BS 787-1:1969



Specification for

# Mining type flameproof gate-end boxes —

## Part 1: Gate-end boxes for direct-on-line motor starting (for use on 3-phase a.c. circuits up to 650 V)

Confirmed
January 2011

# Co-operating organizations

The Mining and Quarrying Requisites Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

Association of Mining Electrical and Mechanical Engineers*
British Electrical and Allied Manufacturers' Association*
British Steel Industry
Federation of Associations of Mining Equipment Manufacturers
Institution of Electrical Engineers
Institution of Mechanical Engineers
Institution of Mining Engineers
Mechanical Handling Engineers' Association
Ministry of Power*
National Association of Colliery Managers
National Coal Board*

The Government department and industrial organizations marked with an asterisk in the above list were directly represented on the committee entrusted with the preparation of this British Standard.

This British Standard, having been approved by the Mining and Quarrying Requisites Industry Standards Committee, was published under the authority of the Executive Board on 20 March 1969



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# Contents

# Foreword

This standard makes reference to the following British Standards:

BS 88, *Cartridge fuses of voltage ratings up to 660 volts.*

BS 159, *Busbars and busbar connections.*

BS 229, *Flameproof enclosure of electrical apparatus.*

BS 279, *100-ampere flameproof plugs and sockets (restrained type).*

BS 542, *Cable glands and sealing boxes for association with apparatus for use at mines.*

BS 587, *Motor starters and controllers.*

BS 775, *Contactors.*

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

BS 3101, *Intrinsically-safe remote-control circuits associated with restrained plugs and sockets for use in coal mines.*

BS 3454, *3.3 kV 300 A interchangeable bolted flameproof cable couplers and adaptors (including 660 V 300 A adaptors) primarily for use in mines.*

This British Standard, prepared under the authority of the Mining and Quarrying Requisites Industry Standards Committee, was first issued in 1938 and revised in 1965. This new edition brings the previous standard into line with present practice, and incorporates a range of principles and requirements adopted as standard for a group of gate-end boxes used primarily in coal mining in the United Kingdom. Any further revision, including conversion to the metric system, will be covered in a subsequent publication.

It is recognized that the term "gate-end box" is quite general and may be applied to boxes containing different essential components, such as contactors, circuit-breakers, lighting transformers, etc., depending upon the purpose for which they are to be used. This standard, designated as BS 787-1, covers boxes in which the essential apparatus is an air-break electrically operated contactor, which together with the associated equipment provides control and protection for coalface machinery.

BS 787-2 covers gate-end boxes in which the essential apparatus is an air-break circuit-breaker. It is envisaged that additional parts of this British Standard will be issued to cover other types of gate-end boxes, such as lighting units and drill units.

This Part of BS 787 continues to accept a 30 A rated box as standard, in addition to the 80 A and 150 A boxes originally recognized.

A distinction is made between an isolator and an isolating switch, and tests are specified for an isolating switch capable of breaking the same current as the contactor. A test position in association with the isolating switch is an optional feature. In addition to earth fault protection, earth fault electrical lockout has been included.

Reference is also made to BS 3101, "*Intrinsically safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*", which lays down boundary conditions for the operation of the circuit.

NOTE Where metric equivalents have been given (see Appendix A), the figures in imperial units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on the tables in BS 350, "*Conversion factors and tables*".

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.**

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14, 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.

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## 1 Scope

This British Standard specifies requirements for flameproof gate-end boxes designed primarily for use, in the mining industry, on 3-phase a.c. circuits up to 650 V, for direct-on-line contactor starting and for the protection of coalcutters, conveyors, loaders and the like.

## 2 Definitions

For the purposes of this British Standard, the following definitions apply:

**2.1**
**gate-end box**

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

NOTE For the purposes of this standard, the apparatus is essentially an air-break electrically operated contactor with associated equipment to provide control and protection for coalface machinery.

**2.2**
**isolator**

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

**2.3**
**isolating switch**

a switch which isolates a circuit and is capable of breaking not less than its rated current at rated voltage

**2.4**
**contactor**

a device suitable for repeatedly opening and closing the circuits of electrical apparatus; it functions electro-magnetically, the speed of make and of break being independent of the operator

**2.5**
**cable coupling unit (flit plug)**

a unit consisting of a cable sealing box and cable gland together with means for connecting the cable conductors to insulated contact tubes within the sealing box, which is designed to receive the cable; to provide room to spread and connect the cores; to protect the cores; to allow for the attachment of the cable gland; to provide for sealing the insulating materials of the cable, and to facilitate ready connection to or disconnection from a similar unit or other apparatus

**2.6**
**cable coupler adaptor**

a device used to connect a cable coupling unit to apparatus. It may either be separate from or integral with the flameproof enclosure of the apparatus to which the cable coupling unit is to be connected

for the purposes of this standard, the term "adaptor" also includes the unit used to connect other types of cable terminations to apparatus

**2.7**
**cable sealing and dividing box**

a box 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 suitable 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

**2.8**
**detachable cable sealing box**

a cable sealing box so designed that it can be detached from associated apparatus without cutting the cable and without disturbing the sealing

**2.9**
**flameproof enclosure**

a flameproof enclosure for electrical apparatus is one that will withstand, without injury, any explosion of the prescribed flammable gas that may occur within it, under practical conditions of operation within the rating of the apparatus (and recognized overloads, if any, associated therewith) and will prevent the transmission of flame such as will ignite the prescribed flammable gas which may be present in the surrounding atmosphere (see **7.2.3**)

**2.10**
**rating**

the value assigned by the maker to some limitations of performance under certain specified conditions known as the "rated conditions"

**2.11**
**restrained plug and socket**

a plug and socket, the 2 portions of which, when engaged, are designed to be held together by an operating bolt, a screwed union ring, or some other equivalent device. Such a device enables the plug to be readily inserted or withdrawn

**2.12**
**bolted plug and socket**

a plug and socket, the 2 portions of which, when fully engaged, are designed to be held together by one or more bolts or screws, or studs and nuts, in such a way that they cannot be disengaged without the use of tools

**2.13**
**intrinsically safe circuit**

a circuit in which any electrical sparking that may occur in normal working under the conditions specified by the certifying authority, and with the prescribed components, is incapable of causing an ignition of the prescribed flammable gas or vapour (see **7.2.4**)

**2.14**
**local control**

external control by means of a manually operated switch or push button integral with the gate-end box

**2.15**
**remote control**

control by means of a manually operated switch or push button located at a point separate from the gate-end box

**2.16**
**automatic control**

control by means of any device other than a manually operated switch or push button

**2.17**
**sequence interlocking**

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

**2.18**
**overcurrent release**

a device that causes the contactor to open the circuit automatically when the current exceeds the predetermined value at which the release has been adjusted to operate

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 (see **6.10.1**).

