Thermit welding

Objectives: At the end of this lesson you shall be able to
- **state the principle of thermit welding**
- **describe the parts of thermit welding equipment**
- **explain the sequence of operation for completing the weld**
- **state the application of thermit welding.**

Thermit welding

Thermit is a trade name for a mixture of finely divided metal oxide (usually iron oxide) and a metal reducing agent. (almost always aluminum). The thermit mixture may consist of about five parts of aluminium and eight parts of iron oxide, and the weight of thermit used will depend on the size of the parts of to be welded. The ignition powder usually consists of powdered magnesium or a mixture of Aluminum and Barium Peroxide.

Principle of thermit welding

The heat necessary for joining in the thermit welding process is obtained from a chemical reaction that takes place between a metal oxide (Iron oxide) and a metal reducing agent. (Aluminum) When ignited by using a burning magnesium ribbon in one spot of thermit mixture. The reaction spreads throughout the mixture. The tremendous heat released approximately 2760°C (5000°F) causes the iron to change to a liquid state within 25 to 30 seconds. As the aluminium in the mixture combines with the oxygen from the iron oxide, it forms Alumina oxide, which serves as slag and float to the top. Thermit reaction is an exothermic process. There are two types of Thermit Welding:

1 Plastic or Pressure Thermit Welding

2 Fusion of Non-pressure Thermit Welding

Plastic or Pressure thermit welding

This type is used mainly for butt welding of thick pipes of rails. In this weld, pressure is used to join the metal. The work pieces are clamped into C.I moulds and are forced together when the desired temperature is achieved. The thermit is heated in a crucible above the work. While heating, the lighter aluminium oxide slag rises to the top . When pouring temperature is reached, the thermit solution is poured into the mould. When the thermit mixture has heated the work pieces sufficiently, the work pieces are forced together forming a pressure butt weld. The whole welding process takes 45 to 90 seconds for welding of thick walled pipe.

Fusion of non-pressure thermit welding

In this process, the work pieces are lined up, leaving a space between the ends tha are to be welded. Wax is placed between the joint. The whole frame is suspended in a mould, and then the molten metal is poured. The first step in preparing a non-pressure thermit weld is the cleaning of the joint.

Equipments, materials and supplies

The thermit welding processs requires an adequate supply of

1 Thermit mixture

2 Thermit Ignition powder and a

3 Device (Flint Gun, Hot Iron Rod etc…)

Thermit mixture

The most commonly used types of thermit for welding the various ferrous metals are:

1 Plain Thermit

2 MS Thermit or Forging Thermit

3 Cast Iron Thermit

4 Steel Mill Wabblers

5 Rail welding Thermit

6 Thermit for welding electric connections

Plain thermit

A mixture of finely divided Aluminium and Iron Oxide. This is the basic of most thermit mixtures and yields maximum temperature.

MS thermit

This is a plain thermit with the addition of manganese and mild steel punching, and is used in welding steel. Manganese is added to adjust the chemistry of thermit mixture (Carbon may also be added, the mild steel punching are used to augment the metal content)

Cast iron thermit

Cast iron Thermit consists of plain thermit with addition of Ferro-silicon and Mild Steel punching and is used for welding cast iron. The mild steel punching augments the total metal content. Unless the weld area is post heat treated, this weld metal is generally not machinable and, because of the different contraction between it and the cast iron parent metal. It is limited to use where the maximum weld dimension is less than 8 times its width.

Thermit for steel mill wabblers

This consists of plain thermit with additions of manganese and carbon to provide a hard, wear resistant, machinable steel especially adopted to the building up of worn wabbler ends of steel mill rolls.

Thermit for welding rail

These mixtures usually consist of plain thermit with additions of carbon and manganese to adjust hardness of the deposited metal to the hardness of the rail being welded. Alloys are also added for controlling resistance to abrasion and to act as grain refiners.

Thermit for welding electric connections

This consists of Copper Oxide and Aluminium.

