BS 5067:1985

Specification for

Flameproof transformers for use in mines

Confirmed January 2011

UDC 622.005:621.314.2 – 213.34

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mining and Quarrying Requisites Standards Committee (MQE/-) to Technical Committee MQE/15, upon which the following bodies were represented:

Association of British Mining Equipment Companies
BEAMA Transmission and Distribution Association
Health and Safety Executive
National Coal Board

This British Standard, having been prepared under the direction of the Mining and Quarrying Requisites Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 July 1985

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The following BSI references relate to the work on this standard:
Committee reference MQE/15
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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This revision of BS 5067 has been prepared under the direction of the Mining and Quarrying Requisites Standards Committee. It extends the scope of the 1974 edition to include higher voltages up to 11 kV. BS 5067:1974 is superseded and withdrawn.

Transformers complying with this standard are suitable for Group I enclosures and may also be suitable for other groups of gases (see BS 4683-2 and BS 229).

NOTE For the purposes of this British Standard, the IEC convention for expressing the symbol for the unit kilovolt amperes, i.e. kVA, has been used as this is in general use in the electrical industry, rather than the convention indicated in BS 5775 (ISO 31).

Attention is drawn to the Health and Safety at Work etc. Act 1974, the Factories Act 1961, the Mines and Quarries Act 1954, the Regulations made under these Acts, and also any other appropriate statutory requirements or Bye-laws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user. The address of the recognized certification authority in the UK for Group I (coal mining) apparatus for flameproof purposes is as follows:

Health and Safety Executive

HSE (M) Certification Support Unit

Harpur Hill

Buxton

Derbyshire SK 17 9JN.

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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 12, an inside back cover and a back cover.

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

1 Scope

This British Standard specifies design requirements for dry-type flameproof three-phase power transformers intended for use below ground in mines.

This standard does not apply to transformers of the types covered by BS 2538[1)] and BS 5126-4.

Appendix A lists information to be supplied by the purchaser with the enquiry and order.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 General

Transformers shall comply with BS 171 for the rating and performance of the main component within the flameproof enclosure, except where specifically modified or extended in this standard.

3 Insulation and temperature rise

The insulation materials of components within the transformer enclosure shall comply with either class H or class C of BS 2757.

The temperature rise of any part of the external surface of the enclosure(s) shall not exceed 60 °C when the transformer is tested at normal continuous full load current with the rated primary voltage applied to the principal tapping as described in **3.6** of BS 171-2:1978.

4 kVA Ratings

The three-phase kVA ratings shall be one of the following:

50, 150, 300, 500, 750 and 1 000.

5 Voltages and connections

5.1 Voltages

The no-load voltages shall be selected from the following:

Nominal primary voltage: 3.3 kV, 6.6 kV, 11 kV

No-load secondary voltage: 565 V, 1 130 V, 3.4 kV, 6.8 kV

NOTE See Appendix A for information that should be provided by the purchaser.

5.2 Connections

The connections shall be either delta-star or star-star, as designated by the symbols Dy11 or Yy0, respectively, in Figure 5*a* of BS 171-4:1978.

6 Frequency

The designed frequency of operation shall be 50 Hz.

7 Voltage adjustment tappings

The primary windings shall be provided with tappings at – 5 % and – 10 % of the rated voltage in addition to the principal tapping at the rated primary voltage.

A readily accessible off-circuit selecting device, having the positions clearly marked, for example as shown in Figure 1, shall be provided to enable the tappings to be changed.

8 General design and construction

8.1 Flameproof construction

Transformers shall comply with Group I enclosures of either BS 4683-2 or BS 5501-1 and BS 5501-5.

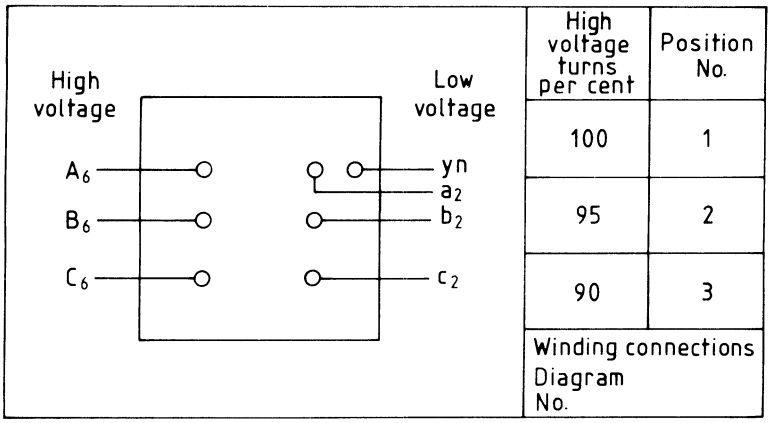


Figure 1 — Example of a terminal marking plate showing standard items of information to be provided and their arrangement

[1)] Under revision.

Transformers designed before the date of publication of this standard and certified as flameproof in compliance with BS 229 for Group I enclosures shall be deemed to comply with this standard if they comply with all other requirements of this standard.

8.2 Materials

The transformer enclosure shall be of mild steel.

NOTE 1 It is essential that enclosures should be substantially constructed sufficient to withstand rough conditions of handling, e.g. being slung or pushed into or out of cages, and being transported below ground.

No part external to the flameproof enclosure of any transformer 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 mass and the content of magnesium and titanium together does not exceed 6 % by mass. No component external to the flameproof enclosure shall be painted or coated with preparations containing, in metallic form, aluminium, magnesium or titanium.

NOTE 2 These limitations have been imposed to avoid the hazards of incendive sparking due to friction between rusted steel or iron and the metals in question.

8.3 Lifting

Six lifting lugs shall be provided on the enclosure body, i.e. four for normal lifting and two at one end for lowering the transformer on end down a shaft. At least four shackles complying with BS 3032 shall be fitted. Each lug and shackle shall be of sufficient strength to support the whole weight of the transformer, complete with its ancillary equipment, when slung by any one lug.

Means shall also be provided for the attachment of haulage chains to the fender or to the base of the tank or enclosure.

8.4 Drainage

Any drainage devices supplied to release condensed moisture shall comply with **8.1** in all positions between, and including, fully opened and fully closed.

9 Lifting and anchoring of core

The core and winding assembly shall be provided with means for attaching withdrawal and/or lifting tackle.

Means shall also be provided to ensure correct registration of the core in the enclosure, and to prevent movement of the core and windings when the enclosure is on its side or end.

10 Removable covers

Each removable door or cover which gives access to an enclosure containing live components, including those with any neutral link, shall carry the warning:

"OPEN HV ISOLATOR BEFORE REMOVING THIS COVER".

This warning shall either be embossed on the door or cover, or be of indelible lettering on a metal plate permanently secured to the door or cover.

11 Wheels

If wheels and axles are to be fitted, provision shall be made for the mounting of axles fitted with flanged wheels having a tread diameter of 305 mm. The design of the wheel mounting shall provide for adjustment so that the clearance between rail level and the lowest part of the transformer can be set at either 25 mm or 127 mm.

NOTE 1 See Appendix A for information that should be provided by the purchaser concerning the provision of wheels and axles.

The track gauge shall be as specified by the purchaser.

NOTE 2 It is preferred that the wheels and axles be arranged to fit track gauges within either of the ranges 457 mm to 769 mm or 610 mm to 922 mm, increasing in each range by increments of 13 mm.

12 Mounting flanges and terminals

12.1 Mounting flanges

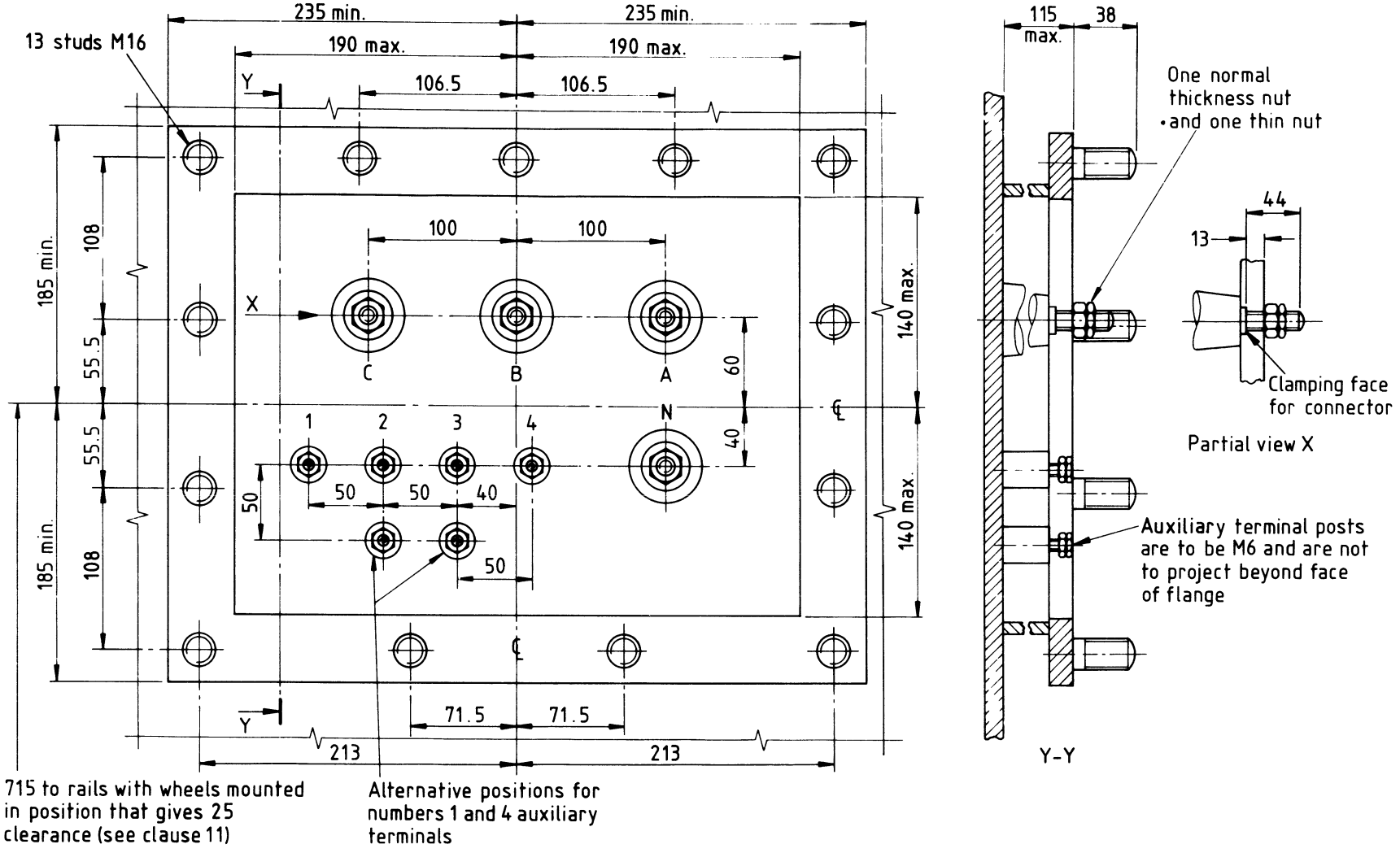
Mounting flanges shall be provided on the ends of transformers having ratings of 150 kVA and above in accordance with a), b) or c) as follows:

a) lower-voltage end flange as shown in Figure 2;

b) higher-voltage end flange as shown in Figure 3 for transformers having primary voltages not exceeding 6.6 kV;

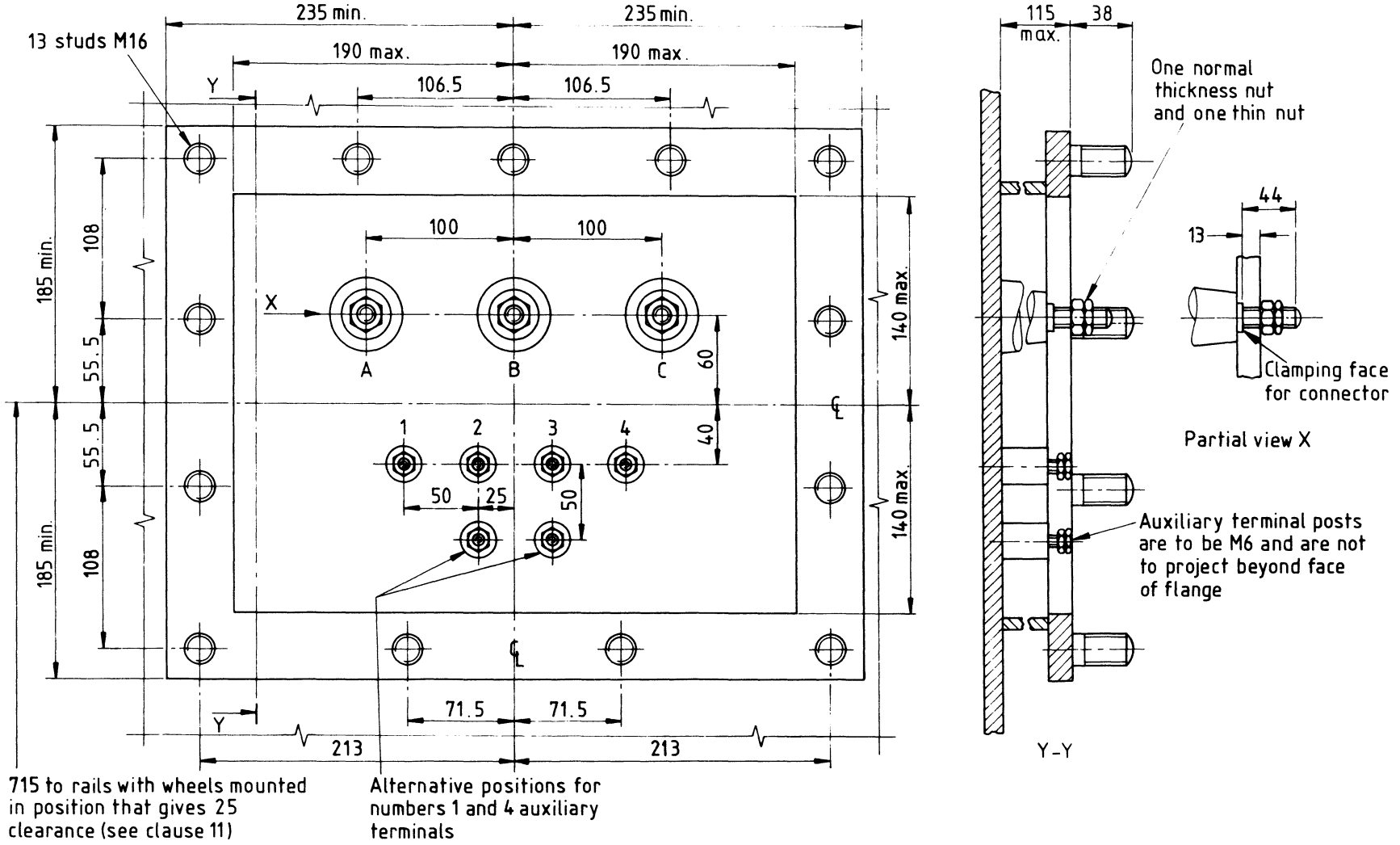
c) higher-voltage end flange as shown in Figure 4 for transformers having voltages exceeding 6.6 kV and up to 11 kV.

NOTE The mating equipment flanges are shown in Figure 5 and Figure 6.



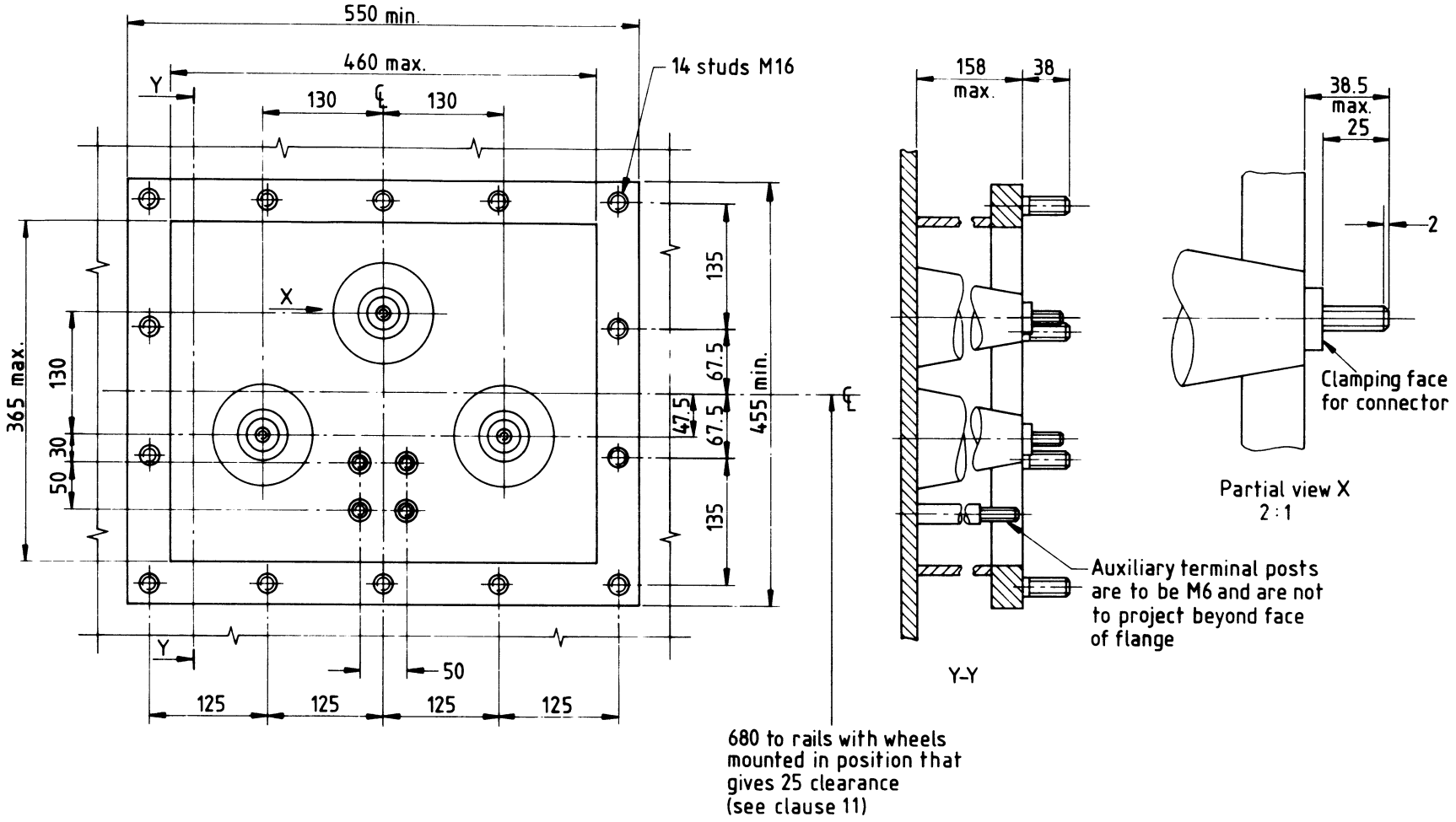
All dimensions are in millimetres.

Figure 2 — Mounting flange at lower-voltage end of transformer



All dimensions are in millimetres.

Figure 3 — Mounting flange at higher-voltage end of transformer (for voltages not exceeding 6.6 kV)



All dimensions are in millimetres.

Figure 4 — Mounting flange at higher-voltage end of transformer (for voltages exceeding 6.6 kV and up to 11 kV)

12.2 Terminals

The form and positioning of terminal posts and their bushings shall be as shown in Figure 2, Figure 3 or Figure 4; see also **12.1** a), b) and c).

The terminal posts shall be of copper complying with BS 1433 and shall have the following thread sizes, as designated in BS 3643, according to their current rating.

Lower-voltage end:

