

Foreword

The formulation of standard for the methods of test for corn mill was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Standardization of Postharvest Machinery Testing and Evaluation” which was funded by the Bureau of Postharvest Research and Extension (BPRE) of the Department of Agriculture (DA).

This standard was reviewed by the Study Team for the Formulation of Standards for Corn Mill and by the Technical Committee on Postharvest Machinery and was circulated to various private and government agencies/organizations concerned for their comments and reactions. This standard was presented to the Philippine Society of Agricultural Engineers (PSAE) and subjected to a public hearing organized by the National Agriculture and Fisheries Council (NAFC).

This standard has been technically formulated in accordance with PNS 01: Part 4:1998 – Rules for the Structure and Drafting of Philippine National Standards.

The comments and reactions received during the presentation and public hearing were taken into consideration in the finalization of this standard.

In the preparation of this standard, reference was made to Primer on Philippine Grains Standardization Program-National Food Authority, 1998.

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Agricultural Machinery – Corn Mill – Methods of Tests

1 Scope

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

- 1.1 verify the mechanism, main dimensions, materials, accessories of the corn mill 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 main products and by-products of corn milling through laboratory analysis; and
- 1.5 report the results of the tests.

2 Reference

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

| | |
|---------------|---|
| PAES 210:2000 | Agricultural Machinery: Corn Mill – Specifications |
| ISO 6540:1980 | Maize – Determination of moisture content (on milled kernels and whole kernels) |

3 Definitions

For the purpose of this standard, the definitions given in PAES 210:2000 and the following shall apply:

3.1**aspirator**

cleaner that uses air to separate lower density material from the corn kernels/corn grits such as floured corn, germ and bran

3.2**bulk density**

ratio of the weight (kg) of the corn kernels, to its volume (m³)

3.3**degerminated corn kernels**

shelled corn kernels where the germ and pericarp have been removed

3.4**feed rate**

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

3.5**foreign matter**

impurity

any matter which is not corn kernels/corn grits or fragment of corn kernels/corn grits
sand, gravel, dirt, pebbles, stones, lumps of earth, clay, mud, weeds and other crop seeds

3.6**input capacity**

weight of corn kernel per unit loading time into the hopper/intake pit, expressed in kilogram per hour

3.7**laboratory sieve shaker**

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

3.8**milling capacity**

quantity of corn kernels that the corn mill can process to produce corn grits per unit of time

3.9**output capacity**

weight of the milled corn collected per unit of time

3.10**precleaner**

auxiliary device of the corn mill that removes foreign material

3.11**primemover**

electric motor, or gasoline-fed, or diesel-fed engine used to run the corn mill

3.12**purity**

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

3.13**sifter**

oscillating screen

wire mesh or perforated metal sheet, moving in back-and-forth direction, permitting smaller particles to fall through the openings and larger particles to remain on top

4 General Conditions for Test and Inspection

4.1 Role of manufacturer/dealer

The manufacturer/dealer shall submit to the official testing agency specifications and other relevant information on the corn mill. The sampled corn mill shall be submitted for testing. He/She shall abide with the terms and conditions set forth by an authorized testing agency. The interested party shall provide testing materials and other variable cost such as fuel, etc.

4.1 Role of the representative of the manufacturer/dealer

An authorized representative of the manufacturer/dealer shall operate, adjust, repair, and shall decide on matters related to the operation of the machine.

4.2 Test site conditions

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

4.3 Suspension of test

If during the test run, the machine stops due to major component breakdown or malfunctions so as to affect the performance of the machine, the test may be suspended. The decision to suspend or to continue the test is at the discretion of the testing agency concurred by the representative.

5 Test Preparation

5.1 Preparation of the corn mill for testing

A check shall be made by the manufacturer and testing authority to verify that the corn mill has been assembled and installed in accordance with the instruction of the manufacturer.

