

# FINAL DRAFT UGANDA STANDARD

FDUS 905-1

First Edition  
2011-mm-dd

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## Rotating electrical machines — General requirements – Part 1: Three phase cage induction motors — High efficiency and Minimum Energy Performance Standards requirements



Reference number  
FDUS 905-1: 2011

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## **Foreword**

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Tourism, Trade and Industry established under Cap 327, of the Laws of Uganda. UNBS is mandated to co-ordinate the elaboration of standards and is

- (a) a member of International Organisation for Standardisation (ISO) and
- (b) a contact point for the WHO/FAO Codex Alimentarius Commission on Food Standards, and
- (c) the National Enquiry Point on TBT/SPS Agreements of the World Trade Organisation (WTO).

The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of representatives of consumers, traders, academicians, manufacturers, government and other stakeholders.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

**NOTE** This standard features two test methods for determination of losses.

**Method A:** This method is identical to Method 1 of IEC 61972. It is also technically equivalent to the method specified in IEEE 112-B (USA). This method requires direct measurement of additional load losses and differs from Method B described below.

**Method B:** This method is based on US IEC 60034-2, including Amendment 1:1995 and Amendment 2:1996. In this method, an allowance of 0.5% fixed stray (additional load) loss is assumed for all the motors.

### **Committee membership**

The following organizations were represented on the Energy Management Technical Committee, UNBS/TC 13, during the development of this standard:

- Department of Mechanical Engineering, Makerere University
- Econoler
- Electricity Regulatory Authority (ERA)
- GTZ-Promotion of Renewable Energy and Energy Efficiency Programme (GTZ-PREEEP)
- Ministry of Energy and Mineral Development
- Private Sector Foundation Uganda (PSFU)
- Uganda Manufacturers' Association (UMA)
- Uganda National Bureau of Standards (UNBS)
- Water and Electricity Consumers' Association (WECA)

The following organizations were represented on the Lighting Appliances Sub-committee of the Energy Management Technical Committee, UNBS/TC 13, during the development of this standard:

- Centre for Research in Energy and Energy Conservation (CREEC), Makerere University
- Department of Electrical Engineering, Makerere University
- Econoler
- Industrial Technical Solutions (ITS) (U) Ltd
- Kiboko Enterprise (U) Ltd
- Ministry of Works and Transport
- Osram/Dembe Trading Co. Ltd

- Uganda National Bureau of Standards (UNBS)
- Uganda National Chamber of Commerce and Industry (UNCCI)
- Ultra-Tec Uganda Ltd



# Rotating electrical machines — General requirements – Part 1: Three phase cage induction motors — High efficiency and Minimum Energy Performance Standards requirements

## 1 Scope

This Uganda Standard applies to three-phase cage induction motors with ratings from 0.73 kW and up to but not including 185 kW. The scope covers motors of rated voltages up to 1100 V a.c.

NOTE This range includes motors with ratings of 1 hp and 1 CV/PS (French/German or metric horsepower).

This standard specifies the minimum efficiency values that a motor shall meet, and also the minimum efficiency values that a motor shall meet in order to be designated 'high efficiency'. Two methods of measurement are prescribed (Method A and Method B) for determination of efficiency. Only one method need be applied.

The MEPS requirements of this standard do not apply to the following:

- a) Submersible (sealed) motors specifically designed to operate wholly immersed in a liquid.

NOTE This exclusion does not apply to motors that normally operate with a surrounding medium of air but that may withstand inundation.

- b) Motors that are integral with, and not separable from, a driven unit.

NOTE An example is a motor constructed on the same shaft as a compressor for an air conditioning unit.

- c) Multi-speed motors.

- d) Motors that have been granted exemption by the relevant regulatory authority due to their application placing restraints on the motor dimensions or other key design aspects.

- e) Motors for use only for short-time duty cycle applications (for example, those used for hoists, roller doors and cranes) which have a duty type rating of S2 under IEC 60034-12.

NOTE Exclusion from MEPS for these types of motors is based on their low projected usage and hence low total energy consumption.

This standard applies to all motors.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

US 905-2, *Rotating Electrical Machines — General Requirements — Methods for determining losses and efficiency — Three-phase cage induction motors*

US IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

US IEC 60034-2, *Rotating electrical machines — Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*

IEC 60034-5, *Rotating electrical machines — Part 5: Degrees of protection provided by the integral design of rotating electrical machines — (IP code) — Classification*

IEC 60034-7, *Rotating electrical machines — Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)*

IEC 60034-12, *Rotating electrical machines — Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60072, *Dimensions and output series for rotating electrical machines (all Parts)*

IEC 61972, *Method for determining losses and efficiency of three-phase cage induction motors*

### **3 Definitions**

For the purposes of this standard, the following terms and definitions shall apply.

**3.1 multi-speed motor**  
motor that can run at two or more discrete speeds by using switchgear to reconfigure the connection of its winding or windings to the supply. The term does not include a motor that runs at different speeds by means of a variable voltage or variable frequency controller.

**3.2 rewind motor**  
motor that has had its insulated winding(s) replaced

**3.3 Supplier**  
In Uganda 'supplier' means the manufacturer or, where a completed product is manufactured for exclusive supply to a second agent, the second agent may be identified as the supplier. For products manufactured outside Uganda 'supplier' means manufacturer's local agent or importer, having an address in the country(s) where the product is sold (Uganda).

### **4 Marking**

#### **4.1 General**

Motors shall have rating plates marked in accordance with US IEC 60034-1.

#### **4.2 Determination of claims of efficiency**

The motor efficiency marked on a nameplate, specified in technical literature or otherwise claimed shall not be less than the value obtained by a test undertaken by or for the supplier.



## 5 Verification of compliance

### 5.1 Minimum Energy Performance Standard (MEPS)

A motor does not comply with this standard if its measured efficiency is less than the value determined in Clause 7.

### 5.2 High efficiency performance

A motor does not comply with this standard if its measured efficiency is less than the value determined in Clause 8.

NOTE Regulatory authorities shall undertake verification tests to check the compliance with this standard.

## 6 Tolerances

The tolerances given in Table 1 (reproduced, in part, from US IEC 60034-1) shall be applied.

NOTE Further details are contained in clauses 7 and 8.

**Table 1 — Tolerances on efficiency**

ITEM	QUANTITY	TOLERANCE
1	Efficiency $\eta$ (per unit)	
1(a)	By summation of losses	-15 % of $(1 - \eta)$
	motors up to and including 50 kW	-10 % of $(1 - \eta)$
	- motors above 50 kW	
1(b)	By total loss measurement	-15 % of $(1 - \eta)$
2	Total losses	+10 % of the total losses

## 7 Minimum efficiencies for all motors (Method A and B)

### 7.1 General

Motors manufactured in or imported into Uganda prior to 1 October 2011 or manufactured in or imported had no MEPS requirements.

### 7.2 Minimum efficiency — Test Method A

Where measured in accordance with US 905-2 or with IEC 61972 or with a standard method technically equivalent thereto, the efficiency of a motor, at either rated load or at 75 % rated load, shall be not less than the value specified in the relevant table of Annex A. The appropriate table of Annex A applies based on the guide in Table 2.

**Table 2 — Efficiency table guide (Method A)**

Minimum efficiency	Level 1A Table A.1
--------------------	-----------------------

### 7.3 Minimum efficiency — Test Method B

Where measured in accordance with US IEC 60034-2 or with a standard method technically equivalent thereto, the efficiency of a motor, at either rated load or at 75 % rated load, shall be not less than value specified in the relevant table of Annex B.

The appropriate table of Annex B applies based on the guide in Table 3.

**Table 3 — Efficiency table guide — Method B**

Minimum efficiency	Level 1B Table B.1
--------------------	-----------------------

## 8 Minimum efficiencies — High efficiency motors (Methods A and B)

### 8.1 High efficiency — Test Method A

A motor may be designated ‘high efficiency’ (designated Heff-A in Table 4) only if its efficiency, measured in accordance with US 905-2 or with IEC 61972 or with a standard method technically equivalent thereto, at either rated load or at 75 % rated load, is not less than the value specified in the relevant table of Annex A. The appropriate table of Annex A applies based on the guide in Table 4.

**Table 4 — Efficiency table guide — Method A**

High efficiency	Heff-A  Table A.1
-----------------	-------------------------

### 8.2 High efficiency — Test Method B

A motor may be designated ‘high efficiency’ (designated Heff-B in Table 5) only if its efficiency, measured in accordance with US IEC 60034-2 or with a standard method technically equivalent thereto, at either rated load or at 75 % rated load, is not less than the value specified in the relevant table of Annex B. The appropriate table of Annex B applies based on the guide in Table 5.

**Table 5 — Efficiency table guide—Method B**

High Efficiency	Heff-B Table B.2
-----------------	---------------------

## 9 Application and test result formats

### 9.1 General

Where the relevant regulatory authority requires registration or approval for MEPS, clauses 9.2 to 9.4 shall apply.

## 9.2 Registration

An application for MEPS and high efficiency registration of the make and model of the motor shall be submitted in the format shown in Appendix C of this Standard.