**2.19**
**inverse time lag overcurrent release**

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

## 3 Service conditions

Gate-end boxes in accordance with this standard are suitable, within the limits of their ratings, for installations where the service conditions are not more severe than the following:

1) *Ambient temperature.* A peak value not exceeding 40 °C with an average value not exceeding 35 °C over 24 h periods.

2) *Altitude.* An altitude not exceeding 3 300 ft (1 000 m) above sea level.

NOTE When a gate-end box intended for service at high altitudes is tested near sea level, the limits of temperature rise, as indicated in **6.16**, should be reduced by 1 % for each 1 000 ft (300 m) above sea level at which the gate-end box is intended to work in service. The correction does not apply for altitudes below 3 300 ft (100 m).

## 4 Ratings

**4.1 Voltages.** The maximum voltage shall be 650 V. The following supply voltages shall be regarded as standard:

400 V, 440 V, 500 V, 550 V, 600 V and 650 V.

Boxes designed for other than the standard voltages up to 650 V, provided they satisfy all other requirements specified herein, shall be deemed to comply with this standard.

Standard boxes shall be suitable for a voltage variation at least 10 % below and at least 6 % above the declared voltages of the supply for which they are designed, subject again to the maximum of 650 V.

**4.2 Supply frequencies.** The standard frequency shall be 50 Hz. Boxes designed for other frequencies within the range of 25–60 Hz, provided they satisfy all other requirements specified herein, shall be deemed to comply with this standard.

**4.3 Currents**

**4.3.1** *Current rating of boxes.* The following continuous current ratings shall be regarded as standard:

30 A, 80 A and 150 A.

Boxes designed for other than the standard ratings, provided they satisfy all other requirements specified herein, shall be deemed to comply with this standard.

**4.3.2** *Current rating of busbars.* The standard current rating of busbars, where fitted, shall be 300 A. Busbars of other ratings, agreed between the manufacturer and the purchaser, shall also be deemed to comply with this standard.

## 5 Marking

**5.1 Nameplates.** All gate-end boxes shall be permanently marked with the following particulars:

1) The name of the manufacturer or his agent.

2) Manufacturer's type or reference.

3) Manufacturer's serial number.

4) Maximum rated current in amperes.

5) Voltage or voltage range.

6) Frequency.

7) The number of the flameproof certificate and the number or numbers indicating the group of gases and vapours covered by the certificate.

8) A reproduction of the registered flameproof mark (if the manufacturer holds a licence to apply this mark), or any other mark required by the Ministry of Power.

9) Where applicable the intrinsic safety certificate details as required by the Ministry of Power.

10) Additional marking as may be required by any other certifying authority.

**5.2 Terminals.** Terminal markings, when used, shall be as follows:

| | |
|---|---|
| Line terminals: | $L_1$–$L_2$–$L_3$ |
| Outgoing terminals: | A–B–C |

**5.3 Busbar interconnecting trunks.** All busbar interconnecting trunks (see **6.3**) shall be permanently marked with the following particulars:

1) Manufacturer's name or trade mark.

2) Manufacturer's type or reference.

**5.4 Busbar end covers.** All busbar end covers (see **6.4**) shall be marked with the following particulars:

1) Manufacturer's name or trade mark.

2) Manufacturer's type or reference.

**5.5 Diagrams.** Diagrams of connections, which shall be durable and legible, shall be securely attached in an accessible position within the main chamber.

## 6 Design and construction

A gate-end box in accordance with this standard shall comply with the requirements of BS 229[1)] and shall have been certified by the Ministry of Power as flameproof for Group 1 gases (methane/firedamp). The gate-end box may also be certified for any group of gas by any appropriate certifying authority, as may be required.

Unless otherwise agreed between the manufacturers and the purchaser, no external components shall be made of aluminium, magnesium or titanium, or of any alloys except those in which the total content of these 3 constituents does not exceed 15 % by weight and in which the content of magnesium and titanium together does not exceed 10 % by weight. Neither shall any of the component parts be painted or coated with preparations containing, in metallic form, any of the metals referred to above.

NOTE When applying for flameproof certification, it will be necessary, for compliance with BS 229, "*Flameproof enclosure of electrical apparatus*", for the manufacturer to specify the types of fittings for which he has made provision in accordance with **6.2** to **6.6** inclusive.

The following subclauses relate to the basic unit:

**6.1** Enclosing case
**6.5** Outgoing cable
**6.8** Means of isolation
**6.9** Main contactor
**6.10.1** Overcurrent protection
**6.12** External controls
**6.13** Provision for earthing

The following subclauses relate to optional items:

**6.2** Incoming and throughgoing cable
**6.3** Coupling of units
**6.4** Busbar end covers
**6.6** Auxiliary cables
**6.7** Busbars
**6.10.2** Undervoltage protection
**6.10.3** Earth fault protection for main conductors
**6.10.4** Earth fault electrical lockout
**6.10.5** Earth continuity protection
**6.10.6** Plug electrical interlock
**6.10.7** Pilot-to-earth fault protection
**6.11** Provision for control
**6.14** Instruments

The following subclauses relate to both the basic unit and optional items:

**6.15** Fuses
**6.16** Temperature limits
**6.17** Clearances

**6.1 Enclosing case.** The enclosing case shall comprise a main chamber and an isolator/busbar chamber, each with suitable access covers, and shall incorporate, or be adapted for mounting on, skids to facilitate transport.

[1)] BS 229, "*Flameproof enclosure of electrical apparatus*".

