

# Indian Standard

## TEST CODE FOR CHAFF CUTTER

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 28 November 1975, after the draft finalized by the Agricultural Product Processing Equipment Sectional Committee had been approved by the Agricultural and Food Products Division Council.

**0.2** Chaff cutters are being extensively manufactured and used in the country for cutting the fodder. This test code has been evolved to serve as a guide for evaluating objectively the performance and constructional durability of chaff cutters. This code is intended to help the manufacturers to develop and various purchasing agencies to select the suitable chaff cutter to meet their requirement.

**0.3** In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960\*.

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### 1. SCOPE

**1.1** This code prescribes method of testing for chaff cutter to evaluate its performance and durability.

### 2. TERMINOLOGY

**2.0** For the purpose of this standard, the following definitions shall apply.

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

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

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

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

\*Rules for rounding off numerical values (revised).

**2.5 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.

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

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

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

### **3. TYPES**

**3.1** The types of chaff cutters shall be as given in **3.1.1** to **3.1.3**.

**3.1.1** On the basis of cutting mechanism:

- a) Cylinder type, and
- b) Flywheel type.

**3.1.2** On the basis of cut-chaff dropping position:

- a) Let-fall type,
- b) Throw-away type, and
- c) Blow-up type.

**3.1.3** On the basis of source of power:

- a) Manually-operated ( light duty ),
- b) Animal-operated ( medium duty ), and
- c) Power-operated ( heavy duty ).

### **4. SELECTION OF CHAFF CUTTER FOR TEST**

**4.1 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.

**4.2 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 Appendix A as well as any other information required to carry out the test.

## 5. TESTS

### 5.1 Type Tests

#### 5.1.1 General

- a) Checking of specifications ( *see* 7.1 ),
- b) Checking of material ( *see* 7.2 ), and
- c) Visual observations and adjustments ( *see* 7.3 ).

#### 5.1.2 Test at No-Load

- a) Power consumption ( *see* 8.1 ), and
- b) Visual observations ( *see* 8.2 ).

#### 5.1.3 Test at Load

- a) Short run tests ( *see* 9.1 ):
  - 1) Quality of cut ( *see* 9.1.5.1 ),
  - 2) Quantity of cut ( *see* 9.1.5.2 ),
  - 3) Power requirement ( *see* 9.1.5.3 ),
  - 4) Visual observations ( *see* 9.1.4.2 ), and
  - 5) Blowing efficiency ( *see* 9.1.5.7 ).
- b) Long run tests ( *see* 9.2 ).

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

### 5.2 Routine Tests

- a) Checking of specifications ( *see* 7.1 ),
- b) Visual observations and adjustments ( *see* 7.3 ), and
- c) Test at no-load ( *see* 8 ).

## 6. PRE-TEST OBSERVATIONS

**6.1 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  $100 \pm 2^\circ\text{C}$  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 weighings is less than one milligram. Calculate the moisture content by the following formula:

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

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.

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

**6.2 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.

## 7. GENERAL TESTS

**7.1 Checking of Specifications** — Check the specifications mentioned by the manufacturer ( see 4.1 ) and record the data in Specification Sheet as given in Appendix A.

**7.2 Checking of Material** — Check the material for all components and record the observations in Data Sheet as given in Appendix B.

**7.3 Visual Observations** — Record the observations in Data Sheet as given in Appendix C.

## 8. TEST AT NO-LOAD

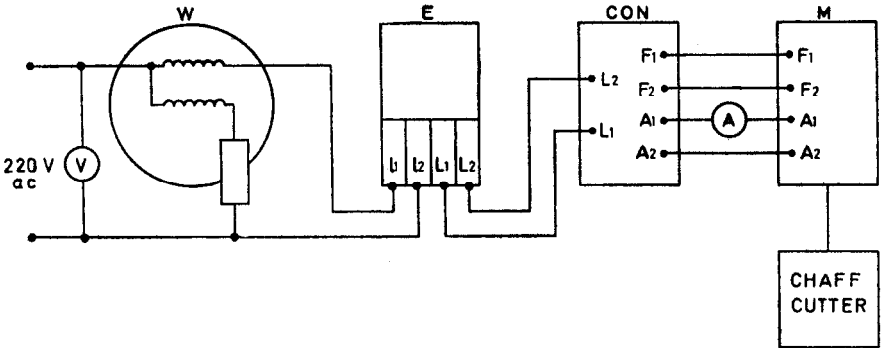
### 8.1 Power Consumption

**8.1.1** 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.

**8.1.2** Attach the chaff cutter to an electric motor as shown in the circuit diagram given in Fig. 1. 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.

**8.1.2.1** In case of 8.1.2(a), the power delivered to the cutter head would be the power output of the motor; whereas in case of 8.1.2(b), the allowances for flat belt and V-belt drive losses may be taken as 6 and 8 percent respectively.



