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भारतीय मानक मसौदा

बीज/ अनाज प्रसंस्करण मशीनरी — इंडेंटेड सिलेंडर ग्रेडर — परीक्षण संहिता

(*आई एस 12576 का पहला पुनरीक्षण*)

Indian Standard

SEED/GRAIN PROCESSING MACHINERY — INDENTED CYLINDER GRADER — TEST CODE

(*First Revision of IS 12576*)

ICS 65.060

Agriculture and Food Processing Equipment Sectional Committee, FAD 20	Last Date of Comments: **9 March 2024**

FOREWORD

(*Adoption clause will be added later*)

With the modernization of seed processing industry, indented cylinder graders are being increasingly manufactured and used in the country. A need was, therefore, felt for the preparation of this standard to provide uniform guidelines for conducting tests on the grader.

The standard was originally published in 1989. Industries including Small, Micro and Medium Enterprises (MSMEs) manufacturing this equipment is substantial and the numbers are increasing regularly in the country. This revision has been undertaken to incorporate the following modifications keeping in view the technological advancements in the field and the standard has been brought out in the latest style and format of the Indian Standards:

a) The formula used in the calculation of power requirement has been corrected.
b) Clause 4.5 for determination of bulk density, angle of repose and coefficient of friction of seed has been incorporated.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2: 2022 ‘Rules for rounding off numerical values (*second revision*)’.

1 SCOPE

This standard prescribes method for testing of indented cylinder grader used for grain and seed industry.

2 REFERENCES

The Indian Standards given reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated.

IS No.	*Title*
IS 4333 (Part 1): 2018	Methods of analysis for foodgrains: Part 1 Refractions (*third revision*)
IS 4333 (Part 2): 2017/ ISO 712: 2009	Methods of analysis for foodgrains: Part 2 Determination of moisture content (*second revision*)
IS 4333 (Part 3): 2023/ ISO 7971-3: 2019	Methods of Analysis for Foodgrains: Part 3 Determination of Bulk density Called Mass per Hectolitre (Routine Method) (*third revision*)
IS 6663: 1972	Method for determination of angle of repose of grains
IS 8972: 1978	Determination of coefficient of friction of foodgrains

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Foreign Matter — It includes inorganic and organic matter. The inorganic matter shall include sand, gravel, dirt, pebbles, and stones, lumps of earth, mud and iron chips. The organic matter shall include chaff, straw, weed seeds, dead insects, worms and other grains.

3.2 Head Grain — Grain of size three-fourth and above in length of a whole grain shall be called head grain.

NOTE **—** The term grain shall cover seed also and for the purpose of seed processing, head grain will be the grain in whole size.

3.3 Indented Cylinder Grader — A machine which makes the length separation of seeds/grains by either, lifting or rejecting them in pockets or indentations pressed into the side of a cylindrical body which revolves with the seed/grain mass inside the cylinder.

3.4 Large/Big Brokens — Grain kernels of less than three-fourth of the whole grain in length and bigger than medium broken grain shall be called large/big brokens.

3.5 Medium Brokens — Grain kernels of less than one-half of the size of whole grain in length and bigger than small/fine brokens shall be called medium brokens.

3.6 Rated Input Capacity — The maximum feed rate at which the grading efficiency shall be within the specified limit.

3.7 Small/Fine Brokens — Grain kernels of less than one-fourth of the size of whole grain in length shall be called small/fine brokens.

3.8 Total Broken — The sum total of small, medium and large brokens.

4 PRE-TEST OBSERVATIONS

4.1 Determination of Grain Size

4.1.1 Ten number of randomly taken whole grains shall be kept in a straight line lengthwise and total length measured and average length of a grain shall be calculated by dividing total length by 10. An average of three replications should be taken as length of the grain. The length of grains can precisely be measured with the help of vernier caliper or screw gauge.

4.1.2 Ten number of the same grains should be kept in a straight line breadth wise and on the similar line, the average breadth of the grain should be determined. Breadth can be measured with the help of vernier caliper or screw gauge. An average of three replications should be taken as breadth of grain.

