Specification for

Mining type flameproof gate-end boxes —

Part 4: Gate-end boxes for drilling machines (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
Council of Underground Machinery Manufacturers
Department of Trade and Industry*
Engineering Equipment Users' Association
Federation of Manufacturers of Construction Equipment and Cranes
Institute of Quarrying
Institution of Mechanical Engineers
Institution of Mining Engineers
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 25 January 1972

The following BSI references relate to the work on this standard:
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Amendments issued since publication

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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 171, *Power transformers.*

BS 229, *Flameproof enclosure of electrical apparatus.*

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 861, *Air-break switches and isolators.*

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

BS 1395, *30-ampere flameproof plugs-and-sockets and cable-couplers.*

BS 2613, *Electrical performance of rotating electrical machines.*

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.*

BS 3871, *Miniature and moulded case circuit-breakers.*

This British Standard has been prepared, under the authority of the Mining and Quarrying 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 issued in 1938, and has been revised and re-issued as BS 787-1, BS 787-2 and BS 787-3, to cover gate-end boxes in which the essential apparatus is, respectively, an air-break electrically operated contactor, an air-break circuit-breaker and a lighting transformer. This additional specification, designated BS 787-4, extends the scope of the original BS 787 by covering gate-end boxes in which the essential apparatus is for controlling electrically operated drilling machines.

NOTE Although 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 relevant 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 and ii, pages 1 to 13 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 flameproof gate-end boxes designed primarily for use in the mining industry, on 3-phase a.c. circuits up to 650 V, for controlling one or two electrically-operated drilling machines.

NOTE The titles of the British Standards referred to in this standard are listed on page ii.

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 a transformer, frequency changer or frequency transformer, with contactor(s) and associated equipment to provide control and protection of drilling machines.

2.2
isolating switch

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

2.3
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

2.4
transformer

a piece of apparatus, without moving parts, which transforms alternating voltage in one winding into alternating voltage in one or more other windings, usually at different values

2.5
frequency changer

a rotating machine for converting a.c at one frequency and voltage to a.c. at another frequency and voltage

NOTE Where a static device is used without a rotating machine, the term "frequency transformer" should be used to distinguish it from a frequency changer.

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 be either 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 termination to apparatus

2.8
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

2.9
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

2.10
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 **6**)

2.11
rating

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

2.12
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, a screwed union ring, or some other equivalent device. Such device enables the plug to be readily inserted or withdrawn

2.13
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

2.14
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

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
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.

2.17
inverse time lag overcurrent release

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

2.18
instantaneous short circuit release

a device which operates without intentional time delay, at a predetermined current, to cause the supply to be cut off from a circuit

3 Service conditions

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

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

3.2 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 (1 000 m).

4 Ratings

4.1 Voltages. The maximum voltage shall be 650 V. Standard gate-end boxes shall be suitable for a voltage variation at least 10 % below and at least 6 % above the declared voltage 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. Gate-end boxes designed for other frequencies within the range of 42 Hz to 60 Hz, provided they satisfy all other requirements specified herein, shall be deemed to comply with the requirements of this standard.

4.3 Output voltages. The preferred no-load output voltage shall be 125 V 3-phase. Other voltages may be used, subject to agreement between the purchaser and the manufacturer.

4.4 Output frequency. The standard output frequency shall be the same as the supply frequency, except when a frequency changer or frequency transformer is employed, when the output frequency shall be 150 Hz.

4.5 Output kV A. The standard output kV A shall be not less than 1.25 kV A for single circuit units or 2.5 kV A for double circuit units.

4.6 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 the requirements of this standard.

5 Marking

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

1) The registered trade name or trademark of the manufacturer or his agent.

2) Manufacturer's type or reference.

3) Manufacturer's serial number.

4) Maximum rated output in kV A.

5) Supply voltage or voltage range, and frequency.

6) Output voltage or voltage range, and 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).

9) Where applicable, the intrinsic safety certificate details as required by the Department of Trade and Industry.

10) 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 registered name or trademark.

