BRITISH STANDARD

BS 787-2:1968

Incorporating Amendment No. 1

Specification for

Mining type flameproof gate-end boxes —

Part 2: Gate-end boxes with air-break circuit-breakers (for use on 3-phase a.c. circuits up to 650 volts)

Confirmed January 2011

Co-operating organizations

The Colliery Requisites Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government 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 Colliery Requisites Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 30 August 1968

The following BSI references relate to the work on this standard:
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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 862, *Air-break circuit-breakers (including totally-enclosed and flameproof types) for voltages not exceeding 660 volts.*

BS 936, *Oil circuit-breakers for medium-voltage alternating-current systems.*

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 has been prepared, under the authority of the Colliery Requisites Industry Standards Committee, to standardize the main features of gate-end boxes used primarily in coal mining in the United Kingdom.

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.

BS 787 was first issued in 1938, and has been revised and re-issued as BS 787-1:1965 to cover gate-end boxes in which the essential apparatus is an air-break electrically operated contactor. This additional specification, designated as BS 787-2, extends the scope of the original BS 787 by covering 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 forms of gate-end boxes, such as lighting units and drill units.

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 350-1, "*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 and ii, pages 1 to 16 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 British Standard specifies requirements for mining type flameproof gate-end boxes with air-break circuit-breakers for use on 3-phase a.c. circuits up to 650 volts.

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 In this particular instance the apparatus is essentially an air-break circuit-breaker with associated equipment to provide control and protection of other electrical apparatus.

2.2
isolator

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

2.3
air-break circuit-breaker

a device, hand or power operated, capable of making, carrying and breaking currents in air, at substantially atmospheric pressure, under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short-circuit

2.4
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

2.5
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

2.6
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

2.7
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 to connect other types of cable terminations to apparatus

2.8
restrained plug and socket

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

2.9
bolted plug and socket

a plug and socket, the two 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

2.10
flameproof enclosure

an enclosure for electrical apparatus 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 **7.2.4**)

2.11
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**)

2.12
rating

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

2.13
local control

external control by means of an external handle for a hand operated circuit-breaker, or by push button for an electrically operated circuit-breaker

2.14
remote control

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

2.15
automatic control

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

2.16
sequence interlocking

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

2.17
overcurrent release

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

2.18
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

2.19
undervoltage release

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

2.20
shunt release

a device which 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

3 Service conditions

Gate-end boxes in accordance with this specification 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-hour periods.

2) *Altitude*. An altitude not exceeding 3 300 feet (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 feet (300 m) above sea level at which the circuit-breaker is intended to work in service. The correction does not apply for altitudes below 3 300 feet (1 000 m).

4 Ratings

4.1 Voltages. The maximum voltage shall be 650 volts.

The following supply voltages shall be regarded as standard:

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

Boxes designed for other than the standard voltages up to 650 volts, 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 volts.

4.2 Supply frequencies. The standard frequency shall be 50 Hz(c/s). Gate-end boxes designed for other frequencies within the range of 25–60 Hz(c/s), 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 preferred continuous current ratings of boxes shall be:

200, 300, 400 amperes

Boxes designed for other 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 current rating of busbars, where fitted, shall be at least equal to the circuit-breaker rating, with a minimum rating of 300 amperes.

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) Making capacity peak (kA).

6) Breaking capacity (kA).

7) Voltage or voltage range.

8) Frequency.

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

10) 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.

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

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

5.2 Terminals. Terminal markings, if required, for incoming and outgoing connections shall be agreed between the manufacturer and the purchaser.

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 specification shall comply with the requirements of BS 229[1)] (Note) 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 manufacturer and purchaser, no external component shall be made of aluminium, magnesium or titanium, neither shall any alloy containing aluminium and/or magnesium and/or titanium be used unless the total content of these three constituents does not exceed 15 % by weight, and in which the content of magnesium and titanium together does not exceed 10 % by weight.

No external part shall be painted or coated with preparations containing, in metallic form, aluminium, magnesium or titanium.

