Guidance on the repair and overhaul of apparatus intended for use in coal mines susceptible to firedamp

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This is a web-friendly version of Guidance on the repair and overhaul of apparatus intended for use in coal mines susceptible to firedamp, originally produced by HM Inspectorate of Mines.
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Foreword

This guidance on the repair and overhaul of apparatus intended for use in coal mines susceptible to firedamp is part of a series of publications produced by the Deep Mined Coal Industry Advisory Committee. The Committee was appointed by the Health and Safety Commission as part of its formal advisory structure.

This document is in two parts:

**Part 1** deals with the repair and overhaul of electrical apparatus

**Part 2** deals with the repair and overhaul of flameproof reciprocating internal combustion engines.
Introduction

1 This part of the document gives guidance, principally of a technical nature, on the repair and overhaul of certified electrical apparatus designed for use in potentially explosive atmospheres found underground in coal mines. A list of the members of the IAC Electrical Working Group formed to prepare this part of the document is included at Annex B.

2 The scope of Part 1 does not cover the use of electrical apparatus, maintenance (other than where this cannot be disassociated from repair and overhaul), performance, or the use of accessories such as cable entry systems (which may require renewal when the apparatus is re-installed). Similarly, it does not cover other safety related matters such as the prevention of electric shock, electrical overload, short circuit, earth leakage protection and interlocking between isolators/enclosure covers. These and other analogous matters, not directly associated with preventing the ignition of an explosive atmosphere, will need to be the subject of separate negotiations between the user and repairer.

3 Recommendations regarding routine maintenance, and the selection and installation of intrinsically safe electrical apparatus for use in potentially explosive atmospheres in mines, may be found in BS 6704.

4 It is assumed that good engineering practices are adopted throughout.

5 Paragraphs 33 to 113 deal with responsibilities under the Health and Safety at Work etc Act 1974, and those aspects of the repair and overhaul of explosion proof apparatus which are common to all equipment. The subsequent paragraphs then provide specific guidance relevant to the types of protection used in mines, ie flameproof apparatus, intrinsically safe apparatus and increased safety apparatus.

6 Legislation/standards/documents which are relevant to this guidance are listed in Annex A.

Definitions and terms

7 The following definitions apply to this part of the document:

Serviceable condition – A condition of the apparatus, such that it is fit for use, unlikely to be an igniting source for an explosive atmosphere, and is in accordance with the relevant explosion protection concept standard.

Relevant standard – This means the standard to which the apparatus was originally certified.

Repair – An action to restore apparatus to its serviceable condition, where an examination and inspection has established that the apparatus is faulty or damaged, or parts are replaced which can affect explosion protection.

Overhaul – An action to restore apparatus to its serviceable condition, where an examination and inspection has established that the apparatus is not faulty or damaged, and parts are not replaced which can affect explosion protection.
Maintenance – Routine actions taken to preserve the serviceable condition of the installed apparatus.

Component part – An indivisible item from an assembly of such parts which may form an apparatus.

Reclamation or recovery – A means of repair involving the removal or addition of material to restore component parts, which have sustained damage, to a serviceable condition.

Modification – A change to the design of the apparatus which may affect material, fit, form or function.

Manufacturer – The maker of the apparatus (who may also be the supplier, the importer or the agent) in whose name usually the certification (where appropriate) of the apparatus was originally registered.

User – The user of the apparatus.

Repairer – The repairer of the apparatus, who may be the manufacturer, the user, or a third party (repair agency).

Certification – The issue of a document by a recognised body, or notified body, testifying that a type of apparatus or a type of component or a procedure conforms with the requirements of a European Directive, a European Harmonised Standard, a published national or recognised international standard.

Approval – The issue of a document by the Health and Safety Executive (HSE) indicating that a type of apparatus meets the requirement of a particular legal obligation, using powers given to them under legislation relating to that type of apparatus.

Certificate references – A certificate reference number may refer to a single design or a range of apparatus of similar design. The suffix ‘X’ or ‘B’ when added to the certificate number indicates special conditions of use and that the certification documents need to be studied before such apparatus is installed, repaired, overhauled, reclaimed, or modified.

Copy winding – Process by which a winding is totally or partially replaced by another, the characteristics and properties of which are at least as good as those of the original.

Type of protection ‘d’ (flameproof) – As defined in the protection concept standard relating to the type of apparatus being repaired, ie BS 229, BS 4683, BS 5501, EN 50018. This is generally a type of protection in which parts which can ignite an explosive atmosphere are placed in an enclosure which can withstand an internal explosion of flammable gas without damage and without transmitting incendive flames from the interior to the explosive atmosphere surrounding the enclosure.

Type of protection ‘i’ (intrinsically safe) – As defined in the protection concept standard relating to the type of apparatus being repaired, ie BS 1259, BS 5501, EN 50020. This is generally a type of protection in which no spark or any thermal effect produced in the test conditions prescribed in the relevant standard(s) (which include normal operation and specific fault condition) is capable of causing ignition of a given explosive atmosphere.
Type of protection ‘e’ (increased safety) – As defined in BS 5501, EN 50019. This is generally a type of protection by which measures are applied so as to prevent, with a higher degree of security than normal industrial type apparatus, any parts from producing arcs or sparks in normal operation or from exceeding specified temperature limits.

Background information

Statutory requirements for mines

8 Electrical equipment intended for use in a potentially explosive atmosphere is legally required to be of such construction, or so protected as to prevent danger arising from such use.

9 The legal requirements for zoning and explosion protection in mines are covered by The Electricity at Work Regulations 1989 which require the manager of every mine in Great Britain to assess the risk of flammable gas occurring in the mine workings and to indicate, on plans, those places where flammable gas is likely to occur.

10 Such places are defined as “zones in which firedamp, whether or not normally present, is likely to occur in a quantity sufficient to indicate danger”. The same regulations define “firedamp” as “a mixture of flammable gases naturally occurring in mines”.

11 Having designated the zones on a plan, the manager must ensure that those places are identifiable underground so that workers know where the zones start and finish. The manager must also ensure that mine workers are made aware of the requirement that any electrical apparatus is not to be energised inside a zone unless it is protected in such a way as to prevent it from being an igniting source for an explosive firedamp/air atmosphere.

12 The above Regulations contain a list of the various types of apparatus which may be energised in the zones. With the exception of mining type cables and certain apparatus which is constantly supervised under manager’s operating rules, the majority of electrical apparatus is expected to be of a type which is “certified” by a third party test house, ie having a certificate testifying that the design conforms with a recognised published standard relating to the protection of electrical apparatus intended for use in a potentially explosive atmosphere.

Certification

13 Certificates are usually issued to the manufacturer of the apparatus (or to an agent) by one of the recognised European Test Houses. With the exception of rare items of apparatus allowed by ‘special certificates’ (type ‘s’) or ‘inspection certificates’, the majority of explosion protected electrical apparatus will be of a type constructed in accordance with recognised national standards (eg British Standards), or more recently CENELEC European Harmonised Standards.

14 In Great Britain, a Government owned mining certification service was set up in 1931 to issue certificates for explosion protected apparatus intended for use in mines. This service, now known as the Mining Equipment Certification Service (MECS), has continued to the present day. In 1991 SIRA Test and Certification Ltd (SIRA) set up a privately owned certification service offering the same facilities. Both test houses in Great Britain have been approved by the Secretary of State for Employment as notified European Test Houses (under the Electrical Equipment for
15 Until the 1960s, only two types of concept protection certificates were issued for mining apparatus in Great Britain, these being for flameproof apparatus (FLP) and intrinsically safe apparatus (IS).

16 In 1977 the British Standards for flameproof apparatus (ie BS 229 and BS 4683) and intrinsically safe apparatus (ie BS 1259) were joined by, and co-existed with, the BS 5501: Parts 1-9: series of standards, the latter being copies of the first editions of European CENELEC standards in the series EN 50014 to EN 50039. This resulted in small quantities of other types of explosion protected apparatus entering mines in Great Britain, in particular, apparatus known as increased safety (type ‘e’) and moulded/encapsulated (type ‘m’). When the second editions of the CENELEC standards replaced the first editions in 1994/95 they were given BS EN standard designation with European numbering. Thus, the second edition of the European harmonised standard BS 5501: Part 1 (EN 50014) was published in Great Britain by BSI as BS EN 50014.

17 A list of the various types of explosion protection, suitable for use in mines susceptible to firedamp, can be found in Appendix 1 of the Code of Practice approved under section 16 of the Health and Safety at Work etc Act 1974, entitled The Use of Electricity in Mines which accompany the Electricity at Work Regulations (Statutory Instrument No. 635 of 1989).

18 The list in the Approved Code includes the earlier types of protection defined in British Standards BS 4683, BS 1259, BS 5501, also the types of protection given in the European Harmonised Standard EN 50014 with the exception of the type of protection ‘o’ – oil filled apparatus (as defined and described in EN 50015).

19 Restrictions are placed on the use of oil filled electrical apparatus in mines in Great Britain because of the risk of atmospheric pollution of the mine ventilation system should the oil catch fire. See regulation 23 of the Electricity at Work Regulations 1989.

20 The objective of this document, as well as giving guidance on the practical means of maintaining the electrical safety and performance requirements of repaired apparatus, is to recommend procedures for maintaining after repair compliance of the apparatus with the provisions of the Certificate of Assurance or Conformity or with the provisions of the appropriate explosion protected Standard.

21 The document is divided into separate parts, some of which are concerned with an individual type of explosion protection. In those cases where an apparatus incorporates more than one type of protection, reference will need to be made to all of the relevant parts involved. The reader will, however, note that this guidance excludes types of protection ‘o’ – oil filling; ‘q’ – sand filling; ‘p’ – pressurised; and ‘m’ – encapsulated which is generally considered to be irreparable.

**Effects of the Explosive Atmospheres Directive (94/9/EC)**

23 In the case of apparatus intended for use in gassy mines susceptible to firedamp, the Regulations/Directive do not apply to apparatus placed on the market or put into service for the first time before 1 March 1996.

24 After that date and up to 30 June 2003, apparatus may be used on the market or put into service for the first time if it is in compliance with either the Directive/Regulations or the GB statutory requirements/certification arrangements in place on 23 March 1994.

25 After 30 June 2003 apparatus cannot be placed on the market or put into service for the first time unless it complies with 94/9/EC as meeting the requirements of categories M1 or M2 (as defined in the Directive).

26 Apparatus which was legally in service on 30 June 2003 may be repaired or overhauled and put back into service after 30 June 2003 without the need to comply with 94/9/EC, providing no modifications are made which would require re-certification, or a supplementary certificate to be obtained to cover the modifications.

27 To date, two notified bodies have been appointed for the purposes of 94/9/EC in GB, these are the HSE’s Mining Equipment Certification Service (MECS) and SIRA Certification Service Ltd.

**Repair of apparatus**

28 Users are recommended to utilise the most appropriate repair facilities for any particular item of equipment, whether they be the facilities of the manufacturer or a suitably competent and equipped repairer.

29 The document recognises the necessity of a required level of competence for the repair of apparatus.

30 In the case of the repair or overhaul of apparatus which has been the subject of third party certification, such as by MECS or SIRA, it may be necessary to clarify the position of the continued conformity of the apparatus with the certificate.

31 Assuming that repairs and overhauls are carried out using good engineering practices then;

   a) if manufacturers’ specified parts or parts as specified in the certification documentation are used in a repair or overhaul, those aspects of the repair or overhaul may be presumed to be in conformity with the certificate;

   b) if repairs or modifications are carried out on the apparatus in accordance with details in the certification documents, eg dimensions are within allowable tolerances, the apparatus may still conform with the certificate;

   c) if repair or overhaul is carried out on the apparatus in accordance with the relevant protection standards and subjected to the relevant tests, then, although not necessarily in accordance with (a) and (b) above, the apparatus is acceptable for re-use;

   d) if other repair or modification techniques are to be used, then it will be necessary to seek authoritative advice, eg from the manufacturer or owner, regarding the suitability of the apparatus for continued use in a “zone” in a coal mine.
32. In considering the above options, users are strongly recommended to adopt (a) or (b) where it is possible to do so. Before any repair or overhaul work to (c) or (d) are undertaken the repairer will need to seek the written permission of the user.

### Statutory requirements/duties

33. The relevant statutory requirements for mines are the Health and Safety at Work etc Act 1974 (HSW Act) and the Mines and Quarries Act 1954. Relevant regulations are made under these Acts include, the Electricity at Work Regulations 1989, the Provision and Use of Work Equipment Regulations 1992 (PUWER), the Supply of Machinery (Safety) Regulations 1992, and the Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 1996.

