I.L.O. Codes of Practice

Prevention of Accidents Due to Electricity Underground in Coal Mines

INTERNATIONAL LABOUR OFFICE
GENEVA
1959

PRINTED BY "LA TRIBUNE DE GENÈVE", GENEVA (SWITZERLAND)

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INTRODUCTION

For many years the International Labour Office has been engaged in extensive activities with the object of promoting higher standards of safety and health in coal mines. A *Model Code of Safety Regulations for Underground Work in Coal Mines for the Guidance of Governments and of the Coal-Mining Industry*[1] was adopted by a Tripartite Technical Conference in 1949; meetings of experts on the prevention and suppression of dust in mining, tunnelling and quarrying were held in 1952 and 1955; a substantial study in two volumes, entitled *Safety in Coal Mines*[2], was published in 1953 and 1955; and the subject was discussed in 1956 at the Sixth Session of the Coal Mines Committee. In spite of all the national and international efforts made, however, the accident rates in coal mines remain very high and the world is from time to time shocked by disasters such as the one that occurred on 8 August 1956 in the Charleroi coalfield of Belgium, where 262 miners lost their lives underground as the result of an outbreak of fire in the Bois du Cazier mine at Marcinelle.

The Marcinelle disaster undoubtedly intensified interest in all countries in the prevention of coal-mining accidents and has in particular given urgency to the problem of preventing major disasters which may cost the lives of large numbers of miners. One sign of this intensification of interest can be seen in the convening by the High Authority of the European Coal and Steel Community of a conference on safety in coal mines, which opened in September 1956 and concluded its work in February 1957.

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[1] Geneva, I.L.O., 1950.

[2] Studies and Reports, New Series, No. 33 (2 vols.).

The disaster also stimulated the I.L.O. to accelerate its plans for further action designed to help reduce accident risks in coal mines. The experience acquired in the compilation of the Model Code and *Safety in Coal Mines* showed that the subject was vast and at the same time exceedingly complex. It therefore seemed appropriate that the Office should deal successively with selected branches of the subject rather than endeavour to cover it all again at one and the same time.

After consulting a number of experts, the Office came to the conclusion that the next branches of the subject to be selected for treatment should be mine fires and electricity underground. Research undertaken by the I. L. O. had shown that fire and electricity have been factors in a substantial proportion of coal-mine disasters in recent years.

In November 1956 the Director-General proposed to the Governing Body of the International Labour Office that a number of suitably qualified experts should meet to make recommendations concerning the prevention of accidents in coal mines caused by fire and electricity underground. He suggested that the agenda of the meeting should be as follows:

(1) Mine Fires (risks, technical preventive measures, fire-protection organisation at the mine, fire-fighting equipment, procedure in case of fire, rescue organisation, etc.).

(2) Electricity Underground (risks, authorisation procedure for the use of electrical equipment, technical preventive measures applicable to all mines, additional technical preventive measures required in fiery and dusty mines, electrical safety organisation at the mine, supervision, operation and maintenance of electrical equipment, etc.).

The Governing Body accepted the Director-General's proposals and at its session of May-June 1957 fixed the date and composition of the meeting.

The meeting was held at the International Labour Office, Geneva, from 2 to 18 October 1957 and was attended by the following experts:

Mr. E. BERTIEAUX (France), former Director of the Central Rescue Station of the Nord and Pas-de-Calais Coalfields, Douai.

Mr. C. BIHL (France), Director, Lorraine Coalfield, Merlebach.

Mr. W. BLUME (Federal Republic of Germany), Miners' Trade Union, Bochum.

Mr. J. BLUNT (United Kingdom), Divisional Safety Engineer, North-Eastern Division, National Coal Board, Doncaster.

Mr. I. V. BOBROV (U.S.S.R.), Director of the Makeevka Research Institute for Safety in Coal Mining, Makeevka.

Mr. J. COWAN (United Kingdom), Principal Electrical Inspector of Mines, Safety and Health Division, Ministry of Power, London.

Mr. E. DEMELENNE (Belgium), Divisional Director, Mining Administration, Liège.

Mr. A. DENIS (Belgium), General Manager, S.A. des Charbonnages de Monceau-Fontaine, Roux.

Mr. C. R. DROUARD (France), Principal Inspector of Mines, Paris.

Mr. W. E. FELEGY (United States), Sub-District Supervisor, U.S. Bureau of Mines, San Francisco.

Mr. S. FLOWERS (Australia), Senior District Mining Engineer of the Joint Coal Board, Newcastle.

Mr. G. GECK (Federal Republic of Germany), Ministerial Counsellor, Mining Section, Federal Ministry of Economic Affairs, Bonn.

Mr. P. GÉRARD (Belgium), Divisional Director, Mining Administration, Hasselt.

Mr. T. L. GIBBS (Union of South Africa), Deputy Government Mining Engineer, Department of Mines, Johannesburg.

Mr. C. GRARD (France), Chief Underground Engineer, Nord and Pas-de-Calais Coalfields, Lens.

Mr. S. S. GREWAL (India), Chief Inspector of Mines in India, Department of Mines, Dhanbad.

Mr. F. HÜLSBERG (Federal Republic of Germany), Chief of the Electrotechnical Department of the Mining Testing Station, Dortmund-Derne.

Mr. E. JONES (United Kingdom), Vice-President, National Union of Mineworkers, Wrexham.

Mr. D. J. KNUTTEL (Netherlands), Inspector of Mines, State Inspectorate of Mines, Heerlen.

Mr. S. KURACHI (Japan), Assistant Chief of the Coal Mine Section of the Mine Safety Bureau, Ministry of International Trade and Industry, Tokyo.

Mr. M. MARRA (Italy), Superintending Mining Engineer, Directorate General of Mines, Ministry of Industry and Trade, Rome.

Mr. S. OSAGAWA (Japan), Manager, Mine Safety Inspection Division, Yamano Coal Mine, Mitsui Mining Co. Ltd., Fukuoka-Ken.

Mr. A. S. STUGAREV (U.S.S.R.), Chairman of the Committee of the U.S.S.R. Council of Ministers for Safety Inspection in Industry and Mines, Moscow.

Mr. W. H. TOMLINSON (United States), Training Administration Officer, United States Bureau of Mines, Pittsburgh.

Mr. J. WRONSKI (Poland), Chief of Service, Institute of Mining Safety, Mikolow.

Mr. Bertieaux was accompanied by Mr. M. AUSSEIL, Chief Engineer of the Aquitaine Coalfield, Decazeville; Mr. Bihl was accompanied by Mr. CŒUILLET, Principal Engineer,

Charbonnages de France, Paris, and by Mr. BRONNER, Engineer attached to the General Management of the Lorraine Coalfield, Merlebach; Mr. Jones was accompanied by Mr. L. JAMES, Head of the Safety Department, National Union of Mineworkers, Ebbw Vale; Mr. Knuttel was accompanied by Mr. P. DE ZEE, Head of the Safety Department of the State Mines, Heerlen, and by Mr. H. L. OMERS, Chief Mining Engineer, Orange Nassau Mine, Chief of the Electrical Service, Heerlen; and Mr. WRONSKI was accompanied by Mr. H. BYSTRON, Chief of the Mine Ventilation Service, Institute of Mining Safety, Mikolow.

The Governing Body had also authorised the Director-General to invite the High Authority of the European Coal and Steel Community, the Miners' International Federation and the International Electrotechnical Commission to be represented at the meeting by observers. The High Authority was represented by Mr. M. GERLACHE, Division of Labour Problems, Luxembourg; the Miners' International Federation by Mr. N. DETHIER, General Secretary, Federation of Belgian Mineworkers' Unions, Brussels; and the International Electrotechnical Commission by Mr. J. COWAN, one of the experts taking part in the meeting.

