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भारतीय मानक मसौदा

बायोमास पेलेटाइज़र — क्रैंक-पिस्टन-सिलेंडर प्रकार — विशिष्टि और परीक्षण संहिता

Draft ***Indian Standard***

BIOMASS PELLETISER — CRANK-PISTON-CYLINDER TYPE — SPECIFICATION AND TEST CODE

ICS 65.060

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

FOREWORD

(*Shall 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.

Pelletization is a critical and main operation in biomass pellet production, which converts the hammered biomass into pellet shape by compression. Crank-piston-cylinder type pelletiser is used for carrying out this operation. The critical or working element such as die of the pelletiser is prone to wear & tear very frequently, therefore, it becomes important for the manufacturer to select appropriate material for such critical elements and other components as well to ensure the minimal maintenance & longevity of the machine.

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 pelletiser needs less maintenance, functions with adequate performance, and lasts longer.

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) FAD20(27725)WC Plant layout & optimal process for production of biomass pellets – guidelines
b) FAD 20(27726)WC Biomass Shredder – Specification and Test Code
c) FAD 20(27727)WC Biomass Hammer Mill – Specification and Test Code
d) FAD 20(27728)WC Biomass Pelletiser – Ring Die 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 specifies material, performance, construction and other requirements of crank-piston-cylinder type pelletiser. It also prescribes the working mechanism for the guidance of user and the test methods for evaluating the performance of the pelletiser.

2 REFERENES

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

The definitions given in Doc. No. FAD 20 (27725) WC & Doc. No. FAD 20 (27728) WC shall be used for the purpose of this standard.

4 TYPES

Based on the direction of feeding, the crank-piston-cylinder type pelletiser may be of following types:

4.1 Crank-Piston-Cylinder Type Pelletiser with Vertical Feeding

In this type of machine, the pulverised biomass is fed from the top of the pelletizer in vertical direction. Vertical screw feeder/conveyors are used where space is limited. It is effective in conveying the powdery and granular materials for pelletisation. The screw feeder conveys the material in equal proportions into the feeding inlet port. Vertical screw conveyor relies on the centrifugal force of the material to drive up/down feeding. Vertical screw feeder is a common conveying equipment, which mainly consists of a feed port and spiral screws.

4.2 Crank-Piston-Cylinder Type Pelletiser with Horizontal Feeding

The horizontal feeders/conveyors convey the biomass along the displacement direction by the rotating screw blade. The material is conveyed by the thrust of the forward movement of the material behind. The horizontal screw feeder is a common conveying equipment, which mainly consists of a feed port, spiral blades.

5 MATERIAL

5.1 The components of the pelletiser shall be made from material as specified in column 3 of Table 1. The materials should conform to the relevant Indian Standards as per column 4 of Table 1.

Table 1 Material Specification for Various Components of Pelletiser
(*Clause* 5.1)

Sl. No.	Component	Material	Ref to Indian Standard
(1)	**(2)**	**(3)**	**(4)**
1.	Bush	Brass/Bronze	IS 319
2.	Connecting rod	Mild steel	IS 2062

3.	Crank shaft	EN 8	-
4.	Cylinder liner/sleeve	Cast Iron	IS 210
5.	Die Holder	EN9	-
		EN8	-
6.	Feed hopper	Mild steel	IS 2062
7.	Feeder box	Casted mild steel	IS 1030
8.	Flywheel/Pulley	Cast iron	IS 210
9.	Main Body	Mild steel	IS 2062
10.	Pellet Die	D2 Steel	-
		EN9	-
		En 31	-
		20MnCr5	-
11.	Piston rod	EN 8	-
12.	Punch/Tikki	20MnCr5	-
		EN 9	-
		EN24	-
		High Carbon High Chromium steel (HCHCR)	-
13.	Ram	EN 9	-
		20MnCr5	-
14.	Other data, if any		

6 PERFORMANCE REQUIREMENTS

6.1 The efficiency of pelletizers shall not be less than 85% at settings as specified by the manufacturer.

6.2 The fines percentage in pellets shall not be more than 5% when tested as per the method given in IS 17656.

6.3 The particle density (true density) of pellets should be ≥ 1100 kg/m^3.

6.4 The bulk density of pellets made from various type of biomass may vary, but it should not be less than 600 kg/m^3.

6.5 The mechanical durability of pellets shall not be less than 95% mass when determined as per method given in **10.5.3.8**.