NOTE These limitations have been imposed to avoid the hazards of incendive sparking due to friction between rusty steel and the metals described.

NOTE When applying for flameproof certification, it will be necessary, for compliance with BS 229[1)], 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	Circuit-breaker
6.10.1.1	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
6.10.1.2	Short-circuit protection
6.10.2	Undervoltage protection
6.10.3	Earth fault protection for main conductors
6.10.4	Earth fault electrical lockout
6.10.5	Electrical interlocking
6.10.6	Plug electrical interlock
6.10.7	Interlock circuit/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

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

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

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

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 two 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 2) above] 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 specified 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, as approved by the certifying authority.

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

6.7 Busbars. When required, provision shall be made for the fitting of three throughgoing busbars complying with BS 159[5)].

[2)] BS 3454, "*3.3 kv 300 A interchangeable bolted flameproof cable couplers and adaptors*".
[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*".

6.8 Means of isolation. An off-load triple pole isolator, having a continuous current rating equivalent at least to that of the circuit-breaker, shall be provided in the busbar chamber. Unless otherwise specified the isolator shall have three positions, namely ON, OFF and EARTH respectively, and in normal operation, shall be interlocked with the circuit-breaker to ensure that the isolator cannot be opened or closed with the circuit-breaker closed. It shall not be possible to open the main chamber unless the isolator is in the OFF position, or to close the isolator while the main chamber is open. The ON, OFF and EARTH positions of the isolator shall be clearly indicated. With the isolator in the EARTH position it shall be possible to close the circuit-breaker, thereby earthing the outgoing cable.

Provision shall be made for locking the isolator in the OFF and EARTH positions.

6.9 Circuit-breaker. A triple pole manually operated air-break circuit-breaker shall be included in the main chamber; alternatively, power operation may be provided when agreed between the purchaser and the manufacturer.

6.9.1 ***Operation.*** The circuit-breaker shall be arranged for trip-free operation to ensure that the moving contacts return to and remain in the open position when the opening operation is initiated after the initiation of the closing operation, even if the closing demand is maintained.

The operating handle spindle, where it passes through the wall of the enclosure, shall be provided with a renewable bush. The circuit-breaker shall comply with the appropriate requirements for operation in service, as specified in BS 936[6)].

6.9.2 ***Performance.*** The circuit-breaker shall be capable of meeting the performance figures stated in the following table for all rated voltages and frequencies:

Continuous current rating	Breaking current (symmetrical)	Making current	Power factor (maximum)
amperes	kA	kA	
200	4.5	9	0.3
300	7.25	14.5	0.3
400	9	18	0.3

6.9.3 ***Test feature.*** When required, provision may be made for a "test" feature to permit operation of components within the gate-end box which are associated with electrical interlocking circuits or with control circuits.

6.10 Protection

6.10.1 ***Overcurrent and short-circuit protection***

6.10.1.1 *Overcurrent protection*. Overcurrent protection shall be provided by the fitting of inverse time lag overcurrent releases in two phases, except that where earth fault protection is excluded an additional device shall be fitted in the third phase. The device shall conform to the requirements of the appropriate clause of BS 936[6)] and shall have inverse time lag characteristics suitable for currents for a range of duties up to the full load continuous rating of the circuit-breaker.

6.10.1.2 *Short-circuit protection.* When required, instantaneous short-circuit releases may be provided; when these are fitted the value(s) at which the releases are to operate shall be agreed between the purchaser and the supplier. The device shall not be self-resetting. Means shall be provided to prevent operation of the resetting mechanism by unauthorized persons.

6.10.2 ***Undervoltage protection.*** Provision shall be made in each box for the inclusion, when required, of an under-voltage release which shall operate on a falling voltage between the limits of 50 % and 20 % of the declared voltage and be capable of closing at voltages down to 85 % of the declared voltage of the system which shall be one of the voltages specified in Clause **4**.

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.

6) BS 936, "*Oil circuit-breakers for medium-voltage alternating-current systems*".

