

**PERSONAL PROTECTIVE EQUIPMENT FOR WELDING AND ALLIED
PROCESSES: PRACTICAL GUIDANCE ON ASSESSMENT AND SELECTION**

INTRODUCTION

1 This information document contains internal guidance which has been made available to the public. The guidance is considered good practice (rather than compulsory) but you may find it useful in deciding what you need to do to comply with the law. However, the guidance may not be applicable in all circumstances and any queries should be directed to the appropriate enforcing authority.

2 This guidance is for employers, employees and others who have responsibility for ensuring the health and safety of workers using welding and allied processes. Manufacturers and suppliers of personal protective equipment (PPE) for these processes may also find this document useful. It brings together key considerations for the assessment and selection of PPE.

3 This guidance only deals with hazards directly associated with welding and allied processes. It does not deal with processes such as chemical cleaning, hazards such as manual handling, specialised processes such as underwater welding, electron beam welding, laser welding, brazing or metal spraying.

4 effective protection can only be provided by PPE when it is suitable for the job, it is adequately maintained and it is worn properly by the user who has been trained to use it. This document only provides information on the selection of PPE, it does not cover aspects related to the maintenance and storage of PPE, legal requirements, training or instruction in the use of PPE.

5 due to the varied nature and location of work in welding and allied processes, it is not possible in this document to address work which may give rise to special needs for PPE. therefore, this guidance should not be used as a substitute for professional advice in such special situations.

ACTION BEFORE CONSIDERING PPE

6 Welding and allied processes produce hazards which are determined mainly by process conditions and the materials being used. It is the nature and severity of these hazards that determine the type and level of risks. Only when these risks cannot be adequately reduced by other means should the use of PPE be considered. The references provided at the end of this document should be consulted to ensure that adequate steps have been taken before PPE is considered.

7 However, it may not always be possible to use measures other than PPE to control the risks and in these circumstances PPE, normally the last line of defence, becomes the only line of defence available to adequately protect workers. Therefore,

it is of vital importance that suitable PPE is chosen for the job and that the performance standard required from PPE is determined directly by the nature and level of risks involved in performing the task.

GENERAL CONSIDERATIONS IN SELECTING PPE

8 The hazards and risks arising from welding and related activities are summarised at Appendices 1 and 2. Once the risks which are actually present have been determined and, where appropriate, other control measures used to reduce the level of risk, then consideration can be given to further reducing the risks by use of PPE.

9 In circumstances where PPE is the only protection against a particular hazard, it becomes vital that suitable PPE is chosen for the job. The performance standard required from PPE is determined directly by the nature and level of risks involved in performing the task. Selection of PPE without reference to the risks involved in doing the work can be a waste of resources and may provide no protection.

10 In selecting PPE it is important to ensure that the chosen item of PPE will provide the necessary protection under the conditions of use. For example, respiratory protective equipment (RPE) designed to protect from welding fume only, will not provide protection against asphyxiation in welding where shielding gases are used.

11 Adequate protection will only be offered when:

- (1) the right items or combinations of PPE are worn;
- (2) the PPE being used is suitable for the welding environment;
- (3) the PPE fits each worker properly without causing undue discomfort;
- (4) the worker is given information and training in the use of PPE; and
- (5) the PPE in use is maintained regularly.

12 Wearing several different types of PPE at the same time (eg eye and hearing protection) may lead to unnecessary discomfort for the worker and in some cases it may compromise the effectiveness of some items. For many welding and related operations, several items of PPE are liable to be worn and it is therefore important in selecting PPE that due consideration is given to the compatibility of different items of PPE. It may be better to select one item in which the protective components are integrally combined by one manufacturer.

Costs considerations

13 When comparing the costs of engineering and PPE/RPE controls, long-term costs should be used. Initial costs of PPE/RPE may be low but the cost of replacement and maintenance needs to be added.

Considering the options

14 The selection process can be assisted by consulting several suppliers of protective equipment and considering the options carefully. For example, one type or size of PPE will not fit all workers and consideration should be given to availability of suitable sizes. All new items of PPE must be CE marked and only marked items must be used. Such items will usually have been tested and marked to a harmonised European standard. Specific requirements which go beyond those in European standards can be discussed with suppliers and they may request the manufacturer to tackle unique protection needs.

15 Discussion with others in the welding industry such as managers of other firms, trade associations etc can assist in making informed choices.

Consultation with workers

16 Injuries, losses and damage can often be reduced where workers are consulted on their preference for the types of PPE that provide adequate protection. Decisions will be better informed after a trial period to get wearers' views on comfort before ordering in bulk.

Special requirements

17 At times, work requirements are such that they present additional risks and create special requirements for PPE. For example, if work involves use of equipment or a combination of equipment not normally used; uses consumables and materials not normally handled, or where the workers have no experience of working in new environments which present additional hazards such as confined spaces or work at heights.

18 When such special hazards arise, the risks that may arise must be assessed to make sure that PPE will be adequate for the job and workers must be adequately informed and instructed before they start work.

19 It is recommended that specialist advice is obtained if the risks, control measures and suitability of PPE are uncertain.

SPECIFIC CONSIDERATIONS IN SELECTING PPE

Hazards and risk assessment

20 Selection of PPE must be based on a risk assessment. A structured approach to the assessment of risks and selection of PPE for welding and allied processes is necessary. Key considerations are:

- (1) identify all the hazards of the work being done;
- (2) assess the risks for which control measures are required;
- (3) control risks by means other than PPE;
- (4) assess the requirements for personal protection needed to control residual risk;
- (5) determine the type of PPE and the performance level required; and
- (6) select suitable PPE ensuring compatibility of different items.

