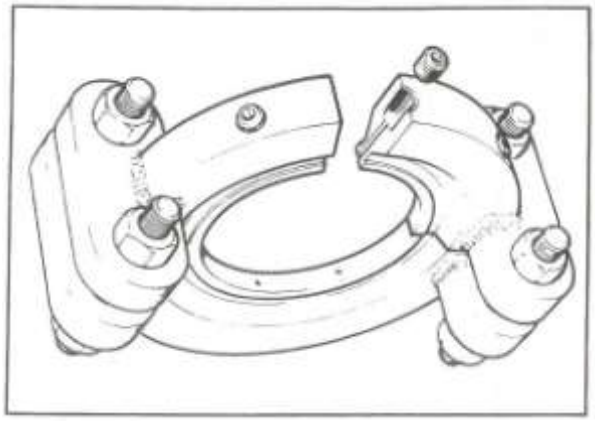
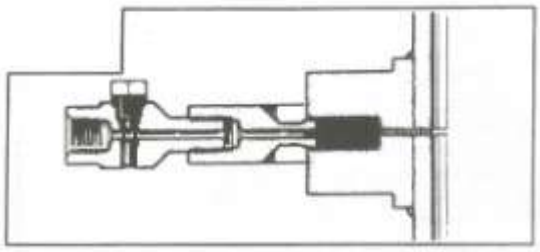
TECHNIQUES FOR SEALING WIDE GAP FLANGES



For sealing leaking flange type connections at all pressures where the gap between the flanges is greater than ⅜ inch (10 mm) the Furmanite insert clam is used.

Each Furmanite clamp is tailor made for the specific duty and flange. The tongue of the clamp is sized to fit the gap between the flanges with the correct offset should the gap be of variable width. Flange drilling is avoided.



THE FURMANITE CLAMP

The Furmanite clamp and bolting are designed to conform to the appropriate code stresses. The clamp is manufactured from high grade steel and welded to recognised standards. It is guaranteed to be capable of taking full line pressure should there be a complete collapse of the sealing gasket or failure of the injected compound.

The Furmanite clamp has an injection point at each bolt to ensure proper filling of the gap and bolt clearances. The clamp illustrated has shut off valves screwed into the deep rim, alternatively clamps can be made with integral shut off valves.

The Furmanite clamp is safe. It will not result in extra load on the flanges.

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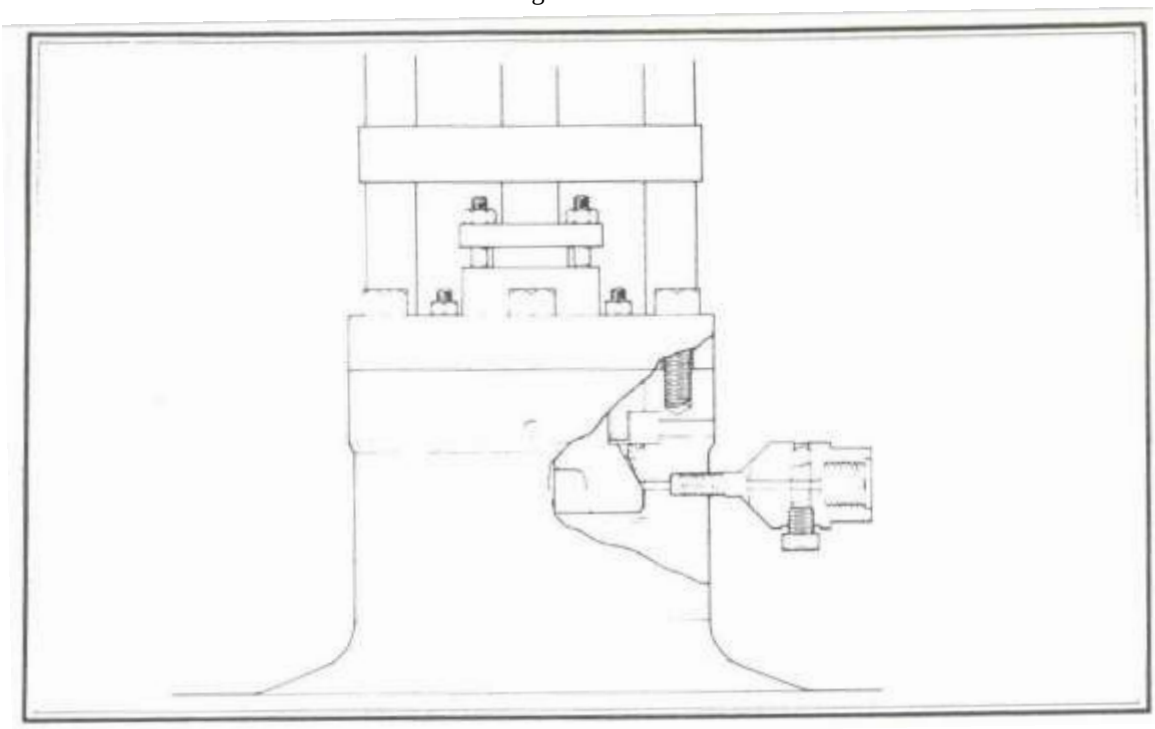
SPECIALIST REPAIR TECHNIQUES-PRESSURE SEAL VALVES