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 circuit-breaker to trip when the earth fault current attains 5 amperes, 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 re-setting by hand, means being provided to prevent operation of the re-setting device by unauthorized persons. When earth fault electrical lock-out 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 amp or less, the protection shall cause the circuit-breaker to trip 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 lock-out 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 circuit-breaker electrically while an earth fault exists, but any such arrangement shall be of a type certified as intrinsically safe.

6.10.5 ***Electrical interlocking.*** Provision shall be made, where required, for the inclusion of electrical interlocking and/or remote tripping circuits. Such circuits shall operate at a voltage not exceeding 25 volts a.c. or 30 volts d.c. when associated with auxiliary cable glands or bolted plugs and sockets, and shall be certified as intrinsically safe when used with restrained plugs and sockets. If required, means shall be provided to trip the circuit-breaker in the event of a fault to earth on the interlocking or tripping circuit.

6.10.6 ***Plug electrical interlock.*** Where a restrained plug and socket is specified in accordance with **6.5**, an intrinsically safe circuit shall be provided to ensure that, in normal operation, the circuit-breaker shall open before the main plug contacts leave their corresponding socket contacts, and that the circuit-breaker cannot be closed until the main plug contacts are engaged with their corresponding socket contacts. The arrangement shall be such that the insertion of a plug into its socket shall not alone cause an electrically operated circuit-breaker to close.

6.10.7 ***Interlock circuit/earth fault protection.*** When required, means shall be provided to trip the circuit-breaker in the event of a fault to earth on the interlocking or intrinsically safe circuits specified in **6.10.5** and **6.10.6** where these are provided. Means may also be provided at the box to enable an authorized person, without opening the enclosure, to test this feature.

6.11 Provision for control. Where the circuit-breaker in a gate-end box is power operated, 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.

When a number of alternative methods of control are required in one unit, means may 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" position of this switch inoperative when operational considerations make this necessary. The tripping method used on the gate-end box shall be effective, whichever 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[7)] or be of a type certified as intrinsically safe.

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

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.

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 an ammeter and/or 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[8)], Category AC.16, as minima.

6.16 Temperature limits. The temperature limitation of the various parts shall be specified as follows:

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 862[9)].

6.16.2 ***Busbars.*** The maximum permissible temperature limitation for busbars shall be in accordance with the relevant clauses of BS 159[10)].

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**.

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 be not 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 specification 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 shall be made on every gate-end box supplied. Two 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 regarded 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.

The method of determining the values and conditions of all factors involved in the type tests shall be in accordance with BS 936[11)].

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

8) BS 88, "*Cartridge fuses of voltage ratings up to 660 volts*".
9) BS 862, "*Air-break circuit-breakers including totally-enclosed and flameproof types*".
10) BS 159, "*Busbars and busbar connections*".
11) BS 936, "*Oil circuit-breakers for medium-voltage alternating-current systems*".

7.2.1 ***Temperature rise tests.*** Tests on all continuously rated current carrying parts in circuit shall be made to prove compliance with the requirements of **6.16**. During these tests, all covers shall be closed and all shunt connected apparatus shall be fed from an a.c. supply at the declared voltage and frequency, since 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 the covers closed, to ensure that the circuit-breaker complies with the provisions of **6.9.2**.

The method of determining the values and conditions of all factors involved in the type tests for making and breaking capacities, such as prospective current, recovery voltage, power factor etc. shall be as defined in BS 936[12)].

7.2.3 ***Flameproofness.*** The gate-end box shall comply with the test requirements of BS 229[13)] 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[14)] appropriate to Class 1 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.*** A mechanical endurance test shall be made by carrying out a number of operating cycles in accordance with the following table; each operating cycle shall consist of one closing operation and one opening operation:

Number of operating cycles

Rated normal current in amperes	Number of operations without maintenance or adjustment (min.)
200	2 000
300	2 000
400	2 000

10 % of the operating cycles shall be made as make/break operations by closing the circuit-breaker with the trip energized through the main or arcing contacts, or through contacts closing simultaneously with these. The tests shall be made without current through the main or arcing contacts (except for the trip coil current). After the test all parts shall be in good working order and shall not show permanent distortion or undue wear. The operating mechanism shall be used during this test and if it is power operated the auxiliary supply shall be controlled to give a force corresponding to 106 % of the rated voltage subject to a maximum of 650 volts. No mechanical adjustment shall be made during the test.