The design shall include such provision as will permit, without structural alteration, the attachment of adaptors, cable fittings, interconnecting trunks, etc., as specified in **6.2** to **6.5**, in any combination that may be required for normal installation and operation of the gate-end box. To facilitate this a preferred design of busbar-coupling flange is shown in Figure 1, but other designs shall be deemed to comply with this standard provided they satisfy all other requirements specified herein.

**6.2 Incoming and throughgoing cable.** For the attachment of incoming or throughgoing cables the busbar chamber shall be fitted at either end or both ends, as required, with:

1) all adaptor suitable for the reception of a cable coupling unit (flit plug), e.g. as specified in BS 3454[2)],

or

2) a detachable cable sealing and dividing box, e.g. as specified in BS 542[3)],

or

3) any other fitting which is approved by the certifying authority.

**6.3 Coupling of units.** When 2 or more gate-end boxes are required to be coupled together, this shall be achieved either by:

1) the bolting together of appropriate flanges,

or

2) the fitting of interconnecting busbar trunking. Where the preferred design of busbar flange indicated in **6.1** is adopted the interconnecting busbar trunk shall conform to the dimensions and tolerances shown in Figure 2. The preferred minimum width of flange shall be 1 in.

The coupling arrangements shall be sufficiently robust as to prevent, in normal use, undue strain being placed on the flanges of the gate-end box or those of the interconnecting busbar trunking.

Where skids are provided, it is usual for the skids to be either continuous or, where individual skids are fitted, for coupling plates to be bolted between the skids. Where the preferred design of busbar trunking [see first paragraph of **6.3** 2)] is adopted, the design of coupling plate shall conform to Figure 3.

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

**6.4 Busbar end covers.** When required, a suitable cover shall be fitted to either end of the busbar chamber, as appropriate, to complete the enclosure when a cable fitting is provided at one end only. Where the preferred design of busbar flange indicated in **6.1** is adopted the end cover shall conform to the dimensions and tolerances shown in Figure 4. The preferred minimum width of flange shall be 1 in.

**6.5 Outgoing cable.** For the attachment of the outgoing cable, the case of the gate-end box shall be fitted with:

1) an adaptor suitable for the reception of a cable coupling unit (flit plug), e.g. as specified in BS 3454[2)],

or

2) a detachable cable sealing and dividing box, e.g. as specified in BS 542[3)],

or

3) a socket for the reception of a suitable plug which, when combined, forms a restrained plug and socket coupling, e.g. as specified in BS 279[4)],

or

4) a socket for the reception of a suitable plug which, when combined, forms a bolted plug and socket coupling which is approved by the certifying authority.

**6.6 Auxiliary cables.** When required, provision shall be made for the fitting of auxiliary cable glands for remote control, interlocking, or other external circuits. Such glands shall comply with the requirements of the appropriate British Standard, where applicable.

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

NOTE Plugs and sockets associated with intrinsically safe circuits should be non-interchangeable with plugs and sockets used on power circuits in the box.

**6.7 Busbars.** When required, provision shall be made for the fitting of 3 through-going busbars complying with BS 159[5)].

**6.8 Means of isolation.** A triple pole isolator or isolating switch, having a continuous current rating equivalent at least to that of the contactor, shall be provided in the busbar chamber, so arranged that it shall not be possible to open the main chamber unless the isolator or isolating switch is in the OFF position. It shall be impossible, in normal operation, to close the isolator or isolating switch while the main chamber is open.

[2)] BS 3454, "*3.3 kV 300 A interchangeable bolted flameproof cable couplers and adaptors (including 660 V 300 A adaptors) primarily for use in mines*".
[3)] BS 542, "*Cable glands and sealing boxes for association with apparatus for use at mines*".
[4)] BS 279, "*100-ampere flameproof plugs and sockets (restrained type)*".
[5)] BS 159, "*Busbars and busbar connections*".

Where the means of isolation is not designed to break the rated breaking current of the contactor (see **6.9**) provision shall be made to ensure that, under normal conditions, the contactor opens before the main isolating contacts. The ON and OFF positions of the isolator or isolating switch shall be clearly indicated.

Provision shall be made for locking the isolator or isolating switch in the OFF position.

Provision may be made for reversing the phase sequence by means of the isolator or isolating switch so as to reverse the rotation of the motor controlled by the gate-end box.

**6.9 Main contactor.** An electro-magnetically operated triple pole contactor complying with BS 775[6], Utilization category AC.4 (8 hour duty), Mechanical duty Class II, shall be provided in the main chamber.

Where the main contactor is controlled by an auxiliary relay, the minimum values of incoming supply voltage at which the contactor shall pick up and drop off shall be less than the corresponding values for the relay.

NOTE A flameproof gate-end box to this standard is not intended to interrupt abnormal currents such as those resulting from a phase to phase short circuit.

**6.9.1** *Test feature.* Where required, provision may be made for a test feature associated with a means of isolation. This shall allow operation of the contactor and the control circuit components in the main chamber without the outgoing power circuits being energized.

**6.10 Protection**

**6.10.1** *Overcurrent protection.* Overcurrent protection shall be provided by the fitting of inverse time lag overcurrent releases in 2 phases, except that where earth fault protection is excluded an additional device shall be fitted in the third phase. The devices shall conform to the requirements of BS 587[7] and shall have inverse time lag characteristics suitable for motor starting currents for a range of duties up to the full load continuous rating of the box.

**6.10.2** *Undervoltage protection.* Means shall be provided to ensure that the contactor opens when the supply voltage falls to the appropriate value specified in BS 775[6] (except where such value is modified by the requirements of BS 3101[8], where applicable) and does not reclose on the restoration of supply voltage up to 120 % of the rated voltage, except when the control is specifically designed so to operate, e.g. a float-switch control.

**6.10.3** *Earth fault protection for main conductors.* Provision shall be made in the gate-end box for the fitting, when required, of earth fault protection.

Where such protection is designed for operation on power systems in which the neutral of the power transformer is solidly earthed, it shall cause the contactor to open when the earth fault current attains 5 A, or such lower figure as may be agreed between the purchaser and the supplier. The earth fault trip shall not be self-resetting but shall be arranged for external resetting by hand, means being provided to prevent operation of the resetting device by unauthorized persons. When earth fault electrical lockout is provided this shall be as specified in **6.10.4**.

