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भारतीय मानक मसौदा
बायोमास श्रेडर — विशिष्टि और परीक्षण संहिता

Draft Indian Standard

BIOMASS SHREDDER — SPECIFICATION AND TEST CODE

ICS 65.060

Agriculture And Food Processing Equipment Sectional Committee, FAD 20	Last date of comments **: 26 October 2025**

FOREWORD

(*Adoption clause will be added later*)

Climate change and global warming are serious problems that the world has been facing for a long time. One of the major reasons for these problems is the use of fossil fuels like coal, oil, and gas. Significant amount of the electricity is still produced by burning coal in thermal power plants. To reduce the use of coal and protect the environment, the Government of India is promoting the use of clean and renewable sources of energy like solar and wind power.

The Ministry of Power, Government of India has set up a mission known as 'Sustainable Agrarian Mission on use of Agro Residue in Thermal Power Plants' (SAMARTH) to promote the use of crop residues such as rice straw, wheat straw, mustard straw, and other agricultural waste (after conversion into pellets) along with coal for power production.

Biomass co-firing helps in two ways – it reduces the amount of coal used and also provides a solution to the problem of burning crop residue in open fields, which causes air pollution. Farmers can now earn money by selling their crop waste instead of burning it.

Shredding is a critical preliminary operation in biomass pellet production, which reduces the size of raw biomass to ensure compatibility with subsequent processing equipment, such as hammer mills, and pelletizer etc. This size reduction facilitates efficient handling and uniform feeding into the hammer mill, which is essential for consistent pellet quality.

To achieve the desired particle size and maintain uniformity within acceptable limits, it is necessary to design, manufacture, and select high-quality shredding equipment. The working components of shredders are subject to significant wear and tear due to the abrasive nature of biomass materials and thus needed to be replaced very frequently.

A need was felt to develop this standard to assist manufacturers in selecting appropriate materials of construction, incorporating safety features, and ensuring that the biomass shredder meets minimum performance criteria.

A series of Indian Standards are being developed for various equipment used in the production of biomass pellets. Apart from this standard, four other standards under development are as under:

a) FAD 20(27725)WC Plant layout & optimal process for production of biomass pellets – guidelines
b) FAD 20(27727)WC Biomass Hammer Mill – Specification and Test Code
c) FAD 20(27728)WC Biomass Pelletiser – Ring Die Type – Specifications and Test Code
d) FAD 20(27729)WC Biomass Pelletiser – Crank, Piston, and Cylinder Type – Specifications and Test Code

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 stipulates material, constructional, performance, and other requirements of the biomass shredder. It also prescribes the test methods for evaluating the performance of the shredder.

2 REFERENCES

The following standards given in Annex A contain provisions which through 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.

3 TERMINOLOGY

In addition to the definitions given in Doc. No. FAD20 (27725) WC, the following definitions shall be used for the purpose of this standard:

3.1 Biomass Shredder — A size reduction equipment used to break down the shear, cut, and tear apart the biomass into the desired size.

3.2 Feed Mechanism — The mechanism meant for uniform feeding of the biomass into the shredder and regulating the feed rate.

3.3 Rated Shredding Capacity — The shredding capacity at which the shredding efficiency shall be within the specified limit.

3.4 Shredding Capacity — The amount of biomass shredded by the machine per unit time.

4 TYPES

The number, shape, and configuration of blades of biomass shredder can vary depending on the type of biomass and the desired particle size, however, based upon the number of shafts, shredder may be of following types.

4.1 Single Shaft Shredder

Single Shaft Shredder is equipped with only one shaft with rotary blades, a hydraulic-driven pusher plate/arm, and a screen underneath the rotating shaft. The material is fed into the hopper, the hydraulic-driven plate/arm pushes the material towards the cutting shaft to ensure the material is efficiently shredded by the rotary cutting blades.

4.2 Dual Shaft Shredder

Dual Shaft Shredder is built with two shafts of blades, which are also called dual shearing shafts. A dual shaft shredder features two parallel rotating shafts, each equipped with blades arranged in a staggered pattern. It is used to shred tougher and thicker materials compared to single shaft shredders.

4.3 Four Shaft Shredder

The blades on the shafts rotate to pull in and shear the material, creating a consistent shredding action. It is equipped with four rotating shafts that provide high efficiency and processing capacity. It is used to shred complex and dense materials effectively.