NOTE Applications in the form of computer printouts, which present all the application data in a similar layout to the forms in Annex C, are equally valid.

To register, contact the relevant State regulatory authority.

## 9.3 Report format

A summary report for one of the test methods shall accompany the MEPS registration application.

For Method A, the format of the summary report shall be in accordance with Annex B of US 905-2.

For Method B, the summary report shall be relevant to US IEC 60034-2.

A detailed test report to support the MEPS application shall be retained by the supplier.

## 9.4 Availability

Detailed test results to support the MEPS application shall be made available to the relevant regulatory authority upon request. Records shall be retained for at least five years after the last date of manufacture or import, whichever is applicable.

## 9.5 MEPS transition

All products within the scope of MEPS manufactured or imported for sale on or after 1 October 2011 shall meet the MEPS 2009 requirements. Such units shall hold a valid registration at the time of sale, which shall indicate compliance with the relevant MEPS requirements.

# 10 Holding of records

## 10.1 General

Where the registration or approval of MEPS is not required, clauses 10.2 to 10.4 shall apply.

## 10.2 Data

Annex C outlines the information that shall be recorded and held by the motor supplier (refer to C.4 to C.7) to support the performance claims inherently made with respect to MEPS.

## 10.3 Test report

See 9.3.

## 10.4 Availability

The documents required by this section shall be made available to the relevant regulatory authority upon request. Records shall be retained for at least five years after the last date of manufacture or import, whichever is applicable.

## Annex A (normative)

### Efficiency requirements — Test Method A

This annex sets out MEPS and high efficiency requirements using test Method A in accordance with US 905-2 or IEC 61972.

The efficiency values in the Tables A.1 and A.2 shall be applied for minimum efficiency or high efficiency based on Tables 2 or 4.

**Table A.1 (Level 1A) — Minimum Efficiency—Test Method A**

Rated output kW	%			
	2-pole	4-pole	6-pole	8-pole
0.73	78.8	80.5	76.0	71.8
0.75	78.8	80.5	76.0	71.8
1.1	80.6	82.2	78.3	74.7
1.5	82.6	83.5	79.9	76.8
2.2	84.1	84.9	81.9	79.4
3	85.3	86.0	83.5	81.3
4	86.3	87.0	84.7	82.8
5.5	87.2	87.9	86.1	84.5
7.5	88.3	88.9	87.3	86.0
11	89.5	89.9	88.7	87.7
15	90.3	90.8	89.6	88.9
18.5	90.8	91.2	90.3	89.7
22	91.2	91.6	90.8	90.2
30	92.0	92.3	91.6	91.2
37	92.5	92.8	92.2	91.8
45	92.9	93.1	92.7	92.4
55	93.2	93.5	93.1	92.9
75	93.9	94.0	93.7	93.7
90	94.2	94.4	94.2	94.1
110	94.5	94.7	94.5	94.5
132	94.8	94.9	94.8	94.8
150	95.0	95.2	95.1	95.2
<185	95.0	95.2	95.1	95.2

NOTE 1 For intermediate values of rated output, the efficiency shall be determined by linear interpolation.

NOTE 2 Tolerances specified in Table 1 are applicable to the above values only in the case of a verification test.

**Table A.2 (Heff-A) — Minimum High Efficiency—Test Method A**

Rated output kW	Minimum high efficiency %			
	2-pole	4-pole	6-pole	8-pole
0.73	81.4	82.9	78.8	75.0
0.75	81.4	82.9	78.8	75.0
1.1	83.0	84.5	80.9	77.6
1.5	84.8	85.6	82.4	79.6
2.2	86.2	86.9	84.2	81.9
3	87.2	87.8	85.6	83.6
4	88.1	88.7	86.7	85.0
5.5	88.9	89.5	87.9	86.5
7.5	89.9	90.4	89.0	87.8
11	90.9	91.3	90.2	89.3
15	91.6	92.1	91.0	90.4
18.5	92.1	92.4	91.6	91.1
22	92.4	92.8	92.1	91.5
30	93.1	93.4	92.8	92.4
37	93.6	93.8	93.3	92.9
45	93.9	94.1	93.7	93.5
55	94.2	94.4	94.1	93.9
75	94.8	94.9	94.6	94.6
90	95.0	95.2	95.0	94.9
110	95.3	95.5	95.3	95.3
132	95.5	95.6	95.5	95.5
150	95.7	95.9	95.8	95.9
<185	95.7	95.9	95.8	95.9

NOTE 1 For intermediate values of rated output, the efficiency shall be determined by linear interpolation.

