

Australian Standard[®]

**ROTATING
ELECTRICAL MACHINES
OF PARTICULAR TYPES
OR FOR PARTICULAR
APPLICATIONS**

**Part 11—Dimensions and
Performance of Small Power
Electrical Machines**

This part of the standard, prepared by Committee EL/9, Rotating Electrical Machinery, was approved on behalf of the Council of the Standards Association of Australia on 8 November 1979, and was published on 1 February 1980.

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PREFACE

This revised edition of AS 1360, Part 11—1977 was prepared by the Association's Committee on Rotating Machines.

The revision was undertaken in response to requests from the industry to permit shaft extensions of smaller diameter for low-load applications. The opportunity was also taken to make other necessary changes.

The revision differs from the original as follows:

- (a) Shaft extensions of smaller diameter are specified for frame numbers S80 and S90 for limited torque applications where mechanical adequacy is assured (see Table 11.5.1, frame numbers S80-14 and S90-16).
- (b) Descriptions of dimensional symbols have been clarified; redefined symbols ED and ES replace previously specified EB and EC (see Fig. 11.5.1).
- (c) The application of limits of shaft extension runout has been extended to all machines (see Clause 11.5.1).
- (d) The tolerance on H for resilient-mounted frames has been considerably increased (see Table 11.6.1).

It is recognized in practice that there is some overlap between this part and Part 10 which specifies dimensions of three-phase electric motors. Motors of certain rating may be constructed to comply with either this part or Part 10; mechanical considerations may require a heavier form of construction, e.g. a larger shaft extension (see Note to Table 11.5.1), in which case reference should be made to Part 10.

In the application of this part, reference may be necessary to the following standards:

AS 1044	Limits of Electromagnetic Interference for Electrical Appliances and Equipment
AS 1110	ISO Metric Hexagon Precision Bolts and Screws
AS 1275	Metric Screw Threads for Fasteners (Based on ISO Recommendations)
AS 1359	General Requirements for Rotating Electrical Machines Part 1—Definitions Part 20—Classification of Types of Enclosure* Part 21—Classification of Methods of Cooling Part 22—Classification of Mounting Arrangements and Types of Construction Part 51—Noise Level Limits
AS 1360	Rotating Electrical Machines of Particular Types or for Particular Applications Part 10—Dimensions and Outputs of Standard Single-speed Three-phase General Purpose Motors
AS 1654	Limits and Fits for Engineering

AS C98	Flameproof Enclosure of Electrical Equipment for Explosive Atmospheres
AS C320	Classification of Insulating Materials for Electrical Machinery and Apparatus on the Basis of Thermal Stability in Service
BS 2725	Memorandum on the Measurement of Cooling Medium Temperature when Testing Electrical Machines, Transformers and Other Electrical Apparatus
BS 4235	Metric Keys and Keyways Part 1—Parallel and Taper Keys

* In course of preparation. Meanwhile reference may be made to AS 1939 Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment.

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STANDARDS ASSOCIATION OF AUSTRALIA

**Australian Standard
for
ROTATING ELECTRICAL MACHINES OF PARTICULAR TYPES AND
FOR PARTICULAR APPLICATIONS**

**PART 11. DIMENSIONS AND PERFORMANCE OF SMALL POWER
ELECTRIC MACHINES**

11.1 SCOPE. This Part of this standard specifies the dimensions and performance of a.c., d.c., and universal type electrical machines intended for applications for which a lighter construction than that specified in AS 1360, Part 10 is adequate and having the following characteristics:

- (a) Foot, flange, face-flange or resilient mounting.
- (b) Sleeve or rolling bearings.
- (c) Any type of enclosure.
- (d) A rated voltage up to and including 240 V d.c., 480 V single-phase a.c., or 650 V three-phase a.c.
- (e) A continuous rated output (or equivalent continuous rated output for short-time rated machines) up to and including 0.75 kW (or kV.A) for each 1000 r/min of the rated speed (or synchronous speed for a.c. machines).

NOTE: It is recognized that in practice there is some overlap between the ratings covered by this Part and those covered by Part 10: e.g. motors of certain ratings may be constructed to comply either with this Part or with Part 10 but not necessarily with both.

11.2 DEFINITIONS.* For the purpose of this Part, the following definitions apply:

11.2.1 General Definitions.

11.2.1.1 Rotating electrical machine — an electrical apparatus depending upon electromagnetic induction for its operation and having components capable of relative rotary movement and intended for converting energy.

11.2.1.2 General purpose machine — any machine designed, listed and offered in standard ratings with operating characteristics and mechanical construction suitable for use under usual service conditions without restrictions to a particular application or type of application.