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 the requirements of this standard shall comply with the requirements of BS 229 (see Note) and shall have been certified by the Department of Trade and Industry as flameproof for Group I gases (methane/firedamp). The gate-end box may also be certified for any group of gas by an appropriate certifying authority as may be required.

Unless otherwise agreed between the manufacturer and the purchaser, no external component shall be made of aluminium, magnesium or titanium, or of any alloys except those in which 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. Neither shall any such component be painted or coated with preparations containing, in metallic form, any of the metals referred to above.

NOTE 1 These limitations have been imposed to avoid the hazards of incendive sparking due to friction between rusted steel or iron and the metals described.

NOTE 2 When applying for flameproof certification, it will be necessary for compliance with the requirements of BS 229 for the manufacturer to specify the types of fittings for which he has made provision in accordance with the requirements of **6.2** to **6.6** inclusive.

The following subclauses relate to the basic unit:

6.1 Enclosing case

6.5 Outgoing cable

6.7 Means of isolation

6.8 Means of reversing

6.9 Contactors

6.11.1 Overcurrent and short circuit protection

6.12 Provision for control

6.13 External control devices

6.14 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 Busbars

6.10 Voltage and frequency changers

6.11.2 Undervoltage protection

6.11.3 Earth fault protection and electrical lockout for outgoing circuits

6.11.4 Electrical interlocking and earth continuity protection

6.11.5 Pilot-to-earth fault protection

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.

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 considered to comply with the requirements of this standard provided they satisfy all other requirements specified herein.

6.2 Incoming and throughgoing cable. For the attachment of incoming or through-going 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) a detachable cable sealing and dividing box, e.g. as specified in BS 542, 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, and the preferred minimum width of flange shall be 1 in.

The coupling arrangements shall be sufficiently robust 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)] is adopted, the design of coupling plate shall conform to that shown in 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, and the preferred minimum width of flange shall be 1 in.

6.5 Outgoing cable. Provision shall be made for the attachment of each outgoing cable by means of:

1) a socket for the reception of a suitable plug which, when combined, forms a restrained plug and socket coupling; or

2) a socket for the reception of a suitable plug which, when combined, forms a bolted plug and socket coupling,

in each instance constructed in accordance with the requirements of the appropriate British Standard (e.g. BS 1395) where applicable, or as otherwise agreed between the manufacturer and the purchaser.

6.6 Busbars. When required, provision shall be made for the fitting of three throughgoing busbars complying with the requirements of BS 159.

6.7 Means of isolation

6.7.1 ***Main isolating switch.*** A triple pole isolating switch, having a continuous current rating of not less than 15 A and being capable of making and breaking its rated current at 650 V, shall be provided in the busbar chamber. It shall not be possible to open the main chamber unless the isolator is in the OFF position, or to close the isolating switch while the main chamber is open. The ON and OFF positions of isolating switch shall be clearly indicated and provision shall be made for locking in the OFF position.

6.7.2 ***Outgoing circuit isolating switch.*** Where required, a suitably rated triple pole on/off switch(es) or circuit breaker(s) with external operating handle(s) capable of being locked in the OFF position, may be provided to isolate separately each outgoing circuit.

6.8 Means of reversing. Means shall be provided, without opening the gate-end box, for separately reversing the phase rotation of each outgoing circuit.

6.9 Contactors. Each outgoing circuit shall be controlled by an electro-magnetically operated triple pole contactor and in addition, for 150 Hz units, a main contactor suitable for operation at the line voltage shall be provided. Each contactor shall be situated in the main chamber and shall have a continuous rating of not less than 10 A and shall comply with the requirements of BS 775, Utilization category AC4 (8 h duty), Mechanical duty Class II. Where a contactor is controlled by an auxiliary relay, the minimum voltage at which the contactor shall pick up and drop off shall be less than the corresponding values for the relay. In all cases the operating voltage of contactor coils shall be agreed between the purchaser and the manufacturer.

6.9.1 Provision may be made for a "test" feature which shall allow operation of control circuit components in the main chamber without the outgoing circuits being energized.