34. The following references to certain statutory requirements are for guidance only and the reader’s attention is drawn to the complete requirements of the Act and relevant regulations.

#### Manufacturer duties

35. The manufacturer’s responsibilities under the HSW Act 1974 are stated in section 6 of the Act, in particular, section 6(1)(c) states:

> “to take such steps as are necessary to secure that there will be available in connection with the use of an article at work adequate information about the use for which it is designed and has been tested, and about any conditions necessary to ensure that, when put to that use, it will be safe and without risks to health”.

36. It is therefore not acceptable to merely assume that adequate information is or can be so widely circulated that it is always available where and when it is needed. Specific steps must be taken to make it available. Sources of adequate information are users, manufacturers or, under certain circumstances, the certifying authorities.

37. The manufacturer will also need to take into account the Supply of Machinery (Safety) Regulations 1992 and the Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 1996 (which implement the Flammable Atmospheres Directive 94/9/EC).

#### User duties

38. Apart from the need to comply with section 2 of the HSW Act 1974 (regarding safe maintenance of plant and systems by the employer), the user is also required to pay due regard to section 6 of the Act should they wish to undertake the repair or overhaul of the equipment themselves.

39. The Provision and Use of Work Equipment Regulations 1992 amplify and makes more explicit the general duties on employers, the self-employed and people in control to provide safe plant and equipment.

40. In particular, regulation 7 of the PUWER 1992 which states:

> Where the use of work equipment is likely to involve a specific risk to health or safety, every employer shall ensure that repairs, modifications, maintenance or servicing of that work equipment is restricted to those persons who have been specifically designated to perform operations of that description (whether or not also authorised to perform other operations).
The employer shall ensure that the persons designated for the purposes of the above paragraph have received adequate training related to any operations in respect of which they have been so designated”.

41 The user will therefore need to ascertain that any repair organisation is competent to perform the repairs. This may be achieved by assessing that the repairer meets the relevant requirements of this guidance with particular reference to quality control, quality assurance, requirements for the workshop equipment and competence of the persons directly involved in the repair and/or overhaul.

42 The user will also have the responsibility of checking that, in the case of a repair to a component part of an apparatus, the whole apparatus is safe before it is put to use.

43 The user will need to be aware of any changes in responsibility for health and safety if refurbishment and/or re-installation is to be carried out by a third party.

44 The user will also need to take into account the Electricity at Work Regulations 1989 and associated Approved Code of Practice relating to the Use of Electricity in Mines, The Supply of Machinery (Safety) Regulations 1992 and the regulations which implement the Flammable Atmospheres Directive 94/9/EC.

**Repairer duties**

45 The repairer’s legal responsibility is outlined in the generality of section 36 of the HSW Act 1974, which states:-

“Where the commission by any person of an offence under any of the relevant statutory provisions is due to the act or default of some other person, that other person shall be guilty of the offence, and a person may be charged with and convicted of the offence by virtue of this subsection whether or not proceedings are taken against the first-mentioned person”.

46 The repair organisation will therefore need to have adequate repair and overhaul facilities, utilise appropriate equipment and employ competent persons to carry out the required repairs, checks and tests, taking into account the specific type of protection, so as not to be accused of an offence under section 36.

**Guidance for the manufacturer**

**Documents**

47 In addition to the certificate, other documents, eg the appropriate drawings, specifications etc suitable for the repair and/or overhaul, will need to be maintained. In particular, clause 1.7.4 of Schedule 3 of the Supply of Machinery (Safety) Regulations 1992 requires instructions, drawings and diagrams etc to be made available.

**Repair and overhaul data**

48 The data available for the repair and/or overhaul will generally include, but need not be limited to details of the:

a) technical specification;

b) performance and conditions of use;
c) dismantling and assembly instructions;

d) certification limitations where specified;

e) marking (including certification marking);

f) recommended methods of repair/overhaul for the apparatus.

Spare parts

49 The list of spare parts will need to be included with the repair and/or overhaul data and it will identify those parts that particularly affect the means by which the apparatus complies with the appropriate standard or certificate.

Guidance for the user

Certificates and documents

50 The certificate and other related documents will normally have been obtained as part of the original purchase contract.

Records and work instructions

51 Records of any previous repairs, overhauls or modifications need to be kept by the user and made available to the repairer. It will be in the interests of the user that the repairer is notified, whenever possible, of the fault and/or nature of the work to be done.

52 Special requirements, stipulated in the user’s specifications, and which are supplementary to the various standards, will need to be brought to the attention of the repairer.

53 The user will need to inform the repairer of any statutory requirement for compliance with certification.

Repairs performed by the user

54 Where repairs are carried out by the user, then the guidance given in the following paragraphs also apply to the user.

Guidance for the repairer

Certification and standards

55 The repairer’s attention is directed at the need to be aware of, and to comply with, the relevant explosion protection standards and certification requirements applicable to the apparatus to be repaired or overhauled.

Training

56 The repairer of the apparatus will need to ensure that those concerned with the repair and/or overhaul of the certified apparatus are properly trained, competent, and supervised on this type of work.
57 Such training will need to cover:

a) general principles of the type of protection and marking;

b) those aspects of equipment design which affect the protection concept;

c) certification and standards;

d) identification of replacement parts or components authorised by the manufacturer;

e) particular techniques to be employed in repairs referred to in other parts of this guidance.

58 Appropriate refresher training will need to be given from time to time. It is recommended that intervals between training do not exceed 3 years.

**Testing**

59 This guidance document does not cover performance testing, following repair and overhaul, except where it may affect the explosion protection.

60 In the case of repairs to electrical apparatus affecting the type of protection, the parts which have been repaired may need to be subjected to new routine verifications and tests in accordance with the relevant standard. The need for such tests and their nature will have to be agreed between the user and the repairer. These tests need not necessarily be made by the repairer.

61 Should it prove impractical to carry out certain tests (eg a component of a complete apparatus taken off site for repair, such as the rotor of a rotating machine) then, before putting the repaired apparatus back into service, the repairer will need to ascertain from the user or the manufacturer the consequences of omitting such tests.

62 Attention is drawn to section 40 of the Health and Safety at Work etc Act 1974 which states:–

“In any proceedings for an offence under any of the relevant statutory provisions consisting of a failure to comply with a duty or requirement to do something so far as is reasonably practicable, or to use the best practical means to do something, it shall be for the accused to prove (as the case may be) that it was not practicable or not reasonably practicable to do more than was in fact done to satisfy the duty or requirement, or that there was no better practical means than was in fact used to satisfy the duty or requirement”.

**Documentation**

63 The repairer will need to seek all necessary information/data from the manufacturer or user for the repair and/or overhaul of the apparatus. This may include information relating to previous repairs, overhauls or modifications. The repairer will need to have copies of the relevant explosion protection standards available.

64 Before repairs are undertaken, the repairer will need to produce a documented specific repair procedure indicating how the repair will be undertaken. In some cases it may be necessary to discuss this procedure with the user before the repair work is undertaken.
On completion of repairs, the repairer, who may also be the user, will need to provide the following details to allow the user’s maintenance records to be updated:

a) details of the fault detected;

b) full details of the repair and overhaul work;

c) list of replaced or reclaimed parts;

d) the results of all checks and tests.

Spare parts

It is recommended that repairers use the manufacturer’s spare parts for the overhaul and repair process.

Where the manufacturer’s recommended spare parts are not used, testing may be required to verify that no lowering of the explosion protection results from the repair.

Sealed parts

It is strongly recommended that parts which are required by the apparatus specification and certification documents to be sealed, are replaced only by the particular spare part(s) detailed in the parts list.

Devices incorporated in electrical apparatus to indicate interference by third parties (e.g. security seals) as distinct from those required in the certification documents, are not intended to fall within the scope of this sub-clause.

Sparking

Any evidence of unusual sparking identified by the repairer may need to be referred to the manufacturer and/or the user.

Any equipotential bonding arrangements will need to be replaced and positioned to at least the provisions of the original specification.

On dismantling rotating machines, if inspection of the rotor indicates signs of sparking, or rubbing against the stator, this may need to be referred to the manufacturer and/or the user for advice.

Identification of repaired and overhauled apparatus

Marking needs to be legible and durable, taking into account the possible chemical corrosion.

Modular apparatus will need to be provided with marking on each repaired module.

It is recommended that the marking includes the following:

a) the relevant symbol (see paragraphs 81 and 82);

b) the name of the repairer or their registered trade mark;
c) the repairer’s reference number relating to the repair;

d) the date.

76 The marking will need to be on a plate (not aluminium or similar light metal), securely attached to the repaired apparatus without adversely affecting the explosion protection.

77 If the apparatus has been the subject of previous repairs, the earlier plate detailing those repairs may be removed. In such cases a record will need to be made of all the markings on the earlier plate and passed to the user.

Reparer’s label

78 Apparatus which has been either overhauled or repaired will need to be marked to identify that an overhaul or repair has been performed. The marking is described in paragraphs 81 and 82.

79 Apparatus which is subject to routine maintenance by the user is not required to have a repairer’s label fitted.

80 Fitting of the label indicates that the overhauler/repairer has assumed the responsibilities outlined in paragraph 45 for the particular work performed as part of the overhaul or repair.

Relevant labels

81 The following label designates that the whole of the apparatus is in full compliance with the standard and certificate:

![R label](image)

Reparer’s Name ........................................

Ref No ......................................................

Date ......................................................

82 The following label designates that the apparatus, or part of it, is in compliance with the standard, but not necessarily in compliance with the certificate:
Removal/addition of marking labels

83 It may be necessary to amend, remove or supplement the existing label(s) in certain circumstances as follows:

a) If after repair or overhaul the whole of the apparatus still complies with the standard and certification, the manufacturer’s certification label will need to be retained and the repairer’s label bearing the symbol ‘R’ within a square added;

b) if the apparatus is changed during repair or overhaul so that it still complies with the standard but does not necessarily comply with the certificate, the certification label will need to be retained and the repairer’s label bearing the symbol ‘R’ within an inverted triangle added;

c) if after repair, overhaul or modification, the apparatus is changed so that it no longer conforms with the explosion protection standard, the certification label will need to be removed unless a supplementary certificate has been obtained. The repairer will need to pass this information to the user indicating that the apparatus is no longer in a certified condition, no longer complies with a protection standard and limitations on further use of the equipment in hazardous zones may be necessary.

Quality assurance

84 Certification to BS EN ISO 9001 or 9002 1994, having a scope appropriate to the repair of apparatus, represents what is probably the best available means for a repairer of certified equipment to provide assurance to the market. It involves assessment by specialists with many years of experience of the type of products involved, using an interpretation of the requirements which specifically addresses the particular problems encountered. The assessment and continued surveillance visits may need to include random product audits which, while being unable to be used in any ways as a guarantee of the product, are a searching test of the effectiveness of the repairer’s system.

85 User representatives of the Deep Mined Coal IAC have agreed that repairers participating in a quality control scheme to BS EN ISO 9001 or 9002, adapted/tailored to suit the repair of apparatus, will be given preference in the placing of repair contracts.
86 Manufacturing licences issued by the Electrical Equipment Certification Service (EECS) in accordance with their conformity assurance programme do not include repair activity. EECS do, however, operate a voluntary scheme designed specifically to cover the repair of explosion protected equipment.

87 Details of documents published by HSE EECS entitled Repair licence scheme guide and rules, Quality management system certification guide and Quality assessment schedule for repair and overhaul of certified products are given in Annex A.

Reclamation procedures

General
88 This sub-section deals only with the reclamation of parts which affect explosion protection. Reclamation not affecting explosion protection does not need special attention other than the use of good engineering practice.

Exclusions
89 Some component parts are considered not to be reclaimable and are therefore excluded from the scope of this document such as:

a) component parts made from glass, plastic or any material that is not dimensionally stable;

b) fasteners;

c) component parts which have been stated by the manufacturer to be non-repairable, eg some encapsulated assemblies.

Requirements
90 Any reclamation will need to be carried out by trained personnel, skilled in the process to be employed and using good engineering practices.

91 If any proprietary process is used, the instructions of the originator of such a process will need to be followed.

92 All reclamation will need to be properly documented and records retained. Such records will need to be provided to the user and will need to include:

a) identification of the component part;

b) method of reclamation;

c) detail of any dimensions which differ from those in relevant certification documents or the original dimensions of the component part;

d) the date;

e) names of the organisation carrying out the reclamation.

