

Foreword

The pursuance of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) with funding from the Department of Agriculture.

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

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

ASAE S358.1, Moisture Measurement – Forages. ASAE Standards 1986.

ISO 8909-1:1994 (E/F), Forage Harvesters – Part 1: Vocabulary.

ISO 8909-2:1994 (E), Forage Harvesters – Part 2: Specifications of characteristics and performance.

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Agricultural Machinery – Forage Chopper – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for power-driven forage chopper use for animal forage. Specifically, it shall be used to:

- 1.1 verify the mechanism, dimensions, materials, accessories of the forage chopper and the list of specifications submitted by the manufacturer;
- 1.2 determine the performance of the machine;
- 1.3 evaluate the ease of handling and safety features;
- 1.4 analyze the chopped forage through laboratory analysis; and
- 1.5 report the results of the tests.

2 References

The following normative document contains provisions which through reference in this text constitute provisions of these standards:

PAES 103:2000 Agricultural Machinery - Methods of Sampling

PAES 218:2004 Agricultural Machinery – Forage Chopper - Specifications

3 Definitions

For the purpose of this standard, the definitions given in this document are used as they are defined:

3.1**chopping efficiency**

ratio of the weight of the fresh chopped materials collected at all outlets, to the total fresh weight of the input of the chopper, expressed in percent

3.2**forage**

any crop used as silage, soilage or animal feed, usually mixed with fermenting agents.

3.3**feeding table**

part of the forage chopper where the forage to be chopped are loaded

3.4

output capacity

weight of processed material collected per unit time, expressed in kilogram per hour

3.5

overall height

distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the forage chopper

NOTE All parts of the forage chopper projecting upwards are contained between these two planes.

3.6

overall length

distance between the vertical planes at the right angles to the median plane of the forage chopper and touching its front and rear extremities

NOTE All parts of the forage chopper, in particular, components projecting at the front and at the rear are contained between these two planes. Where an adjustment of components is possible, it shall be set at minimum length.

3.7

overall width

distance between the vertical planes parallel to the median plane of the machine, each plane touching the outermost point of the forage chopper on its respective side

NOTE All parts of the forage chopper projecting upwards are contained between these two planes.

3.8

prime mover

electric motor or internal combustion engine used to run the forage chopper

3.9

running -in period

preliminary operation of the machine to make various adjustments prior to the conduct of test until the operation is stable

4 General Conditions for Test and Inspection

4.1 Selection of forage chopper to be tested

Forage chopper submitted for test shall be sampled in accordance with PAES 103.

4.2 Role of manufacturer/dealer

The manufacturer shall submit specifications and other relevant information about the forage chopper and shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the representative of the manufacturer/dealer

An officially designated representative of the manufacturer shall operate, adjust, repair, and shall decide on matters related to the operation of the machine.

4.4 Test site conditions

The forage chopper shall be tested as installed for normal operation. The site should have ample provisions for crop handling, temporary storage and workspace.

4.5 Test instruments

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the forage chopper test is shown in Annex A.

4.6 Test materials

Test materials to be used shall be commonly or locally grown and newly harvested forage crop. The amount of test material to be supplied shall be at least 75 % of input capacity of forage chopper.

5 Test and Inspection

5.1 Verification of the manufacturer's technical data and information

5.1.1 This inspection is carried out to verify the mechanism, main dimensions, materials and accessories of the forage chopper in comparison with the list of manufacturer's technical data and information.

5.1.2 A plain and level surface shall be used as reference plane for verification of forage chopper's dimensional specifications.

5.1.3 The items to be inspected and verified shall be recorded in Annex B.

5.2 Performance test

5.2.1 This is carried out to obtain actual data on overall machine performance.

5.2.2 Initial data of the crop conditions such as type of crop, variety, source and length of forage crop shall be recorded.

5.2.3 Test materials to be used

Test materials prepared to be used for the running-in and for each test trial shall be the same.

5.2.4 Running-in and preliminary adjustment

Before the start of the test, the forage chopper should have undergone running-in period wherein various adjustments of the forage chopper shall be made according to the recommendation of the manufacturer. (No other adjustments shall be permitted while the test is on-going).

5.2.5 Termination of test

If during the test run, the machine stops due to major component breakdown or malfunctions, the test shall be terminated by the test engineer.

5.2.6 Operation of the forage chopper

The forage chopper shall be operated at the recommended settings of the manufacturer and the setting shall be maintained during the test trial. After the test run, the chopping area shall be cleaned and then prepared for the next test trial. This procedure shall be repeated for the succeeding test trials.

5.2.7 Test trial

A minimum of three test trials, with duration of at least 15 minutes per trial, shall be adopted.

5.2.8 Data collection

5.2.8.1 Duration of test

The duration of each test trial shall commence at the start of the chopping operation and ends after feeding of the last batch and shall be recorded as operating time.

5.2.8.2 Noise level

The noise emitted by the machine shall be measured using a noise level meter at the location of the feeder and collector of the chopped materials. The noise level shall be measured approximately 50 mm away from the ear level of the feeder and collector of the chopped materials.

