



BS 5524 : 1987

UDC 621.316.3:621.3.048.1/.83:
621.3.027.7:620.1

© British Standards Institution. No part of this publication may be photocopied or otherwise reproduced without the prior permission in writing of BSI

British Standard Specification for

Gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above

Harmonized with CENELEC HD 358 S2

Appareillage sous enveloppe métallique à isolation gaseuse de tension
assignée égale ou supérieure à 72,5 kV — Spécifications

Gasisolierte metallgekapselte Schaltanlagen für Nennspannungen ab 72,5 kV

British Standards Institution

AVA Documents
Document Sharing Hub

Foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Committee and is related to IEC 517 : 1986 'Gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above' published by the International Electrotechnical Commission (IEC). This standard is in agreement with Harmonization Document HD 358 S2 published by the European Committee for Electrotechnical Standardization (CENELEC) and contains a declared UK category B deviation to table 1 which will remain in force until IEC 517 is next revised and harmonized. This British Standard supersedes BS 5524 : 1978 which is withdrawn.

Terminology and conventions. For ease of reproduction the text of IEC 517 has been used as the basis of this British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used in the figures as a decimal marker. In British Standards it is the current practice to use a full point on the baseline as the decimal marker.

References to page numbers in the text relate to the IEC page numbers given in brackets at the bottom of each page.

Cross-references

International standard	Corresponding British Standard
	BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms
IEC 50 (IEV 151) : 1978	Part 1 : Group 02 : 1980 Electrical and magnetic devices terminology (Technically equivalent)
IEC 50 (IEV 441) : 1984	Part 2 : Group 06 : 1985 Switchgear and controlgear terminology (including fuse terminology) (Technically equivalent)
IEC 60-2 : 1973	BS 923 : Guide on high-voltage testing techniques Part 2 : 1980 Test procedures (Identical)
IEC 137 : 1984	BS 223 : 1985 Specification for bushings for alternating voltages above 1000 V (Technically equivalent)
IEC 270 : 1981	BS 4828 : 1985 Guide for partial discharge measurements (Identical)
IEC 529 : 1976	BS 5490 : 1977 Specification for classification of degrees of protection provided by enclosures (Identical)
IEC 651 : 1979	BS 5969 : 1981 Specification for sound level meters (Identical)
IEC 694 : 1980	BS 6581 : 1985 Specification for common requirements for high-voltage switchgear and controlgear standards (Identical)
IEC 859 : 1986	BS 6904 : 1987 Guide for cable connections for gas-insulated, metal-enclosed switchgear for rated voltages of 72.5 kV and above (Identical)

The Technical Committee has reviewed the provisions of IEC 56-4, 129, 141 and 480, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this British Standard.

A related British Standard for IEC 56-4 is BS 5311 'Specification for a.c. circuit-breakers of rated voltage above 1 kV' Part 4 'Type tests and routine tests'.

A related British Standard for IEC 129 is BS 5253 'Specification for a.c. disconnectors (isolators) and earthing switches of rated voltage above 1 kV'.

A related British Standard for IEC 480 is BS 5209 'Code of practice for the testing of sulphur hexafluoride taken from electrical equipment'.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

CONTENTS

	Page
Foreword	Inside front cover
Committees responsible	Back cover
Specification	
1. Scope	3
2. Normal and special service conditions	3
3. Definitions	3
4. Rating	5
4.1 Rated voltage	6
4.2 Rated insulation level	6
4.3 Rated frequency	6
4.4 Rated normal current and temperature rise	6
4.5 Rated short-time withstand current	7
4.6 Rated peak withstand current	7
4.7 Rated duration of short-circuit	7
4.8 Rated supply voltage of closing and opening devices and auxiliary circuits	7
4.9 Rated supply frequency of operating devices and auxiliary circuits	7
4.10 Rated pressure of compressed gas supply for operation	8
4.101 Rated density of gas for insulation	8
5. Design and construction	8
5.1 Requirements for liquids in switchgear and controlgear	8
5.2 Requirements for gases in switchgear and controlgear	8
5.3 Earthing	8
5.4 Auxiliary equipment	9
5.5 Dependent power closing	9
5.6 Stored energy closing	9
5.7 Operation of releases	9
5.8 Low and high pressure interlocking devices	9
5.9 Nameplates	9
5.101 Degree of protection	10
5.102 Internal fault	11
5.103 Enclosures	12
5.104 Partitions	13
5.105 Pressure relief	13
5.106 Disconnectors and earthing switches	14
5.107 Interlocks	14
5.108 Noise	15
5.109 Provisions for dielectric tests on cables	15
6. Type tests	15
6.1 Dielectric tests	16
6.2 Radio interference voltage (RIV) tests	20
6.3 Temperature-rise tests	20
6.4 Measurement of the resistance of the main circuit	21

