**BUREAU OF INDIAN STANDARDS**

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| भारतीय मानक मसौदा  **प्री-क्लीनर के साथ बाजरा के लिए क्लीनर सह ग्रेडर ⎯ *विशिष्टि***  **और परीक्षण कोड**  *Draft Indian Standard*  **CLEANER CUM GRADER FOR MILLETS WITH PRE-CLEANER ⎯ SPECIFICATION AND TEST CODE**  **ICS No 65.060** |
| Agriculture and Food Processing Equipment Last date of comments: **19 July 2023**  Sectional Committee, FAD 20 |

**FOREWARD**

(*Formal clause will be added later*)

Pre-cleaning and cleaning of seeds/grains is an important post-harvest processing operation which upgrades the quality of seeds /grains and thereby its commercial value. Pre-cleaning, precedes the cleaning to remove the larger size impurities, plant parts, stem stones, mud, etc., which permits the free flow of the produce into the cleaner and helps in achieving higher capacity and effectiveness of cleaning. Manual sieving is the common method of pre-cleaning and cleaning of seeds/grains at the farm level, processing units and grain markets. This process is time consuming and labour intensive, thus expensive. Mechanical means of pre-cleaning and cleaning are fast, precise and economical. Followed by cleaning, the seeds/ grains are graded to further upgrade the commercial value by separation based on size (diameter, length, width, thickness, etc.). Rotary type and vibratory type pre-cleaners attached with aspirator are the common types of pre-cleaners. For further removal of the chaffy seeds / grains and light weight impurities, blower / aspirator is provided. A set of sieves mounted on an oscillating sieve box with provision to fix the sieves of different types of perforations and opening sizes will be used to remove the heavier larger and smaller size impurities as over flow and under flow resulting in a quality produce. Such equipment are manufactured by a number of manufacturers for use as multi-grain type, suitable for many food grains / seeds by making appropriate adjustment and replacing the sieves. With importance gained for the millet crops in our regular dietary habits and as raw materials for the various value added products in the processing industries, exclusive machinery for this crop is a requirement of the day. Also for the quality assurance and performance certification purpose, standards for the specifications and the test code will ensure quality of the machinery manufactured and thus the quality of the process and the produces / products.

In preparation of this standard, assistance has been derived from ………… and have contributed technically.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

This standard specifies material, constructional, performance and other requirements of pre-cleaner (cleaner) cum grader for millet crops. This standard also prescribes method of testing to evaluate the performance and durability of this equipment.

**2 REFERENCES**

The standards listed below contain provisions which, through reference in this text, constitute provisions 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 listed below. In case the standards are to be referred in this clause they are to be listed as follows:

|  |  |
| --- | --- |
| *IS No.* | *Title* |
| IS 210: 2009 | Grey iron castings — Specification (*fifth revision*). |
| IS 277: 2018 | Galvanized steel strips and sheets (plain and corrugated) —  Specification (*seventh revision*). |
| IS 399: 1963 | Classification of commercial timbers and their zonal distribution  (*first revision*) |
| IS 816: 1969 | Code of practice for use of metal arc welding for general construction in mild steel (*first revision*). |
| IS 2405 (Part 1): 2023 | Industrial Sieves — Specification Part 1 Wire Cloth Sieves (*second revision*) |
| IS 2405 (Part 2): 2023 | Industrial Sieves — Specification Part 2 Wire Sieves (*second revision*) |
| IS 2062: 2011 | Hot rolled medium and high tensile structural steel — Specification (*seventh revision*). |
| IS 4333 (Part 2): 2017/  ISO 712: 2009 | Methods of analysis for food grains: Part 2 — Determination of moisture content (*second revision*). |
| IS 5718: 2000 | Agricultural produce processing equipment - seed cleaners — Test code (*second revision*). |
| IS 8440: 2023 | Paddy cleaners — Test code (*first revision*). |

**3 TERMINOLOGY**

For this standard, the following definitions shall apply.

**3.1 Aspirator** — A component of the pre-cleaner / cleaner used for drawing the air through the seed / grain mass to remove the light weight impurities.

**3.2 Blower** — A device to produce air blast by taking the atmospheric air through suction.

**3.3 Broken Grain / Kernel** — Millet grains / kernels which are broken and whose size is less than three-fourth of its original size.

**3.3.1** *Large / Big Brokens* — Millet grains / kernels which are less than 3/4th of its whole grain size but bigger than medium broken.

**3.3.2** *Medium Brokens* — Millet grains / kernels which are less than l/2 of its whole grain size but bigger than small / fine broken.

**3.3.3** *Small / Fine Brokens* — Millet grains / kernels which are less than 1/4th and bigger than l/8th of its size of whole grain.

**3.3.4** *Whole grain / kernel* — Millet grains / kernels of size three-fourth and above in its original size are whole grains / kernels.

**3.3.5** *Total Brokens* — The total of the small, medium and large brokens.

**3.4 Clean Seed / Grain** — The seeds / grains free from foreign matter.

**3.5 Cleaning** — Removal of plant materials, foreign matter, light weight impurities, etc. based on the difference in terminal velocity from the grain mass using blast of air produced from blower.

**3.6 Dehusked / Unpolished Kernel** — Millet grains from which husk only has been removed.

**3.7 Feed Mechanism** — The mechanism which feeds the millet grains into the pre-cleaner / cleaner and regulates the feed rate.

**3.8 Feed Rate** — The mass of seeds / grains fed into the inlet of the equipment per unit time.

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

**3.10 Gyro Sifter** — A grader in which the whole grains and broken grains / kernels are separated by screening after passing them over a set of gyrating screens. A rotary or flat sieve could also be used for grading.

**3.11 Lower / Bottom Screen** — The screen fitted as the last / at the bottom for separating finer / smaller foreign matter from seeds / grains.