NOTE 2 Tolerances specified in Table 1 are applicable to the above values only in the case of a verification test.

## Annex B (normative)

### Efficiency Requirements — Test Method B

This annex sets out MEPS and high efficiency requirements using test Method B in accordance with US IEC 60034-2.

The efficiency values in the Tables B.1 and B.2 shall be applied for minimum efficiency or high efficiency based on compliance with Tables 3 and 5 respectively.

**Table B.1 (Level 1B) — Minimum efficiency—Test Method B**

Rated output kW	%			
	2-pole	4-pole	6-pole	8-pole
0.73	80.5	82.2	77.7	73.5
0.75	80.5	82.2	77.7	73.5
1.1	82.2	83.8	79.9	76.3
1.5	84.1	85.0	81.5	78.4
2.2	85.6	86.4	83.4	80.9
3	86.7	87.4	84.9	82.7
4	87.6	88.3	86.1	84.2
5.5	88.5	89.2	87.4	85.8
7.5	89.5	90.1	88.5	87.2
11	90.6	91.0	89.8	88.8
15	91.3	91.8	90.7	90.0
18.5	91.8	92.2	91.3	90.7
22	92.2	92.6	91.8	91.2
30	92.9	93.2	92.5	92.1
37	93.3	93.6	93.0	92.7
45	93.7	93.9	93.5	93.2
55	94.0	94.2	93.9	93.7
75	94.6	94.7	94.4	94.4
90	94.8	95.0	94.8	94.7
110	95.1	95.3	95.1	95.1
132	95.4	95.5	95.4	95.4
150	95.5	95.7	95.6	95.7
<185	95.5	95.7	95.6	95.7

NOTE 1 For intermediate values of rated output, the efficiency shall be determined by linear interpolation.

NOTE 2 Tolerances specified in Table 1 are applicable to the above values only in the case of a verification test.

NOTE 3 Values in italics are also the European Efficiency 2 values.

**Table B.2 (Heff – B) Minimum high efficiency — Test Method B**

Rated output kW	Minimum high efficiency %			
	2-pole	4-pole	6-pole	8-pole
0.73	82.9	84.5	80.4	76.5
0.75	82.9	84.5	80.4	76.5
1.1	84.5	85.9	82.4	79.1
1.5	86.2	87.0	83.8	81.0
2.2	87.5	88.2	85.5	83.3
3	88.5	89.1	86.9	84.9
4	89.3	89.9	87.9	86.2
5.5	90.1	90.7	89.1	87.7
7.5	90.9	91.5	90.1	88.9
11	91.9	92.2	91.2	90.3
15	92.5	92.9	92.0	91.4
18.5	92.9	93.3	92.5	92.0
22	93.3	93.6	92.9	92.4
30	93.9	94.2	93.6	93.2
37	94.2	94.5	94.0	93.7
45	94.6	94.8	94.4	94.2
55	94.9	95.0	94.8	94.6
75	95.4	95.5	95.2	95.2
90	95.5	95.7	95.5	95.5
110	95.8	96.0	95.8	95.8
132	96.1	96.1	96.1	96.1
150	96.1	96.3	96.2	96.3
<185	96.1	96.3	96.2	96.3

NOTE 1 For intermediate values of rated output, the efficiency shall be determined by linear interpolation.

NOTE 2 Tolerances specified in Table 1 are applicable to the above values only in the case of a verification test.

**Annex C**  
(normative)

**Application for registration or renewal of registration of electric motor  
for energy efficiency determination**

**C.1 Scope**

This annex sets out the required format for submitting an application for registration and record keeping.

**C.2 Application form**

**Section 1 Application Details**

I hereby apply for registration of an electric motor for the purpose of energy efficiency pursuant to the.....

(Specify the Regulation under which this application is made)

In the State/Territory/Area.....

(Specify the State/Territory/Area in which this application is made)

**Section 2 Applicant Details**

Name of applicant: .....

Name of company: .....

Business address: .....

Suburb/Town .....

Postcode: .....

Contact Person: (The contact person must be in Uganda): .....

Position/Title: .....

Phone: .....

Facsimile( ): .....

Email Address: .....

The Standard to which this application is made? .....

.....

.....US 905-2

What is this application for? MEPS only/ MEPS and High Efficiency



Is the application for a single model or a family of models? ..... Single/Family

(indicate correct answer)

**Section 3 Description of Electric Motor**

Country of manufacture: .....

Name of manufacturer: .....

Make of the motor: .....

Year and month model(s) first manufactured: ..... imported: .....

(If registering a family of models, list all model names and numbers covered by this application.)

Model number(s):.....

Does this model or family replace or supplement another with the same specifications?