Mr. Drouard was unanimously elected Chairman of the Meeting.

As a possible basis for discussion the Office had prepared two preliminary draft codes of practice, the first relating to the prevention of accidents caused by fires and the second to the prevention of accidents caused by electricity underground in coal mines.

These preliminary drafts had been compiled from the *Model Code of Safety Regulations for Underground Work in Coal Mines*, from the recommendations of the Coal-Mining Safety Conference of the European Coal and Steel Community held at Luxembourg in 1956-57 and from numerous national regulations, standards, instructions, codes of practice, manuals, research reports, safety pamphlets, etc.

The Office had endeavoured to confine the provisions of the drafts to those that were either already widely applied in coal-mining countries or appeared to merit consideration by an international meeting of experts. The meeting set up two groups, one for fires and the other for electricity.

The Electricity Group was composed of Messrs. Bihl, Bobrov, Cowan, Demelenne, Denis, Drouard, Felegy, Gibbs, Hülsberg, Osagawa and Wronski, accompanied by Messrs. Bronner, Cœuillet and Omers. Mr. Drouard was elected Chairman of the group and Mr. Cowan Reporter. A drafting committee was appointed, consisting of Messrs. Cowan, Drouard, Felegy and Gibbs, assisted by Messrs. Bronner and Cœuillet.

The preliminary draft relating to the prevention of accidents due to electricity underground in coal mines was accepted as the basis for discussion.

The Office had not included in the draft detailed provisions concerning constructional requirements to be satisfied by electrical equipment. Such requirements are dealt with in great detail in some national regulations and in numerous national standards, and also in the international standards of the International Electrotechnical Commission. Hence it seemed preferable that the code of practice should confine itself as regards construction to references to these regulations and standards. However, in some cases the experts wished to draw the attention of manufacturers to certain requirements to be satisfied by electrical equipment used underground in coal mines. For the rest, they suggested that attention should be paid in the various countries to the relevant specifications or recommendations of the International Electrotechnical Commission relating to electrical apparatus of the types used underground in coal mines.

In addition to omitting constructional requirements, the Office had also considered it inadvisable to deal with electricity not provided by the mine supply network on

the ground that the inclusion of provisions concerning matters such as exploders, shotfiring lines, electric cap lamps and batteries would make the code of practice less homogeneous and at the same time add substantially to its scope and size.

The text of the code of practice as revised by the Group was discussed, amended and finally adopted by the full meeting. The present text is the one finally adopted with slight editorial amendments, introduced by the Office.

Many provisions of the code of practice prepared by the experts differ in some degree from the corresponding provisions of the *Model Code of Safety Regulations for Underground Work in Coal Mines*. The experts were informed that the Governing Body of the I.L.O. had recently recognised the desirability of amending those provisions of the Model Code that are no longer in keeping with the best practices of the present time. They considered that revision was necessary in so far as concerns electricity, and that their recommendations would provide a very useful basis for the experts who would subsequently be entrusted with the revision of the Model Code.

The meeting endeavoured to keep constantly in mind that coal-mining techniques are steadily progressing and that in drafting the provisions of a code of practice allowance has to be made both for existing conditions and for conditions that, it may be expected or hoped, will exist in the future. Consequently the experts set out to frame the code of practice in such a way as to ensure a maximum of protection under existing conditions without at the same time hindering technical progress.

The experts endorsed the view of the Office that the code of practice, although couched in the language of sets of rules, has no binding force whatsoever, but is merely a body of practical advice for the guidance of all those who, in any capacity, have some responsibility for safety in coal mines. The value of the code lies in the fact that it is the

work of a group of experts and embodies the knowledge and experience of many countries.

The experts realised that not all the provisions can be applied as they stand to all the coal mines of every country; some of them will require adaptation to national or local conditions. They further realised that it would not be practicable to apply some of the provisions to existing mines and equipment, but they were satisfied that subject to the necessary adaptation the code as a whole might usefully serve as a guide to those planning new mines and designing new equipment and also for the alteration or extension of existing mines or equipment.

The experts hoped that this code of practice will be of value to all countries, and particularly to those which are being rapidly industrialised but have not yet had sufficient experience in the prevention of accidents due to electricity underground in coal mines.

They consequently recommended that the code should be widely distributed in an appropriate form in coal-producing countries so as to reach all those who have a part to play in combating mining accidents. They are convinced that if the code is everywhere followed as a guide, the toll taken by accidents due to electricity underground in the coal mines of the world can be appreciably reduced.

PART I

PROVISIONS APPLICABLE TO ALL COAL MINES

SECTION 1. GENERAL PROVISIONS

Definitions

1. In this Code of Practice—

(a) the term " competent authority " means a minister, government department or other public authority having power to issue or approve regulations or instructions in respect of safety in the use of electricity underground in coal mines, or an authority entrusted with the enforcement of such regulations or instructions;

(b) the term " manager " means a duly qualified and duly appointed person legally responsible for the technical direction of the mine, whether he is the mine operator or a person appointed by him;

(c) the term " hand-held apparatus " means apparatus that can be held in the hands while connected to a supply of electricity, e.g. hand-drilling machine;

(d) the term " portable apparatus " means apparatus that can move while connected to a supply of electricity, e.g. coal cutter;

(e) the term " semi-stationary apparatus " means apparatus that is moved often but only when disconnected from a supply of electricity, e.g. scraper conveyor driving head at a face;

(f) the term " stationary apparatus " means apparatus that is seldom if ever moved and only when disconnected from the supply of electricity, e.g. main transformer or main roadway conveyor driving head;

(g) the term " voltage " means—

(i) the voltage between the two poles of the system in the case of a direct current system;

(ii) the root mean square voltage between the two poles of a single-phase alternating current system;

(iii) the root mean square voltage between any two phases of a polyphase alternating current system.

Procedure for Authorisation of Installation of Electrical Equipment

General Provision.

2. Electrical equipment should only be installed in any mine or part of a mine in so far as is allowed under the regulations in force at the time and in the conditions laid down therein.

Notification.

3. Notices should be sent by the manager to the competent authority of the intention to introduce or reintroduce electrical energy into any mine or into any district in any mine.

Plans.

4. A scale plan periodically brought up to date should be kept in the office at the mine showing the position and essential characteristics of main stationary electrical apparatus and cables.

5. A wiring plan of the associated equipment should be kept in electrical equipment rooms.

Registers.

6. The manager should appoint a qualified person to keep at the mine a register (electricity register) in a form to be

specified by the competent authority and in which should be entered the essential particulars of all statutory examinations, inspections and tests carried out and such other particulars as may be required by the competent authority.

Reporting of Accidents Involving Personal Injury and of Dangerous Occurrences

7. (1) The occurrence of any accident involving personal injury or of any dangerous occurrence such as serious breakdown of or damage to apparatus should be promptly reported to a supervisory official.

(2) The manager should have all personal accidents and dangerous occurrences investigated and take adequate measures to prevent recurrences.

8. The manager should send without delay to the competent authority in the form and subject to the conditions prescribed by that authority—

(a) notice of any accident due to the use of electricity that results in loss of life or serious personal injury or that may provide useful information; and

(b) notice of any dangerous occurrence, such as ignition of firedamp or of coal dust or any outbreak of fire, due to the use of electricity.

9. The competent authority should undertake an investigation into the causes and circumstances of any fatal or serious accident, and of any dangerous occurrence of a particularly serious character, with a view to obtaining any information useful for preventing its recurrence.

