



WELDING AND CUTTING

PTS 60.2107

Rev 1

JUNE 2006

PREFACE

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AMENDMENTS RECORD SHEET

Chap No.	Sect No.	Description	Issue No.	Date	Rev No.	Date	App (initial) by:
All	All	PTS 60.041 Welding and Cutting	1	Sept 04	0	0	IGA

Chap No.	Sect No.	Description	Issue No.	Date	Rev No.	Date	App (initial) by:
All	All	Renumbering from PTS 60.041 to PTS 60. 2107	1	June 06	1	June 06	IGA

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In those countries where statutory regulations or national codes of practice concerning welding and cutting apply or where there is specific requirement such as ANSI/ASC 2.49.1 - 94, or API 2009, these must be observed and should be read in conjunction with the recommendations made herein.

1. **INTRODUCTION**

Many hazards are associated with welding and cutting, but as in other operations they can be controlled by appropriate preventive measures. Unless these measures are taken, the hazardous situations can easily give rise to personal injury and/or material damage.

Some typical examples are:

- The brilliant light of an arc (exposure to which can result in eye injuries)
- The heat of an arc, molten metal, sparks, hot objects, etc. (causing burns, fires/explosions)
- Toxic fumes released during the welding/cutting process
- Electrical hazards
- Mishandling of gas cylinders
- The welder at his work seldom being able to see, hear or smell what happens around or behind him.

2. **PREPARATION FOR WORK**

At all locations and installations a written work permit should be obtained from the appropriate authority prior to the start of a welding or cutting job, unless the work is to be done in an unrestricted area or one specially designated for the purpose. For welding or cutting inside new vessels, or on or in old vessels and equipment, a special permit should be obtained even if the work is being carried on inside a designated area. The work permit should specify inter alia any stand-by safety and firefighting equipment which should be on the spot before the start of work. Special precautions should be taken regarding screening (see section 3.1), scaffolding (ramps and toe boards), location of welding sets, and the position, handling and use of gas cylinders.

Welders and burners should be skilled tradesmen. Apprentices and helpers should work under the supervision of a qualified person.

3. **GENERAL CONSIDERATIONS**

3.1 **EYE INJURIES**

Radiant energy in the visible and invisible frequency ranges is emitted from the arc or flame whenever welding operations are undertaken. The visible radiation is too bright for the naked eye and both visible and invisible radiation will adversely affect the eyes and will also burn the skin in much the same way as sunlight.

The eyes can be protected from the harmful and over-bright effects of the radiant

energy by special lenses mounted in goggles, helmets or face shields. The type of lens used will depend on the welding operation taking place.

In welding shops permanent screens should be installed to protect welders and others not immediately engaged in the work. These screens should be non-reflecting and properly installed so that they do not interfere with access, lighting and ventilation. Most welding work is carried out at bench height so that screens rarely need to be extended to ground level where they could seriously affect general ventilation. Through proper design local extraction ventilation is unlikely to be affected.

In certain circumstances, such as welding part way up the bulkhead of ships or on overhead structures, screens cannot be used. Special precautions need to be considered in these cases to protect the eyes of nearby workers, supervisors, inspectors and others from eye flashes.

3.2 BURNS

3.2.1 Thermal. Burns of the skin from hot metal, spattered slag or metal, or from handling hot objects such as tools, rods or the work may be effectively prevented by the use of protective clothing such as arm and leg guards, aprons, shirts and gauntlets.

3.2.2 Radiant. The risk of burns from radiant energy on the unprotected skin of the welder (such as arms, neck, ears or face) is easily prevented by the wearing of appropriate protective clothing. The use of ultra-violet barrier creams (e.g. Uvistat ointment) may also be considered in certain situations.

Note: Clothing made from standard grades of nylon and other man-made fibres is not recommended for protection against thermal or radiant burns.

3.3 TOXIC FUMES

Welding, cutting and brazing operations produce mixtures of gases, fumes and smokes, the composition of which will depend on a number of factors such as base metal, welding temperature, arc intensity, type of electrode and flux, metal covering, contamination, shielding gases, etc. The intense heat and radiant energy generated in welding operations act on the atmospheric gases to produce mainly oxides of nitrogen and some ozone. These gases are always present whenever welding, cutting or brazing takes place, and both are irritant gases which are dangerous if inhaled in concentrations above those recommended for safe working.

In addition other gases, fumes and smokes are produced from the burning of the base metal, the welding rods, metal coatings, contaminants (e.g. solvents), fluxes, etc. The fumes consist mainly of iron oxide but oxides of zinc, manganese, nickel, antimony, copper, cadmium, etc. can be present as well as fluorides.

Metal surfaces may be coated with protective films of, for instance, lead paint, zinc galvanising, cadmium, oil or plastic. When these surfaces are heated other toxic fumes are generated.

The inhalation of metal oxides in excess of recommended safe levels (see Bibliography item 7) can produce a temporary fever - metal fume fever. It is a

temporary illness which may have a delayed onset but usually passes off within a few hours with no apparent evidence of permanent injury or residual effects.

Inhalation of the fumes of certain metal oxides at *high concentrations* may cause prolonged fever, permanent impairment or even death. In this respect the fumes from lead, cadmium, manganese, antimony and copper are particularly toxic and work evolving these fumes should be carried out with special care.

Pipes and other metal work covered with lead paint/coating, and some special alloys of iron and steel which contain lead, can release lead fumes when cut or welded.

Cadmium is used in paints and plated on metal surfaces and when these are cut or welded highly toxic fumes of cadmium oxide are liberated. Cadmium is also a component of silver solder.

Although medical surveys of manual arc welders have revealed little or no effect on general health (References 1, 2, 3, and 4), it is nevertheless good practice to avoid unnecessary exposure to the fumes.

Surveys of actual welding operations (see Bibliography item 7) have shown that when using the standard type of welding helmets/face shields the concentrations of welding fumes and gases inhaled by the welder during the normal course of his work are generally within the recommended levels except for work in confined spaces. However to achieve satisfactory conditions at all times adequate ventilation is necessary unless respiratory protection is used.

Specifications for welding and cutting which provide appropriate safeguards for the health of the welder are therefore essential and should be prepared for all relevant operations.

Natural air movement in open spaces normally provides enough ventilation for most operations but the cutting of scrap metal, welding in trenches, etc. may require the use of adequate respiratory protection.

For welding and cutting operations inside buildings, enclosed spaces etc. the gas, fumes and smoke should preferably be drawn away from the breathing zone of the welder. The best method of removing these contaminants is by means of a properly designed local exhaust system, (Ref. Bibliography item 6). The construction of the welding booth, the location, size and shape of the exhaust, and the exhaust rate are of prime importance and the whole area should only be constructed after consultation with ventilation engineers.

In some cases (e.g. confined spaces) it may not be possible to use local exhaust ventilation due to lack of room and general ventilation may be considered instead. The latter is a relatively inefficient method of control involving the removal of large volumes of air. Satisfactory conditions are normally obtained by keeping the fume concentrations below 10 mg/m^3 (as ferric oxide). Ventilation rates which may be needed to obtain this result are given in the following table: