BRITISH STANDARD

BS 5126-2: 1993

# Mining type flameproof supply and control units for use on systems up to 1100 V —

## Part 2: Specification for circuit breaker units

Confirmed January 2011

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mining Requisites Standards Policy Committee (MRE/-) to Technical Committee MRE/16, upon which the following bodies were represented:

Association of British Mining Equipment Companies

British Coal Corporation

Health and Safety Executive

This British Standard, having been prepared under the direction of the Mining Requisites Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 December 1993



First published November 1976
Second edition December 1993

The following BSI references relate to the work on this standard:
Committee reference MRE/16
Draft for comment 89/79378 DC

**ISBN 0 580 22422 8**

**Amendments issued since publication**

| Amd. No. | Date | Comments |
|---|---|---|
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# Contents

# Foreword

This Part of BS 5126 has been prepared, under the direction of the Mining Requisites Standards Policy Committee. It supersedes BS 5162-2:1976 which is withdrawn. This revision updates the standard to reflect today's usage of 1 100 V mining type flameproof supply and control units (commonly known in the UK as "gate-end boxes") and takes account of expected future development.

This Part of BS 5126 covers circuit breaker units, whilst Parts 1, 3 and 4 cover direct-on-line motor starter units, lighting transformer units and units to power drilling machines, respectively. All have standard busbar and other fixing dimensions, enabling the different units to be fastened together to form a switchboard.

This standard is arranged to be in close alignment with IEC (International Electrotechnical Commission) criteria for various electrical features.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.** Attention is drawn to the Health and Safety at Work etc. Act 1974 [1], the Mines and Quarries Act 1954 [2], the Regulations made under these Acts, and also any other appropriate statutory requirements or byelaws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user. The addresses of the recognized certification authorities in the United Kingdom for Group I (for mines susceptible to firedamp) apparatus are:

Health and Safety Executive
Mining Equipment Certification Service
Harpur Hill, Buxton, Derbyshire, SK17 9JN

SIRA Certification Service
Saighton Lane
Saighton
Chester, CH3 6EG

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This Part of BS 5126 specifies requirements for flameproof supply and control units designed primarily for use in the coal mining industry on 1 100 V three-phase a.c. circuits and dual-voltage 1 100 V/550 V units with circuit breakers for the control and protection of power circuits. Provision is also made for operation on other voltages, where required.

In addition to the definitive requirements, this standard also requires the items detailed in clause **4** to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

NOTE 1 To facilitate cross-reference and subject location recall between the Parts of this standard, a uniformity of clause arrangements is maintained. At subclause level, because of the different purposes and individual technical features of the four types of control unit, some differences in title and/or subclause arrangements have been unavoidable, but have been made without disturbing the general pattern.

NOTE 2 The figures in this standard show only such features and dimensions essential for function and interchangeability. Dimensions are in millimetres. Untoleranced values less than 100 mm are ± 0.15 mm and those greater than 100 mm are ± 0.25 mm.

## 2 References

### 2.1 Normative references

This Part of BS 5126 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on page 20. Subsequent amendments to, or revisions of, any of these publications apply to this Part of BS 5126 only when incorporated in it by updating or revision.

### 2.2 Informative references

This Part of BS 5126 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

## 3 Definitions

For the purposes of this Part of BS 51126, the following definitions apply.[1)]

**3.1**
**supply and control unit (gate-end box)**

a flameproof enclosure containing electrical apparatus, such as transformer, control gear, switchgear and/or protective gear, designed primarily for use underground

NOTE 1 In this Part of BS 5126, the term "unit" has in many instances been used in abbreviation of "supply and control unit".

NOTE 2 For the purposes of this Part of BS 5126, the enclosed apparatus is essentially an electrical circuit breaker with associated equipment.

**3.2**
**circuit breaker**

a mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuit

NOTE A circuit breaker is usually intended to operate infrequently, although some types are suitable for frequent operation.

**3.3**
**disconnector (isolator)**

a mechanical device capable of opening or closing a circuit under conditions of no load or negligible current

**3.4**
**cable half coupler (flit plug)**

a detachable cable sealing box utilizing contact tubes and pins to facilitate ready connection to, or disconnection from, a similar unit or other apparatus

**3.5**
**cable coupler adaptor**

a device used to connect either a cable half coupler or other type of cable termination to apparatus. If used to connect a cable half coupler, it may either be separate from, or be integral with, the enclosure of the apparatus

**3.6**
**cable sealing box**

a device designed to receive and protect the end of the cable, with provision for sealing the conductors and the insulating material of the cable with a filling compound and having a cable gland for attaching the cable to the box, together with any terminals provided for connection to the conductors of the cable within the box. The box may form part of, or be detachable from, the apparatus with which it is associated

**3.7**
**detachable cable sealing box**

a cable sealing box that can be detached from associated apparatus without disturbing the sealing of the cable

[1)] The terms in brackets are those commonly used in practice.

**3.8**
**dual-voltage unit**

a unit capable of operating from either of two selected supply voltages, the preferred values of which are 1 100 V and 550 V

**3.9**
**restrained plug and socket**

a plug and socket in which the two portions are engaged, retained and disengaged by means of a manually operated device

**3.10**
**bolted cable plug and socket**

a plug and socket designed to be held together by two or more bolts or screws, or studs and nuts in such a way that the plug cannot be disengaged from the socket without the use of a tool

**3.11**
**sequence interlocking**

means by which operation is made dependent on the fulfilment of other prescribed conditions

**3.12**
**overcurrent protection**

a device that causes the circuit being protected to be automatically disconnected from the supply when the current exceeds the predetermined value

NOTE The preferred term "overcurrent" is used throughout this standard, but in certain other British Standards to which reference is made, the term "overload" may be used when referring to these devices.

**3.13**
**inverse time lag overcurrent release**

a device that retards the tripping of the circuit breaker by a time inversely dependent upon the magnitude of the overcurrent

**3.14**
**undervoltage release**

a device that causes the circuit breaker to open the circuit if the voltage falls below a predetermined value

**3.15**
**shunt release**

a device that causes the circuit breaker to open when energized from a source of voltage that may be independent of the circuit in which the circuit breaker is connected

## 4 Information and requirements to be agreed and to be documented

### 4.1 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) the number and date of this British Standard, i.e. BS 5126-2:1993;

b) the service conditions, if other than those specified in clause **5**;

c) information relating to the circuit breaker to be controlled, where known:

1) the full load current rating of the circuit breaker;

2) any information concerning special conditions likely to affect the performance of the circuit breaker;

d) any information concerning special conditions likely to affect the performance of the unit;

e) whether the unit is to have dual-voltage and, if so, the rated supply voltages (see **6.1**);

f) the rated frequency of the supply system and its deviation if greater than ± 2 Hz (see **6.2**);

g) the rated thermal load current (see **6.3**);

h) the rated thermal current of busbars (see **6.4**);

i) whether two or more units are to be coupled together (see **7.4**);

j) whether provision for incoming and throughgoing cable fittings is required at one or both ends of the unit, and the type of fitting required (see **7.6.1**);

k) the type of outgoing cable fittings, together with the number, if any, of the auxiliary cable fittings needed and the control and interlock circuit for the restrained plug and socket of the outgoing cable, if other than one conforming to BS 3101:1986 and BS 7202:1989 (see **7.6.2**);

l) whether provision is necessary for the fitting of auxiliary cable glands (see **7.6.3**);

m) whether short circuit protection is to be omitted (see **7.10.2**);

n) whether any auxiliary circuits are to be connected across the power circuit (see **7.10.4**);

o) whether provision for a remote opening function is to be omitted and whether a telemetry opening function is to be provided (see **7.11.2**);

p) the type of earth fault protection (see **7.10.6**);

q) whether provision for a remote opening function is to be omitted and whether a telemetry opening function is to be provided (see **7.11.2**);

r) whether either the local or remote closing function is to be omitted and whether a telemetry closing function is to be provided (see **7.11.3**);

s) the instrumentation (see **7.14**);

t) live compartment indication in the switch disconnector chamber (see **7.16**);

u) whether voltage-free auxiliary contacts are to be fitted and whether they are to be used for control (see **7.21**);

v) the testing authority for type tests, if other than the manufacturer (see **8.1.2**);

w) the certifying authority, if other than a UK authority (see foreword).

### 4.2 Items to be agreed between the contracting parties

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

a) additional protection to take account of overloading (see **7.10.1**);

b) the value of the prospective earth fault current (see **7.10.6**);

c) whether earth fault electrical lockout is to be omitted (see **7.10.7**);

d) the terminals to be marked and the information to be displayed (see **9.2**);

e) the form of the diagrams (see **9.5**).

