

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This standard has been technically prepared in accordance with PNS 01-4:1998 (ISO/IEC Directives Part 3:1997) – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that certain course of action is preferred but not necessarily required.

In the preparation of this standard, the following documents/publications were considered:

AMTEC Test Reports on Electric Motors

PAES 117:2000, Agricultural Machinery – Small Engine – Methods of Test

Smith, D.W., Sims B.G, and D.H. O’Neill. *Testing and Evaluation of Agricultural Machinery and Equipment – Principles and practices*. FAO Agricultural Services Bulletin 110. 1994.

Fink, D.G. and H.W. Beaty. *Standard Handbook for Electrical Engineers*. 13th ed. McGraw-Hill International Editions. Electrical Engineering Series. 1993.

McPartland J. F. and B.J. McPartland. *National Electrical Code Handbook*. 23rd ed. Conforms to the 1999 NEC. McGraw-Hill International Editions.

Agricultural Machinery – Electric Motor – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for electric motor. Specifically, it shall be used to:

- 1.1 verify the main dimensions, weight, and other technical data of the electric motor submitted by the applicant/dealer
- 1.2 evaluate the operator's manual as to clarity, usefulness and adaptability
- 1.3 determine the laboratory performance of electric motor
- 1.4 prepare a report on the results of the tests

2 Reference

The following normative document contains provisions, which, through reference in this text, constitute provisions of this National Standard:

PAES 103:2000, Agricultural Machinery – Method of Sampling

PAES 129:2002, Agricultural Machinery – Electric Motor – Specifications and Applications

3 General Conditions for Test and Inspection**3.1 Electric Motor on Test**

The electric motor to be tested shall have been sampled in accordance with PAES 103. The applicant/manufacture shall submit the technical data and information of the electric motor.

3.2 Role of the Manufacturer/Dealer

The manufacturer/dealer shall submit to the official testing agency the specifications and other relevant information on the electric motor. An official representative shall be appointed to conduct minor repair, handle, adjust and witness the test. It shall be the duty of the representative to make all decisions on matters of adjustment and preparation of the machine for testing. The manufacturer/dealer shall abide with the terms and conditions set forth by the official testing agency.

3.3 Running-in

The electric motor to be tested shall have been run-in by the testing agency as recommended by the manufacturer.

3.4 Suspension of Test

If during test run, the electric motor malfunctions so as to affect its performance, the test may be suspended with the concurrence of both the official testing agency and the manufacturer's/dealer's representative.

4 Tests and Inspection

4.1 Verification of Manufacturer's Technical Data and Information

4.1.1 This inspection is carried out to verify that the main dimensions, weight of the electric motors and other pertinent data conform to the list of technical data and information submitted by the manufacturer.

4.1.2 A plain and level surface shall be used for this investigation.

4.1.3 The items to be inspected and verified are given in Annex A.

4.2 Performance Tests

4.2.1 Test conditions

4.2.1.1 Performance data shall be obtained under stabilized normal operating conditions.

4.2.1.2 No data shall be taken until torque, speed and temperature have been maintained for at least 1 minute.

4.2.1.3 Torque, output shaft speed, temperature, vibration and sound emitted by the electric motor shall be measured and recorded. The average of three stabilized values shall be taken.

4.2.2 Varying load test

4.2.2.1 This is carried out to establish the performance characteristic of an electric motor.

4.2.2.2 Performance data shall be obtained under normal operating conditions.

4.2.2.3 During testing, the speed of the electric motor shall not fluctuate by more than 1% or ± 10 rpm whichever is greater from the set/selected speed.

4.2.2.4 Performance data shall be recorded and shall be the average of three stabilized readings.

4.2.2.5 Ambient conditions such as temperature and relative humidity shall be recorded.

4.2.2.6 The electric motor shall be mounted on a dynamometer. Power measuring instruments shall be connected to the input line of the motor. The instruments shall be connected as close as possible to the motor terminals to minimize voltage drop.

4.2.2.7 During the test, data shall be obtained for at least ten settings starting from no load to a maximum 110% of the rated full load. Line voltage shall be constant throughout the duration of the test. Input power, line voltage, load current, shaft torque, shaft speed and casing temperature shall be recorded for every increment of the load.

4.2.2.8 Results shall be presented in tabular and graphical forms. The following curves shall be presented:

4.2.2.8.1 Load current vs. Output power

4.2.2.8.2 Load current vs. Input power

4.2.2.8.3 Load current vs. Shaft torque

4.2.2.8.4 Load current vs. Motor efficiency

4.2.2.8.5 Input power vs. Output power

4.2.2.8.6 Shaft torque vs. Shaft speed

4.2.2.8.7 Output power vs. Shaft torque

4.2.2.8.8 Output power vs. Shaft speed

4.2.2.8.9 Output power vs. Motor efficiency

4.2.2.8.10 Items to be measured and recorded are given in Annex B.

5 Formulas

The formulas to be used during calculations and testing are given in Annex C.