11.2.1.3 Universal motor — a motor which can be operated by either direct current or single phase alternating current of normal frequencies.

11.2.1.4 Adjustable-speed motor — a motor the speed of which can be adjusted to any value in a specified range.

11.2.1.5 Multi-speed motor — a motor which can be operated at any one of two or more speeds which are

substantially constant over its normal range of loads.

11.2.2 Cooling.

11.2.2.1 Cooling — a procedure by means of which heat resulting from losses occurring in a machine is given up first to a primary coolant by increasing its temperature. The heated primary coolant may be replaced by new coolant at a lower temperature or may be cooled by a secondary coolant in some form of heat exchanger.

11.2.2.2 Open circuit cooling — a method of cooling in which the coolant is drawn from the medium surrounding the machine, passes through the machine and then returns to the surrounding medium.

11.2.2.3 Closed circuit cooling — a method of cooling in which a primary coolant is circulated in a closed circuit through the machine and, if necessary, through a heat exchanger. Heat is transferred from the primary coolant to the secondary coolant through the structural parts or in the heat exchanger.

11.2.2.4 Air-over-machine (AOM) cooling — a method of cooling where the machine is located in an air stream, the source of air movement not being an integral part of the machine.

11.2.3 Duty and Duty Cycles.

11.2.3.1 Duty — a statement of the loads, including no-load and rest and de-energized periods, to which a machine is subjected, including their duration and sequence in time.

11.2.3.2 Duty cycle — a variation of load with time in which the cycle time is too short for thermal equilibrium to be attained.

11.2.3.3 Cyclic duration factor — the ratio between the period of loading including starting and electric braking and the duration of the duty cycle, expressed per unit.

11.2.4 Loads.

11.2.4.1 Load — all the numerical values of the electrical and mechanical quantities that signify the demand to be made at a given instant on a rotating machine by an electric circuit or a mechanism.

11.2.4.2 No-load — the state of a machine rotating at normal speed under rated conditions but when no output is required of it.

* Definitions from Part 1 of AS 1359 are included here for convenience.

11.2.4.3 *Rest and de-energized* — the complete absence of all movement and of all electrical or mechanical supply.

11.2.4.4 *Stalling* — a condition where a loaded machine is brought to rest while remaining energized.

11.2.4.5 *Overload* — the excess of the actual load over the rated load.

11.2.4.6 *Momentary overload* — an overload the duration of which is so short as not to affect appreciably the temperature of the machine.

11.2.5 Rating.

11.2.5.1 *Rating* — the whole of the numerical values of the electrical and mechanical quantities with their duration and sequences assigned to the machine by the manufacturer, which define the performance of the machine under specified conditions.

11.2.5.2 *Rated value* — the numerical value of a quantity included in the rating.

11.2.5.3 *Rating plate* — a plate affixed to a machine or apparatus giving its principal rated data and the values of the quantities corresponding to rating.

11.2.5.4 *Maximum continuous rating (MCR)* — the statement of the output assigned to the machine by the manufacturer, at which the machine may be operated for an unlimited period while complying with the requirements of this Part of this standard.

11.2.5.5 *Short-time rating (STR)* — the statement of the output assigned to the machine by the manufacturer, at which the machine may be operated for a stated limited period, starting at the ambient temperature while complying with the requirements of this standard. The preferred times for short-time ratings are 5, 10, 30, 60 and 90 min.

11.2.5.6 *Equivalent continuous rating (ECR)* — the statement of the output assigned to the machine for test purposes by the manufacturer, at which the machine may be operated until thermal equilibrium is reached and which is considered to be equivalent to the applied short-time rating.

11.2.6 Overspeeds.

11.2.6.1 *Overspeed* — a speed in excess of rated speed.

11.2.6.2 *Runaway speed of a generator set* — the maximum speed attained by a set consisting of a prime mover and a generator, after the removal of the full load of the generator, with the speed regulator inoperative.

11.2.7 Starting Characteristics.

11.2.7.1 *Starting* — the process of bringing a machine up to speed from rest.

NOTE: This includes energizing, breaking away, accelerating and, if necessary, synchronizing with the supply.

11.2.7.2 *Locked rotor current (breakaway starting current)* — the maximum measured steady-state r.m.s. current taken from the line with the motor at rest; for all angular positions of its rotor, with rated voltage at rated frequency applied.

11.2.7.3 *Locked rotor current of a motor and starter* — the steady-state r.m.s. current taken from the line with the motor at rest, with the starter in its original starting position and with rated voltage at rated frequency applied.