**3.12 Maximum Input Capacity** — The maximum feed rate at which no choking occurs in the processing equipment and no stalling occurs in the prime mover at the speed specified by the manufacturer.

**3.13 Millet Grader** — A machine used for grading the millet grains / kernels according to size (diameter, thickness, width, etc.) and to separate the broken grains, damaged grains, impurities and foreign matter from the grain mass.

**3.14 Polished / Pearled Millet Grains** — The millet grains / kernels from which the bran layers have been fully / partially removed by polishing / pearling.

**3.15 Pre-cleaning** — Removal of larger size impurities from the mass of kernels / grains and facilitate further cleaning and grading.

**3.16 Rated Input Capacity** — The feed rate at which the cleaning efficiency is within the specified limit.

**3.17 Routine Tests** — Tests carried out on each equipment to check the requirements which are likely to vary during production.

**3.18 Scalper** — An equipment fitted with screen used for pre-cleaning (removal of large size impurities) of seeds / grains.

**3.19 Screen/ Sieve** — The component in the form of perforated or slotted sheet or wire mesh which separates the seeds / grains on the basis of size.

**3.20 Screen / Sieve Cleaning Mechanism** — The mechanism which keeps the perforations of the screen open and prevent clogging.

**3.21 Screen Slope** — The inclination in degrees of the screen with the horizontal.

**3.22 Seed / Grain Cleaner** — A machine which removes foreign matter from the given seed / grain mass.

**3.23 Shaking Mechanism** — The mechanism which shakes the sieve box at the specified speed, stroke length, etc.

**3.24 Sieve Aspirator** — A grader that separates broken grains / kernels from grain mass through vibrating screens in conjunction with an air stream. The light weight impurities are separated by an aspirator.

**3.25 Type Tests** — Tests carried out on cleaner to prove conformity with the requirements of relevant standard. These are intended to prove the general qualities and design of a particular type of cleaner.

**3.26 Unclean Seeds / Grains** — The mixture of clean seeds / grains and foreign matter.

**3.27 Upper / Top Screen** — Screen to eliminate foreign matter bigger than the seeds / grains in size. The seeds / grains flow down from upper / top screen to lower /bottom screen as under flow.

**4 TYPES OF MILLETS AND EQUIPMENT**

**4.1 Millet Grains**

Millets are the group of small grains and following are the crops classified under millets (Table 1). These grains are equally rich in nutrients to rice and wheat. Though they look similar in shape and size, they differ and cleaning / grading require different sieve perforations as given below.

**Table 1 Common Name and Botanical Name of Millet Crops**

(*Clause* 4.1)

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Common Name of Millets** | **Botanical Name** |
| i) | Sorghum / Jowar/ Great Millet | *Sorghum bicolor* |
| ii) | Bajra / Pearl millet | *Pennisetum glaucum* |
| iii) | Finger/ Ragi millet | *Eleusine corocana* |
| iv) | Kodo millet | *Paspalum scrobiculatum* |
| v) | Foxtail / Italian millet | *Setaria italic* |
| vi) | Little millet | *Panicum miliare* |
| vii) | Proso/ Common millet | *Panicum miliaceum* |
| viii) | Barnyard millet | *Echinochloa esculenta* |
| ix) | Browntop millet | *Urochloa ramose* |

The Central Seed Certification Board, Government of India, New Delhi, has prescribed the type of sieve perforation and the aperture opening for these millets crops as given below in Table 2.

**Table 2 Sieve Opening Size for Millets**

(*Clause* 4.1)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Crop** | **Screen Aperture Size in mm** | |
|  |  | **Top Screen** | **Bottom Screen** |
| i) | Sorghum/ Jowar/ Great millet | 4.75 r\* | 2.10 s#, 3.50 r |
| ii) | Bajra/ Pearl millet | 3.25 r | 1.30 s, 1.30 r, 1.40 r, 1.40 s, 1.60  r, 1.90 s |
| iii) | Finger/ Ragi millet | 3.25 r | 1.40 s |
| iv) | Kodo millet | 3.80 r | 1.60 s, 2.00 r |
| v) | Foxtail millet | 3.25 r | 1.20 s, 1.30 r |
| vi) | Little millet | 2.50 r | 1.60 r |
| vii) | Proso/ Common millet | 3.80 r | 1.60 s |
| viii) | Barnyard millet | 3.25 r | 1.40 s, 1.80 r |
| ix) | Browntop millet | 3.25 r | 1.2 x 20 oblong |

These types and size of sieves will be used for cleaning and grading of millet grains. However the size of these sieve openings vary with the varieties and the manufacturer’s recommendation’.

NOTE — Here “r” stands for round hole and “s” stands for square slot.

**4.2 Pre-Cleaners**

Pre-cleaning is the removal of the large size impurities from the seeds / grains and is also called as scalping. Pre-cleaning is essential in the process line to remove trash and other plant parts present in seeds / grains that would clog feed hoppers, elevators, sieves, etc. and thereby increase capacity of processing machines. The commonly used types of pre-cleaners / scalpers are, vibrating type and real / rotary type scalper.

**4.2.1 Vibrating / Reciprocating Type Pre-cleaner**

The pre-cleaner / scalper consists basically of a vibrating screen / sieve. The screen opening is large enough to allow the rough seeds / grains to pass through readily, while larger size inert material is ‘scalped off’ / removed. The material received in the feed hopper flows to the sieve. Vibration / reciprocation of the sieve is achieved through appropriate mechanism, viz., eccentric, cranks, cams, etc. The levels of vibration depend on nature of seeds /grains. Normally the fan /blower / aspirator is used for air circulation / displacement of air to remove lighters impurities like immature, chaff, straw, etc.