93 A reclamation procedure which would result in dimensions affecting explosion-protection integrity being different from those given in relevant certification documents may be permissible if such changed dimensions still meet the requirements of the relevant explosion-protection standard. In adopting such procedures care needs to be taken to ensure that the cumulative effects of engineering tolerances do not prejudice the safe running clearance of rotating parts, eg the air-gap between a rotor and stator. In the event of any uncertainty
regarding the permissibility, from an explosion-protection safety point of view, of an intended reclamation procedure, the advice of the manufacturer or certifying authority will need to be sought. It may also be necessary to carry out tests to verify that the reclamation procedure is acceptable.

94 If reclamation are contracted out by the repairer to a specialised industry, such reclamation will need to be supervised by the repairer.

**Acceptable/unacceptable reclamation procedures**

95 The following outlines some of the reclamation procedures which may be applicable to explosion protected apparatus. It will be recognised that not all procedures are applicable to all methods of protection. Detailed advise is given in the appropriate parts of this document.

96 It will be the responsibility of the repairer to satisfy themselves, on the completion of reclamation, that the apparatus is in a serviceable condition.

**Metal spraying**

97 Metal spraying is not recommended unless there is agreement between the user and the repairer, the materials are metallurgically compatible and the parent base metal is free from cracks or similar defect.

98 Similarly, metal spraying is not recommended when the extent of the wear or damage, plus the machining necessary to prepare the component part for reclamation, weakens the part beyond safe limits.

99 It is strongly recommended that any sprayed metal inlay is not taken into account when strength is considered.

100 Machining processes prior to the application of the metal spray may introduce stress raisers and will need to be taken into account as they may further weaken the component. Details of such procedures are given in BS 4761. See also BS 4495 and BS 4950 for other spraying processes.

**Electroplating**

101 Electroplating is not recommended for reclamation of electrical apparatus intended for use in coal mines.

**Sleeving**

102 It is recommended that this method be used only when the extent of the wear or damage, plus the machining necessary to prepare the part for reclamation, does not weaken the part beyond safe limits. It is also recommended that sleeving is not taken into account when strength is considered.

**Brazing or welding (welding applies to both metallic and non-metallic enclosures)**

103 Reclamation by brazing or welding may be appropriate if the technique employed ensures the correct penetration and fusion of braze or weld with parent material, resulting in adequate reinforcement, the prevention of distortion, the relief of stresses and the absence of blow-holes or significant cracks. It should be recognised that welding raises the temperature of the component to a high level and may cause fatigue cracks to propagate.

**Metal stitching**

104 Metal stitching is not recommended for the reclamation of electrical apparatus intended for use in coal mines.
Machining of stator and rotor cores (rotating machines)
105 It is recommended that damaged stator or rotor cores are not machined (skimmed) without reference to the manufacturer to ascertain the maximum permissible air gap. In the event that the manufacturer has ceased trading the certifying authority may be contacted for advice.

Threaded holes for fasteners
106 Threads which have been damaged beyond an acceptable extent may be reclaimed, depending upon the type of protection, by the following means:

a) oversize drilling, re-tapping and the fitting of a proprietary thread insert;

b) oversize drilling, plugging, re-drilling and re-tapping;

c) plug welding, re-drilling and tapping.

107 Drilling and re-tapping elsewhere on the flamepath or FLP flange is not recommended for the reclamation of electrical apparatus intended for use in coal mines.

Re-machining
108 Re-machining worn or damaged surfaces may be appropriate if:

a) the component part is not weakened beyond safe limits;

b) the integrity of the enclosure is maintained;

c) the required surface finish is achieved.

Modifications
109 It is strongly recommended that no modification be made to the certified apparatus unless that modification is permitted in the certificate or is agreed in writing by the manufacturer. Such modifications may require the issue of a supplementary certificate. Subsequent clauses of this document give detailed instructions regarding modifications in the context of different types of protection.

110 Where a modification is proposed which would result in the apparatus not conforming with the certification documents and the relevant type of protection standard, the user will need to be informed in writing that the apparatus is no longer suitable for use in a hazardous zone, and their written instructions obtained. If the proposal is subsequently carried out, following instruction from the user, the certification label will need to be removed (see paragraph 83).

Temporary repairs
111 Temporary repairs which affect the explosion protection are not recommended for electrical apparatus used in coal mines.

Removal of damaged windings
112 The procedure of softening the impregnating varnish of windings with solvents, or the application of heat to facilitate the removal of the windings, is acceptable provided that the operation is carried out with caution so as not to significantly affect the insulation between the laminations of magnetic parts. Particular caution is necessary and, if in doubt, the advice of the manufacturer will
need to be sought regarding the construction of the core and the inter-laminar insulation material.

113 The need for caution in the above circumstances arises from the fact that an increase in core loss, which could result from degradation of inter-laminar insulation, could result in the temperature classification being exceeded. Repairers will need to satisfy themselves that on completion of the reclamation the apparatus is in a serviceable condition.

Type of protection ‘d’ (flameproof)

Application

114 The section contains additional guidance for the repair, overhaul, reclamation and modification of an apparatus with type of protection ‘d’. It should be read in conjunction with the general guidance section, and any other appropriate clauses if relevant.

115 The relevant apparatus standards are those to which the apparatus was originally manufactured. (See Annex A).

116 Group I flameproof apparatus enclosures have to be capable of withstanding an internal explosion of firedamp without damage (which affects the explosion protection). They are also designed to be incapable of transmitting incendive flames from the interior of the enclosure to the outside atmosphere during a firedamp/air explosion. The ‘type testing’ of such apparatus therefore usually involves exploding a firedamp air mixture inside a fully assembled enclosure to demonstrate non-transmission of flame and to obtain a reference pressure to work to. The apparatus is then ‘routinely tested’ after manufacture (by hydraulic means) to demonstrate a pressure withstand safety factor (usually 1.5 times the explosion reference pressure). Some non-fabricated apparatus having small internal volume and obvious mechanical strength (eg a casting for a small stop/start switch) may be exempted, by the certification authority, from the need to have routine pressure testing performed after manufacture. As checking the integrity of the enclosure involves tests which require the use of special facilities and trained operators, it is easier and preferable that repairers replace damaged enclosures by new ones obtained from the original manufacturer, rather than attempt reclamation.

Repair and overhaul

Enclosures

117 It is recommended that the repairer uses the manufacturer’s spare parts for the overhaul and repair process. It is also recommended that damaged parts are repaired only if the type of protection is preserved. Particular attention will need to be paid to the correct assembly of flameproof enclosures after repair or overhaul, in order to ensure that the flameproof joints comply with the requirements of the standard and where appropriate with the certification documents. Flameproof joints may be protected by the use of grease, non-setting sealing compound or non-hardening tape applied externally. Flame paths could be impaired if they are painted with a hard-setting paint or compound.

118 Where gaskets which are not part of the flamepath are incorporated into the flameproof joints, replacements will need to be of the same materials and
dimensions as the original. Any proposed change will need to be referred to the apparatus manufacturer, user or certification authority.

119 Care needs to be taken when changing surface finish, paint etc, as this may affect the surface temperature of the enclosure and thus the temperature classification.

120 Water cooling jackets will need to be pressure tested to the manufacturer’s design pressure. Normally the apparatus passes the test if the pressure does not decay over a 30 minute period. The cooling jacket will need to be measured for the volume of water held in the jacket at normal atmospheric pressure.

121 The minimum values are as defined in the certification documents for each piece of equipment and these will normally state values for flow and volume.

122 Before a rewound or repaired rotating machine is put back into service, it is important to ensure that fan cover ventilation holes are not blocked or damaged as to impair the passage of cooling air over the machine, and that any fan clearances are in compliance with the requirements of the apparatus standards, if appropriate. If a fan or fan cover is found to be damaged so as to require renewal, the replacement parts will need to be obtained from the manufacturer. If unobtainable, then they will need to be of the same dimensions and at least the same quality as the original parts. The design will need to take account of the requirements of the apparatus standard to avoid frictional sparking and electrostatic charging, and of the chemical environment in which the machine is used.

**Cable entries**

123 After repair or overhaul, cable entries into flameproof enclosures will need to conform to the conditions detailed in the appropriate apparatus standard and/or certification documents where applicable.

**Internal parts**

124 Although the explosion protection of flameproof apparatus depends mainly upon the construction of the enclosure, some internal parts can influence its integrity and are mentioned in the protection concept standard. It will be noted that in some cases the requirements for group I apparatus (ie mining) differ from those for Group II apparatus (non-mining). For example, the comparative tracking index (CTI) of insulating materials (as defined in IEC 112) used in Group I apparatus must be at least CTI400 for certain apparatus (eg switchgear).

**Terminations**

125 Care will need to be taken when refurbishing terminations to maintain clearance and creepage distances. Any replacement terminals, bushings or parts will need to be obtained from the manufacturer or will conform with the relevant apparatus standard and/or certification documents, where applicable.

**Insulation**

126 A class of insulation higher than that originally provided may be employed, eg a winding insulated with Class E material may be repaired using Class F material. A superior class of insulation compared with that originally used does not necessarily permit an increase in apparatus rating without reference to the manufacturer.

**Windings and rotors**

**General**

127 It is recommended that original winding data is from the manufacturer. If this is not possible then use may be made of copy winding techniques. The materials
used in rewinding will comprise an appropriate insulation system. If a higher
temperature class of insulation is proposed compared with that of the original,
the rating of the winding may not be increased without reference to the
manufacturer, as the temperature classification of the apparatus could then be
adversely affected.

**Repair of rotating machine rotors**

128 Faulty die-cast aluminium rotor cages will need to be replaced by new rotors
obtained from the manufacturer or their distributor. Bar-wound cage rotors may be
re-wound using similar materials of identical specification. Particular care is
necessary to ensure that, when replacing conductors in a cage rotor, such
conductors are tight in the slots. The method of achieving tightness employed by
the manufacturer will need to be adopted.

**Testing after repair of windings**

129 Windings, after complete or partial repair, will need to be subjected, preferably
with the apparatus assembled, to the following tests, as far as is reasonably
practicable:

a) The resistance of each winding needs to be measured at room temperature
and compared with manufacturers’ data, when available. In the case of multi-
phase windings, the resistance of each phase or between line terminals will
need to be balanced as far as is reasonable.

b) An insulation resistance test will need to be applied to measure the resistance
between the windings and exposed metal parts/earth, between windings
where possible, between windings and auxiliaries, and between auxiliaries and
earth. A minimum test voltage of 500 Vdc is recommended. Minimum
acceptable insulation resistance values are a function of rated voltage,
temperature, type of apparatus and whether the rewind is partial or complete.
The insulation resistance would not normally be less than 50 Mohms at 20°C
on a completely rewound apparatus intended for use up to 650 V.

c) A high voltage test in accordance with a relevant standard will need to be
applied between windings and exposed metallic parts/earth, between
windings where possible, and between windings and auxiliaries attached to
the windings.

d) The transformer or similar apparatus will preferably be energised at rated
supply voltage. The supply current, secondary voltage and current will then be
measured. The measured value will need to be compared with that derived
from the manufacturer’s design data, where available, and in multi-phase
systems would normally be balanced in all phases, as far as is reasonable.

e) High-voltage (eg 1000 Vac/1500 Vdc and above) and other special apparatus
may require additional tests which are included in the repair or overhaul
contract.

**Rotating machines**

130 It is recommended that rotating machines will be subject to the following
additional tests:

a) With the machine running at full speed the cause of any untoward noise and/
or vibration will need to be investigated and corrected.

b) A check on the balance in all phases of cage machines with the stator
windings energised at an appropriately reduced voltage and with the rotor
locked to obtain full-load rated current. This test, which in some respects is an alternative to a full load test, is used to confirm the integrity of the stator winding and its joints and to indicate the presence of rotor defects.

c) For high voltage machines (eg 1000 Vac/1500 Vdc and above) and non-cage machines, where (a) and (b) may be inappropriate, alternative and/or additional tests may be the subject of the repair or overhaul contract.

**Note:** Guidance on test voltages and additional tests for rotating machines can be found in BS 4999.

(d) If possible, use can be made of load current frequently spectrum analysis techniques which allow a 'fingerprint' to be established for a particular motor. This allows comparisons to be made following subsequent repairs, thereby highlighting any significant deficiencies.

**Auxiliary equipment**

*Temperature sensors*

131 If temperature sensors are included to monitor winding temperatures, it is recommended that they are embedded in the winding before varnishing and curing.

*Other auxiliary devices*

132 Where auxiliary devices are based on different types of explosion protection, the corresponding clauses of this document will need to be consulted before any repairs are undertaken.

