PHILIPPINE NATIONAL STANDARDS FOR RICE AND CORN COMBINE HARVESTER
PNS/PAES 224:2015 - Agricultural Machinery - Rice Combine Harvester - Specifications

PNS/PAES 225:2015 - Agricultural Machinery - Rice Combine Harvester - Methods of Test
PNS/PAES 241:2018 - Agricultural Machinery - Corn Combine Harvester - Specifications

PNS/PAES 242:2018 - Agricultural Machinery - Corn Combine Harvester - Methods of Test
1. Scope
This standard specifies the methods of test and inspection for rice combine harvester. Specifically, it shall be used to:

1.1 verify the mechanism, main dimensions, weight, materials and accessories of the rice combine harvester, and the list of specifications submitted by the manufacturer/supplier/dealer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features;

1.4 determine the effect of harvesting on grain quality through laboratory analysis and;

1.5 prepare a report on the results of the tests.

2 Reference
The following normative documents contain provisions, which, through reference in this text, constitute provisions of this National Standard:


PNS/PAES 103:2000 Agricultural Machinery – Method of Sampling

PNS/PAES 205:2015 Agricultural Machinery – Mechanical Rice Thresher – Methods of Test

PNS/PAES 212:2015 Agricultural Machinery – Rice Reaper – Methods of Test

Specifications

Definition:
Corn Combine Harvester - machine which performs a combination of harvesting, dehusking, shelling, separating, cleaning, and conveying kernels into a holding bin.
Specifications

Classifications:
Types of Traction
1. Wheel Type
2. Track Type (Crawler)
3. Half-Track Type
Classifications:
Types of Unloading
1. Bulk Unloading
2. Manual Unloading
Specifications

Classifications:
Typical Corn Combine Harvester
Specifications

Classifications:
Modified Corn Combine Harvester
Specifications

Common Parts and Components:
Specifications

General Fabrication Requirements:
1. Steel bars and metal sheets shall be generally used for the fabrication of corn combine harvester.

2. Reel assembly, and pick-up tines shall be made of either stainless steel, steel alloys, or any abrasion-resistant coated materials.
Specifications

**General Fabrication Requirements:**

3. The serrated edge of the cutting knife shall be case hardened at Rockwell C Scale (RC) 46 to RC 52 for AISI 1080 to AISI 1085.

4. The non-hardened portion of the cutting knife shall have hardness within RC 25 to RC 27.
Specifications

General Fabrication Requirements:

5. Bolts and nuts, screws, bearings, bushing and seals shall conform to the food safety requirements, PAES or other international standards.
Specifications

**Header or Feed Table Requirements:**

1. The header should be composed of reel assembly, fluted rollers, and cutter bar.

2. The reel shall be adjustable vertically to suit different corn stalk height.

3. The header shall be adjustable vertically to fit various height of cut.
Specifications

Feeding Unit Requirements:

1. The feeding unit should be composed of feeder or conveyor and front beater or corn ear elevator.

2. There should be a reverse mechanism.
Specifications

Shelling Unit Requirements:

1. The shelling unit should be composed of shelling drum, concaves, open grates, and beaters or stripper drums.

2. Concaves should be adjustable to change the clearance between the concave and the cylinder.
Specifications

Separating Unit Requirements:

1. The separating unit shall be provided with deflectors, rotary beaters to regulate the movement of the cob and to deflect flying kernels.
Specifications

Cleaning Unit Requirements:

1. The cleaning operation shall be mechanical using screens and blowers.

2. The cleaning unit should consist of kernel pan, chaffer with adjustable openings, tailings auger, sieves with adjustable position and inclination, and adjustable blower.
Specifications

Cob/Stalk Handling Unit Requirements:

1. The cob/stalk handling unit should be composed of stalk spreader, chaffs spreader, and plain cob ejector or beater.
Specifications

Kernel Handling Unit Requirements:
1. The kernel handling unit should be composed of auger, kernel conveyor, and collector or tank.

2. The tank shall minimize the bridging of kernels.

3. Steps and handrails for the collector tank shall be provided.
Specifications

Operator’s Seat Requirements:

1. The operator’s seat and control locations relative to the Seat Index Point (SIP) shall conform to PAES 139:2004.

2. The seat cover should be heat insulated.

3. Protective guards/screens located at the front of the operator and side of the header shall be provided.
Specifications

Safety, Workmanship, and Finish:
1. Safety requirements shall conform to ISO 4254-7. Warning notices shall be provided in accordance with PAES 101:2000.
2. Corn combine harvester shall be fitted with slow-moving vehicle (SMV) emblem at the rear.
3. Head and tail lights shall be provided.
4. The noise level should conform with the Occupational Safety and Health Standard (Rule 1074.01 - 1074.03).
5. Ear protective device shall be provided if 95 dB(A) is exceeded during operation.