5 MATERIAL

5.1 The components of the shredder shall be made from material as specified in column 3 of Table 1 and the material should conform to the relevant Indian Standards as given in column 4 of this table.

Table 1 Material Specifications for Various Components of Shredder
(*Clause* 5.1)

Sl. No.	Component	Material or Grade	Ref to Indian Standard
(1)	(2)	(3)	(4)
1.	Base frame	Mild steel	IS 2062
2.	Cleaning fingers	Mild steel	IS 2062
3.	Coupling	Casted Mild Steel	-
4.	Cutting Blade	Alloy steel	ASTM A387
		ISAR 550	IS 18809
		High carbon steel	-
		D2 Steel	-
5.	Fixed plate	ISAR 550	IS 18809
		Alloy steel	ASTM A387
		High carbon steel	-
6.	Feed hopper	Mild steel	IS 2062
7.	Gear	Forged alloy steel	-
8.	Gear box casing	Cast Iron	IS 210
9.	Pulley	Cast iron	IS 210
10.	Rotor shaft	EN8	-
11.	Shredder casing	Mild steel	IS 2062
12.	Spacer	Mild steel	IS 2062
13.	V-Belt	-	IS 2494 (Part 1)

6 PERFORMANCE PARAMETERS

6.1 The shredded length for any type of feed stock shall not be more than 75 mm.

6.2 The shredder shall withstand all the tests given in **11**.

6.3 The life cycle of blade/rotor should be reported by the manufacture for biomass used for testing. The variation in the shredding capacity, shredding efficiency, specific energy consumption shall be recorded during the long run test (*see* **11.6**) and the shall not be more than 5% with respect to the values as declared by the manufacturer.

7 CONSTRUCTIONAL REQUIREMENTS

7.1 Power Transmission — Suitable system for transmitting the power should be provided. It may consist of belt drive, chain drive or gear drive. The profile of the rack tooth and the module of the gears should be as given in IS 2535 (Part 1) & IS 2535 (Part 2).

7.2 Hopper — It shall be made of sheet having thickness not less than 5 mm, and it shall be provided with a feed regulating device.

7.3 Shredder Casing — The thickness of the casing/body sheet of the shredder shall not be less than 12 mm and the provision shall be made for easy replacement of the shredding drum.

7.4 Cutters/Blades — All the blades shall be installed in such a way that the rotor is statically and dynamically balanced.

8 OTHER REQUIREMENTS

8.1 The frame of the shredder shall be designed in such a way that it is stable while installed on a plane surface.

8.2 The guards shall be so designed as not to hinder in easy adjustment, servicing and operation of separator. The guards shall have sufficient strength to support load of 600 N applied at any point over an area of 0.1 m^2 without any permanent set.

8.3 All the emergencies stop mechanisms shall be clearly marked and located in visible areas around the machine.

8.4 Adequate arrangements for cooling/lubrications of gearbox and coupling during operations shall be made.

8.5 All the controls shall be easily accessible and capable of being locked at selected position.

8.6 A feed reversing mechanism shall be provided.

10 WORKMANSHIP AND FINISH

10.1 The components of shredder shall be free from cracks, pits, holes and other visual defects which may be detrimental for their use.

10.2 Welding used for joining different components shall not be porous and shall be smooth (*see* IS 816).

10.3 A rust preventive coating shall be provided to the steel components.

11 TESTS

11.1 Selection and Specification of Shredder

11.1.1 *Selection*

The shredder shall be randomly selected by testing authority from the production line with the agreement of the manufacturer.

11.1.2 *Specification*

The manufacturer shall supply the details of the specifications of the shredder listed in the specification sheet given in Annex B, as well as any further data required to carry out the tests. The manufacturer shall also supply all the relevant literature, such as operation and maintenance manual and parts catalogues, normally supplied along with the machine. The specification given by the manufacturer shall be checked and reported by the testing authority.

11.2 Pre-Test Observation

11.2.1 *Type of Biomass*

The type and quantity of the biomass used in shredder shall be observed and reported.

11.2.2 *Determination of Moisture*

The moisture content of feed material shall be in between 8 % to 14 % when determined by oven dry method in accordance with IS 17655 (Part 3).

11.2.3 *Running-in and Preliminary Adjustments*

11.2.3.1 The machine shall be installed at level and preferably on a hard surface. All the adjustments shall be made in accordance with the manufacturer's recommendations.

11.2.3.2 The machine shall be run-in for at least 30 minutes at no-load before commencing the test. The running-in shall be carried out in accordance with the manufacturer's recommendations.

