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Agroprocessing machines — Test methods —

Part 5: Maize mill

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In order to match with technological development and to keep continuous progress in industries, standards are subject to periodic review. Users shall ascertain that they are in possession of the latest edition

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 269-5 was prepared by Technical Committee RSB/TC 47, Steel, aluminium and related products.

In the preparation of this standard, reference was made to the following standard (s):

1) XYZ: Title

2) XYZ:Title

The assistance derived from the above source is hereby acknowledged with thanks.

This second edition cancels and replaces the first edition (RS 269-5:2015) which has been technically revised.

DRS 269 consists of the following parts, under the general title *Agricultural machinery— Test methods*:

— *Part 1: rice thresher*

— *Part 2: Power operated maize sheller*

— *Part 3: Rice mill*

— *Part 4: Heated air mechanical grain dryer*

— *Part 5: Maize mill*

Committee membership

The following organizations were represented on the Technical Committee on *Steel, aluminium and related products* (RSB/TC 47) in the preparation of this standard.

University of Rwanda/college of science and technology

University of Rwanda/College of agriculture animal science and veterinary medicine

Kabizu business group

Rwanda Polytechnic/IPRC Kigali

Rwanda Polytechnic/IPRC Ngoma

Rwanda Polytechnic/IPRC Musanze

RWANTECH Boilers

Rwanda Inspectorate and competition authority

Rwanda Institute for Conservation Agriculture

ACER Ltd

Rwanda Standards Board (RSB) – Secretariat

Agroprocessing machines — Test methods — Part 5: Maize mill

1 Scope

This Draft Rwanda Standard specifies the methods of sampling, testing and inspection for maize mill.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

RS 268-5, *Agroprocessing machines — Specification — Part 5: Maize mill*

RS 241, *Agriculture machinery — Methods of sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in RS 268-5 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1

degerminated maize kernels

shelled maize kernels where the germ and pericarp have been removed

3.2

feed rate

weight of the maize kernels fed into the maize mill per unit of time

3.3

laboratory sieve shaker

equipment with definite shaking motion used to sort the size of the milled materials using standard screen sieves

3.4

Purity

ratio of the weight of clean maize kernels, to the total weight of uncleaned maize kernels, expressed in percent

4 General conditions for test and inspection

4.1 Role of manufacturer/dealer

The manufacturer/dealer shall comply with the test procedures of national testing authority.

4.2 Test site conditions

The maize mill shall be tested as installed for normal operation. The site shall have ample provisions for grain handling, temporary storage and workspace.

5 Suspension of test

5.1 If during the test run, the machine stops due to breakdown or malfunction so as to affect the machine's performance, the test may be suspended.

5.2 The decision to suspend or to continue the test is at the discretion of the test engineer and concurred by the representative.

6 Test preparation

6.1 Preparation of the maize mill for testing

6.1.1 A check shall be made by the manufacturer/client and testing authority that the maize mill has been assembled and installed in accordance with the instruction of the manufacturer.

6.1.2 The maize mill shall be cleaned adequately for the purpose of testing.

6.2 Test materials

The maize kernels to be used for testing shall be of the same grade and prepared in sufficient quantity, using the procedure given in Annex A.

6.3 Running-in and preliminary adjustments

6.3.1 Before the start of the test, the maize mill shall have undergone a breaking-in period.

6.3.2 The maize mill shall be operated at the test site for sufficient duration with and without load.

6.3.3 During the running-in period, the various adjustments of the maize mill shall be made according to the manufacturer's recommendations.

6.3.4 No other adjustments shall be permitted during the test.

7 Pre-test observation

The specifications claimed by the manufacturer and the physical details given in Annex B shall be verified by the recognized testing authority.

