

Australian Standard[®]

**a.c. motor starters (up to and
including 1 000 V)**

Part 4: Rheostatic rotor starters

The following scientific, industrial and governmental organizations were officially represented on the committee entrusted with the preparation of this standard:

Associated Chambers of Manufactures of Australia

Australian Electrical Manufacturers Association

Australian-British Trade Association

Department of Defence

Department of Industry and Commerce

Electricity Supply Association of Australia

Institution of Engineers, Australia

Railways of Australia Committee

Testing Authorities

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including 1 000 V)**

Part 4: Rheostatic rotor starters

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PREFACE

This standard was prepared by a subcommittee of the Association's Committee on Industrial Switchgear and Controlgear. It forms one part of a four-part standard for a.c. motor starters being published to supersede AS C381—1967, Reduced Current Motor Starters, where a.c. starters up to 1000 V are concerned (for a.c. starters over 1000 V and d.c. starters, AS C381 is still applicable).

Part 1 of this standard applies to direct-on-line (full voltage) starters, Part 2 to star-delta starters and Part 3 to autotransformer starters.

This standard applies to rheostatic rotor starters for industrial use, intended to start a three-phase induction motor having a wound rotor by cutting out resistors previously inserted in the rotor circuit, to provide means for the protection of the motor and its associated circuits against operating overloads and to cause the motor to stop intentionally, and of which the main contacts are intended to be connected to circuits of rated voltages not exceeding 1000 V a.c.

This standard has been based on the International Electrotechnical Commission Publication 292-3, Low Voltage Motor Starters, Part 3—Rheostatic Rotor Starters, and acknowledgement is made of the assistance received therefrom. However, some of the requirements of that publication have been modified to take account of local conditions. Where this standard deviates technically from the IEC document, by way of additional or different requirements, this deviation is indicated by a rule in the margin against the clause, or part thereof, affected.

In the application of this standard reference may be necessary to the following Australian standards:

AS 1029 A.C. Contactors (up to and including 1000 V)
AS 1431 Control Switching Devices
 Part 1—General Requirements
 Part 4—Contactor Relays.*

* In course of preparation.

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STANDARDS ASSOCIATION OF AUSTRALIA

**Australian Standard Specification
for
A.C. MOTOR STARTERS
(up to and including 1000 V)**

PART 4—RHEOSTATIC ROTOR STARTERS

SECTION 1. SCOPE, OBJECT AND APPLICATION

1.1 SCOPE. This Part of the specification applies to rheostatic rotor starters for industrial use intended to start an a.c. induction motor having a wound rotor by cutting out resistors previously inserted in the rotor circuit, to provide means for the protection of the motor against operating overloads, and to cause intentionally the motor to stop.

It applies only to starters having main contacts intended for connection to supply circuits of which the rated voltage does not exceed 1000 V a.c. and in the case of asynchronous slip-ring motors (wound rotors), where the highest voltage between slip-rings does not exceed twice the rated insulation voltage of the switching devices inserted in the rotor circuit (see Clause 4.4.2.5).

This Part of the specification applies also to starters for two directions of rotation when reversal of connections is made with the motor stopped (see Clause 4.4.7). Operations including inching and plugging will necessitate additional requirements which are subject to agreement between purchaser and manufacturer.

This Part applies to resistors which are part of the starter or constitute a unit specially designed to be associated with the starter.

The starters dealt with in this Part are not normally designed to interrupt short-circuit currents. Therefore, suitable short-circuit protection should form part of the installation, but not necessarily in the starter (see Appendix C of Part 1).

The clauses of this Part relating to overload protection are not applicable to starters operating in conjunction with over-temperature protective devices built into the motors.

This Part does not apply to the following equipment:

- (a) Unbalanced starters, *viz* where the resistances do not have the same value in all phases.
- (b) Equipments designed for both starting and the adjustment of speed.
- (c) Liquid starters and those of the 'liquid-vapour' type.
- (d) Static starters using semiconductor elements.

1.2 OBJECT. The object of this Part of the specification is to state—

- (a) the characteristics of rheostatic rotor starters;
- (b) the conditions with which starters must comply with reference to—
 - (i) their operation and behaviour;
 - (ii) their dielectric properties;
 - (iii) the degree of protection provided by their enclosures;
- (c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests; and
- (d) the data to be marked on the apparatus.

1.3 APPLICATION. Rheostatic rotor starters shall, in addition to complying with the requirements of this Part of the specification, comply with the requirements of Part 1 except where amended by this Part.

SECTION 2. DEFINITIONS*

2.1 APPLICATION OF SECTION. For the purpose of this Part of the specification, the following definitions and those given in Part 1 apply.

2.2 RHEOSTATIC STARTER—a starter utilizing one or several resistors for obtaining, during starting, stated motor torque characteristics and/or for limiting the current. It incorporates the mechanical switching devices necessary for cutting out the resistors.

NOTE: A rheostatic starter generally consists of three basic parts which may be supplied either as a composite unit or as separate units to be connected at the place of utilization, viz—

- (a) the mechanical switching device for supplying the stator (generally associated with an overload protective device);
- (b) the resistors inserted in the stator or rotor circuit;
- (c) the mechanical switching device for successively cutting out the resistors.

2.3 RHEOSTATIC ROTOR STARTER—a rheostatic starter for an asynchronous wound-rotor motor, which, during the starting period, successively cuts out one or several resistors previously provided in the rotor circuit.

2.4 SINGLE-STEP STARTER—a starter in which there is no intermediate accelerating position between the OFF and FULL ON positions.

NOTE: This is a direct-on-line starter.

2.5 n-STEP STARTER (see Fig. F1)—a starter in which there are n minus 1 intermediate accelerating positions between the OFF and FULL ON positions.