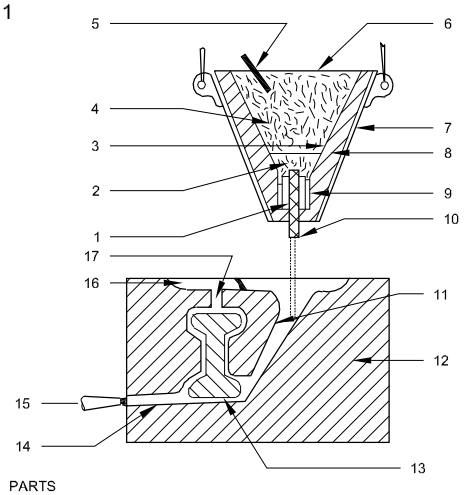
Thermit ignition powder

There are a number of different ignition powders available. Barium per oxide is frequently used. The thermit ignition powder is ignited directly with a match. This should be done by partly burying the match head in the mixture and igniting the match with a thin red hot rod. This avoids the danger of burns injuries to the finger or hand due to the sudden flare in igniting. The thermit ignition powder can also be ignited with a spark from a flint gun or by using a burning magnesium ribbon.

Thermit welding procedure

The ends are to be welded are thoroughly cleaned of scale and rust. After cleaning, the parts to be welded are to be lined up with a gap of 1.5 to 6mm depending upon the size of parts. This gap compensates the contraction of thermit steel and the shrinkage of the base metal. The next stage is making wax pattern of the weld. A refractory sand mould is rammed up around the wax joint and necessary gates and risers provided. Ramming should be light between the moulding sand and the wax. When ramming is completed, the pattern may be drawn and loose sand may be wiped out. Then, the heat is given to the wax pattern through the heating gate to melt and burn out wax. The heating is continued until the ends to be welded are at a red heat. This prevents the thermit steel being chilled, as it would be if it came into contact with cold metal. The preheating gate is now sealed off with sand. Now, charge the thermit in the crucible. The approximate weight of thermit is 12 to 14 kgs against one kg. of wax. The outside shell of crucible is made by steel and is lined with manganese tar lining. At the bottom, a magnesia stone and a thimble is provided through which the tapping pin works. The thimble is inserted in the stone which provides a channel through which the molten metal is poured for each reaction a new thimble is used. The thimble is plugged by suspending the tapping pin and placing a metal disc above pin. The metal disc is lined with refractory sand. At the top of the thermit, low ignition temperature thermit is placed in the crucible. When ignited in one spot of thermit mixture, the reaction spreads throughout the mixture. The reacted can be heard, as soon as the noise of reaction stops, the crucible should be tapped. The intense heat of thermit melts the preheated ends of the parts to be welded and the fusion welding takes place. Then the mould is allowed to cool overnight. If possible or at least for 12 hours and cut away the gates and risers with a cutting torch and finish the weld. (Fig 1)

Fig 1



PARTS

1. MAGNESIA THIMBLE
2. REFRACTORY SAND
3. MAGNESIA TARLINING
4. THERMIT MIXTURE
5. IGNITOR
6. REACTION VESSEL
7. STEEL SHELL
8. METAL DISC
9. MAGNESIA STONE
10. TAPPING PIN
11. POURING GATE
12. SAND MOULD
13. SECTION TO BE WELDED
14. PREHEATING GATE
15. TORCH
16. SLAG BASIN
17. RISER

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Application

Thermit welding is mainly used in rail welding, concrete reinforcement rod welding, building up of steel mill wobbler ends and for electrical connections.

1 Rail welding

Rails are welded to create long railways for electrified and other fast tracks. This increases the passenger comfort and keeps the maintenance cost down. Spillage of goods (like coal) is minimised in mining industry.

2 Reinforcement steel rod welding

In big building projects, a massive number of joints are to be carried out for joining of reinforcement steel at a short time. Thermit welding is applied by using prefabricated moulds with reaction chambers.

Backing strips and backing bars

Objective: At the end of this lesson you shall be able to
- **understand the principle of backing strips and backing bars.**

Definition

While welding the product supported and control the distortion of the concened jobs/product. To minimise the distortion and contraction we can use backing strips and backing bars.

The following sketchs are to be used.

