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**BUREAU OF INDIAN STANDARDS**

**DRAFT FOR COMMENTS ONLY**



# *भारतीय मानक मसौदा*
# बायोमास पेलेटाइज़र – रिंग डाई प्रकार – विशिष्टि और परीक्षण संहिता

*Draft* ***Indian Standard***
# BIOMASS PELLETISER – RING DIE 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

(*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.

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

Therefore, 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(27729)WC Biomass Pelletiser – Crank-Piston-Cylinder Type – Specification 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 ring die 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

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 Feed mechanism** – The mechanism meant for uniform feeding of the hammered biomass into the pelletiser and regulating the feed rate.

**3.2 Pelletiser –** An equipment used to densify the biomass into small, uniform pellets for easier handling, storage and use, often for fuel or industrial applications.

**3.3 Mechanical Durability** – The ability of pellets to remain intact when handled, such as during storage, transport, or agitation and a quality parameter which is measured by how well the pellets resist shocks and friction.

## 4 TYPES

**4.1** Based on the position of die, the ring die pelletizer shall be of following types:

**4.1.1** *Vertical Ring Die Pellet Mill*

A Vertical Ring Die Pellet Mill is a specific kind of pelletizing machine mainly used to produce biomass pellets. In this design, the ring die is static and is placed in horizontal plane, while the rotating compression rollers are mounted on a vertical shaft and rotate in horizontal plane to apply pressure for pellet formation. The rollers apply pressure to the raw materials, pushing them through the holes in the die to form pellets. A rotating blade cuts the pellets in the desired size. This vertical setup improves gravity-assisted material flow, which in turn boosts the overall efficiency of the pelletizing process.

**4.1.2** *Horizontal Ring Die Pellet Mill*

A Horizontal Ring Die Pellet Mill is a specialized machine to produce biomass fuel and feed pellets. The ring die rotates in vertical plane mounted on a horizontal shaft. The rotating compression rollers are mounted on horizontally placed shafts and rotate in vertical plane to apply pressure for pellet formation. The process starts with a feeding auger that delivers raw material into a sealed chamber, where it is softened and compressed under high pressure between the rotating ring die and rollers. This compression forms cylindrical pellets through the die's holes, which are then cut to length by a fixed blade before being discharged.

## 5 MATERIALS

**5.1** The components of the pelletiser shall be made from materials 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/Grade | Ref to Indian Standard |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1. | Compression roller | 20CrMnTi | IS 3077 |
| 2. | Die cover | SS 202 | IS 6911 |
| | | SS 304 | IS 6911 |
| 3. | Feed hopper | SS 304 | IS 6911 |
| | | SS 202 | IS 6911 |
| 4. | Gear | 20CrMnTi | IS 3077 |
| | | 20MnCr5 | - |
| 5. | Gear box | Cast iron (FG 260) | IS 210 |
| 6. | Main housing (Bearing Chamber) | EN 8 | - |
| | | Mild Steel | IS 2062 |
| 7. | Main shaft | EN8 | - |
| 8. | Pellet cutting blade | SS440 | IS 6911 |
| | | SS410 | IS 6911 |
| | | SS304 | IS 6911 |
| 9. | Ring Die | 20CrMnTi | - |
| | | X46Cr13 | - |
| 10. | 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 percentage of fines in pellets should be ≤ 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, however, 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 **10.5.3.8**.

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

**6.7** The life cycle of ring die should be reported by the manufacture for biomass used for testing. The variation in the efficiency, rated capacity, specific energy consumption shall be recorded during the long run test (*see* **10.5.3**) and the shall not be more than 5% with respect to the values as declared by the manufacturer.

## 7 CONSTRUCTION REQUIREMENTS

### 7.1 Frame

The frame shall be designed to resist deformation under the high forces exerted during pelleting.

### 7.2 Hopper

The feed hopper should have minimum thickness of 1.5 mm and that of ring die cover shall be not less than 4 mm. The material of the hopper & ring die cover should be hard enough to withstand contact with raw biomass and mechanical components without undue wear and rusting.

### 7.3 Feeding System

The feeding system shall be able to maintain consistent and uniform material flow into the pelleting chamber. It shall be designed in a way that it can accommodate all types of biomass.

### 7.4 Main Shaft and Drive Mechanism

The shaft should have the hardness not less than 40 HRC for resistance to wear and impact stress when determined as per the method prescribed in ISO 6508 (Part 1).

### 7.5 Ring Die

The ring die shall have a surface hardness in between 50 HRC to 60 HRC when determined as per the method prescribed in ISO 6508 (Part 1) in order to withstand the high pressures involved in pellet formation and to reduce wear from the constant friction during the extrusion process. The die holes should be uniformly shaped and spaced, with the die surface case hardened to prevent deformation under load.

### 7.6 Compression Rollers

Rollers shall be surface case hardened, and surface hardness of the rollers shall be in between 50 HRC to 60 HRC when determined as per the method prescribed in ISO 6508 (Part 1) to withstand the high pressure exerted during the compression process while maintaining effective functioning over extended periods.

### 7.7 Cooling System

The cooling system components (such as air cooler, radiator, etc.) shall be provided and it shall be able to maintain the cooling oil temperature at below 90°C.