5.2 Test instruments and other needs

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the corn mill test is shown in Annex A. These instruments should be calibrated regularly. Before and after each test, these instruments shall be physically checked for operation and shall be cleaned, respectively. A checklist of instruments and materials shall be prepared to be used before departure to and from the testing area.

5.3 Test materials

The corn kernels to be used for testing shall be prepared in sufficient quantity, using the procedure given in Annex B. However, if the test materials are beyond the recommended characteristics, the manufacturer has the option to pursue the test.

5.4 Running-in and preliminary adjustments

Before the start of the test, the corn mill should have undergone a break-in period. The corn mill shall be operated at the test site by the official representative of the manufacturer for sufficient duration with and without load. During the running-in period, various adjustments of the corn mill shall be made according to the manufacturer's recommendations. No adjustments shall be permitted during the test.

6 Pre-test observation

6.1 Verification of specifications

The specifications claimed by the manufacturer and the physical details given in Annex C shall be verified by the testing agency.

6.2 Test materials

Representative test samples shall be collected from the test lot to determine the moisture content, bulk density and purity.

7 Performance test

7.1 Operation of the corn mill

The corn mill shall be operated at the recommended settings (i.e. speed, clearances, etc.) of the manufacturer. The recommended feeding rate shall be maintained during the test run with duration of at least one hour. After the test run, the milling area shall be cleaned and then prepared for the next test trial. This procedure shall be repeated for the succeeding test trials.

7.2 Sampling

Samples shall be collected at the different outlets during each test trial. Sampling procedure is given in Annex D.

7.3 Data collection

7.3.1 Duration of test

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

7.3.2 Noise level

The noise level emitted by the machine shall be measured using a noise level meter at the location of the operators and baggers. The noise shall be taken approximately 5 cm away from the ear level of the operators and baggers.

7.3.3 Speed of components

The speed of the rotating shafts of the major components of the corn mill shall be taken using a tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 7.3.2 and 7.3.3 as specified in Annex E.

7.3.4 Fuel/Electric energy consumption

Before the start of each test trial, the fuel tank shall be filled to its capacity and after each test trial, the fuel consumed shall be taken using graduated cylinder. In case electric motor is used as primemover, a power meter shall be used to measure electric energy consumption.

7.3.5 Data recording and observations

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

8 Laboratory Analysis

This is carried out to analyze the kernel samples taken during the performance test.

8.1 Laboratory analysis shall be made to determine the degerminator efficiency, losses and percentage of corn grits of other sizes from each outlet. The laboratory procedures to be followed in the analysis are given in Annex F and the data sheet to be used is given in Annex G.

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

9 Formula

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

10 Test Report

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

- 10.1** Title
- 10.2** Summary of Results
- 10.3** Purpose and Scope of Test
- 10.4** Methods of Test
- 10.5** Conditions of the Machine
- 10.6** Description of the Machine
- 10.7** Results of Test
- 10.8** Observations (include pictures)
- 10.9** Names and Signatures of Test Engineers

Annex A
Minimum List of Field and Laboratory
Test Equipment and Materials

| A.1 | Equipment | Quantity |
|----------------|--|-----------------|
| A.1.1 | Performance Test | 1 |
| A.1.1.1 | Grain Moisture Meter (duly calibrated using the standard method) Range: 12% to 30% (for corn) | 1 |
| A.1.1.2 | Tachometer (contact type or photo electric type; Range: 0-5,000 rpm; | 1 |
| A.1.1.3 | Timers (capacity: 60 minutes) Accuracy: 0.1 sec | 2 |
| A.1.1.4 | Measuring Tape (capacity: 5m) | 1 |
| A.1.1.5 | Noise Level Meter Range: 30 to 130 dB(A) | 1 |
| A.1.1.6 | Weighing Scale Capacity: 100 kg; Scale divisions: 0.5 kg | 1 |
| A.1.1.7 | Graduated Cylinder (for engines) (500- mL capacity) or Watt-Hour Meter (for electric motors) 60 Hz, 220 V | 1 |
| A.1.1.8 | Camera | 1 |
| A.1.2 | Laboratory Test | |
| A.1.2.1 | Weighing Scale (Sensitivity: 0.1 g) | 1 |
| A.1.2.2 | Magnifying Lens (minimum of 10 magnifications) | 1 |
| A.1.2.3 | Grain Sampler/Divider | 1 |
| A.1.2.4 | Sieves | |
| A.2 | Materials | |
| A.2.1 | Sample Bags | 100 |
| A.2.2 | Labeling Tags which include | 100 |
| A.2.2.1 | Date of test | |
| A.2.2.2 | Machine on test | |
| A.2.2.3 | Sample source | |
| A.2.2.4 | Variety | |
| A.2.2.5 | Trial number | |

