भारतीय मानक **IS 11459 : 2024**

Indian Standard

शक्ति-चलित भूसा कटर — विशिष्टि एवं परीक्षण संहिता

(पहला पुनरीक्षण)

Power-Operated Chaff Cutter — Specification and Test Code

(First Revision)

ICS 65.060

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Agriculture and Food Processing Equipment Sectional Committee, FAD 20

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Agriculture and Food Processing Equipment Sectional Committee had been approved by the Food and Agriculture Division Council.

Power-operated chaff cutters are very commonly used by farmers for cutting the chaff. The chaff cutters vary in dimensions, material of construction and other quality characteristics considerably from manufacturer to manufacturer which causes great inconvenience to the user specially replacement of the components. A need was, therefore, felt for preparation of an Indian Standard to guide the manufacturers to produce quality product and also to help the users in selection of good quality chaff cutters.

This standard was first published in 1985. The first amendment was issued in 1995 to update material required for some of the components. This revision has been taken up to keep pace with the latest technological developments and to update the safety measures in the standard.

In this revision, following modifications have been incorporated in the standard:

a) The test methods applicable for power-operated chaff cutter which were earlier published in IS 7897 : 1975 have been incorporated;
b) The specifications for the blade which were earlier published in IS 1511 : 1979 have been incorporated;
c) Safety requirements applicable to power operated chaff cutter which were earlier covered in IS 15542 : 2005 have been incorporated;
d) The raw material specifications for various components have been incorporated/updated; and
e) Pedestal bearing, discharge box and flywheel cover have been added in the list of components while bush bearing has been removed from the listed components.

Figures given in this standard are meant for illustration of various components and dimensions of chaff cutters and they should not be treated as suggestive of any standard design.

The composition of the Committee responsible for the formulation of this standard is given in Annex J.

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.

Indian Standard

POWER-OPERATED CHAFF CUTTER —SPECIFICATION

(First Revision)

1 SCOPE

This standard specifies material, construction, safety requirements and method of testing for power-operated chaff cutter run by electric motor, diesel engine, tractor PTO or any source providing the required rotary power.

2 REFERENCES

The standards given in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

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

3.1 Feed Rolls — The corrugated rolls, placed one above the other to compress the fodder and to hold it firmly while cutting takes place.

3.2 Throat — The rectangular passage through which the compressed fodder passes for cutting.

3.3 Feed Tray — The component which receives the fodder and feeds it to the feed rolls.

3.4 Cutter Head — The assembly of the components which actually cuts the fodder. This may be cylinder or flywheel type.

3.5 Feed Interference — The obstruction in advancing the fodder against the back of the blades. This occurs if the blade is not properly inclined to the plane of rotation.

3.6 Let-Fall Type — The chaff cutter in which the cut fodder is dropped down to the bottom of chaff cutter.

3.7 Throw-Away Type — The chaff cutter in which the cut fodder is thrown away to the front ward of the chaff cutter.

3.8 Blow-Up Type — The chaff cutter in which the cut fodder is blown up through the blow-up pipe.

3.9 Chute-Fed Chaff Cutter — A chaff cutter in which the feeding of the fodder crop is done through a chute.

3.10 Conveyor Fed Chaff Cutter — A chaff cutter in which the feeding of the fodder crop is done through a conveyor.

3.11 Cylinder Type — A chaff cutter the cutting mechanism of which consists of a rotating cutting cylinder.

3.12 Fly Wheel Type — A chaff cutter having rotating fly wheel with blades.

4 TYPES

4.1 On the basis of cutting mechanism, power-operated chaff cutter shall be of following types:

a) Fly wheel type (*see* Fig. 1B); and
b) Cylinder type (*see* Fig. 1A).

4.2 On the basis of cut-chaff dropping position, power-operated chaff cutter shall be of following types:

a) Let-fall type (*see* Fig. 1B);
b) Throw-away type (*see* Fig. 1C); and
c) Blow-up type.

4.3 On the basis of feeding system, power-operated chaff cutter shall be of following types:

a) Chute-fed (*see* Fig. 1C); and
b) Conveyor-fed (*see* Fig. 2).

5 MATERIALS

5.1 The material for construction of various components of the chaff cutter, other than blade, shall be as given in col (3) of Table 1. The material shall conform to Indian Standards given in col (4) of Table 1.

5.2 The chemical composition of the steels to be used for the manufacture of blades shall be as follows:

a) Carbon steel

1)	Carbon	0.60 percent to 0.90 percent
2)	Silicon	0.10 percent to 0.40 percent
3)	Manganese	0.50 percent to 1.0 percent
4)	Sulphur	0.05 percent, *Max*
5)	Phosphorous	0.05 percent, *Max*

