

## **Foreword**

The pursuance of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) with support 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:

Ibarra E. Cruz. “A Study and Evaluation of a Small-capacity oil expeller”. 1980

Product Quality Control & Research Division. Laboratory Manual. Philippine Coconut Authority. 2005

United Nations Industrial Development Organization and Asian & Pacific Coconut Community. “Introduction to Mechanical and Solvent Extraction of Coconut Oil.

Intermediate Technology Development Group. “Principles of Oil Extraction”.  
<http://www.itdg.org>

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**Agricultural Machinery – Coconut Oil Expeller – Methods of Test**

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**1 Scope**

This standard specifies the methods of test and inspection for coconut oil expeller used for extracting oil from copra. Specifically, it shall be used to:

- 1.1** verify the mechanism, dimensions, materials, accessories of the coconut oil expeller 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 products of extraction through laboratory analysis; and
- 1.5** report the results of the tests.

**2 References**

The following normative documents contain provisions, which through reference in this text constitute provisions of these standards:

PAES 103:2000 Agricultural Machinery – Method of Sampling

PAES 230:2005 Agricultural Machinery – Coconut Oil Expeller - Specifications

**3 Definitions**

For the purpose of this standard, the definitions given in PAES 230 and the following shall apply

**3.1 desiccators**

container where oven-dried samples are cooled without affecting its moisture content

**3.2 crude oil production rate**

quantity of crude oil that the expeller can extract per unit of time, expressed in kilogram per hour

### 3.3

#### **overall height**

distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the oil expeller

NOTE All parts of the oil expeller projecting upwards are contained between these two planes.

### 3.4

#### **overall length**

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

NOTE All parts of the oil expeller, 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.

### 3.5

#### **overall width**

distance between the vertical planes parallel to the median plane of the oil expeller, each plane touching the outermost point of the oil expeller on its respective side

NOTE All parts of the oil expeller projecting laterally are contained between these two planes.

### 3.6

#### **purity**

amount of input test material free of foreign matter expressed as percentage of the total weight of the sample

### 3.7

#### **running-in period**

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

### 3.8

#### **wet copra meal**

copra residue that pass through the expeller barrel together with the crude oil but is filtered by the perforated screen placed at the entrance of the crude oil chute

## **4 General Conditions for Test and Inspection**

### **4.1 Selection of Oil expeller to be tested**

Machine 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 oil expeller 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 oil expeller shall be tested as installed for normal operation. The site should have ample provisions for material 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 coconut oil expeller test is shown in Annex A.

### **4.6 Test material**

Test materials to be used shall be copra with the following characteristics:

#### **4.6.1 Test material characteristics**

- |                                 |   |  |
|---------------------------------|---|--|
| <b>4.6.1.1</b> Variety          | : | locally grown (as much as possible single variety) |
| <b>4.6.1.2</b> Moisture Content | : | 8%, maximum  |
| <b>4.6.1.3</b> Purity           | : | 98 %, minimum                                      |
| <b>4.6.1.4</b> Condition        | : | hammermilled                                       |

#### **4.6.2 Quantity to be supplied**

The amount of test material to be supplied shall be at least 75% of input capacity (kg/h) of the oil expeller.

### **4.7 Running-in and preliminary adjustment**

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

### **4.8 Termination of test**

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

## **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, dimensions, materials and accessories of the oil expeller in comparison with the list of manufacturer's technical data and information.

**5.1.2** 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 moisture content and purity 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** Operation of the oil expeller

The oil expeller shall be operated at the recommended settings of the manufacturer. After the test run, the expeller area shall be cleaned and then prepared for the next test trial. This procedure shall be repeated for the succeeding test trials.

**5.2.5** Test trial

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

**5.2.6** Data collection

**5.2.6.1** Duration of test

The duration of each test trial shall start with the extraction of oil from the test materials in the extraction chamber and ends after the last discharge from the copra meal output chute comes out and shall be recorded as operating time.

**5.2.6.2** Temperature of the expeller barrel

The temperature at the entrance and exit of the expeller barrel shall be measured using a multi-point temperature recorder.

**5.3.6.3** Noise level

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

#### **5.2.6.4 Speed of components**

The speed of the rotating shafts of the major components of the oil expeller shall be taken using a tachometer.

**NOTE** Measurements shall be taken with and without load for sub-clauses 5.2.6.3 and 5.2.6.4.

#### **5.2.6.5 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 as the primemover, a power meter shall be used to measure electric energy consumption.