Where earth fault protection is designed for operation on power systems in which the maximum earth fault current (i.e. the prospective earth fault current) is restricted to 1 A or less, the protection shall cause the contactor to open when the fault current attains a value of 40 % of the prospective earth fault current, or such lower value as may be agreed between the purchaser and the supplier. With this form of protection, and where an electrical lockout is provided (**6.10.4**), the earth fault trip may be self-resetting provided that the lockout is not self-resetting. The means of re-setting the lockout shall be designed to prevent operation by unauthorized persons.

In all cases:

1) visible indication of the earth fault trip shall be provided, and

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

**6.10.4** *Earth fault electrical lockout.* Additional means may be provided for locking out the contactor electrically while an earth fault exists, but any such arrangement shall be of a type certified as intrinsically safe.

**6.10.5** *Earth continuity protection.* If required, provision shall be made in the gate-end box to cause, in the event of an open-circuit or undue increase in resistance of the earth connection between the gate-end box and the controlled apparatus, the contactor to open if in the closed position or not to close if in the open position. Any circuit involved shall be of a type certified as intrinsically safe.

NOTE The effectiveness of this protection depends upon the extent to which alternative parallel paths to the earth conductor exist.

[6] BS 775, "*Contactors*".
[7] BS 587, "*Motor starters and controllers*".
[8] BS 3101, "*Intrinsically-safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*".

**6.10.6** *Plug electrical interlock.* Where a restrained plug and socket is specified, an intrinsically safe circuit shall be provided for the purpose of interlocking the plugs, to ensure that the circuit of the contactor coil shall be broken before the main pins of the plug leave their corresponding socket contacts. The electrical connections shall be such that the insertion of a plug into its socket shall not alone cause the main contactor to close.

**6.10.7** *Pilot-to-earth fault protection.* If required, provision shall be made in the gate-end box to cause, in the event of inadvertent contact between the pilot core and earth, the contactor to open if in the closed position or not to close if in the open position. Any circuit involved shall be of a type certified as intrinsically safe.

Means may be provided at the box to enable an authorized person, without opening the enclosure, to test the pilot-to-earth protection for correct functioning.

**6.11 Provision for control.** Provision shall be made, as required, for one or more of the following methods of control:

1) Local control.
2) Local control with sequence interlocking.
3) Remote control.
4) Remote control with sequence interlocking.
5) Automatic control.

When a number of alternative methods of control are required in one unit, means shall be provided to convert from one method to another. When the means provided take the form of an externally operated switch, this shall be capable of being locked in any position.

An internal link shall be provided to render the "local" start position inoperative when operational considerations make this necessary. The STOP button on the gate-end box shall be effective in opening the contactor, whatever method of control is used.

Where restrained plugs and sockets are used in association with external control cables, all control circuits shall comply with the requirements of BS 3101[9)] or be of a type certified as intrinsically safe.

**6.12 External controls.** The external handles, levers or push buttons shall be so designed and arranged as to minimize the risk of inadvertent operation, damage or distortion due to mishandling, falls of roof, or collision with other gear.

The START switch, where provided, shall be so arranged as to minimize the risk of inadvertent operation.

**6.13 Provision for earthing.** An external earthing terminal, with brass nuts, not less in size than ½ in Whitworth shall be provided to enable the containing case to be earthed, irrespective of any means provided for attaching the metallic covering of the cable feeding the apparatus, and be so designed that the connection between an earthing conductor and the casing can be made mechanically secure and electrically efficient.

**6.14 Instruments.** Provision may be made for fitting either an ammeter or a voltmeter, as required.

**6.15 Fuses.** Where auxiliary circuits and/or instruments are connected across the power circuit they shall be protected by fuses. These fuses shall comply with the requirements of BS 88[10)], Category AC16, as minima.

**6.16 Temperature limits.** The temperature limitation of the various parts shall be as indicated below.

NOTE Reference should be made to Clause **3** for service conditions.

**6.16.1** *Contacts, conductors and coils.* The maximum permissible temperature limitation for contacts, conductors and coils shall be in accordance with the relevant clauses of BS 587[11)], or BS 775[12)], as appropriate.

**6.16.2** *Busbars.* The maximum permissible temperature limitation for busbars shall be in accordance with the relevant clauses of BS 159[13)].

**6.17 Clearances.** The minimum clearance in air between live parts at different potentials, and between live parts and earth, shall be such that no flash-over occurs when the gate-end box is tested in accordance with **7.2** and **7.3**.

9) BS 3101, "*Intrinsically-safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*".
10) BS 88, "*Cartridge fuses of voltage ratings up to 660 volts*".
11) BS 587, "*Motor starters and controllers*".
12) BS 775, "*Contactors*".
13) BS 159, "*Busbars and busbar connections*".

There is at present insufficient evidence available to determine the minimum safe creepage distance for any class of insulating material. The creepage distance between live parts at different potentials, and between live parts and earth, may vary according to the expected surface resistivity of the insulating material under service conditions. For main conductors, the clearance and creepage shall not be less than ¾ in (19 mm), with the exception of those components for which particular clearances are stipulated in the appropriate British Standards to which this standard refers.

## 7 Tests

**7.1 General.** Tests shall be made to prove compliance with all the requirements of this standard. It is not intended, nor is it recommended that all tests should be made on every gate-end box supplied. Three kinds of tests are recognized, as follows:

1) *Type tests*, which shall be made on a representative sample of each particular type of box.

2) *Routine (individual) tests*, which shall be made on each gate-end box manufactured to this standard.

All tests shall be carried out with the box in clean and new condition.

**7.2 Type tests.** Unless otherwise specified when inviting tenders, type tests on boxes identical in essential respects with those purchased shall be accepted as evidence of compliance of the boxes with the general requirements of this standard.

Type tests shall be made by a recognized authority who, except for tests for flameproofness and intrinsic safety, may be the manufacturer, unless the purchaser specifies otherwise.

Records of all type tests, with appropriate detailed drawings of the box, as tested, shall be held available by the manufacturer.

**7.2.1** *Temperature rise tests.* Tests on all continuously rated current carrying parts in circuit shall be made to prove compliance with **6.16**. During these tests, all covers shall be closed and all shunt connected apparatus shall be fed from an a.c. supply at their declared voltage and frequency, as the heating of one part may materially affect another.