**4.2.2. Reel / Rotary Type Pre-cleaner**

The sieve is formed in the shape of drum / reel. The opening in the reel provides the passage for the smaller impurities and seeds / grains delivered from outer circumference to pass through and larger size impurities discharged out from the outer surface. Air from blower removes the dust particles and light weight impurities and the seeds / grains will be delivered for further cleaning and grading / separation. A single cylinder rotary screen type pre-cleaner is shown in **Fig. 1**.

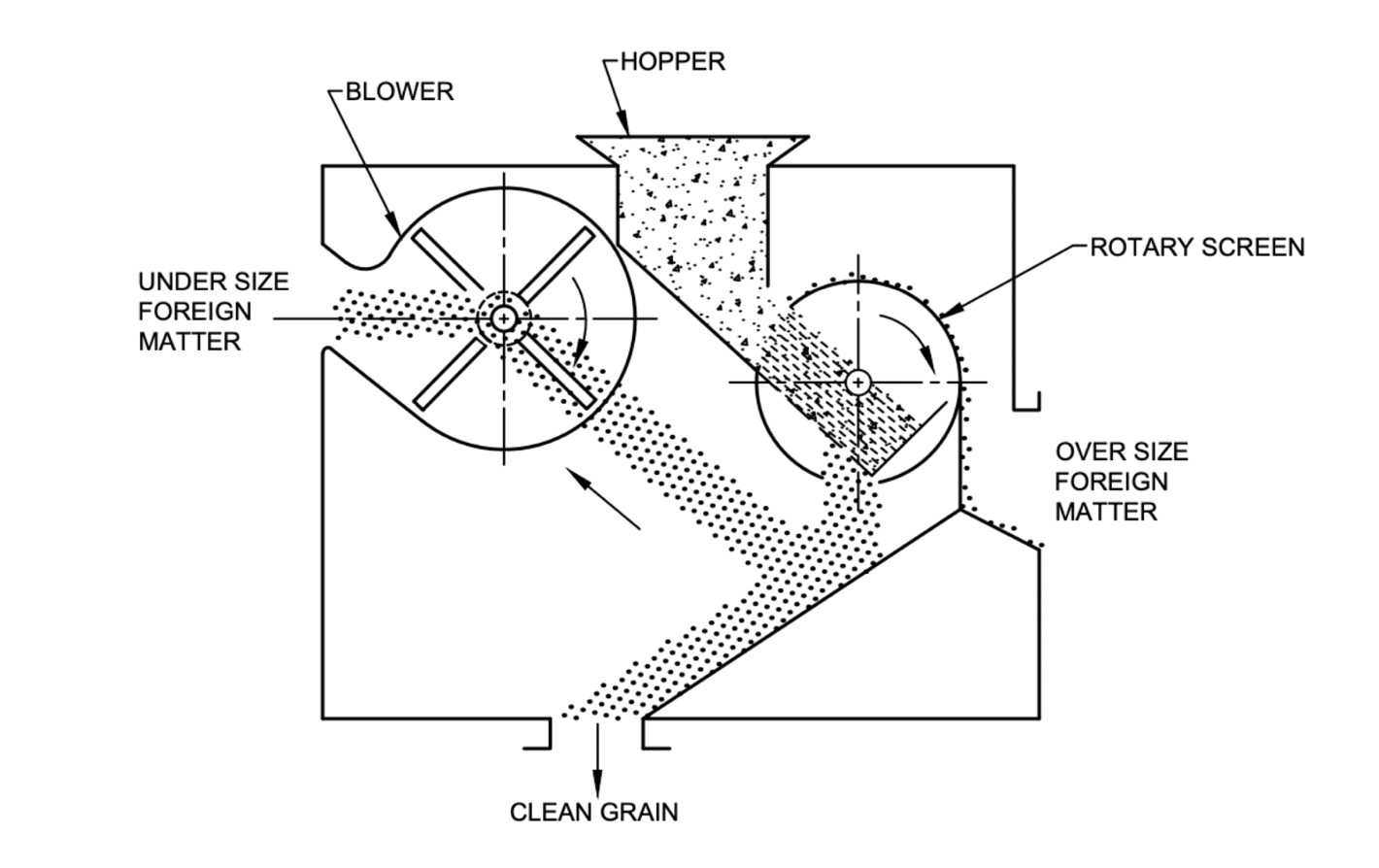


FIG. 1 A SCHEMATIC OF SINGLE CYLINDER ROTARY SCREEN TYPE PRE-CLEANER.

**4.3 Cleaners**

Cleaning of seeds / grains is the process of removal / separation of light weight impurities, chaffy grains, etc. to improve the quality of the produce. This is achieved by the action of the air which aspirates / blows the impurities based on the difference in the terminal velocity exist between them. A cleaner will necessarily be provided with blower(s) or aspirator(s) with a duct where the grain /seed mass come in contact with the air blast. There will be outlets provided for the good / bold seeds / grains, immature grains, chaffy materials, etc. and baffles will be also provided in the duct to adjust the locations of these outlets, depending on the seeds / grains.

**4.4 Graders**

Seeds / grains are primarily graded according to the thickness / diameter using the sieves / screens of appropriate type of opening and size. Separation / grading based on length, width, mass, etc. are done to remove the damaged / broken seeds / grains. The sieves are placed horizontal with a mild inclination and made to vibrate / reciprocate. The whole sieve arrangement is placed in a sieve box with provision to hold a number of sieves and changing the sieves as per requirement based on the type of the crop(s). Provisions will be also there to adjust the slope, stroke length, speed (number of strokes/min.), etc. with outlet for collecting both over flow and under flow from each sieve. Rotary sieves / screens are made by rolling the sieves in to a drum / rotor and mounted appropriately and rotated. Mild slope or auger for feeding will be provided to facilitate easy movement of the feed entering the drum. Depending on the number of grades desired, number of sieves will be placed in both cases. Clogging of sieves will be avoided through a suitable mechanism. A schematic of an air screen cleaner cum grader for millet grains is shown in Fig. 2.