21 An important consideration of the risk assessment is to determine those parts of the body at risk from the hazards. The extent of risk will also be influenced by the frequency and duration of the exposure.

22 Due to the varied nature of work in welding and allied processes, the type of PPE required is determined not only by the type of welding and materials being used but also by the immediate environment in which the work is being carried out. For this reason it is not possible to address the specific requirements for each type of operation and provide a detailed list of controls and PPE requirements. For example, PPE requirements for working in confined spaces where hazardous fumes and gases may accumulate or shielding gases may create an oxygen deficient atmosphere, would be very different from those in a well-ventilated workshop. Thus, in discussing PPE requirements reference is made to the risks rather than any specific welding operation.

23 Appendix 1 summarises the hazards associated with welding and allied processes. The hazards listed are only those for which PPE may be required. For example, fire and explosion hazards are not mentioned.

24 Once the risks arising from the work activities have been determined and, wherever appropriate, other means have been used to reduce the level of risk to as low as is reasonably practicable, then consideration can be given to further reducing the risks by use of PPE. Personal protective equipment typically required for welding and related activities is summarised in Appendix 2.

25 Considerations for the selection of face shields and welding shields, safety eye wear, filters, ear protectors, RPE, hand protection and general protective clothing and shoes are outlined at paragraphs 26-71.

Face shields and helmets

26 FACE SHIELDS AND welding shields are usually required to protect the head, face and eyes from radiation, burns and physical injury that may be caused by sparks and spatter. Whether a face shield or a welding shield is required will depend on the type of welding and the welding parameters. Appendix 3 contains a summary of the potential suitability and performance of face SHIELDS/welding shields.

Considerations in choosing a face shield or welding shield

27 In gas welding where sparks or spatter are not produced, use of a shield may not be necessary and welding goggles (paragraphs 34-37) fitted with suitable welding filters (paragraphs 38-44) can provide adequate protection.

28 A face shield or welding shield can be attached to a helmet or head harness so leaving both hands free, or may be held in one hand. The shield should extend so as to cover the sides of the face so giving protection when working in the vicinity of other operators and should be of light weight to reduce operator fatigue. Welding shields must be suitable for protection against molten metal and hot particles and conform to the requirements of BS EN 175: 1997 Personal protection: equipment for eye and face protection during welding and allied processes, or an equivalent specification.

29 Welding shields should be made of light weight material capable of blocking welding radiation, withstanding heat and providing protection from sparks and spatter. A light-tight housing, either an integral part of the shield body or attached securely to it, holds the filter assembly (filter ± cover plate ± backing plate).

30 Some housings allow the wearer to raise the filter out of the line of vision without moving the shield. Such a housing should either stay up or down and not stop in an intermediate position. Shields with reflective coatings help reduce radiant heat reaching the welder's face.

31 Protective hoods are available to provide full head protection from sparks and metal droplets when working in restricted spaces or in a situations where an extensive amount of spatter is produced. They should have a suitable housing to take standard sized filter assemblies and be made of material resistant to flame and molten metal spatter. Leather is normally used.

32 In situations where it is likely that sparks and spatter may get past the welding shield (eg when working overhead), it is recommended that appropriate goggles (eg BS EN 166 Personal eye protection specifications 1B59KN) are worn behind the welding shield to provide extra protection for the eyes.

33 When choosing a welding shield or helmet it should be noted that:

- (1) for work at or below eye level, welding shields which curve under the chin are better than ones with straight fronts. They provide a good light seal around the edges and can reduce the amount of fumes in the

worker's breathing zone. For work above eye level, straight fronted shields provide more protection for the lower throat and upper chest region.

- (2) welder's shields may interfere with the fit of respirators. Welding shields with a built-in respiratory protection or ones which allow a respirator to fit correctly beneath are available. Some respirators are specifically designed to fit beneath face shields. Helmets are also available as carriers for welding shields and they provide head protection.

Safety eye wear

34 Safety eye wear is aimed at preventing radiation, projectiles and airborne material from reaching the eyes. Appendix 4 contains a summary of the potential suitability and performance of safety eye wear.

Considerations in choosing safety eye wear

35 In situations where the risk from injury by molten metal is considered to be too severe, the use of spectacles (even those with side shields) will not provide adequate protection and it is recommended that suitable goggles are used. Other considerations as noted at paragraph 32 should also be borne in mind. Similarly, in situations where a worker frequently switches between welding and grinding operations, it is recommended that goggles are worn behind the shield to avoid the constant switching between wearing a welding shield and goggles.

36 BS EN 175 refers to equipment for eye and face protection during welding and allied processes. BS EN 166 refers to personal eye protection for general industrial use. See paragraphs 38-44 for information on welding filters.

37 When choosing safety eye wear it should be noted that:

- (1) it is important to consider comfort and fit when considering suitable eye protectors. Single size non-adjustable spectacles are common but cannot be expected to provide satisfactory comfort and fit to all wearers;
- (2) if good fit is not achieved, eye protectors may not provide the intended level of protection. To provide good comfort and fit many types of spectacles have adjustable side arms and tilting frames. Some goggles are provided with deformable foam flange seals to achieve improved comfort and fit;
- (3) various types of lens material are available together with various coatings to provide additional properties such as abrasion resistance, impact resistance and anti-fogging. Given the choice in safety eye wear, wherever possible workers' involvement in the selection process should be sought;

- (4) sidearms of spectacles and head-bands of goggles can disturb the fit of full facemask RPE and ear protectors and THE nose bridge of spectacles and goggles can disturb the fit of half mask and filtering piece respirators and vice-versa;
- (5) safety eye wear may need to be worn behind the welding shield, eg when slag is removed or a weld is ground, and therefore it is required that it be compatible with the shield. If goggles are used, types that resist misting are preferred (marked 'N' in BS EN 166).