### 7.8 Power Transmission

**7.8.1** Suitable system for transmitting the power shall be provided with heavy duty gear drives for main components, V-belt & pulley or sprocket & chain drive for feeding system and other components.

**7.8.2** 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.

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

**7.8.4** 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.

**7.8.5** 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** Provision shall be made for the lubrications of bearing, and the bearing shall be dust proof.

**8.2** The rotor shaft of the main/transmission shaft shall be finished to close tolerance at the bearing, and the bearings shall be properly aligned.

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

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

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

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

**8.7** Dust collector (such as fans, ducts, etc.) should be provided for the safety of bearings.

## 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 ring die 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 Ring Die 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*

The 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 in between 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 ring die pelletizer shall be run at no-load for minimum of 30 minutes at the rated speed for four 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 % to 14%). If moisture content is high, material shall be dried to bring it to sufficient moisture content through natural or mechanical drying.

**10.5.2** *Operation and Collection of Data*

After the stabilization of the operation, the ring die 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 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.

With the help of in-feed screw, the dried and granulated raw material is 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 compressive force exerted by the rollers, eliminating the use of binding agents. In the last step, the pellets come out from the pelleting machine.

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

Three sets of product samples each weighing 2 kg shall be taken from the outlet for each run for further analyses for moisture content, particle size, particle density and bulk density.

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 weighed 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 30 minutes with the feed rates 80, 90, 110, 120 percent of the rated capacity declared by the manufacturer by adjusting the inlet opening of the hopper.

**10.5.2.4** The pellets shall be cooled in ambient conditions. The moisture content of pellets shall be more 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

$C$ = Rated 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 in 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. The density shall be ≥ 1100 kg/m$^3$.

**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. The diameter of compression plate shall be more the pellet diameter.

**10.5.3.8** *Mechanical durability*

It is the ability of pellets to remain intact when handled, such as during storage, transport, or agitation. It's a quality parameter that's measured by how well the pellets resist shocks and friction. The mechanical durability of pellets shall be determined in accordance with IS 18557 (Part 1).

**10.5.3.9** *Gross calorific value*

The gross calorific value shall be determined by using bomb calorimeter in accordance with IS 17654.

**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.

**10.5.3.12** *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

$\eta_{load}$ = Efficiency of prime mover at load, (0.90, if not specified)

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

$Q$ = throughput of the machine, kg/h

NOTE — Reference for the efficiency of the prime mover at load and at no load has been taken from IS 14442.

**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**

The ring die pelletizer shall be operated for at least 20 h at no load. The period should be covered by a continuous run of at least 5 h. 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**

The 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 rated capacity, kg/h
d) Specific energy consumption, kWh/kg
e) Type
f) Model Number
g) Year of manufacturing
h) Direction of rotating parts

### 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 ring die 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 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 3077:2022 | Roasted and ground coffee — Specification (*third revision*) |
| IS 6911:2017 | Stainless steel plate, sheet and strip — Specification (*second revision*) |
| IS 14442:2024 | Agricultural produce milling machinery — Burr mill — Specification and test code (*first revision*) |
| IS 17642:2021<br>ISO 17828 : 2015 | Solid biofuels — Determination of bulk density |
| IS 17643:2021<br>ISO 17829 : 2015 | Solid biofuels — Determination of length and diameter of pellets |
| IS 17654:2021<br>ISO 18125 : 2017 | Solid biofuels — Determination of calorific value |
| IS 17655 (Part 3):2025<br>ISO 18134-3 : 2023 | Solid biofuels — Determination of moisture content Part 3 Moisture in general analysis sample (*first revision*) |
| IS 17656:2021<br>ISO 18846 : 2016 | Solid biofuels — Determination of fines content in samples of pellets |
| IS 18557 (Part 1):2024<br>ISO 17831-1 | Solid biofuels — Determination of mechanical durability of pellets and briquettes Part 1 Pellets |
| ISO 6508-1 : 2023 | Metallic materials — Rockwell hardness test — Part 1: Test method |
| FAD20(27725)WC | Plant layout & optimal process for production of biomass pellets – guidelines |

# 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 ring/die/rollers (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
d) Type of gears and gearbox

## B-5 Pelletizing and Extrusion

a) Size of the ring
b) Others

## 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 Performance Parameters

a) Rated capacity, kg/h

b) Efficiency, %
c) Specific energy consumption, Wh/kg

## B-9 Tools, Accessories, Operation Manual and Spare Parts List to be Provided

NOTES
1 The item which is not applicable in a ring die 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. | Compression roller | |
| 2. | Die cover | |
| 3. | Feed hopper | |
| 4. | Gear | |
| 5. | Gear box | |
| 6. | Main housing (Bearing Chamber) | |
| 7. | Main shaft | |
| 8. | Pellet cutting blade | |
| 9. | Ring Die | |

NOTE — Delete the component which is not applicable to a ring die 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 of:

a) Feed rate
b) Speed of ring die
c) Speed of roller
d) Speed of cutter blade
e) Screw speed
f) Length of pellet

# 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**

**F-8 Speed of Shaft**

**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.<br>2.<br>3.<br>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

(*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 & 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**

**J-16 Any Marked Observation Affecting Performance.**

**J-17 Any Major Breakdowns During Test**

**J-18 Other Observations, If any**