*Light transmitting and plastics parts*

133 It is strongly recommended that repair or re-cementing light transmitting and plastics parts is not undertaken and only complete replacement assemblies, as specified by the manufacturer, are used. Light transmitting or other parts made from plastics are not normally cleaned with solvents. Household detergents are recommended for this purpose.

*Encapsulated parts*

134 It is recommended that encapsulated parts, eg switching devices in luminaires, are not repaired.

*Batteries/cells*

135 Batteries or cells are rarely used in modern flameproof apparatus because of the risk of electrolytic gases (eg hydrogen and oxygen) being evolved inside the enclosure and affecting its flame transmission properties. Where cells or batteries are used, they will need to be replaced only with identical cells or batteries to those specified in the manufacturer’s or certification documentation.

*Lamps*

136 Lamp types specified by the manufacturer will need to be used as replacements and the maximum wattage specified not exceeded.

*Lampholders*

137 Replacements listed by the manufacturer will need to be used.

*Ballasts*

138 It is recommended that chokes or capacitors are only replaced by the manufacturer’s listed parts, unless reference is made to the manufacturer to determine if alternatives may be used.
Reclamation

Enclosures

139 It is recommended that reclaimed component parts of flameproof enclosures are re-used only if they pass appropriate tests, eg the over-pressure test prescribed in the relevant flameproof protection concept standard, torque testing of re-tapped holes, metallurgical examination.

a) Apparatus which has exemption from routine pressure testing after manufacture, issued by the certifying authority, will need pressure testing following reclamation because the exemption could be considered to be invalidated.

b) It may be necessary to perform an over-pressure test on reclaimed apparatus if it is obvious that the strength of the enclosure has been affected by the reclamation process, eg reclamation of a motor shaft may not affect the strength of the flameproof enclosure, whereas reclamation of the motor end shield may affect the strength of the flameproof enclosure.

140 Damage to components which are not an integral part of the flameproof enclosure, eg fixing lugs, may be repaired by welding or metal stitching but care must be taken to ensure that the integrity and stability of the apparatus is not impaired. It is particularly important to check that any cracks being repaired do not extend to the flameproof enclosure.

Flameproof joints (flamepaths)

141 It is recommended that damaged or corroded flameproof joint faces are only machined if the resultant joint gap, flange dimensions, flamepaths and surface finishes are not affected in such a way that they contravene the apparatus standard and, where appropriate, the certification documents. Before commencing such work it is advisable to consult with the manufacturer.

Flanged joints

Welding and re-machining flanged joint faces may be permissible, having due regard to the limitations of the technique (see paragraphs 103-108). However, metal spraying is not recommended.

Spigotted/cylindrical joints

Machining the male part will require addition of metal to and machining of the female part (or vice versa), thus ensuring that the flameproof dimensions comply with the apparatus standard, and where appropriate, the certification documents. If only one part is damaged, that part can be restored to its original dimensions by the addition of metal and re-machining. The addition of metal may be by sleeving or welding. Unfused metal spraying is not recommended. When either the male or female part could be routinely replaced during subsequent service, then any reclamation of those parts will need to take this into account, eg care must be taken not to exceed the maximum permissible flameproof gap between a replacement spigotted cable entry adapter and a reclaimed hole in an enclosure.

Threaded joints

a) It is not recommended that damaged male threaded parts of cable entries and other similar entries (eg adapters) be reclaimed, new components will need to be used. Damaged female threads may be repaired providing they meet the required fit and thread engagement. Consultation with the manufacturer is recommended.
b) Reclamation of the threaded parts of screwed covers and of the associated housings may be impracticable and is not recommended.

**Threaded holes for fasteners**

142 Reclamation of damaged threaded holes may be carried out using the techniques described in paragraph 106.

**Shafts and housings**

143 Shafts and bearing housings, including flameproof joints, may be reclaimed, eg by the use of metal spraying or sleeving techniques. Any subsequent machining will need to be to the flameproof dimensions as specified in the apparatus standard and/or the certification documents, as appropriate. Welding may be appropriate having due regard to the limitations of the technique (see paragraph 103).

**Journals**

144 Journals may be reclaimed by suitable homogenous welding technique or other equivalent techniques agreed between the user and repairer.

**Rotors and stators**

145 If rotors and stators are to be lightly skimmed to remove eccentricities and surface damage then the resultant increased air gap between rotor and stator will need to take account of, for example, a change in pressure piling characteristics or a change in the external temperature of the machine such that it may no longer comply with its surface temperature classification (ie for machines constructed to BS 4683) or its maximum permissible surface temperature (ie 150°C for machines constructed to BS 5501 or EN 50018). The maximum permissible air gap is specified in the manufacturer’s and certification documents – the repairer will need to ensure compliance with these documents.

146 Skimmed or damaged stator cores will need to be submitted to a ‘flux test’ to ensure that there are no hot spots which could infringe the temperature classification or cause subsequent damage to the stator windings.

**Modifications**

**Enclosures**

147 Modifications which may affect the explosion protection of the apparatus or the enclosure will need to be referred to the original manufacturer, certificate holder or the certifying authority for advice.

**Cable entries**

148 Provision of additional entries will need to be referred to the original manufacturer, certificate holder or certifying authority for advice.

149 It is recommended that cable entries with an enclosure are not changed from indirect entry (eg plug and socket) to a direct entry without reference to the original manufacturer, certificate holder or certifying authority for advice.

**Terminations**

150 It is recommended that termination assemblies which incorporate a flameproof flamepath are not modified. Those not containing a flameproof flamepath will need to be replaced by alternatives of adequate design and construction in terms of numbers, current carrying capacity, creepage and clearance distances, and quality.
Windings
151 Where apparatus is to be rewound for another voltage, other than that shown on the certification documents, it is recommended that reference is made to the original manufacturer, certificate holder or certifying authority for advice prior to undertaking this work. In such cases the person carrying out the work will need to ensure that, for example, the magnetic loading, current densities, losses are not increased, appropriate new creepage and clearance distances are observed and the new voltage is within the limits of certification documents. The rating plate will need to be changed to show the new parameters, and test report passed to the user covering these aspects.

152 Before rewinding a rotating machine for a different speed it is recommended that reference is made to the original manufacturer, certificate holder or certifying authority for advice.

Auxiliary equipment
153 It is recommended that additional auxiliary apparatus (eg anti-condensation heaters, temperature sensors etc) only be fitted inside flameproof enclosures where the certification drawings show such items as permissible variations. Otherwise, the repairer will need to refer to the original manufacturer, certificate holder or certifying authority for advice.

Type of protection ‘i’
(intrinsic safety – IS)

Application
154 This section contains additional guidance for the repair, overhaul, reclamation and modification of an apparatus with type of protection ‘i’. It is to be read in conjunction with the general guidance section, and any other appropriate clauses if relevant. The relevant protection standards are those to which the apparatus was originally manufactured (see Annex A).

155 In addition to certification, certain apparatus may be approved by HSE pursuant to regulation 20(1) of the Electricity at Work Regulations 1989 and as a condition of the approval such apparatus may have to meet performance or specification requirements of relevant HSE Testing Memoranda or British Standards. Compliance with this guidance would generally ensure that such performance or specification requirements are still met following repair/overhaul and subsequent recalibration/testing.

156 Group I intrinsically safe apparatus and systems have to be constructed so that any electrical sparks produced during normal working or fault working do not have sufficient energy to ignite a firedamp/air mixture, and that no exposed part of the circuit exceeds the ignition temperature of coal dust (or firedamp if coal dust is prevented from forming a layer). This is normally achieved by limiting the current in the circuit to very low values, thereby restricting its heating effects and arcing energy. The acceptable values of current vary according to the metals capacitance in the circuit. Graphs are printed in BS EN 50020 showing these values. Care will need to be taken to ensure that the appropriate version of the standard is used for the repair as these graphs have been modified during revision/updating of the standards. In assessing BS 1259 apparatus it has become common practice for testing officers to refer to these graphs.
157 Interpretation of intrinsically safe circuit parameters needs special training and experience, because the circuit not only has to be assessed for normal working but for faults occurring. Repair work must therefore only be performed by competent persons, able to assess the risks associated with circuit repairs, however minor. As a general rule, only identical components and wiring will be used to replace faulty parts and an assessment will need to be made to establish why the original part became faulty (eg if a resistor is ‘open circuit’, was it caused by an overload fault elsewhere on the circuit?).

158 Certain IS apparatus and systems need to continue to operate and remain energised in explosive concentrations of flammable gas for safety reasons (eg gas monitoring systems, telephone systems). This small category of apparatus and systems, in addition to being certified to the ‘ia’ category by a certifying authority, are also approved by HSE (HM Inspectorate of Mines) under regulation 20 of the Electricity at Work Regulations 1989. Although overhaul and repair of approved apparatus and systems will not normally need to be covered by a variation approval, modifications will need to be discussed with HM Inspectorate of Mines, irrespective of whether or not supplementary certification is obtained from the certifying authority.

159 In some IS systems, one part of the circuit may be in the hazardous zone and the other part in a gas free place (eg a computer at the mine surface monitoring gas levels at the coal face). In these systems care is needed to ensure that the correct isolating barrier devices or coupling units are in place to segregate the circuits and prevent non-IS power supplies from the gas free place accessing the hazardous zone (eg during faults on the mine’s electrical system, or lightning strikes on overhead power lines etc). Normally such barrier devices comprise Zener diodes, fuses, limiting resistors etc, and are not designed to be repaired because safety depends upon such components and they may have been over-stressed in operation.

160 Intrinsically safe apparatus may have one of two categories of approval, Ex’ia’ and Ex’ib’. However, the requirements for repair and overhaul apply to both categories.

**Repair and overhaul**

**Enclosures**

161 The enclosures of intrinsically safe apparatus for use in Group I situations are intended to give a minimum degree of protection, eg IP54, depending upon the intended location of use. Any repairs will need to ensure that there is no reduction in the degree of protection. A more stringent degree of protection than that specified in the standard may have been provided to cater for environmental conditions, in which case any repair will need to cater for such higher degree of protection.

**Cable entries**

162 Special entries are used to maintain the degree of protection of the enclosure. Any repairs will need to ensure that there is no reduction in the degree of protection.

**Terminations**

163 When repairing terminal compartments, any terminals replaced will normally be of the same type as the original. Where the same type is not available, any alternative type used will need to satisfy the creepage (according to CTI) and clearance requirements specified in the standard for the maximum voltage of the
apparatus and the separation requirement by the standard to avoid inadvertent cross-connection, eg by provision of earthed or insulating screens/barriers between connections.

**Soldered connections**
164 When it is necessary to carry out repairs which require soldering techniques to be used, care will need to be taken to ensure that the basis of certification is not invalidated, eg:

a) different requirements of redundancy may apply to the connection depending on whether machine or hand soldering is used;

b) different requirements for creepage distances may apply dependent upon whether the joint is coated after soldering.

**Fuses**
165 The replacement of fuses will need to be carried out with care. Where a fuse is found to have ruptured, an investigation will need to be made to establish that other components have not failed or been over-stressed. It is important that the replacement fuse has the same rating, characteristics and rupturing capacity as that originally fitted by the manufacturer.

**Relays**
166 If a relay is found to be faulty, the replacement will need to be obtained from the equipment manufacturer or, where this is impracticable, it may be replaced by one which is identical.

**Safety barriers**
167 It is recommended that modular or encapsulated safety barriers are not repaired.

168 It is not always necessary to replace a faulty device with one of exactly the same type number and manufacture, but any replacement will need to have the same safety characteristics and electrical rating. The replacement will need to take account of the safety of the installation, eg to prevent reduction of the creepage-clearance distances below those specified in the standard.

**Printed circuit boards**
169 These components often have critical distances between conducting tracks (creepage distances) which may need to be maintained. Therefore, when components are replaced care will need to be taken in positioning them on the board. Where boards need to be varnished after repair, at least two independent coats of insulating varnish of the type prescribed by the manufacturer will need to be applied in the appropriate manner, eg brush, dip, coating etc.

**Opto-couplers**
170 It is recommended that only components of the same or directly equivalent type and certification be used as replacements.

**Electrical components**
171 Components such as resistors, transistors, Zener diodes etc, may be replaced with items purchased from any source providing they are identical replacements. In exceptional circumstances, however, some manufacturers use a ‘select on test’ procedure for some components. Where this is the case, the documentation supplied with the repaired equipment will need to indicate either that replacements were obtained from the equipment manufacturer or how the replacements were selected.
**Batteries/cells**
172 It is recommended that only those types of battery/cell specified in the equipment manufacturer’s documentation be used as replacements. Where batteries are encapsulated, it is recommended that the whole assembly be replaced.