Filters for welding radiation

38 FILTERS FOR welding RADIATION are needed to ensure that harmful radiation reaching the eyes is reduced to a safe level. The filter scale number chosen will depend on the extent of protection required which is determined mainly by the welding conditions and worker's closeness to the weld. Appendix 5 provides information on the suitability of filters for some welding and related work.

Considerations in choosing a filter

39 The filter selected for use by the welder is determined by the energy of the process. BS EN 169: 1992 Specification for filters for personal eye-protection equipment used in welding and similar operations, specifies standards of protection required for different welding processes.

40 Filter scale numbers range from 1.2-16 and, according to the conditions of use, the next greater (in strong natural light) or the next smaller scale number can be used. Filters are normally used with cover plates and/or backing plates to protect the filters and eyes from damage. Filter assemblies should incorporate appropriate impact resistance.

41 Welding filters are available with switchable scale numbers. These automatically darken when a welding arc is struck. BS EN 379: 1994 Specification for filters with switchable or dual luminous transmittance for personal eye-protectors used in welding and similar operations, specifies the requirements for light transmittance and switching times for light and dark shades for filters of this type.

42 Filter requirements for welder's assistants will depend upon their proximity to the welding operation. If an assistant is working close to the welder then a filter scale number should be the same as the welder's but when working at some distance and not directly assisting in the making of the weld, then a lower scale number filter than the welder's may be suitable. Use of filters with switchable scale numbers are considered appropriate as they automatically adjust to provide the required protection.

43 Other workers and passers by can normally be protected from incidental exposure by use of welding screens and curtains. If this is not possible, then safety eye wear with suitable filters and side shields will be necessary. Filter scale numbers 1.2-4 are normally appropriate.

44 When choosing a filter it should be noted that:

- (1) a filter with too low a scale number will not provide adequate protection and a filter with too high a scale number will cause the worker to move too close to the radiation source and may lead to higher risk of inhaling welding fumes; and
- (2) the filter should fit properly in the filter holder, usually a welder's shield, to avoid leakage of radiation.

Ear protectors

45 EAR PROTECTORS are required to ensure that exposure to noise is adequately controlled and that when worn properly can be expected to keep the risk of damage to hearing to below that arising from exposure to the second action level (daily personal noise exposure of 90 dB(A)). A noise assessment by a competent person should provide information about the employees' exposure to noise and may include advice on the selection of appropriate ear protectors. If work conditions are such that sparks and spatter might enter the ear, then the use of ear protection will also provide protection against the entry of such particles. The main types of hearing protectors available are given in Appendix 6. More information is included in HSE publication L108 Reducing noise at work. Guidance on the Noise at Work Regulations 1989 Part 6.

Considerations in choosing ear protectors

46 Ear protectors are available in many forms. If properly selected, used correctly and adequately maintained the devices listed at Appendix 6 should be capable of providing adequate protection from exposure to high noise levels. Spatter can easily damage the seal on earmuffs. Protectors selected should use seal material which is capable of withstanding heat and spatter impact.

47 Manufacturers of hearing protection are required to supply information on the results of tests carried out on a protector to determine the amount of noise reduction they will offer. This information can be used to ensure correct selection of ear protectors to provide adequate protection for the conditions in the workplace.

48 Standards for ear PROTECTORS are given in BS EN 352: 1993 Hearing protectors: safety requirements and testing. Part 1 relates to earmuffs, Part 2 to earplugs and Part 3 to earmuffs attached to industrial safety helmets. BS EN 458:1994 Recommendations for selection, use, care and maintenance: guidance document, is the most important standard for purchasers and users of hearing protection. It outlines the current method of selection, how the devices should be used and how to look after protectors to ensure that they are giving their optimum performance.

49 When choosing ear protectors it should be noted that:

- (1) in choosing a particular type of ear protection, due regard should be paid to worker's preference, the pattern of use (prolonged, short-term,

intermittent), the work activity being performed and its compatibility with any other PPE being used;

- (2) to achieve adequate protection during the lifetime of the earmuffs it is important that the seal material does not become loose or damaged. Thus in selecting earmuffs, particular regard should be paid to the quality of the seal material used in its construction; and
- (3) poor compatibility of ear protectors with the safety eye wear may lead to reduction in the level of protection being achieved. It is recommended that wherever possible during the selection process particular regard should be paid to the compatibility of ear protectors with other items of PPE in use. There are manufacturers who supply head protection for welders which combines built-in hearing, eye and respiratory protection.

Respiratory protective equipment (RPE)

50 The purpose of RPE is to ensure that the wearer is provided with air which is safe to breathe. Requirements for RPE depend upon the nature of the contaminant (gas, vapour, fume or dust), its concentration in the air being breathed and the exposure limit for the substances present. Respiratory protective equipment using filters is normally sufficient to protect against particles (fumes and dust). Where asphyxiation is possible from breathing the contaminated air within the work area, or there are high concentrations of particle and/or gaseous contaminants, there is a need for RPE which provides air from an independent source. The main types of RPE available are given at Appendix 7.