## 5 Service conditions

Within the limits of their ratings, units shall be suitable for use in installations operating under the intended service conditions. Unless otherwise specified by the purchaser [see **4.1** b)], the service conditions shall be not more severe than the following.

a) *Ambient temperature:* a peak value not exceeding 40 °C with an average value not exceeding 35 °C over 24 h periods. The lower limit of the ambient temperature is – 5 °C.

b) *Altitude:* an altitude at the site of installation not exceeding 2 000 m (6 600 ft) above sea-level.

## 6 Rated values

### 6.1 Supply voltage

The maximum rated supply voltage shall be 1 100 V. Units shall operate normally within the limits of – 10 % and + 6 % of the declared rated supply voltage.

The purchaser shall state on the enquiry and/or order whether the unit is to have dual-voltage [see **4.1** e)]. In this case, unless otherwise specified by the purchaser, the rated supply voltages shall be 1 100 V and 550 V.

### 6.2 Supply frequency

Units shall have a rated supply frequency within the range 40 Hz to 62 Hz.

The purchaser shall state the supply frequency required, and its deviation if greater than ± 2 Hz, on the enquiry and/or order [see **4.1** f)].

NOTE The standard frequency is 50 Hz. The normal deviation is not greater than ± 2 Hz.

### 6.3 Thermal load current

The maximum rated thermal load current of the unit, excluding outgoing cable fittings, shall be the current rating.

Unless otherwise specified by the purchaser [see **4.1** g)], the rated thermal load current of the unit shall be 300 A.

NOTE The duty rated current may be less than the maximum rated thermal load current depending upon the lowest rated component fitted.

### 6.4 Thermal current of busbars

The rated thermal current of busbars shall be stated. Unless otherwise specified by the purchaser [see **4.1** h)], the value shall be one of the following:

a) 300 A;

b) 400 A.

### 6.5 Short time withstand current

The rated short time withstand current for 1 100 V and 550 V units shall be 6.25 kA and 7.25 kA, respectively, at a power factor of 0.3 for 1 s.

## 7 Design and construction

### 7.1 General

The flameproof parts of a unit supplied in accordance with this standard shall conform to one of the following standards:

a) BS 4683-2:1971

b) BS 5501-5:1977;

c) BS 6709:1986;

for Group I enclosures, with fittings in accordance with **7.4**, **7.5** and **7.6**. However, units designed and certified before the date of publication of this standard, which have been certified as flameproof in accordance with BS 229 for Group I gas (methane/firedamp) shall be deemed to conform to this standard provided that the requirements of all other clauses are met.

The design and construction of units shall minimize the risk of inadvertent operation arising from either:

1) pressure changes within the enclosure; or

2) changes in the parameters of electronic components or programmable electronic systems due to variations in temperature or electrical interference.

Any circuits required to be intrinsically safe shall conform to BS 1259:1958 appropriate to Class 1, or BS 5501-7:1977 appropriate to Group I.

NOTE 1 Where a unit conforming to this standard and to BS 5501 is to be directly connected to apparatus conforming to BS 229 or BS 1259 or BS 4683, it may be necessary to construct the unit such that it conforms to BS 6709.

NOTE 2 Where a unit is not to be connected as in note 1, then in order to promote the increasing use of BS 5501 in parallel with the progressive phasing out of Group I apparatus conforming to earlier standards, such a unit should conform to BS 5501.

The material for external components and enclosures shall be one of the following:

i) a corrosion resistant ferrous alloy; or

ii) a non-ferrous metal, other than aluminium, magnesium or titanium; or

iii) an alloy containing the metals aluminium, magnesium, titanium, either singly or in combinations, providing that the total content of these three constituents does not exceed 15 % (*m*/*m*) of the alloy and the combined content of magnesium and titanium does not exceed 6 % (*m*/*m*) of alloy.

NOTE 3 These limitations have been imposed to avoid the hazards of incendive sparking due to friction between rusted steel or iron and the metals listed.

### 7.2 Supply and control unit assembly

NOTE A supply and control unit comprises a basic unit together with optional features.

The basic unit shall conform to the following:

**7.3** for the enclosing case
**7.6.2** for the fittings for the outgoing cable
**7.7** for busbars
**7.8** for the means of isolation
**7.9** for the circuit breaker
**7.10.1** for overcurrent protection
**7.10.2** for short circuit protection
**7.10.5** for undervoltage or shunt trip protection
**7.10.6** for earth fault protection for outgoing main conductors
**7.10.9** where a vacuum or gas-filled circuit breaker is fitted, for detection of failure of circuit breaker interrupting medium
**7.11** for control methods, except telemetry.
**7.12** for external control devices
**7.13** for provision for earthing
**7.16** for live compartment indication in the main chamber
**7.18** for internal protective cover

Where supplied, the optional features shall conform to the following:

**7.4** for coupling of units
**7.5** for busbar end cover
**7.6.1** for the fittings for the incoming and throughgoing cables
**7.6.2** for electrical control and interlock circuit for outgoing cables
**7.6.3** for the fittings for auxiliary cables
**7.10.3** for the short circuit protection test facility
**7.10.4** for auxiliary circuit protection
**7.10.7** for earth fault electrical lockout for outgoing main condutors
**7.10.8** for pilot-to-earth fault protection and test facility
**7.11** for the telemetry control method
**7.14** for instrumentation
**7.15** for the selection and indication of voltage
**7.16** for live compartment indication in the disconnector chamber
**7.21** for voltage-free auxiliary contact

The supply and control unit, i.e. the basic unit plus the optional features, shall conform to the following:

**7.17** for temperature limits
**7.19** for creepage distance and clearance
**7.20** for insulating material

### 7.3 Enclosing case

The enclosing case shall comprise a main chamber and a disconnector/busbar chamber, each with access covers. It shall be equipped with lifting points and shall incorporate, or be adapted for mounting on, skids to facilitate transport (see Figure 1).

The design shall include such provision as will permit, without structural alteration, the attachment of adaptors, cable fittings, interconnecting trunks, etc., as specified in **7.4**, **7.5** and **7.6**, in any combination that may be required for normal installation and operation of the unit.

The busbar coupling flange shall conform to the dimensions and tolerances shown in Figure 2.

### 7.4 Coupling of units

The purchaser shall state on the enquiry and/or order [see **4.1** i)] whether two or more units are to be coupled together. When this is required, interconnecting busbar trunking shall be fitted. The interconnecting busbar trunk shall conform to the dimensions and tolerances shown in Figure 3.

Where an 1 100 V unit having a busbar chamber end flange as shown in Figure 1 is to be used for operation on a system voltage of up to 650 V, and is to be coupled to a unit having a busbar chamber flange as shown in Figure 1 of BS 787-1:1969, a busbar interconnecting adaptor trunk as shown in Figure 4 shall be fitted.

Where busbar trunking is used to connect two units together, means shall be provided on the units to accommodate skid coupling plates conforming to Figure 1. Where an adaptor as shown in Figure 4 is used, the coupling plates shown in Figure 5 shall be used.

NOTE 1 The coupling arrangements need to be sufficiently robust to prevent, in normal use, undue strain being placed on the flanges of the unit or those of the interconnecting busbar trunking.

NOTE 2 Where skids are provided, it is usual either for the skids to be continuous or, where individual skids are fitted, for coupling plates to be bolted between the skids.

NOTE 3 In some designs the bottom of the enclosing case can be utilized as an individual skid.

### 7.5 Busbar end cover

Where cable attachments conforming to **7.6.1**, or couplings conforming to **7.4** are not used, an end cover as shown in Figure 6 shall be fitted to complete the enclosure.

### 7.6 Fittings for cables

#### 7.6.1 *Incoming and throughgoing cable*

The busbar chamber shall be fitted with a means of attaching incoming or throughgoing cables. The purchaser shall state on the enquiry and/or order whether provision for the fittings is required at one or both ends of the unit and which of the following types is to be used [see **4.1** j)]:

a) an adaptor for the reception of a cable half coupler, e.g. as specified in BS 3454;

b) a compound filled detachable cable sealing and dividing box;

NOTE A suitable compound should conform to BS 7383.

c) any other fitting which is acceptable to the certifying authority[2)].

The cable details shall be given in accordance with the appropriate British Standard.

#### 7.6.2 *Outgoing cable*

The purchaser shall state on the enquiry and/or order [see **4.1** k)] which of the following fittings is required on the unit for outgoing cable, together with the number, if any, of the auxiliary cable fittings needed. The cable details shall be given in accordance with the appropriate British Standard.

a) Sockets for the reception of suitable plugs which, when combined, form plug and socket couplings, e.g. as specified in BS 5620.

These shall be of either the restrained or bolted types and shall be constructed and mounted so that the properties of the flameproof enclosure of the unit are maintained, even when the plug is separated from the socket.

Restrained plugs and sockets shall be such that the properties of the flameproof enclosure they form are maintained in the event of internal explosion, both when the plug and socket are connected together and at the moment of separation of the contacts, other than those for earthing or those which are in non-incendive circuits.