The sealing of high pressure leaks from pressure seal valves is a very specialised area of Furmanite's leak sealing technology. Due to the large number of manufacturers of pressure seal valves and the diversity of construction methods, each type of valve must be assessed individually. It is of critical importance to identify in each case the correct drilling position for the fitting of the Furmanite injection adaptor to enable the leak to be repaired successfully.

WORLDWIDE EXPERIENCE

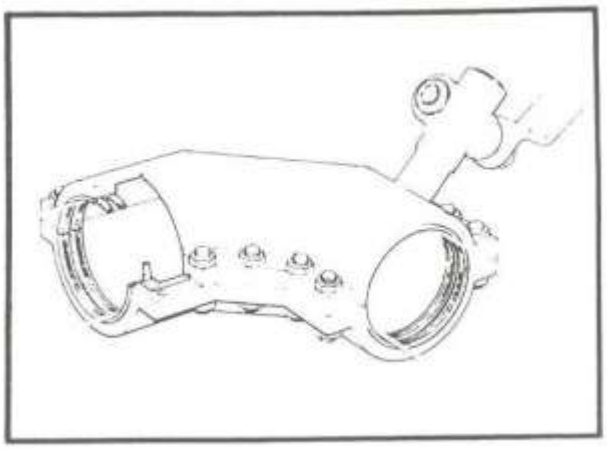
As a result of Furmanite's many years of Experience throughout the world the company holds information on file covering a wide range of pressure seal valves. This has built up through a close working relationship with both customers and manufacturers of pressure seal valves. With this knowledge, Furmanite has successfully sealed numerous types of pressure seal valves using specially formulated compounds injected through standard injection adaptors, all of which incorporate a safety shut-off screw. In addition Furmanite offer customers a design modification to facilitate the successful repair of any future leakage which may develop.

FURMANITE

PIPELINE REPAIRS

For leaking pipelines requiring a temporary repair to enable the plant to run until the next scheduled shutdown, Furmanite provide and fit custom designed box clamps. Whenever possible non destructive testing is requested before the work commences to indicate the extent of the defect, and thus ensure that positions of sound metal are selected for the edge seals of the box to be secured. On applications where unequal pressure forces exist auxiliary pipe restrainers are fitted.

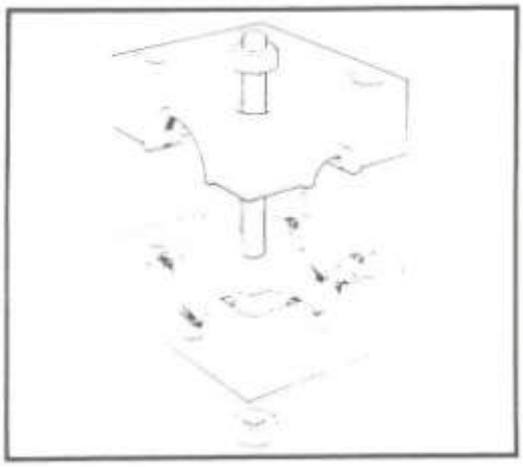
In all cases, Furmanite recommend that the plant operator replaces the defective pipe or joint at the next scheduled shutdown.



BOX CLAMPS

These are two basic types of boxes: monobloc and fabricated boxes.

Monobloc Boxes



These are machined in two halves, each half being cut from a single piece of metal with no welding involved. Monobloc boxes are particularly suitable for small sizes of fixture including Straights, Tees or Elbows. A variety of materials can be selected for manufacture to suit a wide range of process fluids and operating temperatures.

Fabricated Boxes

Produced by fabricators qualified to ASME IX and using standard tube and plate materials to pressure vessel codes, these boxes are designed in accordance with Furmanite's strict Quality Assurance programme. Fabricated boxes have applications for standard and non-standard shapes of pipe, including Straights, Tees, Elbow and Pulled Bends. They have no size limitations.

Edge Seals

Furnamite box clamps feature peripheral edge seals which allows some flexibility for out of round pipe diameters. An important benefit of the Furnamite design is that in most cases the box does not require injection filling with compound thus avoiding possible ingress of compound into the line or collapse of the pipe. Only in special circumstances following a full engineering assessment may box filling with a compound be permitted.