51 BS 4275: 1997 Guide to implementing an effective respiratory protective device programme, introduces protection factors (PFs) which are quoted at Appendix 7. These refer to the protective performance of the RPE that can realistically be expected to be achieved in the workplace by 95% of adequately trained and supervised wearers using properly functioning and correctly fitted RPE. For example, a PF=10 implies that in the workplace the RPE can realistically be expected to protect up to 10 times the occupational exposure limit. However, it is practicable to achieve performance better than the PFs indicated in BS 4275, providing the advice given in HSE guidance HSG53 Respiratory protective equipment, a practical guide for employers is adopted.

Considerations in choosing respiratory protective equipment

52 For particles, several types of RPE with suitable filters may be used. For example, the choice may be between a disposable respirator, a half mask with an appropriate filter or a powered helmet. All of these may be able to provide adequate protection.

53 Welding fume consists of very small particles of condensed vapour. These particles penetrate dust respirator filters more easily than larger dust particles and reduce the effectiveness of filters. The design of filters already takes account of this. However, there are no standards for filters specifically for use against welding

fumes. Users should choose RPE which will protect at levels of contamination several times higher than those expected during work.

54 If a respirator is used for protection against more than one type of contaminant (gas or, vapour and fume or dust) then combination filters should be used. Some manufacturers make filters specifically for welders but caution should be exercised in selection. The relevant standard for gas and combined filters is BS EN 141: 1991 Specification for gas filters and combined filters used in respiratory protective equipment.

55 respiratory protective equipment must be CE marked or be approved by HSE. HSE's approval procedure ended on 30 June 1995, but the equipment can still be used if it is suitable and well maintained.

56 In environments where there is an immediate danger to life or health from breathing the air, RPE must provide air from an independent source. Several types are referred to at Appendix 7 and further information can be found in HSG53.

57 When choosing RPE it should be noted that:

- (1) effective fitting of face masks depends on a good contact between the skin and the mask. The effectiveness of the seal may depend on the size of the face and mask and facial hair. Workers with spectacles, facial hair or beard stubble will not achieve an effective seal with masks. Where an effective face seal cannot be achieved, use of RPE incorporating hoods or helmets may be necessary; and
- (2) work-related factors such as the physical effort required to do the job, how long the RPE needs to be worn and requirements for visibility, mobility and communication influence the effectiveness of RPE in use. It is essential to ensure that the RPE selected for use is compatible with other PPE in use such as welding shields, safety glasses or goggles and ear protectors. Again, integrated devices are available as an alternative.

Hand protection

58 Gloves are needed to prevent heat discomfort, to protect against electrical shock, contact heat, heat radiation, sparks and spatter and UV radiation from the welding process. When handling materials having sharp edges there is a need to protect from cuts. Information on protective equipment for the hands is given at Appendix 8.

Considerations in choosing gloves

59 In arc welding and cutting, hands are very close to live conductors, particularly when changing electrodes. Welding gloves chosen should provide protection against electrical contact. Similarly gloves should provide adequate protection against welding radiation.

60 Most welding gloves are made of leather to withstand heat, sparks and spatter. Cloth gloves are normally used as liners inside welding gloves. Materials in the lining should provide insulation from heat and absorb perspiration.

61 Aluminised and similar outer coatings, reflect heat radiation but are poor for contact heat and electrical insulation. Gloves should have seams arranged inside to prevent burning of stitches and trapping of hot metal particles. Threads used in seams should withstand the operating temperature. At high temperatures synthetics stretch and allow seams to open. Cotton threads give the best protection in high heat applications. Such matters are taken into account during testing for CE marking, but gloves must be selected which are appropriate for the working conditions.

62 There is no specific standard for welders' gloves, although prEN 12477 is being developed. Gloves conforming to European standards must meet the general requirements (BS EN 420: 1994 General requirements for gloves) and any other requirements that are identified in the risk assessment, eg BS EN 407: 1994 Protective gloves against thermal risks (heat and/or fire) and BS EN 388: 1994 Protective gloves against mechanical risks.

63 When choosing gloves it should be noted that:

- (1) gloves should fit well. Too tight a fit will cause the seams to cut into the hands. Loose fitting gloves cause problems in handling work items;
- (2) gloves should be compatible with the work. They should allow dexterity and manipulation of small parts when required; and
- (3) welding gloves should be used for the purpose of their design. Use of moistened gloves (eg caused by handling wet components) can increase the risk of electrical shock or heat transmission. Use of oily and greasy gloves increases flammability and the risk of burns. Damage caused by abrasion, puncture or crushing can reduce the effectiveness of gloves. Thus it is important to ensure that welding

gloves are not used for other operations which may compromise their effectiveness under welding conditions. Other suitable gloves should be made available for non-welding operations.

General protective clothing and shoes

64 Personal protection is required for those exposed parts of the body which are at risk from radiation, heat, electrical contact, sparks and spatter. Depending on the work, items which may be needed are aprons, sleeves, shoulder covers, jacket, boiler suit, caps, leggings or spats and shoes. The risk assessment will take into account the working positions and therefore determine which parts of the body require protection.

Considerations in choosing protective clothing and shoes

65 Typically, protective clothing must cover as much of the exposed skin as possible. Any personal clothing worn at the same time should not be made of synthetic materials (eg nylon) which can ignite. Wool and cotton fabrics are preferable for personal clothing.