11.3 General

11.3.1 *Checking of Specifications*

The specifications given by the manufacturer (*see* **5.1**) shall be checked and reported in the proforma given in Annex B.

11.3.2 *Checking of Material*

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

11.3.3 *Visual Observations and Checking of Provisions for Adjustments*

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

11.4 Test at No-load

11.4.1 *Determination of Power Consumption*

After the running-in is over, the shredder shall be run at no-load for minimum of 30 minutes at the rated speed for 3 times. The difference between the two consecutive energy meter readings shall be taken as the power consumption at no-load, and shall be reported in Annex E.

11.4.2 *Visual Observation*

During and after no-load run, the visual observations given in Annex E shall be recorded.

11.5 Test at Load

11.5.1 *Feed Material*

Adequate quantity of biomass material (such as paddy straw or fibrous material) of known quantity shall be taken for shredding process. A choice of feed material taken shall be dependent on the manufacturer or on the availability of the material. There shall be no need to dry the material and the raw material as such shall be fed into the shredder.

11.5.2 *Operation and Collection of Data*

After the stabilization of the operation, the shredder shall be operated at the specified speed for 20 hours at the rated capacity specified by the manufacturer. The period should be covered by a continuous run of at least 5 hours in a day. If the machine stops during the trial of less than 5 hours due to any reason including breakdown of machine, power cut, etc., such trial shall be initiated again for that day. The shredder may be fed with one raw material or in the combination of more than one using conveyors or manually.

11.5.2.1 During the above run, the following data and samples shall be collected:

a) Three sets of samples each weighing 500 g shall be taken from the outlet for each run for further analysis for moisture content, size (diameter and length) and bulk density.
b) The speed of the main shaft and the readings of the energy meter shall be recorded for each run.

11.5.2.2 At the end of feeding, the machine shall be run idle for some time, so that practically no more material already fed comes out. At the end of the test, the material dropped from the outlet shall be collected and weighted and shall be added to the mass of material collected during run test.

11.5.2.3 The test given in **11.5.2.1** shall be repeated for half an hour run with the feed rates 80%, 90%, 110%, 120% of the rated capacity declared by the manufacturer by adjusting the inlet chute of the hopper.

11.5.2.4 The data shall be recorded in the data sheet as given in Annex F.

11.5.3 *Performance Evaluation of Machine*

From the observations made above, the following shall be calculated:

11.5.3.1 *Shredding capacity*

$$C = \frac{W_i}{T} \times \frac{M_o}{M_t}$$

Where,

C = Shredding Capacity of the machine, kg/h,

W_i = Weight of material fed, kg

T = Time taken to shred the input material, h

M_o = mass of output biomass of desired size after shredding in the samples taken for analysis, kg

M_t = Mass of sample taken for analysis, kg

11.5.3.2 *Shredding efficiency*

$$E = \frac{M_o}{M_i} \times 100\ \%$$

Where,

E = shredding efficiency, %

M_i = mass of input biomass, kg

M_o = mass of biomass of desired size after shredding, kg

11.5.3.3 *Specific energy consumption*

$$Sp = \frac{[(P_{load} \times \eta_{load}) - (P_{no\ load} \times \eta_{no\ load})]}{Q}$$

Where,

Sp = Specific Energy Consumption, Wh/kg

P_{load} = Energy meter reading (average) at load, W

$P_{no\ load}$ = Energy meter reading (average) at no load, W

η_{load} = Efficiency of prime mover at load (assume 0.90, if not specified)

$\eta_{no\ load}$ = Efficiency of prime mover at no load (assume 0.50, if not specified)

Q = throughput of the machine, kg/h

11.5.3.4 *Determination of power consumption*

The difference between the two consecutive energy meter readings shall be taken as the power consumption. The data shall be recorded in the data sheet as given in Annex G.

11.6 Long-run Test (Endurance Test)

The equipment used in production of shredded material shall be operated for at least 20 hours at load. The period should be covered by a continuous run of at least 5 hours. During and after the operation, no breakdown or defects shall develop in the machine. The major breakdown, defects developed, and repairs made, shall be recorded in the data sheet given in Annex H.

12 SUMMARY REPORT

For the guidance of the user, a summary report on the proforma as given in Annex J shall be compiled.