Notices and Signs

10. The following notices should be kept exhibited at suitable places:

(a) a notice prohibiting unauthorised persons from entering electrical equipment rooms;

(b) a notice prohibiting unauthorised persons from handling or interfering with electrical apparatus;

(c) a notice containing directions as to procedure in case of fire;

(d) a notice containing directions as to the rescue of persons in contact with live conductors and the restoration of persons suffering from electric shock; and

(e) a notice specifying the person to be notified in case of electrical accident or dangerous occurrence, and indicating how to communicate with him.

11. At all places where contact with or proximity to electric equipment can cause danger, suitable warnings should be placed.

12. All notices and warnings displayed should be of durable material, legible, posted at conspicuous places and maintained in good condition.

13. The text and layout of placards, notices and signs used for identical purposes should be uniform.

Rescue and First Aid

14. Appropriate equipment for releasing persons from live apparatus should be readily available and well maintained at designated and easily accessible places in the neighbourhood of apparatus the voltage of which exceeds 1,100 V: Provided that this provision need not apply to metal-clad or firedamp-proof apparatus.

15. The greatest possible number of persons, including all supervisors and electricians, should be adequately trained in the manual application of artificial respiration to persons suffering from electric shock, and in particular should be aware of the necessity for immediate and continued application.

SECTION 2. INSTALLATION

General Provisions

16. All parts of the electrical installation should—

(a) be of a standard of construction not lower from the safety point of view than national or international standard specifications approved or accepted by the competent authority;

(b) be of adequate size and characteristics for the work they may be called upon to do;

(c) be so constructed, installed and maintained as to prevent danger of fire, external explosion and electric shock;

(d) be of adequate mechanical strength to withstand working conditions underground;

(e) be not liable to be damaged by water, dust or electrical, thermal or chemical action to which they may be subjected; and

(f) be efficiently insulated or have all bare live parts enclosed or otherwise protected.

Personal Protective Equipment.

17. Personal protective equipment such as rubber gloves and rubber boots should not be considered as providing adequate protection against the risk of electric shock.

Identification.

18. Electrical equipment should bear the essential identification marks and particulars for its use.

Existing Installations.

19. New regulations issued by the competent authority should specify to what extent and after what reasonable period they will apply to existing installations and to alterations and extensions of such installations.

Voltage Limitation.

20. (1) The following nominal voltages for the supply of electrical apparatus should not be exceeded:

Stationary apparatus	12,000 V
Semi-stationary apparatus	7,200 V
Portable apparatus (excluding that referred to below)	1,100 V
Electric trolley haulage	650 V
Hand-held apparatus, lighting apparatus (excluding hand lamps), and signalling apparatus with insulated wires	300 V
Telephone systems	65 V
Signalling apparatus with bare wires and hand lamps	42 V

(2) Voltages exceeding 1,100 V should only be used in a shaft or a roadway.

(3) Voltages exceeding 7,200 V should be used only in a shaft or the vicinity of a shaft.

Protection of Lower-Voltage Systems against Higher Voltage.

21. (1) In any transformer precautions should be taken to prevent or eliminate in the lower-voltage system any over-voltage which might be caused by leakage or induction from the higher-voltage system.

(2) For this purpose one or more of the following methods should be used:

(a) (i) permanent earthing of a point of the lower-voltage system;

(ii) automatic earthing, as long as the fault persists, of the neutral point of the lower-voltage system by means of a suitable device;

(b) earthing of a metal body inserted between the primary and secondary windings of the transformer;

(c) automatic cutting-off of the supply of electricity to the transformer when an overvoltage occurs in the lower-voltage system;

(d) any other suitable method.

Protection against Accidental Contacts.

22. Where the voltage exceeds 42 V, except in an intrinsically safe circuit, accidental contact with live parts of an installation should be prevented by—

(a) placing them out of reach;

(b) protective barriers;

(c) enclosure; or

(d) insulation.

23. (1) Covers, protective mesh and housings should be made of incombustible material, possess adequate mechanical strength and be reliably secured.

(2) The size of the openings of protective mesh or wire netting should be determined in relation to the distance to the nearest live parts.

Protection against Overloads and Short-Circuits.

24. The devices used to provide protection against overloads and short-circuits should be installed at the origin of supply conductors.

25. In case of a short-circuit in any circuit whatsoever the supply of electricity should be cut off automatically as soon as practicable by means of automatic circuit-breakers or fuses of sufficient breaking capacity, taking account of the most unfavourable conditions that may occur and the selectivity of tripping.

26. Automatic circuit-breakers used to provide protection against short-circuits should be of the locked-out type unless they are—

(a) accessible only to authorised persons, in which case the cause of the tripping should be apparent; or

(b) used in series with fuses and special precautions are taken.

27. (1) Automatic overload protection devices should be designed to follow as far as practicable the thermal variation of the parts to be protected closely enough to ensure that the supply of electricity is cut off before the parts reach a dangerous temperature.

(2) All apparatus and conductors should be constructed, installed, maintained and supplied in such a way that the maximum allowable temperature is not exceeded while they are in operation.

Protection against Fire.

28. In addition to the measures for the prevention, detection and fighting of fires recommended in the code of practice entitled *Prevention of Accidents Due to Fires Underground in Coal Mines* [1], the measures recommended in paragraphs 29-32 below should be taken in respect of electrical installations.

29. As far as practicable, combustible material should not be used in the construction of any room or recess containing electrical apparatus.

30. No flammable material should be stored in rooms, recesses or compartments containing electrical apparatus other than telephones, lighting apparatus or firedamp-proof apparatus.

31. Adequate fire-extinguishing equipment suitable for use on live parts should be kept ready for immediate use in or near any room, recess or compartment contai ing such parts.

[1] Geneva, I.L.O., 1959.

32. On the occurrence of a fire caused by any electrical apparatus or a fire liable to affect any electrical installation—

(a) the supply of electricity should be cut off from such apparatus or installation as soon as practicable; and

(b) the fire should be attacked as soon as possible and reported to the nearest available supervisor.

Lightning Protection.

33. Where necessary suitable lightning arresters should be installed on the surface of the mine to protect the installation below ground from abnormal voltage due to atmospheric electricity.

Leakage Protection.

34. (1) In alternating current systems of which the neutral point is earthed and the voltage exceeds 300 V effective means should be provided for cutting off the supply of electricity automatically from the circuit when the leakage current to earth exceeds either *(a)* 15 per cent. of the rated current for that circuit, or *(b)* 5 A.

(2) In alternating current systems of which the neutral point is insulated and the voltage exceeds 300 V effective devices should be provided to ensure—

(a) the cutting off of the supply of electricity automatically from the circuit if a dangerous single-phase fault occurs, and in any case before the resistance of this fault drops to zero; or

(b) the continuous monitoring of the over-all insulation resistance of the system by an apparatus that is insensitive to capacitative currents of the system, provided this device affords adequate safety and, in particular, the flexible cables supplying the portable apparatus are suitably protected.

35. Any earth-leakage protective device should be so designed that its operation can be checked at least partially.

Ventilation.

36. All places where apparatus is installed should be adequately ventilated in order to ensure proper cooling of the apparatus.

Cutting Off Power on Surface.

37. (1) Main switchgear for cutting off the supply of electricity from all underground installations should be installed on the surface.

(2) The switchgear should be accessible only to authorised persons.

(3) During the time any conductor is live a competent person authorised to operate the switchgear should be constantly available close at hand.

Cutting Off Power Underground.

38. Efficient means should be provided to cut off the supply of electricity at the origin of every circuit.

Working Space.

39. Electrical apparatus should be so installed that it can be easily and safely inspected, maintained and operated.

Means of Communication.

