



GS 112-3

Guidance for Specification GS 112-3

LOW VOLTAGE INDUCTION MOTORS

October 1993

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LOW VOLTAGE INDUCTION MOTORS			
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SCOPE AND PURPOSE			
This document gives specification guidance on all BP application and testing requirements for low voltage induction motors. Its purpose is for the specification of fit-for-purpose low voltage induction motors at minimum cost.			
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

This Guidance for Specification enables the application requirements for low voltage induction motors to be properly described by purchasers and for vendors to properly define the performance characteristics.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 112-3) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.

Principal Changes from Previous Edition

This Guidance for Specification is a revision of BP Std 221 which was issued in May 1982 and which was based upon the requirements of the 1981 issue of OCMA Spec No. ELEC 1. This revision is based upon [EEMUA Publication No. 132](#) which has superseded OCMA Spec No. ELEC 1.



Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, or the Custodian. See Quarterly Status List for contacts.



1. SCOPE

This Specification gives requirements for induction motors suitable for operation on alternating current supplies at voltages not exceeding 1000 V rms. The normal maximum rating for such machines will be 150 kW, but in exceptional circumstances, where machines rated up to 1000 V and exceeding 150 kW are required, then this Specification shall apply.

This Specification covers all classes of induction motors generally found in industry and includes both single phase and three phase machines which may be required for installation in areas classified either as hazardous or non-hazardous. Machines for use in areas classified as hazardous may be of flameproof or increased safety construction, for use in Zone 1 and Zone 2 areas, or of Type N construction for use in Zone 2 areas only.

The value of 150 kW as the break point between low voltage and high voltage machines is based upon economic considerations for motors taken in isolation. Overall system considerations, particularly economic, must always be born in mind and on occasion it may be better to employ one voltage level and to consider the use of soft start techniques, at low voltage, for relatively large motors, and unit transformers, at high voltage, for relatively small motors.

Provided that decided advantage can be proven there is no objection to employing machines, suitable for use in one particular area classification, within a less onerous area (e.g. Type 'e' in either Zone 2 or non-hazardous areas).

2. GENERAL

2.1 Documentation

2.1.1 This Specification shall be read in conjunction with an enquiry or purchase order and all data sheets associated therewith.

2.1.2 The purchaser and vendor shall complete the Data Sheet.

2.2 Exceptions

2.2.1 Tenders for the supply of equipment against this Specification shall either include an unqualified affirmation regarding compliance with the Specification or a complete list of detailed exceptions.

2.2.2 A vendor may offer other suitable proposals where price or technical advantage may accrue, but such proposals shall form a supplement to the main tender.



2.3 Conflicts

If any of the reference documents conflict and definition is not established by the provisions of Section 3 of this Specification then the vendor shall bring this to the attention of BP and shall state the basis of design used.

2.4 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume

3. STANDARD DESIGN REQUIREMENTS

3.1 General

- 3.1.1 All types of motor shall comply with all parts of [EEMUA Publication No. 132](#) (1988) except those clauses which deal exclusively with machines for rated voltages above 1000 V.

EEMUA Publication No. 132 has been selected as a base standard because it is a recognised industry standard for the users of induction motors, especially those users in the petro-chemical industry.

- 3.1.2 All types of motor shall comply with the following parts of [BS 4999](#) unless such requirements conflict with the requirements of 3.1.1.

Part 101	Specification for rating and performance
Part 102	Methods for determining losses and efficiency from tests
Part 103	Specification for symbols
Part 105	Classification of degrees of protection provided by enclosures for rotating machines
	Unless otherwise specified on the Data Sheet the degree of protection shall be IP 55
Part 106	Classification of methods of cooling



Unless otherwise specified on the Data Sheet the cooling arrangement shall be IC 01 41

Part 107 Specification for symbols for types of construction and mounting arrangements

Unless otherwise specified on the Data Sheet horizontal foot mounted machines shall be IM 1001 and vertical flange mounted machines shall be IM 3011 in accordance with Code II.

Part 108 Specification for terminal markings and direction of rotation.

Part 111 Specification for built-in thermal protection for electric motors rated at 660 volts a.c. and below

Part 112 Specification for starting performance of single-speed three phase cage induction motors

Part 141 Specification for standard dimensions

Part 142 Specification for mechanical performance: vibration

Part 143 Specification for tests

Part 145 Specification for winding terminations

Note: [BS 4999](#) Part 0 (General introduction and information on other Parts), gives the relationship between [BS 4999](#) and various international standards. Where the international documents, or their equivalent for any particular country, are identical to or technically equivalent to [BS 4999](#) then they may be used as the reference document. Otherwise, the relevant parts of [BS 4999](#) must be complied with unless agreed in writing to the contrary.