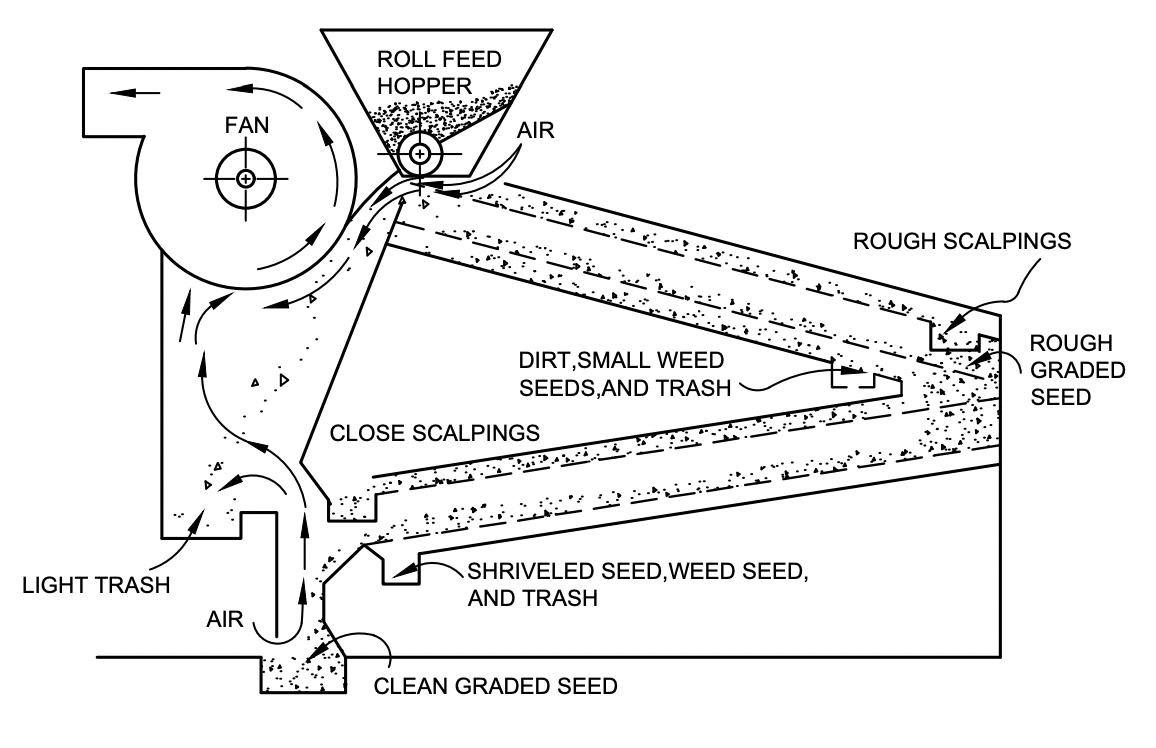


FIG. 2 A SCHEMATIC OF A CLEANER – CUM – GRADER FOR MILLETS

**5 MATERIAL**

The material for various components (*see* also **Fig. 1** and **Fig. 2**) shall be as given in column 3 of Table 1. The material shall conform to the relevant Indian Standard given in column 4 of Table 3.

**Table 3 Material of Construction**

(*Clause* 5.1)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Component** | **Material** | **Reference to IS** |
| (1) | (2) | (3) | (4) |
| i) | Bearing housing / plumber block | Cast iron | IS 210 |
| ii) | Blower casing | Mild steel | IS 2062 |
|  |  | Cast iron | IS 210 |
|  |  | Mild steel | IS 2062 |
| iii) | Blower impeller (blade holder) | Cast iron | IS 210 |
| iv) | Bottom and top drum of Elevator | Cast iron | IS 210 |
| v) | Bucket / cups | Mild steel / plastics | IS 2062 |
| vi) | Elevator body / frame | Mild steel | IS 2062 |
|  |  | wood | IS 399 |
| vii) | Feed hopper | Mild steel | IS 2062 |
|  |  | Stainless steel (SS 204/ 304) | IS 6911 |
| viii) | Feed roll | Cast iron | IS 210 |
| ix) | Feed rate/ distribution plates | Mild steel | IS 2062 |
|  |  | Stainless steel (SS 204/ 304) | IS 6911 |
| x) | Frame | Mild steel | IS 2062 |
| xi) | Gears | High carbon steel |  |
| xii) | Cam | High carbon steel |  |
| xiii) | Hand wheels / adjustment levers | Cast iron | IS 210 |
|  |  | Mild steel | IS 2062 |
| xiv) | Plummer block | Cast iron | IS 210 |
| xv) | Pullies | Cast iron | IS 210 |
|  |  | Mild steel | IS 2062 |
| xvi) | Screens / sieves | Mild steel | IS 2062 |
|  |  | Galvanized iron | IS 277 |
|  |  | Stainless steel (SS 204/ 304) | IS 6911 |
| xvii) | Shafts | Mild steel | IS 2062 |
| xviii) | Sieve Frame | Mild steel | IS 2062 |
|  |  | wood | IS 399 |

**5.2** The wire cloth sieve and perforated type sieve should conform to IS 2405 part 1 and IS 2405 part 2 respectively.

**6 CONSTRUCTIONAL REQUIREMENTS**

**6.1 Frame** — The main frame shall be fabricated using suitable size of mild steel / galvanised iron material with channel / angle sections and shall be covered wherever required with mild steel sheet / galvanised sheet / stainless steel sheet of adequate thickness, not less than 1.0 mm, depending on the requirements.