Annex B
Test Materials for Corn Mill

B.1 Sample Characteristics

Test materials to be used shall have the following characteristics:

- B.1.1** Variety : hybrid
- B.1.2** Grain moisture content : dried to uniform moisture content of $14 \pm 1\%$
- B.1.3** Purity, percent, minimum : 95

B.2 Quantity to be Supplied

The amount of test material to be supplied shall be sufficient for at least two and a half hour of continuous milling operation. At least two test trials shall be conducted with minimum duration of one hour per trial. The excess amount shall be used for running-in prior to the actual conduct of test trials.

Approximately: 2.5 hour x milling capacity (t/h)

B.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 C Specifications of Corn Mill

Name of Applicant/ Distributor: _____
 Address: _____
 Tel No: _____
 Name of Manufacturer: _____
 Address: _____
 Tel No: _____

GENERAL INFORMATION

Make: _____ Type: _____
 Serial No: _____ Brand/Model: _____
 Production date of corn mill to be tested: _____
 Testing Agency: _____ Test Engineer: _____
 Date of Test: _____ Location of Test: _____

Items to be inspected

| ITEMS | Manufacturer's Specification | Verification by the Testing agency |
|---|------------------------------|------------------------------------|
| C.1 Main Structure | | |
| C.1.1 Overall dimensions (mm) | | |
| C.1.1.1 length | | |
| C.1.1.2 width | | |
| C.1.1.3 height | | |
| C.1.2 Weight, without engine (kg), if applicable | | |
| C.2 Primemover | | |
| C.2.1 Electric motor | | |
| C.2.1.1 Brand | | |
| C.2.1.2 Type | | |
| C.2.1.3 Make or manufacturer | | |
| C.2.1.4 Serial number | | |
| C.2.1.5 Rated power (kW) | | |
| C.2.1.6 Rated speed (rpm) | | |
| C.2.1.7 Phase | | |
| C.2.1.8 Voltage (V) | | |
| C.2.1.9 Current (A) | | |
| C.2.1.10 Frequency (Hz) | | |
| C.2.2 Engine | | |
| C.2.2.1 Brand | | |
| C.2.2.2 Model | | |
| C.2.2.3 Make or manufacturer | | |
| C.2.2.4 Type | | |
| C.2.2.5 Serial number | | |
| C.2.2.6 Rated power (kW) | | |
| C.2.2.7 Rated speed (rpm) | | |
| C.2.2.8 Displacement (cm ³) | | |

| ITEMS | Manufacturer's Specification | Verification by the Testing agency |
|----------|------------------------------|------------------------------------|
| C.2.2.9 | Cooling system | |
| C.2.2.10 | Starting system | |
| C.3 | Intake Hopper/Loading Pit | |
| C.3.1 | Holding capacity (kg) | |
| C.3.2 | Materials of construction | |
| C.3.3 | Features | |
| C.4 | Pre-cleaner | |
| C.4.1 | Size (L x D), mm | |
| C.4.2 | Materials of construction | |
| C.5 | Degerminator | |
| C.5.1 | Type | |
| C.5.2 | Size (L x D), mm | |
| C.5.3 | Materials of construction | |
| C.6 | Elevator(s) | |
| C.6.1 | Type | |
| C.6.2 | No. of units | |
| C.6.3 | Size of buckets | |
| C.7 | Steel Roller | |
| C.7.1 | Size (L x D), mm | |
| C.7.2 | No. of units | |
| C.7.3 | No. of serration/inch | |
| C.7.4 | Materials of construction | |
| C.8 | Sifter | |
| C.8.1 | Size (L x W), mm | |
| C.8.2 | No. of screens | |
| C.8.3 | Size of perforations, mm | |
| C.8.4 | Length of stroke, mm | |
| C.8.5 | Materials of construction | |
| C.9 | Safety devices | |
| C.10 | Special features | |

C11 Corn milling process flow diagram

Annex D

Sampling and Measurement for Test Material

D.1 Sampling procedures for corn kernels

The crop conditions such as purity, bulk density and moisture content of kernel to be used in each test trial shall be taken using “representative samples”, each weighing one (1) kilogram. This is done by taking samples, each at the top, middle and bottom of the pile. Samples representing the materials for each test trial shall be placed in appropriate containers for laboratory analysis.

D.2 Sampling from different outlets

During each test trial, three samples each shall be collected from the outlets of the different components (degerminator, roller mill, sifter outlets, cyclones etc.) of the corn mill to be analyzed in the laboratory. The minimum amount of sample to be taken shall be twice as much as what is needed for a particular analysis. The excess sample shall be used for reference purposes or for an eventual second check in case of review.

D.3 Handling of Samples

All samples to be taken to the laboratory shall be placed in appropriate containers and properly labeled. If the sample is to be used for determining moisture content, it must be kept in dry and airtight containers.

D.4 Other Measurements Required During the Test Run

Data shall be taken for the following: speed of rotating components and noise level at operator’s and bagger’s location. For each data to be taken, there shall be a minimum of five observations. These shall be taken without and with load. Before taking of data, it should be ensured that the feed rate, speed and other functional characteristics have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial.

D.5 Measurement of Fuel Consumption

D.5.1 For corn mill using engine as primemover

To get the amount of fuel consumed, the tank shall be filled to full capacity before the test. After the test, fill the tank with measured fuel to the same level before the test. When filling up the tank, careful attention shall be paid to keep the tank horizontal and not to leave empty space in the tank.

D.5.2 Using electric motors as primemover

Use a power meter to measure the voltage, current and the total electric power consumption of the corn mill. 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. Data shall be taken simultaneous with the collection of samples for laboratory analysis.

Annex E
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 | AVE. |
|---|---------|---------|---------|------|
| E.1 Conditions of Test Sample | | | | |
| E.1.1 Variety | | | | |
| E.1.2 Source | | | | |
| E.1.3 Moisture content (%) | | | | |
| E.2 Weight of input (kg) | | | | |
| E.3 Weight of main products (kg) | | | | |
| E.3.1 Grit #10 | | | | |
| E.3.2 Grit #12 | | | | |
| E.3.3 Grit #14 | | | | |
| E.3.4 Grit #16 | | | | |
| E.3.5 Grit #18 | | | | |
| E.4 Weight of by-products (kg) | | | | |
| E.4.1 Grit #20 | | | | |
| E.4.2 Grit #24 | | | | |
| E.4.3 Floured corn (“tiktik”) | | | | |
| E.4.4 Germs (“sungo”) | | | | |
| E.4.5 Bran (“tahop”) | | | | |
| E.5 Output time (h) | | | | |
| E.6 Output capacity (t/h) | | | | |
| E.7 Milling time (h) | | | | |
| E.8 Milling capacity (t/h) | | | | |
| E.9 Total milling recovery | | | | |
| E.9.1 Main product recovery (%) | | | | |
| E.9.2 By-product recovery (%) | | | | |
| E.10 Speed of components (rpm) | | | | |
| E.10.1 Primemover | | | | |
| E.10.1.1 Without load | | | | |
| E.10.1.2 With load | | | | |
| E.10.2 Degerminator shaft | | | | |
| E.10.2.1 Without load | | | | |
| E.10.2.2 With load | | | | |
| E.10.3 Aspirator shaft | | | | |
| E.10.3.1 Without load | | | | |
| E.10.3.2 With load | | | | |
| E.10.4 Roller #1 shaft | | | | |
| E.10.4.1 Without load | | | | |
| E.10.4.2 With load | | | | |
| E.10.5 Roller #2 shaft | | | | |
| E.10.5.1 Without load | | | | |