up to and including 315 A; M12

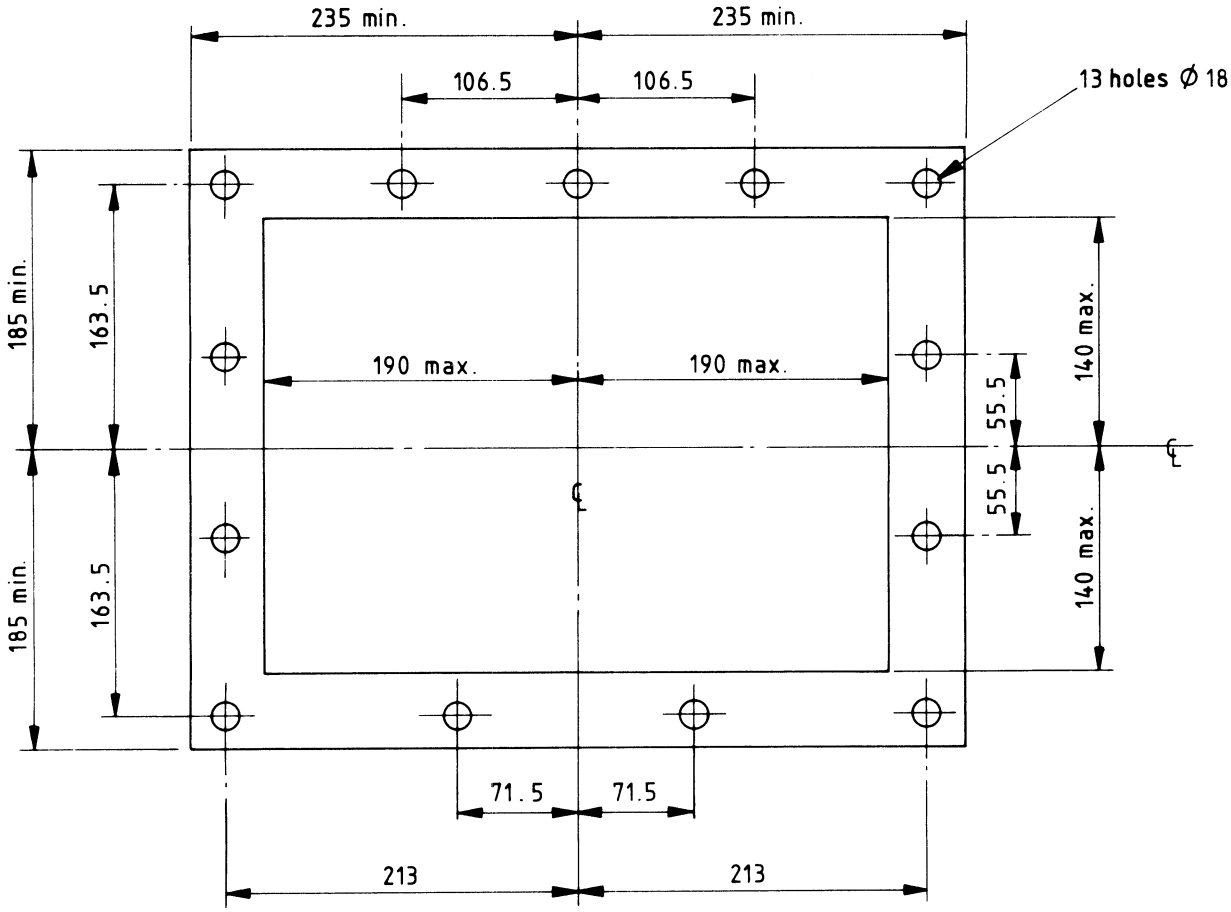
over 315 A up to and including 630 A; M20 × 2.0

Higher-voltage end:

all current ratings; M12

The dimensions of hexagon nuts shall comply with BS 3692 for the appropriate thread diameter. For terminals up to and including 12 mm diameter, one normal thickness nut and one thin nut shall be used; for sizes above 12 mm diameter, two thin nuts shall be used. The nuts shall be of brass complying with BS 2874.

The tolerance class for terminal nuts and posts shall be grade 6H and grade 6g respectively as specified in BS 3643.



All dimensions are in millimetres.

Figure 5 — Equipment flange (for voltages not exceeding 6.6 kV)

12.3 Clearance and creepage

The clearance and creepage distances in air shall be not less than the values given in Table 1.

Insulating materials shall have a comparative tracking index of not less than 250 when tested as described in BS 5901.

Table 1 — Clearance and creepage distances in air

	Up to 1 130 V	Up to 6.8 kV	Up to 11 kV
	mm	mm	mm
Clearance, phase to phase	25	74	127
Clearance, phase to earth	25	55	76
Creepage, phase to earth	32	74	127

13 Provision for cable terminations

The transformer terminals shall be contained in an air-filled enclosure.

NOTE 1 This may be a separate terminal chamber or may fulfil additional functions, i.e. form part of a high voltage circuit breaker or a chamber for housing protective equipment at the lower-voltage end of the transformer.

The terminal chamber, or the equipment of which it forms part, shall be suitable for fitting to the appropriate flange as shown in Figure 2, Figure 3 and Figure 4.

The terminal chamber or the equipment comprising part of the chamber shall be provided with facing(s) to receive cable sealing boxes or cable coupler adaptors. The facing shall comply with the appropriate British Standards.