Fig 1

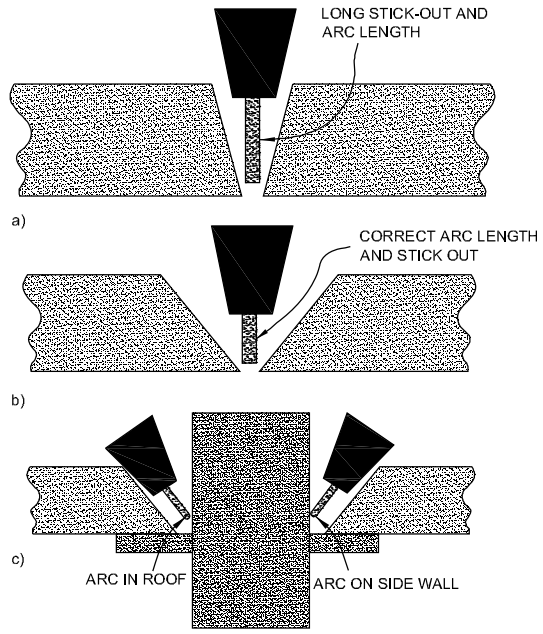
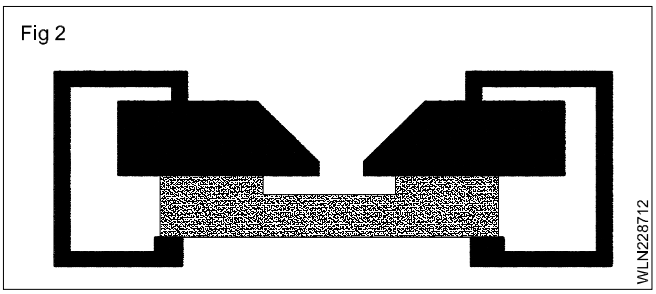


Fig 2



The temperature and fast cooling is applied on fully heat treated samples.

The microstructure results due to cooling at the maximum holding temperature as well as independant of the applied pressure value.

The effect of heat treatment and cooling rate on the properties of fast cooling from the upper limit and proesize distruction do not change significantly throughout the sample sarees.

In the experiments the effect of fast and slow cooling the bathing prior to heating these was a heat distribution of intervals.