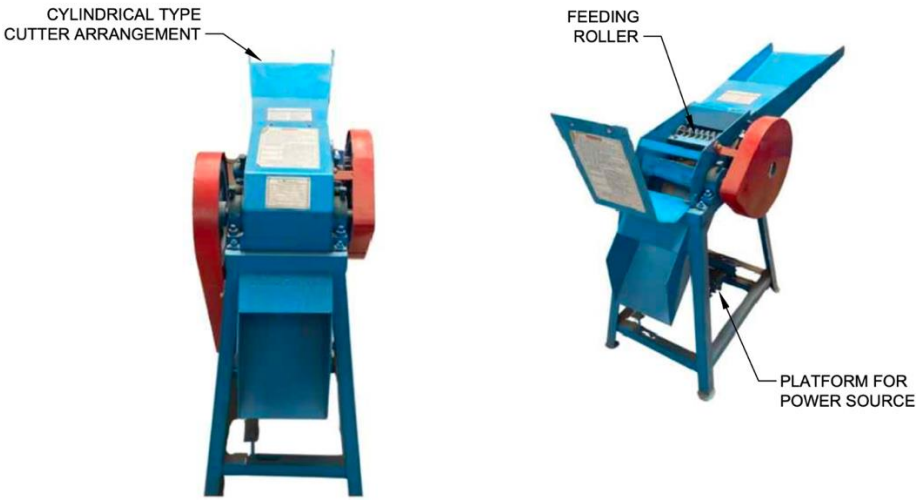


FIG. 1A POWER-OPERATED CYLINDRICAL TYPE

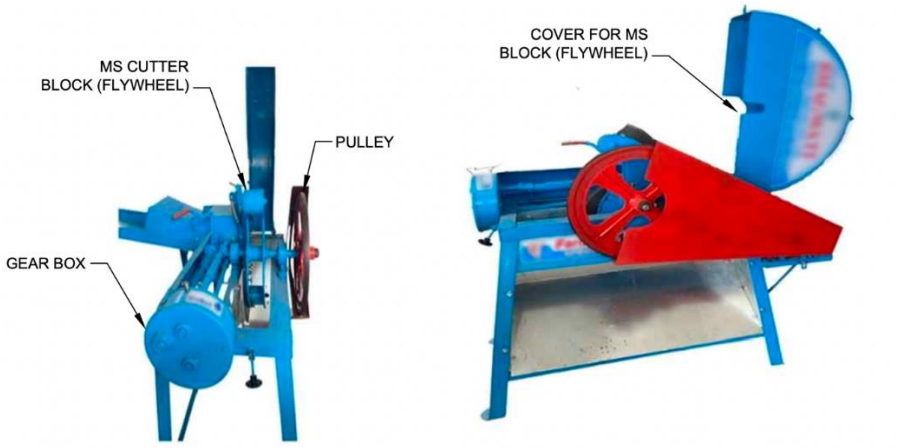


FIG. 1B POWER-OPERATED FLYWHEEL TYPE (MS BLOCK) LET FALL TYPE

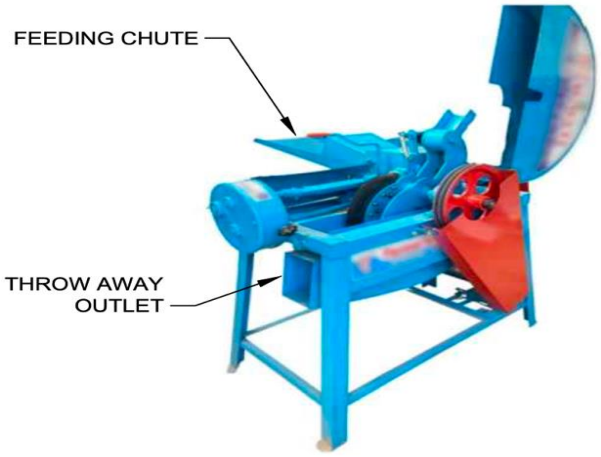


FIG. 1C POWER-OPERATED FLYWHEEL TYPE (MS BLOCK) THROW AWAY TYPE

FIG. 1 POWER-OPERATED CHAFF CUTTER

FIG. 2 CONVEYOR TYPE POWER-OPERATED CHAFF CUTTER

b) Alloy steel

1) Carbon 0.55 percent to 0.90 percent
2) Silicon 0.10 percent to 0.40 percent
3) Manganese 0.50 percent to 0.80 percent
4) Sulphur 0.05 percent, *Max*
5) Phosphorous 0.05 percent, *Max*
6) Aluminum 0.1 percent, *Max*
7) Chromium 0.1 percent to 0.2 percent

5.2.1 Some of the typical steels that may be used for the manufacture of blades are T 65, T 70 Mn 65, T 75, T 60 Mn 65, T 85 and 40Cr1 [*see* IS 1570 (Part 2)].

5.3 All cast iron components shall have a hardness of 160 HB to 220 HB [*see* 1S 1500 (Part 1)].

6 HARDNESS

6.1 The blade shall be either fully or partially hardened.

6.2.1 The fully hardened blade shall be properly and uniformly heat treated to have a hardness of 40 HRC to 45 HRC or 370 HB to 422 HB [*see* IS 1586 (Part 1)].

6.2.2 The partially hardened blades shall be properly heat treated to have a hardness of 40 HRC to 45 HRC [*see* IS 1586 (Part 1)] up to two-thirds portion of the blade from the tip of the beveled edge.

7 CONSTRUCTIONAL REQUIREMENTS

7.1 Cutter Head — It shall consist of fly wheel and blade in case of fly wheel type and cylinder in case of cylinder type.

7.1.1 In case of cylinder types, the cutting reel may be spring-mounted. Provision for adjusting height of reel in contact with throat shall be provided. Provision shall also be made for lubricating bearings at each end of the real shaft.

7.2 Blower — Blower, if provided, shall be centrifugal type with the suitable arrangement for controlling air blast.

7.3 Transmission System — The gears shall properly mesh and shall be suitably covered. Provision shall be made for lubrication. A suitable arrangement shall be provided for clutching or declutching of drive.

7.4 Mounting of Power Source (Motor/Engine) — The power source shall be mounted on a frame made of MS angle (minimum 35 mm × 35 mm × 5 mm). The size of frame will depend on size of motor/engine. The power transmission is through single/double groove V-belt and cast-iron pulley, the pulley of power source shall be of 100 mm diameter. The minimum size of cylinder pulley should be 265 mm diameter.

7.5 Cylinder — The cylinder wheel is fabricated by MS flat seating along the diameter for mounting of chaff blades. One central hole with bush is provided for mounting the main power transmission shaft. Cylinder must be covered fully with MS sheet of minimum 2 mm thickness.

7.6 The requirements pertaining to flywheel, main shaft, worm, worm gear, feed rolls, cover plates, back plate, feeding trough and stand are covered in IS 7898 as these are common to both manually operated and power-operated chaff cutters.

7.7 Allowable deviations for dimensions without specified tolerance shall be as given in IS 2102 (Part 1).

Table 1 Material of Construction

(*Clause* 5.1)

Sl No.	Parts	Material	Applicable Standard
i)	Flywheel	Cast iron	IS 210
		Mild steel	IS 2062
	Flywheel cover	Mild steel	IS 2062
ii)	Cylinder	Mild steel	IS 2062
iii)	Frame	Cast iron	IS 210
		Mild steel	IS 2062
iv)	Cover plate	Cast iron	IS 210
		Mild steel	IS 2062
v)	Shear plate	Cast iron	IS 210
		Mild steel	IS 2062
		Alloy steel	IS 4711
vi)	Feed rolls	Cast iron	IS 210
		Mild steel	IS 2062
vii)	Feed roll shafts	Cast iron	IS 210
		Mild steel	IS 2062
viii)	Spring	Spring steel	IS 4454 (Part 1)
ix)	Tie rod	Cast iron	IS 210
		Mild steel	IS 2062
x)	Worm and worm gear	Cast iron	IS 210
xi)	Legs	Mild steel	IS 2062
xii)	Leg support	Mild steel	IS 2062
xii)	Shaft and axles	Mild steel	IS 2062
xvi)	Pedestal bearing	Alloy steel	IS 4711
xvii)	Feeding chute	Mild steel	IS 2062
		CRCA sheet	IS 513
xviii)	Fingers, If separate	Cast Iron	IS 210
xix)	Blade cover	Mild steel	IS 2062
		Plastic	-
xx)	Pulley	Cast iron	IS 210
xxi)	Blower	Mild steel	IS 2062
		CRCA sheet	IS 513
xxii)	Discharge box	Mild steel	IS 2062
		CRCA sheet	IS 513
xxiii)	Belts	Textile belts	IS 1891 (Part 1)

7.8 Feeding Systems — The feeding system in the chaff cutter shall be of chute or conveyor type. The minimum length of chute and conveyor shall be 900 mm and 1 200 mm respectively. The chute or conveyor shall be covered up to a minimum of 450 mm near feed roll side. In case of chaff cutter with conveyor feeding, a feed reversing device may be provided.

7.8.1 *Requirements of Feed Reversing Device*

7.8.1.1 *Construction*

It comprises a feed pressing roller, two corrugated feed rollers and conveyor with power transmission system. For this type of chaff cutters with power ratings of 15 kW or more, a feed reversing mechanism is recommended. It comprises of a gear box, a clutch lever and two joining shafts with universal joints (*see* Fig. 3). In some chaff cutters fast and loose pulleys to cut-off the drive to the upper and lower feed rollers are also used. In the feeding system with feed reversing mechanism, if the hand of an operator gets entrapped, the clutch lever is pressed by his hand or shoulder and the drive to the feed roller is cut-off in the neutral position or the direction of the upper and lower feed rollers is reversed.

