

CONFIRMED
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Specification for Contactors —

**Part 2: A.C. contactors for voltages
above 1 kV and up to and
including 12 kV**

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Foreword

This revision of BS 775-2:1956, issued under the authority of the Electrical Industry Standards Committee, follows very closely draft Recommendations for high-voltage alternating-current contactors being prepared by the International Electrotechnical Commission (IEC).

The deviations from the IEC document are, apart from editorial changes obviously required for the purposes of a British Standard, mainly editorial and minor technical modifications and additions aimed at improving the clarity of the standard. These include the alignment of definitions in clause 2 with those appearing in BS 4727 “*Glossary of electrotechnical, power, telecommunications, electronics, lighting and colour terms*”, Part 2:Group 06 “*Switchgear and controlgear terminology (including fuse terminology)*”. More significant deviations include the following:

4.3.1.2 Rated insulation voltage. The list of preferred values does not appear in the IEC document.

4.3.4.3 Intermittent periodic duty or intermittent duty. Class of intermittent duty 10 is not given in the IEC document. The necessary consequential changes to related clauses have been made.

4.3.5 Rated making and breaking currents. For alignment with other h.v. switch and control gear standards, the terms “rated making current” and “rated breaking current” have been used in preference to “making capacity” and “breaking capacity”.

4.3.5.3 Ability to withstand overload currents. The ability to withstand overload currents is referred to as subject to agreement between the purchaser and the manufacturer, pending completion of work in progress, whereas the IEC document says only that the subject is under consideration.

4.3.6 Utilization categories. A reference in the IEC document to non-standard utilization categories has been omitted.

8.2.2 Verification of temperature-rise limits. References to AWG conductor sizes have been omitted.

8.2.3.3 Value of the test voltage. North American values have been omitted from Table 8.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, 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 General

1.1 Scope

This part of BS 775 specifies requirements for contactors intended for closing and opening electric circuits, and, if combined with suitable relays, for protecting those circuits against operating overloads which may occur therein.

It applies only to contactors of which the main contacts are intended to be connected to circuits having a rated voltage exceeding 1 000 V a.c. but not exceeding 12 000 V a.c., for non-exposed installations.

NOTE 1 A contactor forming part of a controlgear assembly will, in matters not covered by this standard, be subject to the requirements of a new British Standard which is in course of preparation, based on IEC Publication 298 "*High-voltage metal-enclosed switchgear and controlgear*".

NOTE 2 Contactors which are intended to provide short-circuit protection should additionally satisfy the relevant conditions specified for circuit-breakers in the appropriate British Standard.

NOTE 3 The title of the British Standard referred to in this standard as given on the inside back cover.

1.2 Object

The object of this part of BS 775 is to state:

- a) the characteristics of contactors;
- b) the requirements with which contactors shall comply with reference to:
 - 1) their operation and behaviour;
 - 2) their dielectric properties;
- c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests;
- d) the data to be marked on the apparatus.

2 Definitions

For the purposes of this part of this British Standard the following definitions apply.

2.1 Definitions concerning contactors

2.1.1

switching device

a device designed to make or break the current in one or more electric circuits

2.1.2

mechanical switching device

a switching device designed to close and open one or more electric circuits by means of separable contacts

2.1.3

controlgear

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 the control of power consuming equipment

2.1.4

contactor (mechanical)

a mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions, including operating overload conditions

NOTE 1 A contactor is usually intended to operate frequently.

NOTE 2 A contactor may also be capable of making and breaking short-circuit currents.

2.1.5

electro-magnetic contactor

a contactor in which the force for closing or opening the main contacts is provided by an electro-magnet

2.1.6

pneumatic contactor

a contactor in which the force for closing or opening the main contacts is provided by a device using compressed air, without the use of electrical means

2.1.7

electro-pneumatic contactor

a contactor in which the force for closing or opening the main contacts is provided by a device using compressed air under the control of electrically operated valves

2.1.8

latched contactor

a contactor, the moving elements of which leave the position of rest when the operating means are energized, but which are prevented by means of a latching arrangement from returning to the position of rest when the operating means are de-energized. The latching and the release of the latching may be mechanical, magnetic, electrical, pneumatic, etc

NOTE Because of the latching, the latched contactor actually acquires a second position of rest and, according to the definition 2.1.4, it is not a contactor. However, since the latched contactor in both its utilization and its design is more closely related to contactors in general than to any other classification of switching device, it is considered proper to require that it complies with the specifications for contactors wherever they are applicable.

2.1.9**main circuit**

all the conducting parts of a contactor included in the circuit which it is designed to close or open

2.1.10**pole of a contactor**

the portion of a contactor associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together

NOTE A contactor is called single-pole if it has only one pole. If it has more than one pole, it may be called multipole (two-pole, three-pole, etc.) provided the poles are or can be coupled in such a manner as to operate together.