NOTE It is unnecessary for the maker to record the performance of the full range of coils which can be provided. It is required that sufficient tests be made to ensure compliance by interpolation or deduction.

**7.2.2** *Performance tests.* Tests shall be made on a completely assembled gate-end box, with covers closed, to ensure that:

1) the contactor complies with the category and duty class, as regards current making and breaking for the appropriate number of operations, as required by **6.9**;

2) where the isolating switch is designed to break the rated breaking current of the contactor, it is capable of making and breaking this current 5 times, at a power factor of 0.2 to 0.3, at intervals of 10 s.

Where provision is made for reversing the phase sequence, this test shall be repeated for the alternative direction of operation.

**7.2.3** *Flameproofness.* The gate-end box shall comply with the test requirements of BS 229[14] for Group I (methane/firedamp) gas and the requirements of any certifying authority as may be agreed.

**7.2.4** *Intrinsic safety.* Any circuits required to be intrinsically safe shall comply with the test requirements of BS 1259[15] appropriate to Class I and shall be certified as intrinsically safe by the Ministry of Power and/or any other certifying authority as may be agreed.

**7.2.5** *Mechanical tests.* The mechanical endurance test shall be made by operating the contactor, by means of its own operating mechanism and associated control circuits, without passing current through the main contacts, on-and-off 1.2 million times, after which all mechanical working parts (except contacts) shall be in order and shall be without permanent distortion and/or undue wear.

During the test no adjustment or replacement of parts other than contacts (main and auxiliary shall be permissible, and the number of such adjustments or replacements shall not exceed 10.

The frequency of operation shall be not less than 150 times per hour.

A similar mechanical endurance test shall be made by operating 5 000 times all working parts of the isolator, or isolating switch, and its associated auxiliary contacts. During the test no adjustment or replacement of parts shall be permissible.

**7.3 Routine (individual) tests**

**7.3.1** *High voltage test.* The gate-end box shall be capable of withstanding a high voltage test when in clean, new condition with the cover (or covers) closed after having been exposed to ordinary atmosphere with the cover (or covers) open for at least 24 h prior to the test.

[14] BS 229, "*Flameproof enclosure of electrical apparatus*".
[15] BS 1259, "*Intrinsically safe electrical apparatus and circuits for use in explosive atmospheres*".

The test voltage shall be 1 000 V a.c. plus twice the rated maximum voltage of the model, with a minimum of 2 000 V at a frequency of between 25 Hz and 100 Hz, of approximate sine wave form, and shall be applied for 1 min as follows:

1) With the contactor open, across any main or auxiliary contacts connected directly or indirectly to a main pole or poles and which in operation may be required to withstand the supply voltage.

2) Between main poles with both isolator and contactor closed and the potential circuits connected at one pole only. This test to be repeated for alternative positions of the isolator.

3) Between main poles and any other metal parts insulated therefrom, with the isolator and contactor as in 2).

4) Between the main poles and any other independent circuits.

Instruments and other ancillary apparatus may be disconnected during this test and tested separately in accordance with the appropriate British Standard.

NOTE A value of insulation resistance is not specified, as it is not practicable to prescribe limits for the range of apparatus covered by this standard. Further, it is considered that the high voltage test determines whether the insulation is satisfactory or otherwise.

**7.3.2** *Control circuits.* The contactor control circuits, where applicable, shall be tested to prove compliance with the operating values laid down in BS 3101[16)].

**7.3.3** *Overcurrent releases.* Overcurrent releases shall be proved by test to function correctly at currents within 10 % of the marked operating value, at each end of the range.

Additional tests shall be made to ensure that the time delay characteristics are in accordance with the declared characteristics. It is the responsibility of the manufacturer to show that his method of test is such as to prove compliance.

**7.3.4** *Operation tests.* The gate-end box shall be connected up as it is intended to be installed, and tested for correct functioning of the following, when fitted:

1) Earth fault protection (**6.10.3**).

2) Earth fault electrical lockout (**6.10.4**).

3) Earth continuity protection (**6.10.5**).

4) Plug electrical interlock (**6.10.6**).

5) Pilot-to-earth fault protection (**6.10.7**).

6) Provision for control (**6.11**).

7) Test feature for control circuit (**6.9.1**).

## 8 Information to be supplied to the manufacturer with the enquiry

The purchaser should supply with the enquiry the following information[17)]:

### 8.1 Information relating to the supply system

1) System — unearthed or earthed (method of earthing).

2) Declared voltage or voltage range of the circuit.

3) Frequency.

### 8.2 Information relating to the motor, where known

1) Full load current or rated output of the motor in hp.

2) Starting current of the motor at the specified voltage.

3) Any information concerning special conditions likely to affect the performance of the gate-end contactor.

### 8.3 Information relating to the gate-end box

1) Standard continuous current rating.

2) Current rating of busbars, when required.

3) Whether the means of isolation should include provision for reversing and/or a test feature.

4) System of control required (see **6.11**).

5) Whether earth fault protection is required.

6) If earth fault protection is required, whether electrical lockout is also required.

7) Whether earth continuity protection is required.

8) Whether pilot-to-earth fault protection is required.

9) Whether an ammeter or voltmeter is required.

### 8.4 Cables and cable entries

1) *Provision for main supply cables.* Whether provision is required at one end or both ends of the gate-end box for main cable attachments; the type required should be stated.

2) *Provision for outgoing cables.* Details should be given as to the type of outgoing cable attachment required, together with the number, if any, of the auxiliary cable fittings needed.

In either case, the cable details should be given in accordance with the appropriate British Standard.

16) BS 3101, "*Intrinsically-safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*".

17) It is recognized that the whole of this information may not be available at the time of the enquiry, in which case further details should be supplied with the order.