The requirements of Publication No. 132 invoke [BS 4999](#) and this document is also invoked in the further requirements of BP. It should be noted that [BS 4999](#) is the UK equivalent of [IEC 34](#) modified by relevant [CENELEC Harmonisation Documents](#). It is therefore a suitable base document for use in all parts of the world in which the use of IEC and CENELEC documents are commended. It should be noted that differences between [IEC 34](#), CENELEC requirements and individual national standards do exist and that, as noted above, the BP requirements are based upon the British Standard requirement. Any requirement to meet other national interpretations of [IEC 34](#), with or without CENELEC Harmonisation Document requirements applying, which do not match the requirements of [BS 4999](#) must be identified and agreed in writing between the purchaser and the vendor. This procedure is intended to be the means by which particular local needs can be met whilst at the same time properly documenting deviations from the normal international BP requirements.

The degree of ingress required (IP 55) is entirely suitable for situations where machines are not subject to excessive dust settlement or immersion in water. If any doubt exists then the particular conditions pertaining should be evaluated and a special enclosure agreed between purchaser and vendor.

Low voltage motors are normally of the totally enclosed fan ventilated pattern (IC 01 41). Internal and external cooling is provided by integral shaft mounted fans.

Low voltage motors are normally of the foot mounted double endshield bearing pattern with single horizontal shaft extension (IM 1001) or of the vertical flange mounted double endshield bearing pattern with single downward pointing shaft extension (IM 3011).

3.2 Small-Power Electric Motors

In the absence of suitable industry or international standards BS 5000 is invoked for the particular types of machine described. This standard, in turn, largely invokes BS 4999 which, as already described, is largely compatible with the international requirements of IEC 34.

3.2.1 Motors rated up to and including 0.75 kW per 1000 rpm shall comply with the requirements of BS 5000 Part 11.

3.2.2 Unless otherwise specified on the Data Sheet, machines rated 180W and below should be single-phase machines of the capacitor type, provided with metal clad capacitors having a paper dielectric, or of the split phase type incorporating a self-contained centrifugal switch. Motors rated in excess of 180W should be three-phase machines.

3.3 General Purpose Motors

See Commentary to 3.2.

3.3.1 General purpose (GP) motors shall comply with the requirements of BS 5000 Part 10. (CENELEC HD 231 identical in respect of dimensions and outputs).

If the requirements of BS 5000 Part 10 are incompatible with those of EEMUA Publication No. 132 (1988), because of the reduced noise requirements of the latter, then Tables 1-5 of BS 5000 Part 10 may be ignored but non-compliance with the Tables shall be entered on the Data Sheet by the manufacturer.

3.4 Type N Motors

See Commentary to 3.2.

3.4.1 Type N motors shall comply with the requirements of BS 5000 Part 16.

Unless otherwise specified on the Data Sheet, the maximum surface temperature shall be 200°C (392°F) (Temperature Class T3).

- 3.4.2 Type N motors shall be suitable for selection, installation and maintenance in accordance with [BS 5345](#) Parts 1 and 7.

3.5 **Flameproof (Type d) Motors**

Opportunity is provided for purchasers to invoke international standard [IEC 79](#) or the equivalent European Standards. The preferred requirements for BP applications are the Euronorms (EN) because these are the standards normally met by vendors commonly supplying BP and against which certification by independent testing authorities has been obtained.

In the absence of an internationally agreed selection, installation and maintenance document, BS 5345 is invoked. This document is entirely compatible with BS 4999 and the EN 50 000 series of standards.

- 3.5.1 Flameproof (Type d) motors shall comply with the requirements of [IEC 79](#), or [EN 50 014](#) and [EN 50 018](#), as specified on the Data Sheet.

Unless otherwise specified on the Data Sheet, the motor enclosure shall be classified Group IIB and the maximum surface temperature shall be 200°C (392°F) (Temperature Class T3).

- 3.5.2 Flameproof (Type d) motors shall be suitable for selection, installation and maintenance in accordance with the requirements of [BS 5345](#) Parts 1 and 3.

3.6 **Increased Safety (Type e) Motors**

See Commentary to 3.5.

- 3.6.1 Increased safety (Type e) motors shall comply with the requirements of [IEC 79-7](#), or [EN 50 014](#) and [EN 50 019](#), as specified on the Data Sheet.