Clause	Page
6.5 Short-time and peak withstand current tests	21
6.101 Verification of making and breaking capacities	22
6.102 Mechanical operation tests	22
6.103 Verification of the degree of protection for auxiliary circuits	22
6.104 Proof tests for enclosures	22
6.105 Weatherproofing test	24
6.106 Test under conditions of arcing due to an internal fault	24
6.107 Thermal stability test	24
6.108 Operation tests at limit temperatures	24
7. Routine tests	25
7.1 Power-frequency voltage tests on the main circuit	25
7.2 Dielectric tests on auxiliary and control circuits	25
7.3 Measurement of the resistance of the main circuit	26
7.101 Partial discharge measurement	26
7.102 Pressure tests of enclosures	26
7.103 Gas leakage tests	26
7.104 Mechanical operation tests	26
7.105 Tests of auxiliary electrical, pneumatic and hydraulic devices	27
7.106 Verification of the correct wiring	27
7.107 Tests after erection on site	27
8. Guide to the selection of the switchgear for service	31
9. Information to be given with enquiries, tenders and orders	31
9.101 Information with enquiries and orders	31
9.102 Information with tenders	32
10. Rules for transport, storage, erection and maintenance	33
10.1 Conditions during transport, storage and erection	33
10.2 Erection	33
10.3 Maintenance	33
APPENDIX AA — Recommended method for the weatherproofing test for outdoor gas-insulated metal-enclosed switchgear	34
APPENDIX BB — Methods for testing gas-insulated metal-enclosed switchgear under conditions of arcing due to an internal fault	37
APPENDIX CC — Technical and practical considerations of site testing	40
Tables	
I.	6
II. Degrees of protection against ingress of foreign solid objects and against access to live or moving parts	10
Figures	
AA1. Arrangement for the weatherproofing test	35
AA2. Example of a nozzle meeting the requirements of the weatherproofing test	36

British Standard Specification for

Gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above

1. Scope

This standard specifies requirements for gas-insulated metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure, for alternating current of rated voltages of 72.5 kV and above, for indoor and outdoor installation, and for service frequencies up to and including 60 Hz.

For the purpose of this standard the term "switchgear" is used for "gas-insulated metal-enclosed switchgear".

The gas-insulated metal-enclosed switchgear covered by this standard consists of individual components intended to be directly connected together and able to operate only in this manner.

This standard completes and amends, if necessary, the various relevant standards applying to the individual components constituting gas-insulated metal-enclosed switchgear.

2. Normal and special service conditions

Unless otherwise specified, the gas-insulated metal-enclosed switchgear is designed to be used under normal service conditions.

Refer to Clause 2 of IEC Publication 694: Common Clauses for High-voltage Switchgear and Controlgear Standards, with the following modification:

At any altitude the dielectric characteristics of the internal insulation are identical with those measured at sea-level. For this insulation, therefore, no requirements concerning the altitude are applicable.

For indoor installation, the humidity of the ambient air may attain high values, but condensation on the equipment does not normally occur.

3. Definitions

For the definitions of general terms used in this standard, reference is made to IEC Publications 50(441): International Electrotechnical Vocabulary (IEV), Chapter 441: Switchgear, Controlgear and Fuses, and 50(151, Chapter 151: Electrical and Magnetic Devices. The following definitions apply for the purpose of this standard:

3.101 *Switchgear*

A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy (IEV 441-11-02).

3.102 *Metal-enclosed switchgear and controlgear*

Switchgear and controlgear assemblies with an external metal enclosure intended to be earthed, and complete except for external connections (IEV 441-12-04).

3.103 *Gas-insulated metal-enclosed switchgear*

Metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure (IEV 441-12-05).

Note. — This term generally applies to high-voltage switchgear and controlgear.

3.104 *Transport unit*

A part of gas-insulated metal-enclosed switchgear suitable for shipment without being dismantled.

3.105 *Enclosure*

A part of gas-insulated metal-enclosed switchgear retaining the insulating gas under the prescribed conditions necessary to maintain safely the rated insulation level, protecting the equipment against external influences and providing a high degree of protection to personnel.

3.106 *Compartment*

A part of gas-insulated metal-enclosed switchgear, totally enclosed except for openings necessary for interconnection and control.

Note. — A compartment may be designated by the main component contained therein, e.g. circuit-breaker compartment, busbar compartment.

3.107 *Component*

An essential part of the main or earthing circuits of gas-insulated metal-enclosed switchgear which serves a specific function (for example circuit-breaker, disconnector, switch, fuse, instrument transformer, bushing, busbar, etc.).

3.108 *Partition*

A part of gas-insulated metal-enclosed switchgear separating one compartment from other compartments (IEV 441-13-06).

3.109 *Bushing*

A structure carrying a conductor through a partition or an enclosure and insulating it therefrom, including the means of attachment to the partition or enclosure.

3.110 *Main circuit*

All the conductive parts of gas-insulated metal-enclosed switchgear included in a circuit which is intended to transmit electrical energy (IEV 441-13-02).

Note. — Connections to voltage transformers are not considered part of the main circuit.

3.111 *Auxiliary circuit*

All the conductive parts of gas-insulated metal-enclosed switchgear included in a circuit (other than the main circuit) intended to control, measure, signal and regulate (IEV 441-13-03).

Note. — The auxiliary circuits of gas-insulated metal-enclosed switchgear include the control and auxiliary circuits of the switching devices.

3.112 *Rated value*

A quantity value assigned, generally by a manufacturer, for a specified operating condition of gas-insulated metal-enclosed switchgear (IEV 151-04-03).

Note. — See Clause 4 for individual rated values.

3.113 *Ambient air temperature (of gas-insulated metal-enclosed switchgear)*

The temperature, determined under prescribed conditions, of the air surrounding the external enclosure of gas-insulated metal-enclosed switchgear.

3.114 *Design temperature (of the enclosure)*

The highest temperature which can be reached by the enclosure under service conditions. This is generally the upper limit of ambient air temperature increased by the temperature rise due to the flow of rated normal current.

Note. — Solar radiation should be taken into account when it has a significant effect.

3.115 *Design pressure (of the enclosure)*

The pressure used to determine the thickness of the enclosure. It is equal to at least the upper limit of the pressure reached within the enclosure at the design temperature.

3.116 *Disruptive discharge*

Phenomena associated with the failure of insulation under electric stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or almost zero.

Notes 1. — The term applies to discharges in solid, liquid and gaseous dielectrics and to combinations of these.

2. — A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength (non-self-restoring insulation); in a liquid or gaseous dielectric, the loss may be only temporary (self-restoring insulation).

3. — The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

The term "flashover" is used when a disruptive discharge occurs over the surface of a solid dielectric in a gaseous or liquid medium.

The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

4. **Rating**

The rating of gas-insulated metal-enclosed switchgear comprises the following:

- a) rated voltage and number of phases;
- b) rated insulation level;
- c) rated frequency;
- d) rated normal current (for main circuits);
- e) rated short-time withstand current (for main and earthing circuits);
- f) rated peak withstand current (for main and earthing circuits);
- g) rated duration of short circuit;
- h) rated values of the components forming part of gas-insulated metal-enclosed switchgear, including their operating devices and auxiliary equipment;
- i) rated density of gas for insulation.

The co-ordination of rated voltages, rated short-time withstand currents, rated peak withstand currents and rated normal currents of gas-insulated metal-enclosed switchgear is under consideration.

4.1 *Rated voltage*

Refer to Sub-clauses 4.1 and 4.1.2 of I E C Publication 694 with the addition of the rated value 72.5 kV.

Note. — Components forming part of the switchgear may have individual values of rated voltage in accordance with the relevant standards.

4.2 *Rated insulation level*

For gas-insulated metal-enclosed switchgear with a rated voltage of 72.5 kV and above, rated withstand voltage values have been selected from Sub-clause 4.2 of I E C Publication 694 (as listed in Table I).

The switchgear comprises components having a definite insulation level. Although internal faults can largely be avoided by the choice of a suitable insulation level, measures to limit external overvoltages (surge arresters, protective sparkgaps) should be considered.