When a unit is fitted with a restrained plug and socket, an electrical control and interlock circuit shall be provided. The contacts used for electrical interlocking of the restrained plug shall make after and break before the main contacts when engaging or dis-engaging the plug.

Unless the purchaser specifies otherwise on the enquiry and/or order [see **4.1** k)], the circuit shall conform to BS 3101:1986 and BS 7202:1989 and shall be provided with pilot-to-earth fault protection (see **7.10.8**).

b) An adaptor suitable for the reception of a cable half coupler, e.g. as specified in BS 3454.

c) A detachable cable sealing and dividing box.

Where agreed between the supplier and purchaser, an electrical control and interlock as described in item a) shall be provided in items b) and c).

Although fittings for outgoing cables may be mounted on the disconnector/busbar chamber, for flameproofing purposes they shall be part of the main chamber. They shall be mounted on the unit in a horizontal plane at the least angle so as to clear point "X" in the example shown in Figure 7.

[2)] See foreword.

#### 7.6.3 *Auxiliary cable*

The purchaser shall state on the enquiry and/or order [see **4.1** l)] whether provision shall be made for the fitting of auxiliary cable glands for remote control, interlocking, monitoring or other external circuits. Such glands shall conform to any relevant British Standard.

It shall be possible, without structural alteration, to fit a cover plate in place of an auxiliary cable gland.

Plugs and sockets with intrinsically safe circuits shall not be interchangeable with plugs and sockets used on non-intrinsically safe circuits in the unit.

Outlets for intrinsically safe apparatus shall be clearly identified.

### 7.7 Busbars

Three throughgoing busbars conforming to the temperature rise requirements of BS 5486-2:1988 shall be fitted.

NOTE It is recognized that BS 5486-2:1988 relates to units up to 1 000 V a.c., but the requirements specified therein are applicable when the units are used at their maximum operating voltage of 1 100 V.

### 7.8 Means of isolation

A switch disconnector breaking all phases of the supply shall be provided in the busbar chamber, having a continuous current rating of not less than the rated thermal load current of the unit. Unless otherwise specified, the disconnector shall have three positions, i.e. ON, OFF and EARTH, and, in normal operation, shall be interlocked with the circuit breaker to ensure that the disconnector cannot be opened or closed with the circuit breaker closed. It shall not be possible to open the main chamber unless the disconnector is in the OFF position, or to close the disconnector while the main chamber is open. The ON, OFF and EARTH positions of the disconnector shall be clearly indicated. With the disconnector in the EARTH position it shall be possible to close the circuit breaker, thereby earthing the outgoing cable.

The disconnector shall conform to the relevant clause of BS EN 60947-3:1992 category AC-20B, except where modified by the requirements of this standard.

Provision shall be made for locking the disconnector in the OFF and EARTH positions, and the arrangement shall be capable of accommodating any padlock having dimensions within the envelope shown in Figure 8.

For mechanical endurance all moving parts of the disconnector and any auxiliary contacts or mechanical interlocks operated by the movement of the disconnector shall be capable of 3 000 no-load operating cycles, i.e.

OFF — ON — OFF — EARTH — OFF.

The disconnector shall be capable of carrying the maximum through fault current for the maximum length of time necessary for the circuit breaker to open when tested in accordance with **8.3.4** of BS EN 60947-2:1992, in a fully assembled unit.

### 7.9 Circuit breaker

#### 7.9.1 *General*

A triple-pole circuit breaker shall be included in the main chamber, and shall conform to the appropriate clauses of BS EN 60947-2:1992, subject to the limitations in this subclause.

NOTE It is recognized that BS EN 60947-2:1992 relates to circuit breakers up to 1 000 V a.c., but the requirements therein specified are applicable to this unit when used at the maximum rated operating voltage of 1 100 V, except where varied by the requirements of this standard.

#### 7.9.2 *Closing operation*

"Dependent manual closing" shall not be used as a method of closure. "Dependent electrical power closing" shall be capable of securing the closure of the power breaker at any supply voltage down to 75 % of the rated control supply voltage.

#### 7.9.3 *Opening operation*

"Dependent manual opening" shall not be used as a method of opening. The circuit breaker shall be trip-free and have its energy for the opening operation stored prior to the completion of the closing operation. If fitted, shunt opening release shall operate correctly at all values down to 50 % of rated control supply voltage. All other methods of opening initiated by protective devices shall conform to **7.10**.

#### 7.9.4 *Rated making and breaking capacity*

The circuit breaker shall be capable of the performances given in Table 1 at the preferred rated operating voltages and frequencies (see **6.1** and **6.2**), when tested in accordance with **8.3.4** (Test sequence II) in BS EN 60947-2:1992.

#### 7.9.5 *Mechanical and electrical endurance*

The circuit shall conform to the mechanical and electrical endurance requirements in BS EN 60947-2:1992.

#### 7.9.6 *Interrupting medium*

Oil shall not be used as an interrupting medium. Vacuum circuit breakers and gas-filled circuit breakers shall be provided with protection in accordance with **7.10.9**.

### 7.10 Protection

#### 7.10.1 *Overcurrent protection*

Overcurrent protection shall be provided by the fitting of inverse time lag devices applied to not less than two phases. The protection shall conform to the relevant requirements of BS EN 60947-2:1992 and shall be of inverse time lag overcurrent release type for a range of duties up to the full load continuous rating of the unit. Where this requirement cannot be met with one device, a range of readily replaceable devices shall be available and if these are of the plug-in type, means shall be provided to ensure that the circuit breaker cannot be closed when the device is removed.

The range of settings covered by the overcurrent device shall be marked either in amperes or in such a manner that the setting in amperes can be readily determined.

Any additional protection provided to take account of overloading due to starting, running and cyclic operation shall be agreed between the supplier and purchaser [see **4.2** a)].

NOTE It is preferable that the output relay of a solid-state detector is of the normally energized type.

#### 7.10.2 *Short circuit protection*

Unless the purchaser specifies otherwise on the enquiry and/or order [see **4.1** m)], short circuit protection shall be fitted. Where it is fitted, it shall not be of the self-resetting type and means shall be provided to prevent operation of the resetting mechanism by unauthorized persons. A visual indication of the short circuit fault trip shall be provided.

NOTE 1 It is preferable that the design of the device differentiates between circuit breaker load current and short circuit fault current thus making possible settings below starting current values.

**Table 1 — Circuit breaker performance**

| Rated operating voltage<br>V | Continuous current rating<br>A | Breaking current (symmetrical)<br>kA | Making current (peak)<br>kA | Power factor (maximum)<br>lag |
|---|---|---|---|---|
| 1 100 | 300 | 6.25 | 12.5 | 0.3 |
| 550 | 300 | 7.25 | 14.5 | 0.3 |

Where the design of the device depends for its operation on detection of current only, the protection shall be capable of operation at 6, 8 and 10 times the full load current setting of the overcurrent device.

If the short circuit protection is of the indirect acting type, it shall not operate through a shunt trip release, i.e. it shall be undervoltage release.

NOTE 2 Where the system fault level exceeds the rating of the circuit breaker, adequate back-up protection should be provided elsewhere.

#### 7.10.3 *Short circuit protection test facility*

Where a short circuit protection test facility is provided it shall be possible for an authorized person, without opening the enclosure, to test whether the short circuit protection functions correctly.

#### 7.10.4 *Auxiliary circit protection*

The purchaser shall specify any auxiliary circuits and/or instruments to be connected across the power circuit on the enquiry and/or order [see **4.1** n)]. Where auxiliary circuits and/or instruments are connected across the power circuit, they shall be protected by fuses conforming to BS 2692-1:1986 and shall have a breaking capacity of at least 12 kA at 1 100 V. All other fuses shall conform to BS 88-1:1988.

Wiring used to connect fuses to the power circuit shall be capable of withstanding the cut-off current of the fuse.

NOTE 1 Wiring between the power circuit and fuses should be kept as short as practicable and arranged so as to minimize risk of short circuit, either by providing additional insulation and/or by enhanced segregation.

All other auxiliary circuit wiring, contacts and connections shall be capable of continously carrying the minimum current required to rupture the protective fuse provided.

NOTE 2 This minimum current is normally 1.6 times the fuse rating.

#### 7.10.5 *Undervoltage or shunt trip protection*

Unless the purchaser specifies a shunt trip on the enquiry and/or order [see **4.1** o)], undervoltage protection shall be fitted. Where it is fitted, it shall operate to open the circuit breaker on a falling voltage between the limits of 50 % and 20 % of the declared voltage and shall allow closing of the circuit breaker at voltages down to 75 % of the rated supply voltage.

Where shunt trip protection is fitted it shall be capable of operating to open the circuit breaker at voltages down to 50 % of the rated supply voltage.

#### 7.10.6 *Earth fault protection for outgoing main conductors*

Earth fault protection shall be provided and the type of protection, e.g. single-point, multi-point, shall be specified on the enquiry and/or order [see **4.1** p)]. The protection shall be designed such that when one phase is connected to earth in a system having near infinite insulation resistance, the circuit breaker opens when the fault current attains a value of not greater than 25 % of the prospective earth fault current.

The value of the prospective earth fault current shall be agreed between the supplier and purchaser [see **4.2** b)].

NOTE The 25 % value is greater than the 20 % specified in BS 5126-1:1993 to allow discrimination by fault current trip settings.

If the protection in the unit can detect earth faults only on the outgoing cable(s) connected to it, the earth fault protection shall not be self-resetting. If the protection in the unit can detect earth faults elsewhere on the power system, although the earth fault protection may be self-resetting, earth fault electrical lockout (see **7.10.7**) shall be provided. Means shall be provided to reset the protection without opening the enclosure and shall prevent resetting by unauthorized persons.

In all cases:

a) visible indication of the earth fault trip shall be provided; and

b) it shall be possible for an authorized person, without opening the enclosure, to test that the protection functions correctly.

#### 7.10.7 *Earth fault electrical lockout for outgoing main conductors*

Unless otherwise agreed between the supplier and purchaser [see **4.2** c)] earth fault electrical lockout shall be fitted. Where it is fitted, means shall be provided for locking out the circuit breaker electrically while an earth fault exists. Any monitoring circuit for this purpose shall conform to BS 7202:1989.

The earth fault electrical lockout shall not reset if the impedance between the outgoing circuit conductors and earth is less than that which would cause the earth fault protection (see **7.10.6**) to operate.

The earth fault trip shall not be self-resetting. Means shall be provided to reset the protection without opening the enclosure and shall prevent resetting by unauthorized persons.

Visible indication of earth fault trip shall be provided.

#### 7.10.8 *Pilot-to-earth fault protection and test facility*

In the event of inadvertent contact between the pilot core and earth, where an electrical control and interlock is fitted provision shall be made to cause the circuit breaker to open if in the closed position, or not to close if in the open position.

#### 7.10.9 *Detection of failure of circuit breaker interrupting medium*

Where a vacuum or gas-filled circuit breaker is fitted, means shall be provided to detect a failure of the interrupting medium. Such means shall include a contact which may be used to:

a) initiate tripping of the incoming supply to the main circuit breaker where failure of the interrupting medium may lead to failure of insulation across the contacts; or

b) open the main circuit breaker and prevent its reclosing where the failure of the interrupting medium affects only the rated breaking performance of the circuit breaker.

### 7.11 Control methods

#### 7.11.1 *General*

The controls given in **7.11.2** and **7.11.3** for opening and closing shall be provided. The control method shall be such that in the event of the circuit breaker opening due to operation of any protection device (see **7.10**), or an opening function (see **7.11.2**), or loss of mains power to the unit, the circuit breaker shall not be capable of reclosing unless there has been an intentional operation of the closing function selected in accordance with **7.11.3**.

#### 7.11.2 *Opening*

All connected opening functions shall remain operable whichever closing function in **7.11.3** is selected.

A local opening function on the front of the unit shall be provided.

Unless the purchaser specifies otherwise on the enquiry and/or order [see **4.1** q)], provision shall be made for a remote opening function from an auxiliary circuit connection on the right hand side of the unit.

NOTE 1 Where restrained plugs and sockets are used the plug electrical control and interlock circuit may be used as a trip circuit associated with the trailing cable [see **7.6.2** a)].

Additionally, where specified by the purchaser on the enquiry and/or order, a telemetry opening function shall be provided.

NOTE 2 At the present time Parts 1 and 3 of BS 6556 are appropriate standards for digital data transmission systems; however, BS 6556-3 does not specify application data within the protocol and this has to be the subject of agreement between the supplier and purchaser.

#### 7.11.3 *Closing*

Only one closing function shall be operable at any one time and shall be accompanied by an opening function at the same place. Where more than one closing function is provided it shall be possible for an authorized person, without opening the enclosure, to select the required closing function.

Where dependent power closing or stored energy closing is utilized (as opposed to independent manual closing), unless the purchaser specifies otherwise on the enquiry and/or order [see **4.1** r)], both local and remote functions shall be provided as follows:

a) a local closing function on the front of the unit; and

b) a remote closing function from an auxiliary circuit connection on the right hand side of the unit.

NOTE 1 Where restrained plugs and sockets are used, the plug electrical control and interlock circuit may be used as a closing circuit associated with a trailing cable [see **7.6.2** a)]. Attention is drawn to the second paragraph of Appendix A of BS 3101:1986.

Additionally, where specified by the purchaser on the enquiry and/or order, a telemetry closing function shall be provided.

NOTE 2 At the present time Parts 1 and 3 of BS 6556 are appropriate standards for digital data transmission systems; however, BS 6556-3 does not specify application data within the protocol and this has to be the subject of agreement between the supplier and purchaser.

### 7.12 External control devices

The external handles, levers or push buttons shall be arranged to minimize the risk of inadvertent operation; also damage or distortion due to mishandling, falls of roof, or collision with other gear. Where operating spindles pass through the wall of the enclosure, they shall be provided with a renewable bush.

### 7.13 Provision for earthing

An external earthing terminal, with brass nuts, not less in size than M12 conforming to BS 3692:1967, shall be provided to enable the enclosing case of the unit to be earthed, irrespective of any means provided for attaching the metallic covering of the cable feeding the apparatus.

### 7.14 Instrumentation

The purchaser shall state on the enquiry and/or order what instrumentation is required [see **4.1** s)]. Provision shall be made for the fitting of a device to indicate load current or supply voltage.

### 7.15 Selection and indication of voltage

When a unit is designed for dual-voltage operation, the preferred selection of voltage shall be made internally. Means shall be provided to enable the selected voltage to be indicated externally.

### 7.16 Live compartment indication

Live compartment indication shall be provided in the main chamber and, when specified on the enquiry and/or order [see **4.1** t)], additionally in the disconnector chamber.

The indicator shall be a light emitting source either glowing in steady state or switching on and off at a rate of at least once per second and shall indicate the presence of incoming supply voltage on the main and auxiliary circuits. The illumination level of the indicator shall be such that it is visible externally from the front of the chamber(s).

Indicator circuits shall not be galvanically connected to the power conductors and every component used to reduce the supply voltage to the light emitting source shall have a rating of at least 1 200 V.

NOTE Design of the live compartment indication should take into account the necessity for the equipment to be highly reliable and in addition should allow for easy replacement of parts.

### 7.17 Temperature limits

The temperature limits of individual components shall conform to the relevant British Standards when tested in accordance with those standards, i.e. BS 88-1:1988, BS 2692-1:1986, BS 5486-2:1988, BS EN 60947-2:1992 and BS EN 60947-3:1993.

Where the temperature of such a component in a fully assembled unit could exceed the temperature limit specified by its relevant British Standard owing to the heating effect of other component(s), that component shall conform to all other specified performance requirements of this standard at the ratings assigned to it when incorporated in the fully assembled unit.

NOTE See clause **5** for service conditions.

### 7.18 Internal protective cover

Under each access cover to potentially live parts not isolated by the integral disconnector, there shall be a further protective cover Which forms an enclosure having a minimum degree of protection IP20 to BS EN 60529:1992 and bearing the following prominently displayed and permanently legible warning notice:

"DANGER — IS THE SUPPLY ISOLATED?"

This cover shall be so located that it has to be removed before contact can be made with potentially live parts.

Where the protective enclosure is constructed of a non-metallic material, it shall conform to **7.20**.

### 7.19 Creepage distance and clearance

The minimum clearance between live parts at different potentials, and between live parts and earth, shall be such that no flash-over occurs when the unit is tested in accordance with clause **8**.

Where live parts connected to the mains supply pass from one flameproof compartment to another, the creepage distance and clearance in air between them and between live parts and earth shall be not less than 32 mm and 25 mm, respectively. All other live parts shall conform to either a relevant product standard, or Table 2.

**Table 2 — Creepage distance and clearance**

| Working voltage | Creepage distance | | Clearance |
|---|---|---|---|
| | CTI[a] > 600 | CTI[a] 400 to 600 | |
| V | mm | mm | mm |
| 15 | 1.6 | 1.6 | 1.6 |
| 30 | 1.8 | 1.8 | 1.8 |
| 60 | 2.1 | 2.6 | 2.1 |
| 110 | 2.5 | 3.2 | 2.5 |
| 175 | 3.2 | 4 | 3.2 |
| 275 | 5 | 6.3 | 5 |
| 420 | 8 | 10 | 6 |
| 550 | 10 | 12.5 | 8 |
| 750 | 12 | 16 | 10 |
| 1 100 | 20 | 25 | 14 |

[a] Comparative tracking index (CTI), see BS 5901:1980.