40. (1) Important substations underground should be connected, by telephone or equivalent means of communication, to the main switch station on the surface, possibly through the main switch station underground.

(2) They should be connected together only through the main switch station.

Earthing

General Provisions.

41. In the case of apparatus where the voltage exceeds 42 V (or 65 V for telephones) the following should be earthed:

(a) armouring and metallic coverings of cables;

(b) external metallic parts of electrical apparatus which are not normally live; and

(c) metallic parts in the immediate vicinity of live conductors.

42. Earthing systems should be so installed that no dangerous voltage can arise between earthed parts and the earth.

43. Earthing should be ensured by one or more of the following:

(a) conductive sheaths or armourings of cables;

(b) special conductors forming parts of cables; or

(c) visible outside conductors.

44. All parts of earthing systems should—

(a) have perfect electrical continuity;

(b) be efficiently connected electrically to earth by means of suitable earth electrodes or by any other equivalent means;

(c) have adequate mechanical strength; and

(d) be properly maintained and periodically checked.

45. (1) The metal parts of electrical installations which require to be earthed should be provided with clearly visible earthing terminals which permit a reliable connection with the earthing conductor.

(2) Whenever an apparatus is equipped with more than one earthing terminal perfect electrical continuity should be ensured between these terminals.

Earthing Conductors.

46. Earthing conductors, and particularly their attachments and connections to earthing terminals, should be protected against corrosion where necessary.

47. Except for testing purposes no switch, fuse, circuit-breaker or other circuit-opening device should be placed in any earthing conductor.

48. Earthing conductors should have a total conductance equal to at least half that of the largest current-carrying conductor in the circuit.

49. All connections in earthing conductors should be carefully made, using efficient methods.

50. Water pipes, air pipes and haulage-track rails, except electric-trolley haulage rails used as return conductors, should not be used as earthing conductors, but should be earthed if there is risk of their becoming live.

Earth Electrodes.

51. (1) Earth electrodes should be so constructed that their resistance to earth does not exceed 5 ohms.

(2) The underground system should be connected to surface electrodes if the resistance to earth of underground electrodes exceeds 5 ohms.

52. Earth electrodes at the surface of the mine should be separate and at a safe distance from the earth electrodes of lightning rods.

Insulation

53. Wood, slate or marble, unless carefully chosen, treated, protected against moisture or immersed in a dielectric, should not be used as supports for bare current-carrying parts.

54. Circuit-breakers should be housed in strong casings to prevent persons coming into contact with a live part during operation.

Electrical Equipment Rooms

General Provisions.

55. The location, construction and installation of every room, recess or compartment containing electrical apparatus should be such as to ensure the best practicable protection against water, falls of ground and ground movement.

56. (1) Large electrical equipment rooms, such as pump rooms and main distribution stations, should have at least two separate and easily accessible ways of escape.

(2) The doors, if any, of these rooms should—

(a) open outward;

(b) be easy to open at all times from the inside; and

(c) be openable from the outside only with a special key.

(3) If the electrical equipment housed in these rooms contains considerable quantities of combustible oil, the rooms should be so laid out that in case of fire smoke cannot escape to the workings.

Battery Charging Underground.

57. Batteries should not be charged underground except in rooms or places equipped for the purpose.

58. (1) Battery-charging rooms should be well ventilated by a split of air which should pass directly into a main return airway.

(2) Batteries should always be on the return side of the electrical equipment installed in the charging room.

59. Precautions should be taken to protect persons against injury from electrolyte.

60. Electrical lighting equipment in battery-charging rooms should be of a type approved for this purpose by the competent authority.

Electrical Equipment

General Provisions.

61. In electrical installations precautions should be taken to protect a lower-voltage system from overvoltage from a higher-voltage system.

62. New electrical apparatus which is non-arcing in normal operation should as far as practicable use only incombustible dielectrics which are physically and chemically stable.

63. New electrical apparatus which is arcing in normal operation and which contains a combustible dielectric liquid should be used only if its designed content of such liquid is low.

64. (1) Whenever the use of apparatus containing large quantities of combustible dielectric liquid cannot be avoided such apparatus should—

(a) either be very strongly constructed to avoid leakage of dielectric and be used only where it may be permitted by the regulations issued by the competent authority; or

(b) be installed in a fireproof room or compartment equipped with—

(i) tightly closing fireproof doors;

(ii) suitable fire-extinguishing equipment; and

(iii) a sump large enough to collect and entrap all the dielectric liquid.

(2) The ventilation of these rooms should be automatically diverted or cut off as soon as fire breaks out in the rooms.

65. Apparatus containing combustible dielectric liquid and not placed in rooms should be so constructed and installed that even in case of a dangerous occurrence there will be no emission of combustion vapours or smoke.

66. Apparatus which contains combustible dielectric liquid and which is non-arcing in normal operation should

be equipped with a protective device to cut off its supply of electricity as soon as a defect occurs that may result in abnormal heating.

67. Combustible dielectric liquids should conform to specifications laid down in national regulations or standards.

68. In apparatus containing a dielectric in liquid or powder form it should be possible to ascertain the level of the dielectric from outside the apparatus, and the level should be checked frequently.

69. Interlocks should not be roughly treated and should be frequently inspected to detect broken or bent parts.

Transformers.

70. (1) Transformers should be protected against overload, short-circuits and intermixing of voltages and be adequately cooled.

(2) Protection against overload should, as a rule, be placed on the service side.

71. Transformers for portable electric apparatus should—

(a) be of the double-wound type; and

(b) be provided with a protective device against intermixing of voltages as indicated in paragraph 21 (2).

Distribution Switchgear.

72. Distribution switchgear should be placed in closed cubicles or boxes accessible only to authorised persons.

73. Distribution switchgear should be provided with protective devices against overloads, short-circuits and faults to earth, and, if no hazard can result, with no-volt protection.

74. Earthing conductors in cubicles or boxes should be clearly recognisable either by their colour or by some other means.

75. Conductors carrying different voltages and enclosed in the same sheath should be clearly recognisable.

76. It should be possible to isolate the distribution switchgear by a suitable circuit-breaking device.

77. The placing of extraneous articles on, or in the immediate vicinity of, distribution switchgear should be prohibited.

78. The clearances and leakage paths between live parts and the enclosure should be adequate to prevent damage to the enclosure.

79. In the case of ring mains, switchboard panels and cable inlets should be clearly marked to indicate the additional danger.

Circuit-Breakers.

80. Circuit-breakers should—

(a) be of adequate breaking and making capacities to perform their normal function; and

(b) have their essential characteristics clearly marked on them.

81. (1) In circuits where the voltage exceeds 42 V the isolating device should act on all poles.

(2) Fixed lighting installations may be exempted from this requirement provided they comply with the requirements of paragraphs 145 and 146.

82. It should not be possible for circuit-breakers to be opened or closed inadvertently by gravity or by mechanical impact.

83. (1) It should not be possible to break or to establish the continuity of the neutral conductor without simultaneously breaking or establishing the continuity of the associated live conductors.

(2) The continuity of earthing conductors should not be broken except when necessary in exceptional cases.

(3) The connection between the neutral point and earth should not be broken except for a short period, for testing purposes.

84. No automatic tripping device or fuse should be inserted in the supply circuit of any earth-fault protection apparatus or in the protective circuits which they feed.

85. The direction of operation of hand-operated circuit-breakers should be clearly recognisable.

86. In cubicles or compartments containing fuses or remote-controlled or automatic circuit-breakers, no part where the voltage exceeds 42 V should be accessible before such part has been made dead—

(a) by means of a circuit-breaking device placed on the incoming side and effectively preventing access to current-carrying parts; or

(b) by some other equivalent device.

