

M501: MEASUREMENT OF HAZARDOUS SUBSTANCES INCLUDING RISK ASSESSMENT

STUDENT SUPPORT INFORMATION – WELDING, SOLDERING AND THERMAL METAL CUTTING

Welding is the principal industrial process for joining metals or plastics whereby they are heated, melted and mixed to form a joint with properties similar to those of the materials being used.

Welding, soldering and thermal metal cutting are essential industrial processes producing a range of potentially toxic metal fumes from welded material, welding rods or fluxes. Irritant and oxidising gases can also be produced, together with inert, asphyxiating gases from certain welding technologies.

Metals can also be cut by a flame or an electric arc, or be removed by “gouging” with an electric arc.

Brazing is the joining of materials with a filler having a melting point above 450°C, but below the melting point of the base metals.

Soldering is the joining of metals using a metal filler with a melting point below 450°C. The joined metals can be different metals. The filler metals commonly used are lead-tin alloys.

The heat in welding may come from a flame, an electric arc, friction or pressure.

The commonly encountered welding processes include:

- Manual Metal Arc Welding (MMAW) – the electric arc welding of metal using a flux coated electrode. The electrode is coated with a flux which acts as an electrical insulator outside the arc area and which, on vapourising, forms a shielding gas (carbon dioxide) to protect the arc zone and the molten weld pool, as well as a slag thermal insulator, to protect the cooling weld deposit from the air. The coating also contains fluxing agents, arc stabilisers, deoxidisers, binding agents etc and where required alloying agents.

- Gas Metal Arc Welding (GMAW) – the electric arc welding of metal using a gas shielded wire electrode. This process is also known as Metal Inert Gas (MIG) Welding or hard wire welding. An arc is struck between a continuous spool fed wire consumable electrode and the workpiece. The electrode melts and provides filler metal to the weld. The arc and weld are shielded by one of a variety of shielding gases – carbon dioxide, argon or helium. GMAW is used in the welding of both steel and aluminium. High levels of ozone can be produced
- Submerged Arc Welding (SAW) – the electrode is submerged beneath a pile of loose flux which protects the arc zone and the weld from the air and takes part in the metallurgical reactions with the molten weld metal. The electrode is fed automatically in SAW processes.
- Flux Cored Arc Welding – these processes may or may not be gas shielded. and employ a continuous wire containing a flux-core which is similar to coatings uses for MMAW electrodes.
- Gas Tungsten Arc Welding – or Tungsten Inert Gas (TIG) Welding. A shield of inert gas is used to protect the arc zone and the weld metal from the air, this preventing oxidation and contamination of the metal. The electrode is tungsten and the inert shielding gas is argon, helium or a gas mixture. The electrode contributes no metal to the weld, but weld metal may be added by means of a suitable uncoated filler rod.
- Resistance Welding – this process involves spot, seam, projection, butt, flash and stud welding. A high current at low voltage flows through the workpiece from electrodes usually made of copper. Both heat and pressure are involved in producing a forge weld.
- Air Carbon Arc Cutting and Gouging – an arc is struck between a copper coated carbon electrode and the workpiece. The pool of molten metal produced is blown away by jets of compressed air. Metal cutting with the electric arc may also be done by the oxygen arc cutting or tungsten arc cutting methods.

- Plasma Arc Welding, Plasma Arc Cutting and Plasma Arc Gouging. Plasma arc welding may be carried out with or without the use of a filler metal. Gases used include argon, hydrogen and nitrogen.
- Oxyfuel welding, cutting and heating (oxygen-acetylene (oxyacetylene) or oxygen propane (oxypropane) mixtures are the most common fuel mixtures used.
- Other types of welding processes include metal spraying, microwelding and special processes such as electron beam welding, friction welding, laser welding and drilling. plasma arc welding, spark erosion machining and thermit welding.

The hazards associated with the welding process can include ergonomic, electric shock, bright light, ultraviolet radiation, toxic fumes and gases, heat, fire and burns and noise.