6.10 Voltage and frequency changers

6.10.1 ***Transformer.*** The transformer, conforming to the requirements of the relevant clauses of BS 171, shall be of the 3-phase, "AN" type, continuously rated at not less than 1.25 kV A for single units and not less than 2.5 kV A for double units, the primary winding being suitable for compliance with the requirements of **4.1** and **4.2**.

A separate 3-phase winding shall be provided on the secondary side of the transformer, for each drill circuit, as the preferred method. Alternatively, a single full capacity winding for both drill circuits will be considered to meet the requirements of this standard. The neutral point of the secondary winding shall be arranged for connection to earth through a removable link to facilitate testing, one side of the link having a direct connection to an earthing terminal (see also **6.11.3**).

6.10.2 ***Voltage and frequency changer.*** The voltage and frequency changer shall have a continuous rating of not less than 1.25 kV A for single units and not less than 2.5 kV A for double units. The changer shall be suitable for operating on a 3-phase supply in accordance with the requirements of **4.1** and **4.2**.

A separate 3-phase 150 Hz output winding shall be provided to supply drilling machine(s). The neutral point shall be brought out from the winding, for earthing purposes. Where a frequency changer is used, it shall conform appropriately with the requirements of BS 2613.

6.11 Protection

6.11.1 ***Overcurrent and short circuit protection***

6.11.1.1 *Primary circuit protection.* Suitably rated HBC fuses complying with the requirements of BS 88, category AC 16 as minima, shall be provided in the main chamber, in each phase of the circuits between the main isolating switch and the transformer primary windings.

6.11.1.2 *Outgoing circuit protection.* Each outgoing circuit shall be provided, in at least two phases, with:

1) overcurrent protection conforming to the requirements of BS 587, and

2) unless otherwise agreed between the purchaser and the manufacturer, an instantaneous short circuit release which is not self-resetting.

6.11.2 ***Undervoltage protection.*** Means shall be provided to ensure that the contactor(s) open(s) when the supply voltage (see **4.1**) falls to the value specified in **6.12**.

6.11.3 ***Earth fault protection and electrical lockout for outgoing circuits.*** Provision shall be made in the gate-end box for the fitting, when required, of earth fault protection. Additionally, means may be provided for locking out the circuit electrically while an earth fault exists, but any such arrangement shall be of a type certified as intrinsically safe.

The earth fault protection shall operate to remove power from any outgoing defective circuit 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 unless earth fault electrical lock-out which is not self-resetting is provided.

Resetting of either the earth fault trip or the electrical lockout shall be arranged for external operation by hand, means being provided 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.

6.11.4 ***Electrical interlocking and earth continuity protection.*** Where restrained plug(s) and socket(s) are utilized, each outgoing circuit shall incorporate control circuit(s) for the purpose of interlocking the plug(s) 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.

This type of circuit shall give earth continuity protection which, in the event of an open circuit or undue increase in resistance to earth, connection between the gate-end box and the drilling machine shall cause the contactor to open if in the closed position, or not to close if in the open position.

6.11.5 ***Pilot-to-earth fault protection.*** If required, provision shall be made in the gate-end box to cause, in the event of accidental contact between the pilot core and earth, the contactor(s) to open if in the closed position or not to close if in the open position. Any such 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.

Where pilot-to-earth fault protection is provided it is recommended that the circuit should be capable of working with a remote rectifier complying with the requirements of BS 3101.

6.12 Provision for control. Each outgoing circuit shall be arranged for remote control from the switch in the drilling machine, via the pilot and earth conductors in the drill cable. The control circuit(s) shall be of a type certified as intrinsically safe by the Department of Trade and Industry and/or any other certifying authority as may be agreed.

The actual values of incoming supply voltage at which the contactor will "pick-up" and "drop-off" shall be less than the actual values of "pick-up" and "drop-off" voltages for the remote control circuit. The minimum pick-up voltage of the control circuit which causes its associated contactor to close shall be not less than 80 % and not greater than 85 % of the declared supply voltages. With the drill switch closed, the control circuit shall cause its associated contactor to open when the supply voltage falls to a value not greater than 70 % nor less than 60 %[1)] of the declared value. These conditions shall be satisfied with any external cable, pilot and earth lead return resistance in the range 0 Ω to 3 Ω.