- 3.6.2 Increased safety (Type e) motors shall be suitable for selection, installation and maintenance in accordance with the requirements of [BS 5345](#) Parts 1 and 6.

3.7 **Certification for use in Hazardous Areas**

- 3.7.1 All types of motor for use in Hazardous Areas classified either Zone 1 or Zone 2 shall have been appropriately certified by a recognised National Certifying Authority.

- 3.7.2 Recognised National Certifying Authorities are identified in [IEC 79-9](#). In the UK the National Certifying authorities are the EECS (Electrical Equipment Certification Service, formerly BASEEFA) and SIRA.
- 3.7.3 Copies of the relevant certification documents shall be submitted by the manufacturer with the tender.

4. SPECIAL DESIGN REQUIREMENTS

4.1 General Characteristics

4.1.1 Residual Voltage

Motors shall be capable of being reconnected to the supply at any time after disconnection without any detrimental effect on the machine i.e. the residual voltage magnitude and phase angle may be at any value when the motor is reconnected.

The requirement for reconnection under any conditions of motor and supply phase displacement, which for low voltage motors is not an onerous requirement, permits system designers not to be unduly concerned with the effects of short periods of supply failure. Subject to the effects on the supply system many small motors can be left connected during supply interruption and these will then re-accelerate automatically upon restoration of the supply.

4.2 Winding and Cable Terminations

4.2.1 When a threaded entry is required, as identified on the Data Sheet, a detachable plate or box incorporating a threaded entry shall be employed. The minimum thickness of the material used for this purpose shall be 8 mm.

4.2.2 All threaded entries shall be tapped ISO metric to [BS 3643](#), Part 3, 1967 with a constant pitch of 1.5 mm and to medium fit tolerance class 6H. The size of thread required shall be as specified on the Data Sheet.

4.3 Weather Protection

4.3.1 All fixing bolts and the flanges of all flameproof (Type d) motors shall be coated with an approved grease during the course of assembly at the manufacturer's works.

Approved greases are those which the vendor has received permission to use by the relevant certifying authority.

4.3.2 All vertically-mounted motors having a single shaft extension at the bottom shall be protected with a rain cowl supplied by the vendor.



- 4.3.3 Motors shall be designed to prevent the accumulation of moisture within the machine enclosure. Unless specified, anti-condensation heaters shall not be provided.

The purpose of an anti-condensation heater is to preclude the possibility that the specified insulation level of the machine is seriously reduced by the entry of water or water vapour into the machine. Modern non-hygroscopic insulation materials largely obviate the possibility of this occurring and manufacturers generally take good care to ensure that all conducting items are insulated to a high standard.

- 4.3.4 Where a drain hole is provided, it shall be at the lowest point on the stator, subject to accessibility for the removal of the threaded plug when the machine is mounted in the service position. In the case of motors for use in hazardous areas the drain hole shall be sealed with a draining device approved by the Certifying Authority.

Care must be exercised to ensure that the means of removing, and replacing, drain plugs are not impeded by the position in which the motor is mounted. This is not always the responsibility of the motor manufacturer but often the responsibility of a 'package' (e.g. pump set) vendor who provides the mounting (e.g. bedplate) for the motor.

- 4.3.5 To prevent the ingress of water or other deleterious matter prior to cabling, open cable entries shall be adequately sealed (IP 55) before the motor is despatched from the manufacturer's works. In the case of motors for use in hazardous areas where more than one entry is provided into a terminal box, all entries shall be plugged with an appropriate stopper plug which where necessary shall be provided with certification marking to identify that it has appropriate component approval given by a Certifying Authority.

4.4 Shaft Couplings

- 4.4.1 Where gear type couplings are used, as identified on the Data Sheet, the motor bearings shall be capable of absorbing an additional axial thrust transmitted through the coupling of at least 0.25 x the coupling tooth load. This thrust shall be considered as additional to the axial loads generated within the machine.

4.5 Plant Identification

- 4.5.1 In addition to the motor rating plate, a separate motor plant equipment identification plate shall be screwed to a non-removable part of the frame in a readily-visible position. The plate shall be fabricated from stainless steel and be engraved with the Plant No. given on the Data Sheet. The means by which the plate is screwed to the frame shall allow for the plate to be removed and replaced by a similar plate.



4.6 Condition Monitoring

When indicated on the Data Sheet the motor shall be provided with points suitable for the application of portable vibration monitoring equipment. The type, number and location of the points shall be as shown on the Data Sheet remarks section.