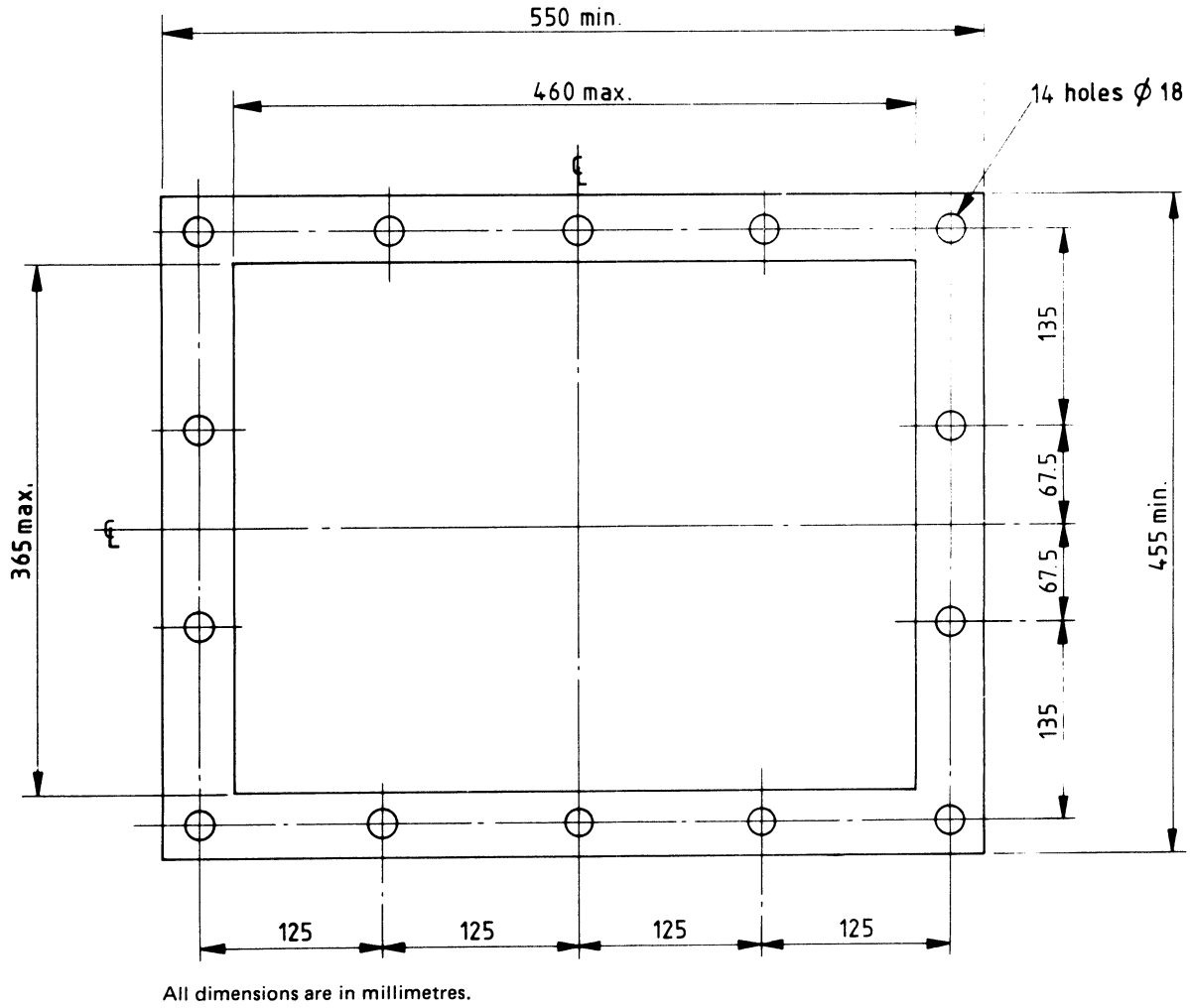


Figure 6 — Equipment flange (for voltages exceeding 6.6 kV and up to 11 kV)

Cable glands and sealing boxes, where fitted, shall comply with BS 542.

NOTE 2 The cable coupler adaptors should be those covered by the following British Standards:

BS 3454 for voltages up to 3.3 kV

BS 3905 for voltages up to 6.6 kV.

Cable terminations shall be so arranged that cables fitted with cable sealing boxes or other similar fittings can be disconnected and detached from the transformer without disturbing the sealing compound, without exposing the interior of the transformer enclosure(s), and without the bushings having to be moved.

NOTE 3 Where switchgear is fitted, cable entry may be limited to one direction only.

If required by the purchaser, the manufacturer shall provide covers for the physical protection of the terminals and bushings when a removable type terminal chamber is not in position (see Appendix A).

Cable couplers that are certified as flameproof may not, when used singly, have the necessary current rating to carry the output of the larger sizes of transformer. In such cases, more than one outlet shall be provided with suitable overcurrent protection for each circuit.

14 Over-voltage protection and earthing

14.1 General

Provision shall be made for protection against danger arising from the charging of the lower-voltage components by contact with, or leakage from, higher-voltage components. To assist in complying with this requirement, provision shall be made for the connection to earth, where necessary, of the neutral point of the secondary winding.

NOTE Information on earth fault protection systems is given in Appendix B.

14.2 Provision for earthing neutral point of secondary winding

The neutral point of the secondary winding shall be brought out to an insulated terminal.

An earth terminal shall be provided at the lower-voltage end of the transformer, either in the lower-voltage chamber (see **B.5**) or in such other fitment as shall be ordered by the purchaser for the termination of a neutral to earth connection where necessary.

NOTE The form of any fault protection equipment should be specified by the purchaser (see Appendix A).

The connection between the neutral of the transformer and the insulated terminal shall have a current carrying capacity of not less than half that of the connection between the secondary line terminals and the transformer winding.

14.3 Earthing of enclosure

An external earthing terminal shall be provided to enable the transformer enclosure to be securely and efficiently earthed irrespective of any means provided for attaching to the cable gland the metallic covering of the cables connected to the transformer.

14.4 Earthing terminals

Provision shall be made for the mechanical attachment of connections to the terminals referred to in this clause.