6.13 External control devices. External handles, levers or push-buttons shall be so designed and proportioned as to minimize risk of damage or distortion due, for example, to mishandling, falls of roof, or collison with other gear.

6.14 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.

6.15 Fuses. Where auxiliary circuits are connected to the primary supply, they shall be protected by fuses. These fuses shall comply with the requirements of BS 88, category AC 16 as minima.

6.16 Temperature limits. The temperature limits of individual components shall comply with the requirements of the appropriate British Standards when tested in accordance with such standards.

NOTE In this connection the following particular British Standards are quoted for reference:

BS 88, *Cartridge fuses of voltage ratings up to 660 volts.*
BS 159, *Busbars and busbar connections.*
BS 171, *Power transformers.*
BS 587, *Motor starters and controllers.*
BS 775, *Contactors.*
BS 861, *Air-break switches and isolators.*
BS 2613, *Electrical performance of rotating electrical machines.*
BS 3871, *Miniature and moulded case circuit-breakers.*

Where the temperature reached by a component in a fully assembled unit could, due to the heating effect of other component(s), exceed the temperature limit prescribed by the relevant British Standard, the design shall be such that this excess temperature does not cause deterioration of performance of the component(s) to a value below that specified in the relevant British Standard.

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

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 the requirements of **7.2** and **7.3**.

NOTE 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.

[1)] The value of 60 % may be increased to 65 % in the future, subject to investigations.

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.

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 shall be made at the declared output kV A on a fully assembled unit with all covers closed and all apparatus energized at the declared voltage and frequency, to ensure compliance with the requirements of **6.16**.

Tests on all 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. Where a transformer having primary tappings is used, the tests shall be conducted at the declared output kV A with the supply connected to the tapping giving the maximum watts loss, with a secondary current of sinusoidal wave form.

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

1) The isolating switch shall be capable of breaking the supply current with the output circuits on *a*. no-load, and *b*. full load.

2) Where out-going circuit isolating switch(es) or circuit breaker(s) are fitted these shall be capable of breaking the full rated output of the circuit.

3) The contactor(s) complies with the requirements of **6.9**.

4) Any combination of fuses and contactor, used to control outgoing circuits, shall be capable of making and interrupting the prospective fault current.

5) If a circuit breaker is used to provide an instantaneous short circuit release, the circuit breaker shall be capable of interrupting prospective fault currents.

7.2.3 ***Flameproofness.*** The gate-end box shall comply with the test requirements of BS 229 for Group 1 (methane/firedamp) gas, and the requirements of any certifying authority as may be required.

Any circuits required to be intrinsically safe shall comply with the test requirements of BS 1259 appropriate to Class 1 and shall be certified as intrinsically safe by any certifying authority as may be required.

7.2.4 ***Mechanical tests.*** A 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. The mechanical endurance test for the isolating switch and secondary circuit switches or circuit breakers shall satisfy the relevant clauses of BS 861 or BS 3871.

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 being exposed to ordinary atmosphere with the cover (or covers) open for at least 24 h prior to the test.

In carrying out the following test it shall be ensured that the test voltage is applied in such manner as to avoid overstressing the transformer insulation by induced overvoltage.

Each test shall be made with an approximately sinusoidal a.c. voltage, of frequency between 42 Hz and 60 Hz; the test voltage shall be 1 000 V plus twice the working voltage of the circuit being tested and shall be applied for at least one minute. Alternatively, a value of 1 250 V plus twice the working voltage of the circuit being tested may be applied for at least three seconds, as follows:

1) Test *a*. between phases and *b*. between phases and earth on incoming and outgoing circuits, also between the incoming and outgoing circuits, with the transformer connected or disconnected as appropriate.

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

3) 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 requirements of 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 not.

7.3.2 ***Control circuits.*** The contactor control circuits shall be tested to prove compliance with the operating values stated in **6.12**.

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

8 Information to be supplied to the manufacturer with the enquiry[2)]

The purchaser should supply with the enquiry the following information.