Depending on the vibration monitoring system adopted, the monitoring points may be one a number of types. The simplest type is a location marked with paint, on which a hand held transducer is placed. Alternatively a milled surface may be provided for a magnetically held transducer. Also, a purpose designed stud may be bonded in place onto which a transducer can be locked. The three methods produce results in order of increasing reliability.

The maximum number of monitoring points would be six, these being vertical, horizontal and axial at both drive and non drive ends. Rarely is it practical or desirable to use so many points. Unless otherwise stated three points will be provided, on at either end located perpendicularly to give vertical and horizontal measurements, and one other to give axial measurements.

5. NOISE

5.1 Acoustic Terms and Definitions

Terms and definitions used in evaluating and stating noise data shall be in accordance with [EEMUA Publication No. 140](#)

5.2 Measurement and Testing Procedures

The vendor shall provide details of the noise emission from his equipment in octave bands. He shall also provide details of any narrow band noise emitted by his equipment that is noticeable to the ear, together with the octave band or bands in which it occurs.

Noise levels shall be measured and calculated in accordance with the procedures stated in [EEMUA Publication No 140](#).

Alternatively, by prior agreement of the purchaser, such measurements and calculations may be carried out in accordance with the procedures stated in [BS 4999: Part 109](#) (Technically equivalent to [CENELEC HD 53.9](#) and related to [IEC 34-9](#)), but with the specific exclusion of Appendix 109D of that standard.

5.3 Noise Reduction

Where the noise-limiting requirements of this Specification cannot be met without the provision of noise-reducing features, the levels with and without these features shall be stated in any proposal. Such features shall not compromise, in any way, the correct operation of the machine, or any other requirements of this Specification.



Such features shall not be provided without the specific approval of the purchaser.

In order to reduce the noise levels of a low voltage motor, manufacturers sometimes propose the use of a secondary enclosure, or hood, enclosing the whole machine. If the machine is one of the types certified for use in a hazardous area then purchasers should ensure that the employment of an additional enclosure is covered by the certification for use within the hazardous area.