## Appendix A Metric values

The following metric values are calculated equivalents of the respective inch dimensions given in Figure 1, Figure 2, Figure 3 and Figure 4.

| in | mm | in | mm |
|---|---|---|---|
| 0.006 | 0.15 | $3^5/_8$ | 92.1 |
| 0.010 | 0.25 | $3^3/_4$ | 95.2 |
| $^1/_8$ | 3.2 | $3^7/_8$ | 98.5 |
| $^3/_{16}$ | 4.8 | 4 | 101.6 |
| $^1/_4$ | 6.4 | $4^1/_2$ | 114.3 |
| $^3/_8$ | 9.5 | 5 | 127.0 |
| $^7/_{16}$ | 11.1 | $5^3/_4$ | 146.0 |
| $^1/_2$ | 12.7 | 5.995 | 152.3 |
| $^9/_{16}$ | 14.3 | 6 | 152.4 |
| $^5/_8$ | 15.9 | 6.005 | 152.5 |
| 1 | 25.4 | $6^1/_2$ | 165.1 |
| $1^1/_8$ | 28.6 | $7^1/_2$ | 190.5 |
| $1^1/_4$ | 31.8 | 9 | 228.6 |
| $1^3/_4$ | 44.5 | 12 | 305 |
| 2 | 50.8 | $14^1/_2$ | 368 |
| $2^1/_4$ | 57.2 | | |
| $2^1/_2$ | 63.5 | $18^1/_4$ | 463 |
| $2^5/_8$ | 66.7 | $21^1/_4$ | 540 |
| 3 | 76.2 | 26 | 662 |
| $3^1/_4$ | 82.5 | | |