Notes 1. — Regarding the external parts of bushings (if any), refer to I E C Publication 137: Bushings for Alternating Voltages above 1 000 V.

2. — The waveforms considered in Table I are accepted lightning impulse and switching impulse shapes, pending the results of studies on the ability of this equipment to withstand other types of impulses.

TABLE I

Refer to Table 4 of IEC Publication 694

4.3 *Rated frequency*

Refer to Sub-clause 4.3 of I E C Publication 694 with the addition of the following rated values:

16 $\frac{2}{3}$ Hz and 25 Hz

4.4 *Rated normal current and temperature rise*

4.4.1 *Rated normal current*

Refer to Sub-clause 4.4.1 of I E C Publication 694 with the addition of the following paragraph:

Some main circuits of gas-insulated metal-enclosed switchgear (e.g. busbars, feeder circuits, etc.) may have different values of rated normal current. They should preferably be selected from the following values:

1 250 A — 2 000 A — 3 150 A — 4 000 A — 6 300 A

4.4.2 *Temperature rise*

Refer to Sub-clause 4.4.2 of IEC Publication 694 with the addition of the following supplement:

The temperature rise of components contained in the switchgear which are subject to standards not covered by the scope of IEC Publication 694 shall not exceed the temperature-rise limits permitted in the relevant standard for those components.

The temperature rise for accessible enclosures shall not exceed 30 K. In the case of enclosures which are accessible but need not be touched during normal operation, the temperature-rise limit may be increased to 40 K.

Note. — When applying a temperature rise equal to or higher than 65 K for parts of the enclosure not accessible to the operator, every precaution is to be taken to ensure that no damage is caused to the surrounding insulating materials.

4.5 *Rated short-time withstand current*

Refer to Sub-clause 4.5 of IEC Publication 694 with the addition of the following paragraph:

The rated short-time withstand current should preferably be selected from the following values:

25 kA — 31.5 kA — 40 kA — 50 kA — 63 kA — 80 kA — 100 kA

4.6 *Rated peak withstand current*

Refer to Sub-clause 4.6 of IEC Publication 694.

Note. — In principle, the rated short-time withstand current and the rated peak withstand current of a main circuit cannot exceed the corresponding rated values of the weakest of its series connected components.

4.7 *Rated duration of short-circuit*

Refer to Sub-clause 4.7 of IEC Publication 694.

4.8 *Rated supply voltage of closing and opening devices and auxiliary circuits*

Refer to Sub-clause 4.8 of IEC Publication 694.

4.9 *Rated supply frequency of operating devices and auxiliary circuits*

Refer to Sub-clause 4.9 of IEC Publication 694 with the addition of the following paragraph:

The rated supply frequency of operating devices and auxiliary circuits is the frequency at which the conditions of operation and temperature rise of these devices and circuits are determined.

4.10 *Rated pressure of compressed gas supply for operation*

Refer to Sub-clause 4.10 of IEC Publication 694 with the addition of the following paragraph:

The pressure of the compressed gas supply is understood to be the pressure measured in the reservoir immediately before the operation.

4.101 *Rated density of gas for insulation*

The rated density of gas for insulation is the density assigned by the manufacturer at which the switchgear is intended to be used in service.

The minimum gas density is the value of the density assigned by the manufacturer at and above which the rated insulation level applies.

5. **Design and construction**

Gas-insulated metal-enclosed switchgear shall be designed so that normal service, inspection and maintenance operations, earthing of connected cables, locating of cable faults, voltage tests on connected cables or other apparatus and the elimination of dangerous electrostatic charges, can be carried out safely, including the checking of phase sequence after erection and extension.

The design of the equipment shall be such that the agreed permitted movement of foundations or thermal effects do not impair the assigned performance of the equipment.

All components of the same rating and construction which may need to be replaced shall be interchangeable.

The various components contained within the enclosure are subject to their relevant standards except where modified by this standard.

5.1 *Requirements for liquids in switchgear and controlgear*

Refer to Sub-clause 5.1 of IEC Publication 694.

5.2 *Requirements for gases in switchgear and controlgear*

Refer to Sub-clause 5.2 of IEC Publication 694.

Note. — For checking of sulphur hexafluoride in service, refer to IEC Publication 480: Guide for the Checking of Sulphur Hexafluoride (SF₆) Taken from Electrical Equipment.