6.6 The pelletizer shall withstand all the test given in **10**.

7 CONSTRUCTIONAL REQUIREMENTS

7.1 Main Body

The main body of the pelletizer shall be made of the sheet with thickness not less than 30 mm and the hardness of the sheet shall not be less than 65 HRC when determined as per the method prescribed in ISO 6508 (Part 1).

7.2 Hopper

The material of the hopper should be hard enough to withstand contact with raw biomass and mechanical components without undue wear and rusting.

7.3 Worm/Feed Auger/Conveyor

The worm conveyor should be designed to handle specific load capacities based on the type of material being processed. Both vertical and horizontal screw conveyors (augers) are essential for transporting raw materials to the processing area. The choice of material for these components is critical for ensuring durability, efficiency, and resistance to wear. The thickness of the auger flights and housing should be sufficient to withstand operational stresses. Typical thickness ranges from 5 mm to 15 mm, depending on the design and application. The material should have high tensile strength to endure the mechanical stresses during operation. Hardness levels should typically be around HRC 40-60 when determined as per the method prescribed in ISO 6508 (Part 1), depending on the application.

7.4 Piston Cylinder Assembly

The piston cylinder assembly shall be smooth running, without any noise. There shall be a brass sleeve in the piston cylinder for the smooth running and to reduce the temperature.

7.5 Power Transmission

Suitable system for transmitting the power shall be provided. It may consist of V-belt and pulley, gears or sprocket and chain.

7.5.1 Transmission guards shall be provided to prevent accidental contact of persons or parts of clothing being caught in the transmission system, unless the system is so constructed or placed as to be safe without guards.

7.5.2 The guards shall be so designed as not to hinder in easy adjustment, servicing and operation of separator.

7.5.3 It is preferable that all guards shall be either permanently attached or firmly secured to prevent their removal without the aid of tools. The servicing and adjustments shall be possible without complete removal of the guards.

7.5.4 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 permanent set.

8 OTHER REQUIREMENTS

8.1 The auger used in the conveyor shaft for feeding the material shall be minimum 10 mm thickness.

8.2 Provision shall be made for the lubrications of piston/cylinder, bearing and they shall be dust proof.

8.3 The rotor shaft of the crank shaft and flywheel shall be finished to close tolerance at the bearing, and they shall be properly aligned.

8.4 In case of belt drive, provision shall be made for belt tightening.

8.5 The belt guards shall be designed in a way that they are easily replaceable during maintenance.

8.6 Adequate provision for cooling/lubrications of cylinder during operations shall be provided.

8.7 Various controls shall be accessible easily and capable of being locked at selected position.

9 WORKMANSHIP AND FINISH

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

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

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

10 METHODS OF TEST

10.1 Selection and Specification of Pelletizer

10.1.1 *Selection*

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

10.1.2 *Specification*

The manufacturer shall supply the details of the specifications of the pelletizer consisting of the items 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.

10.2 Pre-Test Observation

10.2.1 *Determination of Composition of Feed*

Different type of agro-waste and herbaceous-waste can be used for production of pellets. The type and quantity of the material used for pellet making shall be supplied by the manufacturer and noted in proforma given in Annex F.

10.2.2 *Determination of Moisture*

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

10.2.3 *Running-In and Preliminary Adjustments*

10.2.3.1 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.