6 Test Report

The test report shall include the following information in the order given:

- 6.1** Name of Testing Agency
- 6.2** Test Report Number
- 6.3** Title
- 6.4** Summary
- 6.5** Purpose and Scope of Test
- 6.6** Methods of Test
- 6.7** Description of the Electric Motor
- 6.8** Table1 – Electric Motor Specifications
- 6.9** Table 2 – Results of Varying Load Performance Test
- 6.10** Observations
- 6.11** Name(s) and Signature(s) of Test Engineer(s)

ANNEX A

Inspection Sheet for Electric Motor

Name of Applicant : _____

Address : _____

Telephone No. : _____

Name of Distributor : _____

Address : _____

Name of Manufacturer : _____

Factory Address : _____

GENERAL INFORMATION

Brand : _____ Model : _____

Serial No. : _____

Production date of electric motor to be tested : _____

Items to be inspected

ITEMS	Manufacturer's Specifications	Verification by the Testing Agency
A1 Dimensions and weight of electric motors		
A1.1 Overall length, mm		
A1.2 Overall width, mm		
A1.3 Overall height, mm		
A1.4 Output shaft diameter, mm		
A1.5 Weight, kg		
A2 Electric motor specification		
A2.1 Type		
A2.1.1 Based on current source		
A2.1.1.1 Alternating current (AC) motor		
A2.1.1.1.1 Single-phase		
A2.1.1.1.2 Three-phase		
A2.1.1.2 Direct current (DC) motor		
A2.1.1.3 Universal motor		
A2.1.2 Based on construction		
A2.1.2.1 Shunt-wound motor		
A2.1.2.2 Series-wound motor		
A2.1.2.3 Compound-wound motor		
A2.1.2.4 Synchronous motor		
A2.1.2.5 Wound motor		
A2.1.2.6 Squirrel-cage motor		

ITEMS	Manufacturer's Specifications	Verification by the Testing Agency
A2.1.3 Based on starting		
A2.1.3.1 Split-phase		
A2.1.3.2 Capacitor-start induction-run		
A2.1.3.3 Permanent split-capacitor		
A2.1.3.4 Two-value capacitor		
A2.1.3.5 Shaded pole		
A2.1.3.6 Repulsion-start induction-run		
A2.1.3.7 Repulsion		
A2.1.3.8 Repulsion induction		
A2.1.4 Based on size		
A2.1.4.1 Fractional horsepower		
A2.1.4.2 Integral horsepower		
A2.1.5 Based on duty rating		
A2.1.5.1 Intermittent		
A2.1.5.2 Continuous		
A2.1.6 Based on temperature rating		
A2.1.7 Based on service factor		
A2.1.8 Based on enclosure		
A2.1.8.1 Totally enclosed		
A2.1.8.1.1 Nonventilated (TENV)		
A2.1.8.1.2 Fan-cooled (TEFC)		
A2.1.8.1.3 Explosion-proof		
A2.1.8.1.4 Dust-ignition-proof		
A2.1.8.1.5 Water-proof		
A2.1.8.1.6 Pipe ventilated		
A2.1.8.1.7 Water-cooled		
A2.1.8.1.8 Water-and-air-cooled		
A2.1.8.1.9 Air-to-air-cooled		
A2.1.8.1.10 Guarded TEFC		
A2.1.8.1.11 Encapsulated		
A2.2 Rated power, kW		
A2.3 Power factor		
A2.4 Rated voltage, V		
A2.5 Rated current, A		
A2.6 Rated shaft speed, rpm		
A2.7 Frequency, Hz		
A2.8 Motor efficiency, %		
A2.9 Temperature rating, °C		

Annex B
Varying Load Performance Test Data Sheet

Electric motor on test
 Brand : _____
 Model : _____
 Serial No. : _____

Test Conditions:
 Ambient Temperature
 Dry bulb, °C : _____
 Wet bulb, °C : _____
 Relative Humidity, %: _____
 Atmospheric Pressure, mb: _____

Date of test: _____

Input of the Motor			Output of the Motor			Motor Efficiency %	Temperature of the Casing °C
Line Voltage V	Load Current A	Power kW	Torque kg-m	Shaft Speed rpm	Power kW		

Observations:

Annex C**Formulas Used For Calculations****C Varying Load Test****C.1 Shaft Output Power, P_o , (kW)**

$$P_o = \frac{T \times N}{974}$$

where: T is the shaft torque, kg-m
 N is the shaft speed, rpm

C.2 Motor Efficiency, ε_m , (%)

$$\varepsilon_m = \frac{P_o}{P_i} \times 100$$

where: P_o is the shaft output power, kW
 P_i is the input power, kW