### **5.2.7 Sampling and sample handling**

#### **5.2.7.1 Sampling for test materials**

The conditions of the test materials such as moisture content and purity shall be taken using three “representative samples” each weighing 1 kg which represents the different conditions of test materials in the bulk. This is done by randomly taking samples from the bulk. Half (500g) of the 1 kg 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.

#### **5.2.7.2 Sampling from output chute**

During each test trial, three samples of copra meal and extracted crude oil, each weighing 100g shall be randomly collected from the output chute of the oil expeller to be analyzed in the laboratory. Half (50 g) of the 100 g sample shall be used for laboratory analysis and the other half (50 g) shall be used for reference purposes or for an eventual second check in case of review.

#### **5.2.7.3 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 (desiccators).

#### **5.2.7.4 Data recording and observations**

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

## **6 Laboratory Analysis**

Laboratory analysis shall be made to determine the purity, moisture content and oil content of the input and output materials. The laboratory test data sheet to be used is given in Annex D.

## **6.1 Purity determination**

Take three 500-g samples from the “representative samples” of the input. Clean the samples to remove the impurities, weigh and record.

### **6.2.1 Moisture content**

Moisture content of the copra and copra meal shall be measured using oven method.

**6.2.1** Weigh three 5 grams each of finely ground samples and place it into the moisture can.

**6.2.2** Place the moisture can in the oven and dry at 100°C-105°C for four hours.

**6.2.3** Remove from the oven, cool in desiccators to room temperature and weigh.

**6.2.4** Calculate the moisture content of the copra and copra meal using the formula given in Annex E.

## **6.3 Oil content**

**6.3.1** Determination of the oil content of copra

**6.3.1.1** Weigh previously dried filter paper. Record the weight as  $W_1$ .

**6.3.1.2** Weigh about 5 grams of copra sample in the previously dried filter paper and record its weight as  $W_2$ .

**6.3.1.3** Tie the sample tightly with a string to avoid spillage during the solvent extraction process.

**6.3.1.4** Extract with petroleum ether in an extraction apparatus for 5 hours.

**6.3.1.5** Remove the sample and air dry then oven-dry at 105°C for 10 to 15 minutes.

**6.3.1.6** Grind the sample in a mortar and pestle careful of no sample loss during the grinding and transfer back to filter paper.

**6.3.1.7** Extract the sample once again with petroleum ether for another 5 hours.

**6.3.1.8** Remove the sample, air-dry in the oven for 3 hours at 105°C.

**6.3.1.9** Cool the sample in the desiccators for 30 minutes and weigh. Record the weight as  $W_3$ .

**6.3.1.10** Determine the moisture content of the sample from the same batch of sample used for oil analysis.

**6.3.1.10** Calculate the oil content using the formula given in Annex E

.



### 6.3.2 Determination of the oil content of copra meal

6.3.2.1 Weigh previously dried filter paper. Record the weight as  $W_1$ .

6.3.2.2 Weigh about 5 grams of copra sample in the previously dried filter paper and record its weight as  $W_2$ .

6.3.2.3 Tie the sample tightly with a string to avoid spillage during the solvent extraction process.

6.3.2.4 Extract with petroleum ether in an extraction apparatus for 5 hours.

6.3.2.5 Remove the sample and air dry then oven-dry at 105°C.

6.3.2.6 Cool the sample in the desiccators for 30 minutes and weigh. Record the weight as  $W_3$ .

6.3.2.7 Determine the moisture content of the sample from the same batch of sample used for oil analysis.

6.3.2.7 Calculate the oil content using the formula given in Annex E.

6.3.3 Calculate the extraction efficiency and extraction loss using the formula given in Annex E.

## 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

8.3 Purpose and Scope of Test

8.4 Methods of Test

8.5 Description of the Machine

Table 1 – Machine Specifications

8.6 Results and Discussions

**8.7** Observations (include pictures)

Table 2 –Performance test data

**8.8** Names, signatures and designation of test engineers

**Annex A**  
(informative)

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

<b>A.1</b>	<b>Equipment</b>	<b>Quantity</b>
<b>A.1.1</b>	<b>Field</b>	
<b>A.1.1.1</b>	Thermocouple wire	1
<b>A.1.1.2</b>	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
<b>A.1.1.3</b>	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
<b>A.1.1.4</b>	Tape measure (with maximum length of 5m)	1
<b>A.1.1.5</b>	Noise level meter Range: 30 dB (A) to 130 dB (A)	1
<b>A.1.1.6</b>	Weighing scale (capacity: 100 kg) Scale divisions: 500 g	1
<b>A.1.1.7</b>	Graduated cylinder (for engines) (500 mL capacity) or Watt-hour meter (for electric motors) 60 Hz, 220 V	1
<b>A.1.1.8</b>	Camera	1
<b>A.1.2</b>	<b>Laboratory</b>	
<b>A.1.2.1</b>	Weighing scale (Sensitivity: 0.1 g)	1
<b>A.1.2.2</b>	Extraction Apparatus	1
<b>A.1.3</b>	Hot Plate	1
<b>A.1.4</b>	Porcelain Mortar and Pestle	1
<b>A.1.4</b>	Drying oven	1
<b>A.1.5</b>	Desiccators	1
<b>A.2</b>	<b>Materials</b>	
<b>A.2.1</b>	Pale for extracted oil and copra meal	2
<b>A.2.2</b>	Labeling tags which include	20
<b>A.2.2.1</b>	Date of test	
<b>A.2.2.2</b>	Oil Expeller on test	
<b>A.2.2.3</b>	Sample source	
<b>A.2.2.4</b>	Variety	
<b>A.2.2.5</b>	Trial number	
<b>A.2.3</b>	Aluminum or tinned metal dishes	6
<b>A.2.4</b>	Water Bath	1
<b>A.2.5</b>	Whatman Filter Paper No.2 Sizes 12.5 cm and 15 cm	6
<b>A.2.6</b>	Absorbent Cotton	
<b>A.2.7</b>	Petroleum ether or Hexane	

**Annex B**  
(informative)

**Specifications of Oil Expeller**

Name of Applicant/ Distributor: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

Name of Manufacturer: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

**GENERAL INFORMATION**

Make: \_\_\_\_\_ Type: \_\_\_\_\_

Serial No: \_\_\_\_\_ Brand/Model: \_\_\_\_\_

Production date of Oil expeller 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
<b>B.1</b> Main structure		
<b>B.1.1</b> Overall dimensions, mm		
<b>B.1.1.1</b> length		
<b>B.1.1.2</b> width		
<b>B.1.1.3</b> height		
<b>B.1.2</b> Weight, without engine (kg), if applicable		
<b>B.2</b> Hopper		
<b>B.2.1</b> Height from the ground, mm		
<b>B.2.2</b> Location		
<b>B.3</b> Power Transmission		
<b>B.3.1</b> Pulley		
<b>B.3.1.1</b> Primemover		
<b>B.3.1.1.1</b> Type		
<b>B.3.1.1.2</b> Dimension, mm		
<b>B.3.1.2</b> Speed Reducer Input Shaft		
<b>B.3.1.2.1</b> Type		
<b>B.3.1.2.2</b> Dimension, mm		
<b>B.3.2</b> Sprocket		
<b>B.3.2.1</b> Speed Reducer Output Shaft		
<b>B.3.2.1.1</b> Diameter, mm		
<b>B.3.2.1.2</b> No. of teeth		
<b>B.3.2.2</b> Extractor Shaft		
<b>B.3.2.2.1</b> Diameter, mm		
<b>B.3.2.2.2</b> No. of teeth		
<b>B.4</b> Extraction chamber		
<b>B.4.1</b> Extractor Shaft		

ITEMS	Manufacturer's Specification	Verification by the Testing agency
<b>B.4.1.1</b> Type		
<b>B.4.1.2</b> Length, mm		
<b>B.4.1.3</b> Outer diameter, mm		
<b>B.4.1.4</b> Pitch, mm		
<b>B.4.1.5</b> Material		
<b>B.4.2</b> Barrel (cage)		
<b>B.4.2.1</b> Inside diameter		
<b>B.4.2.2</b> No. of bars		
<b>B.4.2.3</b> Spacing of the bars		
<b>B.4.2.4</b> Bar thickness		
<b>B.5</b> Main Frame		
<b>B.5.1</b> Material		
<b>B.6</b> Prime mover		
<b>B.6.1</b> Electric motor		
<b>B.6.1.1</b> Brand		
<b>B.6.1.2</b> Make or manufacturer		
<b>B.6.1.3</b> Serial No.		
<b>B.6.1.4</b> Type		
<b>B.6.1.5</b> Rated Power, kW		
<b>B.6.1.6</b> Rated Speed, rpm		
<b>B.6.1.7</b> Frequency, Hz		
<b>B.6.1.8</b> Voltage		
<b>B.6.2</b> Engine		
<b>B.6.2.1</b> Brand		
<b>B.6.2.2</b> Model		
<b>B.6.2.3</b> Make or manufacturer		
<b>B.6.2.4</b> Serial No.		
<b>B.6.2.5</b> Type		
<b>B.6.2.6</b> Rated Power, kW		
<b>B.6.2.7</b> Rated Speed, rpm		
<b>B.6.2.8</b> Displacement (cm <sup>3</sup> )		
<b>B.6.2.9</b> Cooling system		
<b>B.6.2.10</b> Starting system		