| ITEMS | Trial 1 | Trial 2 | Trial 3 | AVE. |
|---------------------------------|---------|---------|---------|------|
| E.10.5.2 With load | | | | |
| E.10.6 Oscillating screen shaft | | | | |
| E.10.6.1 Without load | | | | |
| E.10.6.2 With load | | | | |
| E.11 Noise level [db(A)] | | | | |
| E.11.1 Operator | | | | |
| E.11.1.1 Without load | | | | |
| E.11.1.2 With load | | | | |
| E.11.2 Bagger | | | | |
| E.11.2.1 Without load | | | | |
| E.11.2.2 With load | | | | |
| E.12 Power consumption | | | | |
| E.12.1 Power (kW) | | | | |
| E.12.1.1 Without load | | | | |
| E.12.1.2 With load | | | | |
| E.12.2 Current (A) | | | | |
| E.12.2.1 Without load | | | | |
| E.12.2.2 With load | | | | |
| E.12.3 Voltage (V) | | | | |
| E.12.3.1 Without load | | | | |
| E.12.3.2 With load | | | | |
| E.13 Fuel consumed (L) | | | | |
| E.14 Fuel consumption (L/h) | | | | |

E.15 Observations:

E.15.1 Ease of loading

E.15.2 Ease of cleaning parts

E.15.3 Ease of adjustments

E.15.4 Ease of collecting output

E.15.5 Safety

E.15.6 Labor requirements

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

E.15.8 Others

Annex F

Laboratory Analysis

F.1 Purity determination

Take three 500 grams samples from the “representative samples” of the input. Clean the corn kernels to remove the impurities, the clean corn kernel shall be weighed and recorded.

F.2 Moisture content

This shall be taken using a calibrated meter or by oven method. Five samples shall be taken for moisture content determination using a calibrated moisture meter. Using oven method based on ISO 6540:1980, three samples of not less than 100 g each is drawn from the bulk corn kernel sample. The mean value determined from the 100 g samples shall be taken as the moisture content of the corn kernels.

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

Three 100 g samples shall be taken from the output of the degerminator. These samples shall be analyzed to determine the percent degerminated, undegerminated and impurities.

F.4 Analysis of main products

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

F.5 Analysis of by-products

In each test trial, take three 100 g samples from each of the outlet of floured corn, germs and bran. Separate any impurities and take the final weight of the sample.

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

In each test trial, take three 100 g samples from the roller mill output. Using laboratory sieve shaker with sieves of the same sizes (for the main product) with the corn mill, get the weight of the samples that remained on each sieve and determine the percentages of corn grits (main products). Compare the result with the output (main product) of the corn mill.

**Annex G
Laboratory Test Data Sheet**

Machine Tested: _____
 Analyzed by: _____

G.1 Moisture Content Determination

G.1.1 Using calibrated moisture meter

_____ Average _____

G.1.2 Oven method (100 g sample)

Final weight (g) _____ Average _____

Moisture content (%) _____ Average _____

G.2 Purity determination (500 g sample)

Final weight (g) _____ Average _____

Purity (%) _____ Average _____

G.3 Analysis of output from degerminator

| | Trial 1 | Trial 2 | Trial 3 | Ave |
|---|---------|---------|---------|-----|
| A Initial weight of sample (g) | | | | |
| B Weight of degerminated corn kernels (g) | | | | |
| C Weight of undegerminated corn kernels (g) | | | | |
| D Weight of impurities (g) | | | | |