<table>
<thead>
<tr>
<th>Duration per day, hours</th>
<th>Sound levels, dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1½</td>
<td>102</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>½</td>
<td>110</td>
</tr>
<tr>
<td>¼</td>
<td>115</td>
</tr>
</tbody>
</table>
Specifications

Safety, Workmanship, and Finish:

6. The machine shall be free from manufacturing defects.
7. Any metallic surfaces shall be free from rust.
8. Picking section shall be coated with anti-corrosive paint.
9. The machine shall be free from sharp edges and surfaces that may injure the operator (except cutting blades)
10. Rotating parts shall be dynamically balanced.
11. All moving parts shall be provided with safety features in accordance with PAES 101:2000.
## Specifications

### Performance Requirements

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Performance Data</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting Loss (%), maximum</td>
<td>3.0</td>
<td>Kernels left in the test area after harvesting over input kernels</td>
</tr>
<tr>
<td>Separation Loss (%), maximum</td>
<td>1.5</td>
<td>Shelled kernels from the cob and husk output over input kernels</td>
</tr>
<tr>
<td>Unshelled Loss (%), maximum</td>
<td>0.5</td>
<td>Unshelled kernels from the kernel, husk, and cob output over input kernels</td>
</tr>
<tr>
<td>Purity (%), minimum</td>
<td>97</td>
<td>Weight of cleaned kernels over weight of uncleaned kernels</td>
</tr>
<tr>
<td>Mechanically Damaged Kernel (%), maximum</td>
<td>3.0</td>
<td>Output kernels that were broken and/or scratched due to the corn combine harvester mechanisms</td>
</tr>
<tr>
<td>Net Cracked Kernels (%), maximum</td>
<td>5.0</td>
<td>Cracked kernels due to the corn combine harvester mechanisms</td>
</tr>
<tr>
<td>Total Grain Loss (%), maximum</td>
<td>2.0</td>
<td>Summation of losses (harvesting, separation, and unshelled)</td>
</tr>
</tbody>
</table>
Methods of Test

Definitions:

Effective Field Capacity - actual area covered over total operating time (ha/h)

Theoretical Field Capacity - computed rate of harvesting based on effective width and actual travelling speed (ha/h)

Field Efficiency - effective field capacity over theoretical field capacity (%)

Potential Yield - estimated yield per unit area (tons/ha)

Fuel Consumption - fuel consumption per unit time of operation (L/h)
**Methods of Test**

**Formulas:**

**Effective Field Capacity**

\[ ef_c = \frac{A_T}{T} \]

where:
- \( ef_c \) is the actual field capacity (ha/h)
- \( A_T \) is the area covered during test (ha)
- \( T \) is the total operating time (h)

**Theoretical Field Capacity**

\[ tf_c = \frac{W_S A}{10} \]

where:
- \( tf_c \) is the theoretical field capacity (ha/h)
- \( W \) is the working width (m)
- \( S_A \) is the average operating speed (km/h)

**Field Efficiency**

\[ \varepsilon_f = \frac{ef_c}{tf_c} \times 100 \]

where:
- \( \varepsilon_f \) is the field efficiency (%)
- \( ef_c \) is the effective field capacity (ha/h)
- \( tf_c \) is the theoretical field capacity (ha/h)

**Fuel Consumption**

\[ FC = \frac{F}{T} \]

where:
- \( FC \) is the fuel consumption (L/h)
- \( F \) is the amount of fuel consumed (L)
- \( T \) is the total operating time (h)
Methods of Test

Formulas:

Total Kernel Input

\[ TKI = W_{CS} + L_T \]

where:
- \( TKI \) is the total kernel input (kg)
- \( W_{CS} \) is the weight of cleaned shelled kernels (kg)
- \( L_T \) is the summation of all losses (kg)

Unshelled loss

Amount

\[ US_W = \frac{W_{US}}{D_C} \times T \]

where:
- \( US_W \) is the unshelled loss (kg)
- \( W_{US} \) is the weight of unshelled clean kernel (kg)
- \( D_C \) is the duration of collection (h)
- \( T \) is the total operating time (h)

Percentage

\[ US_p = \frac{US_W}{TKI} \times 100 \]

where:
- \( US_p \) is the unshelled loss (%)
Methods of Test

Formulas:

**Total Grain Loss**

\[ TGL = \frac{L_T}{TKI} \times 100\% \]

where:

- \( L_T \) is the summation of all losses (kg)
- \( TKI \) is the total kernel input (kg)