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

10.3 General

10.3.1 *Checking of Specifications*

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

10.3.2 *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.

10.3.3 *Visual Observations and Checking of Provisions for Adjustments*

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

10.4 Test At No-Load

10.4.1 *Determination of Power Consumption*

After the running-in is over, the pelletizer 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 given in Annex E.

10.4.2 *Visual Observation*

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

10.5 Test at Load

10.5.1 *Feed Material*

Adequate quantity of biomass material or mixture of two or more material of known quantity shall be taken for pellet making process. Choice of feed material taken for pellet formation depend on the manufacturer or availability of the material. The material taken shall be chopped into small pieces by shredder or chipper grinder. The shredded material should be pulverised in hammer mill to get materials into powder form having largest particle dimension ≤3.15 mm. If different types of materials are used, then the mixing shall be done in the hammer mill, or separate mixer should be provided. The powder material used for pellet formation shall have sufficient moisture content (8-14%). If moisture content is high, material shall be dried to desirable moisture content in sun or in dryer.

10.5.2 *Operation and Collection of Data*

After the stabilization of the operation, the pelletizer 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. 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.

With the help of in-feed screw, the dried and granulated raw material gets fed into the machine. The worm present in the machine pushes the material further into the processing chamber. The biofuel pellets are formed with a high-pressure mechanical punch, eliminating the use of binding agents. In the last step, the pellets come out from the cooling line.

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

a) Three sets of product samples each weighing 2 kg shall be taken from the outlet for each run for further analyses for moisture content, size, particle density, and bulk density.
b) The speed of the main shaft and the readings of the energy meter shall be recorded.

10.5.2.2 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.

10.5.2.3 The test given in **10.5.2.1** shall be repeated for half an hour with the feed rates 80%, 90%, 110%, 120% of the rated capacity declared by the manufacturer by adjusting the inlet chute of the hopper.

10.5.2.4 The pellets shall be cooled in ambient conditions. The moisture content of pellets shall be less than 9%.

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

10.5.3 *Performance Evaluation of Machine*

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

10.5.3.1 *Rated capacity*

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

where

C = Capacity of the machine, kg/h
W_i = Weight of material fed, kg
T = Time taken to form pellets from the input material, h
M_o = mass of output pellets of desired size from the samples taken for analysis, kg
M_t = Mass of sample taken for analysis, kg

10.5.3.2 *Size of pellets*

The sample for determination of size of pellets shall be prepared in accordance with IS17643. The length and diameter of pellets shall be measured by using vernier calliper. The length of a pellet shall be measured along the axis of the cylinder. The diameter shall be measured perpendicular to the axis (as per IS 17643). The size of pellets shall be in range of 6 mm to 20 mm diameter.

10.5.3.3 *Biomass loss*

$$Biomass\ Loss\ (kg) = M_i - M_o$$

10.5.3.4 *Efficiency*

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

where

M_i = mass of input biomass on moisture-free basis, kg

M_o = mass of output pellet of desired size on moisture-free basis before drying, kg

10.5.3.5 *Bulk density*

The bulk density of the pellets shall be determined in accordance with IS 17642. The bulk density should be ≥ 600 kg/m^3.

10.5.3.6 *Particle density of pellets*

The particle density of the pellets shall be determined in accordance with IS 17642.

10.5.3.7 *Hardness of pellets*

Hardness is evaluated by using Texture Analyser using Textural Profile Analysis test (TPA). A single pellet shall be placed on its sample platform. The constant load at a rate of 0.2 mm/s shall be applied using TPA equipped with a 500 kg load cell. The hardness is measured in a compression mode by taking the minimum load to cause bio-yield resulting in crack or breaking of the pellets. This force shall be taken as a measure of pellet hardness. Twenty pellets from each run shall be used for the average hardness**.**

10.5.3.8 *Mechanical durability*

It shall be determined in accordance with IS 18557 (Part 1). The mechanical durability of pellets shall be ≥ 95% mass.