15 Marking and rating plates

The following shall be securely fitted to the enclosure in a prominent position:

a) a terminal marking plate, for example as shown in Figure 1;

b) a rating plate, for example as shown in Figure 7, by which the transformer shall be permanently marked with the following particulars:

1) the number and date of this British Standard, i.e. BS 5067:1985[2)];

2) the manufacturer's type designation;

3) the manufacturer's registered trade name or trade mark;

4) the number of the flameproof certificate and its group number(s) where applicable;

5) the temperature classification, where appropriate;

6) additional marking as may be required by any relevant certifying authority.

All plates shall be of metal as specified in **8.2** and the inscriptions shall be raised or engraved.

[2)] Marking BS 5067:1985 on or in relation to a product is a claim by the manufacturer that the product has been manufactured to the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, BSI, PO Box 375, Milton Keynes MK14 6LO in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

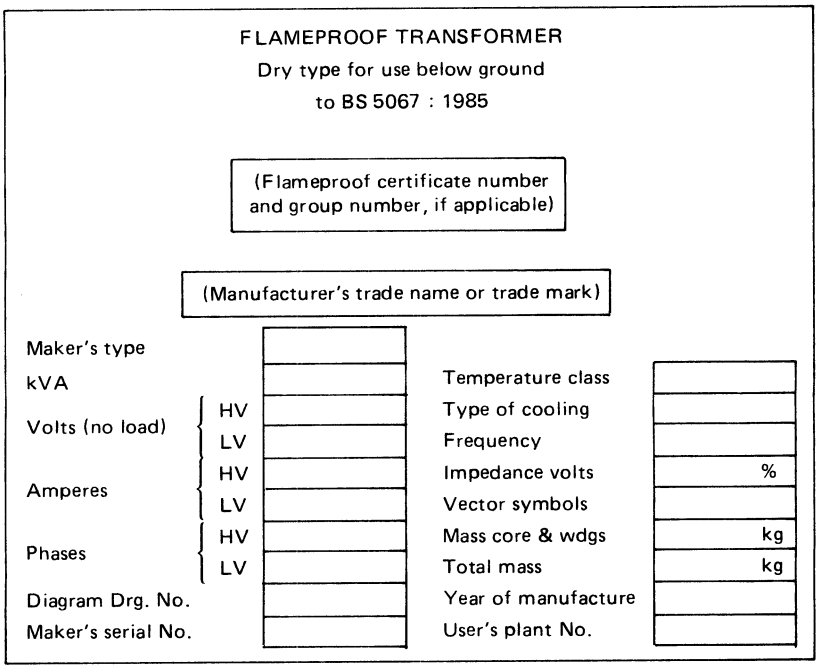


Figure 7 — Example of rating plate for flameproof transformer showing standard items of information to be provided and their arrangement

Appendix A Information to be supplied by the purchaser with enquiry and order

The normal provisions of the standard are covered by the following list of items (if any deviations are required they should be clearly specified):

a) the number of this British Standard, i.e. BS 5067:1985;

b) number of units required;

c) frequency (Hz);

d) kVA rating;

e) service voltage:

nominal primary voltage

secondary voltage at no-load (see clause **5**)

f) connections (see **5.2**);

g) temperature conditions of cooling air, if any of the following limits are exceeded:

yearly average	20 °C
daily average	30 °C
peak	40 °C

h) whether provision is required for wheels and axles (see clause **11**);

i) whether wheels are to be provided by the manufacturer or by the purchaser. Details of the wheels and axles should be sent with the order;

j) range of track gauge (see clause **11**);

k) whether physical protection for the terminals and bushings is required;

l) direction of cable entry/entries at each end, e.g. whether cable approaches transformer vertically upwards, downwards, or horizontally from left to right, normal to the side or end of the tank or enclosure;

m) whether through-going cable is required;

n) where cable attachments are to be supplied by the manufacturer:

1) the type and relevant British Standard number of the attachments and the flange facing required;

2) the British Standard number and the size and type of primary and secondary cable, the number of cables or cable cores per phase, the section of each core, and the diameter under and over the various coverings; also details of the type of coverings, armour, etc;

o) whether earth fault protection is required (see clause **14**). Where earth fault protection is required, its form should be indicated by the purchaser;

p) the arrangement required for earthing the secondary winding (see clause **14**);

q) ancillary equipment to be specified (see clause **13**), e.g. switchgear, lower-voltage chamber, instruments.

Appendix B Earth fault protection

B.1 General

Three protection systems are described in **B.2**, **B.3** and **B.4**. The housing of circuit components is covered in **B.5**.

B.2 System a. Transformer neutral solidly connected to earth

In this system the flow current in the neutral-to-earth connection is measured by means of a current transformer. A relay fed by the secondary of the current transformer is set to trip at a predetermined level of current in the neutral; the action of the relay is to trip the high voltage circuit breaker.

An injection coil is provided on the current transformer to permit testing of the protection system.

In this system there is no deliberate attempt to restrict the magnitude of fault current in the neutral connection.

NOTE This system is not now normally used underground in British coal mines.