$V$  = Voltmeter, 0-300 V, ac moving iron type

$E$  = Energymeter, 3 ampere, single phase, 1 600 rev/kWh

$W$  = Wattmeter, 0-230 V, single phase, dynamometer type

$CON$  = 1.5 kW speed controller

$M$  = dc motor shunt wound, 1.5 kW, 220 V

$A$  = Ammeter, 0-10 A

FIG. 1 CIRCUIT DIAGRAM

**8.1.3** Run the motor coupled with chaff cutter for about 30 minutes at the speed of the chaff cutter specified by the manufacturer. In case of manually operated chaff cutter, the speed of the cutter head should be 50 rev/min. Record the following:

- Resistance of the winding of the motor ( $R$  ohms),
- Initial reading of the energymeter ( $E_1$  watthour),
- Final reading of the energymeter ( $E_2$  watthour), and
- Time of run ( $T_1$  minutes).

**8.1.4** Calculate the total power at no-load ( $P_1$ ) by the following formula. Due allowance for type of drive (see 8.1.2.1) shall be given:

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

**8.1.5** Record the data according to Item 1 of Data Sheet as given in Appendix D.

**8.2 Visual Observations** — During and after completing power consumption test (see 8.1), the observations given in Item 2 of Data Sheet as given in Appendix D shall be made visually and recorded.

## 9. TEST AT LOAD

### 9.1 Short Run Tests

**9.1.1** Install the chaff cutter in accordance with **8.1.1**.

**9.1.2** Attach the motor in accordance with **8.1.2**.

**9.1.3** 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 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:

$$W_s = 4 D$$

where

$W_s$  = mass of the bundle in g, and

$D$  = effective width of feed roll in mm.

**9.1.4** Operate the cutter head at the speed specified by the manufacturer or at 50 rev/min in case of manually-operated chaff cutter and feed the fodder manually or mechanically. 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 metres 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.

**9.1.4.1** Before and after the test, record the following data under item 8 of Data Sheet as given in Appendix E:

- a) Speed of the cutter in 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 energymeter reading in kWh, and
- f) Height of blowing in m ( in case of blow-up type ).

**9.1.4.2** During and after the above test, the observations given under item 9 of Data Sheet as given in Appendix E shall be made and recorded.

**9.1.5 Calculations**— Calculate the following and record the data in pro forma given in item 10 of Appendix E.

**9.1.5.1 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 9.1.4.1(b) ] and measure the length of each piece and calculate the quality of work by the following formulae:

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

where

$Q$  = quality of work, and  
 $\sigma$  = standard deviation of length of cut.

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

where

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

$$c) x = \frac{\pi D_f N_f}{NR}$$

where

$D_f$  = diameter of feed rolls in mm,  
 $N_f$  = rev/min of feed rolls,  
 $N$  = rev/min of flywheel or cutter head, and  
 $R$  = number of blades used.

**9.1.5.2 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 9.1.4.1 (c) ], and  
 $T$  = duration of operation in minutes [ see 9.4.1.1(d) ].

**9.1.5.3 Power requirement** — Calculate the power requirement by the following formulae giving due allowances to the type of drive ( see 9.1.2 ):

$$a) P_2 = \frac{60 ( E_4 - E_3 )}{1\,000 \times T}$$

where

$P_2$  = total power consumed at load in kW,

$E_4$  = final reading of energymeter in Wh [ see 9.1.4.1(e) ],

$E_3$  = initial reading of energymeter in Wh [ see 9.1.4.1(e) ],  
and

$T$  = Duration of operations in minutes [ see 9.1.4.1(d) ].

$$b) P_3 = P_2 - P_1$$

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.

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

$$W_5 = \frac{W_4}{P_2}$$

**9.1.5.5 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:

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

where

$W_6$  = corrected quantity of cut in kg/h,

$W_4$  = quantity of cut in kg/h,

$M$  = observed moisture percent ( see 6.1 ), and

$L$  = measured average length of cut in mm.

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

where

$W_7$  = corrected quality of cut in kg/kWh.



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

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

**9.1.5.7 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

$\eta$  = blowing efficiency in percent,

$g$  = acceleration due to gravity,

$H$  = height of blowing up in m [ see 9.1.4.1(f) ], and

$V$  = circumferential speed of the tip ( m/s ) of blower.

**9.2 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 Appendix F.

## 10. SUMMARY REPORT

**10.1** For the guidance of the users, compile a Summary Report on the pro forma given in Appendix G.

# APPENDIX A

( Clauses 4.2 and 7.1 )

## PRO FORMA FOR SPECIFICATION SHEET

*To be Filled by*

Manufacturer	Testing Station
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### 1. General

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