5.2.8.3 Speed of components

The speed of the rotating shafts of the major components of the forage chopper shall be taken using a tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 5.2.8.2 and 5.2.8.3 as specified in Annex C.

5.2.8.4 Fuel/Power consumption

Before the start of each test trial, the fuel tank shall be filled to its capacity. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank. In case an electric motor is used primemover, a power meter shall be used to measure electric energy consumption.

5.2.9 Sampling and sample handling

5.2.9.1 Sampling for test materials

The conditions of the test materials such as length of forage crop shall be measured by randomly taking 20 “representative samples” which represents the different conditions of test materials in the bulk.

5.2.9.2 Sampling from output chute

During each test trial, three samples each weighing one kilogram shall be randomly collected from the output of the forage chopper to be analyzed in the laboratory. Half (500 g) of the one kilogram sample shall be used for laboratory analysis and the other half (500 g) shall be used for reference purposes or for an eventual second check in case of review.

5.2.9.3 Handling of Samples

All samples to be taken to the laboratory shall be placed in appropriate containers and properly labeled.

5.2.9.4 Data recording and observations

Record sheet for all data and information during the test is given in Annex C.

6 Laboratory Analysis

Laboratory analyses shall be made to determine moisture content, accuracy and precision of cut of the chopper. The laboratory test data sheet to be used is given in Annex D.

6.1 Moisture content

This shall be taken using oven-dry method.

6.1.1 For each test trial, select three representative sample weighing at least 25 g of chopped materials and place in the moisture can. The moisture can shall be sealed to ensure that no moisture is lost or gained by the sample between the time it was collected and when it is weighed. Record the initial weight.

6.1.2 Dry the sample in the oven with temperature of $103\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ for 24 h.

6.1.3 After removing the samples from the oven, the moisture can with the sample should be placed in a desiccator and allowed to cool to the ambient temperature.

6.1.4 Weigh the moisture can plus the dried sample. Record the final weight. Calculate the moisture content using Equation E.1 in Annex E.

6.2 Analysis of products

In each test trial, randomly take three-30 pieces samples from the outlet. The length of each piece in the samples shall be measured to find the average length of cut, the coefficient of variation, precision (% error) of cut and chopping efficiency of the forage chopper.

6.3 Quality of products

In each test trial, randomly take three-250 g samples from the outlet. Uncut forage from the samples shall be separated and weighted. Chopping efficiency shall be calculated using the equation in Annex E.

Observations on the quality of the chopped materials shall be recorded.

7 Formula

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

8 Test Report

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

- 8.1 Title
- 8.2 Summary of results
- 8.3 Purpose and scope of test
- 8.4 Methods of test
- 8.5 Conditions of the machine
- 8.6 Description of the machine
- 8.7 Results of test
- 8.8 Observations (include pictures)
- 8.9 Names, signatures and designation of test engineers

Annex A
(informative)

**Minimum List of Field and Laboratory
Test Equipment and Materials**

A.1	Equipment	Quantity
A.1.1	Field	
A.1.1.1	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
A.1.1.2	Digital Timers (range: 60 minutes) Accuracy: 0.1 sec	2
A.1.1.3	Tape measure (with maximum length of 5 m)	1
A.1.1.4	Noise level meter Range: 30 dB(A) to 130 dB(A)	1
A.1.1.5	Weighing scale (capacity: 100 kg) Scale divisions: 500 g	1
A.1.1.6	Graduated cylinder (for engines) (500 mL capacity) or Watt-hour meter (for electric motors) 60 Hz, 220 V	1
A.1.1.7	Camera	1
A.1.1.8	Triple beam balance	1
A.1.2	Laboratory	
A.1.2.1	Weighing scale (Sensitivity: 0.1 g)	1
A.1.2.2	Air oven	1
A.1.2.3	Desiccator	1
A.1.2.4	Foot rule (calibration 1 mm)	1
A.1.2.5	Aluminum moisture can	9
A.2	Materials	
A.2.1	Sample bags	
A.2.2	Labeling tags which include	
A.2.2.1	Date of test	
A.2.2.2	Forage chopper on test	
A.2.2.3	Sample source	
A.2.2.4	Variety	
A.2.2.5	Trial number	

Annex B
(informative)

Specifications of Forage Chopper

Name of Applicant/ Distributor: _____

Address: _____

Tel No: _____

Name of Manufacturer: _____

Address: _____

Tel No: _____

GENERAL INFORMATION

Brand/Model: _____ Make: _____

Serial No: _____ Type: _____

Date Manufactured: _____

Items to be inspected

ITEMS	Manufacture's Specification	Verification by the Testing agency
B.1 Main structure		
B.1.1 Overall dimensions, mm		
B.1.1.1 length		
B.1.1.2 width		
B.1.1.3 height		
B.1.2 Weight, without primemover, kg if applicable		
B.2 Chopping assembly		
B.2.1 Type		
B.2.2 Size, diameter, mm		
B.2.3 Cutting device		
B.2.3.1 Type		
B.2.3.2 Dimension, (L x W), mm		
B.2.3.3 No. of knives		
B.2.3.4 Means of attachment		
B.2.3.5 Materials		
B.3 Feeding table		
B.3.1 Dimension (L x W), mm		
B.3.2 Height from the ground, mm		
B.3.3 Material		
B.4 Dimension of feeding inlet, L x D, mm		
B.5 Dimension of output chute, L x D, mm		
B.6 Main frame material		
B.7 Primemover		
B.7.1 Engine		
B.7.1.1 Brand		