2.1.11**main contact**

a contact included in the main circuit of a contactor, intended to carry in the closed position the current of the main circuit

2.1.12**breaking current**

the current in a pole of a contactor at the instant of initiation of the arc during a breaking operation

It is the r.m.s. value of the a.c. component

2.1.13**making current**

the current in a pole of a contactor at the instant of initiation during a making operation

NOTE 1 For a multipole contactor in a polyphase circuit the making current may differ from one pole to another and from one operation to another, as for alternating current it depends on the instant of current initiation relative to the wave of the applied voltage.

NOTE 2 Where, for a polyphase circuit, a single value of making current is referred to, this is, unless otherwise stated, the highest value in any phase.

2.1.14**recovery voltage**

the voltage which appears across the terminals of a pole of a contactor after the breaking of the current

NOTE This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

2.1.15**transient recovery voltage (TRV)**

the recovery voltage during the time in which it has a significant transient character

NOTE 1 The transient voltage may be oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and the contactor. It includes the voltage shift of the neutral of a polyphase circuit.

NOTE 2 The transient recovery voltage in three-phase circuits is, unless otherwise stated, that across the first pole to clear, because this voltage is generally higher than that which appears across each of the other two poles.

2.1.16**power-frequency recovery voltage**

the recovery voltage after the transient voltage phenomena have subsided

NOTE The power-frequency recovery voltage may be referred to as a percentage of the rated voltage.

2.1.17**rated short-time current**

the rated value of current that a contactor can carry in the closed position during a specified short time under prescribed conditions of use and behaviour

2.1.18**over-current**

any current exceeding the rated current

2.1.19 overload

operating conditions in an electrically undamaged circuit, which cause an over-current

NOTE An overload may cause damage if sustained for a sufficient time.

2.1.20**conducting part**

a part which is capable of conducting current although it may not necessarily be used for carrying service current

2.1.21**non-exposed installation**

an installation in which the equipment is not subject to over-voltages of atmospheric origin

NOTE Such installations are usually connected to cable networks.

2.1.22**ambient air temperature**

the temperature, determined under prescribed conditions, of the air surrounding the complete contactor (e.g. for enclosed contactors, it is the air outside the enclosure)

2.2 Definitions concerning positions and control and auxiliary circuits of a contactor**2.2.1****position of rest**

the position which the moving elements of the contactor take up when its electro-magnet or its compressed-air device is not energized

2.2.2**control circuit**

all the conducting parts of a contactor (other than the main circuit) used for the closing operation or opening operation, or both, of the contactor

NOTE Pneumatic contactors do not include control circuits.

2.2.3**control contact**

a contact included in a control circuit of a contactor and mechanically operated by the contactor

NOTE A control contact is part of the design of a contactor.

2.2.4**auxiliary circuit**

all the conducting parts of a contactor intended to be included in a circuit other than the main circuit and the control circuits of the contactor

NOTE Auxiliary circuits serve supplementary requirements such as signalling, interlocking, etc., and as such they may be part of the control circuit of another switching device.

2.2.5**auxiliary contact**

a contact included in an auxiliary circuit of a contactor and mechanically operated by the contactor

NOTE An auxiliary contact is intended to satisfy supplementary requirements such as signalling, interlocking, etc., and as such may be part of a control circuit of another switching device.

2.2.6**a-contact (make contact)**

a control or auxiliary contact which is closed when the main contacts of the contactor are closed and open when they are open

2.2.7**b-contact (break contact)**

a control or auxiliary contact which is open when the main contacts of the contactor are closed and closed when they are open

2.2.8**closed position**

the position in which the pre-determined continuity of the main circuit of the contactor is secured

2.2.9**open position**

the position in which the pre-determined clearance between open contacts in the main circuit of the contactor is secured

2.2.10**operation (of a contactor)**

the transfer of the moving contact(s) from one position to the other

NOTE 1 This may be a closing operation or an opening operation.

NOTE 2 If distinction is necessary, an operation in the electrical sense, e.g. make or break, is referred to as a switching operation and an operation in the mechanical sense, e.g. close or open, is referred to as a mechanical operation.

2.2.11**operating cycle (of a contactor)**

a succession of operations from one position to the other and back to the first position

NOTE 1 This may be a closing operation followed by an opening operation.

NOTE 2 A succession of operations not forming an operating cycle is referred to as an operating series.

2.2.12**closing operation**

an operation by which the contactor is brought from the open position to the closed position

2.2.13**opening operation**

an operation by which the contactor is brought from the closed position to the open position

3 Classification

3.1 According to the method of control, contactors are designated as electro-magnetic, pneumatic or electro-pneumatic.

NOTE This standard may also apply to contactors fitted with other types of control as far as it is practically applicable.

3.2 According to the interrupting medium, contactors are divided into different groups, e.g. air break, oil-immersed break, vacuum or other sealed media.

NOTE According to the interrupting medium, contactors exhibit differing switching characteristics, e.g. opening time, transient over-voltage. These effects need to be taken into account in applying contactors in service.