173 Some IS battery power supplies used to supply apparatus essential for safety of persons in the mine are approved as separate entities by HSE, under regulation 20 of the Electricity at Work Regulations 1989. This allows them to continue in operation with explosive concentrations of flammable gas present in the atmosphere. Where IS apparatus or an IS system is normally supplied from an HSE approved power supply, it is recommended that the power supply is not replaced by a non-approved power supply without the user being informed and agreeing to the change.

**Internal wiring**
174 Certain distances between conductors and their associated segregation are critical. Disturbed or replacement wiring will need to be configured and located in the same position as the original wiring, paying particular attention to replacing any screens or barriers, extra outer sheathing or double insulation, methods of fixing and colour coding.

**Transformers**
175 If a transformer is found to be faulty, the replacement will need to be obtained from the equipment manufacturer. It is recommended that embedded (encapsulated) thermal trip devices are not repaired or replaced.

**Encapsulated components**
176 Encapsulated components, eg batteries with internal current-limiting resistors or fuse-Zener diode assemblies, are non-repairable and it is recommended that they be replaced only with assemblies of the original design from the equipment manufacturer.

**Non-electrical parts**
177 Where the apparatus has non-electrical parts, eg fittings or windows, that do not affect the electrical circuit or creepage and clearance distances and hence the intrinsic safety, these may be replaced by new parts of equivalent type. For non-metallic parts, electrostatic properties will need to be taken into account.

**Testing**
178 Before equipment containing only intrinsically safe circuits is re-installed in the hazardous area, then after completion of the repair or overhaul the insulation between the intrinsically safe circuit and the enclosure will need to be checked by applying a 500 Vac-50-60Hz, or 700 Vdc voltage between the terminals and the enclosure for one minute. The result of such a test would generally be in excess of 1 Megohm.

179 This test may be omitted if the enclosure is of insulating material or if one side of the circuit is galvanically connected to the enclosure for safety reasons.

**Reclamation**
180 It is recommended that components on which intrinsic safety depends are not reclaimed.
Modifications

181 It is recommended that modifications to intrinsically safe apparatus only be carried out following reference to the original manufacturer, certificate holder or the certifying authority for advice.

Type of protection ‘e’
(increased safety)

Application

182 This section contains additional guidance for the repair, overhaul, reclamation and modification of an apparatus with type of protection ‘e’. It is to be read in conjunction with the general guidance section, and any other appropriate clauses if relevant. The relevant apparatus standards are those to which the apparatus was originally manufactured (see Annex A).

183 Group I increased safety apparatus (type ‘e’) is constructed so that no part of it produces an arc or spark in normal operation, or exceeds the specified temperature limits of 150°C where coal dust can form a layer or 450°C where coal dust is prevented from forming a layer. To achieve this protection the standard does not allow switches, contacts and other possible arc sources to be used in the construction of the apparatus. Similarly, terminals have to be of a special type which cannot loosen in service and detailed attention is paid to the quality of insulating materials, maintaining enhanced creepage and clearance distances and preventing the ingress of contaminants which might lead to tracking between terminals.

184 The use of type ‘e’ apparatus in mines in Great Britain has, to date, been limited to various types of junction boxes, solenoid valve assemblies and large traction batteries used to power locomotives or free-steered vehicles. This section therefore deals mainly with these types of apparatus.

185 Unlike the non-mining industries, type ‘e’ motors have not as yet been introduced to mines in Great Britain and therefore the repair of such motors and their associated specially designed switchgear (which may incorporate finely tuned/set protection circuits arranged to shadow the operating characteristics of the motor) is not covered in this document.

Repair and overhaul

Enclosures

186 While it is preferable to obtain new parts for enclosures from the manufacturer, in principle, damaged parts may be repaired or replaced, provided that the degree of protection and temperature classification as stipulated on the certification label are preserved.

187 A more stringent degree of protection than that specified in the apparatus standard may have been provided to cater for environmental conditions in which case any repair will need to take account of such higher degree of protection. The repairer will need to pay attention to impact test requirements of all parts of the
enclosure and also the degree of protection provided for ventilation inlet and outlet openings, as detailed in the apparatus standard. The majority of Group I (mining) increased safety apparatus enclosures have an IP rating of IP54. Type ‘e’ vehicle traction battery containers usually have a rating of IP23 because of the need to compromise between dispersion of electrolytic gases and preventing the ingress of dust and dripping mine water.

188 Because of the arduous conditions of usage normally associated with the coal face, some apparatus, such as increased safety coal face lights, are subjected to the higher of the two levels of impact energy listed in the explosion concept standard (ie 20 Joules). The repairer will therefore need to check the level of impact test performed on the original apparatus to ensure that the apparatus is still capable of meeting that requirement following repair.

189 Attention is drawn to the effects of surface finishes, paint etc, on the temperature classification of enclosures. It is recommended that only finishes specified by the manufacturer are to be applied.

**Cable entries**

190 Entries will need to preserve IP54 minimum degree of protection or such higher degree of protection as may have been provided for in the certification of the apparatus.

**Terminations and internal connections**

191 Terminations and internal connections used in increased safety apparatus are required by the standard to be of a special type, capable of carrying the load without overheating, loosening or arching in service.

192 The design of terminations, in terms of the materials used, the creepage and clearance distances and the CTI of termination insulation, will normally be fully specified in the certification documents. It is recommended that replacement parts be obtained from the manufacturer or their advice sought regarding acceptable alternatives.

193 If internal connections are to be renewed, the insulation on such connections will need to have the same electrical, thermal, and mechanical properties to that originally supplied.

194 The cross-sectional area of any replacement connection will need to be equivalent to that originally fitted. The permitted methods of connecting conductors are given in the protection standard.

195 Where terminations are loose leads, the methods of termination including insulation will need to be in accordance with the certification documents.

**Insulation**

196 Comprehensive details of the insulation systems are normally included in the certification documents. Where this does not apply, full information will need to be sought from the manufacturer.

**Auxiliary equipment**

197 If temperature sensors are included to monitor enclosure/component temperatures, it is recommended that these only be replaced by spares supplied by the manufacturer, or alternatives of an identical specification, and they will need to be installed as described in the certification documents.

**Light transmitting parts/plastics parts**

198 It is recommended that light transmitting and plastics parts are not repaired and only replacement components provided by the manufacturer are used.
199 Light transmitting parts or other parts made of plastics are not normally cleaned with solvents. Household detergents are recommended for this purpose.

**Encapsulated parts**

200 In general, it is recommended that encapsulated parts are not repaired or reclaimed.

**Batteries/cells**

201 The use of type ‘e’ batteries in coal mines has been mainly limited to locomotive and free-steered vehicle traction batteries.

202 Reference will need to be made to the manufacturer’s documentation before carry out any repair or replacement. Replacement cells or batteries will need to be identical to the originals, or be those listed as alternatives on the certification drawings/documents. It is recommended that no more than 6% of the cells in a traction battery having sweated or soldered inter-cell connections be replaced using crimped connectors.

203 Where bolted inter-cell connectors are included in the certification documents, such connectors will need to be tightened to the torque value specified by the manufacturer.

**Lamps**

204 Lamp types specified by the manufacturer will need to be used as replacements and the maximum wattage not be exceeded.

**Lampholders**

205 It is recommended that only manufacturers’ replacement lampholders are used, and where the wiring to the lampholder is factory made (crimps etc), rewiring is not undertaken unless the repairer has the equipment to make up the wiring to the same standard.

**Ballasts**

206 It is recommended that chokes and capacitors only be replaced with the manufacturer’s listed parts.

**Testing**

207 Following repair, an insulation resistance test will need to be applied to measure the resistance between circuit components and earth. A minimum test voltage of 500 Vdc is recommended.

208 For traction batteries, the advice of the manufacturer will need to be sought regarding accepted methods of measuring insulation resistance. The aim is to achieve the level of 1 Megohm between live parts and the battery container, as specified in the protection standard.

209 The apparatus should preferably be energised at rated supply voltage. The supply current will then be compared with that derived from the manufacturer’s data. Checks will need to be made of component temperatures after a reasonable operating period, and these will then need to be compared with the limits outlined in the relevant standard.

210 Where water/dust seals are replaced by ones which are not identical to the originals fitted by the manufacturer, the repairer will need to have facilities to perform the ‘ingress protection tests’ (to verify IP rating) and the report submitted to the user will need to include the results of such tests.
Reclamation

211 Reclamation using the techniques detailed in the general guidance section may be used with the type of protection ‘e’ apparatus subject to the following clauses.

Enclosures

212 If minor damage to enclosures, terminal boxes and covers is to be repaired by welding or metal stitching, care will need to be taken to ensure that the integrity of the apparatus is not significantly impaired so as to degrade the type of protection. In particular, it should remain capable of withstanding the impact test and maintain the degree of ingress protection following the repair.

213 It is recommended that any ventilation arrangements provided (eg on traction battery containers) are not covered, blocked or changed in any way.

Joints

214 If damaged or corroded joint faces are to be machined, the mechanical strength and operation of the component will need to be considered as well as the degree of ingress protection afforded.

215 Spigotted joints are normally provided to achieve close tolerance location. Thus, machining the male part will require addition of metal to the female part (or vice versa) to maintain the location properties of the joint. If only one part is damaged, that part may be restored to its original dimensions by the addition of metal and re-machining.

Spindles and bushes

216 If spindles and bushes are to be reclaimed, this may be carried out by use of metal spraying or sleeving techniques. Welding may be appropriate with due regard to the limitations of the technique (see paragraph 103).

Modifications

217 It is recommended that modifications which may affect the explosion protection of the apparatus are not carried out without reference to the original manufacturer, certificate holder or the certifying authority for advice.

Enclosures

218 Enclosures may be modified provided that the specified temperature classification, ventilation requirements, degrees of ingress protection and impact test requirements of the appropriate standards are met. Following such modification, tests will need to be carried out, as appropriate, to confirm compliance with the relevant standards.

219 In the case of traction battery containers, the manner of current take off, eg plugs/sockets, will need be as specified in the certification documents. These will either specify a double pole isolator fitted to the container, or separate plugs and sockets for each pole of the battery supply.

Cable entries

220 Special care will need to be taken to ensure that if alteration is made to entries, the specified type and degree of ingress protection are maintained.
Terminations
221 It is recommended that modifications to terminations which affect the current carrying capacity or anti-loosening properties are not made without reference to the original manufacturer, certificate holder or, certifying authority for advice.

Operating voltage
222 It is recommended that rewinding of apparatus for another voltage be carried out only after reference to the original manufacturer, certificate holder, or, certifying authority. Such rewinding will need to take account of, for example, the fact that magnetic loading, current densities and losses are not increased, new appropriate creepage and clearance distances are observed, and the new voltage and other parameters are within the limits of the, certification documents. The rating plate will need to be changed to show the new parameters.

Auxiliary equipment
223 In cases where additional auxiliary equipment is requested, eg anti-condensation heaters or temperature sensors, the original manufacturer, certificate holder or certifying authority will need to be consulted to establish the feasibility of the procedure for the proposed modification.
Annex A: Relevant Legislation/Standards/Documents

Legislation

The Health and Safety at Work etc Act 1974 (Chapter 37)

The Mines and Quarries Act 1954 (Chapter 70) and Regulations made under this Act

The Electricity at Work Regulations 1989 (SI 1989 No. 635)

The Supply of Machinery (Safety) Regulations 1992 (SI 1992 No. 3073)

The Provision and Use of Work Equipment Regulations 1992 (SI 1992 No. 2932)


Standards

All standards listed below may have been revised over the years and repairers will need to use the appropriate version during repair and overhaul. The dates shown are those current at the time of preparation of this document.