**Annex C**  
(informative)

**Performance Test Data Sheet**

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

<b>C.1 Information on the Test Materials</b>					
<b>C.1.1</b>	Crop				
<b>C.1.2</b>	Source				
<b>C.1.3</b>	Condition				
<b>C.1.4</b>	Moisture content, %				
<b>C.2 Result of Performance Test (First Extraction)</b>					
<b>ITEMS</b>		<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Ave.</b>
<b>C.2.1</b>	Speed of Components, rpm				
<b>C.2.1.1</b>	Electric Motor				
<b>C.2.1.1.1</b>	Without load				
<b>C.2.1.1.2</b>	With load				
<b>C.2.1.2</b>	Reducer Shaft				
<b>C.2.1.2.1</b>	Without load				
<b>C.2.1.2.2</b>	With load				
<b>C.2.1.3</b>	Extractor Shaft				
<b>C.2.1.3.1</b>	Without load				
<b>C.2.1.3.2</b>	With load				
<b>C.2.2</b>	Noise Level, dB(A)				
<b>C.2.2.1</b>	Without load				
<b>C.2.2.2</b>	With load				
<b>C.2.3</b>	Power Consumption				
<b>C.2.3.1</b>	Power, kW				
<b>C.2.3.1.1</b>	Without load				
<b>C.2.3.1.2</b>	With load				
<b>C.2.3.2</b>	Voltage, V				
<b>C.2.3.2.1</b>	Without load				
<b>C.2.3.2.2</b>	With load				
<b>C.2.3.3</b>	Current, A				
<b>C.2.3.3.1</b>	Without load				
<b>C.2.3.3.2</b>	With load				
<b>C.2.4</b>	Fuel consumption				
<b>C.2.4.1</b>	Fuel time, h				
<b>C.2.4.2</b>	Fuel consumed, L				
<b>C.2.5</b>	Copra milled, kg				
<b>C.2.6</b>	Crude oil recovered, kg				
<b>C.2.7</b>	% Crude oil recovery				
<b>C.2.8</b>	Copra meal recovered, kg				

<b>C.2.9</b>	% Copra meal recovery				
<b>C.2.10</b>	Wet copra meal recovered, kg				
<b>C.2.11</b>	% Wet copra meal				
<b>C.2.12</b>	Extraction Loss, kg				
<b>C.2.13</b>	% Extraction Loss				
<b>C.2.14</b>	Operating time, h				
<b>C.2.15</b>	Input capacity, kg/h				
<b>C.2.16</b>	Crude oil production rate, kg/h				
<b>C.2.17</b>	Extraction efficiency, %				
<b>C.2.18</b>	Expeller Temp				
<b>C.2.18.1</b>	Maximum °C				
<b>C.2.18.2</b>	Average °C				
<b>C.3</b>	Result of Performance Test (Second Extraction)				
	<b>ITEMS</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Ave.</b>
<b>C.3.1</b>	Speed of Components, rpm				
<b>C.3.1.1</b>	Electric Motor				
<b>C.3.1.1.1</b>	Without load				
<b>C.3.1.1.2</b>	With load				
<b>C.3.1.2</b>	Reducer Shaft				
<b>C.3.1.2.1</b>	Without load				
<b>C.3.1.2.2</b>	With load				
<b>C.3.1.3</b>	Extractor Shaft				
<b>C.3.1.3.1</b>	Without load				
<b>C.3.1.3.2</b>	With load				
<b>C.3.2</b>	Noise Level, dB(A)				
<b>C.3.2.1</b>	Without load				
<b>C.3.2.2</b>	With load				
<b>C.3.3</b>	Power Consumption				
<b>C.3.3.1</b>	Power, kW				
<b>C.3.3.1.1</b>	Without load				
<b>C.3.3.1.2</b>	With load				
<b>C.3.3.2</b>	Voltage, V				
<b>C.3.3.2.1</b>	Without load				
<b>C.3.3.2.2</b>	With load				
<b>C.3.3.3</b>	Current, A				
<b>C.3.3.3.1</b>	Without load				
<b>C.3.3.3.2</b>	With load				
<b>C.3.4</b>	Fuel consumption				
<b>C.3.4.1</b>	Fuel time, h				
<b>C.3.4.2</b>	Fuel consumed, L				
<b>C.3.5</b>	Copra meal milled, kg				
<b>C.3.6</b>	Crude oil recovered, kg				
<b>C.3.7</b>	Crude oil recovery. %				
<b>C.3.8</b>	Copra meal recovered, kg				
<b>C.3.9</b>	Copra meal recovery, %				
<b>C.3.10</b>	Wet copra meal recovered, kg				
<b>C.3.11</b>	Wet copra meal recovery, %				
<b>C.3.12</b>	Extraction Loss, kg				