4.1.3 Thickness of each of the 10 grains should be measured with the help of vernier calipers or screw gauge and the total should be divided by10 to calculate the average thickness of a grain. Average of three replications should be taken as the thickness of the grain.

4.1.4 The size of the grain (*see* Fig. 1) should be calculated by the following formula:

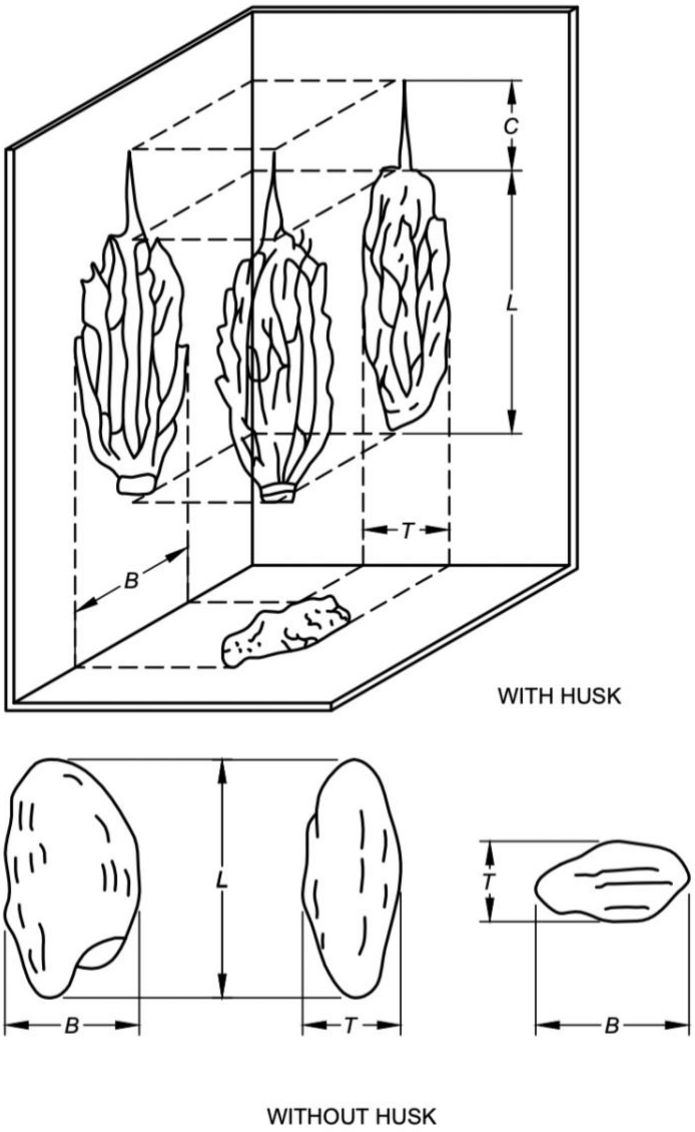
$$\text{Size} = (\text{Length} \times \text{Breadth} \times \text{Thickness})^{1/3}$$

4.2 Determination of Small Medium/Large Brokens and Head Grains

Five representative samples of 10 g each from the grain mass are taken and small/medium/large brokens and head grain are separated by hand picking and percentage fraction shall be calculated.

4.3 Determination of Foreign Matter

The foreign matter present in tile seed mass of the feed shall be determined in accordance with **6.2** of IS 4333 (Part 1).



Where,

L — Length,
B — Breadth,
T — Thickness and
C — Length of Beard

FIG. 1 DIMENSIONS OF RICE KERNEL WITH HUSK AND AFTER MILLING

4.4 Determination of Moisture

The moisture content of the seed mass shall be determined in accordance with IS 4333 (Part 2).

4.5 Bulk density as per IS 4333 (Part 3), angle of repose as per IS 6663 and coefficient of friction as per IS 8972 shall be determined before and after separation in indented cylinder for the commodity to be graded.