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 hours prior to the test.

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

1) With the circuit-breaker open, across each main contact of the isolator and circuit-breaker, and any auxiliary contact connected directly 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 circuit-breaker closed and the potential circuits connected at one pole only.

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

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

12) BS 936, "*Oil circuit-breakers for medium-voltage alternating-current systems*".
13) BS 229, "*Flameproof enclosure of electrical apparatus*".
14) BS 1259, "*Intrinsically safe electrical apparatus and circuits for use in explosive atmospheres*".

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 circuit-breaker control circuits, where applicable, shall be tested to prove compliance with the operating values laid down in BS 3101[15)].

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.*** Tests shall be made at the manufacturer's works to ensure that the gate-end box complies in every respect with the operational requirements of this standard. Such tests shall be in accordance with the appropriate clauses of relevant British Standards and shall include, where applicable:

1) In accordance with BS 936[16)] except where modified, as indicated, by the subclauses of this standard:
   a) Closing operation tests.
   b) Opening operation tests:
      i) when fitted with shunt releases;
      ii) when fitted with overcurrent releases (see also **7.3.3**);
      iii) when fitted with under voltage release (see also **6.10.2**).
   c) Tests to prove satisfactory tripping of the circuit-breaker with the closing power applied.
   d) Tests to prove satisfactory behaviour of the circuit-breaker when the closing operation is initiated with the trip circuit energized.
   e) Tests to prove that the operation of the power closing device, when the circuit-breaker is already closed, causes neither damage to the circuit-breaker nor danger to the operator.
2) Tests to prove compliance of the following, with the appropriate subclauses, as indicated, of this standard:
   a) Earth fault protection (**6.10.3**).
   b) Earth fault electrical lockout (**6.10.4**).
   c) Electrical interlocking (**6.10.5**).
   d) Plug electrical interlock (**6.10.6**).
   e) Pilot to earth fault protection (**6.10.7**).
   f) Local and/or remote control (**6.11** and BS 3101[17)]).

7.3.5 ***Millivolt drop test.*** When required, a millivolt drop or equivalent resistance measurement test shall be made for comparison with the results of similar type tests for temperature rise at rated normal current in accordance with the appropriate clause of BS 936[16)].

8 Information to be supplied to the manufacturer with the enquiry

The purchaser should supply with the enquiry the following information[18)]:

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.

[15)] BS 3101, "*Intrinsically safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*".
[16)] BS 936, "*Oil circuit-breakers for medium-voltage alternating-current systems*".
[17)] BS 3101, "*Intrinsically safe remote-control circuits associated with restrained plugs and sockets for use in coal mines*".
[18)] 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.

8.2 Information relating to the system, where known

1) Full load current of the circuit to be controlled.

2) Any information concerning special conditions likely to affect the performance of the gate-end circuit-breaker.

8.3 Information relating to the gate-end circuit-breaker

1) Standard continuous current rating.

2) Current rating of busbars, when required.

3) Method of closing: hand/power.

4) Remote trip of interlocking feature(s) required.

5) Method of trip: hand/remote.

6) Whether earth fault protection is required.

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

8) Group of gases.

9) Whether an ammeter and/or voltmeter is required.

8.4 Cables and cable entries. Whether provision is required for incoming, throughgoing, outgoing, and auxiliary cable attachments; details of appropriate cables are to be provided, where applicable. In specifying cable details it is desirable that reference be made to the appropriate British Standard or other relevant standard.