5.3 *Earthing*

Refer to Sub-clause 5.3 of IEC Publication 694.

5.3.101 *Earthing of the main circuits*

To ensure safety during maintenance work, all parts of the main circuits shall be capable of being earthed. In addition, it shall be possible, after the opening of the enclosure, to connect earth electrodes for the duration of work.

Earthing may be made by:

- a) earthing switches with a making capacity equal to the rated peak withstand current, if there is no certainty that the circuit connected is not alive;

- b) earthing switches without a making capacity or with a making capacity lower than the rated peak withstand current, if there is certainty that the circuit connected is not alive;
- c) removable earthing devices, only by agreement between manufacturer and user.

5.3.102 *Earthing of the enclosure*

The enclosures shall be capable of being connected to earth. All metal parts intended to be earthed, which do not belong to a main or an auxiliary circuit, shall be connected to earth. For the interconnection of enclosures, frames, etc., fastening (e.g. bolting or welding) is acceptable for providing electrical continuity.

The continuity of the earthing circuits shall be ensured taking into account the thermal and electrical stresses caused by the current they may have to carry.

5.4 *Auxiliary equipment*

Refer to Sub-clause 5.4 of I E C Publication 694.

5.5 *Dependent power closing*

Refer to Sub-clause 5.5 of I E C Publication 694.

5.6 *Stored energy closing*

Refer to Sub-clause 5.6 of I E C Publication 694.

5.7 *Operation of releases*

Refer to Sub-clause 5.7 of I E C Publication 694.

5.8 *Low and high pressure interlocking devices*

Refer to Sub-clause 5.8 of I E C Publication 694 with the addition of the following supplement:

For gas-insulated metal-enclosed switchgear it is recommended that a signal be provided when the gas density for insulation has fallen to the minimum gas density (see Sub-clause 4.101).

5.9 *Nameplates*

Refer to Sub-clause 5.9 of I E C Publication 694 with the addition of the following supplement:

Gas-insulated metal-enclosed switchgear, all its operating devices and main components, as agreed between manufacturer and user, shall be provided with durable and clearly legible nameplates which shall contain the following information:

- manufacturer's name or trade mark;
- type designation or serial number.

It is recommended that the following data are also given:

- rated voltage;
- rated normal currents for busbars and circuits;

- rated frequency;
- rated short-time withstand current;
- rated pressure for operation;
- minimum gas density for insulation;
- design pressure for enclosures.

Note. — The word "rated" need not appear on the nameplate.

5.101 *Degree of protection*

5.101.1 *Degree of protection for the main circuits*

No specification applies to the main circuit and parts directly connected thereto.

5.101.2 *Degree of protection for auxiliary circuits*

For auxiliary circuits the degree of protection against contact of persons with live parts and moving parts shall be indicated by means of the designation specified in Table II.

The characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons, also to the equipment inside the enclosure.

Table II gives details of objects which will be "excluded" from the enclosure for each of the degrees of protection.

The term "excluded" implies that a part of the body or an object held by a person, either will not enter the enclosure or, if it enters, that adequate clearance will be maintained and no moving part will be touched.

Equipment for outdoor installation provided with appropriate protection features shall be indicated by the characteristic letter W placed immediately after the letters IP.

The relevant service conditions shall be observed (see Clause 2) in order to protect the equipment against atmospheric agents.

TABLE II

Degrees of protection against ingress of foreign solid objects and against access to live or moving parts

Designation	Definition
IP2X	Protected against solid objects greater than 12 mm in diameter and fingers or similar objects not exceeding 80 mm in length
IP3X	Protected against tools, wires, etc., of diameter or thickness greater than 2.5 mm and solid objects exceeding 2.5 mm in diameter
IP4X	Protected against wires or strips of diameter or thickness greater than 1.0 mm and solid objects exceeding 1.0 mm in diameter
IP5X	Dust-protected; the ingress of dust is not totally prevented but dust does not interfere with satisfactory operation of the equipment

Note. — The designation of the degree of protection corresponds to IEC Publication 529: Classification of Degrees of Protection Provided by Enclosures. No degree of protection for auxiliary circuits against harmful ingress of water is specified.