Where live parts are connected to the mains supply, distances for line voltages shall also apply between live parts and earth.

No component shall be mounted, or wiring run, in such a manner that the foregoing creepage distance or clearance is reduced.

### 7.20 Insulating material

Insulating material used in circuits operating at a voltage in excess of 250 V or carrying a current of more than 16 A shall have a comparative tracking index of not less than CTI 400 when tested in accordance with BS 5901:1980.

### 7.21 Voltage-free auxiliary contact

The purchaser shall state on the enquiry and/or order whether voltage-free auxiliary contacts are to be fitted for connection to external circuits and whether they are to be used for control [see **4.1** u)]. Where they are to be fitted, they shall be segregated in accordance with BS 5501-7:1977. Where they are to be used for control, they shall additionally be protected against inadvertent operation.

## 8 Verification and tests

### 8.1 General

**8.1.1** The supplier of the unit shall make available to the purchaser all documentation to show that conformity to all requirements of this standard has been achieved.

NOTE 1 The documentation provided can be in the form of test reports, photographs, certificates of compliance, statements or guarantees, whether they be based on his own tests or third party tests (e.g. by a certification authority).

NOTE 2 It is not intended that all tests be carried out on every unit supplied. In some cases it may be pertinent to test a representative sample of the unit or its components for the purpose of verifying that the unit itself has been constructed so as to conform to this standard.

**8.1.2** Two kinds of tests shall be recognized, as follows:

a) type tests, which shall be made on a representative sample of each particular type of unit, and which shall be made by an agreed authority who may be the manufacturer, unless the purchaser specifies otherwise on the enquiry and/or order [see **4.1** v)];

b) routine (individual tests), which shall be made on each unit manufactured to this standard.

### 8.2 Test requirements

The complete unit shall be tested in accordance with BS EN 60947-2:1992 for performance, temperature rise and mechanical operation. The following additional or different requirements shall apply.

a) The dielectric strength test shall be carried out on the unit with the cover(s) closed after being exposed to room atmosphere with the cover(s) open for at least 24 h prior to test.

b) The verification of operating limits shall be in accordance with **7.10.6**.

c) Following completion of the mechanical endurance tests given in **7.8**, the unit shall still be capable of conforming to BS EN 60947-2:1992 and the operating limits given in **7.10.6**.

d) A test shall prove satisfactory operation of the completely assembled unit with the cover(s) closed and when the base of the unit is tilted at an angle of 15° to the horizontal in the forward, backward and in both sideways directions.

e) For routine tests the unit shall be connected as it is intended to be installed and shall be tested for correct functioning of the following, where fitted:

1) short circuit protection (see **7.10.2**);

2) under-voltage and shunt trip protection (see **7.10.5**);

3) earth fault protection (see **7.10.6**);

4) earth fault electrical lockout (see **7.10.7**);

5) control method(s) (see **7.11**).

## 9 Marking

### 9.1 Nameplates

All units shall be permanently marked with the following:

a) the manufacturer's name or trade mark;

b) the serial number of the unit;

c) the maximum rated thermal load current, in amperes;

d) the making capacity peak, in kiloamperes;

e) the breaking capacity, in kiloamperes;

f) the rated supply voltage or voltage range, in volts or kilovolts;

g) the rated supply frequency;

h) identification details of all interlocking, control, monitoring and auxiliary circuits which originate from within the unit and are designed for use external to the unit, e.g. the intrinsically safe certification details, or reference standard relating to the construction of the circuit;

i) the rating of busbars;

j) the number and date of this British Standard, i.e. BS 5126-2:1993[3)];

k) any additional marking required by the standards to be complied with in **7.1**.

**9.2 Terminals**

Any terminal identifications shall correspond to the diagrams required in **9.5**.

The terminals to be marked and the information to be displayed shall be agreed between the supplier and the purchaser [see **4.2** d)].

**9.3 Busbar interconnecting trunks**

All busbar interconnecting trunks (see **7.4**) shall be permanently marked with the following particulars:

a) the manufacturer's name or trade mark;

b) the manufacturer's type or reference.

**9.4 Busbar end covers**

All busbar end covers (see **7.5**) shall be permanently marked with the following :

a) the manufacturer's name or trade mark;

b) the manufacturer's type or reference.

**9.5 Diagrams**

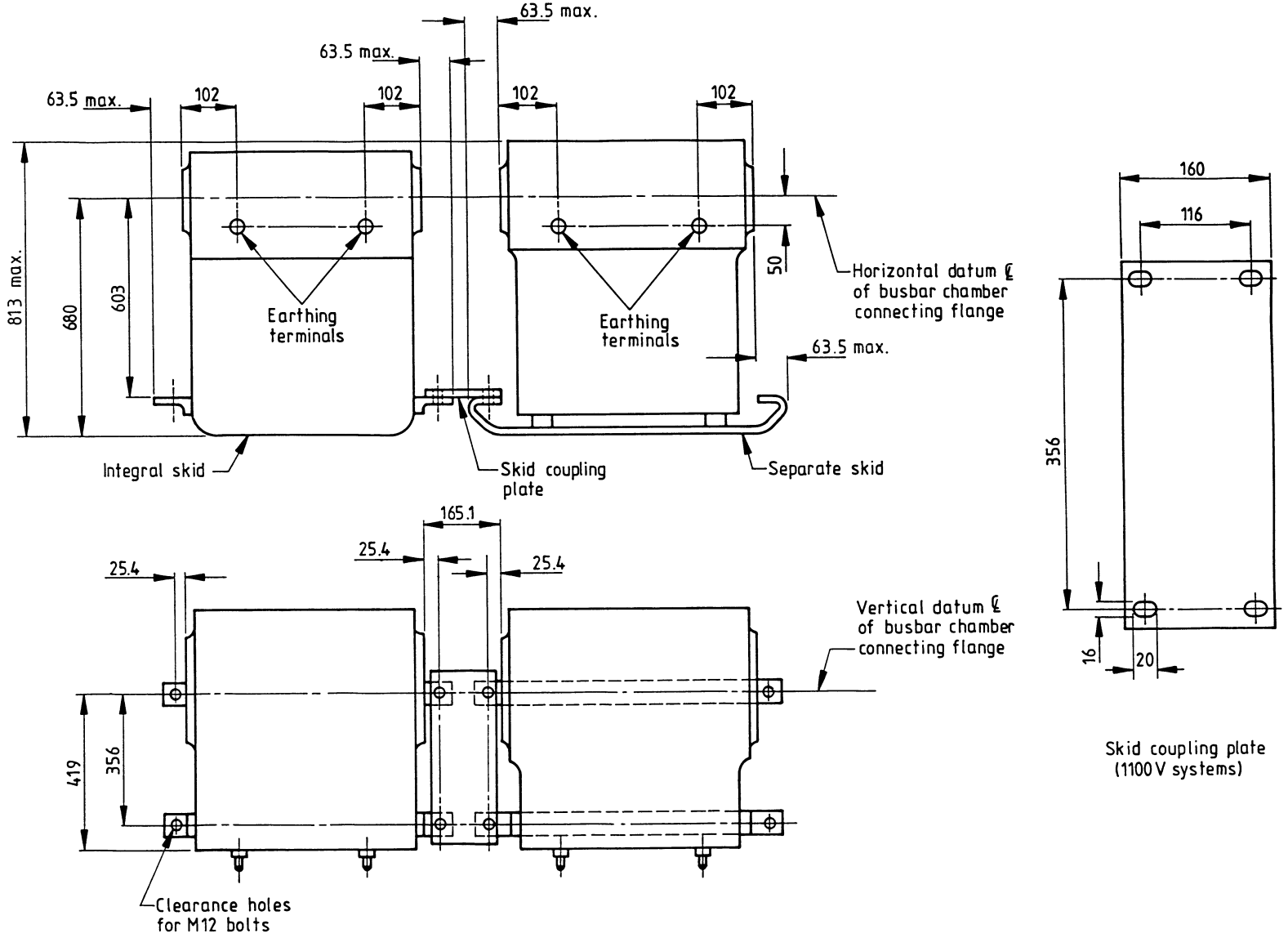
Diagrams of connections shall be provided.

The form of the diagrams shall be agreed between the supplier and the purchaser [see **4.2** e)].

