MRAT 027	Electric arc welding	Applicable to: aluminium; mild steel; stainless steels	See also: 028 064
Process(es) covered:	The creation of a joint using a filler (welding rod) of similar composition to the metal being joined. The electric arc gives rise to fumes from the electrode coatings, metallic oxides, any paint or surface contaminant and possibly to ozone and nitrogen oxides.		

Control Measures

- Always wear a face shield (see Further information) designed for use when arc welding. Self-adjusting variable shade visors are preferable. Observers must also wear suitable eye protection and maintain a safe distance from the welding area. If welding is done in a workshop used by others, then screening should be used to provide protection from glare.
- Wear clothing which provides adequate protection from the heat and hot objects. This should include substantial footwear, leather apron, gaiters, gloves or gauntlets as well as the eye protection.
- Do not use short welding rods.
- Display a suitable warning notice near hot metal which is left to cool.
- Handle hot metals or refractory bricks with suitable tools.
- The open-circuit voltage should be limited to 50 V ac or 120 V dc and, in general, the workpiece should be earthed. Earthing is not necessary if the current supply has reinforced insulation as shown by the identification symbol consisting of two circles within a shield.
- Always carry out welding away from combustible materials, including timber.

Immediate Remedial Measures:

Fumes are inhaled	In the event of dizziness occasioned by fume, remove the affected person to the fresh air until recovered.
Burns to the skin	Cool the affected area under a running cold tap for 20 minutes.
Serious burns to the skin	Send for an ambulance. Cool the affected area under a running cold tap for 20 minutes. Watch for difficulty in breathing or faintness. Gently remove jewellery or watches that might be difficult to remove later if the limb swells.

Storage	

Disposal	

Risk Assessment

Hazards:

Eye damage Burns Electric shock Fire	The arc is an intense source of visible and ultra-violet radiation. Careless handling of hot metals after heating and 'sparks' of metal or hot scale can cause burns. If the operating voltage is sufficiently high, there is an electric shock hazard. Fires can be caused if sparks from welding land on combustible material.

Risks:

Eye damage	The eyes and face must be protected from the intense radiation.
Burns	During welding operations, metal components remote from the weld will be hot enough to burn. After welding, metal structures will remain hot and present a significant risk of burns until cool. A welding electrode that is too short increases the risk of burns to the hand. Rearranging ceramic blocks for a new job can cause burns if they are still hot from a previous use. Inadvertent arcs, caused by putting the live electrode near earthed objects, are also possible causes of burns.
Electric shock	Although most welding equipment used in education works at voltages below that of the mains, electric shocks are still possible.
Fire	Welding in a mixed materials workshop or in an area where combustible materials are stored presents an increased risk of fire.

Further Information:

- Eye protection is marked with a number which describes the darkness of the filter, a manufacturer's mark and a robustness code which may be a number or a letter and number. Face shields for arc welding should now have the following codes on the ocular (lens) where X is the manufacturer's mark: 10, 11 or 12 X 1 or 2 B or S EN169. Older ones should carry the code EW 10, 11 or 12 and the old BS number 679. The filters specified for gas welding are adequate for observers, as long as they can maintain an appropriate distance from the welding area (this should be at least 3 metres).
- The availability of compact kits for metal inert gas (MIG) welding and other modern techniques has encouraged schools and colleges to introduce these systems to complement the simpler technique with coated electrodes.
- Further information is available from Woodhead Publishing Ltd1 who supply materials formerly available from the Welding Institute.
- Teachers should consider the supervision issues when glare screens are used.
- Closed vessels or tanks must not be welded, unless purged of any explosive or flammable materials, and oxygen must **not** be used for this purpose.

SPECIAL NOTE

- Welded joints may be tested by filing a cross section of the joint smooth, polishing the surface and then etching the surface using Nital - a mixture of concentrated nitric acid and ethanol. There have been incidents of such a mixture exploding during the course of preparation. If Nital has to be used then it should be prepared on each occasion that it is needed and **NOT** stored. A maximum of a 2% solution should be made. The solution should be made up by a suitably qualified science technician wearing chemical-resistant gloves and goggles using a fume cupboard. After use the solution **MUST** be disposed of and by safe methods. See 064.

[1] Woodhead Publishing Ltd, Abington Hall, Abington, Cambridge CB1 6AH