BS 229: 1957 Flameproof enclosures of electrical apparatus

BS 1259: 1958 Intrinsically safe electrical apparatus and circuits

BS 4495: Recommendations for the flame spraying of ceramic and cermet coatings

BS 4683: Part 1: 1971 Classification of maximum surface temperature

BS 4683: Part 2: 1971 Construction and testing of flameproof enclosures of electrical apparatus

BS 4761 Specification for sprayed unfused metal coatings for engineering purposes

BS 4950 Sprayed and fused metal coatings for engineering purposes

BS 4999 General requirements for rotating electrical machines

BS 4999: Part 143: 1987 Specification for tests of rotating electrical machines

BS 5501: 1977 Electrical apparatus for potentially explosive atmospheres, Parts 1, 5, 6, 7, 8

BS 5620: 1979 200A Flameproof restrained and bolted plugs and sockets

BS 5750 Quality systems

BS 5781 Measurement and calibration systems

BS 6704: 1987 Selection, installation and maintenance of intrinsically safe electrical equipment in coal mines
BS 7202: 1989 Non-incendive low voltage control/interlock and low voltage earth fault monitoring circuits for use in mines

BS EN 60529: 1991 Specification for degrees of protection by enclosures (IP rating)

IEC 112 Method of test for determining the comparative and proof tracking indices of solid insulating materials under moist conditions

EN Standards relating to electrical apparatus for potentially explosive atmospheres

BS EN 50014: 1993 General requirements

BS EN 50018: 1977 Flameproof enclosure ‘d’

BS EN 50019: 1977 Increased safety ‘e’

BS EN 50020: 1977 Intrinsic safety ‘i’

BS EN 50028: 1987 Encapsulation ‘m’

**Other documents**

HSE EECS Quality assessment schedule for repair and overhaul of certified products

HSE EECS Quality management system certification guide

HSE EECS Repair licence scheme guide and rules

(All three documents are available free of charge, from the Electrical Equipment Certification Service (EECS) at Harpur Hill, Buxton, Telephone: 01298 28000)
## Annex B: Members of the IAC Electrical Working Group

**HSE delegates**

- Mr G Goodlad  
  HMIEM (Chairman)
- Mr B Forbes  
  HMIEM
- Mr R Turton  
  EECS
- Mr S J Ottey  
  EECS
- Mr N P Hill  
  (Secretary)

**Industry delegates**

- Mr J A N Currie  
  HSEC Ltd
- Mr J Glover  
  HSEC Ltd
- Mr J Kenny  
  Coal Investments Plc
- Mr J Mather  
  Coal Investments Plc
- Mr S Malpas  
  Coal Investments Plc
- Mr E Ruck  
  R J Budge Mining Ltd
- Mr S Askins  
  WYKO
- Mr D Ridley  
  Federation of Small Mines
- Mr G Barnes  
  Dowding Mills Plc
- Mr B A Gibbon  
  Dowding Mills Plc
- Mr W A Craig  
  Anderson Mining Services Ltd
- Mr H Rae  
  Allenwest Wallacetown
- Mr J Evans  
  AEMT
- Mr J W Parry  
  Tursdale Engineering
- Mr K McKenzie  
  Tursdale Engineering
- Mr D Garrard  
  Longwall Mine Service Centre
- Mr J Allen  
  BERL
- Mr A G Treves  
  Baldwin & Finances Ltd
- Mr P Jenkins  
  HGM Engineering Ltd
- Mr C Chadwick  
  BICC Components
- Mr P Jackson  
  Peebles Field Services Clarke Chapman Eng
- Mr R Haringham  
  Brush Electrical Machines
- Mr A A Grundy  
  Brush Electrical Machines
- Mr H Radford  
  Rotary Electrical Co Ltd
- Mr D Taylor  
  Bufton Electrical Co Ltd

Written comments were also received from:

- Mr N Greatrex  
  UDM
- Mr R Thurlow  
  HSE EECS

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This is a web-friendly version of *Guidance on the repair and overhaul of apparatus intended for use in coal mines susceptible to firedamp*, originally produced by HM Inspectorate of Mines.
PART 2: Repair and overhaul of flameproof reciprocating internal combustion engines

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Introduction

1 This part of the document gives guidance, principally of a technical nature, on the repair and overhaul of flameproof diesel engines constructed for use in potentially explosive atmospheres found underground in mines. It deals with both the physical aspects of flameproof repairs and also the reduction of dangerous exhaust gase emissions into the mine atmosphere. A list of the members of the IAC Reciprocating Internal Combustion (RIC) Engine Working Group formed to prepare this part of the document is included at Annex B.

2 The scope of Part 2 does not cover maintenance of engines (other than where this cannot be disassociated from repair and overhaul), power output performance, or their use on vehicles etc. These and other analogous matters, not directly associated with the prevention of ignition of an explosive atmosphere or pollution of the mine air by dangerous exhaust emissions, will need to be the subject of separate negotiations between the user and repairer.

3 It is assumed that good engineering practices are adopted throughout.

4 This part of the document covers those aspects of repair and overhaul which are common to explosion protected engines. It also identifies certain specific responsibilities under the Health and Safety at Work etc. Act 1974 applicable to those who are likely to be concerned with the repair of certified or approved apparatus.

5 Legislation / standards/ documents which are relevant to this guidance are listed in Annex A.

Definitions and terms

6 The following definitions apply to this part of the document:

Serviceable condition – A condition of the engine, such that it is fit for use, unlikely to be an igniting source for an explosive atmosphere, and is in accordance with the relevant explosion protection concept standard (which includes control of exhaust emissions).

Relevant standard – The standard to which the apparatus was originally certified/approved.

Repair – An action to restore apparatus to its serviceable condition, where an examination and inspection has established that the apparatus is faulty or damaged, or parts are replaced which can affect explosion protection or exhaust emissions. For example, gaskets within the flamepath or fuel pump, cooling system components, over temperature protection, exhaust gas dilution system (see the diagram in Annex C).

Overhaul – An action to restore apparatus to its serviceable condition, where an examination and inspection has established that the apparatus is not faulty or damaged, and parts are not replaced which can affect explosion protection or exhaust emissions.

Maintenance – Routine actions taken to preserve the serviceable condition of the installed engine.
**Component part** – An indivisible item from an assembly of such parts which may form an engine.

**Reclamation or recovery** – A means of repair involving the removal or addition of material to restore component parts, which have sustained damage, to a serviceable condition.

**Modification** – A change to the design of the engine which may affect material, fit, form or function.

**Manufacturer** – The maker of the flameproof engine assembly (who may also be the supplier, the importer or the agent).

**User** – The user of the flameproof reciprocating internal combustion engine.

**Repairer** – The repairer of the engine - who may be the manufacturer, the user, or a third party (repair agency).

**Certification** – The issue of a document by a recognised body or notified body testifying that a type of engine or a type of component or a procedure conforms with the requirements of a European Directive, a European Harmonised Standard, a published national or recognised international standard.

**Approval** – The issue of a document by the Health and Safety Executive (HSE) indicating that a type of engine meets the requirement of a particular legal obligation, using powers given to them under legislation relating to that type of apparatus.

**Certificate references** – A certificate reference number may refer to a single design or a range of engines of similar design.

**Flameproof enclosure** – As defined in the protection concept standard relating to the type of apparatus being repaired, i.e. BS 6680 or BS 5501: Part 5, BS 4683: Part 2 or EN 50018. This is generally a type of protection in which parts or hot gases which can ignite an explosive atmosphere are placed in an enclosure which can withstand an internal explosion of flammable gas without damage and without transmitting incendive flames from the interior to the explosive atmosphere surrounding the enclosure.

### Background information

7. RIC engines intended for use in underground workings of coal mines susceptible to firedamp and/or combustible dust need to be of such construction and protected to prevent danger arising from their use. The dangers envisaged are:

a) those of ignition of an explosive mixture of firedamp and/or combustible dust and air in the general body of the mine atmosphere; and/or

b) pollution of the mine atmosphere by exhaust emissions.

8. If a RIC engine is used to provide motive power to other machinery such as a locomotive or free-steered vehicle, then hazards other than the two mentioned above may be present, but these are beyond the scope of this guidance document.
Section 83 of the Mines and Quarries Act 1954 states, inter-alia, that a RIC engine, in the absence of specific regulations, shall not be used below ground in a mine without the consent of an inspector.

From 1954, compliance with this requirement has normally been met by the mine manager obtaining the consent of HM Inspector of Mines in charge of the district in which the mine is situated. Such consent has normally required the engine to be approved by the Health and Safety Executive (HSE) and this in turn has called for the engine to meet the requirements described in HSE’s Testing Memorandum No. TM12.

In 1985 British Standard BS 6680 was published, thereby introducing a recognised national standard for flameproof diesel engines intended for use in coal mines. These requirements were subsequently used to form the basis for HSE approval and testing of engines according to BS 6680: 1985 commenced at HSE’s laboratories.

**Effects of the Machinery Directive (89/392/EEC)**

With the coming into force on 1 January 1995 of the European Article 100A Directive on the Supply of Machinery (Directive No. 89/392/EEC) and subsequent amendments, implemented in Great Britain by the Supply of Machinery (Safety) Regulations 1992 (SI No. 1992 No. 3073) and subsequent amendments, the need for RIC engines to be approved by HSE was disapplied for engines meeting the essential safety requirements of the Directive and bearing the distinctive Community CE mark. Such engines, however, being listed in Annex 4 of the Directive (Schedule 4 of the Regulations) are the subject of additional requirements. In that they are required to be either:

a) constructed in accordance with a published Harmonised European Standard relating to their construction (“published” means published in the European Official Journal, the fact that a standard is published by CEN in not sufficient in itself); or

b) subjected to assessment by a notified body. A list of notified bodies can be obtained from: The Department of Trade and Industry, 1 Victoria Street, London, SW1H 0ET.

Engines placed on the market or put into service for the first time before 1 January 1995 are excluded from the requirements. Therefore any engines legally in service before that date (eg by Inspectorate consent or HSE approval) may be repaired or overhauled and put back into service without the need to comply with the Machinery Directive, providing no modifications are made affecting the design.

**Effects of the Explosive Atmospheres Directive (94/9/EC)**


In the case of diesel engines intended for use in gassy mines susceptible to firedamp, the Regulations/Directive do not apply to engines placed on the market or put into service for the first time before 1 March 1996.
16 After that date and up to 30 June 2003, engines may be placed on the market or put into service for the first time if they comply with the Directive/Regulations or the GB statutory requirements (certification or approval arrangements in place on 23 March 1994.

17 After 30 June 2003 an engine cannot be placed on the market or put into service for the first time unless it complies with 94/9/EC as meeting the requirements of category M2 (as defined in the Directive).

18 Engines which were legally in service on 30 June 2003 may be repaired or overhauled and put back into service after 30 June 2003 without the need to comply with 94/9/EC providing no modifications are made which would require re-certification or a supplementary certificate to be obtained to cover the modifications.

19 To date, two notified bodies have been appointed for the purposes of 94/9/EC in GB, these are the HSE’s Mining Equipment Certification Service (MECS) and SIRA Certification Service Ltd.

**Repair of diesel engines**

20 Users are recommended to utilise the most appropriate repair facilities for any particular item of equipment, whether they be the facilities of the manufacturer or a suitably competent and equipped repairer.

21 The document recognises the necessity of a required level of competence for the repair of apparatus.

22 In the case of the repair or overhaul of apparatus which has been the subject of third party certification it may be necessary to clarify the position of the continued conformity of the apparatus with the certificate. In responding to requests for advice, the certifying authority/notified body may decide that only general certification advice can be given as the intellectual rights to the products do not reside with the certifying authority.

23 Assuming that repairs and overhauls are carried out using good engineering practices then;

a) if manufacturers’ specified parts or parts as specified in the certification/approval documentation are used in a repair or overhaul, then those aspects of the repair or overhaul may be presumed to be in conformity with the certificate/approval. Tests, detailed in BS 6680: 1985 or, if appropriate, Testing Memorandum TM12, may have to be repeated to verify this;

b) if repair or overhaul is carried out on the engine in accordance with details in the certification/approval documents, eg dimensions are within allowable tolerances, the engine may still conform with the certificate/approval;

c) if repair or overhaul is carried out on the engine in accordance with the relevant protection standards and subjected to the relevant tests, then, although not necessarily in accordance with (a) and (b) above, the engine is acceptable for re-use;

d) if other repair or modification techniques are to be used, then it will be necessary to seek authoritative advice, (eg from the manufacturer or the owner), regarding the suitability of the apparatus for continued use in underground workings susceptible to firedamp and/or combustible dust.
24 In considering the above options, users are strongly recommended to adopt (a) or (b) where it is possible to do so. Before any repair or overhaul work to (c) or (d) are undertaken the repairer will need to seek the written agreement of the user.

Statutory requirements/duties

25 The relevant statutory requirements for mines are the Health and Safety at Work etc Act 1974 and the Mines and Quarries (M & Q) Act 1954. Relevant regulations are made under these Acts include, the Provision and Use of Work Equipment Regulations 1992 (PUWER), the Supply of Machinery (Safety) Regulations 1992 and its amendments, the Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 1996 and the Electricity at Work Regulations 1989. The following references to certain statutory requirements are for guidance only and the reader’s attention is drawn to the complete requirements of the Act and relevant regulations.