Appendix A Metric values

The following metric values are calculated equivalents of the respective inch dimensions stated on 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		

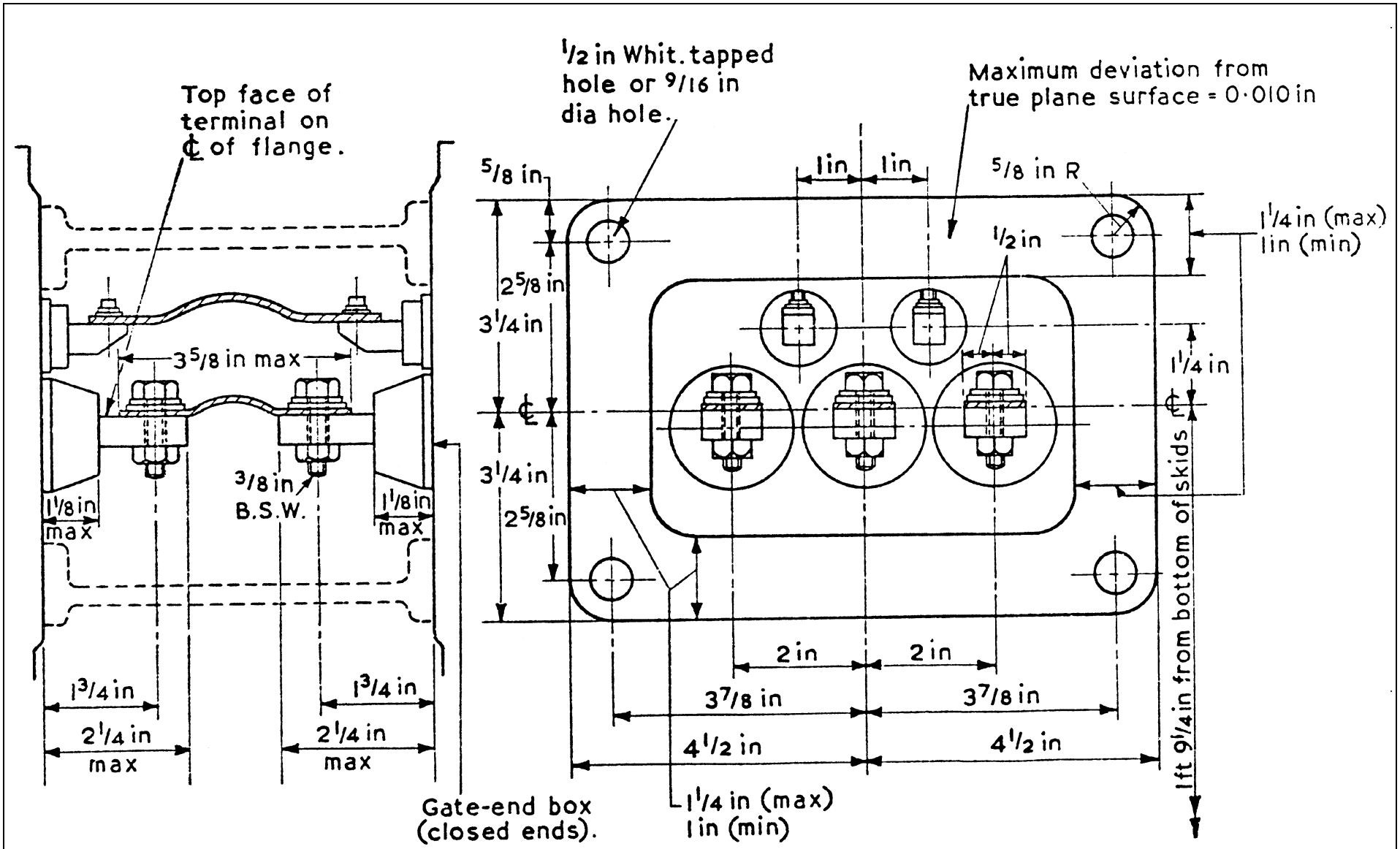

Figure 1 — Arrangement of busbar chamber end flange, terminals and interconnections (see **6.3**)