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PARTIAL LIST OF PRODUCT LEAKS WHICH FURMANITE CAN SUCCESSFULLY SEAL

Acetaldehyde
Acetic Acid, Glacial
Acetic Acid, Hot
Acetone
Acrylic Acid
Air
Aluminium Bromide
Aluminium Chloride
Ammonia Gas, Hot
Ammonia Gas, Cold
Ammonia, Anhydrous
Ammonia / Methane Gas
Aniline
Ammonium Nitrate
Asphalt
Ammonium Sulphate
Ally Chloride
Ammonium Phosphate
&
Hydrogen Cyanide
Benzene
Bromine
Brine
Bunker Oil
Butane
Butanol
Butyl Acrylate
Butyl Alcohol
Butadiene
Black Liquor
Carbamate
Carbolic Acid
Carbon Dioxide
Carbon Disulphide
Carbon Monoxide
Carbon Tetrachloride
Catalyst
Caustic
Chlorinated Salt Brine
Citric Acid
Condensate
Crude Oil
Cumene
Cyanide Solutions
Cyclo-Hexane
Caprolactum
Coke Gas
Coal Tar
Coke Oven Gas
Denatured Alcohol
Dichlorethylene
Diesel Fuel
Dowtherm
Diphenylamine
Diethanolamine
Diethylene Triamine
Disopropanolamine
Ethane
Ethanol
Ethers
Ethyl Alcohol
Ethylbenzene
Ethyl Bromide
Ethyl Chloride
Ethylene Glycol
Ethylene Dichloride
Ethylenediamine
Ethyl Dibromide
Ethylene
Fatty Acids
Fluorine
Fuel Oil
Furan (Furfuran)
Furfural
Furfuryl Alcohol
Formalin
Flue Gas
Gallic Acid
Gas, Manufactured
Gasoline
Gas, Natural
Gilotherm
Helium
Hexane
Hydrochloric Acid
Hydrogen
Hydrogen Chloride
Hydrogen Peroxide
Hydrogen Sulphide
Heptane
Hydrazine
High Graphite Black Oil
Iodine
Inhibited Acids
Isoamyl Alcohol
Isobutane
Isobutyl Alcohol
Isobutylene
Isopropanol
Isopropyl Acetate
Isopropyl Alcohol
Isopropyl Chloride
Isophorone
Jet Fuel
Kerosene
Ketones
Lactic Acid (Hot & cold)
Light Oil, Coal Tar
Linseed Oil
Lubricating Oils
Maleic Acid
Malic Acid
Methane
Methanol
Methylchloride
Methylethylketone (MEK)
Methylene Chloride
Mineral Acids
Mineral Oil
Mixed Acids
Muriatic Acid

Monoethanolamine (MEA)
Methylethyl Alcohol
Malotherm
Naphtha
Naphthalene
Naphthenic Acid
Nitrating Acid
Nitric Acid
Nitrogen
Nitromethane
Nickel Sulphate
Naphtha Vapours & Hydrogen
Nitric Oxide
Nitric Acid – Anhydrous
Nitrous Oxide
Octane
Oil Gas
Oil-Petroleum
Oil Tar
Oil/Water Mixtures
Organic Hydrocarbon Solvents
Oxalic Acid
O-Nitroaniline
Palmitic Acid
Paper Stock
Paraffin
Peanut Oil
Pentane
Petroleum
Phenol
Phosgene Gas
Phosphoric Acid
Phthalic Anhydrous
Xylene Base
Polyethylene
Potassium Carbonate
Potassium Chloride
Potassium Hydroxide
Potassium Salt Solutions
Potassium Sulphate
Potassium Nitrite
Potassium Nitrate
Phthalic Anyhdrous Naphtha Base
Potassium Nitride
Propane
Propyl Alcohol
Propylene Vapour
Pentene
Propythene
Raw Gas
Recovery Acid
Red Oil
Selecto/Steam
Sodium Bicarbonate
Ammonia
Sodium Chloride
Sodium Cyanide
Sodium Hydroxide
Sodium Phosphate
Sodium Sulphide
Steam
Stoddard Solvent
Styrene
Sulphur Chloride
Sulphur Dioxide
Sulphuric Acid
Sulphur
Syn Gas
Sodium Nitrate
Sodium Nitrite
Sulphur Hexafluoride
Sulphur Trioxide
Toluene
Transformer Oil
Trichloracetic Acid
Trichlorethylene
Trisodium Phosphate
Tail Gas
Tetraethyl Lead
Thermex
Thermal Cooling Salt
Urea & Gas
Urea
Vinyl Chloride
Vinyl Chloride Monomer (VCM)
Water
Waxy Distillate
Zoalene