8.1 Information relating to the supply system

1) Voltage.

2) Frequency.

8.2 Information relating to the drilling machine gate-end boxes

1) Number of drilling machines, horsepower and frequency.

2) Current rating of busbars, when required (see **4.6**).

3) Any other requirements (e.g. type of protection).

8.3 Cables and cable entries

1) *Provision for main supply cables*. Whether provision is required at one end of 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.

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

[2)] It is recognized that the whole of this information may not be available at the time of 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		

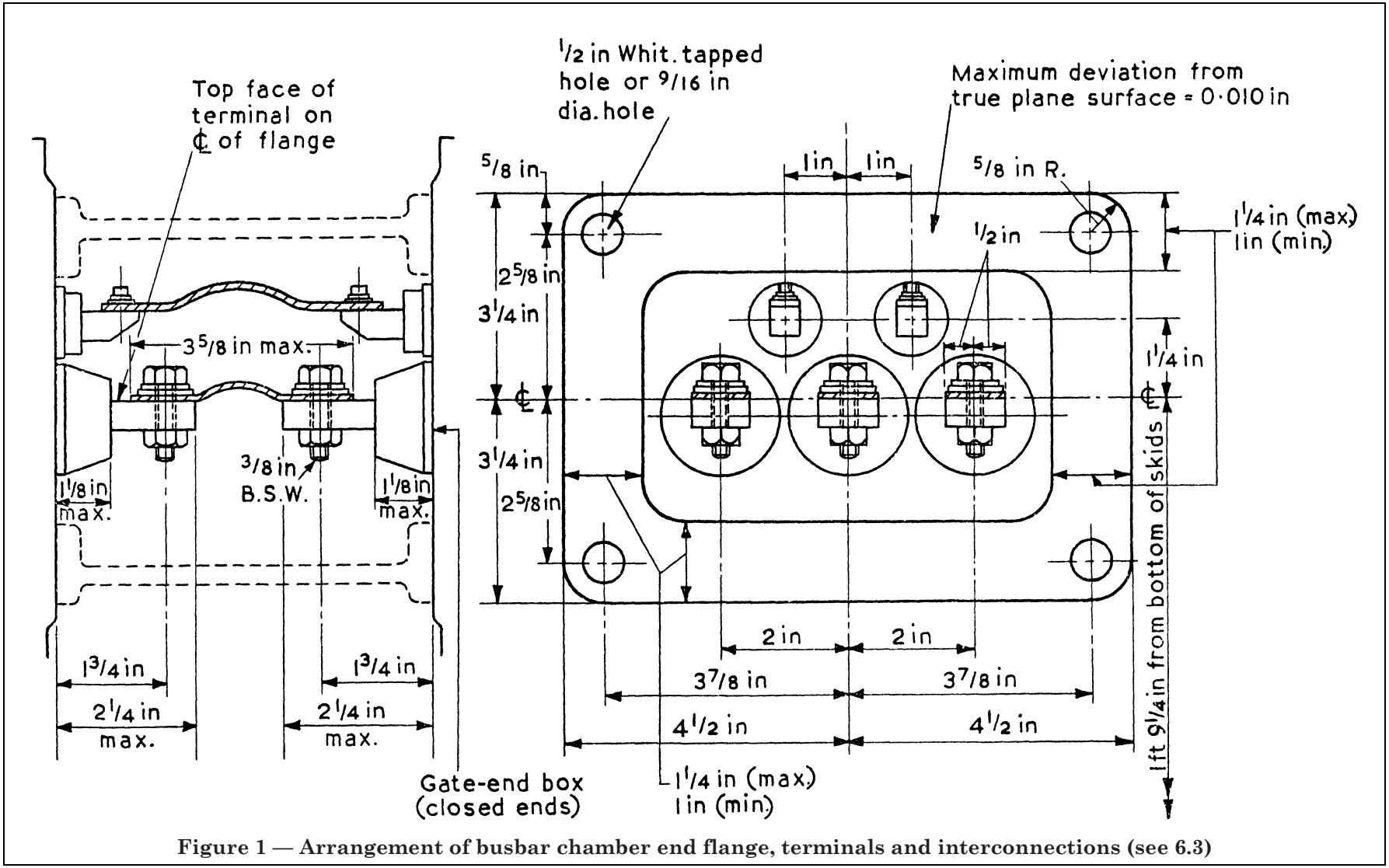

Figure 1 — Arrangement of busbar chamber end flange, terminals and interconnections (see 6.3)