87. No automatic circuit-breaker or fuse should be connected into the neutral conductor or into any part of the earth leakage protection circuit.

88. The opening of an isolating switch in a circuit where the voltage exceeds 42 V should be clearly visible or unmistakably indicated by signal or should involve the opening of a mechanical interlock.

89. (1) It should not be possible to make current-consuming apparatus other than lighting apparatus live from more than one control point.

(2) If the supply of electricity to electrical apparatus can be cut off from more than one point, it should not be possible to restore it as long as the reason for cutting it off remains.

Fuses.

90. Fuses should bear clear markings indicating their rated current, whether they are of the fast- or slow-breaking type and, as far as practicable, their rated breaking capacity.

91. (1) It should not be possible to remove or insert fuses in a circuit where the voltage exceeds 42 V (other than an intrinsically safe circuit) unless the circuit has been made dead by means of an isolating device on the incoming side.

(2) The fuses of such a circuit should be accessible only to authorised persons.

92. Effective protective measures should be taken to ensure that persons removing or inserting fuses will not be endangered, in particular by any adjacent live parts.

Motors.

93. All motors where the voltage exceeds 42 V should be equipped with a switch unless, as in the case of a machine having several motors, there is a single switch to cut off all the motors simultaneously.

94. There should be only one control device for starting a motor.

95. When a motor can be cut off from more than one place, a stopping device should be provided in the immediate vicinity of the motor unless this is impracticable.

96. Motors should be so installed as to ensure that they can be adequately cooled.

97. Each motor should be effectively protected against over-current.

98. After a failure of the supply of electricity, inadvertent starting of a motor which could result in danger should be prevented by means of automatic devices.

99. Motors, distribution apparatus and switchgear should be protected against dripping and splashing water, particularly in pump rooms.

Starting, Control and Resistance Appliances.

100. Starting, control and other resistance appliances should be so designed and installed as to be able to meet the demands to be made upon them.

101. Resistance appliances should be so installed that adequate cooling is ensured.

Welding.

102. Electric welding should only be carried out underground under conditions authorised by the competent authority.

103. The welding voltage should not exceed 65 V direct current or 80 V alternating current except with the permission of the competent authority.

104. Welding from the contact line through series resistances should be prohibited.

105. If the welding convertor is supplied from the contact wire, its frame should be connected by a special conductor to the return conductor at earth potential.

106. An effective electrical connection between welding equipment and the part to be welded should be ensured by means of a securely attached conductor.

Plug-and-Socket Couplings.

107. Except in the case of intrinsically safe circuits, plug-and-socket couplings should be so arranged that when the plug is out of the socket live parts are not accessible.

108. (1) When a plug-and-socket coupling, a plug-and-socket-cable adaptor or a similar connecting device is used in a circuit where the voltage exceeds 42 V, an electrical or mechanical interlock should prevent the breaking or making of the main circuit outside the enclosure of the connecting device.

(2) In case of electrical interlock by means of a pilot circuit included in the cable, either such circuit should be intrinsically safe or the voltage should not exceed 42 V.

(3) In all cases the continuity of the earthing conductor in the connecting device should be broken only after the live conductors have been disconnected and should be restored before any other conductor is connected.

109. (1) Plugs should be so designed that they cannot be introduced into sockets designed for a different voltage.

(2) Plugs used in signalling circuits should be so designed that they cannot be introduced into sockets for telephone circuits, and vice versa.

110. Plug-and-socket couplings for voltages exceeding 42 V should be fitted with a good earthing connection.

Connections.

111. At points where cables and conductors are joined, branched or led into apparatus, they should be—

(a) mechanically protected; and

(b) properly and durably insulated.

112. (1) Conductors and cables should be joined, branched or led into apparatus through junction boxes, sleeves, bushings, glands or equivalent connecting devices.

(2) Junction boxes or other connecting devices should be such that—

(a) good electrical connection between conductors is ensured;

(b) adequate insulating clearance is ensured between conductors and between the conductors and the casing;

(c) excessive strain on the connections is avoided;

(d) the penetration of moisture is prevented;

(e) the protective covering of the cables is secured to the casing of the connecting device; and

(f) cables cannot be damaged by sharp corners, edges, etc.

(3) Junction boxes or plug-and-socket couplings should be used for joining cables whenever practicable.

(4) When parts of cables or conductors are joined together, or cables or conductors are joined to one another or to apparatus—

(a) the attachment should be made by screwing, clamping, soldering, riveting, brazing, crimping or equivalent means;

(b) at the cable ends the wires of each conductor should be soldered together, or cable shoes or equivalent means should be used to prevent the wires from becoming untwisted; and

(c) bolts, studs and the like should be secured by lock nuts, spring washers, soldering or other efficient means.

113. Junction boxes and connectors should be protected as far as possible against traffic, falls of ground, water and other sources of damage.

114. Whenever armoured cables are joined the junction boxes should be bridged by a suitable conductive bond between the armouring of the cables.

115. When flexible cables are required to be frequently disconnected during use plug-and-socket couplings or equivalent devices should be provided.

Conductors and Cables

General Provisions.

116. Cables used underground should be of the best available type for the conditions in which they are to be used.

117. The main cables supplying current to electric motors installed in the vicinity of shafts (such as those for under-

ground fans or drainage pumps) should be duplicated if the stopping of these motors would cause danger.

118. The external coverings of cables should be such that they cannot contribute to the spread of fire.

119. A certificate should be issued by the manufacturer of any new cable giving its essential technical characteristics and such other information as is necessary to ensure its safe use.

120. (1) Bare conductors for voltages exceeding 42 V, other than in metal-clad boxes or cubicles, should be prohibited except for trolley lines for electric haulage, for the bars of switchboards and for earthing.

(2) Trolley lines should not be used as a source of current for hand-held or portable apparatus except with the special permission of the competent authority.

121. Colours, distinguishing markings or some other suitable means should be employed in flexible cables to—

(a) distinguish between cables with a working voltage below 1,100 V and those with a working voltage exceeding 1,100 V;

(b) identify each phase conductor; and

(c) identify the earth conductor, if any.

122. The metal sheathing of any armoured cable should—

(a) be electrically continuous throughout its length;

(b) be earthed;

(c) be effectively protected against corrosion wherever necessary; and

(d) not be used as a current-carrying conductor.

123. (1) Cables should be so placed and secured as to ensure maximum protection against mechanical damage of all kinds, and particularly that due to their own weight, to bending or twisting, to traffic or to ground movements.

(2) Damage to cables or crushing at points of support should be avoided.

124. Supporting devices for cables should—

(a) be of adequate mechanical strength;

(b) permit the cable to move when it is subjected to any unusual pull, except in shafts, staples and inclines having a gradient of more than 45°; and

(c) be spaced sufficiently closely to prevent dangerous sagging.

125. Cable terminal boxes, couplings and other connections should be so designed and fitted that strain on the cable is taken as far as possible by the external sheathing in the case of flexible cables or the armour in the case of semi-flexible or armoured cables.

126. (1) The use of insulated conductors in metal conduit should be permitted only in exceptional cases and for short lengths.

(2) The conduit should be—

(a) of the same type and the same metal throughout, the greatest attention being paid to the joining of sections;

(b) resistant to corrosion.

127. (1) Cables, whether in the open or in culverts, should be so suspended, fixed or laid as to permit easy inspection at all points.

(2) Cables should be buried only in exceptional cases, and when buried they should be laid in ducts or culverts of fireproof construction which provide effective protection against mechanical damage.