Manufacturer duties

26 The manufacturer’s responsibilities under the HSW Act 1974 are stated in section 6 of the Act, in particular, section 6(1)(c) states:

“to take such steps as are necessary to secure that there will be available in connection with the use of an article at work adequate information about the use for which it is designed and has been tested, and about any conditions necessary to ensure that, when put to that use, it will be safe and without risks to health”.

27 It is therefore not acceptable to merely assume that adequate information is or can be so widely circulated that it is always available where and when it is needed. Specific steps must be taken to make it available. Sources of adequate information are users, manufacturers or, under certain circumstances, the certifying authorities.

28 The manufacturer will also need to take into account the Supply of Machinery (Safety) Regulations 1992, especially Schedule 4, and the Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 1996 (which implement the Flammable Atmospheres Directive 94/9/EC).

User duties

29 Apart from the need to comply with section 2 of the HSW Act 1974 (regarding safe maintenance of plant and systems by the employer), the user is also required to pay due regard to section 6 of the Act should they wish to undertake the repair or overhaul of the equipment themselves.

30 The Provision and Use of Work Equipment Regulations 1992 amplify and makes more explicit the general duties on employers, the self-employed and people in control to provide safe plant and equipment.

31 In particular, regulation 7 of the PUWER 1992 which states:

“Where the use of work equipment is likely to involve a specific risk to health or safety, every employer shall ensure that repairs, modifications, maintenance or servicing of that work equipment is restricted to those persons who have been specifically designated to perform operations of that description (whether or not also authorised to perform other operations)".
The employer shall ensure that the persons designated for the purposes of the above paragraph have received adequate training related to any operations in respect of which they have been so designated”.

32 The user will therefore need to ascertain that any repair organisation is competent to perform the repairs. This may be achieved by assessing that the repairer meets the relevant requirements of this guidance with particular reference to quality control, quality assurance, test facilities, requirements for the workshop equipment and competence of the persons directly involved in the repair and/or overhaul.

33 The user will also have the responsibility of checking that, in the case of a repair to a component part of an apparatus, the whole apparatus is safe before it is put to use.

34 In addition, the user will need to be aware of any changes in responsibility for health and safety if refurbishment and/or re-installation is to be carried out by a third party.

35 The user will also need to take into account section 83 of the M and Q Act 1954, The Supply of Machinery (Safety) Regulations 1992 and the regulations which implement the Flammable Atmospheres Directive 94/9/EC.

**Repairer duties**

36 The repairer’s legal responsibility is outlined in the generality of section 36 of the HSW Act 1974, which states:-

“Where the commission by any person of an offence under any of the relevant statutory provisions is due to the act or default of some other person, that other person shall be guilty of the offence, and a person may be charged with and convicted of the offence by virtue of this subsection whether or not proceedings are taken against the first-mentioned person”.

37 The repair organisation will therefore need to have adequate repair and overhaul facilities, utilise appropriate equipment and employ competent persons to carry out the required repairs, checks and tests, taking into account the specific type of protection, so as not to be accused of an offence under section 36.

**Guidance for the manufacturer**

**Documents**

38 The information which the manufacturer is requested to have available is specified in Schedule 3 of the Supply of Machinery (Safety) Regulations 1992, certificate/approval documents and other documents. This includes appropriate drawings, specifications, and other documents to allow the safe repair and/or overhaul.

**Repair and overhaul data**

39 The data available for the repair and/or overhaul will generally include, but need not be limited to:

a) technical specification;
b) performance and conditions of use;

c) dismantling and assembly instructions;

d) certification limitations where specified;

e) marking (including certification marking);

f) recommended methods of repair/overhaul for the apparatus.

Spare parts

40 The manufacturer’s list of spare parts will need to be included with the repair and/or overhaul data and it will identify those parts which are critical to meeting the requirements of the protection concept standard.

Guidance for the user

Certificates and approval documents

41 The certificate/approval and other related documents will normally have been obtained as part of the original purchase contract.

Records and work instructions

42 Records of any previous repairs, overhauls or modifications need to be kept by the user and made available to the repairer. It will be in the interests of the user that the repairer is notified, whenever possible, of the fault and/or nature of the work to be done.

43 Special requirements stipulated in the user’s specifications, and which are supplementary to the various standards, will need to be brought to the attention of the repairer.

44 The user will need to inform the repairer of any statutory requirement for compliance with certification.

Re-installation of repaired apparatus

45 Before the repaired engine is re-commissioned, the whole system, machine or vehicle to which it forms part needs to be checked to ensure that all hazards have been established and protected against.

46 Should it prove impractical to carry out certain tests (eg a flame-trap is removed from the engine and is taken off-site for repair) then, before putting the repaired component back into service, the user will need to ascertain the consequences of omitting such tests.

Repairs performed by the user

47 Where repairs are carried out by the user, then the guidance given at paragraph 56 applies to the user.
Guidance for the repairer

Certification/approval and standards

48 The repairer’s attention is directed at the need to be aware of, and to comply with, the relevant explosion protection standards and certification/approval requirements applicable to the engine to be repaired or overhauled.

Training

49 The repairer of the engine will need to ensure that those concerned with the repair and/or overhaul are properly trained, competent, and supervised on this type of work.

50 Such training will need to cover:

a) general principles of the type of protection and marking;

b) those aspects of equipment design which affect the protection concept;

c) certification/approval and standards;

d) identification of replacement parts or components authorised by the manufacturer;

e) particular techniques to be employed in repairs referred to in other parts of this guidance.

51 Appropriate refresher training will need to be given from time to time. It is recommended that intervals between training do not exceed 3 years.

Testing

52 This guidance document does not cover performance testing, following repair and overhaul, except where it may affect the explosion protection or exhaust emissions.

53 In the case of repairs to engines or components affecting the type of protection, the parts which have been repaired may need to be subjected to new routine verifications and tests in accordance with the relevant standard. The need for such tests and their nature will have to be agreed between the user and the repairer. Such tests need not be made by the repairer.

54 Should it prove impractical to carry out certain tests (e.g., a flame-trap is removed from the engine and is taken off-site for repair) then, before putting the repaired component back into service, the user will need to ascertain the consequences of omitting such tests.

55 Attention is drawn to section 40 of the Health and Safety at Work etc Act 1974 which states:-

“In any proceedings for an offence under any of the relevant statutory provisions consisting of a failure to comply with a duty or requirement to do something so far as is reasonably practicable, or to use the best practical means to do something, it shall be for the accused to prove (as the case may be) that it was not practicable or not reasonably practicable to do more than was in fact done to satisfy the duty or requirement, or that there was no better practical means than was in fact used to satisfy the duty or requirement.”
**Documentation**

56 The repairer will need to seek all necessary information/data from the manufacturer or user for the repair and/or overhaul of the engine (see paragraph 39). This may include information relating to previous repairs, overhauls or modifications. The repairer will need to have copies of the relevant explosion protection standards available.

57 Before repairs are undertaken, the repairer will need to produce a documented specific repair procedure indicating how the repair will be undertaken.

58 On completion of repairs, the repairer, who may also be the user, will need to provide the following details to allow the user’s maintenance records to be updated:

a) details of the fault detected;

b) full details of the repair and overhaul work;

c) list of replaced or reclaimed parts;

d) the results of all checks and tests.

**Spare parts**

**General**

59 It is recommended that repairers use the manufacturer’s spare parts for the overhaul and repair process.

60 Where the manufacturer’s spare parts or recommended spare parts are not used, testing may be required to verify that there is no lowering of the protection afforded.

**Sealed parts**

61 It is strongly recommended that parts which are required by the apparatus specification and certification/approval documents to be sealed, are replaced only by the particular spare part(s) detailed in the parts list.

62 Where a device is to prevent interference by third parties (anti-tamper security seals), these will need to be replaced as part of the repair. Fuel pumps which have been set and calibrated as part of the repair will need to incorporate such anti-tamper devices.

**Sparking**

63 Any evidence of unusual sparking identified by the repairer may need to be referred to the manufacturer and/or the user.

64 On dismantling rotating parts, if those parts show signs of abnormal frictional rubbing, this may need to be referred to the manufacturer and/or the user for advice.

**Identification of repaired and overhauled apparatus**

**General**

65 Marking needs to be legible and durable, taking into account the possible chemical corrosion.
Modular apparatus will need to be provided with marking on each repaired module.

It is recommended that the marking includes the following:

a) the relevant symbol (see paragraphs 73 and 74);

b) the name of the repairer or his/her registered trade mark;

c) the repairer’s reference number relating to the repair;

d) the date.

The marking will need to be on a plate (not aluminium or similar light metal), securely attached to the repaired apparatus without affecting the explosion protection.

If the apparatus has been the subject of previous repairs, the earlier plate detailing those repairs may be removed. In such cases a record will need to be made of all the markings on the earlier plate and passed to the user.

Repairer’s label

Apparatus which has been either overhauled or repaired will need to be marked to identify that an overhaul or repair has been performed. The marking is described in paragraphs 73 and 74. The manner of securing additional labels will need to avoid making holes into flameproof enclosures.

Apparatus which is subject to routine maintenance by the user is not required to have a repairer’s label fitted.

Fitting of the label indicates that the overhauler/repairer has assumed the responsibilities outlined in paragraph 36 for the particular work performed as part of the overhaul or repair.

Relevant labels

The following label designates that the whole of the apparatus is in full compliance with the standard and certificate/approval:
74 The following label designates that apparatus, or part of it, is in compliance with the standard, but not necessarily in compliance with the certificate/approval:

![Label Designation](image)

**Removal/addition of marking labels**

75 It may be necessary to amend, remove or supplement the existing label(s) in certain circumstances as follows:

a) If after repair or overhaul the whole of the apparatus still complies with the standard and certification/approval, the manufacturer’s certification/approval label will need to be retained and the repairer’s label bearing the symbol ‘R’ within a square added;

b) If the apparatus is changed during repair or overhaul so that it still complies with the standard but does not necessarily comply with the certificate or approval, the certification or approval label will need to be retained and the repairer’s label bearing the symbol ‘R’ within an inverted triangle added;

c) If after repair, overhaul or modification, the engine is changed so that it no longer conforms with the standard and certificate/approval (see Definitions and terms in paragraph 6), the certification/approval label will need to be removed unless a supplementary certificate or variation approval has been obtained as appropriate. The repairer will need to pass information to the user highlighting that the engine is no longer in a certified condition, no longer complies with a protection standard and limitations on further use of the equipment in hazardous zones may be necessary.

**Quality assurance surveillance**

76 Certification to BS EN ISO 9001 or 9002 1994, having a scope appropriate to the repair of engines, represents what is probably the best available means for a repairer of certified/approved equipment to provide assurance to the market. It needs to involve assessment by specialists with experience of the type of products involved, using an interpretation of the requirements which specifically addresses the particular problems encountered. The assessment and continued surveillance visits may need to include random product audits which, while being unable to be used in any ways as a guarantee of the product, are a searching test of the effectiveness of the system.
77 User representatives of the Deep Mined Coal IAC have agreed that repairers participating in a quality control scheme to BS EN ISO 9001 or 9002, adapted/tailored to suit the repair of engines will be given preference in the placing of repair contracts.

78 HSE's Electrical Equipment Certification Service (EECS) operate a voluntary scheme aimed specifically at organisations involved in repair and overhaul of certified products. The scheme is similar to the Conformity Assurance Programme (CAP) operated for manufacturers of certified equipment.

79 The CAP schedule does not include repair operations, so if a manufacturer holding such a licence wishes to be included in the repair scheme they would need to apply separately.

80 Details of documents published by HSE entitled Repair licence scheme guide and rules, Quality management system certification guide ad Quality assessment schedule for repair and overhaul of certified products are given in Annex A.

Reclamation procedures

General

81 This section deals only with the reclamation of parts which affect explosion protection or exhaust emissions (see paragraph 23). Reclamations not affecting the explosion protection do not need special attention other than the use of 'good engineering practice'.

Exclusions

82 Some component parts are considered not to be reclaimable and are therefore excluded from the scope of this document such as:

a) component parts made from glass, plastic or any material that is not dimensionally stable;

b) fasteners;

c) component parts eg some encapsulated assemblies, which have been stated by the manufacturer to be non-repairable.

Requirements

83 Any reclamation will need to be carried out by trained personnel, skilled in the process to be employed and using good engineering practices.