Yes.....No.....

If yes, state model(s)?.....

Is the date of manufacture permanently marked on the rating plate in a non-encrypted format:

Yes .....No.....

If yes, provide an example of the date format: .....

If no, provide details on how to determine (from the serial number or other permanent markings for this model) whether the date of manufacture was either:

a) \_ in the 5 year period prior to the introduction of MEPS; or

b) \_ in the 5 year period subsequent to the introduction of MEPS

Note: Only one of the options a) or b) above is required.

**Section 4 Testing and Test Report**

Were tests conducted at the applicant's own facilities? .....

Yes.....No.....

Contact details of the person who conducted the tests: .....

Name and address of the laboratory where tests were conducted:

.....  
 .....

Is a test report to Annex B of US 905-2 (Method A in this Standard) or US IEC 60034-1 (Method B in this Standard), as required for this motor, attached?

Yes.....No.....

If no, state reasons: .....

**Section 5 Specific Equipment Details**

The data required for this section can be entered into an on-line database which has full information on the required options for each field. The values submitted below shall be based on a type test of a representative production version of the motor model in question.

**Equipment Details**

Motor test method applicable:

DUS 905-2 (Method A) .....

US IEC 60034-2 (Method B).....

Other ..... (please specify)

This being technically equivalent to.....Method A..... or Method B.....\_

Rated output: .....kW

Rated voltage (V): ..... Mounting code of IEC 60034-7.....

Rated frequency (Hz):..... Frame code of IEC 60072 .....

Number of poles: .....

Enclosure protection rating to IEC 60034-5: (IP code).....

Full load RPM: ..... Motor design: .....(TEFC, ODPD, other)

Motor winding insulation to US IEC 60034-1: .....

Efficiency at 100% rated load: ..... %      Power factor at 100% rated load:.....

Efficiency at 75% rated load: ..... %      Power factor at 75% rated load:.....

Efficiency at 50% rated load: ..... %      Power factor at 50% rated load:.....

**Section 6 Minimum Energy Performance Standards (MEPS) and high Efficiency compliance**

MEPS are mandatory as specified within the scope of this standard for three-phase motors for 2, 4, 6 or 8 poles, except as outlined in the exclusions stated in Clause 1.2.

MEPS requirements are set out in Clause 7 of this standard. High Efficiency requirements are set out in Clause 7 of this Standard.

Requirement	Test Method	Applicable minimum efficiency %	Compliance (only one answer per requirement)
MEPS 2010 and High Efficiency requirements 2010 (refer to Table A.1 or Table B.1)	<input type="checkbox"/> Method A; or <input type="checkbox"/> Method B	%	<input type="checkbox"/> 75% load only; or <input type="checkbox"/> 100% load only; or <input type="checkbox"/> 75% and 100% load; or <input type="checkbox"/> does not comply.
High Efficiency Requirements 2010 (refer to Table A.2 or Table B.2)	<input type="checkbox"/> Method A; or <input type="checkbox"/> Method B	%	<input type="checkbox"/> 75% load only; or <input type="checkbox"/> 100% load only; or <input type="checkbox"/> 75% and 100% load; or <input type="checkbox"/> does not comply.

**Section 7 Declaration**

I declare that the details stated above are true and correct.

Signature of Applicant: ..... Date.....

For office use only:

Date received: ..... Registration number.....

## Bibliography

- [1] CAN/CSA-C 390-98, *Energy efficiency test methods for three phase induction motors*
- [2] CAN/CSA-C 747-94, *Energy Efficiency for Single- and Three-Phase Small Motors*
- [3] IEC 61972:2002, *Method for determining losses and efficiency of three-phase cage induction motors*
- [4] US IEC 60034-1: 2006, *Rotating electrical machines – Part 1: Rating and performance*
- [5] US IEC 60034-2: 2006, *Rotating electrical machines — Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*

## **Certification marking**

Products that conform to Uganda standards may be marked with Uganda National Bureau of Standards (UNBS) Certification Mark shown in the figure below.

The use of the UNBS Certification Mark is governed by the Standards Act, and the Regulations made thereunder. This mark can be used only by those licensed under the certification mark scheme operated by the Uganda National Bureau of Standards and in conjunction with the relevant Uganda Standard. The presence of this mark on a product or in relation to a product is an assurance that the goods comply with the requirements of that standard under a system of supervision, control and testing in accordance with the certification mark scheme of the Uganda National Bureau of Standards. UNBS marked products are continually checked by UNBS for conformity to that standard.

Further particulars of the terms and conditions of licensing may be obtained from the Director, Uganda National Bureau of Standards.