7.8.1.2 *Material*

The material for various components used in the construction of feed reversing device shall be as given in col (3) of Table 2.

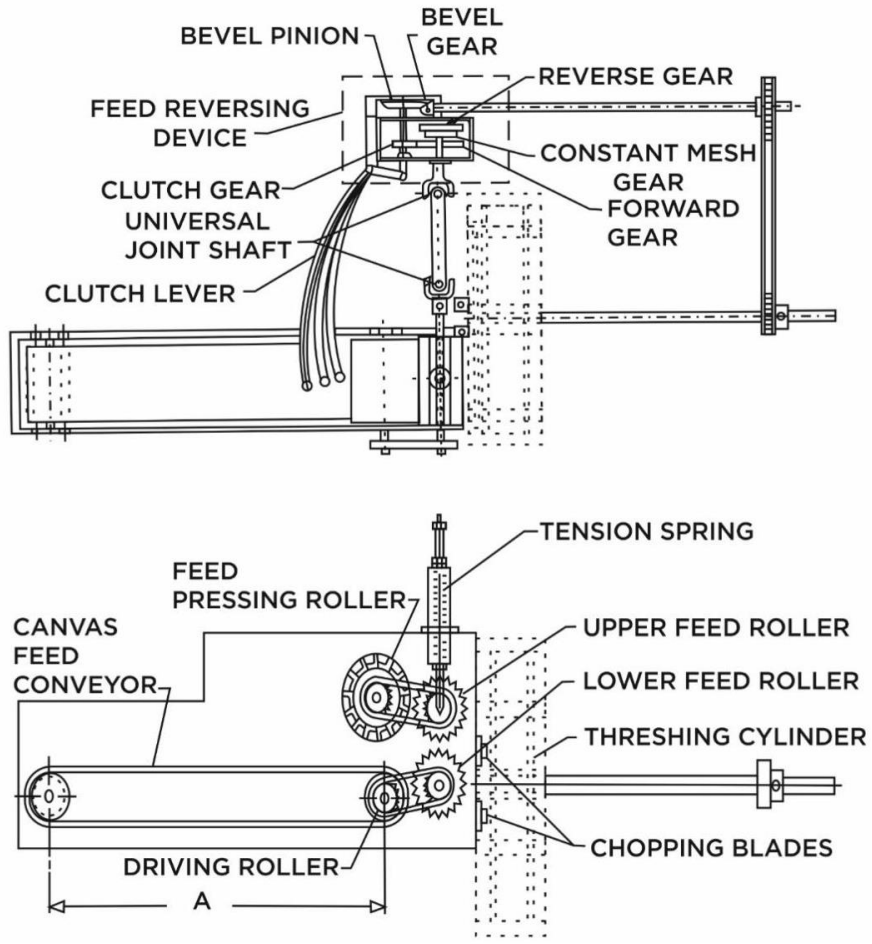


FIG. 3 FEED REVERSING MECHANISM FOR CONVEYOR FED CHAFF CUTTER

Table 2 Material of Construction of Feed Reversing Device

(*Clause* 7.8.1.2)

Sl No.	Component	Material	Relevant Indian Standard
(1)	(2)	(3)	(4)
i)	Conveyor	Canvass, rubber Mild steel slats	IS 1891 (Part 1) IS 2062
ii)	Driving roller	Cast Iron	IS 210
iii)	Pressing roller	Cast Iron	IS 210
iv)	Feed rollers	Cast Iron	IS 210
v)	Tension spring	Spring steel	IS 4454 (Part 1)
vi)	Clutch lever	Mild steel	IS 2062
vii)	Gears	Cast Iron	IS 210
viii)	Gear box	Mild Steel	IS 2062
		Cast Iron	IS 210
ix)	Gear shaft	Mild steel	IS 2062
x)	Stand	Mild steel	IS 2062

7.8.2 *Feed Reversing Device*

7.8.2.1 *Functioning of device* (*see* Fig. 4)

Pinion 'A' receives the drive from the main shaft of the chaff cutter by means of chain and sprocket. Pinion '*A*' meshes with bevel gear '*B*' which is mounted on a counter shaft. On the same shaft a spur pinion 'G' is mounted which slides on splines with the help of a hand lever. When pinion 'G' meshes with the gear 'F on the lower feed shaft, the lower feed roller revolves in clockwise direction and the upper feed roller in anticlockwise direction. This is the feed-in position.

When pinion 'G' is meshed with gear 'C', the direction of rotation of the upper and lower rollers is reversed. In other words, the upper roller rotates in clockwise and the lower roller in anti-clockwise direction. This is the reversed or feedback position and the material being fed moves out instead of moving into the cutting zone chamber.

The third position is when pinion 'G' does not mesh either with gear 'F or 'C'. This is the neutral position. The lever to slide pinion 'G' can be actuated by hand or foot or shoulder.

The details of gears in this system shall be as given in Table 3.

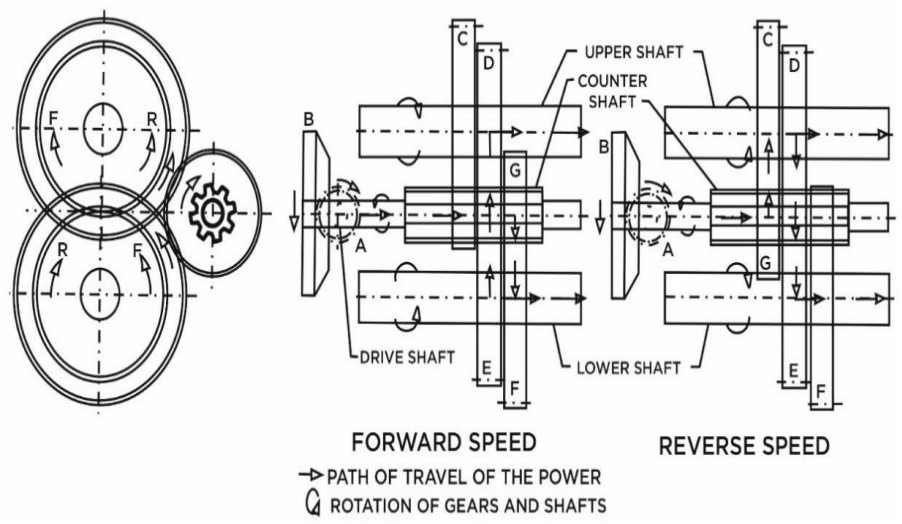


FIG. 4 POWER TRANSMISSION THROUGH FEED REVERSING SYSTEM FOR CONVEYOR FED CHAFF CUTTER

Table 3 Details of Gears in the Feed Reversing Mechanism

(*Clause* 7.8.2.1)

Sl No.	Type of Gear/Pinion	Designation	Shaft on which Mounted
(1)	(2)	(3)	(4)
i)	Bevel gear	A	Splined shaft on main shaft
ii)	Bevel gear	B	Counter shaft
iii)	Spur pinion	C	Counter shaft
iv)	Spur gear	D	Upper feed roller shaft
v)	Spur gear	E	Upper feed roller shaft
vi)	Spur gear	F	Lower feed roller shaft
vii)	Bevel gear	G	Splined shaft on main shaft

7.8.2.2 *Functioning of device* (*see* Fig. 5)

If the roller handle is put in backward direction, bevel gear 'A' which is mounted on splined shaft receives the drive from main shaft. The main shaft moving in anticlockwise direction will rotate bevel gear 'A' also in anticlockwise direction, Bevel gear 'A' meshes with bevel gear 'B' which is mounted on a counter shaft, having at another end a pinion 'C'. This will rotate bevel gear 'B' counter shaft and pinion 'C' in clockwise direction. Gear 'D' meshes with pinion 'C' and rotates in anticlockwise direction. Gears 'D' and 'E' are on the same shaft, hence the direction of rotation of 'E' would also be the same. Gears 'E' and 'F' mounted on upper and lower feed roller shafts, respectively, mesh with each other; therefore, the gear 'F' rotates in clockwise direction. The direction of rotation of upper and lower feed rollers would be the same as that of gears 'E' and 'F'. This is the feed-in position.