**9.6 Warning notices**

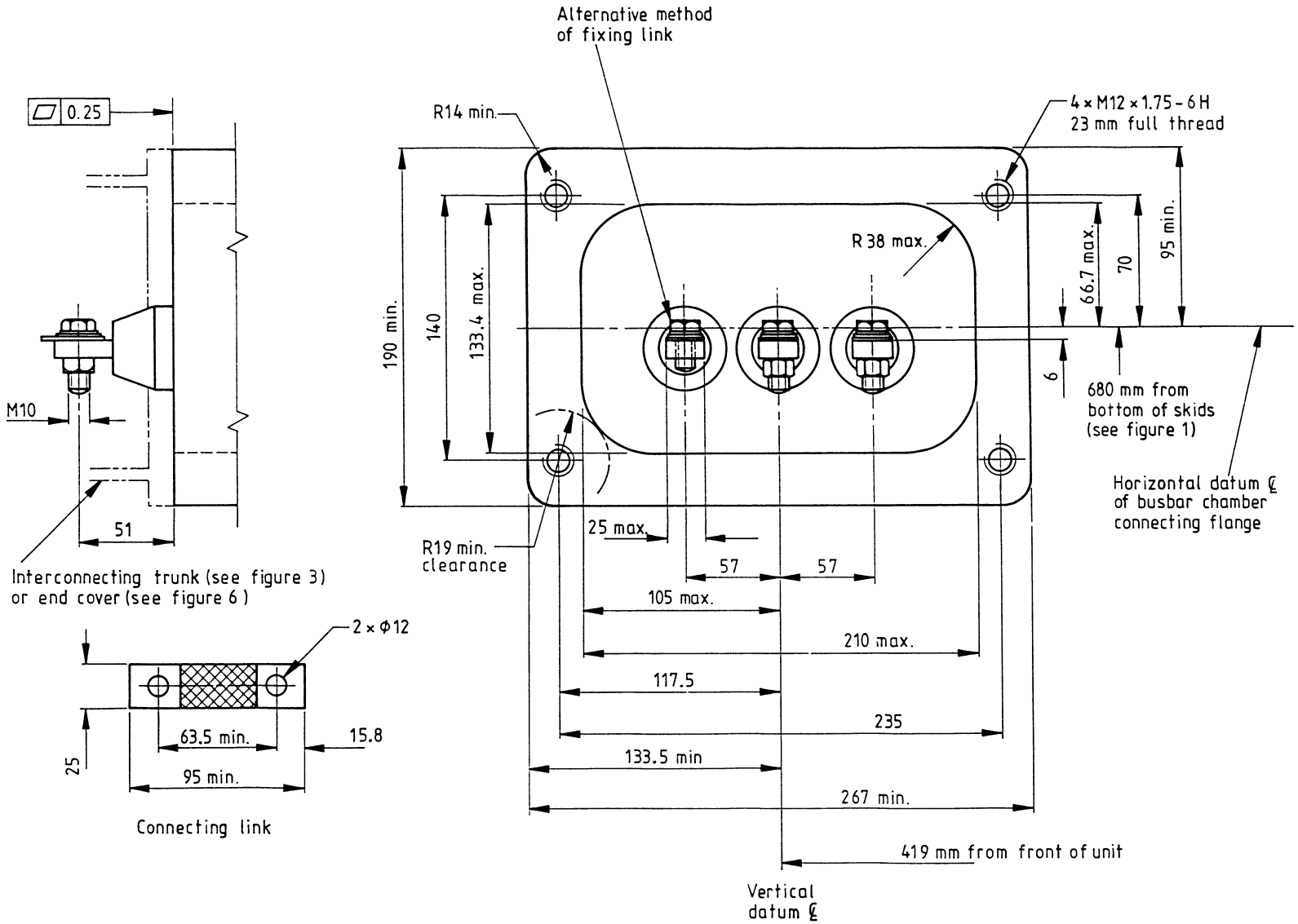
Any compartment containing live connections which can be isolated only elsewhere shall bear an external warning notice on all access covers to that effect.

[3)] Marking BS 5126-2:1993 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.



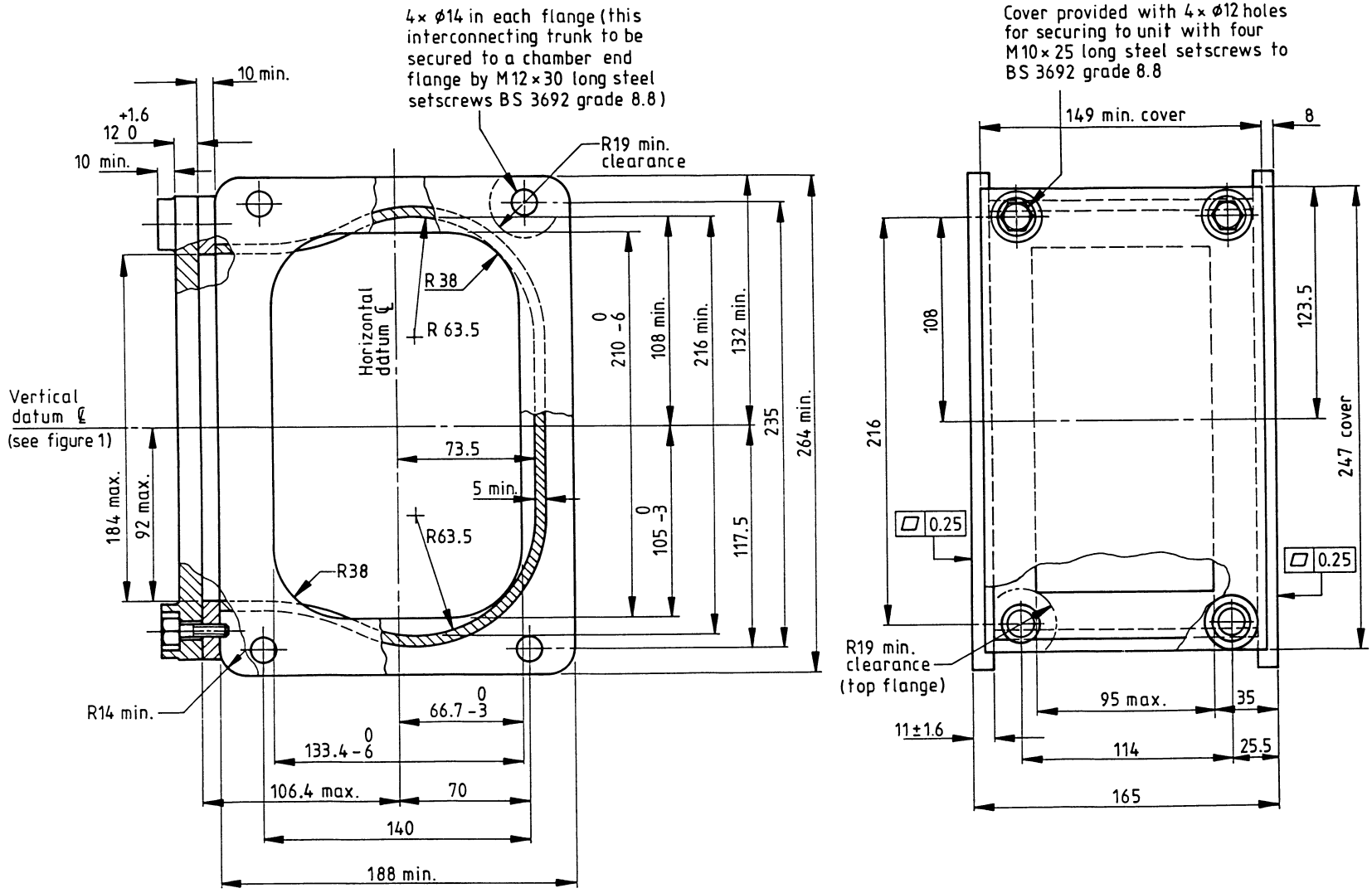

See note 2 to clause 1.

**Figure 1 — Outline of enclosures showing arrangements for earthing terminals and skid couplings**




See note 2 to clause **1**.

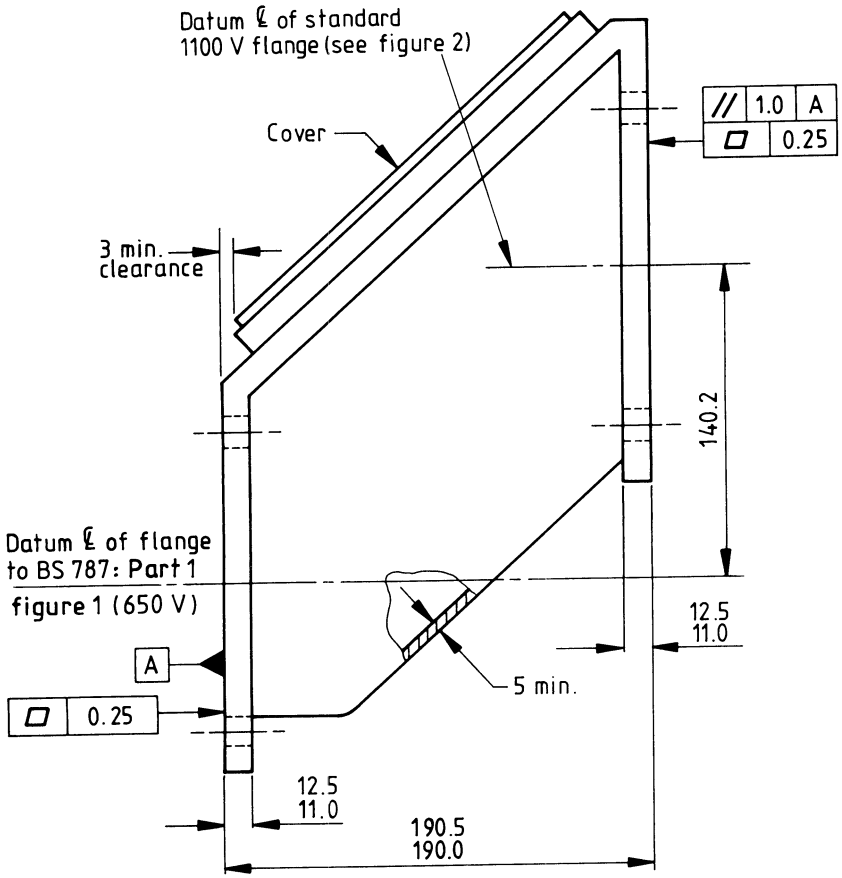
**Figure 2 — Busbar chamber end flange**




See note 2 to clause **1**.