4 Characteristics of contactors

4.1 Summary of characteristics. The characteristics of a contactor shall be stated in the following terms, where such terms are applicable.

Type of contactor (see 4.2).

Rated values (see 4.3).

Control circuits and air-supply systems (see 4.4).

Auxiliary circuits (see 4.5).

4.2 Type of contactor. The following shall be stated:

4.2.1 Number of poles

4.2.2 Kind of current. Number of phases and rated frequency.

4.2.3 Interrupting medium (air, oil, vacuum, etc.)

4.2.4 Method of control (see 3.1)

4.3 Rated values. The rated values established for a contactor shall be stated in accordance with 4.3.1 to 4.3.8, but it is not necessary to establish all the rated values listed.

4.3.1 Rated voltages. A contactor is defined by the following rated voltages.

4.3.1.1 Rated operational voltage. A rated operational voltage (U_e) of a contactor is a value of voltage which, combined with a rated operational current, determines the application of the contactor and to which are referred the rated making and breaking currents, the type of duty, and the utilization category.

For polyphase circuits, it is stated as the voltage between phases.

NOTE 1 A contactor may be assigned a number of combinations of rated operational voltages and rated operational currents for different duties and utilization categories.

NOTE 2 For rated voltages of control circuits, see 4.4.1.

4.3.1.2 Rated insulation voltage. The rated insulation voltage (U_i) of a contactor is the value of voltage which designates it and to which dielectric tests (8.2.3) are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated operational voltage of the contactor. In no case shall the maximum rated operational voltage exceed the rated insulation voltage.

The rated insulation voltage should preferably be chosen from the following list:

2.5, 3.6, 7.2, 12 kV.

4.3.2 Rated currents. A contactor is defined by the following rated currents.

4.3.2.1 Rated thermal current. The rated thermal current (I_{th}) of a contactor is the maximum current it can carry on eight-hour duty (see 4.3.4.1) without the temperature rise of its various parts exceeding the limits specified in 7.2 (Table 5 and Table 6) when tested according to 8.2.2.

NOTE The rated thermal current can differ according to the type of enclosure.

4.3.2.2 Rated operational currents or rated operational powers. A rated operational current (I_e) of a contactor is stated by the manufacturer and takes into account the rated operational voltage (see 4.3.1.1), the rated frequency (see 4.3.3), the rated duty (see 4.3.4), the utilization category (see 4.3.6) and the type of protective enclosure.

In the case of contactors for motors, the indication of a rated operational current may be replaced or supplemented by the indication of the maximum rated power output (kW), at the rated operational voltage considered, of the motor for which the contactor is intended. The manufacturer shall be prepared to state the relationship assumed between the current and the power.

4.3.3 Rated frequency. The supply frequency for which a contactor is designed and to which the other characteristic values correspond.

4.3.4 Rated duty. The rated duties recognized in this British Standard are as follows.

4.3.4.1 Eight-hour duty. Duty in which the main contacts of a contactor remain closed whilst carrying a steady current long enough to reach thermal equilibrium but not for more than eight hours without interruption.

NOTE 1 This is the basic duty on which the rated thermal current of the apparatus is determined.

NOTE 2 Interruption means breaking of the current by operation of the contactor.

4.3.4.2 Uninterrupted duty. Duty in which the main contacts of a contactor remain closed whilst carrying a steady current without interruption for periods of more than eight hours (weeks, months, or even years).

NOTE This kind of service is set apart from the eight-hour duty because oxides and dirt can accumulate on the contacts and lead to progressive heating. Uninterrupted duty can be taken account of either by a derating factor, or by special design (e.g. silver contacts) (see Table 6).

4.3.4.3 Intermittent periodic duty or intermittent duty. Duty in which the main contacts of a contactor remain closed for periods bearing a definite relation to the no-load periods, both periods being too short to allow the contactor to reach thermal equilibrium.

Intermittent duty is characterized by the value of the current, the duration of current flow and by the on-load factor, which is the ratio of the in-service period to the entire period, often expressed as a percentage.

Example. An intermittent duty comprising a current flow of 100 A for 4 min in every 10 min may be stated as: "Intermittent duty 100 A, 4 min/10 min" or "Intermittent duty 100 A, 6 operating cycles per hour, 40 %".

Standard values of on-load factor are 15 %, 25 %, 40 % and 60 %.

According to the number of operating cycles which they are capable of carrying out per hour, contactors are divided into the following classes of intermittent duty:

- Class 0.01: up to 1 operating cycle per hour;
- Class 0.03: up to 3 operating cycles per hour;
- Class 0.1 : up to 12 operating cycles per hour;
- Class 0.3 : up to 30 operating cycles per hour;
- Class 1 : up to 120 operating cycles per hour;
- Class 3 : up to 300 operating cycles per hour;
- Class 10 : up to 1 200 operating cycles per hour.

It is recalled that an operating cycle is a complete working cycle comprising one closing operation and one opening operation.