10.5.3.9 *Gross calorific value*

The gross calorific value shall be determined by using bomb calorimeter in accordance with IS17654.

10.5.3.10 *Moisture content of dried pellets*

The moisture content of final dried pellets shall be determined by oven dry method in accordance with IS17655 (Part 3).

10.5.3.11 *Fines content in the pellets*

The fines fraction and the coarse fraction in the total mass of all fractions shall be determined in accordance with IS 17656. The difference between the total mass of the test sample and total mass of all fractions (coarse and fines) shall be calculated and expressed as the difference in percent of mass of the test sample. If the difference is larger than 10%, the causes for the deviation shall be investigated and the determination shall be repeated. If this is impractical or the difference after repeated determination still exceeds a mass fraction of 10% of the mass of the test sample, the size of the difference in % mass fraction of the test portion shall be reported together with the fines content. The fines percentage shall be ≤ 10%.

10.5.3.12 *Specific energy consumption*

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

where

*S*p = 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

10.5.3.13 *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.

10.6 Long-Run Test (Endurance Test)

The pelletizer shall be operated for at least 20 hours at no 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.

11 SUMMARY REPORT

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

12 MARKING AND PACKING

12.1 Marking

Each pelletizer 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) Direction of rotating parts

12.2 A minimum cautionary notice shall be written in vernacular language legibly and prominently on the main parts of pelletizer:

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;
g) Do not put or take-off belt while pulley is running; and
h) Wear protection (cap) for long haired person.

12.3 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.

12.4 Packing

The pelletizer 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.	*Title*
IS 210:2009	Grey iron castings — Specification (*fifth revision*)
IS 319:2007	Free cutting brass bars, rods and section — Specification (*fifth revision*)
IS 816:1969	Code of practice for use of metal arc welding for general construction in mild steel (*first revision*)
IS 1030:1998	Carbon steel castings for general engineering purposes — Specification (*fifth revision*)
IS 2062:2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
IS 17642:2021 ISO 17828 : 2015	Solid biofuels — Determination of bulk density
IS 17643:2021 ISO 17829 : 2015	Solid biofuels — Determination of length and diameter of pellets
IS 17654:2021 ISO 18125 : 2017	Solid biofuels — Determination of calorific value
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 17656:2021 ISO 18846 : 2016	Solid biofuels — Determination of fines content in samples of pellets
IS 18557 (Part 1):2024 ISO 17831-1	Solid biofuels — Determination of mechanical durability of pellets and briquettes Part 1 pellets
Doc. No. FAD 20 (27725)	Plant layout optimal process for manufacture production of pellets — Guidelines
Doc. No. FAD 20 (27728) WC	Biomass pelletiser- ring die type — Specifications and test code
ISO 6508-1 : 2023	Metallic materials — Rockwell hardness test — Part 1: Test method
Doc. No. FAD 20(27725)WC	Plant layout & optimal process for production of biomass pellets – guidelines
Doc. No. FAD 20(27728)WC	Biomass Pelletiser – Ring Die Type – Specifications and Test Code

ANNEX B
(*Clause* 10.1.2 & 10.3.1)
SPECIFICATION SHEET

B-1 General

a) Name and Address of manufacturers
b) Make
c) Type
d) Size of piston (Diameter), mm
e) Hopper capacity, m^3
f) Height of hopper from ground level, mm
g) Provision for elevator, mm

B-2 Power Unit

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

B-3 Overall Dimensions of the machine

a) Length, mm
b) Width, mm
c) Height, mm
d) Discharge ground clearance, mm
e) Total mass, kg

B-4 Main drive

a) Type
b) Diameter of pulley (Φ), mm
c) No. and size of belts

B-5 Compression and Extrusion

a) Size of the crank block
b) Size of main shaft (Diameter and Length) mm
c) Piston rod length, mm
d) Piston stroke length, mm
e) Cylinder wall sleeve material
f) Cylinder head size
g) Size of connecting rod
h) Size of lubrication oil inlet,
j) Type of lubrication oil