13 MARKING AND PACKING

13.1 Marking

Each shredder shall be marked with following particulars:

a) Manufacturer's name, address and recognized trademark, if any;
b) Batch or code umber;
c) Power rating and capacity;
d) Type;
e) Model Number;
f) Year of manufacturing;
g) Efficiency; and
h) Direction of rotating parts.

13.2 A minimum cautionary notice shall be written in vernacular language legibly and prominently on the main parts of shredder

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 person should be discouraged for working on pelletizer;
d) Do not cross over moving belt;
e) Do not operate pelletizer without guards and safety devices;
f) Do not make adjustments when pelletizer is working; and
g) Do not put or take-off belt while pulley is running.

13.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed there under, and the products may be marked with the Standard Mark.

13.4 Packing

The shredder or its components shall be packed as agreed to between the purchaser and the supplier for safe handling in transit and storage.

ANNEX A
(*Clause* 2)

IS No.	***Tittle***
IS 210:2009	Grey iron castings — Specification (*fifth revision*)
IS 816:1969	Code of practice for use of metal arc welding for general construction in mild steel (*first revision*)
IS 2062:2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
IS 2494 (Part 1):1994	V - Belts - Endless V - Belts for industrial purposes: Part 1 General purpose — Specification (*second revision*)
IS 2535 (Part 1):2004 ISO 53	Cylindrical gears for general and heavy engineering: Part 1 Standard basic rack tooth profile (*third revision*)
IS 2535 (Part 2):2004 ISO 54	Cylindrical gears for general and heavy engineering: Part 2 Module (*third revision*)
IS 4255:2022	Gyratory and cone crushers — Specification (*first revision*)
IS 17655 (Part 3):2025 ISO 18134-3 : 2023	Solid biofuels — Determination of moisture content Part 3 Moisture in general analysis sample (*first revision*)
IS 18809 : 2024	Wear and abrasion resistant steel sheet and plate — Specification
FAD 20(27725)WC	Plant layout & optimal process for production of biomass pellets – guidelines

ANNEX B
(*Clause* 11.1.2)
SPECIFICATION SHEET

B-1 Name and Address of the Manufacturer

B-2 Type of Shredder

B-3 Power Unit

a) Type of prime mover
b) Motor Power
c) Type of drive

B-4 Main Drive

a) Type
b) Shredder Blades
c) Diameter of motor pulley (Φ), mm
d) Diameter of main pulley (Φ), mm
e) Size of main shaft (D × L), mm

B-5 Feeding Arrangement

a) Type of feed mechanism
b) Size of feeding inlet
a) Thickness of sheet, mm
b) Ground clearance of feeding, mm

B-6 Shredding/Crushing Unit

a) Size of shredding drum (D × L), mm
b) Size of feeding inlet (Φ), mm
c) Type of shredding mechanism
d) Size of bale drum (D × L), mm
e) Size rotor blades (L × W/D × T), mm
f) Size of rotor shaft (D × L), mm
g) Shredding rotor (D × L), mm
h) Size of concave grate
j) Number of shredding blade in each rows
l) Number of shredding blade rows
m) Number of counter blades

B-7 Deflector

a) Type
b) Number of vanes
c) Speed ratio between PTO and shredding rotor
d) Size of spacer ring
e) Size of lock nut

B- 8 Overall Dimensions of the Machine

a) Length, mm

b) Width, mm
c) Height, mm
d) Discharge gate ground clearance, mm

B-9 Performance Parameters for Particular Biomass

a) Shredding capacity, kg/h

b) Specific energy consumption, kg/kWh
c) Shredding efficiency, %

B-10 Tools, Accessories, Operation Manual and Spare Parts List to be Provided

NOTES
1 The item which is not applicable in a particular shredder should be crossed while filling.
2 If any other items are provided, their details should be given.

ANNEX C
(*Clause* 11.3.2)
DATA SHEET FOR MATERIAL OF CONSTRUCTION

S. No.	**Component**	**Material**
(1)	(2)	(3)
1.	Base frame	
2.	Belt Conveyors	
3.	Cleaning fingers	
4.	Coupling	
5.	Fixed plate	
6.	Feed hopper	
7.	Gear	
8.	Gear box casing	
9.	Main shaft	
10.	Outer casing	
11.	Pulley	
12.	Rotor shaft	
13.	Screw conveyor/auger	
14.	Shredder casing	
15.	Shredder/Cutting blade	
16.	Spacer	
17.	V-Belt	
18.	Other data, if any	

NOTE — Delete the component which is not applicable to a particular shredder and add if any other component is provided.