5.102 *Internal fault*

5.102.1 *General*

A fault leading to arcing within gas-insulated metal-enclosed switchgear built to this standard has a low order of probability. This results from the application of an insulating fluid other than air at atmospheric pressure which will not be altered by pollution, humidity or vermin. Further, the insulating qualities may be checked by dielectric tests on assembled units in the factory and on site. While the probability of such a fault is low, the probability of a fault occurring with personnel present is even lower, especially since gas-insulated sub-stations are closed electrical operating areas, the access to which is permitted only to authorized personnel.

Examples of measures to avoid arcing due to an internal fault and to limit duration and consequences are:

- insulation co-ordination;
- gas-leakage limitation and control;
- high-speed protection;
- high-speed arc short-circuiting devices;
- remote control;
- internal and/or external pressure reliefs;
- checking of workmanship on site.

Arrangements should also be made to minimize the effects of internal faults leading to arcing on the continued service capability of the switchgear. The effect of an arc should be confined to the compartment in which the arc has been initiated, or to the other compartments in the faulty section, if pressure relief is used between compartments within this section. After disconnection of the compartment or section, restoration of the normal operation of the remaining equipment should be possible.

If, in spite of the measures taken, a test is agreed between manufacturer and user to verify the effect of arcing due to an internal fault, this test should be in accordance with Sub-clause 6.106.

Tests would normally not be necessary in the case of single-phase enclosed switchgear installed in isolated neutral or resonant earthed systems and equipped with a protection to limit the duration of internal earth faults.

5.102.2 *External effects of the arc*

In order to provide a high degree of protection to personnel, the external effects of an arc shall be limited (by a suitable protective system) to the appearance of a hole or tear in the enclosure without any uncontrolled ejection of solid material.

The manufacturer shall provide sufficient information regarding the protective system employed.

Manufacturer and user may agree upon a time during which an arc due to an internal fault up to a given value of short-circuit current will cause no external effects.

5.102.3 *Internal fault location*

The manufacturer of the switchgear should propose appropriate measures for fault location, if required by the user.

5.103 *Enclosures*5.103.1 *General*

The enclosure shall be of metal, permanently earthed and capable of withstanding the normal and transient pressures to which it is subjected in service.

While the enclosures of gas-filled equipment conforming to this standard are permanently pressurized in service they are subjected to particular conditions of service which distinguish them from compressed air receivers and similar storage vessels. These conditions are:

- enclosures envelop the main circuit not only to prevent hazardous approach to live or moving parts but are so shaped that when filled at or above the minimum gas density for insulation (see Sub-clause 4.101) they ensure that the rated insulation level (see Sub-clause 4.2) for the equipment is achieved (electrical rather than mechanical considerations predominate in determining the shape and materials employed);
- enclosures are normally filled with a non-corrosive gas, thoroughly dried, stable and inert; since measures to maintain the gas in this condition with only small fluctuations in pressure are fundamental to the operation of the switchgear and since the enclosures will not be subject to internal corrosion, there is no need to make allowances for these factors in determining the design of the enclosures (however, the effect of possible transmitted vibrations should be taken into account);
- the service pressure employed is relatively low.

For outdoor installation, the manufacturer shall take into account the influence of climatic conditions (see Clause 2).

5.103.2 *Design of enclosures*

Pending international agreement on a standard procedure, methods for the calculation of the thickness and the construction of enclosures either by welding or casting may be chosen from established pressure vessel codes based on the design temperature and design pressure defined in this standard.

Note. — When designing an enclosure, account should also be taken of the following:

- a) the possible evacuation of the enclosure as part of the normal filling process;
- b) the full differential pressure possible across the enclosure walls or partitions;
- c) the resulting pressure in the event of an accidental leak between the compartments in the case of adjacent compartments having different service pressures;
- d) the possibility of the occurrence of an internal fault (see Sub-clause 5.102).

In determining the design pressure of the enclosure, the gas temperature shall be taken as the mean of the upper limits of the enclosure temperature and the main circuit conductor temperature with rated normal current flowing unless the design pressure can be established from existing temperature-rise test records.

For enclosures and parts thereof, the strength of which has not been fully determined by calculation, proof tests (see Sub-clause 6.104) shall be performed to demonstrate that they fulfil the requirements.

Materials used in the construction of enclosures shall be of known and certified minimum physical properties on which calculations and/or proof tests are based. The manufacturer shall be responsible for the selection of the materials and the maintenance of these minimum properties, based on certification of the material supplier, or tests conducted by the manufacturer, or both.