128. (1) Cables in shafts, staples or inclines having a gradient of more than 45° should have an armouring strong enough to support their weight without dangerous sagging.

(2) This armouring should have a safety factor of at least three, allowing for the widest space between supports.

129. Wherever cables are likely to be damaged by shot-firing or any other temporary operation, they should be given additional protection for as long as is necessary.

130. Wherever cables pass through stoppings, ventilation doors, etc., they should be effectively protected against the risk of crushing.

131. The diameter of cable drums should be large enough to prevent damage to insulators, sheaths, screens or armouring.

Flexible Cables.

132. Flexible cables for hand-held or portable apparatus where the voltage exceeds 42 V and where all circuits are not intrinsically safe should—

(a) contain an earthing conductor with a conductance of at least half that of the largest current-carrying conductor;

(b) unless otherwise specified by the competent authority, be protected by at least one continuous metal screen that will ensure that the supply of electricity is cut off automatically if serious damage occurs to the cable; and

(c) be coiled preferably in a figure-of-8.

133. Hand-held apparatus and, where practicable, portable apparatus, should be supplied by a single flexible cable.

134. All flexible cables where the voltage exceeds 42 V, other than those forming part of intrinsically safe circuits, should have external sheathing that is highly resistant to fire and mechanical damage.

135. Automatic devices should be provided for the purpose of making or maintaining dead any hand-held or portable apparatus supplied by a flexible cable in the event

of breakage of the earthing conductor included in the flexible cable.

Hand-Held and Portable Apparatus

136. The supply of electricity to hand-held apparatus should be at a voltage not exceeding 300 V.

137. Hand-held and portable machines should be equipped with a built-in switch.

138. Hand-held electrically-operated tools should be provided with a built-in switch that will break the circuit automatically when the tool is released by the hands.

Lighting

139. The provisions of paragraphs 140 to 156 apply only to lighting supplied from the mine electricity system.

Use of Hand Lamps Underground.

140. The use of hand lamps at a voltage exceeding 42 V should not be permitted.

141. The use of hand lamps should be kept to the minimum necessary and be reserved for such places as pump rooms and repair and maintenance shops.

142. Hand lamps should be—

(a) equipped with a strong cover of glass or other transparent material;

(b) proof against dust and water;

(c) equipped with a strong guard over the cover.

Fixed Lighting.

143. Fixed lighting installations should have incandescent or gaseous discharge lamp bulbs or tubes supplied at a voltage not exceeding 300 V.

144. (1) Fixed lamps underground should be fitted with a strong protective cover of glass or other transparent material.

(2) If the cover is not highly resistant to impact it should be provided with a guard.

(3) Whenever required by local conditions the lamp fitting should be proof against dust and water.

145. A locking device that cannot be opened without a special key should be incorporated in the fittings.

146. Fixed lighting apparatus should be so constructed that the lamp bulb or tube can be replaced without danger of electric shock, unless there are sufficient switches for all supply conductors in the circuit to be made dead.

147. When the installation is supplied from a trolley wire system, the lighting should be limited to the parts of the roadway containing the trolley wire and the immediate vicinity of those parts.

148. When the installation is supplied from a trolley wire system each lamp should—

(a) be protected by a fuse inserted in the circuit between the lamp and the trolley wire;

(b) have an earthing conductor separate from the return conductor;

(c) be sufficiently well insulated from any metal road support.

Lighting at the Face.

149. Lighting apparatus at the face should have incandescent or gaseous discharge lamp bulbs or tubes supplied at a voltage not exceeding 300 V.

150. Face lighting appliances should—

(a) be of particularly strong construction;

(b) be well suited to the conditions under which they are used; and

(c) comply at least with the requirements for fixed lighting installations.

151. Face lighting appliances should be permanently marked with the maximum wattage and voltage of the bulbs or tubes that can be used in the fittings.

152. The components of face lighting appliances, and in particular the connections of lamp bulbs or tubes, should be of specially strong and shock-resistant construction in order to limit the risk of internal short-circuits unless special measures are taken against such short-circuits.

153. A locking device that cannot be opened without a special key should be incorporated in the fittings.

154. (1) Special attention should be paid to materials used for electrical connections of lighting fittings and precautions should be taken, in particular, against the breakdown of the insulation of the conductors inside the fittings.

(2) Cable connections to terminals should not be under any external mechanical strain.

155. (1) The supply of electricity to a face lighting system should be from transformers employed exclusively for the lighting circuit.

(2) The fittings should be properly earthed and provided with a suitable earth leakage protective device.

156. Face lighting should not be considered to make the use of individual miners' lamps unnecessary.

Telephone and Signalling Systems

157. Telephone systems should operate at a voltage not exceeding 65 V.

158. (1) Signalling systems with insulated wires should operate at a voltage not exceeding 300 V.

(2) Signalling systems with bare wires should operate at a voltage not exceeding 42 V.

159. Telephone and signalling systems should have automatic protection against short-circuits.

160. Transformers used to supply current to telephone and signalling systems should have separate windings with either—

(a) the primary and secondary windings on separate and properly earthed cores; or

(b) the primary and secondary windings on the same core with a properly insulated and earthed metallic screen or winding between the two windings.

161. Conductors forming part of telephone or signalling systems should be protected against contact with, or induced voltage from, other conductors or apparatus.

162. (1) In shafts only cables of the best available type should be employed for telephone and signalling systems.

(2) Cables used for signalling circuits should contain no additional conductors except those forming part of a telephone circuit.

(3) A device should be installed in the winding-engine room that clearly indicates any failure of the winding signalling system.

Electric Trolley Haulage

General Provisions.

163. The competent authority should be notified of the intention to install a new electric trolley haulage system or extend an existing system.

164. The voltage of the trolley-wire system should not exceed 650 V.

165. At crossings and junctions of haulage roads containing trolley wires, and where haulage roads meet other roadways, conspicuous notices or warning lights should draw attention to the presence of trolley wires.

166. Where necessary, trolley haulage roads should be properly drained and the trolley wires and feeders should be protected from water seeping through the roof or sides.

Locomotives.

167. Current collectors should be so constructed that—

(a) they can be lowered safely and locked in the lowered position from the locomotive driver's cab;

(b) live parts up to the collector shoe are protected against accidental contact; and

(c) sparking on the trolley line is reduced to a minimum.

168. There should be a disconnecting device between the current collector and the rest of the electrical equipment of the locomotive.

169. An adequate emergency lighting system should be provided in case of current failure.

170. Drivers of trolley locomotives should be protected from contact with live conductors.

171. Controller handles should be impossible to remove unless they are in the " off " position.

172. Conductors and other electric parts on trolley locomotives should be protected against damage to their insulation from oil, heat or other causes.

173. (1) Electrical brake circuits which do not use the motor current should—

(a) not include an automatic circuit-breaking device;

(b) be incapable of being made dead except by means of the controllers; and

(c) be incapable of being broken while the controller is in the " off " position.

(2) Electrical braking devices should in all cases be supplemented by a powerful hand brake which can be locked in position.

174. Locomotives should be provided with fire extinguishers of a type which is safe for use on live parts.

Trolley Lines and Feeders.

175. Bare conductors for trolley lines and feeders should be so installed that—

(a) they are protected as far as practicable against breakage;

(b) they are not likely to cause fires in the timbering;

(c) they are as far as practicable away from the side of the road used by persons travelling on foot.

176. At any point where persons must pass under trolley wires or bare feeders the lowest point of the wires or feeders should be not less than 6 ft. 6 in. (2 m) above the top of the rails.