ANNEX D
(*Clause* 11.3.3)
DATA SHEET FOR VISUAL OBSERVATION AND PROVISIONS FOR ADJUSTMENTS

D-1 Observations

a) Adequacy of marking of inlets and outlets
b) Adequacy of protection of bearings from dust
c) Adequacy of safety arrangements, like cover, controls, etc. specially at moving parts and inlet
d) Provision for lubrication of moving parts
e) Provision of belt tightening, if required
f) Provision for easy changing of components requiring frequent replacement
g) Anti-corrosive coatings provided or not
h) Provision for inspection windows/covers
j) Tightness of bolts, nuts and other fasteners
k) Adequacy of safety guards on moving parts
m) Welding of seams
n) Provision of feed regulating and spreading system
p) Other observations

D-2 Provision for Adjustments

a) For feed control
b) Shredder shaft speed
c) Screen Size Selection
d) Clearance Adjustment

ANNEX E
(*Clause* 11.4.1 & 11.4.2)
DATA SHEET FOR TEST AT NO-LOAD

E-1 Energy Consumption

a) Source of power
b) Type of drive
c) Total time of run
d) Average energy consumption for one hour

E-2 Observations

a) Presence of any marked vibration during operation
b) Presence of undue knocking or rattling sound
c) Any slippage of belts
d) Smooth running of shafts in their respective bearings
e) Any marked unusual wear or slackness in any component
f) Any marked rise in bearing temperature
g) Unusual heating of any component
h) Other observation (if any)

ANNEX F
(*Clause* 11.5.2.4)
DATA SHEET FOR TEST AT LOAD

F-1 Details of Power Supply

F-2 Power Rating, kW

F-3 Type of Drive

F-4 Type and Size (Diameter & Length) of Feed, mm

F-5 Moisture Content of Feed, %

F-6 Moisture Content of Shredded Material, %

F-7 Speed of Shaft, rpm

F-8 Atmospheric Conditions:

a) Temperature, ^{o}C
b) Relative humidity, %

F-9 Test Data

Sl. No.	Date	Starting time	Stopping time	Duration of operation	Speed of shaft	Feed rate, kg/h	Energy meter reading in relation to time	No. of quantity of samples	Shredded material output, kg
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
								1. 2. 3. 4.	

F-10 Observations

a) Presence of any marked vibration during operation
b) Presence of any undue noise
c) Smooth running of shafts in their respective bearings
d) Undue heating of any component
e) Frequent slippage of belts
f) Any marked deformation, wear or breakdown
g) Any marked rise in bearing temperature
h) Unusual heating of any component

j) Frequent loosening of fasteners
k) Any major breakdown or repair conducted
m) Other observation (if any)

ANNEX G

(*Clause* 11.5.3.4)

DATA SHEET FOR EFFICIENCY, CAPACITY AND POWER REQUIREMENT

S. No.	**Item**	**Test No.**				
		1	**2**	**3**	**4**	**Etc.**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Feed rate, kg/h					
2.	Average size, mm					
3.	Shredding Efficiency, %					
4.	Bulk Density, kgm^{-3}					
5.	Gross calorific value, kcal/kg					
6.	Specific energy consumption, kWh/kg					
7.	Power requirement, kW					
8.	Rated capacity, kg/h					

NOTE — GCV need not to be measured in every test, if the feed stock is same.

ANNEX H
(*Clause* 11.6)
DATA SHEET FOR LONG-RUN REST

H-1 Total Running Time

H-2 Continuous Running Time

H-3 Any Major Breakdown

H-4 Any Repairs Conducted

H-5 Any Other Observations

ANNEX J
(*Clause* 12)
SUMMARY REPORT

J-1 Name of Testing Station

J-2 Name of Manufacturer

J-3 Model Number

J-4 Brief Description of the Equipment

J-5 Type of Material Used for Test

J-6 Moisture Content of Raw Material

J-7 Adjustments:

a) For feed control
b) Shredder shaft speed
c) Screen Size Selection
d)Clearance Adjustment

J-8 Power Requirements:

a) At no load
b) At load on rated capacity

J-9 Average Size of Feed & Product (Diameter & Length), mm

J-10 Shredding Efficiency, %

J-11 Rated Capacity, kg/h

J-12 Specific Energy Consumption, kWh/kg

J-13 Any Marked Observation Affecting Performance.

J-14 Any Major Breakdowns During Test

J-15 Other Observations, If Any