If the roller handle is put in forward direction, bevel gear 'G', which is mounted on splined shaft, receives the drive from main shaft and moves in anticlockwise direction. Bevel gear 'G' meshes with bevel gear 'B'. The bevel gear 'B', counter shaft and pinion 'C' will rotate in anticlockwise direction. This will ultimately lead to the rotation of lower feed roller in anticlockwise direction. This is the reversed or feedback position and the material being fed moves out instead of moving into the threshing chamber.

In case the roller handle is kept in central position, feed-reversing mechanism will not operate. This is the neutral position.

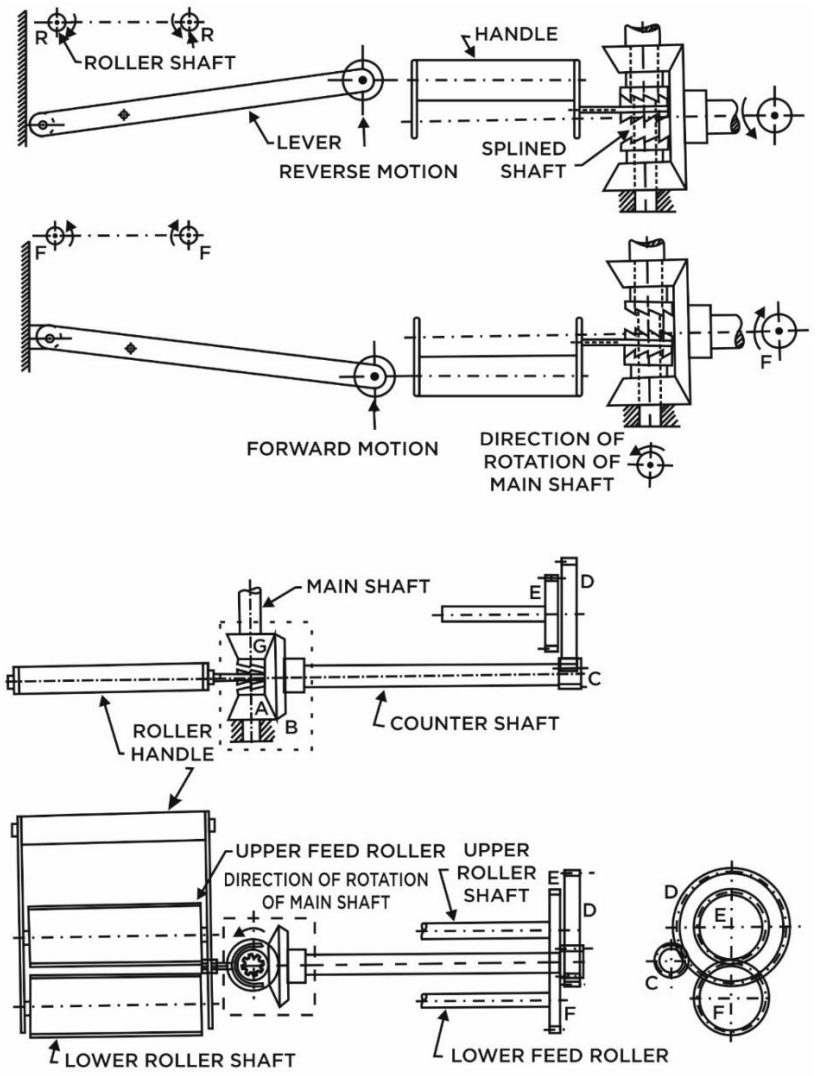


FIG. 5 FUNCTIONING OF FEED REVERSING MECHANISM FOR CONVEYOR FED CHAFF CUTTER

8 SELECTION OF CHAFF CUTTER FOR TEST

8.1 Selection of Sample

The chaff cutter shall be selected at random from the series production by the representative of the testing authority with the consent of the manufacturer. It should be the responsibility of the manufacturer to ascertain that the chaff cutter selected for testing is complete in all respects and necessary adjustments have been carried out in the presence of the representatives of the testing authority.

8.2 Specification and Other Literature — The manufacturer shall supply all literature, operational manual and a detailed drawing. The operational manual shall also contain maintenance instructions, adjustments and safety precautions. The manufacturer shall also supply specification sheet duly filled in as given in Annex B as well as any other information required to carry out the test.

9 TESTS

9.1 Type Tests

9.1.1 *General*

a) Checking of specifications (*see* **11.1**);
b) Checking of material (*see* **11.2**); and
c) Visual observations and adjustments (*see* **11.3**).

9.1.2 *Test at No-Load*

a) Power consumption (*see* **12.1**); and
b) Visual observations (*see* **12.2**).

9.1.3 *Test at Load*

a) Short run tests (*see* **13.1**):

1) Quality of cut (*see* **13.1.5.1**);
2) Quantity of cut (*see* **13.1.5.2**);
3 Power requirement (*see* **13.1.5.3**);
4) Visual observations (*see* **13.1.4.2**); and
5) Blowing efficiency (*see* **13.1.5.7**).

b) Long run tests (*see* **13.2**).

NOTE — Blowing efficiency shall be tested only in blow-up type chaff cutter.

9.2 Routine Tests

a) Checking of specifications (*see* **11.1**),
b) Visual observations and adjustments (*see* **11.3**); and
c) Test at no-load (*see* **12**).

10 PRE-TEST OBSERVATIONS

10.1 Determination of Moisture Content of Chaff — Take about 25 grams from a representative sample of the chaff in a tared aluminium dish having a diameter of at least 50 mm and a depth of about 20 mm. Weigh accurately. Place the dish in an air-oven maintained at 100 °C ± 2 °C and dry for at least 2 hours. Cool in a desiccator and weigh. Repeat the process of heating, cooling and weighing until the difference between two successive weighing is less than one milligram. Calculate the moisture content by the following formula:

$$M = \frac{100 \times (W_1 - W_2)}{(W_1 - W)}$$

where

M = moisture content, percent by mass (wet basis);
W_1 = mass, in g, of the dish with the material before drying;
W_2 = mass, in g, of the dish with the dried material; and
W = mass, in g, of the empty dish.

10.1.1 Moisture determination of five samples shall be done and the average shall be obtained.

10.2 Running-in and Preliminary Adjustments — The chaff cutter shall be new and run-in without load for at least 30 minutes before commencing the test. The adjustment of the speed of shaft/shafts, clearance between rotating and stationary blades, etc, shall be done in accordance with manufacturer's recommendations.

11 GENERAL TESTS

11.1 Checking of Specifications — Check the specifications mentioned by the manufacturer (*see* **8.2**) and record the data in specification sheet as given in Annex B.

11.2 Checking of Material — Check the material for all components and record the observations in data sheet as given in Annex C.

11.3 Visual Observations — Record the observations in data sheet as given in Annex D.

12 TESTS AT NO-LOAD

12.1 Power Consumption

12.1.1 Fix the chaff cutter firmly on level and preferably hard surface. Set the clearance between rotating and fixed blade and make other adjustments in accordance with the manufacturer's recommendations.

12.1.2 Attach the chaff cutter to an electric motor as shown in the circuit diagram given in Fig. 6. The attachment of cutter head with motor may be done by the following ways:

a) Direct coupling the motor with the main axle of the cutter head; and

b) Connecting the motor with the help of flat or V-belt and pulleys with the main axle of the cutter head.

12.1.2.1 In case of **12.1.2(a),** the power delivered to the cutter head would be the power output of the motor; whereas in case of **12.1.2(b),** the allowances for flat belt and V-belt drive losses may be taken as 6 percent and 8 percent respectively.

12.1.3 Run the motor coupled with chaff cutter for about 30 minutes at the speed of the chaff cutter specified by the manufacturer. Record the following:

a) Resistance of the winding of the motor (R ohms);

b) Initial reading of the energy meter (E_1 watthour);

c) Final reading of the energy meter (E_2 watthour); and

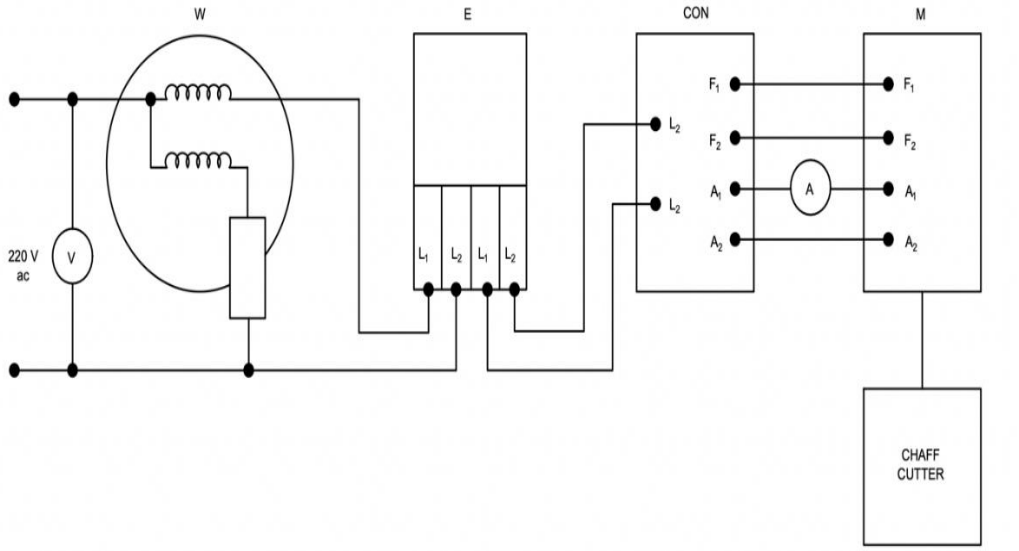
d) Time of run (T_1 minutes).

12.1.4 Calculate the total power at no-load (P_1 *in kW*) by the following formula. Due allowance for type of drive (*see* **12.1.2.1**) shall be given:

$$P_1 = \frac{60 \times (E_2 - E_1)}{1\,000\,T_1}$$

12.1.5 Record the data according to Item **1** of data sheet as given in Annex E.

12.2 Visual Observations — During and after completing power consumption test (*see* **12.1**), the observations given in Item **2** of data sheet as given in Annex E shall be made visually and recorded.



where

V	=	voltmeter, 0 to 300 V, a.c. moving iron type;
W	=	wattmeter, 0 to230 V, single phase, dynamometer type;
E	=	energy meter, 3 ampere, single phase, 1 600 rev/kWh;
CON	=	1.5 kW speed controller;
A	=	ammeter, 0 to10 A; and
M	=	d.c. motor shunt wound, 1.5 kW, 220 V.

FIG. 6 CIRCUIT DIAGRAM

13 TESTS AT LOAD

13.1 Short Run Tests

13.1.1 Install the chaff cutter in accordance with 12.1.1.

13.1.2 Attach the motor in accordance with 12.1.2.

13.1.3 Take sufficient quantity of fodder to be cut from the same variety of crop free from roots. The length of the fodder should, as far as possible, be of the same size. The moisture content of the fodder should be, as far as possible, 75 percent to 85 percent. The fodder should be piled near the feeding tray and should be in bundle form. The mass of the bundle should, as far as possible, be calculated by the following formula:

$$W_3 = 4D$$

where

W_3 = mass, in g, of the bundle; and

D = effective width of feed rolls in mm.

13.1.4 Operate the cutter head at the speed specified by the manufacturer. Ensure that the feeding is done continuously and covers full width and height of the throat. The feed rate specified by the manufacturer may be taken as a guide. The feeding should be done from root side of the fodder. While feeding, rigid plastic pipe of diameter approximately equal to the diameter of the fodder stalk and 2 m in length shall be fed along with the fodder. The duration of the operation shall be not less than 1 hour. The starting and stopping time shall be recorded carefully. The starting time shall be noted when the fodder comes in contact with feed rolls.

13.1.4.1 Before and after the test, record the following data under item 8 of data sheet as given in Annex F:

a) Speed of the cutter in rpm (rev/min);
b) Number of cut pieces of the plastic pipe;
c) Total quantity of the chaff cut in kg;
d) Duration of operation in minutes;
e) Initial and final energy meter reading in kWh; and
f) Height of blowing in m (in case of blow-up type).

13.1.4.2 During and after the above test, the observations given under item 9 of data sheet as given in Annex F shall be made and recorded.

13.1.5 *Calculations* — Calculate the following and record the data in proforma given in item 10 of Annex F.

13.1.5.1 *Quality of cut* — Better quality of cut means least deviation of measured length of cut from the theoretical length of cut. But practically there would be some deviation because of feed interference. Select 25 cut pieces of plastic pipes [*see* **13.1.4.1(b)**] and measure the length of each piece and calculate the quality of work by the following formulae:

$$Q = (1 - \sigma)$$

where

Q = quality of work; and
σ = standard deviation of length of cut.

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - x)^2}{n - 1}}$$

where

n = number of pieces of plastic pipe taken;
i = serial number of cut pieces (1, 2, 3, ...R).
x_i = measured length of cut pieces in mm;
x = theoretical length of cut in mm; and

$$x = \frac{\pi \times D_t \times N_t}{NR}$$

where

D_t = number of pieces of plastic pipe taken;
N_t = measured length of cut pieces in mm;
N = theoretical length of cut in mm; and
R = serial number of cut pieces (1, 2, 3, ...R).