**6.2 Hopper** — Hopper shall be made of mild steel / stainless steel sheet and provided with a feed regulating device. The hopper shall be provided with side slope for easy flow of the grains / kernels.

**6.3 Rotary Screen** — One or multiple perforated rotary screens depending on the capacity shall be used. In case of single screen, the cylinder screen shall rotate in clockwise direction. In case of multiple cylinders, the cylinder screen shall rotate in counter clock wise direction. The speed of rotation of cylinders will be variable. The inclination of the cylinder shall also be made variable to clean different types of seeds/grains effectively.

**6.4 Vibrating / Reciprocating Screen** — The screen opening shall be large enough to allow the rough seeds / grains to pass through readily, while larger size inert material is scalped off / removed. There will be provision to adjust the slope, stroke length and speed.

**6.5 Aspirator / Blower** — The aspirator / blower shall be provided with the control lever or VFD (Variable Frequency Drive) to regulate air flow rate.

**6.6 Transmission Drive** — The suitable drive system like geared motor or sprocket chain or V belt pulley system for transmitting the power shall be provided in the pre cleaner machine.

**6.6.1** Suitable transmission guards shall be provided to prevent accidents due to contact with moving part of the machine with human beings while in operation.

**6.6.2** The guards shall not hinder the operations of the machines even while making adjustments available in the machines.

**6.6.3** It is preferable that all the guards shall be either permanently attached or firmly secured to prevent its removal without the aid or tools. The servicing and adjustment should be possible without removal of the guards.

**6.6.4** The guards shall have sufficient strength to support load at any point during the operation.

**6.7 Shafts** — The shafts shall be supported with suitable bearings and housings on the stable part of machine.

**6.8** The unit may be provided with provision to operate with electric motor / diesel engine / tractor PTO.

**7 PERFORMANCE REQUIREMENTS**

**7.1** The cleaner cum grader with pre cleaner shall be operated at no load in accordance with the method given in 8 of IS 5718. During the no load run, the visual observation shall not show the following abnormalities;

a) Presence of any marked vibrations during operation;

b) Presence of undue knocking or rattling sound;

c) Frequent slippage of belts / chains;

d) Non-smooth running of shafts in the bearing housings

e) Any marked wear or slackness in any components;

f) Any marked rise in temperature of operational bearings and its housing;

g) Vibrations in running of blowers; and

h) No mechanical damage to any components of cleaner cum grader.

**7.2** The rated input capacity in quintals per kWh energy consumed, with 5 and 10 percent foreign matter in the cleaner cum grader, shall be declared by the manufacturer. The various adjustments, clearances and speeds for that capacity shall also be declared. When tested in accordance with the method given in **8.1.9** of IS 8440, the declared capacity shall not differ by ±5 percent.

**7.3** During and after the capacity test, the visual observation shall not indicate the following:

a) Observations given under **7.1 (a)** to **(h)**;

b) Frequent clogging of screen perforations;

c) Non-smooth flowing of material through different components;

d) Frequent clogging of aspiration unit;

e) Any marked wear, deformation and breakdown;

f) Frequent loosening of fasteners; and

g) Leakage of grains from the cleaner, while in operation.

**7.4** When tested in accordance with **8.2** of IS 8440, no breakdown shall occur in any units of the cleaner cum grader with pre-cleaner.

**7.5** When tested in accordance with the method given in Annex A, the cleaner cum grader shall conform to the following requirements:

a) The grader shall meet the requirement given in *Clause* **6** and **7**.

b) The input capacity of the millet grains per kWh energy used shall be not less than 1250 kg. The capacity shall be declared by the manufacturer (*see* **A 6.4**).

c) The grader shall withstand the test given in A.2.

**7.6** The rated input capacity in tonnes / hour and rated energy consumption in kW/tonne for raw seeds/grains with 10 to 20 percent impurities like chaff, dust, soil particles, discoloured seeds/grains, cut and damage seeds/grains, for millets shall be declared when tested in accordance with the method given in IS 5718 or IS 8440 . The declared value shall not differ by 5 percent. The cleaning efficiency shall not be less than 90 percent. It means 90 percent impurities will be separated by pre-cleaner, cleaner and grader from the millet kernels /grains.

**8 OTHER REQUIREMENTS**

**8.1** Provision for tightening belts / chains shall be provided.

**8.2** Arrangement for lubrication of bearings and other moving parts as required shall be provided.

**8.3** Provision for easy transportation or towing with tractor shall be provided. Loading lugs shall also be provided for easily lifting of machine.

**8.4** The cleaner shall be provided with the operator's manual (*see* **4.2** of IS 8132)

**8.5** Provision for changing / adjusting the following shall be made:

a) Feed rate

b) Air displacement

c) Sieves

d) Sieve slope

e) Stroke length of sieve box

**8.6** Magnets shall be provided to arrest iron contaminants.

**8.7** Provision for cleaning the screen and to avoid clogging shall be provided.

**8.8** Suitable inspection window may be provided to inspect the process of cleaning.

**9 METHODS OF TEST FOR CLEANER CUM GRADER FOR MILLETS**

**9.1 Test Material**

**9.1.1** Sufficient quantity of the raw material (millet grains, viz., sorghum, bajra, finger millet, barnyard millet, prose millet, little millet, fox tail millet, kodo millet, brown top millet, etc.), preferably the same variety shall be taken. The proportion of impurities, stones, mud, chaff, plant materials, etc. shall be analyzed by taking 3 samples each of 100 g, and the average shall be reported.

**9.1.2** The moisture content of test material shall be measured according to IS 4333 (Part 2) and shall be not more than 14 percent (w.b.).

**9.2 Running in and Preliminary Adjustments**

**9.2.1** The cleaner cum grader shall be installed on a level and preferably on a hard surface with anti-vibration mount / concrete foundation. All the adjustments shall be made in accordance with the manufacturer’s recommendation.

