

TEST CODE FOR BURR MILL

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FOREWORD

Milling of agriculture produce to grits and flours is an essential unit operation towards making them suitable for human consumption and for feed. Main machinery used in the process include : (1) burr mill (2) hammer mill (3) pin mill (4) disc mill (5) ball mill etc.

This test code has been developed for a burr mill. These could either be horizontally laid or vertically laid grinding surfaces type. In reporting the results of a test or analysis made in accordance with the standard, if the final value observed or calculated is to be rounded off, it shall be done in accordance with IS : 2 : 1960.

1. SCOPE

- 1.1 This test code prescribes method for testing of burr mills in order to have uniformity in reporting of test results of different burr mills. This would, therefore, ensure comparison between various designs/makes of burr mills.

2. REFERENCE

- 2.1 The relevant standards of the Bureau of Indian Standards are necessary adjunct to this standard.

3. TERMINOLOGY

- 3.1 For the purpose of this standard, the following definitions shall apply :

3.2 Capacity

The quantity of the agricultural grains ground in kg/h units into satisfactory quality of the final product.

3.3 Product Quality

Quality of the finished product shall be specified in the form of mean diameter of the particles obtained through sieve analysis and represented either in mm units or in microns.

4. SELECTION AND SPECIFICATION OF BURR MILL

4.1 Selection

For commercial test report or for certification purposes, the burr mill shall be selected from the series production by the testing authority. For this purpose, the sample would be randomly selected of the available lot. In case of testing of the lot, samples could be drawn randomly using the following relationship :

$$n = (N)^{\frac{1}{2}}$$

Where, n = number of machines to be tested
 N = total number produced in a lot.

4.2 Specification and other Literature

The manufacturer/supplier shall provide all literature, operation manual and specification sheet (as given in Annexure-A) duly filled in. The manufacturer/supplier shall indicate the maximum input capacity, rated capacity, and output capacity and furnish any additional information which might be required to carry out the tests.

5. TESTS

5.1 General

- a) Checking the specification
- b) Checking the material
- c) Visual observation and checking of provision for adjustment of feed rate, clearance setting etc.

5.2 Test at no Load

- a) Power consumption
- b) Visual observation
- c) Noise
- d) Vibration

5.3 Test at Load

- a) Determination of capacity
- b) Determination of particle size distribution in the product
- c) Determination of power requirement and specific energy consumption
- d) Temperature rise between flour and feed material
- e) Visual observations
- f) Material retention

5.4 Long-run Test

6. PRE-TEST OBSERVATIONS

6.1 Determination of Feed Quality

The feed for which test is to be done shall be free from

foreign matter such as chaff, stone particles, pieces of metals, mud particles and other agricultural grains. It should be graded before tests.

6.2 Determination of Moisture Content

The feed shall be examined for moisture content determination in accordance with the appropriate Indian S standards. The moisture content shall be expressed in percentage wet basis.

6.3 Determination of Particle Size in Feed

Mean diameter of particles in feed shall be determined by standard sieve analysis and shall be reported in mm or in micron units

6.4 Determination of Feed Variety etc.

The feed shall also be assessed for its type and crop variety. Also the general condition of the feed such as, extent of damage due to insects, moulds and fungi etc. be reported.

7. RUNNING-IN AND PRELIMINARY ADJUSTMENTS

7.1 The burr mill shall be installed on level and preferably on hard surface. All the adjustments shall be made in accordance with the recommendations of the manufacturer.

7.2 The burr mill shall be attached with a suitable prime mover preferably with an electric motor of capacity recommended by the manufacturer and auto voltage stabilizer. A suitable size wattmeter or energy meter shall be fitted. The power delivered to the burr mill may be supplied in the following ways:

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

7.3 The burr mill shall be run - in without load before commencing of the tests. The running-in shall be carried out in accordance with the recommendations of the manufacturer. In the absence of the recommendations, the running-in shall be carried out for 30 min. During the period of run-in, adjustment for various functional components may be done. All the adjustments shall be in accordance with instructions obtained from the Instructions Manual supplied by the manufacturer.

8. GENERAL TESTS

8.1 Checking of Specifications

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

8.2 Checking of Material

The material of construction of various components of the machines shall be checked and reported in data sheet given in Annexure-C.

8.3 Visual Observations and Checking of Provision for Adjustments

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

9. TEST AT NO LOAD

9.1 Speed of Operation

The speed of operation of the main shaft and the feed agitator shall be measured and reported in rpm using a good quality tachometer.

9.2 Power Requirement / Energy Consumption

On running the burr mill at no load for atleast half-an hour, at the specified rpm of the grinding surfaces and record the readings of the energy-meter or the watt meter at an interval of one min for 15 min. In case of energy meter, the readings shall be recorded every 5 min for a period of 30 min.

9.3 Visual Observations

During and after completing power requirement test, the observations given in item (2) of Annexure-E shall be made visually and recorded.

9.4 Noise

The level of noise produced by the machine should preferably be recorded using a noise level meter and shall be reported in dB. The measurements should be done at radius of 2 m and 4 m from centre of the machine at 30° intervals. In case instrumentation is available, data would also be collected on dust level and vibration level produced by the machine at no-load and load conditions.