13.1.5.2 *Quantity of cut* — Calculate the quantity of fodder cut per hour of operation by the following formula:

$$W_4 = \frac{60\,A}{T}$$

where

W_4 = quantity of cut in kg/h,
A = measured quantity of cut in kg in T minutes [*see* **13.1.4.1(c)**]; and
T = duration of operation in minutes [*see* **13.1.4.1 (d)**].

13.1.5.3 *Power requirement* — Calculate the power requirement by the following formulae giving due allowances to the type of drive (*see* 13.1.2):

$$P_2 = \frac{60 \times (E_4 - E_3)}{T}$$

where

P_2 = total power consumed at load in kW;
E_4 = final-reading of energy meter in kWh [*see* 13.1.4.1(e)];
E_3 = initial reading of energy meter in kWh [*see* 13.1.4.1(e)]; and
T = Duration of operations in minutes [*see* 13.1.4.1(d)].

$$P_3 = P_2 - P_1$$

where

P_3 = power consumed by chaff cutter in kW;
P_2 = total power consumed at load in kW; and
P_1 = total power consumed at no-load in kW.

13.1.5.4 *Quantity per unit energy consumed* — Calculate the quantity of cut in kg per kilowatt hour energy consumed (W_5) by the following formula:

$$W_5 = \frac{W_4}{P_3}$$

13.1.5.5 *Corrected quantity of cut* — To avoid the variation of moisture content of fodder and the length of cut, the quantity of cut shall be corrected at 0 percent moisture and 20 mm length of cut by the following formula:

$$W_6 = \left[\frac{W_4 \times (100 - M)}{100}\right] \times \frac{20}{L}$$

where

W_6 = corrected quantity of cut in kg/h;
W_4 = quantity of cut in kg/h;
M = observed moisture percent (*see* 10.1); and
L = measured average length of cut in mm.

$$W_7 = \frac{W_6}{P_3}$$

where

W_7 = corrected quality of cut in kg/kWh.

13.1.5.6 *Performance index* — For comparison of performance of the chaff cutter, calculate the performance index (*PI*) by the following formula:

$$PI = \frac{W_4 \times Q}{P_3}$$

13.1.5.7 *Blowing efficiency* — In case of blow-up type chaff cutter, calculate the blowing efficiency by the following formula:

$$\eta = \frac{100\ (2\ gH)}{V^2}$$

where

η = blowing efficiency in percent;
g = acceleration due to gravity;
H = height of blowing up in m [*see* 13.1.4.1(f)]; and
V = circumferential speed of the tip (m/s) of blower.

13.2 Long Run Test — Operate the chaff cutter for a total period of at least 20 hours which should be covered by continuous runs of at least 5 hours each. Record the major breakdowns in data sheet as given in Annex G. The chaff cutter shall meet the following requirements:

a) The variation in length of cut shall be not more than 10 percent; and
b) The blowing efficiency (if applicable) shall be not less than 99 percent.

The visual observation shall not indicate the following:

a) Non-smooth flow of the material through different components;
b) Frequent clogging of throat and feed rolls;
c) Frequent loosening of the fasteners; and
d) Breakdown in any unit of the chaff cutter.

14 OTHER REQUIREMENTS

14.1 The worm gears should as far as possible, be enclosed and should preferably be run on an oil trough.

14.2 The bearings shall be completely enclosed and shall have provision for lubrication.

14.3 Provision shall be provided to change the inclination of the plane of the cutting knives to the plane of rotation of fly wheel to avoid feed interference.

14.4 Provision to change the direction of rotation of feed rolls should be provided.

14.5 Hooks at suitable places may be provided for lifting the chaff cutter for easy movement.

14.6 The maximum height of cranking from ground level shall be within 800 mm to 900 mm. The cranking radius shall be 250 mm to 350 mm.

14.7 All the three sides of shear plate shall be in one plane.

14.8 Operational manual giving operational, maintenance, assembly instructions and adjustments shall be supplied by the manufacturer with each chaff cutter. Instructions for safe operation of chaff cutter shall also be provided.

14.9 Provision for adjustment of the following shall be made:

a) Feed rate;
b) Length of cut;
c) Feed roll clearance;
d) Space between fixed and rotating blades;
e) Air displacement (if applicable); and
f) Direction of rotation of feed rolls.

14.10 If the cutter head is open, arrangement shall be made for locking it with the stand and the cutting edge of the blade shall be covered.

14.11 Various controls shall be easily accessible and capable of being locked in a chosen position.

14.12 Suitable guards shall be provided on the transmission system of the chaff cutter.

15 SAFETY REQUIREMENTS

15.1 Each power-operated chaff cutter shall be provided with safety provision as given below:

16.1.1 *Blade Guard* — It prevents direct contact of blade in case body part is inserted from blade side (Fig. 7). It consists of a guard made up of mild steel sheet and can be attached to the two existing blade bolts. It can be un-flapped while sharpening the blade. The details of blade guard are given in Fig 7.

15.1.2 *Warning Roller* — A warning roller which is a sort of idler roller with spring (*see* Fig. 8) may be fitted just before the feeding rollers to warn the operator while feeding the fodder crop into the chaff cutter. It may be a conduit GI pipe roller closed at both ends. The upward movement of warning roller shall be controlled by the cam, which lifts the roller when the straw is pushed into the mouth of the chaff cutter. When the chute is empty, the roller shall come down with the help of springs provided for the purpose. The minimum diameter of the roller shall be 40 mm. Warning roller can be used as an alternate to cover chute. Centre shaft and cam lever should be made of mild steel (*see* IS 2062) and pivot axle/adjusting rod should be made of GI pipe.

15.1.3 *Gear Cover* — Warm and pinion assembly shall be covered from all the sides by a metal sheet.

15.1.4 *File Safety Guard* — A guard on sharpening file should be provided to prevent injuries on knuckles of fingers while sharpening the blade.

15.1.5 *Feeding Chute Cover* — The trough on the shear plate side shall be covered up to a length of 450 mm *Min.* The thickness of the chute cover shall not be less than 1.6 mm.

15.1.6 *Height of Feeding Chute* — The height of the feeding chute of the chaff cutter should be between 750 mm and 1 100 mm.