66 Clothing intended to protect those parts of the body considered to be at risk must be designed for that purpose. Suitable leather provides the required degree of protection. Protective clothing conforming to European standards should meet the general requirements of BS EN 340: 1993 Protective clothing general requirements in relation to sizing, strength, durability etc.

67 Specific safety requirements are given in BS EN 470-1: 1995 protective clothing for use in welding and allied processes: General requirements. Protective clothing manufactured to BS EN 470-1 will normally protect the wearer against small splashes of molten metal and will not spread flame if accidentally contacted with an igniting flame. Where the clothing is used in particularly harsh arc-welding processes, damage from radiant heat or droplets of molten metal may render it quickly ineffective, particularly against radiation. In such situations, use of additional leather sleeves, aprons etc, can both prolong the life of the garment and assist in protecting the wearer. Requirements for electrical resistance of protective clothing are to be introduced in the proposed Part 2 of BS EN 470. This standard is also expected to address clothing to protect against particularly harsh welding processes.

68 In terms of construction, 2 specific details to look for in protective clothing are:

- (1) that the protective clothing should be without external pockets or alternatively have internal pockets. If there are external pockets (apart from a ruler pocket behind the side seam of trousers) then a closeable flap should completely overlap the top of the pocket opening and should not be capable of being tucked into the pocket; and
- (2) that closures should be designed so that they do not create openings or folds where molten metal splashes can lodge, eg trousers should not have pleats or turn-ups.

Safety footwear

69 Footwear must give protection against the required level of impact and resist penetration by spatter and sharp objects. Normally high top boots with instep and toe protection are appropriate. Those with rubber soles provide added protection from electrical shock. When feet are exposed to spatter it may enter the shoes and spats over safety boots may be required to prevent this.

70 There is no specific standard for welder's footwear. Two levels of protective footwear are available; 'safety' (200J toecap) and 'protective' (100J toecap). Footwear must be chosen with respect to the levels of risks likely to arise in the workplace.

71 Bs EN 344-1: 1993 Safety, protective and occupational footwear for professional use: Requirements and test methods and BS EN 344-2: 1997 Additional requirements and test methods are the relevant standards on requirements for safety and protective footwear for professional use. BS EN 345 Safety footwear for professional use and BS EN 346 Protective footwear for professional use are concerned with specifications for safety and protective footwear respectively.

SOME SELECTED HSE GUIDANCE DOCUMENTS

72 The following HSE guidance may be useful. The list is not exhaustive.

General

- (1) HSE Booklet Essentials of health and safety at work (ISBN 071760716X).
- (2) HS(G)139: The safe use of compressed gases in welding, flame cutting and allied processes (ISBN 0717606895).
- (3) L101: Safe work in confined spaces, Confined Spaces Regulations 1997, Approved Code of Practice (ISBN 0717614050).
- (4) IND(G)258: Safe work in confined spaces (ISBN 0717614425).

Electrical hazards

- (5) HSG118: Electrical safety in arc welding (No longer in publication).
- (6) HSG107: Maintaining portable and transportable electrical equipment (ISBN 0717607151).

Respiratory hazards

- (7) Guidance Note EH 54: Assessment of exposure to fume from welding and allied processes (ISBN 0717605701).

- (8) HSG37: An introduction to local exhaust ventilation (ISBN 0717610012).
- (9) HSG97: A step by step guide to COSHH assessment (ISBN 0118863797).
- (10) Guidance Note EH40: Occupational Exposure Limits (1998) (ISBN 0717614743).
- (11) HSG53: The selection, use and maintenance of respiratory Protective Equipment, A practical guide (ISBN 0717615375).

Noise

- (12) LI08: Reducing noise at work. Guidance on the Noise at Work Regulations 1989 (ISBN 0717615111).
- (13) INDG75 L (Rev): Introducing the Noise at Work Regulations: A brief guide to the requirements for controlling noise at work (ISBN 0717609618).
- (14) INDG99: Noise at work - A guide for employees (ISBN 0717609626).
- (15) HS(G)138: Sound solutions: Techniques to reduce noise at work (ISBN 0717607917).

APPENDIX 1
(paras 8 and 23)

HAZARDS IN WELDING AND ALLIED PROCESSES

PROCESS		HAZARD						NOTES
NAME	ABBREV.	WELDING RADIATION	ELECTRICAL (relative)	GASES	PARTICLES	NOISE	SPARKS & SPATTER (BURNS)	
GAS WELDING	-	,	-	,	,	-	,	
GAS CUTTING	-	,	-	,	,	-	,	
RESISTANCE WELDING	-	-	,	,	,	-	,	Fumes due to coatings
MANUAL METAL ARC WELDING	MMAW	,	, (medium)	,	,	NOTE	,	Noise level relatively low
GAS TUNGSTEN ARC WELDING	GTAW or TIG WELDING	,	, (medium)	, NOTE	,	NOTE	,	Noise level relatively low. Use of shielding gas introduces asphyxiation hazard.
GAS METAL ARC WELDING	GMAW or MIG or CO ₂ WELDING	,	, (low)	,	,	,	,	
FLUX CORED ARC WELDING	FCAW	,	, (low)	,	,	,	,	
SUBMERGED ARC WELDING	SAW	, NOTE	, (low)	-	NOTE	-	,	Slight risk of accidental exposure to arc radiation. Fume level is low and welder is remote from arc.
ELECTROSLAG WELDING	ESW	, NOTE	, (low)	, NOTE	, NOTE	-	,	Slight risk of accidental exposure to arc radiation. Fume level is low and welder is remote from arc.
PLASMA ARC CUTTING AND WELDING	PAW or PAC	,	, (high)	,	,	,	,	
PLASMA ARC CUTTING AND WELDING (WATER SHROUDED OR SUBMERGED)	-	-	, (high)	-	-	, NOTE	-	Only for water shrouded plasma arc cutting.
ARC AIR CUTTING	AAC	,	, (medium)	,	,	, NOTE	,	Very high noise level likely.
ARC AIR GOUGING	AAG	,	, (medium)	,	,	,	,	
GRINDING	-	-	-	-	,	,	, NOTE	Sparks and hard particles, possibly hot.
CHIPPING	-	-	-	-	,	,	NOTE	Hard particles, possibly hot.