<b>C.3.13</b>	% Extraction Loss	
<b>C.3.14</b>	Operating time, h	
<b>C.3.15</b>	Input capacity, kg/h	
<b>C.3.16</b>	Crude oil production rate, kg/h	
<b>C.3.17</b>	Extraction efficiency, %	
<b>C.3.20</b>	Expeller Temp	
<b>C.3.20.1</b>	Maximum °C	
<b>C.3.20.2</b>	Average °C	

**C.4 Rate the following observations:**

Items	Rating*				
	1	2	3	4	5
<b>C.4.1</b> Ease of loading					
<b>C.4.2</b> Ease of cleaning parts					
<b>C.4.3</b> Ease of adjusting and repair of parts					
<b>C.4.4</b> Ease of collecting output					
<b>C.4.5</b> Ease of transporting the machine					
<b>C.4.6</b> Safety					
<b>C.4.7</b> Vibration					

- \*1 – Very good
- 2 - Good
- 3 - Satisfactory
- 4 - Poor
- 5 – Very poor

**C.5 Other Observations:**

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**Annex D**  
(informative)

**Laboratory Test Data Sheet**

Machine Tested: \_\_\_\_\_

Analyzed by: \_\_\_\_\_

**D.1 Moisture Content (MC) Determination**

Sample material	W <sub>i</sub> (kg)				W <sub>f</sub> (kg)				% MC			
	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Aver	Trial 1	Trial 2	Trial 3	Ave
Copra												
Copra meal from first pass												
Extracted oil from first pass												
Copra cake from second pass												
Extracted oil from second pass												

**D.2 Oil Content (OC) Determination**

Sample material	W <sub>i</sub> (kg)				W <sub>f</sub> (kg)				% OC			
	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Aver	Trial 1	Trial 2	Trial 3	Ave
Copra												
Copra meal from first pass												
Copra cake from second pass												

**Annex E**  
(informative)

**Formula Used During Calculations and Testing**

**E.1 Input Capacity**

$$C_i = \frac{W_i}{T_i}$$

Where:

$C_i$	=	Input Capacity, kg/h
$W_i$	=	Weight of input material, kg
$T_i$	=	Time required to empty the hopper of the input material, h

**E.2 Moisture content**

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

Where:

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

**E.3 Purity**

$$P = \frac{W_f}{W_i} \times 100$$

Where:

$W_f$	=	Final weight of the sample, g
$W_i$	=	Initial weight of the sample, g

**E.4 Oil content**

$$\% \text{ Oil (as received)} = \frac{(W_2 - W_3) \times 100}{W_2 - W_1} - \% \text{ MC}$$

Where:

$W_1$	=	Weight of the dried filter paper, g
$W_2$	=	Initial weight of the sample + mass of the dried filter paper, g
$W_3$	=	Final weight of the desiccators-cooled sample, g

**E.5 Crude oil recovery,  $R_o$  (%)**

$$R_o = \frac{W_o}{W_i} \times 100$$

Where:

$R_o$	=	Crude oil recovery, %
$W_o$	=	Weight of crude oil collected, kg
$W_i$	=	Weight of input, kg

**E.6 Copra meal/wet copra meal recovery**

$$M_r = \frac{W_m}{W_i} \times 100$$

Where:

$M_r$	=	Copra meal recovery, %
$W_m$	=	Weight of meal collected, kg
$W_i$	=	Weight of input, kg

**E.7 Crude oil production rate**

$$P_r = \frac{W_o}{T_T}$$

Where:

$P_r$	=	Crude oil production rate, kg/h
$W_o$	=	Weight of crude oil collected, kg
$T_t$	=	Total time

**E.8 Extraction efficiency**

$$Eff = \frac{\text{wt. of oil collected, kg}}{\text{wt of the oil content of the copra, kg}} \times 100$$

**E.9 Extraction Losses**

$$Losses = 1 - \frac{\text{wt. of oil collected}}{\text{wt. of oil content}}$$

## E.10 Fuel/Electrical energy consumption

### E.10.1 Electrical energy consumption

$$E_c = \frac{P_c T_o}{W_o}$$

Where

$E_c$	=	Electrical energy consumption, kW-h/kg
$P_c$	=	Power consumed, kW
$T_o$	=	Time of operation, h

### E.10.2 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