Fig 3

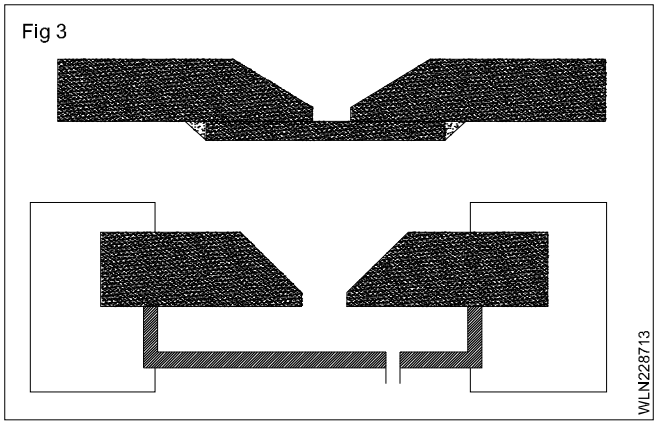


Fig 4

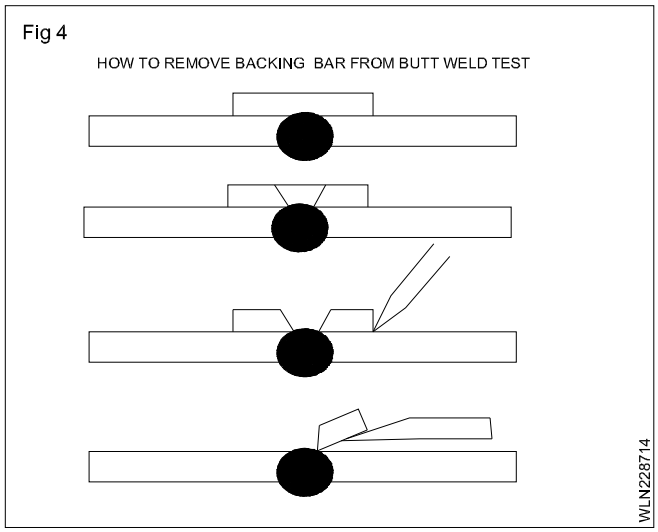


Fig 5

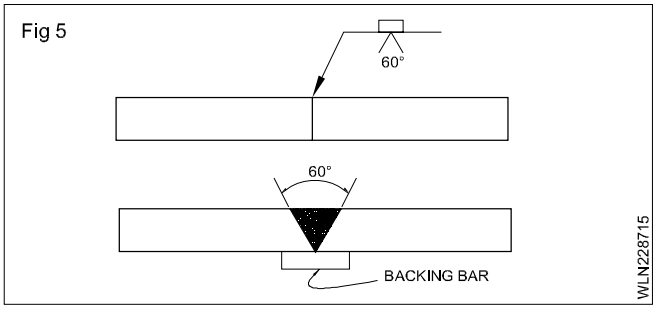


Fig 6

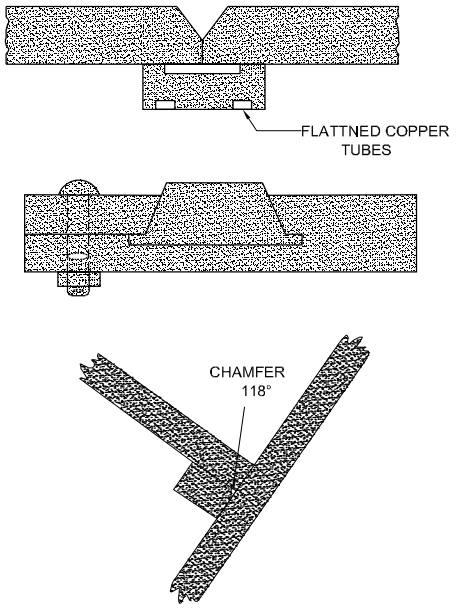


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Fig 7

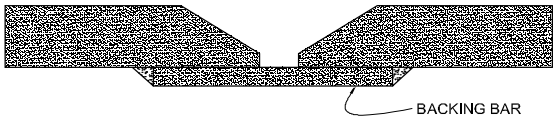

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Fig 8

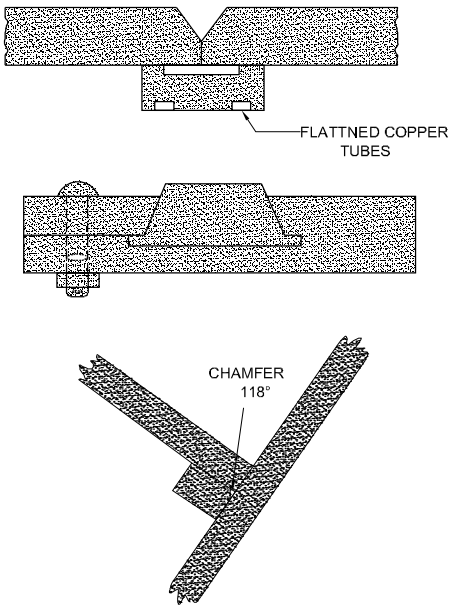

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Fig 9

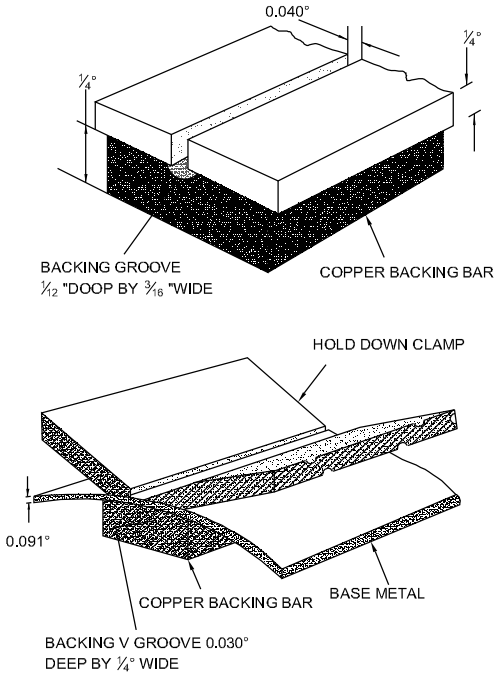

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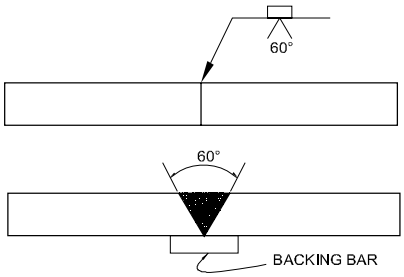
Fig 10



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