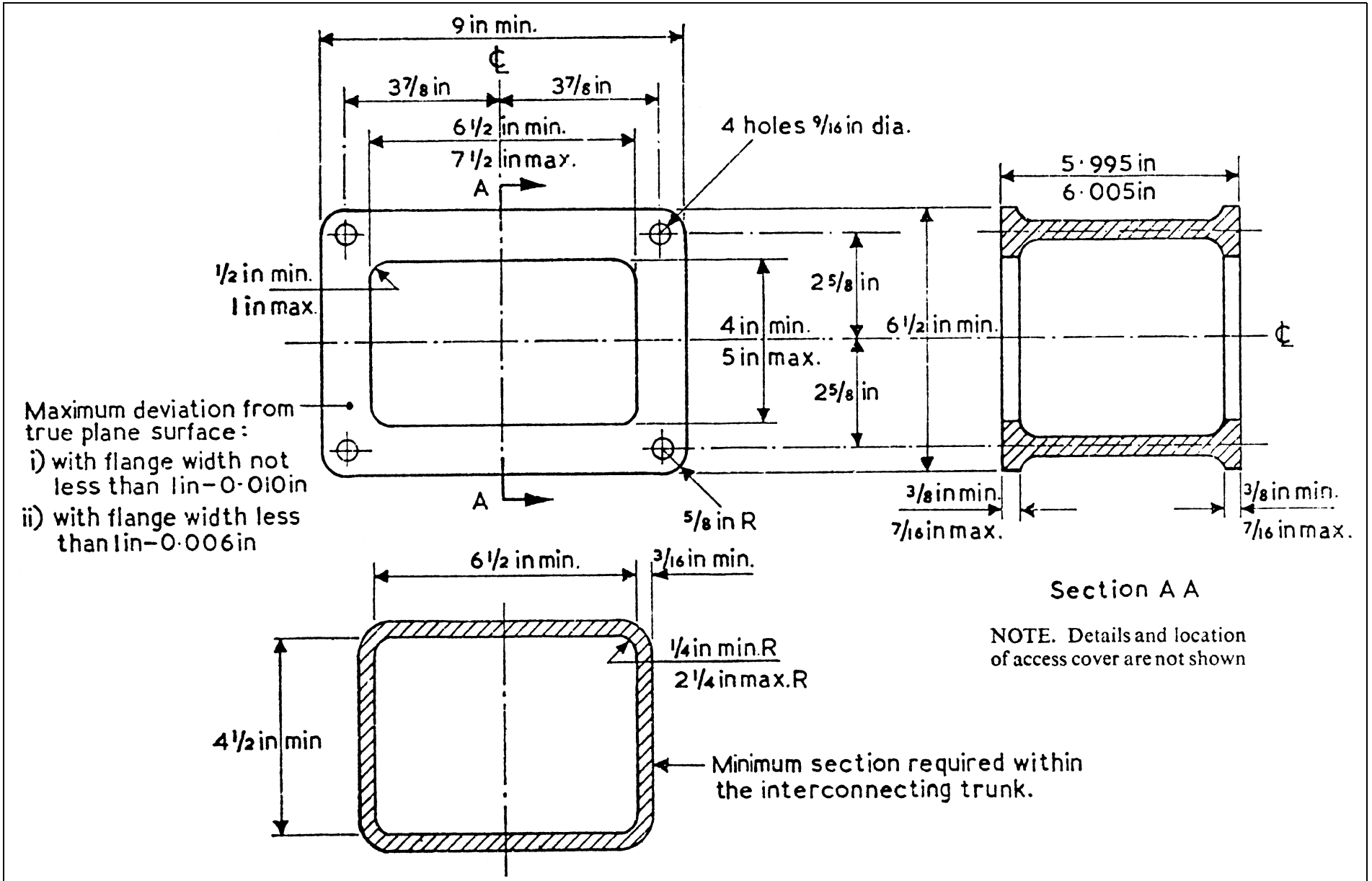

Figure 2 — Busbar interconnecting trunk