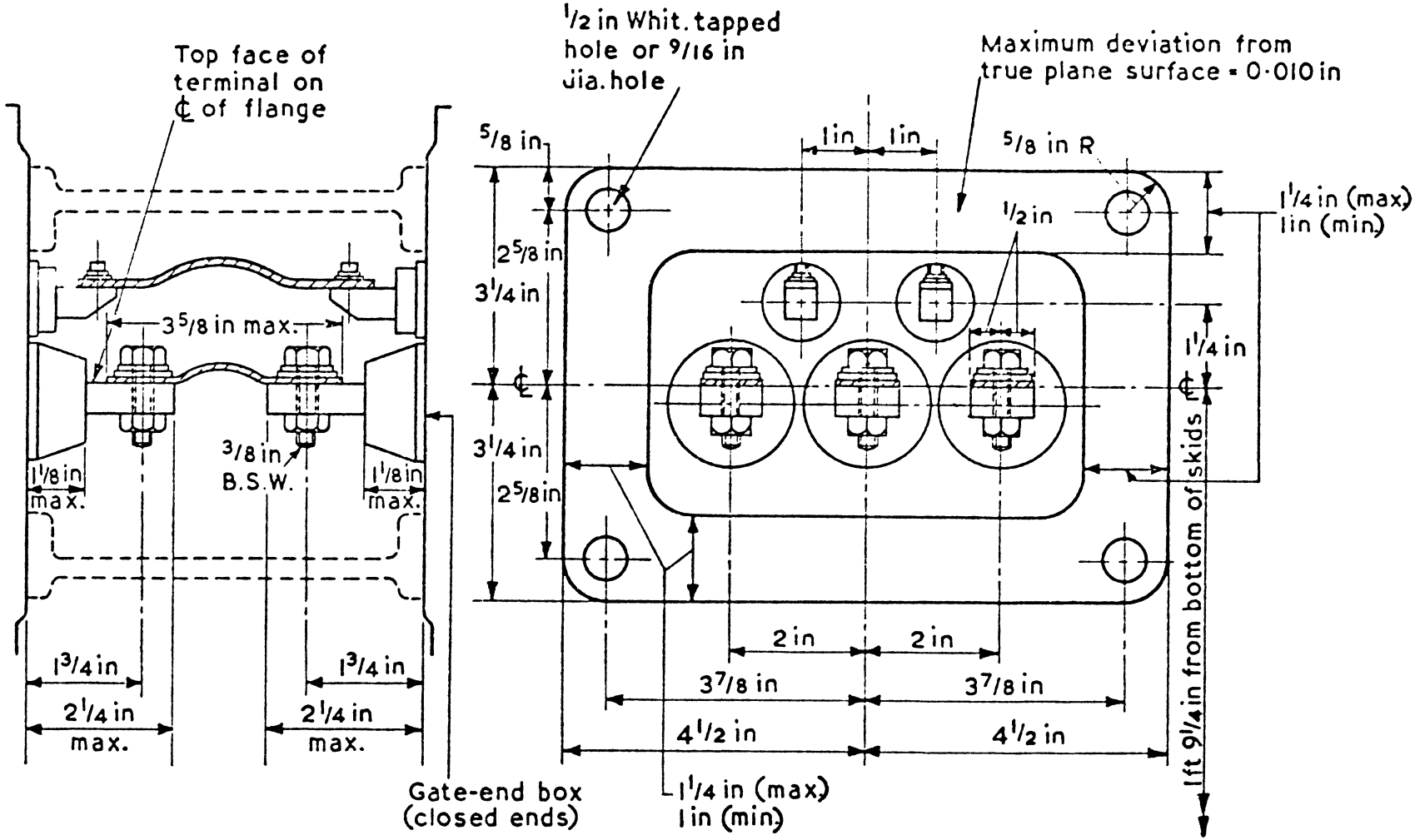


**Figure 1 — Arrangement of busbar chamber end flange, terminals and interconnections (see 6.3)**

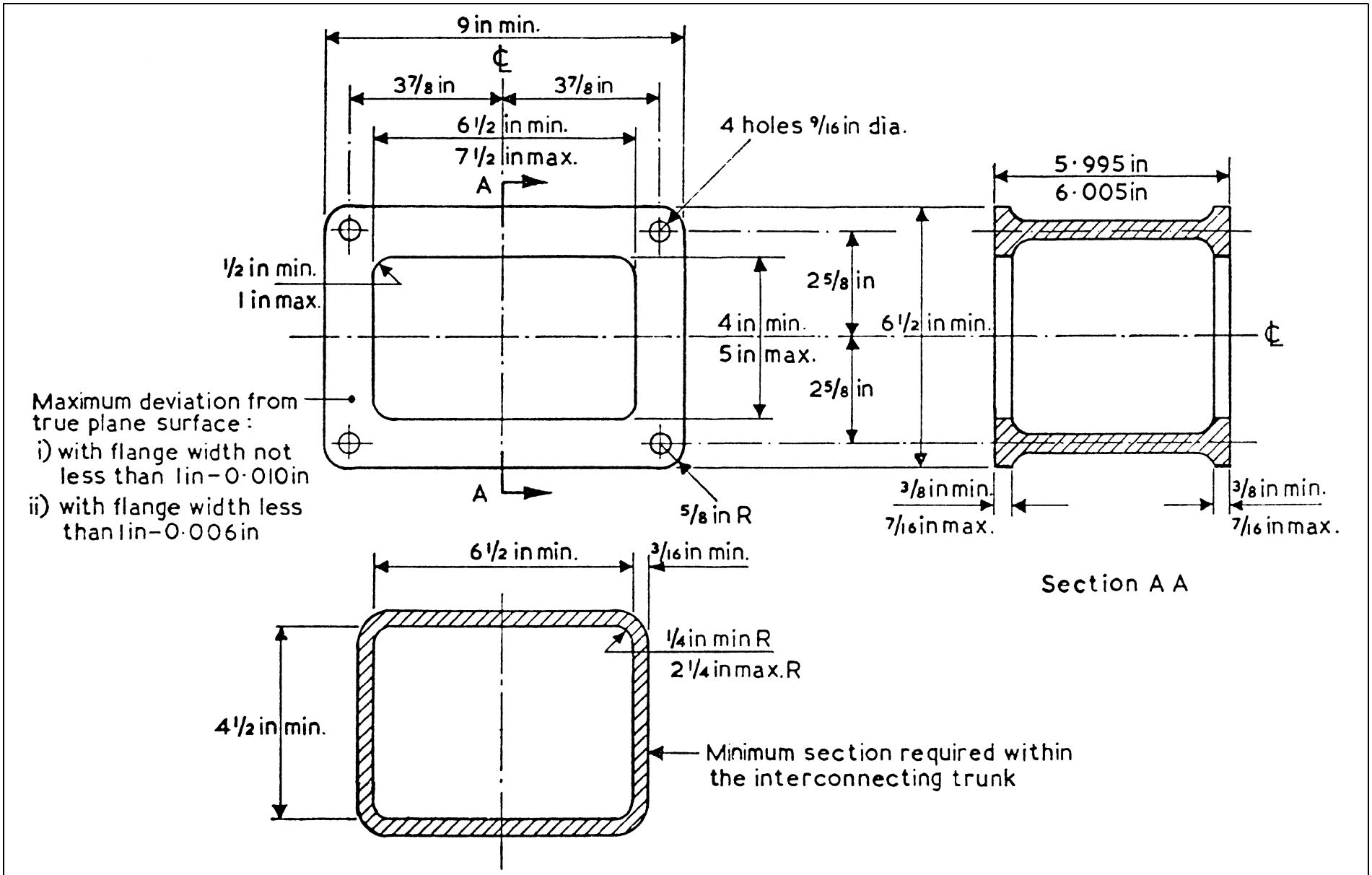


**Figure 2 — Busbar interconnecting trunk**

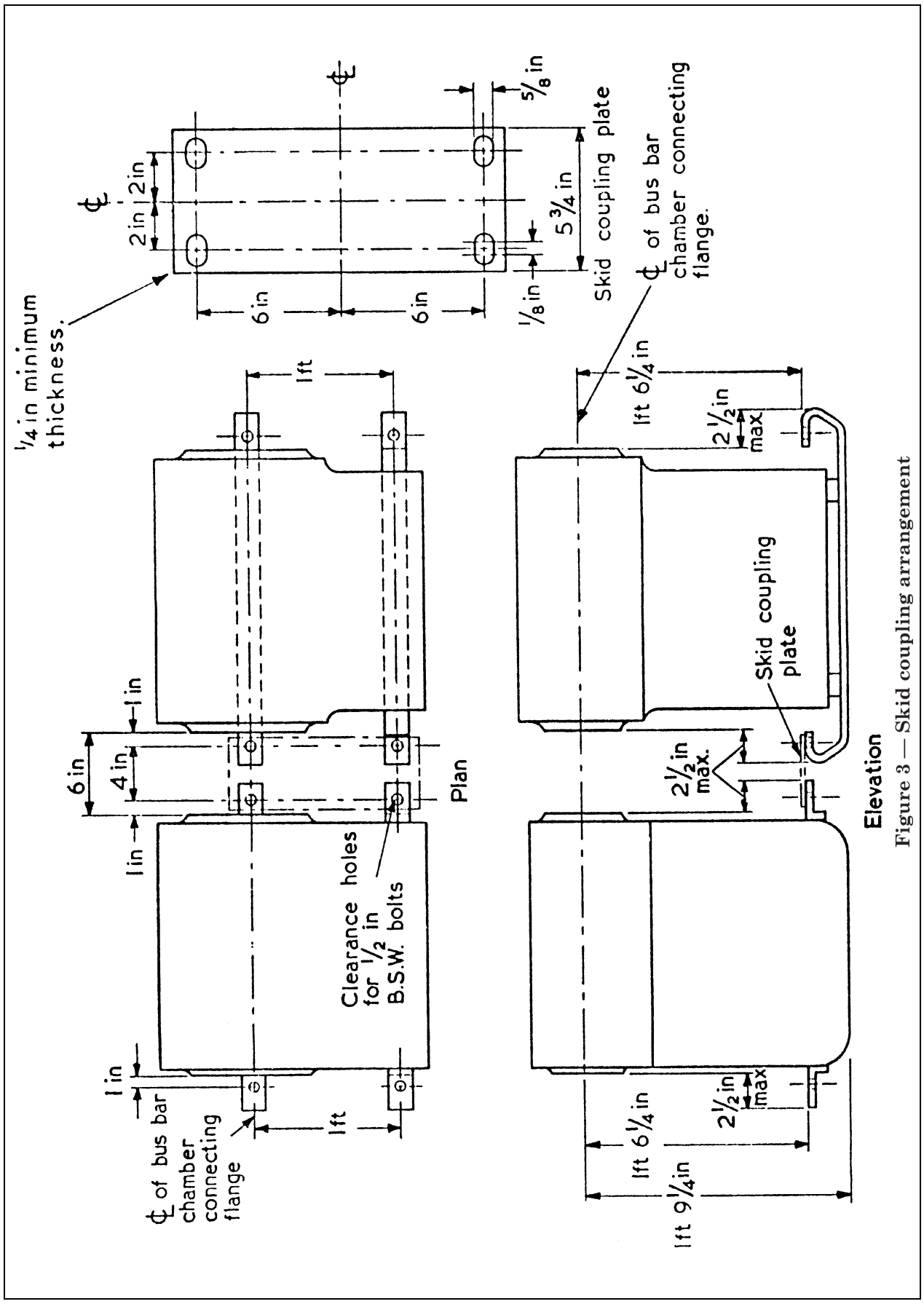


Figure 3 — Skid coupling arrangement

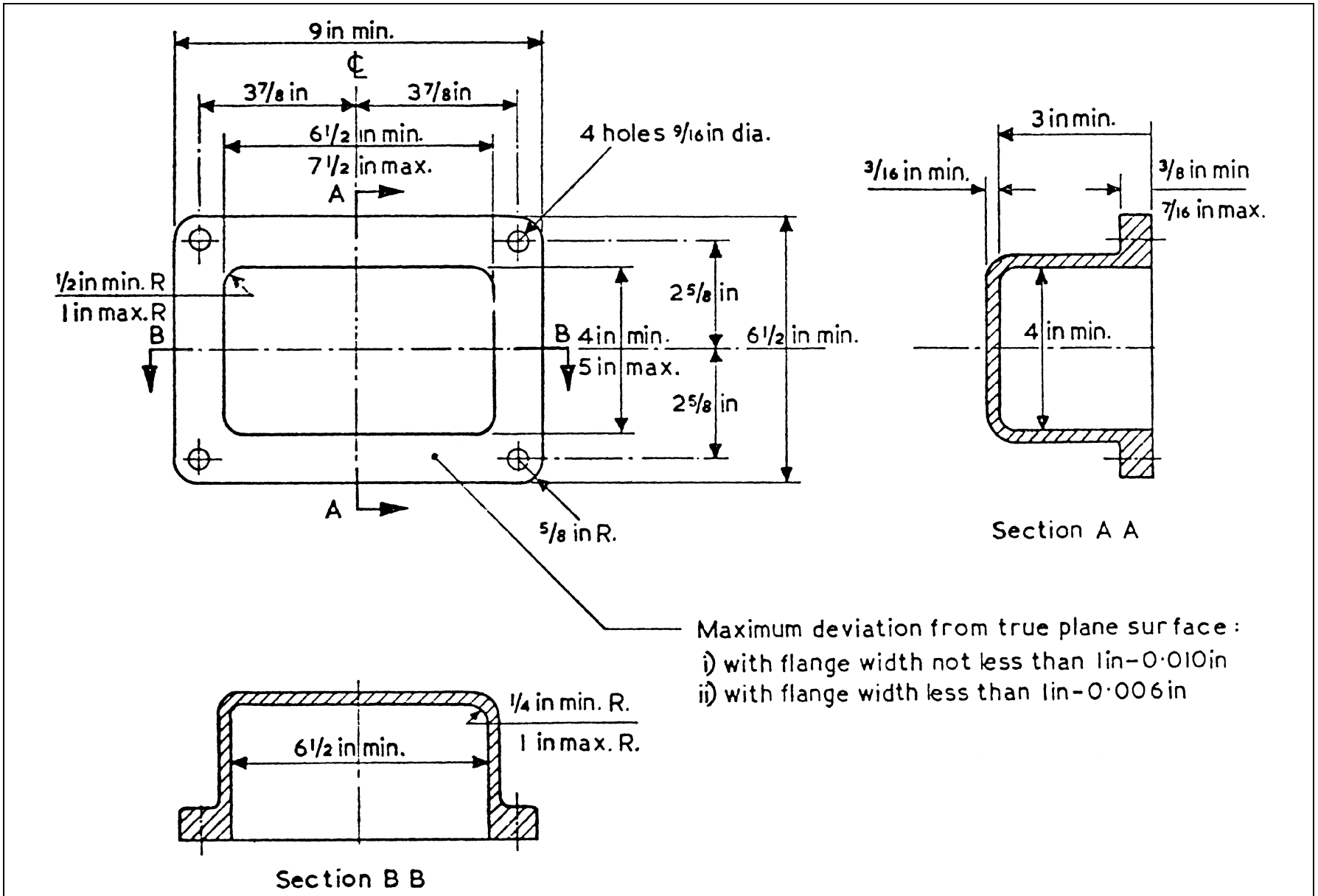


**Figure 4 — Busbar end cover**

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## British Standards

The following are available on application:
YEARBOOK
Including subject index and numerical list of British Standards
SECTIONAL LISTS. Gratis
Acoustics (SL 10)
Aerospace materials and components (SL 25)
Automobile (SL 34)
British Standard Handbooks (SL 27)
Building (SL 16)
Chemical engineering (SL 5)
(Chemicals, fats, glues, oils, soap, etc. (SL 4)
Cinematography and photography (SL 1)
Coal, coke and colliery requisites (SL 13)
Codes of practice (SL 8)
Consumer goods (SL 3)
Documentation, including Universal Decimal Classification (SL 35)
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Electrical engineering (SL, 26)
Farming, dairying and allied interests (SL 31)
Furniture, bedding and furnishings (SL 11)
Gardening, horticulture and landscape work (SL 41)
Gas and solid fuel and refractories (SL 2)
Glassware, excluding laboratory apparatus (SL 39)
Heating, ventilating and air conditioning (SL 42)
Hospital equipment (SL 18)
Illumination and lighting fittings (SL 14)
Industrial instruments, etc. (SL 17)
Iron and steel (SL 24)
Laboratory apparatus (SL 23)
Leather, plastics, rubber (SL 12)
Local authority purchasing officers' guide (SL 28)
Machine tools (SL 20)
Mechanical engineering (SL 6)
Nomenclature, symbols and abbreviations (SL 29)
Non-ferrous metals (SL 19)
Nuclear energy (SL 36)
Packaging and containers (SL 15)
Paints, varnishes, paint ingredients and colours for paints (SL 9)
Personal safety equipment (SL 30)
Petroleum industry (SL 38)
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Textiles and clothing (SL 33)
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