10. TEST AT LOAD

10.1 Test Material

The test material shall be cleaned seed or kernels. Wheat, sorghum, dehusked splits of chickpea and coriander shall

be preferred. The quantity shall be sufficient to work the burr mill for a period of 90 minutes after reading the normal working condition.

10.2 Condition of Moisture Content

The material for test should be at 8-10% moisture content, wet basis, or as specified by the manufacturer.

10.3 Operation and Collection of Data

The burr mill shall be operated at its specified speed and at appropriate clearance (between grinding surfaces) after achieving the normal steady state operation for 30 minutes at a feed rate slightly below 90% of its specified capacity. During the run period, collect the following samples and data :

- a) Three sets of samples of the flour at an interval of 10 min each
- b) The power requirement
- c) The speed of main shaft, and
- d) Temperature of the feed, and that of the flour at an interval of 5 min each

10.3.1 At the end of 30 minutes feeding, run the burr mill for some time so that practically no more material already fed comes out. In case the mill has a large casing, this should be opened to clear all the ground material resting inside. It should be weighed and recorded.

10.3.2 The test given at 10.3 and 10.3.1 be repeated for minimum of 2 times at 100 and 110% of the capacity declared by the manufacturer. The data shall be recorded in accordance with Annexure-F.

10.4 Analysis of Samples

10.4.1 Determination of flour particle size distribution

Standard IS test sieves be used for sample analysis and the distribution be expressed in the following forms:

- Average particle size
- Fineness Modulus
- Uniformity Index

10.5 Energy Consumption

Energy consumption for milling by the tested machine be specified in the form of specific energy for milling as follows :

$$Sp = \frac{P_{\text{load}} \times \eta_{\text{load}} - P_{\text{no load}} \times \eta_{\text{no load}}}{Q}$$

Where,

Sp = Specific energy for milling, Wh/kg

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

P_{no load} = Wattmeter reading (average) at no load, W

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

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

Q = Throughput of the machine, kg/h

Rise in Temperature of the Product

Ideally the mill should not allow rise in the material temperature on processing. However, in practical situations this is not so. Hence, thermometers would be used to measure the temperature of the product at an interval of 1 min from start till 30 minutes of operation. The temperature rise would be calculated as :

Temp. rise (°C) = [Temp. of flour (°C) - Temp. of feed (°C)]

Lesser the rise in temperature measured after 30 min of continuous operation, better is the machine.

10.6 Rated Capacity

Select the feed rate at which specific energy consumption of the machine (for milling) is minimum and at the same time the machine runs without much of noise and problems.

11. LONG RUN TEST

The burr mill shall be operated for a minimum period of 24 hours at no load. This period shall be covered in a maximum of 6 continuous runs of 4 hours each. During and after the operation, record of breakdowns, defects developed and repairing made shall be recorded. The quality of the end product shall be analysed.

DATA SHEET FOR MATERIAL OF CONSTRUCTION

| Sl. No. | Component | Material and Specifications | Confirming to BIS |
|---------|---------------------------------|-----------------------------|-------------------|
| 1. | Body/Frame | | |
| 2. | Grinding surfaces | | |
| 3. | Grinding chamber | | |
| 4. | Hopper | | |
| 5. | Feeder channel | | |
| 6. | Outlet chute | | |
| 7. | Clearance variation arrangement | | |
| 8. | Others (please specify) | | |

SPECIFICATION SHEET FOR BURR MILL

1. GENERAL

- a) Make
- b) Model
- c) Serial number
- d) Year of manufacture
- e) Recommended seeds/kernels for grinding
- f) Rated capacity, kg/h
- g) Rated speed of operation, rpm

2. POWER UNIT

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

3. OVERALL DIMENSIONS

- a) Length, mm
- b) Width, mm
- c) Height, mm
- d) Total weight, kg

4. MILLING CHAMBER

- a) Diameter, mm
- b) Width, mm

5. MILLING SURFACES

- a) Material
- b) Diameter, mm
- c) Width, mm

DATA SHEET FOR VISUAL OBSERVATIONS AND ADJUSTMENTS

1. OBSERVATIONS

- a) Adequacy of makings of direction of rotation
- b) Adequacy of protection of bearings against ingress of dust
- c) Adequacy of safety arrangements at moving parts
- d) Provision for lubrication
- e) Provision for easy changing of components requiring replacements
- f) Tightness of belts, nuts/bolts etc.
- g) Other observations

2. ADJUSTMENTS

- a) Feed-rate
- b) Speed of main shaft
- c) Pressure or clearance between grinding surfaces

DETERMINATION OF FINENESS MODULUS AND UNIFORMITY INDEX

Fineness modulus of flour would be determined through analysis of the observations obtained through sieve analysis. Indian Standard sieves of mesh No: 100, 70, 50, 40, 30, 20 and 15 would be used.

Fineness Modulus (FM) = $\frac{1}{100} \times$ sum of cumulative % of material weight retained by the sieves

Uniformity Index : Would be expressed in a ratio form specifically, the ratio of coarse: medium: fine particles in the product

Coarse aggregate : Rounded off weight of material retained by ISS 100, 70, and 50 mesh sieves

Medium aggregate : Rounded off weight of material retained by ISS 40 and 30 mesh sieves

Fine aggregate : The remaining part

Average particle size in feed, mm = 0.135 (1.366) FM