11.2.7.4 *Locked rotor torque* — the minimum measured torque which the motor will develop at rest for all angular positions of its rotor with rated voltage applied at rated frequency. (See Appendix 11B.)

11.2.7.5 *Locked rotor kV.A* — the kV.A input at rated voltage under locked rotor conditions.

11.2.7.6 *Pull-up torque* (of an a.c. motor) — the smallest torque developed by a motor between zero speed and the speed which corresponds to the breakdown torque when the motor is supplied at the rated voltage and frequency. (See Appendix 11B.)

NOTE: This definition does not apply to motors of which the torque continually decreases with increase in speed.

11.2.7.7 *Breakdown torque* (of an a.c. motor) — the highest torque developed by the motor between synchronous speed and the speed which corresponds to the pull-up torque when the motor is supplied at the rated voltage and frequency. (See Appendix 11B.)

NOTE: This definition does not apply to motors of which the torque continuously decreases with increase in speed.

11.2.8 Temperatures.

11.2.8.1 *Ambient temperature* — the temperature of the medium surrounding a piece of apparatus. It may differ at various distance and directions from the apparatus, and may be subject to fluctuations.

11.2.8.2 *Coolant temperature* — the effective temperature of the ambient air, cooling gas, cooling water or other cooling agent above which the temperature rise of the apparatus is measured. (See BS 2725.)

11.2.8.3 *Temperature rise* — the difference between the temperature at the point under consideration and a reference temperature.

11.2.8.4 *Thermal equilibrium of a machine* — the state reached when the observed temperature rises of the several parts of the machine do not vary by more than 2°C over a period of 1 h.

11.2.9 Tests.

11.2.9.1 *Performance tests* — the tests required to determine the characteristics of a machine and to show that the machine complies with its specification.

11.2.9.2 *Type-tests* — the performance tests taken on one of the first machines of each type of design.

11.2.9.3 *Routine check tests* — the tests applied to a machine to show that it is able to withstand the appropriate high-voltage tests, and is in correct working order both electrically and mechanically.

11.3 FRAME NOMENCLATURE.

11.3.1 *System of Frame Nomenclature.* A system of frame nomenclature is given in AS 1359, Parts 21 and 22; however, in view of the limited number of frames specified herein, a simplified system of designation is used.

11.3.2 *Simplified Designation.* The simplified designation is made up of two three, or four parts comprising a letter, a letter and two digits; in some cases another letter; and in some cases a dash followed by two digits:

- (a) *First part*—a letter indicating the enclosure*, as follows:
- ‘C’ for enclosed ventilated
 - ‘D’ for totally enclosed (all types other than flameproof)
 - ‘E’ for flameproof (all types).
- (b) *Second part, the frame number*—the letter ‘S’ followed by a two-digit number, the number being the dimension ‘H’ in millimetres, being the distance from centreline of a shaft to the base of the feet (for a foot-mounted frame).

NOTE: The letter ‘S’ indicates compliance with this Part (Part 11) of the standard rather than with AS 1360, Part 10.

- (c) *Third part*—a letter indicating the type of mounting, other than foot mounting, as follows:
- ‘A’ for resilient mounting
 - ‘C’ for face-flange mounting.
 - ‘D’ for flange mounting.

NOTE: The absence of a final letter indicates foot mounting.

Example. An enclosed ventilated flange-mounted machine of frame number S80 would be designated CS80D.

- (d) *Fourth part*—a dash and two digits, as follows:
- ‘-14’, applicable only to frame number S80 indicating the alternative 14 mm shaft specified in Clause 11.5.2.
 - ‘-16’, applicable only to frame number S90 indicating the alternative 16 mm shaft specified in Clause 11.5.2.

Example: A totally enclosed machine of frame number S90 with the smaller shaft would be designated DS90-16.

11.4 SYMBOLS FOR DIMENSIONS AND TOLERANCES.

11.4.1 Symbols for Dimensions. The letter symbols and dimension descriptions listed in Table 11.4.1 are mandatory; those listed in Table 11.4.2 are not. In the diagrams shown in Clauses 11.5 and 11.6 the ringed symbols are mandatory.

11.4.2 Tolerances. Where tolerance grades are used they shall have the meanings defined in AS 1654.

NOTE: Tolerance Class j6 is not listed in AS 1654 but is used to comply with the recommendations contained in IEC 72-1971.

11.5 SHAFT EXTENSIONS.

11.5.1 General. Shaft extensions shall be in accordance with Clauses 11.5.2 to 11.5.6 and Tables 11.5.1 and 11.5.2.

11.5.2 Shaft Number. Machines shall have a shaft number in accordance with Table 11.5.1. The shaft number is the nominal diameter of the shaft in millimetres.