177. If the height of trolley wires or bare feeders above the rails is less than 6 ft. 6 in. (2 m) special precautions, such as protection by guards or equivalent means, should be taken to prevent accidental contact with live parts.

178. Trolley wires and feeders should be—

(a) fixed to suitably spaced insulating devices; and

(b) doubly insulated from the anchorage of the suspension device.

179. Trolley wires and feeders should be protected collectively by an automatic circuit-breaker.

180. (1) Sectionalising switches should be placed at suitable intervals to permit trolley wires and feeders to be made dead as required.

(2) Sectionalising switches should—

(a) be clearly visible;

(b) be capable of being locked in the open position by means of a special key; and

(c) have an indicating device showing whether the switch is open or closed.

(3) The gaps in the line between sections should be such that they cannot be bridged by the current collectors of locomotives.

181. Trolley haulage roads should be kept free of loose wires or parts that may have become detached from metal roof supports.

Return Conductors.

182. When rails are used as return conductors—

(a) they should be so connected together by welding, fish plates or other means that the electrical resistance of the joint between two successive rails is not greater than that of one rail of normal length;

(b) the two rails of the same track should be connected by cross bonding of good conductance at intervals not exceeding 110 yds. (100 m) unless the track circuits make wider spacing necessary;

(c) points, crossings and other gaps in the track should be efficiently bridged over electrically and cross bonded unless the track circuits make this impracticable.

Passenger Haulage.

183. (1) The conveyance of persons in trains hauled by electric trolley locomotives should only be permitted under conditions to be specified by the competent authority.

(2) Unless other effective safeguards are provided, the conveyance of persons should be permitted only in cars with well-earthed roofs adequately protecting passengers against contact with live conductors.

184. At all stations where persons enter or leave roofless cars—

(a) there should be a switch by means of which the supply of electricity can be switched off from the trolley wire throughout the length of the station;

(b) there should be light signals, to indicate whether the trolley wire is live or dead, so arranged that at least one can be seen from any part of the train; and

(c) adequate fixed lighting should be provided.

Miscellaneous Provisions

Cable-Reel Locomotives and Machines.

185. Cable-reel locomotives and machines should comply with the requirements of paragraphs 163, 164, 171 and 174.

186. The supply of electricity to a cable-reel locomotive or machine should be ensured as far as practicable by means of a single cable.

Explosives Magazines, Fuel Stores and Other Special Rooms.

187. All electrical installations and equipment in explosives magazines, fuel stores and other special rooms should conform to requirements laid down by the competent authority.

SECTION 3. EXAMINATION, TESTING, OPERATION, MAINTENANCE AND REPAIRS

Examination and Testing

188. All electrical equipment for use underground should be thoroughly examined by the chief electrician of the mine, or a person designated by him, before being put into service in order to ensure that it is suitable for its proposed use.

189. No electrical equipment should be put into service underground until any defects found have been remedied.

190. (1) At the beginning of every shift any person using electrical equipment underground should make a careful external examination of all apparatus for which he is responsible, particularly flexible cables.

(2) Any important defect found should be immediately reported to a supervisor.

191. Electricians of the mine, expressly appointed for the purpose by the chief underground electrician, should—

(a) at least once in every shift check the reading of any instruments provided to ensure the continuous monitoring of the insulation of insulated neutral systems;

(b) at least once in every month inspect all stationary electrical installations underground;

(c) at least once in every week inspect all other electrical installations underground.

192. (1) At least once in every year the chief electrician for underground work, or one or more competent persons designated by him and under his orders, should carry out a thorough inspection of all electrical installations underground.

(2) Alternatively, this inspection may be carried out by officials of an organisation recognised by the competent authority.

193. At appropriate intervals all hand-held and portable apparatus used at the face, together with its flexible cables, should be sent to the repair shop for examination and overhaul.

194. All electrical installations which have a defect that could be dangerous should be immediately taken out of use and be properly repaired before being returned to service.

195. All important defects and irregularities found, together with the action taken in respect of them, should be recorded.

Operation

196. Electrical equipment should be operated only by authorised persons.

197. Electrical equipment should not be operated at a higher voltage, or permanently loaded with a heavier current, than that for which it is designed.

198. No unauthorised person should interfere with any part of electrical equipment.

199. Electrical measurements should be carried out with all necessary precautions against the risks of sparking to which they may give rise.

200. No unauthorised person should enter any room containing electrical equipment except in an emergency.

201. Persons operating hand-held or portable machines should—

(a) not leave the machine while it is in operation;

(b) ensure, before leaving the machine, that the supply of electricity is cut off, by means other than the built-in controls, from the flexible cable that supplies the machine; and

(c) take the cable out of service as soon as any important defect becomes apparent.

202. After a circuit-breaker has tripped following a short circuit the supply of electricity should not be switched on again until the cause of tripping has been discovered and remedied.

203. It should be prohibited—

(a) to block automatic circuit breakers in the closed position, by whatever means, or to render protective interlocks inoperative; and

(b) to alter without authority the setting of circuit-breakers and protective relays.

204. The use of improperly repaired or bridged fuses should be prohibited.

205. Where the voltage exceeds 300 V, plugs and sockets that are not provided with an interlock or otherwise effectively protected should not be connected or disconnected while the circuit is live.

206. Electric trolley locomotive drivers should not leave the locomotive without stopping the motors, applying the brakes, lowering and locking the current collectors and taking all reasonable precautions to ensure that the locomotive cannot move accidentally or be set in motion by an unauthorised person.

207. Trolley wires should be made dead while persons are doing repair or other work in the haulage roads if the live wires could endanger such persons.

Maintenance

208. All parts of electrical installations should be so maintained as to prevent danger as far as is practicable.

209. Maintenance, cleaning and repair work on electrical installations should be carried out only by competent persons designated for this purpose.

210. In case of any abnormal occurrence in an electrical installation, such as overheating, smell of burning, smoking or sparking—

(a) the fact should be reported without delay to a supervisor or an electrician; and

(b) if necessary the supply of electricity should be cut off as soon as practicable from the part of the circuit affected and should not be restored until the cause of the occurrence has been discovered and remedial measures taken.

211. Special precautions should be taken to protect electrical apparatus against damage during operations such as shotfiring and road repairs.

212. The settings of automatic circuit-breakers, thermostats, relays and other automatic protective devices should be maintained correctly.

213. In maintaining and cleaning the interior of automatic circuit-breakers the good condition and correct functioning of the various mechanisms should be checked in accordance with the instructions of the chief electrician of the mine.

214. Hand-held apparatus, such as a lamp, should not be hung up by means of its flexible cable.

215. (1) Flexible cables should—

(a) be kept away from sharp edges and moving parts;

(b) not be subjected to excessive strain; and

(c) be properly stored in a safe place when not in use.

(2) Adequate quantities of each type of flexible cable in use should be kept in reserve at the mine.

(3) Plugs should not be withdrawn by pulling on the flexible cable.

216. Lamp bulbs or tubes for voltages exceeding 42 V should be changed only by authorised persons.

Repairs

Disconnection and Isolation from Supply of Electricity.

217. Before work is begun on any conductor or part of apparatus, except in intrinsically safe circuits or where the voltage is below 42 V—

(a) the persons concerned should be informed;

(b) the parts of the installation on which work is to be done should first be made dead;

(c) where the voltage exceeds 300 V, cables should be discharged by earthing with a safe and efficient device;
(d) the parts of the installation on which work is to be done should be earthed and short-circuited;
(e) if necessary the parts of the installation on which work is to be done should then be disconnected; and
(f) isolation from the supply of electricity and disconnection should be carefully verified and properly indicated.