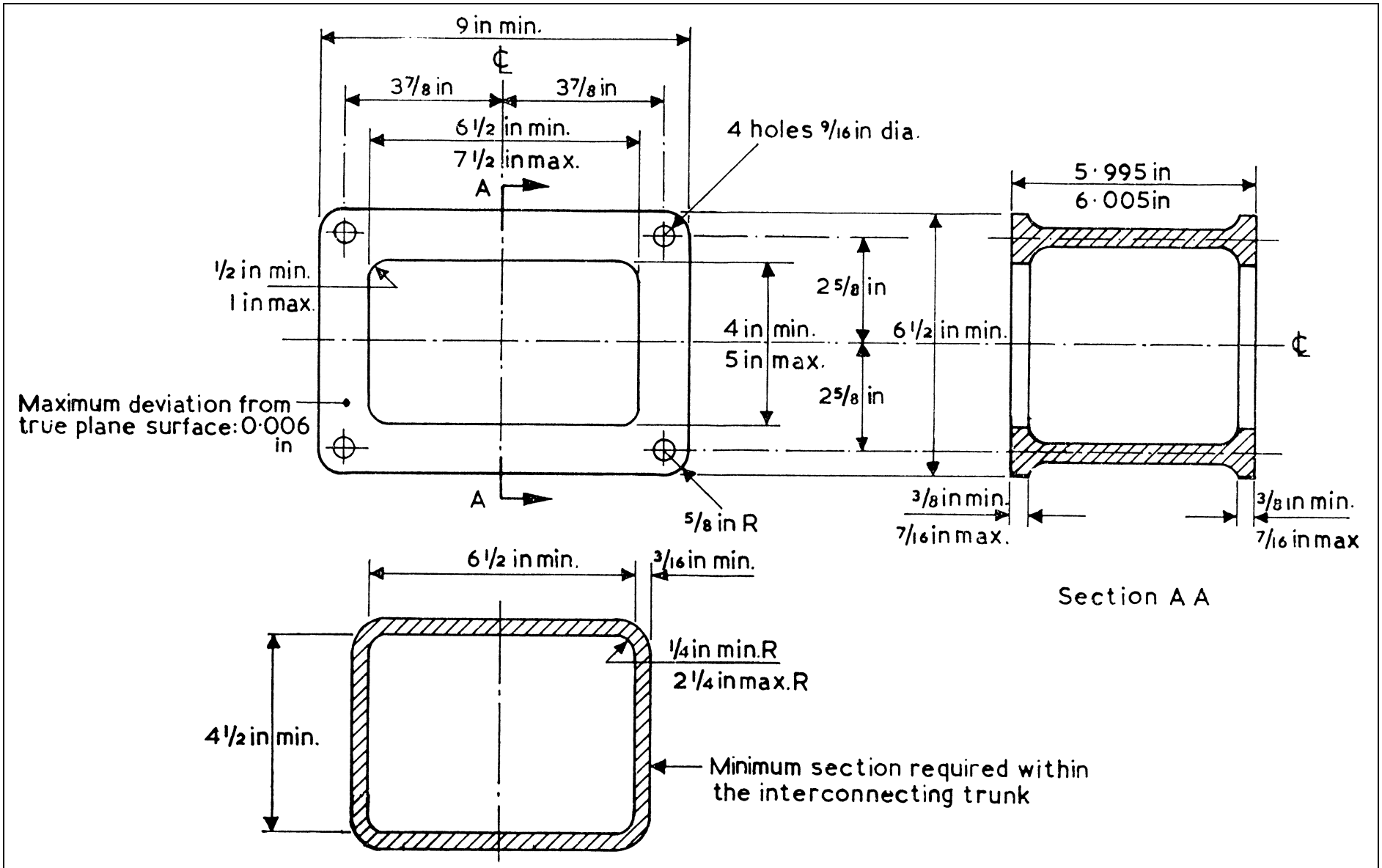

Figure 2 — Busbar interconnecting trunk