B-6 Feeding Arrangement

a) Type of feed mechanism
b) Size of feeding inlet
c) Thickness of sheet, mm
d) Ground clearance of feeding, mm
e) Size of screw conveyor blade

B-7 Briquetting/Pellet/outlet Unit

a**)** Size of outlet die

b) No. of outlet holes in the die
c) Size of die holder (D × L), mm
d) Size of the pallets/ briquettes

B-8 Tools, Accessories, Operation Manual and Spare Parts List to be Provided

NOTES

1 The item which is not applicable in a particular pelletizer should be crossed while filling.

2 If any other items are provided, their details should be given.

ANNEX C
(*Clause* 10.3.2)
DATA SHEET FOR MATERIAL OF CONSTRUCTION

Sl No.	Component	Material
(1)	(2)	(3)
1.	Bush	
2.	Connecting rod	
3.	Crank shaft	
4.	Cylinder liner/sleeve	
5.	Die Holder	
6.	Feed hopper	
7.	Feeder box	
8.	Flywheel/Pulley	
9.	Main Body	
10.	Pellet Die	
11.	Piston rod	
12.	Punch/Tikki	
13.	Ram	
14.	Other data if any	

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

ANNEX D
(*Clause* 10.3.3)
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) Feed rate
b) Screw speed
c) Speed of piston, stokes/min
d) Cutter blade speed
e) Length speed
f) Compression ratio

ANNEX E
(*Clause* 10.4.1 & 10.4.2)
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* 10.2.1 & 10.5.2.5)
DATA SHEET FOR TEST AT LOAD

F-1 Details of Power Supply

F-2 Power Rating, kW

F-3 Type of Drive

F-4 Composition of Feed, %

F-5 Moisture Content of Feed, %

F-6 Moisture Content of Pellets, %

F-7 Size of Pellets (Diameter & Length), mm

F-8 Speed of Shaft, rpm

F-9 Atmospheric Conditions:

a) Temperature
b) Relative humidity

F-10 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. and quantity of samples	Pellet output, kg
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
								1. 2. 3. 4.	

F-11 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) Other observation (if any)

ANNEX G (doubt in reference)
(*Clause* 10.2.1 & 10.5.3.13)
DATA SHEET FOR EFFICIENCY, CAPACITY AND POWER REQUIREMENT

Sl No.	**Item**	**Test No.**				
		1	**2**	**3**	**4**	**Etc.**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Feed rate, kg/h					
2.	Average size of pellet, mm (length and diameter)					
3.	Moisture content of dried pellets, %					
4.	Biomass Loss, kg					
5.	Efficiency, %					
6.	Bulk Density, kgm^{-3}					
7.	Particle density, kgm^{-3}					
8.	Hardness, N					
9.	Mechanical durability, %					
10.	Shatter loss, %					
11.	Gross calorific value, kcal/kg					
12.	Fines content in pellets, %					
13.	Percentage of weight loss during drying					
14.	Power requirement, kW					
15.	Rated capacity, kg/h					

ANNEX H
(*Clause* 10.6)
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 11)
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) Screw speed

(take from previous annex)

J-8 Power Requirements, kW

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

J-9 Average Size of Pellet (Diameter and Length), mm

J-10 Biomass Loss, kg

J-11 Gross Calorific Value, kcal/kg

J-12 Mechanical Durability, %

J-13 Fines Content, %

J-14 Efficiency, %

J-15 Rated Capacity, kg/h

J-16 Specific Capacity, kg/kWh

J-17 Specific Energy Consumption, kWh/kg

J-18 Compression Ratio

J-19 Any Marked Observation Affecting Performance.

J-20 Any Major Breakdowns During Test

J-21 Other Observations, If any.