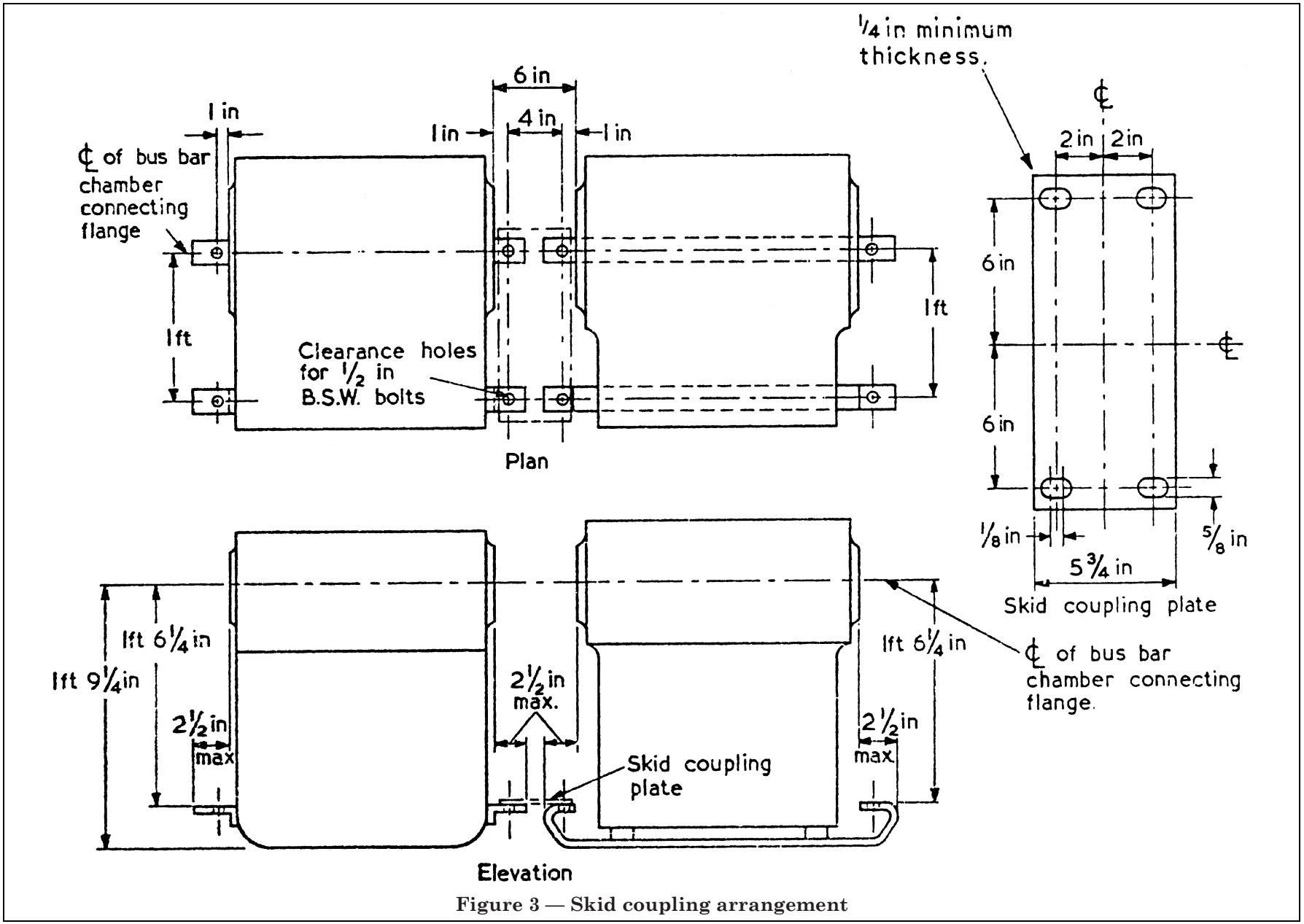

Figure 3 — Skid coupling arrangement

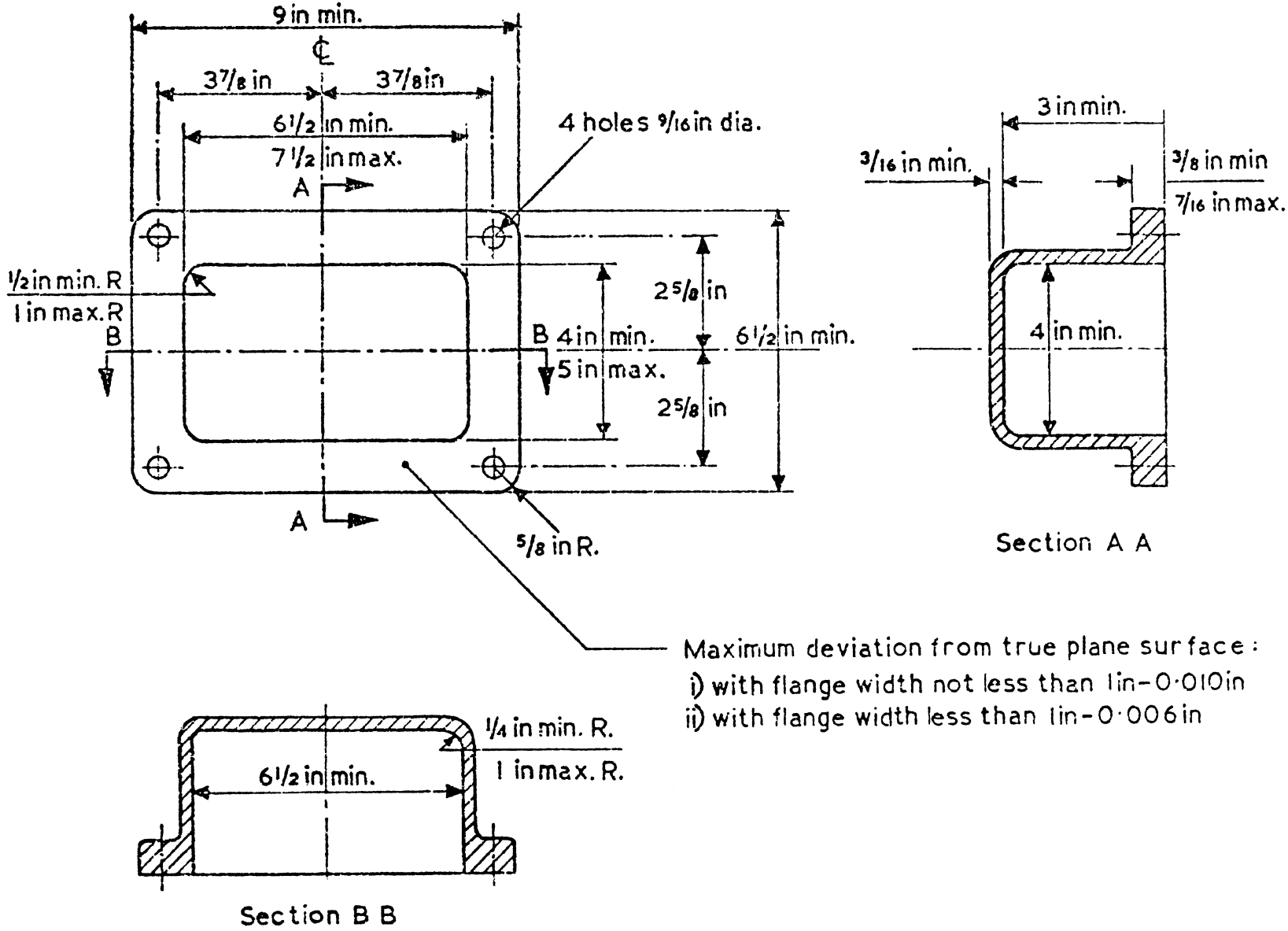

Figure 4 — Busbar end cover

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