TO BE COMPLETED BY PURCHASER										TO BE COMPLETED BY MANUFACTURER										
1	INSTALLATION SITE										37	MANUFACTURER								
2	PLANT IDENTIFICATION NUMBER																			
3	DRIVEN LOAD (EG COMPRESSOR)										38	MANUFACTURERS TENDER REF								
4	DRIVEN LOAD INERTIA (GD ²)				Kg m ²						39	MANUFACTURER WORKS ORDER NO.								
5	DRIVEN LOAD STARTING CHARACTERISTIC				GRAPH ATTACHED						40	FRAME SIZE								
6	DRIVE				DIRECT		VEE BELT				41	FULL LOAD CURRENT				A				
					GEAR BOX						42	LOCKED ROTOR CURRENT				A				
7	COUPLING TYPE											FULL LOAD TORQUE				Nm				
8	RATING	1	2	Phase	V	H _Z	kW					LOCKED ROTOR TORQUE				Nm				
9	SPEED (SYNCHRONOUS)				rpm							PULL UP TORQUE				Nm				
10	DUTY (BS 4999 PART 101)				S1						43	FULL LOAD SPEED				rpm				
11	SERVICE CONDITIONS IF EXCEEDING BS 4999 PART 101				ALTITUDE		m				44	STARTING POWER FACTOR								
12	STARTING CHARACTERISTIC (BS 4999 PART 112)				TEMP		°C				45	EFFICIENCY 1: 3/4 : 1/2 FL								
					N		D				46	POWER FACTOR 1: 3/4 : 1/2 FL								
13	STARTING METHOD				DOL						47	RATING CLASS (BS 4999 PART 101)								
14	SYSTEM NEUTRAL EARTHING				DIRECT		UNEARTHED				48	MACHINE REVERSIBLE				YES				
					RESISTANCE						49	FAN BI-DIRECTIONAL				YES				
15	ROTATION FACING DRIVE END				CLOCK		ANTI-CLOCK				50	STATOR CONNECTION				STAR				
					BI-DIRECTIONAL						51	NUMBER OF STATOR WINDING TERMINALS								
16	INSULATION CLASS				F						52	INSULATION CLASS				F				
17	MAX. TEMPERATURE RISE				80 °C		°C				53	TEMPERATURE RISE				°C				
18	COOLING (BS 4999 PART 106)				IC 01 41						54	TYPE TEST CERTIFICATE REFERENCE								
19	PROTECTION PROVIDED	EARTH FAULT			HRC FUSES						55	COPY OF CERTIFICATE ATTACHED				YES				
		SINGLE PHASE			THERMAL OC						56	MOTOR WEIGHT				kG				
20	WINDING TEMPERATURE DETECTORS				THERMISTORS							NETT GROSS				kG				
					THERMOSTATS						57	MOTOR ROTOR INERTIA (GD ²)				kg m ²				
21	HEATER REQUIRED				NO		YES		V		58	ACCELERATION TIME AGAINST LOAD DEFINED BY ITEMS 3,4, & 5				100 % V				
22	MOUNTING (BS 4999 PT 107)				IM1001		IM3011									80 % V				
23	ENCLOSURE (BS 4999 PT 105)				IP 55						59	e TIME				s				
24	APPARATUS GROUP (EN 50 014)				IIB						60	CERTIFYING AUTHORITY				BASEEFA/EECS				
25	TEMPERATURE CLASS (EN 50 014)				T3						61	APPARATUS CLASSIFICATION								
26	APPARATUS CLASSIFICATION	GP	TYPE n		TYPE d		TYPE e				62	STANDARD (eg EN 50 018)								
		BS 5000	BS5000		IEC 79-1		IEC 79-7				63	CERTIFICATE NUMBER								
		PART 10	PART 16		EN50018		EN50019				64	COPY OF CERTIFICATE ATTACHED				YES				
		PART 11									65	NOISE LEVEL								
27	COLOUR (BS 4800)				MAIN		AUX.					WITH ACOUSTIC TREATMENT				dB(A)				
28	CABLE TYPE				A. OCMA ELEC. 4B (PVCLCSWAPVC)		B. BS 6346 (PVC SWAPVC)					WITHOUT ACOUSTIC TREATMENT				dB(A)				
					C. BS 6207 (MICC)		D. OTHER (SPECIFY)				66	MACHINE ASSEMBLED AT								
29	CABLE RATING AND CONDUCTOR MATERIAL (COPPER OR ALUMINIUM)				MAIN	1000V	V	Cu	Al		67	SPECIFICATION MET IN FULL EXCEPT FOR CLAUSES LISTED				NONE				
					AUX	1000V	V	Cu	Al											
30	CABLE CONDUCTOR SIZE AND NUMBER OF CORES				MAIN	mm ²	3	4												
					AUX	mm ²														
31	CABLE GLAND PATTERN AND THREAD (BS 6121) (BS 6081)				MAIN	mm					68	REMARKS								
					AUX	mm														
32	FRAME EARTH				EXTERNAL		INTERNAL													
33	NOISE LEVEL				81 dB (A)															
34	CONDITION MONITORING POINTS REQUIRED				NO		YES													
35	REMARKS																			
36	SIGNATURE																			
	NAME (PRINT)																			
	ORGANISATION																			
	DATE																			
RE V	DATE	REMARKS				BY	APP				69	SIGNATURE								
												NAME (Print)								
												DEPARTMENT								
												DATE								

DATA SHEET

LOW VOLTAGE INDUCTION MOTOR



DEFINITIONS AND ABBREVIATIONS**Definitions**

Standardised definitions may be found in the BP Group RPSE Introductory Volume.

Abbreviations

BS	British Standard
BASEEFA	British Approvals Service for Electrical Equipment in Flammable Atmospheres
CENELEC	European Committee for Electrotechnical Standardisation
EEMUA	The Engineering Equipment and Materials Users Association
EN	European Standard
HLC	CENELEC Harmonisation Document
IEC	International Electrotechnical Commission.

LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

International Standards

IEC Publication 34	Rotating electrical machines.
IEC Publication 79	Electrical apparatus for explosive gas atmospheres.

European Standards

CENELEC HD 53.9	
CENELEC HD 231	Dimensions of three-phase induction motors.
EN 50 014 (BS 5501, Part 1)	Electrical apparatus for potentially explosive atmospheres. General requirements.
EN 50 018 (BS 5501, Part 5)	Electrical apparatus for potentially explosive atmospheres. Flameproof enclosure 'd'.
EN 50 019 (BS 5501, Part 6)	Electrical apparatus for potentially explosive atmospheres. Increased safety 'e'.

British Standards

BS 3643	ISO metric screw threads.
BS 4800	Specification for paint colours for building purposes.
BS 4999	General requirements for rotating electrical machines.
BS 5000	Rotating electrical machines of particular types or for particular applications.
BS 5345	Selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres.

UK Industry Standards

[EEMUA Publication No. 132 \(1988\)](#) Specification For Three-phase Cage Induction Motors.

[EEMUA Publication No. 133](#) Underground Armoured Cable protected against Solvent penetration and Corrosive attack.

[EEMUA Publication No. 140](#) Noise Procedure Specification.