8 Performance test

8.1 Operation of the maize mill

8.1.1 The maize mill shall be operated at the manufacturer's recommended setting of its components.

8.1.2 The recommended feeding rate shall be maintained during the test run with duration of at least one hour.

8.1.3 After the test-run, the milling area shall be cleaned and then prepared for the next test trial(s).

8.1.4 This procedure shall be repeated for at least three test trial(s).

9 Sampling

9.1 Procedure

Sampling procedure is given in Annex C.

9.2 Data collection

9.2.1 Duration of test

The duration of each test trial shall start with the feeding of the maize kernels into the intake hopper/intake pit and ends after the last discharge from the main output chute.

9.2.2 Noise level

9.2.2.1 The noise emitted by the machine, with or without load, shall be measured using a noise level meter at the location of the operators and baggers.

9.2.2.2 The noise limit shall comply with the requirements specified in RS 236

9.2.3 Speed of components

The speed of the rotating shafts of the major components of the maize mill shall be taken using a tachometer. Measurements shall be taken with and without load for 9.2.2 and 7.1.3 as specified in Annex D

9.2.3 Energy consumption

9.1.4.1 Before the start of each test trial, the fuel tank shall be filled to its capacity and after each test; the fuel consumed shall be measured.

9.1.4.2 In case an electric motor is used as a prime mover, a power meter shall be used to measure electric energy consumption.

9.2.4 Data recording and observations

Record sheet for all data and information during the test is given in Annex D. Observations to be taken during the performance test shall be recorded.

10 Laboratory analysis

10.1 The analysis is carried out to analyze the kernel samples taken during the performance test.

10.2 The laboratory procedures to be followed in the analysis are given in Annex E and the data sheet to be used is given in Annex F.

10.3 The percentage of maize grits of other sizes from each outlet shall be determined using a laboratory sieve shaker with sieves of the same sizes as in the maize mill.

11 Formula

The formula to be used during calculations and testing are given in Annex G.

12 Test report

The test report shall include the following information:

a) title;
b) summary of results;
c) purpose and scope of Test;
d) methods of Test;
e) conditions of the machine;
f) description of the machine;
g) results and discussions;
h) observations (include pictures); and
i) names and signatures of test engineers

Annex A
(normative)

Test materials for maize mill

A.1 Sample characteristics

Test materials to be used shall have the following characteristics:

a) **variety**: hybrid
b) **grain moisture content**: dried to uniform moisture content of 13.5 %
c) **purity**, percent, minimum: 95

A.2 Quantity to be supplied

A.2.1 The amount of test material to be supplied shall be sufficient for at least 3 h 30 min of continuous milling operation.

A.2.2 At least three test trials shall be conducted with minimum duration of 1 h per trial. The excess amount shall be used for running-in prior to the actual conduct of test trials.

A.2.3 Approximately: 2.5 h x milling capacity (t/h)

A.3 Sample preparation

Prepare the sample in such a way that test sample to be used for the running-in and in each test trial shall have identical characteristics in terms of moisture content, purity and variety.

Annex B
(normative)

Specification for maize mill

Name of Applicant (Distributor): _____

Address: _____

Tel No: _____

Manufacturer Name : _____

Address:

_____ Tel

No: _____

Address: _____

GENERAL INFORMATION

Serial No: _____ Brand/Model: _____

Type: _____ Make: _____

Production date of maize mill to be tested: _____

Testing agency: _____ Date of testing: _____

Location of test: _____ Test Engineer: _____

Table B 1 — Items to be inspected

Items	Manufacturer's Specifications	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 engine (kg), if applicable		
B.2 Primemover		
B.2.1 Electric motor		
B.2.1.1 Brand		
B.2.1.2 Type		
B.2.1.3 Make or manufacturer		
B.2.1.4 Serial number		
B.2.1.5 Rated power (kW)		
B.2.1.6 Rated speed (rpm)		
B.2.1.7 Phase		
B.2.1.8 Voltage (V)		
B.2.1.9 Current (A)		
B.2.1.10 Frequency (Hz)		
B.2.2 Engine		
B.2.2.1 Brand		
B.2.2.2 Model		
B.2.2.3 Make or manufacturer		
B.2.2.4 Type		
B.2.2.5 Serial number		
B.2.2.6 Rated power (kW)		
B.2.2.7 Rated speed (rpm)		
B.2.2.8 Displacement (cm3)		
B.2.2.9 Cooling system		
B.2.2.10 Starting system		
B.3 Intake Hopper/Loading Pit		
B.3.1 Holding capacity (kg)		
B.3.2 Materials of construction		
B.3.3 Features		
B.4 Pre-cleaner		
B.4.1 Size (L x D), mm		
B.4.2 Materials of construction		

B.5 Degerminator		
B.5.1 Type		
B.5.2 Size (L x D), mm		
B.5.3 Materials of construction		
B.6 Elevator(s)		
B.6.1 Type		
B.6.2 No. of units		
B.6.3 Size of buckets		
B.7 Steel Roller		
B.7.1 Size (L x D), mm		
B.7.2 No. of units		
B.7.3 No. of serration/inch		
B.7.4 Materials of construction		
B.8 Sifter		
B.8.1 Size (L x W), mm		
B.8.2 No. of screens		
B.8.3 Size of perforations, mm		
B.8.4 Length of stroke, mm		
B.8.5 Materials of construction		
B.9 Safety devices		
B.10 Special features		

Annex C
(normative)

Sampling and measurements for test material

C.1 Sampling from different outlets

C.1.1 During each test trial, three samples each shall be collected from the outlets of the different components of the maize mill to be analyzed in the laboratory.

C.1.2 The minimum amount of sample to be taken shall be twice as much as what is needed for a particular analysis.

C.1.3 The excess sample shall be used for reference purposes or for an eventual second check in case of review.

C.2 Handling of samples

C.2.1 All samples to be taken to the laboratory shall be placed in appropriate containers and properly labelled.

C.2.2 If the sample is to be used for determining moisture content, it must be kept in dry and airtight containers.

C.2 Other measurements required during the test run

C.3.1 Data shall be taken for the following:

a) speed of rotating components; and
b) noise level at operator's and bagger's location.

C.3.2 For each data to be taken, there shall be a minimum of five observations and shall be taken without and with load.

C.3.3 Before taking of data, it should be ensured that the feed rate, speed and other functional characteristics have stabilized.

C.3.4 The time of recording shall be properly spaced during the whole duration of the test trial.

C.3 Measurement of fuel consumption

C.4.1 For maize mill using engine as prime mover

C.4.1.1 To get the amount of fuel consumed, the tank shall be filled to full capacity before the test.

C.4.1.2 After the test, fill the tank with measured fuel to the same level before the test.

C.4.1.3 When filling up the tank, careful attention shall be paid to keep the tank horizontal and not to leave empty space in the tank.

12.1.1 C.4.2 Using electric motors as prime mover

C.4.2.1 Use a power meter to measure the voltage, current and the total electric power consumption of the maize mill.

C.4.2.2 There shall be three sets of data with a minimum of five observations per set taken with load and one set of data taken without load.

C.4.2.3 Data shall be taken simultaneous with the collection of samples for laboratory analysis.

Annex D
(normative)

Performance test data sheet

Test trial No.: _____ Date: _____

Test Engineers: _____ Location: _____

Assistants: _____ Test Specimen: _____

Tested requested by: _____ Manufacturer: _____

Table D 1 — Data sheet

Items	Trial			
	1	2	3	Average
D.1 Conditions of Test Sample				
D.1.1 Variety				
D.1.2 Source				
D.1.3 Moisture content (%)				
D.2 Weight of input (kg)				
D.3 Weight of main products (kg)				
D.3.1 Grit #10				
D.3.2 Grit #12				
D.3.3 Grit #14				
D.3.4 Grit #16				
D.3.5 Grit #18				
D.4 Weight of by-products (kg)				
D.4.1 Grit #20				
D.4.2 Grit #24				
D.4.3 Floured maize (“tiktik”)				
D.4.4 Germs (“sungo”)				
D.4.5 Bran (“tahop”)				
D.5 Output time (h)				
D.6 Output capacity (t/h)				