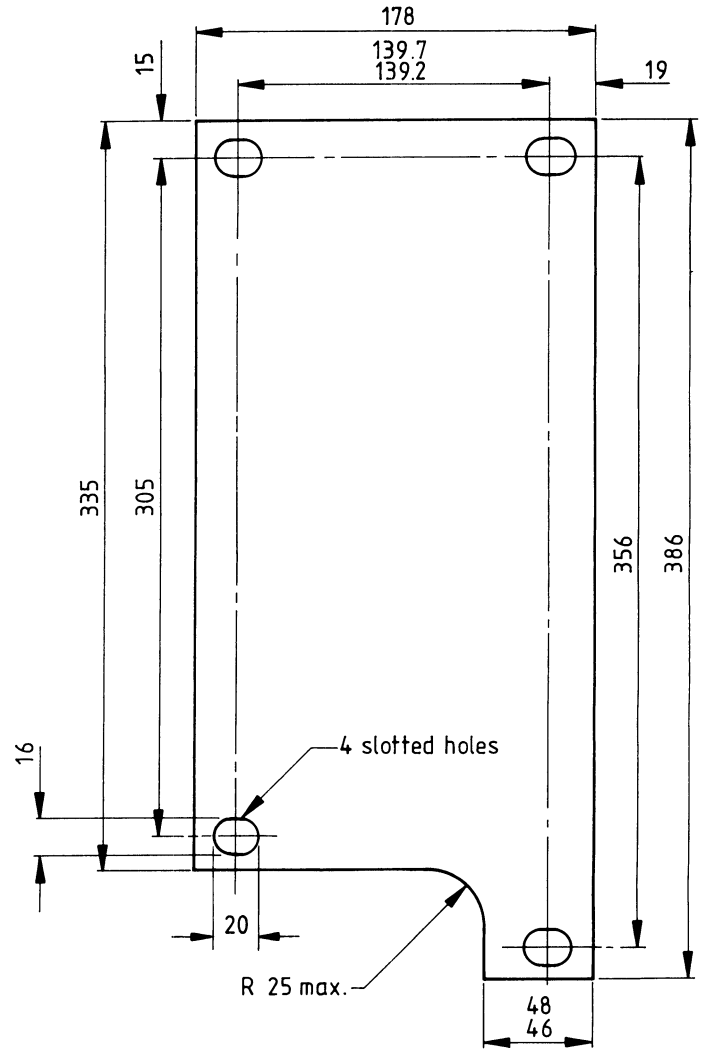
NOTE An alternative cover design, secured by socket head screws, would not be contrary to this standard.

**Figure 3 — Busbar interconnecting trunk with cover plate**



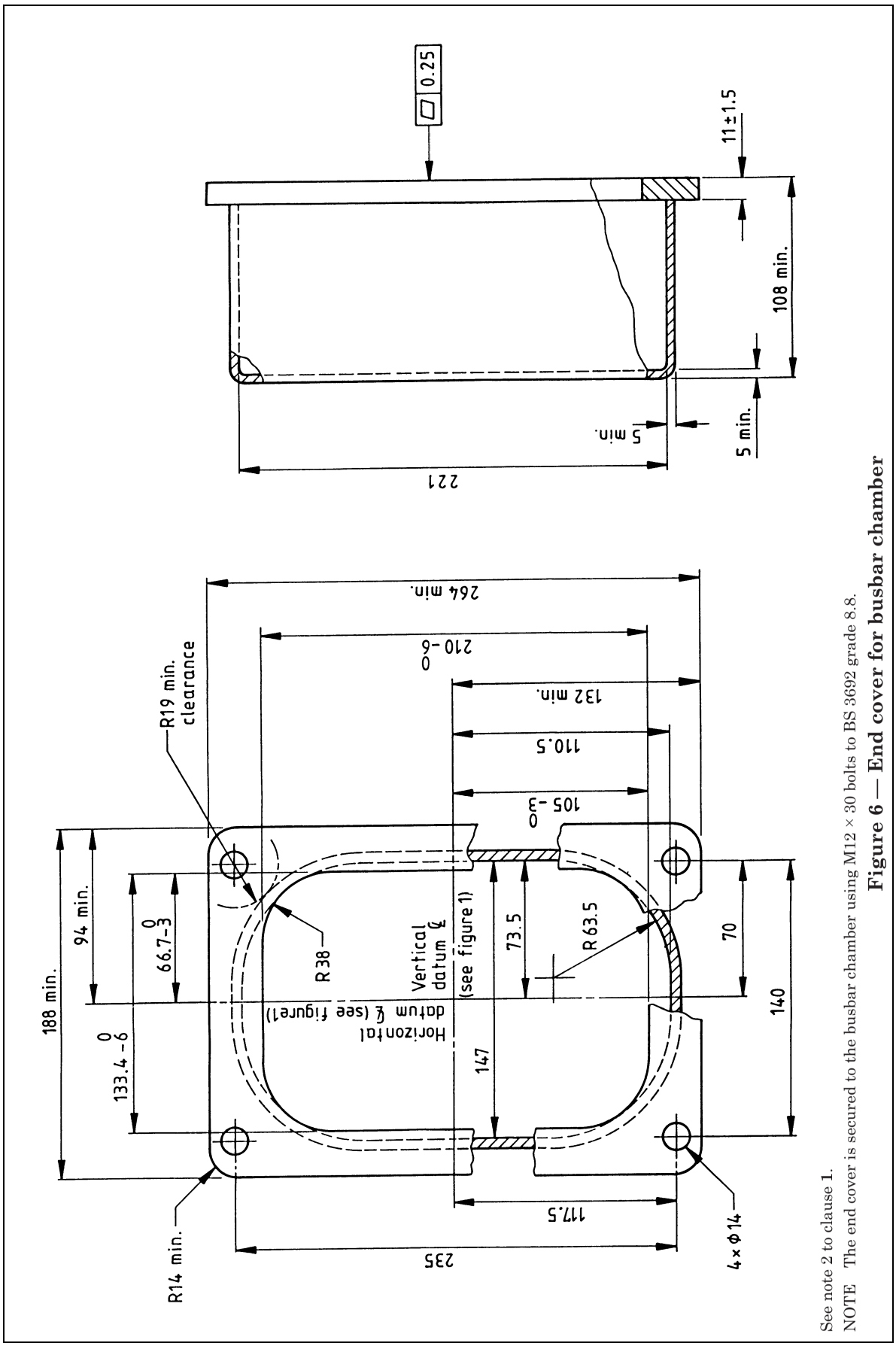

See note 2 to clause **1**.

**Figure 4 — 650/1 100 V busbar interconnecting adaptor trunk**




See note 2 to clause **1**.