**Purity**

\[ P = \frac{W_C}{W_U} \times 100\% \]

where:

- \( P \) is the purity (%)
- \( W_U \) is the weight of uncleaned kernel (g)
- \( W_C \) is the weight of cleaned kernel (g)

**Mechanically Damaged or Broken kernels**

\[ B_K = \frac{W_{BK}}{T_W} \times 100\% \]

where:

- \( B_K \) is the mechanically damaged or Broken kernels (%)
- \( W_{BK} \) is the weight of broken kernels (kg)
- \( T_W \) is the total weight of the sample (kg)

**Harvesting Recovery**

\[ HR = \frac{SK}{PY} \times P \times 100\% \]

where:

- \( HR \) is the harvesting recovery (%)
- \( SK \) is the total cleaned shelled kernel (kg)
- \( PY \) is the potential yield (kg)
- \( P \) is the purity

**Cracked kernels**

\[ NC_K = \frac{C_{ME} - C_{MA}}{100 \text{ kernel sample}} \times 100\% \]

where:

- \( NC_K \) is the net cracked kernels (%)
- \( C_{ME} \) is the number of cracked kernels due to mechanical
- \( C_{MA} \) is the number of cracked kernels due to manual shelling
Methods of Test

General Conditions of Test and Inspection:
Selection of corn combine harvester to be tested

The machine to be tested should be in accordance with PAES 103:2000 or any suitable method of selection.

Role of test applicant

The test applicant shall submit a complete machine specifications and operator’s manual of the machine.

Role of the test applicant’s representative

The representative shall only be allowed to operate, demonstrate, adjust, and repair the machine and decide on matters related to the operation of the machine.
Methods of Test

General Conditions of Test and Inspection:

Suspension/Termination of test

1. If the machine stops due to breakdown or malfunction that can affect the machine’s performance, the test may be suspended.

2. If the test area does not conform to the standards and requirements of testing agency.

Test Area Requirements:

- Completely dried
- Enough for 3 test trials
- Each trial area is rectangular, 1000 m², side ratio of 2:1
- Corn plant shall be locally grown
- Corn ear shall be ready for harvesting and at 28% moisture content at maximum
Methods of Test

Test Instruments:
1. Stopwatch
2. Steel Tape and Caliper
3. Long Tape
4. Graduated Cylinder
5. Marking Pegs
6. Upland Penetrometer
7. Sound Level Meter
Methods of Test

Before Performance Test:
1. Running-in and preliminary adjustments of the corn combine harvester
2. Measure the specifications of the machine
3. Take pictures of the machine, area, and corn samples
4. Obtain the machine settings, plant variety, plant population per m², row spacing, and plant maturity
5. Setup the area for each test trial
Methods of Test

Before Performance Test:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Manufacturer's Specifications</th>
<th>Verification by the Testing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.1 Overall dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.1.1 Length, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.1.2 Width, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.1.3 Height, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3 Machine condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3.1 No. of rows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3.2 Harvesting method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3.3 Working width, mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3.4 Harvesting speed, kph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.4 Traction Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.5 Field capacity, ha/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.6 Engine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.6.1 Brand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.6.2 Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.6.3 Serial Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.6.4 Type (stroke/ignition)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.7 Safety Features (enumerate)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Methods of Test

Before Performance Test:

5. Measure soil hardness
6. Measure crop height
7. Randomly select three 3 meter columns with the harvesters effective width
8. Count the number of corn ears within the selected areas
9. Collect test samples from the selected areas by manual harvesting
Methods of Test

During Performance Test:

1. Measure time to travel 20 meters
2. Measure working width
3. Measure noise level 50 mm away from operator and baggers’ ear level
4. Collect samples from the husk and cob outlet three times for 5 seconds each
5. Observe harvesting pattern
6. Determine total operating time
Methods of Test

After Performance Test:

1. Measure fuel consumed
2. Measure height of cut
3. Randomly select three 3 meter column with the harvesters effective width and collect shelled and unshelled kernels
Methods of Test

**Laboratory Test:**
1. Measure kernel moisture content
2. Determine purity of the output kernels
3. Measure separation and unshelled losses from the husk and cob outlet samples
4. Measure harvesting loss
Methods of Test

Laboratory Test:

5. Determine net cracked kernels from 300 sample kernels

6. Determine mechanically damaged kernels from 300 grams sample kernels

7. Determine potential yield from the pre-performance test samples
Test Report

Contents:
1. Title
2. Summary (Performance Requirements)
3. Purpose and Scope of Test
4. Methods of Test
5. Description of the Machine (Specifications)
6. Results
7. Observations
8. Name(s), Signature(s) of Test Engineer(s)
Contact us!

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