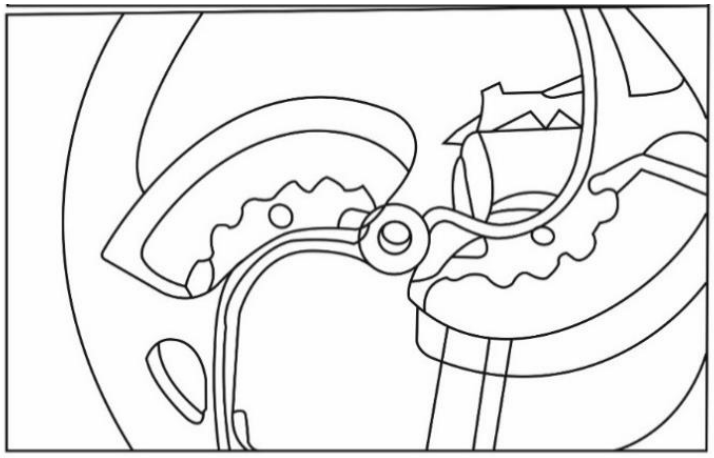


FIG. 7 BLADE SAFETY GUARD

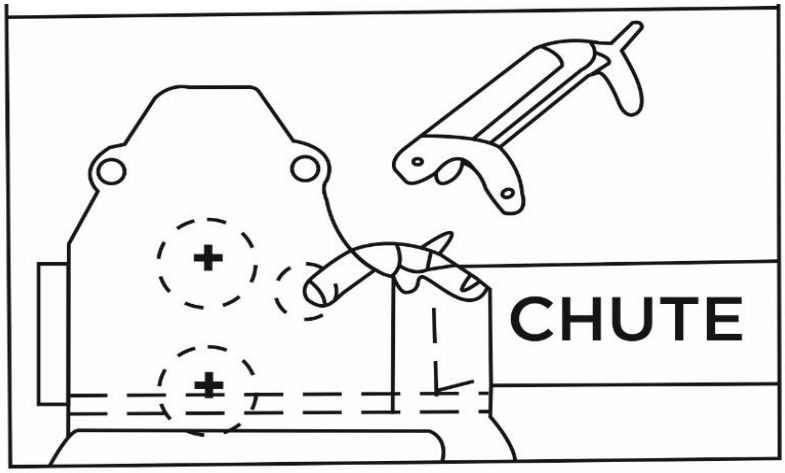


FIG. 8 WARNING ROLLER

15.1.7 A minimum cautionary notice worded as follows shall be written in vernacular language legibly on a label preferably fixed on the main body of the chaff cutter:

a) Do not wear loose dress, bangles, watch etc, while feeding the fodder;
b) Do not smoke and light fire near dry fodder being cut;
c) Do not work under the influence of intoxicants like liquor, opium etc;
d) Children and aged persons should be discouraged for working;
e) Do not push small fodder by hand, use pushing device;
f) Lock the flywheel with the locking pin after work;
g) Instruct children not to play with the machine;
h) Never bring hand near feed rolls and open blade; and
i) Do not touch belt while pulley is running.

15.1.8 *Conveyor System* — Conveyor-fed chaff cutter shall also be provided with the following safety provisions:

a) *Cover* — The minimum length of conveyor shall be 1 200 mm and it shall be covered up to a minimum length of 450 mm near the feed roll side. The thickness of the cover shall not be less than 1.6 mm.
b) *Blower* — If provided, and all other moving parts shall be guarded with mild steel (*see* IS 2062) sheet of minimum thickness of 1.6 mm.

16 CAUTIONARY NOTICES

16.1 A minimum cautionary notice as given in 15.1.7 shall be written in vernacular language legibly on a label preferably fixed on the main body of the chaff cutter.

16.2 A plate having a 'Danger Signal' shall be rigidly fixed near the blades of the chaff cutter.

16.3 Each chaff cutter shall be provided with an operator's manual (Hindi or English or vernacular language) in which all safety aspects are also to be highlighted along with the precautions to be taken for safe operation of chaff cutter.

17 WORKMANSHIP AND FINISH

17.1 All the components of the chaff cutter shall be free from cracks and such other defects that may be detrimental for their use.

17.2 The cast iron components shall not be porous. Welding, if done, shall also not be porous.

17.3 All exposed metallic surfaces shall be free from rust and may be painted, if required.

17.4 Welding used for joining different components shall not be porous; it shall be smooth.

17.5 All sharp corner and protruding fasteners shall be avoided.

17.6 The chaff cutter shall be suitably painted.

18 MARKING AND PACKING

18.1 Marking

Each chaff cutter shall be marked with the following particulars:

a) Manufacturer's name or registered trademark;
b) Code and batch number.
c) Model number;
d) Type;
e) Power rating, kW;
f) Rated input capacity; and
g) Recommended r/min of fly wheel or cylinder.

18.2 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 thereunder, and the products may be marked with the Standard Mark.

18.3 Packing — For ease in packing for transportation, the chaff cutter may be dismantled in suitable sub-assemblies. The packing shall be done as agreed to between the purchaser and the supplier.

19 SAMPLING FOR LOT ACCEPTANCE

Unless otherwise agreed to between the purchaser and the supplier, the criteria for sampling for lot acceptance shall be in accordance as per given in IS 7201 (Part l).

20 SUMMARY REPORT

20.1 For the guidance of the users, compile a Summary Report on the proforma given in Annex H.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 210 : 2009	Grey iron castings — Specification (*fifth revision*)
IS 513 (Part 1) : 2016	Cold reduced carbon steel sheets and strip: Part 1 Cold forming and drawing purpose (*sixth revision*)
IS 1500 (Part 1) : 2019/ISO6506-3 : 2014	Metallic materials — Brinell hardness test: Part 1 Test method (*fifth revision*)
IS 1570 (Part 2) : 1979	Schedules for wrought steels: Part 2 Carbon steels (unalloyed steels) (*first revision*)
IS 1586 (Part 1) : 2018	Metallic materials — Rockwell hardness test: Part 1 Test method (*fifth revision*)
IS 1891 (Part 1) : 2021	Conveyor and elevator textile belting — Specification: Part 1 General purpose belting (*fifth revision*)
IS 2062 : 2011	Hot rolled medium and high tensile structural steel — Specification (*seventh revision*)
IS 2102 (Part 1) : 1993/ISO 2768-1 : 1989	General tolerances: Part 1 Tolerances for linear and angular dimensions without individual tolerance indications (*third revision*)
IS 4454 (Part 1) : 2001	Steel wire for mechanical springs — Specification: Part 1 Cold drawn unalloyed steel wire (*third revision*)
IS 4711 : 2008	Methods for sampling of steel pipes, tubes and fittings (*second revision*)
IS 7201 (Part 1) : 1987	Methods of sampling for agricultural machinery and equipment: Part 1 Hand-tools and hand-operated/animal drawn equipment (*first revision*)
IS 7898 : 2001	Manually operated chaff cutter — Specification and test code (*third revision*)

ANNEX B

(*Clauses* 8.2 *and* 11.1)

PROFORMA FOR SPECIFICATION SHEET

To be filled by

Manufacturer | Testing Station

B-1 GENERAL

a) Make
b) Model
c) Type
d) Year of manufacture

B-2 POWER UNIT

a) Provision
b) Type of prime mover
c) Recommended power
d) Type of drive

B-3 MAIN DRIVE

a) Type
b) Size of handle
c) Size of handle support
d) Size of belt
e) Size of pulley
f) Type of drive
g) Diameter of main shaft, mm

B-4 CUTTER HEAD

a) Type
b) Number of blades
c) Diameter of flywheel or cylinder, mm
d) Size of throat, mm
e) Recommended clearance between fixed and rotating blades

B-5 FEEDING MECHANISM

a) Type of feeding
b) Height of feeding tray
c) Length of feeding tray
d) Size of feeding tray
e) Angle of inclination of tray
f) Type and size of conveyor
g) Number of feed rolls
h) Width of rolls
j) Effective width of rolls
k) Diameter of rolls

m) Space between the axis of upper roll and axis of lower rolls:

1) Minimum
2) Maximum

n) Recommended feeding capacity

B-6 BLOWING UNIT

a) Number
b) Type
c) Number of blades
d) Tip diameter
e) Recommended speed
f) Recommended air displacement
g) Size of feed blowpipe

B-7 TRANSMISSION SYSTEM

a) Method of power transmission and gear ratio from main shaft to:

1) feed rolls
2) conveyor
3) blower
4) cutter head

b) Recommended speed of main shaft

B-8 OVERALL DIMENSIONS

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

B-9 TRANSPORT

a) Type
b) Number of wheels
c) Size of wheels
d) Wheel track

NOTE — In case wheels are not provided, details of alternative provision shall be given.