APPENDIX 2
(paras 8 and 24)

HAZARDS, RISKS AND PPE REQUIREMENTS

HAZARD	RISKS	PPE REQUIREMENTS						
		OPTICAL FILTER	SAFETY EYEWEAR	FACESHIELD	EAR PROTECTORS	RPE	GLOVES	OTHER CLOTHING
WELDING RADIATION	SKIN AND EYE RADIATION BURNS	,	,	,	-	-	,	,
ELECTRICITY	ELECTRICAL SHOCK AND BURNS	-	-	,	-	-	,	,
GASES	INHALATION AND ASPHYXIATION	-	,	-	-	,	-	-
PARTICLES	INHALATION AND PHYSICAL INJURY	-	,	,	-	,	-	-
NOISE	HEARING LOSS	-	-	-	,	-	-	-
SPARKS AND SPATTER	BURNS AND PHYSICAL INJURY	-	,	,	,	-	,	,

APPENDIX 3
(para 26)

FACE SHIELDS AND WELDING SHIELDS

TYPE OF PPE	VARIATIONS	PROTECTION OFFERED	SUITABILITY
FACE SHIELDS	<i>Without reflective coating</i>	Protection offered is for low risk welding operations from low radiation heat/low spatter.	Suitable for welding where little or no spatter is generated as in gas welding.
	<i>With reflective coating</i>	The advantage of reflective coating is its ability to reflect heat away from the wearer, and will be of use in conditions where significant radiant heat is experienced.	As above. Reflective coatings can increase exposure of bystanders.
Welding shields	<i>Hand held</i>	Can provide adequate protection if used properly. If both hands are required for the welding operation then head worn types are required.	Where intermittent short time welding is performed or situations where head worn shield is unsuitable.
	<i>Head worn -stationary window</i>	For most welding operation the head worn shield provides adequate protection.	Shield can be tilted up for unobstructed vision and down for protection while welding, a nod of the head usually lowers the shield
	<i>Head worn -Lift front window</i>	As with above but has the advantage of shield protecting the face with filter removed from the field of vision.	When worn on the head, allows the wearer to lift the filter holder from the field of vision and carry out other work, eg grinding etc.
Welding shields (hand held or head worn)	<i>Straight front</i>	Provide adequate protection, especially when welding above eye level, provide better ventilation under the face than curved underchin type.	
	<i>Curved underchin</i>	Provide a good light seal at around the edges and better protection from fume as compared with the straight front helmets. Relatively poor ventilation inside the shield.	More suitable when welding at eye or below eye level.
Flame proof hoods	<i>Various types</i>	Provide full head protection. against sparks and spatter. High CO ₂ levels possible.	When working in restricted spaces or for use in situation where extensive amount of spatter is produced.

APPENDIX 4 (para 34)

SAFETY EYE WEAR

In all cases, eyewear must be matched to the risks present in the working environment. eg scale number, optical class, mechanical strength, resistance to molten metals / hot solids, scratch and fogging resistance.

TYPE OF PPE	VARIATIONS	PROTECTION OFFERED	SUITABILITY
Spectacles	<i>No sideshield</i>	Can provide frontal protection only and no protection from side.	Not recommended for grinding, chipping and other activities where flying particles are likely.
	<i>Full-sideshield</i>	Can provide protection in grinding, chipping and from sparks and spatter. Both glass and polycarbonate types provide protection against low energy impact, but polycarbonate is lighter and more comfortable to wear. Lenses with abrasion resistant coating are available. Do not provide adequate protection against molten metal splash and hot particles. or medium/high energy impact.	Frames can interfere with some ear protectors, causing discomfort and noise leakage. With suitable filters can be used for protection against incidental exposure from arc radiation for those working near the welder. Not recommended for protection against molten metal and hot particles.
Cover Goggles	<i>No ventilation</i>	Can provide adequate protection from sparks, spatter and low/medium energy impact in grinding and chipping, and protect eyes from airborne particles and gases. Edges should conform to wearer's face.	In humid and hot environments can become misted and frequent cleaning may be required. Do not interfere with ear protectors. Easier to wear behind welding shields than spectacles.
	<i>Indirect ventilation</i>	Can provide adequate protection from sparks and low/medium energy impact, spatter and from airborne particles. Does not protect against gases. Edges should conform to wearer's face.	Useful in hot and humid environments where misting can occur. Do not interfere with ear protectors.
	<i>Direct ventilation</i>	As with the indirect ventilation type but do not provide protection against airborne particles and gases. Edges should conform to wearer's face	Useful when ventilation around the eyes is required. Do not interfere with ear protectors.
Cup Goggles	<i>Direct ventilation</i>	Can provide adequate protection from sparks, spatter and low/medium energy impact in grinding and chipping but do not provide protection against airborne particles and gases.	With suitable filters can be used for gas welding without use of welding shield but use of face shield may still be appropriate.
	<i>Indirect ventilation</i>	Can provide adequate protection from sparks and spatter and low/medium energy impact and from airborne particles. Does not protect against gases.	As with cover goggles with indirect ventilation but these are less bulky and may be more easy to accommodate under the welding shield.
Cover Welding Goggles	<i>Indirect ventilation</i>	Can provide adequate protection from sparks and spatter. When fitted with suitable filter can provide adequate protection from radiation during gas welding. They do not provide adequate protection in arc welding without use of faceshield or welding shield. Edges should conform to wearer's face.	Less bulky than a faceshield or welding shield and would not interfere with other PPE worn in the face region. Face shield or welding shield may be more appropriate if working overhead.