218. (1) Measures such as the removal of fuses, short-circuiting of phases or rendering the remote-control system inoperative should be taken to prevent parts under repair from being made live at any time while the repair work is being carried out.

(2) Disconnection or restoration of the supply of electricity at previously fixed times should be strictly prohibited.

219. Testing for absence of current should be done only with approved appliances tested before use.

Restoration of Supply of Electricity.

220. After any repair—
(a) all connections, including those of permanent earthing conductors, should be examined; and
(b) all protective enclosures should be put back in position.

221. Electrical equipment disconnected for repair or maintenance should only be made live again by a person designated for the purpose, who, before doing so, should satisfy himself that no danger will be caused.

Work in the Vicinity of Live Parts.

222. Except in case of absolute necessity, no work should be done in the vicinity of live parts of installations.

223. If work must be done at a place where there is danger of contact with live parts, either directly or indirectly (through tools, etc.), the danger zone should be barricaded off by guards, partitions or other effective means.

224. Persons working near live parts where the voltage exceeds 42 V and which are not intrinsically safe should—

(a) wear tight-fitting clothing;

(b) take up a safe stance; and

(c) take constant care not to come into contact with live parts.

Flexible Cables.

225. (1) Damaged flexible cables should be properly repaired as soon as practicable.

(2) When temporary repairs have been made to a cable its continuance in use should only be authorised if a competent person takes the responsibility.

226. Repaired flexible cables should be tested before being put back into service.

Electrical Staff

227. The entire underground electrical installation at every mine should be in charge of a chief electrician appointed by the mine manager.

228. Every chief electrician should possess at least the qualifications specified by the competent authority and hold a certificate of competency.

229. A sufficient number of suitably trained electricians to ensure that the electrical installations are inspected and maintained in a safe condition should be appointed by the mine manager.

230. All workers using electrical apparatus underground should have received suitable prior instruction at the place of work in the correct operation of the apparatus and in the dangers involved.

PART II

SUPPLEMENTARY PROVISIONS APPLICABLE TO GASSY AND DUSTY MINES

SECTION 1. GENERAL PROVISIONS

231. (1) The term " gassy mine " means a mine or a part or a district of a mine classified as gassy by the competent authority.

(2) The term " dusty mine " means a mine or a part or a district of a mine classified as dusty by the competent authority.

(3) The term " mine liable to sudden outbursts of firedamp " means a mine or a part or a district of a mine classified as liable to sudden outbursts of large quantities of firedamp by the competent authority.

232. (1) Electricity should not be used in gassy or dusty mines except under conditions laid down by the competent authority.

(2) Electricity should not be used in a mine liable to sudden outbursts of firedamp unless specifically authorised in each case and under conditions laid down by the competent authority.

SECTION 2. INSTALLATION

General Provisions.

233. All electrical equipment installed in a gassy mine should comply with the following conditions:

(a) the equipment should be of a type approved by the competent authority on the basis of a certificate issued

by an officially recognised testing establishment stating that the apparatus is firedamp-proof;

(b) each separate unit of equipment should have the manufacturer's certificate showing that it conforms to the approved type; and

(c) the equipment should bear—

(i) an indication of the method of protection against firedamp;

(ii) the approval number of the type of apparatus; and

(iii) an individual identification mark, such as a manufacturer's serial number.

234. Unless it forms part of an intrinsically safe circuit, electrical apparatus should not be installed in a place where the firedamp content of the general air normally exceeds 1 per cent. unless the competent authority fixes a higher limit.

235. When electric fans must be installed underground at places where the firedamp content of the general air may occasionally exceed 1 per cent., they should not be installed where the firedamp content exceeds that specified in paragraph 250 except by special permission of the competent authority.

236. All electrical apparatus should be installed at places where there is an adequate and continuous flow of air.

Cables and Conductors.

237. Cables should be installed only in roadways that are adequately ventilated, and as far as practicable they should not be placed in high points in the roof.

238. In gassy or dusty mines bare conductors should be used only in intrinsically safe circuits or as earthing conductors.

239. When a plug-and-socket coupling, a plug-and-socket adaptor or a similar connecting device is used in any electrical

circuit an electrical or mechanical interlock should prevent the breaking or making of the main circuit outside a flame-proof enclosure.

240. In gassy mines electric cables should not be placed adjacent to pipes conveying methane.

Electric Trolley Haulage.

241. Electric trolley haulage systems should not be installed—

(a) in return airways;

(b) less than 55 yds. (50 m) from any working face;

(c) in roadways on the return side of old workings that may give off firedamp;

(d) in zones likely to be affected by recent workings, where, as a result of fissures, abnormal emission of firedamp may occur;

(e) in dead-ends; or

(f) in any roadway where adequate ventilation by intake air is not constantly assured.

242. When a firedamp content exceeding a limit to be fixed by the competent authority is detected in the air of trolley haulage roads the supply of electricity should be cut off immediately from all trolley haulage installations which might be affected by this content.

243. Coal dust capable of explosion should be constantly and effectively neutralised in all trolley haulage roads.

Supervision of Gassy Atmospheres.

244. (1) In all gassy mines containing electrical equipment a particularly careful check should be kept on the firedamp content of the air.

(2) For this purpose a sufficient number of instruments for the detection and measurement of firedamp should be constantly available.

SECTION 3. EXAMINATION, TESTING, OPERATION, MAINTENANCE AND REPAIRS

245. The examination, testing, operation, maintenance and repair of firedamp-proof electrical equipment should conform to the provisions of the present section in addition to the provisions of section 3 of Part I.

246. Firedamp-proof equipment should—

(a) be examined at least once in every shift by the personnel using it; and

(b) be thoroughly examined at least once in every year by an electrician of the mine or on the occasion of every workshop overhaul.

247. Hand-held firedamp-proof apparatus should be properly overhauled in the workshop at least once in every year.

248. Electrical examinations and tests should be carried out by competent persons, who should take adequate precautions against the risks involved, particularly the risk of explosion.

249. Firedamp-proof enclosures should only be opened under conditions imposed by the competent authority.

250. (1) When a firedamp content exceeding a limit to be fixed by the competent authority is detected in the general air of any part of a mine, the supply of electricity should be cut off immediately from all electrical apparatus which might be affected by this content, except in the case of telephone and signalling installations approved as firedamp-proof and ventilation installations whose continuous operation is necessary for safety.

(2) The limit mentioned in subparagraph (1) should in no case be higher than 2 per cent.

251. The supply of electricity should be immediately cut off—

(a) from any installation which for any reason has ceased to be firedamp-proof; and

(b) from any installation or conductor in which open sparking occurs.

252. When the supply of electricity has been cut off to prevent danger it should be restored again only after the necessary remedial measures have been taken.

253. (1) Shrouds used to protect bolt-heads and nuts should be kept free from dirt.

(2) In no circumstances should they be removed or wilfully damaged.

254. The design of firedamp-proof enclosures should not be altered in any way, for example by drilling new holes in the casing.

255. Any spare parts upon which the firedamp-proof quality of an enclosure depends should be of the officially approved type.

256. Firedamp-proof equipment should be so maintained as to remain in conformity with the officially approved type.

257. Before putting back into service any piece of apparatus that has been opened, all necessary precautions should be taken to ensure that the apparatus is firedamp-proof.

258. The inside of terminal boxes, other than compound-filled boxes, should constantly be kept in good condition.

259. The fixation of cables should be frequently verified.

260. The joints of flameproof apparatus should be maintained and inspected particularly carefully.

261. Batteries should not be changed underground except in rooms or places equipped for the purpose, unless special devices make it impossible to change them while the circuit is live.

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The figures refer to the numbered paragraphs of the text.