G.4 Analysis of output from roller mill (using Laboratory Sieve Shaker)

| | Trial 1 | Trial 2 | Trial 3 | Average |
|--------------------------|---------|---------|---------|---------|
| a Grit # 10 | | | | |
| i Wt. of size #10 grits | _____ | _____ | _____ | _____ |
| ii Percentage weight | _____ | _____ | _____ | _____ |
| b Grit # 12 | | | | |
| i Wt. of size # 12 grits | _____ | _____ | _____ | _____ |
| ii Percentage weight | _____ | _____ | _____ | _____ |
| c Grit # 14 | | | | |
| i Wt. of size #14 grits | _____ | _____ | _____ | _____ |
| ii Percentage weight | _____ | _____ | _____ | _____ |
| d Grit # 16 | | | | |
| i Wt. of size # 16 grits | _____ | _____ | _____ | _____ |
| ii Percentage weight | _____ | _____ | _____ | _____ |
| e Grit # 18 | | | | |
| i Wt. of size # 18 grits | _____ | _____ | _____ | _____ |
| ii Percentage weight | _____ | _____ | _____ | _____ |

G.5 Analysis of main products (using Laboratory Sieve Shaker)

| | Trial 1 | Trial 2 | Trial 3 | Average |
|-------------------------------|----------------|----------------|----------------|----------------|
| a Grit # 10 | _____ | _____ | _____ | _____ |
| i Wt. of size #10 grits | _____ | _____ | _____ | _____ |
| ii Wt. of other size of grits | _____ | _____ | _____ | _____ |
| b Grit # 12 | _____ | _____ | _____ | _____ |
| i Wt. of size # 12 grits | _____ | _____ | _____ | _____ |
| ii Wt. of other size of grits | _____ | _____ | _____ | _____ |
| c Grit # 14 | _____ | _____ | _____ | _____ |
| i Wt. of size #14 grits | _____ | _____ | _____ | _____ |
| ii Wt. of other size of grits | _____ | _____ | _____ | _____ |
| d Grit # 16 | _____ | _____ | _____ | _____ |
| i Wt. of size # 16 grits | _____ | _____ | _____ | _____ |
| ii Wt. of other size of grits | _____ | _____ | _____ | _____ |
| e Grit # 18 | _____ | _____ | _____ | _____ |
| i Wt. of size # 18 grits | _____ | _____ | _____ | _____ |
| ii Wt. of other size of grits | _____ | _____ | _____ | _____ |

G.6 Analysis of by-products

| | Trial 1 | Trial 2 | Trial 3 | Average |
|-----------------------------------|----------------|----------------|----------------|----------------|
| G.6.1 Floured corn (100 g) | | | | |
| a Final weight of sample (g) | _____ | _____ | _____ | _____ |
| b Weight of impurities (g) | _____ | _____ | _____ | _____ |
| G.6.2 Germs (100 g) | | | | |
| a Final weight of sample (g) | _____ | _____ | _____ | _____ |
| b Weight of impurities (g) | _____ | _____ | _____ | _____ |
| G.6.3 Bran (100 g) | | | | |
| a Final weight of sample (g) | _____ | _____ | _____ | _____ |
| b Weight of impurities (g) | _____ | _____ | _____ | _____ |

Annex H
Formula Used During Calculations and Testing

H.1 Input capacity, C_i (kg/h)

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

H.2 Output capacity, C_o (kg/h)

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

H.3 Milling capacity, C_m (kg/h)

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

H.4 Main product recovery, R_m (%)

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

H.5 By-product recovery, R_b (%)

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

H.6 Losses, L (%)

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

H.7 Fuel/Electrical Consumption**H.7.1 Fuel consumption, F_c (L/h)**

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

H.7.2 Electrical energy consumption, E_c (kW-h)

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