B.3 System b. Transformer neutral connected to earth through an impedance

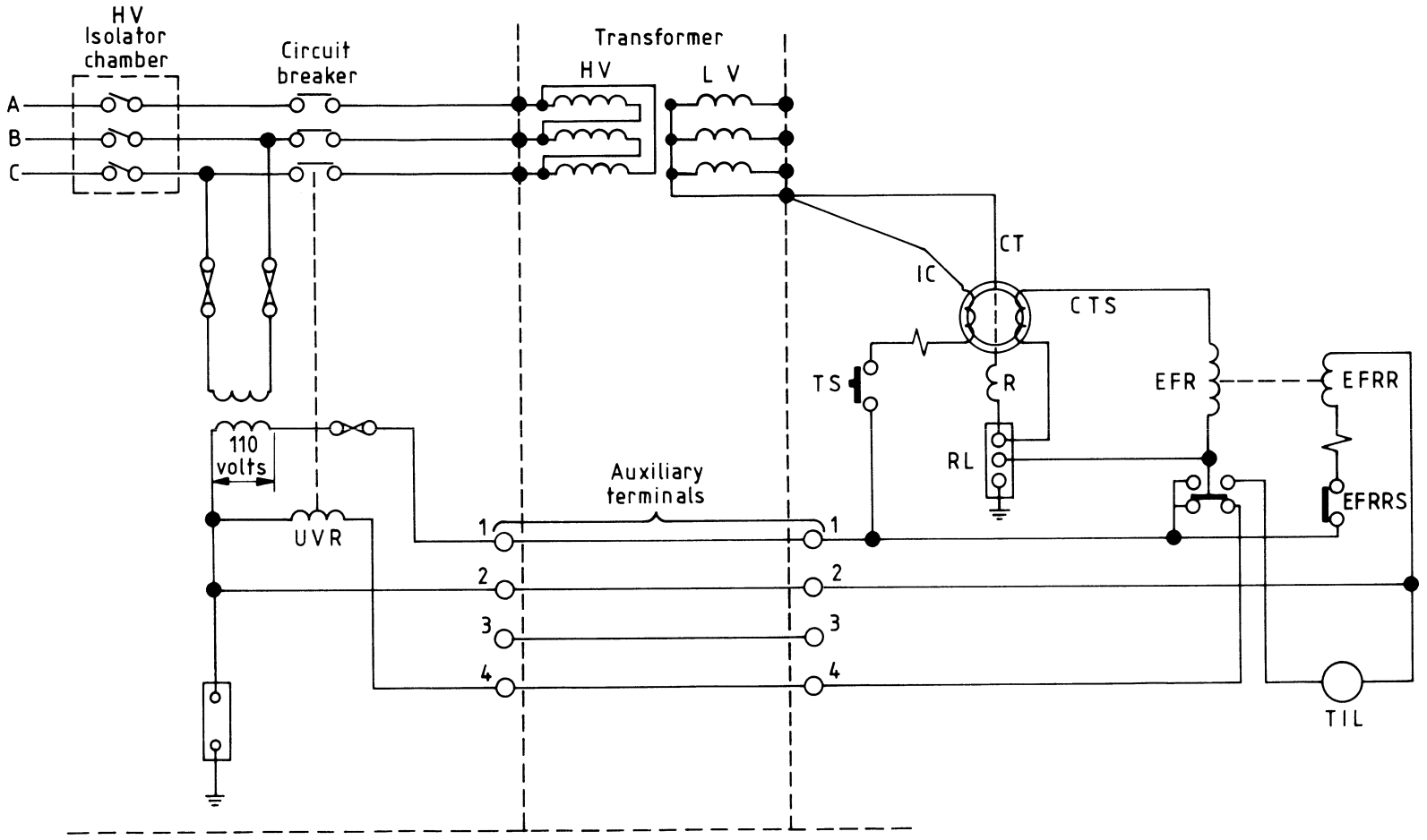
This system is similar to system a, with the exception that an impedance, usually in the form of a reactor, is included in the neutral-to-earth connection. A typical value of current limitation is 15 A. A circuit for this form of protection is shown in Figure 8.

B.4 System c. A system with severe restriction of earth fault current and with sensitive current detection

In this type of system the neutral current is restricted to a value significantly less than in system b. The value of the neutral current is measured by a detecting circuit which causes a relay to operate at the appropriate level; a circuit is provided to test at, or below, this level.

B.5 Housing of circuit components

The components of the earth fault protection circuits of systems a, b or c are housed in a chamber mounted on the flange at the lower-voltage end of the transformer.



Key:

UVR	Under voltage release	EFR	Earth fault relay (latched)
TS	Test switch	EFRR	Earth fault relay reset
CT	Current transformer	EFRRS	Earth fault relay reset switch
IC	Injection coil	TIL	Trip indicating lamp
CTS	Current transformer secondary	RL	Removable three point link
R	Reactor		

Figure 8 — System b type earth fault protection circuit

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Publications referred to

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 and quarries.*

BS 2538, *Air cooled flameproof single-phase lighting transformer units supplied from high voltage systems.*

BS 2757, *Classification of insulating materials for electrical machinery and apparatus on the basis of thermal stability in service.*

BS 3032, *Higher tensile steel shackles.*

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

BS 3643, *ISO metric screw threads.*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts.*

BS 3905, *Specification for 3.8/6.6 kV 300 A bolted flameproof cable couplers and adaptors primarily for use in mines.*

BS 4683, *Electrical apparatus for explosive atmospheres.*

BS 4683-2, *The construction and testing of flameproof enclosures of electrical apparatus*[3)].

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

BS 5126-4, *Specification for units to power drilling machines.*

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

BS 5501-1, *General requirements.*

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

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

[3)] Referred to in the foreword only.

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