84 If any proprietary process is used, the instructions of the originator of such a process will need to be followed.

85 All reclamation will need to be properly documented and records retained. Such records will need to be provided to the user and will need to include:

a) identification of the component part;

b) method of reclamation;
c) detail of any dimensions which differ from those in relevant certification documents or the original dimensions of the component part;

d) the date;

e) names of the organisation carrying out the reclamation.

86 A reclamation procedure which would result in dimensions affecting explosion-protection integrity being different from those given in relevant certification documents may be permissible if such changed dimensions still meet the requirements of the relevant explosion-protection standard. In adopting such procedures care needs to be taken to ensure that the cumulative effects of engineering tolerances do not prejudice the safe running clearance of running parts, eg the air-gap between a fan and its housing.

87 In the event of any uncertainty regarding the permissibility, from an explosion-protection safety point of view, of an intended reclamation procedure, the advice of the manufacturer or where the manufacturer is no longer trading, the advice of the certifying authority, will need to be sought. It may also be necessary to carry out tests to verify that the reclamation procedure is acceptable.

88 If reclamations are contracted out by the repairer to a specialist company, such reclamation will need to be supervised by the repairer.

Acceptable/unacceptable reclamation procedures

89 The following clauses outline some of the reclamation procedures which may be applicable to explosion reciprocating internal combustion engines.

90 It will be the responsibility of the repairer to satisfy themselves, on the completion of reclamation, that the engine, component or part is in a serviceable condition.

Metal spraying
91 Metal spraying may be used to coat light metals, eg as defined in BS 6680: 1985. Otherwise, it is not recommended unless there is agreement between the user and repairer, the materials are metallurgically compatible and the parent metal is free from cracks or similar defect.

92 Similarly, it is not recommended when the extent of the wear or damage, plus the machining necessary to prepare the component part for reclamation, weakens the part beyond safe limits.

93 It is strongly recommended that any sprayed metal inlay is not taken into account when strength is considered.

94 Machining processes prior to the application of the metal spray may introduce stress raisers and will need to be taken into account, as they may further weaken the component.

95 Details of such procedures are given in BS 4761. See also BS 4495 and BS 4950 for other spraying processes.

Electro-plating
96 Electro-plating is not recommended for reclamation of electrical engines or parts of engines intended for use in coal mines.
Sleeving
97 It is recommended that this method be used only when the extent of the wear or damage, plus the machining necessary to prepare the part for reclamation, does not weaken the part beyond safe limits. It is also recommended that sleeving is not taken into account when strength is considered.

Brazing or welding (welding applies to both metallic and non-metallic parts)
98 Reclamation by brazing or welding may be appropriate if the technique employed ensures the correct penetration and fusion of braze or weld with parent material, resulting in adequate reinforcement, the prevention of distortion, the relief of stresses and the absence of blow-holes or significant cracks. It should be recognised that welding raises the temperature of the component to a high level and may cause fatigue cracks to propagate.

Metal stitching
99 Metal stitching is not recommended for the reclamation of engines or parts of engines intended for use in coal mines.

Threaded holes for fasteners
100 Threads which have been damaged beyond an acceptable extent may be reclaimed, depending upon the type of protection, by the following means:

a) oversize drilling, re-tapping and the fitting of a proprietary thread insert;
b) oversize drilling, plugging, re-drilling and re-tapping;
c) plug welding, re-drilling and tapping.

101 Drilling and re-tapping elsewhere on the flamepath or FLP flange is not recommended for the reclamation of flameproof engines intended for use in coal mines.

Re-machining
102 Re-machining worn or damaged surfaces may be appropriate if:

a) the component part is not weakened beyond safe limits;
b) the integrity of the enclosure is maintained;
c) the required surface finish is achieved.

Modifications
103 It is strongly recommended that no modification be made to the engine or its component parts unless that modification is permitted in the HSE approval (before 1 January 1995) or certificate (after 1 January 1995) or is agreed in writing by the manufacturer. Such modifications may require the issue of a supplementary certificate. Subsequent clauses of this document give detailed instructions regarding modifications in the context of different types of protection.

104 Where a modification is proposed which would result in the engine not conforming with the certification documents and the relevant type of protection standard, the user will need to be informed in writing that the apparatus will no longer be suitable for use in a mine susceptible to firedamp, and their written instructions obtained. If the modification described above is subsequently carried
out, following instruction from the user, the certification label will need to be removed (see paragraph 75).

**Temporary repairs**

105 Temporary repairs which adversely affect the explosion protection or exhaust emissions are not recommended for engines used in coal mines.

## Repair and overhaul of engines

### Enclosures

106 It is preferable to obtain new parts from the manufacturer. It is recommended that damaged parts are repaired only if the type of protection is preserved. Particular attention will need to be paid to the correct assembly of flameproof enclosures after repair or overhaul, in order to ensure that the flameproof joints comply with the requirements of the standard and where appropriate with the certification/approval documents. Where flameproof joints are not gasketed, they may be protected by the use of grease, non-setting sealing compound or non-hardening tape applied externally. Flamepaths could be impaired if they are painted with a hard setting paint or compound.

107 Where gaskets are fitted they will need to be of the same materials and dimensions as the original. Any proposed change will need to be referred to the apparatus manufacturer or, where the manufacturer is no longer trading, the certifying authority.

108 The drilling of additional holes into a flameproof enclosure is a modification and the manufacturer’s agreement will be needed.

109 Care needs to be taken when changing surface finish, paint etc, as this may affect the surface temperature of the enclosure.

110 Routine hydraulic pressure testing of the flameproof enclosure needs to be carried out to BS 6680: 1985 part 12.2 or to TM 12 paragraph 162, depending on the protection standard used at the time of original type testing.

### Cooling fans

111 Before an engine is put back into service, it is important to ensure that any ventilation holes are not blocked or damaged as to impair the passage of cooling air over the machine, and that any fan clearances are in compliance with the requirements of the apparatus standards, if appropriate. If a fan or fan cover is found to be damaged so as to require renewal, the replacement parts will need to be obtained from the manufacturer. If unobtainable, then they will need to be of the same dimensions and at least the same quality as the original parts. The design will need to take account of the requirements of the apparatus standard to avoid frictional sparking and electrostatic charging, and of the chemical environment in which the engine is used.

### Internal parts

112 Although the explosion protection of flameproof apparatus depends mainly upon the construction of the enclosure, some internal parts can influence its integrity and are mentioned in the protection concept standard. Where internal
parts can affect the protection (e.g., cause external temperatures to exceed those permitted by the standard), care is needed to ensure that any replacement parts do not change the original characteristics.

**Auxiliary equipment/devices**

113 If temperature sensors, oil level switches etc are fitted to the engine, these may be protected in accordance with the electrical protection standards (e.g., intrinsically safe circuits to EN 50020), and any repairs to these devices need to be in accordance with the appropriate electrical standard and any settings are checked to ensure they comply with the manufacturer’s specification.

**Light transmitting and plastics parts**

114 It is strongly recommended that repairing or re-cementing light transmitting parts is not undertaken, and only complete replacement assemblies, as specified by the manufacturer, be used. Light transmitting or other parts made from plastics are not normally cleaned with solvents. Household detergents are recommended for this purpose.

**Batteries/cells**

115 Starter batteries or cells are rarely used for starting flameproof engines intended for use in Great Britain. Where such batteries are used they will need to be explosion protected in accordance with the electrical protection standard EN 50019.

**Reclamation of flameproof engine parts**

**Enclosures**

**General**

116 It is recommended that reclaimed component parts of flameproof enclosures, are re-used only if they are capable of passing the routine verification tests described in the protection standard. It may not always be necessary to perform the tests if it is obvious that the explosion protection (i.e., strength of the enclosure and inability to transmit flame) has not been impaired by the reclamation.

117 Whether or not the routine verification tests are performed after a reclamation process will need to be the subject of agreement between the user and the repairer as part of the repair contract, e.g., routine pressure tests may be waived if a full metallurgical examination is performed during reclamation.

118 It may be necessary to perform an over-pressure test on reclaimed apparatus if it is obvious that the strength of the enclosure has been affected by the reclamation process, e.g., reclamation of a rotating shaft may not affect the strength of the flameproof enclosure, whereas reclamation of a cover may affect the strength of the flameproof enclosure.

119 Damage to components which are not an integral part of the flameproof enclosure, e.g., fixing lugs, may be repaired by welding but care must be taken to
ensure that the integrity and stability of the apparatus is not impaired. It is particularly important to check that any cracks being repaired do not extend into the flameproof enclosure.

**Flameproof joints (flamepaths)**

120 It is recommended that damaged or corroded flameproof joint faces are only machined if the resultant joint gap, flange dimensions, flamepaths and surface finishes are not affected in such a way that they contravene the protection standard and, where appropriate, the certification documents. Before commencing such work it is advisable to consult with the manufacturer.

a) In the case of flanged joints: welding, and re-machining flanged joint faces may be permissible, having due regard to the limitations of the technique (see paragraph 98-102).

b) In the case of spigotted/cylindrical joints: machining the male part will require addition of metal to and machining of the female part (or vice versa), thus ensuring that the flamepath dimensions comply with the protection standard, and where appropriate the certification documents. If only one part is damaged, that part can be restored to its original dimensions by the addition of metal and re-machining. The addition of metal may be by sleeving or welding.

c) In the case of threaded joints:

i) it is not recommended that damaged male threaded part of entries to the flameproof enclosure be reclaimed, new components will need to be used. Damaged female threads forming part of the flameproof enclosure maybe repaired providing they meet the required fit and thread engagement;

ii) reclamation of the threaded parts of screwed covers and of the associated housings may be impracticable and is not recommended.

**Threaded holes for fasteners**

121 Reclamation of damaged threaded holes may be carried out using the techniques described in paragraph 100.

**Shafts and housings**

122 Shafts and bearing housings, including flameproof joints, may be reclaimed, eg by the use of welding or sleeving techniques. Any subsequent machining will need to be to the flameproof dimensions as specified in the apparatus standard and/or the certification documents, as appropriate. Welding may be appropriate having due regard to the limitations of the technique (see paragraph 98).

**Emissions**

123 Following any engine repair or overhaul the emission measures referred to in BS 6680: 1985 section 6.4, for the engine ingesting ambient air, will need to be repeated where it is possible to do so. The values quoted in BS 6680: 1985 are 0.12% CO and 0.10% by NOx by volume.

**Safety requirements**

124 Repairers will also need to take account of the remainder of B.3.4 of BS 6680 or TM 12 if appropriate, with regard to the testing of safety devices fitted to shut down the engine if abnormal circumstances occur.
**Fuel systems**

125 The repairer needs to take account of section 8 of BS 6680 or TM 12 if appropriate, regarding fuel systems. In particular, fuel pumps will need to be calibrated to ensure emission levels are no greater than those described in paragraph 123.

**Modifications**

**Enclosures**

126 Modifications which may affect the explosion protection of the apparatus or the enclosure will need to be referred to the original manufacturer, certificate holder or the certifying authority for advice.
Annex A: Relevant Legislation/Standards/Documents

Legislation

The Health and Safety at Work etc Act 1974 (Chapter 37)

The Mines and Quarries Act 1954 (Chapter 70) and Regulations made under this Act

The Supply of Machinery (Safety) Regulations 1992 (SI 1992 No. 3073)

The Provision and Use of Work Equipment Regulations 1992 (SI 1992 No. 2932)


Standards

BS 6680: 1985 Flameproof Diesel Engines

BS 5781 Measurement and Calibration Systems

EN 50018: 1977 Flameproof Enclosure ‘d’

EN 50019: 1977 Increased Safety ‘e’

EN 50020: 1977 Intrinsic Safety ‘i’

BS EN 90002 Quality Systems

BS 4683 Part 2: 1971 Construction and testing of flameproof enclosures of electrical apparatus

BS 4761 Specification for sprayed unfused metal coatings for engineering purposes

BS 4495 Recommendations for the flame spraying of ceramic and cermet coatings

BS 4950 Sprayed and fused metal coatings for engineering purposes

Other documents

HSE TM 12 Testing Memorandum No. 12
(Available from HSE’s Mines Inspectorate)

HSE EECS Quality assessment schedule for repair and overhaul of certified products

HSE EECS Quality management system certification guide

HSE EECS Repair licence scheme guide and rules
(All three documents are available free of charge, from the Electrical Equipment Certification Service (EECS) at Harpur Hill, Buxton, Telephone: 01298 28000)
Annex B: Members of the IAC RIC Electrical Working Group

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Annex C: Typical 150 HP engine