ITEMS	Manufacture's Specification	Verification by the Testing agency
B.7.1.2 Model		
B.7.1.3 Serial number		
B.7.1.4 Type (stroke/ignition)		
B.7.1.5 Rated power, kW		
B.7.1.6 Rated speed, rpm		
B.7.1.7 Cooling system		
B.7.1.8 Starting system		
B.7.1.9 Weight, kg		
B.7.2 Electric motor		
B.7.2.1 Brand		
B.7.2.2 Model		
B.7.2.3 Rated power, kW		
B.7.2.4 Rated speed, rpm		
B.7.2.5 Weight, kg		

Annex C
(informative)

Performance Test Data Sheet

Test Trial No. _____ Date: _____
 Test Engineer: _____ Location: _____
 Assistants: _____ Test Specimen: _____
 Test Requested by: _____ Manufacturer: _____

ITEMS	Trial 1	Trial 2	Trial 3	Average
C.1 Conditions of test sample				
C.1.1 Variety				
C.1.2 Source				
C.1.3 Average length of plant, mm				
C.2 Operating time, h				
C.3 Weight of output, kg				
C.4 Output capacity, kg/h				
C.5 Chopping efficiency, %				
C.6 Speed of components				
C.6.1 Primemover				
C.6.1.1 Without load				
C.6.1.2 With load				
C.6.2 Chopping shaft				
C.6.2.1 Without load				
C.6.2.2 With load				
C.7 Noise level, db(A)				
C.7.1 Operator				
C.7.1.1 Without load				
C.7.1.2 With load				
C.7.2 Chopped collector				
C.7.2.1 Without load				
C.7.2.2 With load				
C.8 Fuel consumed, mL				
C.9 Fuel consumption, L/h				
C.10 Minimum labor requirement				

C.11 Rate the following observations:

Items	Rating*				
	1	2	3	4	5
C.11.1 Ease of loading					
C.11.2 Ease of cleaning parts					
C.11.3 Ease of adjusting and repair of parts					
C.11.4 Ease of collecting output					
C.11.5 Ease of transporting the machine					
C.11.6 Safety					
C.11.7 Vibration					

*1 – Very Good

2 – Good

3 – Satisfactory

4 – Poor

5 – Very Poor

C.12 Other Observations

Annex D
(informative)

Laboratory Test Data Sheet

Machine Tested: _____

Analyzed by: _____

D.1 Moisture Content Determination (Oven Method)

Item	Trial 1			Trial 2			Trial 3			Average
Initial weight, g										
Final weight, g										
Moisture content, %										
General Average										

D.2 Accuracy and Precision of Cut

Cut setting: _____

Sample	Length of sample mm									
	Trial 1			Trial 2			Trial 3			Average
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										

Sample	Length of sample mm									
	Trial 1			Trial 2			Trial 3			Average
26										
27										
28										
29										
30										
Average Length of cut										
Average Coefficient of Variation, %										
Percent Error										

D.3 Quality of Cut

D.3.1 Chopping efficiency (250 g sample)

Trial	Weight of uncut materials g	Weight of cut materials g	Chopping efficiency %
1			
2			
3			
Average			

D.3.2 Observations on the quality of cut

Trial	Clear cut	Shredded	Sheared
1			
2			
3			

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Moisture content

$$MC_{\text{wetbasis}} = \frac{W_i - W_f}{W_i} \times 100$$

where:

MC	=	Moisture content, %
W_i	=	Initial mass of the sample, g
W_f	=	Final mass of the sample, g

E.2 Output capacity

$$Co = \frac{W_p}{T_o}$$

where:

Co	=	Output capacity, kg/h
W_p	=	Weight of product, kg
T_o	=	Time of operation, h

E.3 Chopping efficiency

$$Ce = \frac{W_i - W_{uc}}{W_i} \times 100$$

where:

Ce	=	Chopping efficiency, kg/h
W_{uc}	=	Weight of uncut materials, kg
W_i	=	Weight of input materials, kg

E.4 Coefficient of variation

$$Cv = \sqrt{\frac{n \sum x^2 - (\sum x)^2}{n(n-1)}}$$

where:

Cv	=	Coefficient of variation, %
x	=	Value of observation
n	=	Number of observations

E.5 Error, (%)

$$E = \frac{\bar{x} - x}{x} \times 100$$

where:

E	=	Error, %
\bar{x}	=	Mean of n values
x	=	Set of values

E.6 Fuel consumption

$$F_c = \frac{F_1}{T_o}$$

where:

F_c	=	Fuel consumption, L/h
F_1	=	Amount of fuel consumed, L
T_o	=	Time of operation, h