5 SELECTION AND SPECIFICATION

5.1 Selection

For commercial test report or for certificate on purpose, the indented cylinder grader shall be selected from the series production by the testing authority. For prototype testing or confidential test, the machine shall be submitted by the manufacturer directly.

5.2 Specification and Other Literature

The manufacturer shall supply all literature, operation manual and specification sheet as given in Annex A duly filled in. The manufacturer shall indicate the type of grains to be handled, maximum input capacity and rated input capacity shall furnish any further information which might be required to carry out the tests.

6 RUNNING-IN AND PRELIMINARYADJUSTMENTS

6.1 The indented cylinder grader shall be installed on level and preferably on hard surface. All the adjustments shall be made in accordance with the manufacturer's recommendations.

6.2 The grader shall be attached with a suitable prime mover preferably with an electric motor of capacity recommended by the manufacturer and auto-voltage stabilizer. An energy meter or some form of transmission dynamometer shall be fitted. The power delivered to the grader may be supplied in the following ways:

a) Directly coupling the prime mover with the main shaft of the grader, and
b) Connecting the prime mover with the help of a flat or V-belt and pulleys with the main shaft of the grader.

NOTE — In case of (a), the power delivered to the grader would be the power output of the prime mover where as in case of (b), the allowances of 6 and 3 percent, respectively may be made.

6.3 The grader shall be run-in without load before commencing the tests. The running-in shall be carried out in accordance with the manufacturer's recommendation. In the absence of any recommendation by the manufacturer, the grader shall be run-in for 30 minutes. During the period of run-in, adjustment for various functional components may be done. All the adjustments done shall be in accordance with the instructions contained in the instruction manual supplied by the manufacturer.

7 GENERAL TESTS

7.1 Checking of Specification

The specifications given by the manufacturer shall be checked and reported in the proforma given in Annex A.

7.2 Checking of Material

The material of construction of various components of the machine shall be reported in the data sheet given in Annex B.

7.3 Visual Observations and Checking of Provision for Adjustments

The observations and adjustments given in the data sheet in Annex C shall be made and reported.

8 TEST AT NO LOAD

8.1 After the running-in is over, the grader shall be run at no load for 30 minutes at the specified speed. During and after no load run, the visual observation of the grader shall not show the following:

a) Presence of any marked vibration during the operation,
b) Presence of undue knocking of rattling sound,
c) Frequent slippage of belts,
d) Any marked unusual wear or slackness in any component, and
e) Any marked rise in bearing temperature.

8.2 Data shall be recorded in accordance with the proforma given in Annex D.

9 TEST AT LOAD

9.1 Test Material

Sufficient quantity of the seed (wheat/paddy) of the same variety already cleaned by air screen seed cleaner shall be taken. The observations given under **4** shall be made.

9.2 Operation and Collection of Data

The grader shall be operated at its specified speed for 30 minutes at a feed rate slightly below the rated input capacity specified by the manufacturer. During the run period, collect the following samples and data:

a) Three sets of samples of graded fractions like brokens and head grain at an interval of 10 minutes at each outlet.
b) The speed of the main shaft and the reading of the energy meter or dynamometer shall be recorded.

9.2.1 At the end of 30 minutes feeding, run the grader for some time so that practically no more material already fed comes out. At the end of the test, collect and weigh the material.

9.2.2 The test given in **9.2** and **9.2.1** shall be repeated for a minimum of three times at various feed rates covering approximately 90, 100 and 110 percent of rated input capacity declare by manufacturer.

NOTE — For the purpose of certification, the test at **9.2** and **9.2.1** shall be conducted at the capacity declared by the manufacturer and test at **9.2.2** need not be conducted.

9.2.3 The data shall be recorded in accordance with Annex E.

9.3 Analysis of Samples

Three samples of different fractions of graded materials obtained at each outlet should be analysed for the following. Record the data in accordance with Annex F:

a) Main grain outlet, for brokens, head grains, and foreign matter.
b) Rejection outlet, for head grains.