APPENDIX 5
(para 38)

OPTICAL FILTERS FOR WELDING RADIATION

PROCESS	CONDITIONS & FILTER SCALE NUMBER (see BS EN 169 or BS EN 379)						
GAS WELDING OF HEAVY METALS	Acetylene flow (litres/hour)	< 70	71-200	201-800	> 800		
	Filter Scale Number	4	5	6	7		
GAS WELDING WITH EMISSIVE FLUXES (notably light alloys)	Acetylene flow (litres/hour)	< 70	71-200	201-800	> 800		
	Filter Scale Number	4a*	5a*	6a*	7a*		
OXYGEN CUTTING	Oxygen flow (litres/hour)	900-2000	2001-4000	40001-8000			
	Filter Scale Number	5	6	7			
COVERED ELECTRODES	Current (amperes)	< 40	41-80	81-175	176-300	301-500	>500
	Filter Scale Number	9	10	11	12	13	14
METAL INERT GAS (MIG) ON HEAVY METALS [The term 'heavy metals' applies to steels, alloy steels, copper and its alloys]	Current (amperes)	< 100	101-175	176-300	301-500	> 500	
	Filter Scale Number	10	11	12	13	14	
METAL INERT GAS (MIG) LIGHT ALLOYS	Current (amperes)	< 100	101-175	176-250	251-350	351-500	> 500
	Filter Scale Number	10	11	12	13	14	15
TUNGSTEN INERT GAS (TIG) ON ALL METALS AND ALLOYS	Current (amperes)	< 20	21-40	41-100	101-175	176-250	251-400
	Filter Scale Number	9	10	11	12	13	14

PROCESS	CONDITIONS & FILTER SCALE NUMBER (see BS EN 169 or BS EN 379)						
	MAG (metal arc welding with non-inert gas shield)	Current (amperes)	< 80	81-125	126-175	176-300	301-450
Filter Scale Number		10	11	12	13	14	16
ARC-AIR GOUGING	Current (amperes)	< 175	176-225	226-275	276-350	351-450	> 450
	Filter Scale Number	10	11	12	13	14	15
PLASMA JET CUTTING	Current (amperes)	< 150	151-250	251-400			
	Filter Scale Number	11	12	13			

APPENDIX 6
(paras 45 and 46)

EAR PROTECTORS

PPE	PROTECTION OFFERED	SUITABILITY
Earmuffs	By enclosing the ears and forming a seal against the head, earmuffs can provide high attenuation. Also provides physical protection for the ear. In comparison with other types, it is easier to achieve the predicted noise attenuation with earmuffs.	Higher visibility allows for ease of management. However, if worn with eye protection, noise may leak in and it may also be uncomfortable to wear. May not be compatible with safety headwear (headwear with compatible earmuffs is commercially available). More difficult to store and carry than other types. Types are available which incorporate communication devices.
Foam earplugs	Good fit is essential for achieving the intended noise attenuation. If poorly fitted noise attenuation will be much less than that calculated from manufacturer's Comfortable to use for long periods. Issues of size less critical than with other plugs.	Compatible with other PPE worn, such as safety glasses, head worn safety equipment. Easy to carry and store but inconvenient for repeated use. Clean hands required for rolling down prior to insertion and they have limited use life.
Premoulded earplugs	For good attenuation air-tight seal is required, this may not always be possible, especially for sized brands.	Compatible with other PPE worn, such as safety glasses, head worn safety equipment. Easy to carry, store, and keep clean and easier to insert than foam earplugs.
Canal caps or Semi-aural device	Provide less protection than earplugs or earmuffs. Seal is provided at the entrance to the ear canal by flexible pods on a lightweight band.	Compatible with glasses and most PPE for the head. Easy to put on, good for intermittent use, store around the neck.

APPENDIX 7
(paras 50, 51 and 56)

RESPIRATORY PROTECTIVE EQUIPMENT (RPE)

RPE TYPE	PROTECTION OFFERED PFs quoted are taken from BS 4275:1997. See HSG53 for HSE guidance on achieving this level of protection	SUITABILITY
Disposable filtering face piece respirator	Suitable devices can be used for concentrations of 4-20 times the occupational exposure limit (OEL). See manufacturer's recommendations for use. Proper face fit is essential.	Mainly used for protection against dusts, although some models are also available for use against gases and vapours.
Half mask respirator with filter	With a suitable filter, can be used for concentrations of 4-20 times the OEL. See manufacturer's recommendations for use. Proper face fit is essential.	Unsuitable for irritant vapours and mists without further protection for the eyes, such as goggles.
Full facemask respirator with filter	With a suitable filter, can be used for concentrations of 4-40 times the OEL. See manufacturer's recommendations for use. Proper face fit is essential.	Higher protection factor than half mask, protects the face and eyes and suitable for environments where eye protection is necessary if the correct visor is fitted. May interfere with the welding shield. Types specially adapted for the welding environment are available.
Powered respirator with helmet or hood	With a suitable filter, can be used for concentrations of 10-40 times the OEL. See manufacturer's recommendations for use. Proper face fit is essential.	With helmet additional protection is provided for the head. Can be more comfortable to wear than the mask types. Filtered air provided assists in breathing and can provide cooling for the facial region, especially useful in work involving physical exertion. May interfere with welding shield. Special types for welding work are available.
Power assisted respirator with full facemask	With a suitable filter it can be used for concentrations of 10-40 times the maximum multiple of occupational exposure limit. See manufacturer's recommendation for use. Proper face fit is essential .	Available with various added features for the welding environment.