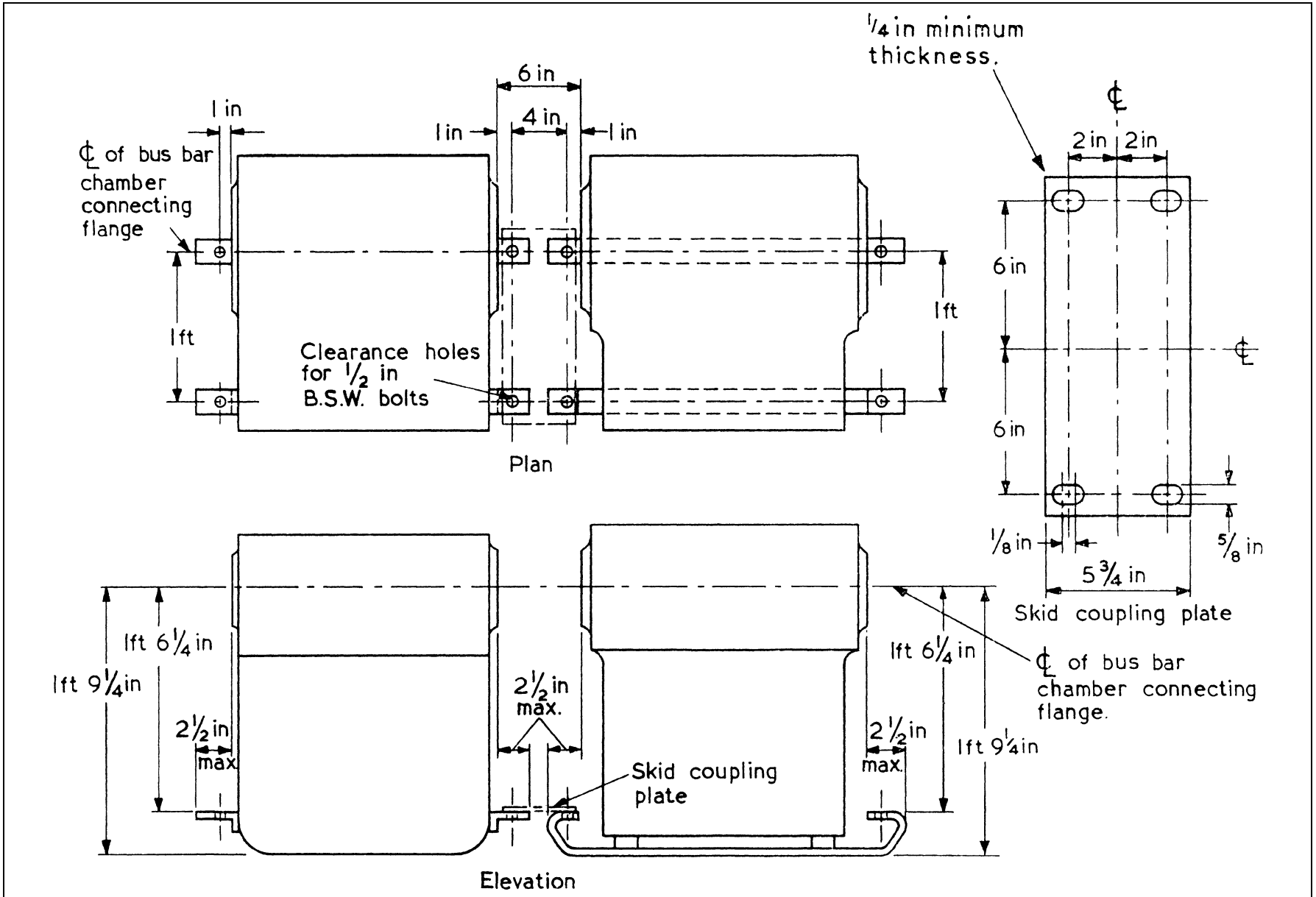

Figure 3 — Skid coupling arrangement

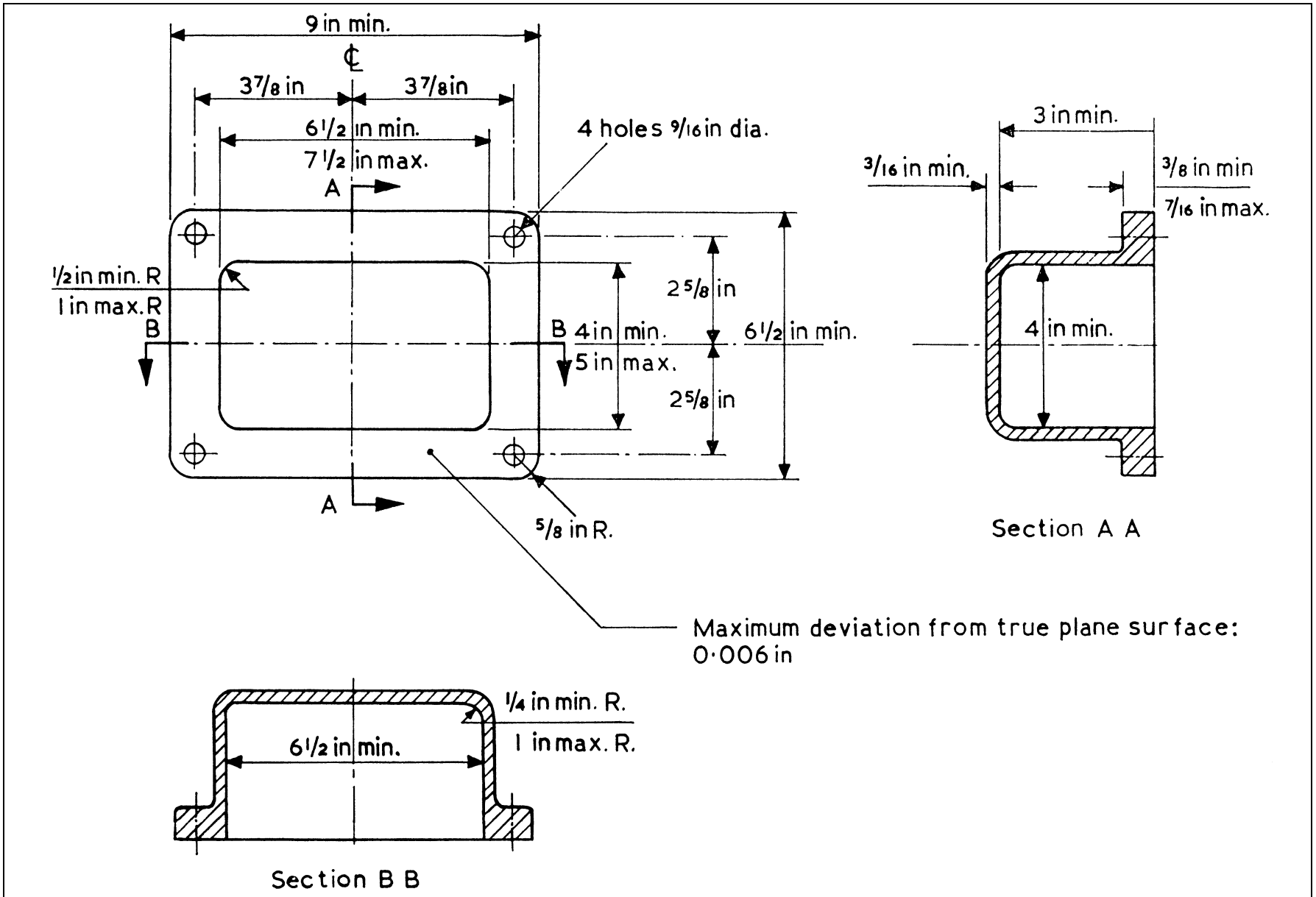

Figure 4 — Busbar end cover

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