9.4 Determination of Grading Efficiency

The grading efficiency shall be calculated by the following formula:

$$D = \frac{E \times (F\text{-}G) \times (E\text{-}F) \times (1\text{-}G)}{F \times (E\text{-}G)^2 \times (1\text{-}G)} \times 100$$

where,

D = grading efficiency in percent,
E = fraction of head grain at main grain outlet,
F = fraction of head grain in feed, and
G = fraction of head grain at rejection outlet.

9.4.1 Record the data in the data sheet as given in Annex G.

9.5 Determination of Power Consumption

The power requirement for each feed rate shall be calculated in accordance with **9.5.1** and **9.5.2.**

9.5.1 In case of prime mover fitted with an energy meter, the readings taken shall be the power consumption for 10 minutes. The power consumption per hour giving due allowance to the type of drive shall be calculated and reported.

9.5.2 In case of prime mover fitted with the dynamometer, the reading taken shall indicate the torque required. The power consumption per hour, giving due allowance to the type of drive (*see* **6.2**), shall be calculated by the following formula:

$$P = \frac{T \times S}{9549.30}$$

Where,

P = power, kW;
T = torque, Nm; and
S = speed, rev/min.

NOTE — For the Purpose of certification, the power consumption at the declared feed rate shall only be calculated.

9.5.3 Record the data in accordance with Annex G.

9.6 Determination of the Rated Input Capacity

Select the feed rate at which the grading efficiency is not less than 85 percent. The capacity in terms of the energy consumed shall be calculated by dividing the capacity by power consumed and shall be expressed in q/kWh. Record the data in Annex G.

NOTE — For the purpose of certification, since the grader has been operated only at declared capacity, it shall be seen whether the grading efficiency is met at the declared capacity or not.

9.7 The observed data and results shall be recorded as per proforma given in Annex G.

10 LONG-RUN TEST

The grader shall be operated for a minimum period of 20 hours at no load. This period should be covered in a maximum of 4 continuous runs. During and after the operation, record the major break-downs, defects developed and repairs made into the data sheet given in Annex H.

ANNEX A
(*Clauses* 5.2 and 7.1)

SPECIFICATION SHEET FOR INDENTED CYLINDER GRADER

A-l GENERAL

a) Make
b) Model
c) Type
d) Year of manufacture
e) Recommended grains for grading

A-2 POWER UNIT

a) Type of prime mover
b) Recommended power, kW
c) Type of drive

A-3 GRAIN FEEDING

a) Method of feeding
b) Location of inlet
c) Height of feeding hopper from ground level in installed condition

A-4 INDENTED CYLINDER

a) Size (length and diameter of cylinder)
b) Cylinder construction
c) Number of indents in one row
d) Number of rows
e) Thickness of sheet
f) Indent diameter
g) Indent depth
h) Distance between two pockets:

1) Across
2) In row

j) Revolution/minute of cylinder
k) Provision of adjustment:

1) Cylinder speed
2) Cylinder slope

A-5 REJECT TROUGH

a) Type
b) Construction
c) Conveyor details
d) Separator details

A-6 FRAME DETAILS

a) Height of indented cylinder centre (from ground level in installed condition)
b) Height of graded grain discharge outlet from ground
c) Height of reject discharge outlet from ground
d) Height of feed hopper from ground level
e) Size of the frame:

1 Length
2 Width

A-7 TRANSPORT ARRANGEMENT

a) Type
b) Number of wheels (in case wheels are not provided, details of an alternative provision shall be given)
c) Size of wheels
d) Wheel bearing
e) Type of towing
f) Wheel tread
g) Wheel base

A-8 TOOLS, ACCESSORIES AND MANUALS PROVIDED

NOTES
1. The items which are not applicable in a particular grader should be crossed while filling.
2. If other items are provided, their details should be filled-in.