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

a) Direct coupling the prime mover with the main shaft of the cleaner cum grader, and

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

**9.2.2.1** In the case of (a), the power delivered to the grader would be the power output of the prime mover, whereas, in the case of (b), the allowances for flat and V-belt drive losses may be taken at 6 percent and 3 percent, respectively.

**9.2.3** The cleaner cum 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 cleaner cum grader shall be run-in for 30 minutes. During the period of the run-in, adjustments for various functional components may be done. All the adjustments done shall be in accordance with the instructions contained in the manual supplied by the manufacturer.

**9.3 Tests**

Tests as indicated in **9.3.1** and **9.3.2** shall be carried out on millet cleaner.

**9.3.1** *Type tests*

**9.3.1.1** *General*

a) Checking of specifications (*see* **6** and ANNEX A),

b) Checking of material (*see* **5.1** and ANNEX B), and

c) Visual observations and checking of provisions for adjustments (*see* **8.5**).

**9.3.1.2** *Test at No-Load*

a) Visual observations (Annex C).

b) Power consumption (Annex D) and

**9.3.1.3** *Test at Load*

a) Short-run tests (*see* **7.1**); and

i) Visual observations (*see* **7.3**),

ii) Cleaning efficiency / effectiveness of cleaning (see 7.6),

iii) Power consumption (*see* **7.5** and **9.7.3**),

iv) Rated input capacity (*see* **7.6** and **9.7.4**), and

b) Long-run test (**9.8** and Annex H).

**9.3.2** *Routine Tests*

a) Visual observations and checking of provision for adjustments (*see* **7.3**), and

b) Test at no-load (*see* **9.3.1.2**).

**9.4 Pre-Test Observations**

**9.4.1** *Determination of Foreign Matter* — The foreign matter present in the millet lot to be cleaned shall be determined in accordance with **3, 4** and **5.2** of IS: 4333 (Part 1).

**9.4.2** *Determination of Moisture* — The moisture content of the millet shall be determined in accordance with IS: 4333 (Part 2).

**9.4.3** Running-in and Preliminary Adjustment

**9.4.3.1** The millet cleaner shall be installed on level and preferably on hard surface. All the adjustments shall be made in accordance with manufacturer's recommendations.

**9.4.3.2** The millet cleaner shall be run-in without load before commencing the tests. The running-in shall be carried out in accordance with the manufacturer's' recommendations.

**9.5 General Tests**

**9.5.1** *Checking of Specifications* — The specifications given by the manufacturer shall be checked and reported in the proforma as given in Annex A.

**9.5.2** *Checking of Material* — The material of construction of all the components of the cleaner shall be reported in the data sheet given in Annex B.

**9.5.3** *Visual Observations and Checking of Provision for Adjustments* — The observations and adjustments given in data sheet in Annex C shall be made and reported.

**9.6 Test at no Load**

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

a) Presence of any marked vibration during the operation,

b) Presence of undue knocking or rattling sound,

c) Frequent slippage of belts / chains,

d) Any marked unusual wear or slackness in any component,

e) Any marked rise in bearing temperature, and

f) Any breakdown of major components.

**9.7 Test at Load**

**9.7.1** *Operation and collection of data*

The cleaner cum grader shall be operated at its specified speed for15 min. 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 in the pre-cleaner at feed, cleaned grain outlet and impurities outlet (s) will be taken at an interval of 5 min at each outlet.

b) Similar three sets of samples at feed, cleaned grain outlet and impurities outlet(s) in the cleaner cum grader, also will be taken.

c) The main shaft's speed and the reading of the energy meter or dynamometer shall be recorded.

**9.7.1.1** At the end of 15 min feeding, run the grader for some time to practically no more material already fed comes out. At the end of the test, weigh the material collected through all outlets.

**9.7.1.2** The test given at **9.7.1** and **9.7.1.1** shall be repeated for a minimum of three times at various feed rates covering approximately 90 percent, 100 percent and 110 percent of rated input capacity declared by the manufacturer.

**9.7.2** *Preparation and Analysis.*

Three samples collected from feed, cleaned grain outlet and impurities outlet(s) in the pre-cleaner and cleaner cum grader shall be analyzed by manually separating the good grains and impurities. Their proportions to the total quantity of the sample will be expressed as fractions as given below;

*Xf* = mass fraction of good grains in feed,

*Xd* = mass fraction of good grains in good grains outlet(s), and

*Xb* = mass fraction of good grains in impurities / reject outlet(s).

**9.7.3** *Determination of Energy Consumption*

The energy requirement for each feed rate shall be calculated in accordance with **9.7.3.1** and

**9.7.3.2.**

**9.7.3.1** In the case of prime mover fitted with an energy meter, the readings taken shall be the energy consumption for 5 min. The energy consumption per hour, giving due allowance to the type of drive, shall be calculated and reported.

**9.7.3.2** In the case of prime mover fitted with the dynamometer, the readings taken shall indicate the torque required. The energy consumption giving due allowance to the type of drive (*see* **9.2.2**) shall be determined after computing power delivered by prime mover by the following formula:

T × S

P =

9549.30

where

*P* = power delivered by the prime mover, kW;

*T* = torque, Nm; and

*S* = speed, rev/min.

**9.7.4** *Determination of the rated input capacity*

**9.7.4.1** Select the feed rate at which the following requirements are met. The capacity in terms of energy consumed shall be calculated by dividing the capacity by the energy consumed (*see* **9.7.3**):

a) It shall be able to remove 90 percent of the impurities during pre-cleaning and 95 percent of the impurities during cleaning and grading, present in the respective feed materials in one pass. The capacity will be calculated from the quantity of the millet grains cleaned and graded and the respective time taken as,

Quantity of the millet grains cleaned and graded (kg) × 60

Capacity, kg/h =

time taken in min

**9.7.5** *Effectiveness of pre-cleaning and cleaning cum grading*

**9.7.5.1** The effectiveness of pre-cleaning and cleaning cum grading shall be computed using the following formula by substituting the values as calculated in **9.7.2**.