B-10 TOOLS, ACCESSORIES AND MANUALS PROVIDED

NOTES

1 The items which are not applicable in a particular chaff cutter shall be crossed while filling.

2 If any other item is provided, its details shall be filled in.

Testing Engineer

ANNEX C

(*Clause* 11.2)

MATERIAL OF CONSTRUCTION DATA SHEET

C-1 DATE OF TEST

C-2 MATERIAL OF CONSTRUCTION

Sl No.	Component	Material	Size	Mass	Hardness
(1)	(2)	(3)	(4)	(5)	(6)
i)	Frame				
ii)	Flywheel				
iii)	Cover plate				
iv)	Shear plate				
v)	Feed rolls				
vi)	Feeding tray				
vii)	Conveyor chain				
viii)	Feed control				
ix)	Blade				
x)	Blower				
xi)	Sliding pan				
xii)	Elevator pipe				
xiii)	Deflector				
xiv)	Shafts				
xv)	Gears				
xvi)	Springs				
xvii)	Stand				
xviii)	Transport wheel				
xix)	Others				

NOTES
1 Delete the component which is not applicable to a particular chaff cutter and add if any other component is provided.
2 Columns 4, 5 and 6 shall be recorded, wherever feasible.

Testing Engineer

ANNEX D

(*Clause* 11.3)

DATA SHEET FOR VISUAL OBSERVATIONS

D-1 OBSERVATIONS

a) Adequacy of protection of bearings against the ingress of dust
b) Adequacy of safety arrangements especially at feeding and moving points
c) Provision for lubrication of moving parts
d) Provision for folding the feeding tray
e) Provision for belt or chain tightening
f) Provision for transportation
g) Provision for easy changing of components requiring frequent replacement
h) Provision for anticorrosive coatings
j) Smoothness of castings
k) Tightness of bolts, nuts and other fasteners
m) Balancing of the cutter head
n) Welding of seams
p) Presence of any pits, burrs, etc
q) Other observations

D-2 PROVISION FOR ADJUSTMENT

a) Feed rate
b) Speed
c) Length of cut
d) Space between two feed rolls
e) Space between fixed and rotating blades
f) Air displacement

Testing Engineer

ANNEX E

(*Clauses* 12.1.5 *and* 12.2)

TEST AT NO-LOAD DATA SHEET

E-1 POWER CONSUMPTION

a) Source of power
b) Type of drive
c) Speed
d) Initial reading of energy meter
e) Total duration of run
f) Final reading of energy meter
g) Ammeter reading
h) Power consumption for one hour

E-2 OBSERVATIONS

a) Presence of any marked oscillation during operation
b) Presence of knocking or rattling sound
c) Frequent slippage of belts
d) Smooth running of shaft/shafts in their respective bearings
e) Any marked unusual wear or slackness in any component
f) Any marked rise in bearing temperature
g) Other observations

Testing Engineer

ANNEX F

(*Clauses* 13.1.4.1, 13.1.4.2 *and* 13.1.5)

TEST AT LOAD DATA SHEET

F-1 SOURCE OF POWER

F-2 POWER RATING

F-3 TYPE OF DRIVE

F-4 VARIETY OF FODDER

F-5 MOISTURE CONTENT

F-6 CLEARANCE BETWEEN FIXED AND ROTATING BLADES

F-7 METHOD OF FEEDING

F-8 TEST DATA

a) Speed of flywheel or cylinder
b) Initial reading of energy meter
c) Duration of operation
d) Quantity of fodder cut
e) Final reading of energy meter
f) Ammeter reading
g) Height of blowing
h) Number of cut plastic pieces

F-9 OBSERVATIONS

a) Smooth flow of the material through different components
b) Frequency of clogging of throat and feed rolls

NOTE — The observations indicated in item **2** of Annex E shall also be made and recorded.

F-10 CALCULATIONS

a) Deviation

Theoretical length of cut (x), mm	**No. of Pieces**	**Measured length of cut (xi), mm**	**(xi-x)**	**(xi-x)^2**	**σ**
(1)	(2)	(3)	(4)	(5)	(6)
	1 2 : 25				
	n = 25			Σ (xi-x)^2	

b) Quality of cut (1 - σ)
c) Quantity of cut (W_4)
d) Power consumed at load (P_2)
e) Power consumed by chaff cutter (P_3)
f) Quantity of cut per unit energy consumed (W_5)
g) Corrected quantity of cut (W_6 and W_7)
h) Performance index (PI)
i) Blowing efficiency (η)

Testing Engineer

ANNEX G

(*Clause* 13.2)

LONG RUN TEST DATA SHEET

G-1 TOTAL RUNNING TIME

G-2 CONTINUOUS RUNNING TIME

G-3 BREAKDOWN IN CUTTER HEAD

G-4 BREAKDOWN IN FEEDING MECHANISM

G-5 BREAKDOWN IN BLOWING MECHANISM

G-6 BREAKDOWN IN TRANSMISSION SYSTEM

G-7 BREAKDOWN IN BODY

G-8 ANY MAJOR REPAIRS CONDUCTED

G-9 ANY OTHER OBSERVATIONS

Testing Engineer

ANNEX H

(*Clause* 20.1)

SUMMARY REPORT

G-1 NAME OF MANUFACTURER

G-2 MODEL NUMBER OF CHAFF CUTTER

G-3 TYPE OF CHAFF CUTTER

G-4 THROAT SIZE

G-5 VARIETY OF FODDER USED

G-6 MOISTURE CONTENT

G-7 ADJUSTMENTS

a) Speed
b) Clearance between fixed and rotating blades
c) Clearance between two feed rolls
d) Air displacement

G-8 POWER REQUIREMENT

a) At no-load
b) At load:
    1) By motor
    2) By chaff cutter

G-9 THEORETICAL LENGTH OF CUT

G-10 QUALITY OF CUT

G-11 QUANTITY OF CUT

a) Per hour
b) Per kWh

G-12 CORRECTED QUANTITY OF CUT

a) Per hour
b) Per kWh

G-13 BLOWING EFFICIENCY

G-14 ANY MARKED BREAKDOWN

G-15 OTHER OBSERVATIONS

Testing Engineer

ANNEX J

(*Foreword*)

COMMITTEE COMPOSITION

Agriculture and Food Processing Equipment Sectional Committee, FAD 20

Organization	*Representative(s)*
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Organization	*Representative(s)*
In Personal Capacity (*CD 223, Ansal Golf Link 1, Greater Noida - 201315*)	DR PITAM CHANDRA
In Personal Capacity (*MIG - 154, E-7 Sector Aerea Colony, Bhopal - 462061*)	SHRI S. D. DESHPANDE
In Personal Capacity (*12/36 Sowbhagya Nagar, A Block Civil, Aerodrome Post, Coimbatore - 641014*)	DR R. VISHWANATHAN
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Member Secretary
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Regional Offices: *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002 { 2323 7617

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Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019 { 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 { 2254 1442 2254 1216

Western : Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093 { 2821 8093

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