* Pending publication of AS 1359, Part 20, reference should be made to AS 1939, Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment. The use of the ‘IP’ (for International Protection) designation is under consideration.

TABLE 11.4.1
SYMBOLS FOR MANDATORY DIMENSIONS

Letter symbol	Dimension description
A	Distance between centrelines of fixing holes (end view)
B	Distance between centrelines of fixing holes (side view)
C	Distance from centreline of fixing holes at driving end of machine to shoulder of shaft
D	Diameter of shaft extension
E	Length of shaft extension from the shoulder
ED	Minimum length of keyway or flat
F	Width of keyway
G	Distance from flat or bottom of keyway to opposite side of shaft extension
H	Distance from centreline of shaft to bottom of feet
K	Diameter of holes or width of closed slots in the feet or mounting pads (or faces) of machine
M	Pitch circle diameter of fixing holes
N	Diameter of spigot
P	Outside diameter of flange
R	Distance from surface of mounting flange to shaft shoulder or end of useful shaft extension
S	Diameter of fixing holes in flange
T	Depth of spigot

TABLE 11.5.1
PERMISSIBLE FRAME/SHAFT
COMBINATIONS

Frame number	S56	S63	S71	(1) S80	(1) S90	(2) S80-14	(2) S90-16
Shaft number	9	11	14	16	19	14	16
Maximum torque for continuous duty, N.m						2.8	4.5

NOTES:

1. For frame numbers S80 and S90, mechanical considerations may require larger diameter shaft extensions; refer to AS 1360, Part 10.
2. The manufacturer should be consulted concerning the mechanical adequacy of the smaller shafts for the intended application.

11.5.3 Shaft Extensions, Flats and Keyways. Each shaft extension shall be provided with a flat as shown in Fig. 11.5.1. or, for shaft number 19 only, a keyway as shown in Fig. 11.5.2. The figures show the meaning of the symbols defined in Tables 11.4.1 and 11.4.2.

11.5.4 Dimensions of Shaft Extensions. Machines shall have shaft extension dimensions in accordance with Table 11.5.2. Where shaft number 19 is provided with a keyway, dimension *ED* shall be 25 mm (minimum), the dimension *F* shall be $6 + 0 - 0.030$ mm, and the keyway corner radius shall be 0.16 mm minimum and 0.25 mm maximum, these values figures being taken from AS 1360, Part 10.

TABLE 11.4.2
SYMBOLS FOR NON-MANDATORY DIMENSIONS

Letter symbol	Dimension description
<i>AA</i>	Width of end of foot (end view)
<i>AB</i>	Overall dimension across feet (end view)
<i>AC</i>	Overall diameter
<i>AD</i>	Distance from centreline of motor to extreme outside of terminal box (end view)
<i>AE</i>	Distance from centreline of machine to centreline of hole in terminal box for conduit or cable entry
<i>BA</i>	Length of foot (side view)
<i>BB</i>	Overall dimension across feet (side view)
<i>CA</i>	Distance from shoulder on second shaft extension to centreline of holes in the nearest feet
<i>DA</i>	Diameter of second shaft extension
<i>EA</i>	Length of second shaft extension from the shoulder or useful length of shaft extension
<i>ES</i>	Minimum length of keyway or flat on second shaft extension
<i>FA</i>	Width of keyway on second shaft extension
<i>GB</i>	Distance from the flat or bottom of the keyway to the opposite surface of the second shaft extension
<i>HA</i>	Thickness of feet
<i>Hb</i>	Distance from centreline to top of lifting device terminal box or other most salient object mounted on top of the machine
<i>HC</i>	Distance from bottom of feet to top of machine
<i>HE</i>	Distance from centreline of machine to terminal box conduit or cable entry
<i>KK</i>	Diameter of holes in terminal box for cable entry
<i>L</i>	Overall length with single shaft extension
<i>LA</i>	Thickness of flange
<i>LB</i>	Distance from fixing face of flange to non-drive end
<i>LC</i>	Overall length of machine with double shaft extension
<i>LD</i>	Distance from centreline of terminal box to fixing face of flange
<i>LE</i>	Distance from extreme point of non-drive end to centreline of fixing holes in nearest feet
<i>LK</i>	Distance from end of bearing housing or resilient mounting (drive end) to centre-line of fixing holes in nearest feet
<i>LL</i>	Distance from centreline of terminal box to centreline of fixing holes in feet nearest to shaft extension