(*Xf* −*Xb*) (*Xd*−*Xf*)×*Xd* ×(1−*Xb*)

*E =*

*(Xd*−*Xb)2 (1*−*Xf)*−*Xf*

where,

*Xf* = mass fraction of good grains in feed,

*Xd* = mass fraction of good grains in good grains outlet(s), and

*Xb* = mass fraction of good grains in impurities / reject outlet(s).

The overall effectiveness of pre-cleaning and cleaning cum grading will be assessed as the mean of effectiveness of pre-cleaning and effectiveness of cleaning cum grading.

(Effectiveness of pre-cleaning + effectiveness of cleaning cum grading)

Overall effectiveness =

2

**9.8 Long Run Test**

**9.8.1** The grader shall be operated for a minimum of 20 h at load, which could be covered by a continuous run of at least 5 h. During and after the operation, no breakdown or defect shall develop in the cleaner cum grader.

**9.9 Summary Report**

For the guidance of the user, compile a summary report on the proforma as given in ANNEX J.

**10 WORKMANSHIP AND FINISH**

**10.1** Welding used for joining components shall not be porous and should be as per IS 816.

**10.2** Any sharp corners and protruding fastens shall be avoided.

**10.3** Components shall be free from cracks, pits, burrs and other visual defects which may be detrimental for its use.

**10.4** All the components of machine shall be painted with the rust preventive paints.

**11 MARKlNG AND PACKlNG**

**11.1 Marking**

Each grader shall be marked with the following particulars:

a) Manufacturer’s name, address and his recognized trade-mark if any;

b) Batch or code number;

c) Power rating and capacity;

d) Type;

e) Mode No.;

f) Year of manufacturing;

g) Direction of rotating parts.

**11.2** A minimum cautionary notice worded as follows shall be written in vernacular language legibly and prominently on the main body of the grader:

a) Do not wear loose dress, bangles, watch, etc, while working;

b) Do not work under the influence of intoxicants like liquor, opium, etc.

c) Children and aged persons should be discouraged for working on cleaner cum grader.

d) Do not cross over moving belts.

e) Do not operate cleaner cum grader without guards and safety devices;

f) Do not make adjustments when grader is working; and

g) Do not put or take-off belt while pulley is running.

**11.3 Packing**  The cleaner cum grader shall be packed for safety and security of human being while in transit and as agreed to between the purchaser and supplier for safe handling in transit.

**ANNEX A**

(*Clauses* **6** and **9.3.1.1**)

**SPECIFICATION SHEET**

 To be filled in by

Manufacturer Testing Station

**1.** *General:*

a) Make

b) Model

c) Type

d) Year of manufacture

**2.** *Power Unit:*

a) Type of prime mover

b) Number of prime movers

c) Recommended power, kW

d) Type of drive

**3.***Main Drive:*

a) Type

b) Size of belt

c) Size of pulley

d) Diameter of main shaft

e) Type and number of bearings

**4.** *Screens:*

**4.1 Pre-cleaner**

a) Type

b) Number of screens

c) Total length and width, mm

d) Effective length and width, mm

e) Size of hole, mm

f) Number of holes per 100 cm2

g) Sieve clearance, mm

h) Screen slope range, degrees

j) Recommended screen slope, degrees

k) Screen speed, rpm or strokes / min.

m) Screen stroke length, cm

n) Provision for screen cleaning

**4.2** *Cleaner cum grader*

a) Type

b) Number of screens

c) Total length and width, mm

d) Effective length and width, mm

e) Size of hole, mm

f) Number of holes per 100 cm2

g) Sieve clearance, mm

h) Screen slope range, degrees

j) Recommended screen slope, degrees

k) Screen speed, rpm or strokes / min.

m) Screen stroke length, cm

n) Provision for screen cleaning

**5.** *Shoes:*

a) Type

b) Number of strokes per minute

c) Length of stroke

d) Number and type of bearing

**6.** *Blower Aspirator:*

a) Type

b) Number of blades

c) Diameter, mm

d) Recommended speed, rpm

e) Provision for changing air displacement

f) Drive, if separate

**7.** *Millet Feeding:*

a) Method of feeding

b) Holding capacity of feed hopper, kg

c) Location and height of feeding hopper from ground level, m

d) Type of feed regulation mechanism

e) Type of feed distribution mechanism

**8.** *Transport Arrangements:*

a) Type

b) Number of wheels

c) Size of wheels

d) Wheel bearings

e) Type of towing arrangement

**9.** *Overall Dimensions:*

a) Length, m

b) Width, m

c) Height, m

d) Ground clearance, m

**10.** Tools, Accessories and Manuals Provided

Test Engineer

**ANNEX B**

(*Clause* 5.1)

**DATA SHEET FOR MATERIAL OF CONSTRUCTION**

**1.** *Date of Test:*

**2.***Material of Construction:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl. No.** | **Component** | **Material** | **Size** | **Mass** |
| (1) | (2) | (3) | (4) | (5) |
| i) | Blower / Aspirator |  |  |  |
| ii) | Blower casing |  |  |  |
| iii) | Blower impeller |  |  |  |
| iv) | Blower Shaft |  |  |  |
| v) | Elevator |  |  |  |
| vi) | Feeding chute / hopper |  |  |  |
| vii) | Frame |  |  |  |
| viii) | Hand wheels / adjustment levers |  |  |  |
| ix) | Main shaft |  |  |  |
| x) | Pullies |  |  |  |
| xi) | Screens / sieves |  |  |  |
| xii) | Shoe |  |  |  |
| xiii) | Sieve box |  |  |  |
| xiv) | Transport wheel |  |  |  |
| xv) | Others |  |  |  |