D.7 Milling time (h)				
D.8 Milling capacity (t/h)				
D.9 Total milling recovery				
D.9.1 Main product recovery (%)				
D.9.2 By-product recovery (%)				
D.10 Speed of components (rpm)				
D.10.1 Prime mover				
D.10.1.1Without load				
D.10.1.2With load				
D.10.2 Degerminator shaft				
D.10.2.1Without load				
D.10.2.2With load				
D.10.3 Aspirator shaft				
D.10.3.1Without load				
D.10.3.2With load				
D.10.4 Roller #1 shaft				
D.10.4.1 Without load				
D.10.4.2 With load				
D.10.5 Roller #2 shaft				
D.10.5.1 Without load				
D.10.5.2 With load				
D.10.6 Oscillating screen shaft				
D.10.6.1 Without load				
D.10.6.2 With load				
D.11 Noise level [db(A)]				
D.11.1 Operator				
D.11.1.1 Without load				
D.11.1.2 With load				
D.11.2 Bagger				
D.11.2.1 Without load				
D.11.2.2 With load				
D.12 Power consumption				
D.12.1 Power (kW)				

D.12.1.1 Without load				
D.12.1.2 With load				
D.12.2 Current (A)				
D.12.2.1 Without load				
D.12.2.2 With load				
D.12.3 Voltage (V)				
D.12.3.1 Without load				
D.12.3.2 With load				
D.13 Fuel consumed (L)				
D.14 Fuel consumption (L/h)				

D.15 Observations:

D.15.1 Ease of loading

_____

_____

D.15.2 Ease of cleaning parts

_____

_____

D.15.3 Ease of adjustments

_____

_____

D.15.4 Ease of collecting output

_____

_____

D.15.5 Safety

D.15.6 Labour requirements

D.15.7 Failure or abnormalities that may be observed on the maize mill or its component parts during and after the milling operation.

D.15.8 Others

Annex E
(normative)

Laboratory analysis

E.1 Purity determination

E.1.1 Take three 500 g samples from the “representative samples” of the input.

E.1.2 Clean the maize kernels to remove the impurities, the clean maize kernel shall be weighed and recorded.

E.2 Moisture content

E.2.1 Shall be taken using a calibrated meter or by oven method.

E.2.2 Five samples shall be taken for moisture content determination.

E.2.4 The mean value determined from the 100 g samples shall be taken as the moisture content of the maize kernels.

E.3 Analysis of output from degerminator to determine the degerminator efficiency

E.3.1 Three 100 g samples shall be taken from the output of the degerminator.

E.3.2 These samples shall be analyzed to determine the percent degerminated, undegerminated and impurities.

E.4 Analysis of main products

E.4.1 This procedure shall be used to determine the percentage of the maize grits for that particular maize grits size and at the same time, to determine the percentage of maize grits of other sizes. **E.4.2** In each test trial, take three 100 g samples from each main product outlet.

E.4.3 Using laboratory sieve shaker with a sieve of the same size with the main product to be analyzed, get the weight of the sample that passed through the sieve but did not pass through the next sieve size.

E.5 Analysis of by-products

E.5.1 In each test trial, take three 100 g samples from each of the outlet of floured maize, germs and bran.

E.5.2 Separate any impurities and take the final weight of the sample.

E.6 Analysis of output from roller mill to compare laboratory result with machine's output

E.6.1 In each test trial, take three100 g samples from the roller mill output.

E.6.2 Using laboratory sieve shaker with sieves of the same sizes (for the main product) with the maize mill, get the weight of the samples that remained on each sieve and determine the percentages of maize grits (main products).