ANNEX B
(*Clause* 7.2)

DATA SHEET FOR MATERIAL OF CONSTRUCTION

B-1 DATE OF TEST

B-2 MATERIAL OF CONSTRUCTION

Sl. No.	Component	Material
i)	Frame	
ii)	Indent	
iii)	Conveyor	
iv)	Reject trough	
v)	Feed hopper	
vi)	Main shaft	
vii)	Transmission system	

ANNEX C
(*Clause* 7.3)

DATA SHEET FOR VISUAL OBSERVATIONS AND ADJUSTMENTS

C-1 OBSERVATIONS

a) Adequacy of marking inlet and outlets
b) Adequacy of marking of direction of rotation of cylinder
c) Adequacy of protection of bearings against ingress of dust
d) Adequacy of safety arrangements, specially at moving points
e) Provision for lubrication of moving parts
f) Provision for belt tightening
g) Provision for transportation
h) Provision for easy changing of components requiring frequent replacement
j) Provision for anti-corrosive coatings
k) Tightness of bolts and nuts and other fasteners
m) Other observations

C-2 PROVISION FOR ADJUSTMENT OF

a) Feed rate
b) Cylinder speed
c) Cylinder slope
d) Waste collector inclination

ANNEX D
(*Clause* 8.2)

DATA SHEET FOR TEST AT NO LOAD

D-l SOURCE OF POWER

D-2 TYPE OF DRIVE

D-3 OBSERVATIONS

a) Presence of any marked vibration during operation
b) Presence of undue knocking or rattling sound
c) Frequent Slippage of drive belt
d) Any marked unusual wear or slackness in any component
e) Any marked rise in bearing temperature
f) Other Observations

ANNEX E
(*Clause* 9.2.3)

DATA SHEET FOR TEST AT LOAD

E-1 SOURCE OF POWER

E-2 POWER RATING

E-3 MACHINE DETAIL

a) Cylinder tilt angle
b) Reject-trough adjustment
c) Speed of driving pulley on load
d) Speed of cylinder on load

E-4 GRAIN

a) Type of grain
b) Variety of grain
c) Size of grain
d) Moisture content
e) Foreign matter before feeding

E-5 TEST DATA

Sl. No.	Date	Starting Time	Stopping Time	Duration of Operation	Speed (rev/min)	Feed Rate (q/h)	Power Required (kW)	Fuel Consumption (1/h)	No. of Samples	Quantity (Kg) of Samples from	Total Quantity of Grain

			at Main Grain Outlet (Kg)
	Main Grain Outlet	Rejection Outlet	
	i.		
	ii.		
	iii.		

* The data should be collected for every test conducted on different feed rates.

E-6 OBSERVATIONS

a) Presence of any marked vibration during operation
b) Presence of undue knocking or rattling sound
c) Frequent slippage of belts
d) Smooth running of shafts in their respective bearings
e) Frequent clogging
f) Smooth flowing of material through different components
g) Any marked rise in bearing temperature
h) Any marked wear, deformation and breakdown
j) Frequent loosening of fasteners
k) Other observations, if any

ANNEX F
(*Clause* 9.3)

DATA SHEET FOR ANALYSIS OF SAMPLES

Sl. No.	**Feed Rate**	**Sample Source**	**Sample Mass**	**Mass of**			**Remarks**
				Head Grain	Broken	Foreign Matter	
			g	g	g	g	
		i) From main grain outlet					
		ii) From rejection outlet					

NOTE – For different feed rates, use the same proforma as above.

ANNEX G
(*Clauses* 9.4.1, 9.5.3, 9.6 and 9.7)

DATA SHEET FOR EFFICIENCY, POWER REQUIREMENT AND CAPACITIES

Sl. No.	**Item**	**Test No.**				
		1	2	3	4	etc
i)	Cylinder speed, rev/min					
ii)	Feed rate, q/h					
iii)	Power required, kW					
iv)	Grading efficiency, percent					
v)	Rated input capacity, q/kWh					

ANNEX H
(*Clause* 10)

DATA SHEET FOR LONG-RUN TEST

H-1 Total running time

H-2 Continuous running time

H-3 Breakdowns in grading unit

H-4 Breakdowns in elevation unit

H-5 Breakdowns in body

H-6 Any major repair conducted

H-7 Any other observation