Test Engineer

**ANNEX C**

(*Clause* 9.3.1.2)

**DATA SHEET FOR VISUAL OBSERVATIONS AND PROVISION**

**FOR ADJUSTMENTS**

**1.** *Observations:*

a) Adequacy of marking of inlet and outlets

b) Adequacy of protection of bearings against the ingress of dust

c) Adequacy of safety arrangements, especially at moving points and at inlet

d) Provision for lubrication of moving parts

e) Provision for belt tightening

f) Provision for transportation

g) Provision for easy changing of components requiring frequent replacement

h) Provision for easy replacement and cleaning of screens

j) Provision for anti-corrosive coatings

k) Tightness of bolts, nuts and other fasteners

m) Welding of seams

n) Adequacy of marking to read speed of both main and blower shafts.

**2.** *Provision for Adjustments of:*

a) Feed rate

b) Shaking speed

c) Screen slope

d) Air displacement

Test Engineer

**ANNEX D**

(*Clause* 9.3.1.2)

**DATA SHEET FOR TEST AT NO-LOAD**

**1.** *Power Consumption:*

a) Source of power

b) Type of drive

c) Total time of run, min.

d) Average power consumption, W

**2.** *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 hearings

e) Any marked unusual wear or slackness in any component

f) Any marked rise in bearing temperature

g) Other observations

Test Engineer

**ANNEX E**

(*Clause* 9.3.1.3)

**DATA SHEET FOR TEST AT LOAD**

**1.** Source of Power

**2.** Power Rating, kW

**3.** Type of Drive

**4.** Type and variety of millet

**5.** Moisture Content, % d.b.

**6.** Percentage of Foreign Matter in the feed Before Feeding / pre-cleaning, %

**7.** Screen Slope, degrees

**8.** Sieve Clearance, mm

**9.** Air Flow rate, m3/ min.

**10.** Maximum Input Capacity, kg/h

**11.** Test Data\*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl.**  **No.** | **Date** | **Starting time** | **Stopping time** | **Duration of operation** | **Spee d (rpm)** | **Feed rate (kg/h)** | **Power required (kW))** | **Fuel cons- umed (1/h)** | **No. of samples** | **Quantity (kg) of samples** | | **Total quantity of grain mixture at clean grain outlet (kg)** | **Total quantity of grain mixture at sieve under flow (kg)** |
| **Clean Grain outlet** | **Foreign matter outlet** |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| **Pre-cleaner** | | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  | i) |  |  |  |  |
| ii) |  |  |
| iii) |  |  |
|  |  |  |
| **Cleaner cum grader** | | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  | i) |  |  |  |  |
|  |  |  |  |  |  |  |  |  | ii) |  |  |
|  |  |  |  |  |  |  |  |  | iii) |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |

**12.** Refer to the table

**13.** *Observation:*

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 of screen perforations

f) Smooth flowing of material through different components

g) Vibration free running of fan

h) Frequent clogging of grain in elevator unit

j) Any marked rise in bearing temperature

k) Any marked wear, deformation and breakdown

m) Frequent loosening of fasteners

n) Other observations (if any)

Test Engineer

**ANNEX F**

(*Clauses* 9.7.2 and 9.7.5)

**DATA SHEET FOR ANALYSIS OF SAMPLES**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.**  **No.** | **Feed rates** | **Source of sample** | **Sample mass, g** | **Clean** | **Mass of**  **Foreign** | **Remarks** |
|  |  |  |  | **grains, g matter, g** | |  |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |

Test Engineer

**ANNEX G**

(*Clause* 9.7.3)

**DATA SHEET FOR EFFICIENCY, POWER REQUIREMENT**

**AND CAPACITIES**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.** | **Item** |  | **Test No.** | |  |  |
|  | **1** | **2** | **3** | **4** | **5** | ***etc.*** |
| 1 | Feed rate, kg/h |  |  |  |  |  |
| 2 | Power required, kW |  |  |  |  |  |
| 3 | Cleaning unit speed, rpm. |  |  |  |  |  |
| 4 | Total grain received at clean grain outlet, kg |  |  |  |  |  |
| 5 | Effectiveness of cleaning |  |  |  |  |  |
| 6 | Rated input capacity, kg/h |  |  |  |  |  |

Test Engineer

**ANNEX H**

(*Clause* 9.8)

**DATA SHEET FOR LONG-RUN TEST**

**1.** Total Running Time, h

**2.** Continuous Running Time, h

**3.** Breakdowns in Cleaning Unit

**4.** Breakdowns in Elevation Unit

**5.** Breakdown in Body / frame

**6.** Any Major Repairs Conducted

**7.** Any Other Observations

Test Engineer

**ANNEX J**

(*Clause* 9.9)

**SUMMARY REPORT**

1. Name and Address of Manufacturer  
2. Model Number  
3. Name of Testing Station  
4. Brief Description of the Cleaner cum grader

5. Type and variety of millet used

6. Percentage of Foreign Matter present before feeding

7. Moisture Content of raw material, % d.b.  
8. Provisions for Adjustment of:

a) Shaking speed

b) Screen slope  
c) Air displacement

d) Feed rate

9. Power requirement, kW: Recommended power

a) Observed power at no-load  
b) Observed power at load at rated input capacity

c) Observed power at maximum input capacity

10. Effectiveness of cleaning of pre-cleaner  
11. Effectiveness of cleaning of cleaner cum grader

11. Rated Input Capacity  
12. Any Marked Observation Affecting Performance

13. Any Marked Breakdowns  
14. Other Observations

Test Engineer