E.6.3 Compare the result with the output (main product) of the maize mill.

Annex F
(normative)

Laboratory test data sheet

Machine Tested: _____

Analyzed by: _____

12.2 F.1 Moisture content determination

F.1.1 Using calibrated moisture meter

Moisture content (%) _____ _____ _____ _____ Average_____

F.1.2 Oven method (100 g sample)

Final weight (g) _____ _____ _____ Average_____

Moisture content (%) _____ _____ _____ Average_____

12.3 F.2 Purity determination (500 g sample)

Final weight (g) _____ _____ _____ Average_____

Purity (%) _____ _____ _____ Average_____

Table F.1 — Analysis of output from degerminator

Items	Trial 1	Trial 2	Trial 3	Average
A Initial weight of sample (g)				
B Weight of degerminated maize kernels (g)				
C Weight of undegerminated maize kernels (g)				
D Weight of impurities (g)				

Table F.2 — Analysis of output from roller mill (using Laboratory Sieve Shaker)

Items	**Trial 1**	**Trial 2**	**Trial 3**	**Average**

c)	Grit # 10 Wt. of size #10 grits Percentage weight				
d)	Grit # 12 Wt. of size # 12 grits Percentage weight				
e)	Grit # 14 Wt. of size #14 grits Percentage weight				
f)	Grit # 16 Wt. of size # 16 grits Percentage weight				
g)	Grit # 18 Wt. of size # 18 grits Percentage weight				

Table F.3 — Analysis of main products (using Laboratory Sieve Shaker)

	Items	**Trial 1**	**Trial 2**	**Trial 3**	**Average**
h)	Grit # 10 Wt. of size #10 grits Wt. of other size of grits				
i)	Grit # 12 Wt. of size # 12 grits Wt. of other size of grits				
j)	Grit # 14				
	Wt. of size #14 grits Wt. of other size of grits				

k)	Grit # 16 Wt. of size # 16 grits Wt. of other size of grits				
l)	Grit # 18 Wt. of size # 18 grits Wt. of other size of grits				

Table F.4 — Analysis of by-products

Items	Trial 1	Trial 2	Trial 3	Average
F.6.1 Floured maize (100 g) Final weight of sample (g) Weight of impurities (g)				
F.6.2 Germs (100 g) Final weight of sample (g) Weight of impurities (g)				
F.6.3 Bran (100 g) Final weight of sample (g) Weight of impurities (g)				

Annex G
(normative)

Formula used during calculations and testing

G.1 Input capacity, $C_i(^{kg}/_h)$

$$C_i = \frac{Wt.of\ corn\ kernel\ input, kg}{Total\ loading\ time, h}$$

G.2 Output capacity, $C_o(^{kg}/_h)$

$$C_o = \frac{Wt.of\ main\ product, kg}{Output\ time, h}$$

G.3 Milling capacity, $C_m(^{kg}/_h)$

$$C_i = \frac{Wt.of\ corn\ kernel\ input, kg}{Total\ operating\ time, h}$$

G.4 Main product recovery, $R_m(\%)$

$$R_m = \frac{Wt.of\ main\ product, kg}{Wt.\ of\ input, kg} \times 100$$

G.5 By-product recovery, $R_b(\%)$

$$R_b = \frac{Wt.of\ by-product, kg}{Wt.of\ input, kg} \times 100$$

G.6 Losses, $L(\%)$

$$L = 100\% - (main\ product\ recovery, \% + by-product\ recovery, \%)$$

G.7 Fuel/Electrical consumption

G.7.1 Fuel consumption, $F_c(^{L}/_h)$

$$F_c = \frac{Amount\ fuel\ consumed, L}{Total\ operating\ time, h}$$

G.7.2 Electrical energy consumption, $E_c(\ kW - h)$

$$E_c = Power\ consumed\ (kW) \times Time of\ operation\ (h)$$

Price based on 23pages