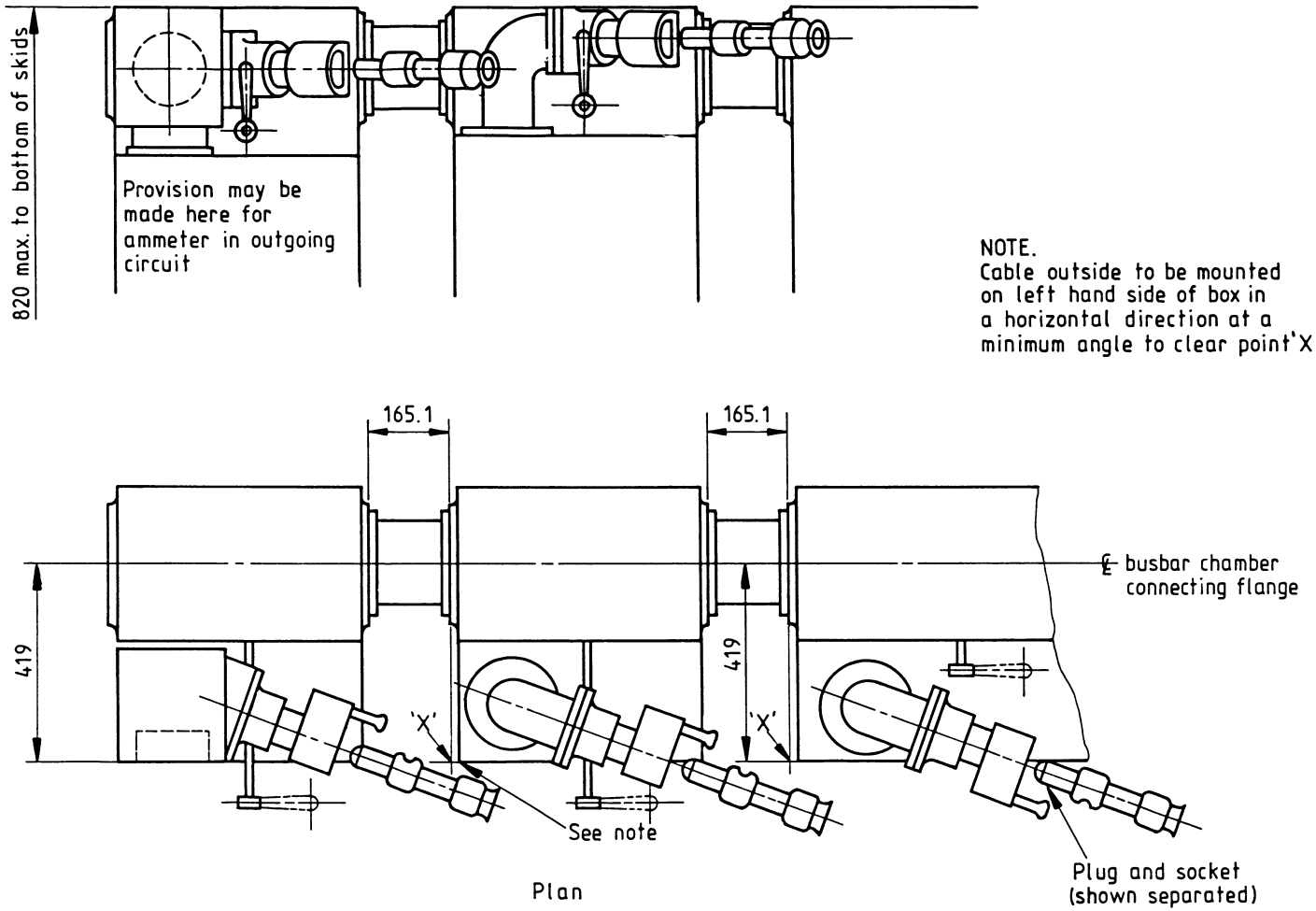
**Figure 5 — 650/1 100 V skid coupling plate**




See note 2 to clause 1.

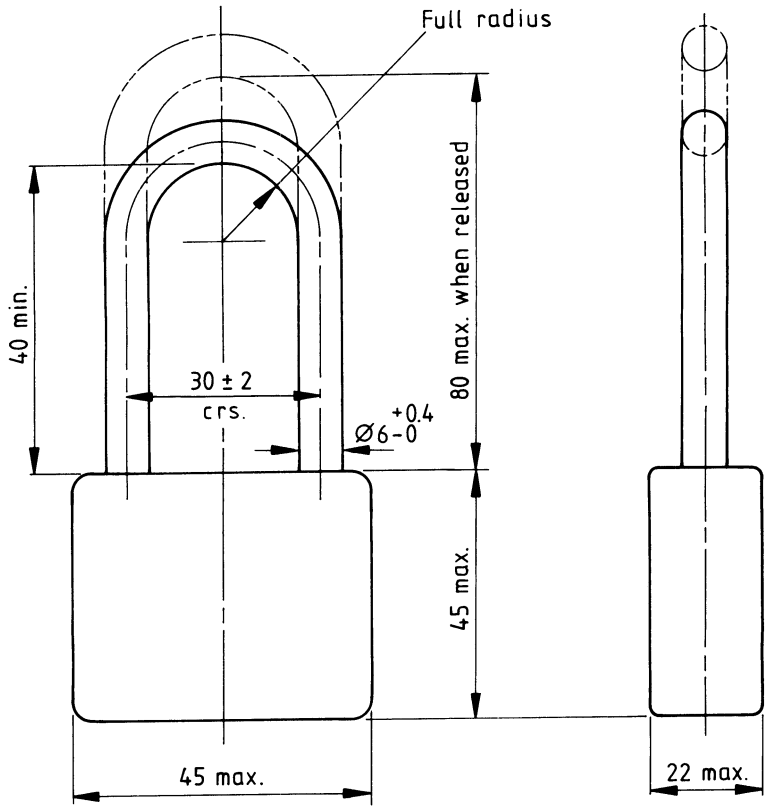
NOTE The end cover is secured to the busbar chamber using M12 × 30 bolts to BS 3692 grade 8.8.

**Figure 6 — End cover for busbar chamber**




See note 2 to clause 1.

**Figure 7 — Example of outgoing cable fittings**




See note 2 to clause **1**.

**Figure 8 — Envelope dimensions for padlocks**

# List of references (see clause 2)

## Normative references

### BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 88, *Cartridge fuses of voltages up to and including 1 000 V a.c. and 1 500 V d.c.*

BS 88-1:1988, *Specification of general requirements.*

BS 787, *Specification for mining type flameproof gate-end boxes.*

BS 787-1:1969, *Gate-end boxes for direct-on-line motor starting (for use on 3-phase a.c. circuits up to 650 V).*

BS 1259:1958, *Intrinsically safe electrical apparatus and circuits for use in explosive atmospheres.*

BS 2692, *Fuses for voltages exceeding 1 000 V a.c.*

BS 2692-1:1986, *Specification for current-limiting fuses.*

BS 3101:1986, *Specification for control and interlock circuits primarily associated with flameproof restrained plugs and sockets for use in coal mines.*

BS 3692:1967, *Specification for ISO metric precision hexagon bolts, screws and nuts. Metric units.*

BS 4683, *Specification for electrical apparatus for explosive atmospheres.*

BS 4683-2:1971, *The construction and testing of flameproof enclosures of electrical apparatus.*

BS 5486, *Low-voltage switchgear and controlgear assemblies.*

BS 5486-2:1988, *Particular requirements for busbar trunking systems (busways).*

BS 5501, *Electrical apparatus for potentially explosive atmospheres.*

BS 5501-5:1977, *Flameproof enclosure "d".*

BS 5501-7:1977, *Intrinsic safety "i".*

BS 5901:1980, *Method of test for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.*

BS 6709:1986, *Specification for interconnection of electrical apparatus, constructed to two or more British Standards, for use in mines susceptible to firedamp.*

BS 7202:1989, *Specification for non-incendive low voltage control/interlock and low voltage earth fault monitoring circuits for use in mines.*

BS EN 60529:1992, *Specification for degrees of protection provided by enclosures (IP code).*

BS EN 60947, *Specification for low-voltage switchgear and controlgear.*

BS EN 60947-2:1992, *Circuit-breakers.*

BS EN 60947-3:1992, *Switches, disconnectors, switch-disconnectors and fuse-combination units.*

## Informative references

### BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 229:1957, *Specification. Flameproof enclosure of electrical apparatus.*

BS 3454:1984, *Specification for 1.9/3.3 kV, 300 A bolted flameproof cable couplers and adaptors (including 380/660 V and 640/1 100 V, 300 A adaptors), primarily for use in mines.*

BS 5126, *Mining type flameproof supply and control units for use on systems up to 1 100 V.*

BS 5126-1:1993, *Specification for direct-on-line motor starters.*

BS 5126-3:1993, *Specification for air-cooled lighting transformer units*[4)].

BS 5126-4:1993, *Specification for air-cooled transformers to power drilling machines*[4)].

BS 5620:1979, *Specification for 200 A flameproof restrained and bolted plugs and sockets for voltages not exceeding 1 100 V, primarily for use in mining.*

BS 6556, *Low speed digital signals for use in coal mines.*

BS 6556-1:1985, *Specification for optical coupling.*

BS 6556-3:1985, *Specification for message protocols.*

BS 7383:1990, *Specification for cold-pour resin-based compound for use as a filling medium in terminating cables in enclosures for voltages not exceeding 11 kV for use in coal mines.*

## Other references

[1] GREAT BRITAIN. Health and Safety at Work etc. Act 1974. London: HMSO[4)].

[2] GREAT BRITAIN. Mines and Quarries Act 1954. London: HMSO[4)].

[4)] Referred to in the foreword only.

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