APPENDIX 7 (CONTINUED)

RESPIRATORY PROTECTIVE EQUIPMENT (RPE)

RPE TYPE	PROTECTION OFFERED PFs quoted are taken from BS 4275:1997. See HSG53 for HSE guidance on achieving this level of protection	SUITABILITY
<p>Equipment providing air from independent source. Various types:</p> <p>(i) Fresh air hose equipment (full face mask or hood);</p> <p>(ii) Compressed air line breathing apparatus (full face mask, hood or full suit);</p> <p>(iii) Self-contained breathing apparatus</p>	<p>Type (i): fresh air supplied by hose from outside the contaminated atmosphere by breathing action or powered fan unit. Can be used for concentrations of 40 times the OEL.</p> <p>Type (ii): As type (i) but the hose is connected to compressed air source. Can be used for concentrations of 40-2000 times the OEL depending on design.</p> <p>Type (iii): Air supplied from compressed gas cylinder carried by wearer. Can be used for concentrations of 40-2000 times the OEL depending on design.</p> <p>Proper fit is essential for types with full facemask. See GN HS G 53.</p>	<p>Type (i): Maximum length of hose that should be used is 9 metres (30 ft) for unpowered types.</p> <p>Type (ii): Need to ensure adequate air supply of acceptable quality. Breathing air quality requirements as per BS 4275.</p> <p>Type (iii): Used in the most hazardous circumstances, including those where the atmosphere may be immediately dangerous to life and health. Use requires special consideration especially in view of fire hazards where oxygen is used. Use also requires a very high standard of training and maintenance.</p>

APPENDIX 8
(para 58)

HAND PROTECTION

PPE	TYPES AVAILABLE *	PROTECTION OFFERED	SUITABILITY
Gloves	1. Cloth and coated cloth gloves	Provide little or no protection from UV or radiated heat or contact heat, wear rapidly on rough or sharp edges.	Use as liners in other gloves or mitts for spot welding and low heat mechanised welding.
	2. Leather-palm cloth-back gloves	For low UV, low heat radiation, low contact heat and of short duration; for rough surfaces and with sharp edges.	Use as for type 1 and for brazing and seam welding.
	3. Short leather work gloves	For moderate to high UV and heat radiation, low to moderate contact heat; for parts having burrs, sharp edges or abrasive surfaces.	Use as for type 2 and for gas and arc welding with low spatter and short arc-on or torch exposure time; TIG and low-amp MIG.
	4. Light-weight all-leather work gloves	For moderate to high UV and heat radiation, low to moderate contact heat, low spatter; may tear against sharp edges.	As with type 3, use with low-temperature TIG and MIG especially when dexterity and manipulation of small parts is required.
	5. Medium-weight all-leather work gloves	For high UV and heat radiation, moderate to high contact heat, low to moderate spatter; and for surfaces having burrs, sharp edges.	For brazing, gas welding, arc welding, manual or arc cutting.
	6. Heavyweight all-leather work gloves	For high to extreme UV and heat conditions, high spatter; and for surfaces having burrs, sharp edges.	For all welding and cutting processes except when dexterity and manipulation of small parts is required. Additional linings and pads may be necessary for prolonged exposure.

* Always check performance requirements against glove specification. Do not rely on visual appearance alone.

APPENDIX 8 - HAND PROTECTION (CONTINUED)

PPE	TYPES AVAILABLE *	PROTECTION OFFERED	SUITABILITY
	7. Heavyweight All-leather work gloves with aluminised back and thumb	For prolonged exposure to UV and radiant heat or high working temperatures. Together with lining gloves (type 1) for good insulation achieved Aluminium has poor abrasion resistance.	For all welding operations where extreme levels of radiation heat such as in arc operations where the arc is maintained for several minutes. Use of leather patches on high wear areas.
Gloves	8. Special thermo-leather gloves	For prolonged exposure to UV and radiant heat or high working temperatures. These gloves have special insulating material linings to give protection under intense heat conditions.	Too bulky for most welding, in combination with hand pads these gloves work well for arc burning or arc gouging.
Leather strips or welting	Various types for various regions of the glove	Protect the vulnerable parts of the gloves, such as seams, high wear areas, thumb or palm region. Aluminised material provide protection against radiant heat	For prolonging the life of gloves and for specific operations, eg, aluminium material can be buttoned on the glove to protect against high radiant heat in continuous arc welding or cutting.
Separate pads	Various types for glove back or palm	When made with high insulating material, pads provide protection against intense heat. They also protect the gloves.	For arc gouging and continuous arc welding.
Mitts	Various types	Protection depends on the insulating material of mitts.	When individual finger work is not required, can also use light weight gloves inside mitts for added protection.

* **Always check performance requirements against glove specification. Do not rely on visual appearance alone.**

September 1998