Example: A three-step rheostatic rotor starter has two sections of resistors used for starting.

2.6 STARTING TIME (t_s)—the length of time the starting resistors or parts of them carry current.

2.7 UNDERCURRENT RELAY—a measuring relay which operates when the current through it is reduced below the operating value.

* For other definitions, reference should be made to the standards listed in the Preface and to AS 1852, International Electrotechnical Vocabulary.

SECTION 3. CLASSIFICATION

3.1 GENERAL. In addition to the classifications set out in Clauses 3.1 to 3.4 of Part 1, the classifications given in the following Clauses 3.2 and 3.3 shall apply to rheostatic rotor starters.

3.2 CLASSIFICATION OF STARTERS ACCORDING TO THE METHOD OF CHANGING STARTING STEPS. According to the method of changing starting steps, starters are classified as—

- (a) automatic changeover (i.e. independent of the operator), e.g. controlled by a timer or an undercurrent relay;
- (b) non-automatic changeover (i.e. dependent on the operator), e.g. controlled by hand or by push-buttons; or
- (c) semiautomatic changeover (i.e. for which the successive orders of the operator during starting are executed only after having been checked by an automatic device).

3.3 CLASSIFICATION OF STARTERS ACCORDING TO THE MEANS OF COOLING OF RESISTORS. According to the means of cooling of resistors starters are classified as—

- (a) having resistors cooled by convection;
- (b) having resistors cooled by forced air; or
- (c) having resistors cooled by immersion in oil.

SECTION 4.

CHARACTERISTICS OF RHEOSTATIC ROTOR STARTERS

NOTE: If for special applications, the intermediate steps are not considered as transitional positions for starting, but on the contrary as normal operating connections, it is recommended that the special characteristics be the subject of agreement between the purchaser and the manufacturer.

4.1 SUMMARY OF CHARACTERISTICS. The characteristics of a rheostatic rotor starter shall be stated in the following terms, where such terms are applicable:

- (a) Type of switching devices (see Clause 4.2).
- (b) Type and characteristics of relays and releases (see Clause 4.3) and number of these devices.
- (c) Degrees of protection of enclosures (see Clause 3.4 of Part 1).
- (d) Rated values (see Clause 4.4).
- (e) Characteristics of starting (see Clause 4.4.8).
- (f) Control circuits and air supply systems (see Clause 4.5).
- (g) Auxiliary circuits (see Clause 4.6).
- (h) Coordination with short-circuit protective devices (see Clause 4.7).
- (j) Types and characteristics of automatic acceleration control devices (see Clause 4.8).
- (k) Types and characteristics of starting resistors (see Clause 4.9).

4.2 TYPES OF SWITCHING DEVICES. The following shall be stated:

- (a) Number of poles, according to their function, for supplying the stator or for short-circuiting resistors.
- (b) Number of phases and rated frequency.
- (c) Interrupting medium (air, oil, vacuum, etc).
- (d) Method of control—
 - (i) manually controlled, including type of operating device, i.e. handle, lever, push-button, or other device; or
 - (ii) indirectly controlled, i.e. electromagnetic, motor-operated, pneumatic.

4.3 TYPES AND CHARACTERISTICS OF RELAYS AND RELEASES

NOTE: Hereinafter, the words 'overload relay' are to be taken to apply equally to an overload relay or an overload release as appropriate.

4.3.1 Types. Relays and releases are of the following types:

- (a) Release with shunt coil (shunt trip—energized to open the starter).
- (b) Undervoltage opening relay or release (opens the starter at a set point below nominal voltage).

- (c) Overload relay, the time-lag of which is—
 - (i) substantially independent of previous load (e.g. time-delay magnetic overload relay); or
 - (ii) dependent on previous load (e.g. thermal overload relay).
- (d) Instantaneous overcurrent relay or release (when applicable).
- (e) Other relays or releases (e.g. phase unbalance relay, control switch associated with devices for the thermal protection of the starter).

NOTES:

1. Types referred to in items (d) and (e) above require consultation between the purchaser and the manufacturer according to the particular application.
2. The overload relay is normally inserted in the stator circuit. As a result, in the case of a rheostatic rotor starter, it cannot effectively protect the rotor circuit, particularly the resistors which are generally more susceptible to damage than the rotor itself or the switching devices in case of faulty starting. Protection of the rotor circuit if required should be the subject of a specific agreement between the purchaser and the manufacturer (see Clause 7.1.1).

4.3.2 Characteristics. The characteristics of relays and releases shall be in accordance with Clause 4.3.2 of Part 1.

4.3.3 Designation and Current Settings of Overload Relays. The designation and current settings shall be in accordance with Clauses 4.3.3.1 to 4.3.3.4 of Part 1.

4.4 RATED VALUES.

4.4.1 General. The rated values established for a starter shall be stated in accordance with the following clauses, but it is not necessary to establish all the rated values listed:

Rated voltages	Clause 4.4.2
Rated currents	Clause 4.4.3
Rated frequency	Clause 4.4.4
Rated duty	Clause 4.4.5
Making and breaking capacities	Clause 4.4.6
Utilization category	Clause 4.4.7
Starting and stopping characteristics	Clause 4.4.8
Mechanical endurance	Clause 4.4.9
Electrical endurance	Clause 4.4.10

4.4.2 Rated Voltages.

4.4.2.1 General. A rheostatic rotor starter shall be defined by the rated voltages specified in Clauses 4.4.2.2. to 4.4.2.5.

4.4.2.2 Rated stator operational voltages. A rated stator operational voltage (U_{es}) of a rheostatic rotor starter is a value of voltage which, combined with a rated stator operational current, determines the application of the stator circuit including its mechanical switching devices and to which are referred the making and breaking capacities, the type of duty and the starting characteristics.

It is expressed as the voltage between phases.