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IS 1973 (1999): Sugarcane Crushers [FAD 20: Agriculture and Food Processing Equipments]



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भारतीय मानक  
गन्ना दलित्र — विशिष्टि  
( तीसरा पुनरीक्षण )

*Indian Standard*  
**SUGARCANE CRUSHERS — SPECIFICATION**  
( *Third Revision* )

ICS 67.180

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**BUREAU OF INDIAN STANDARDS**  
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NEW DELHI 110002

## FOREWORD

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

This standard originally issued in 1961, was meant for bullock driven type sugarcane crushers. Subsequently it was reviewed in 1973 and 1981 to incorporate power driven crushers and various safety provisions. This revision has been taken up to incorporate the requirements of rollers and axles of crushers which were earlier covered in separate standards (IS 6983 : 1973) and updating of referred standards.

The figures given in the standard are meant only for illustration. These should not be considered as suggestive of any standard design.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. 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

## SUGARCANE CRUSHERS — SPECIFICATION

### ( Third Revision )

#### 1 SCOPE

This standard specifies the material, constructional, performance and other requirements of sugarcane crushers operated by animal and power.

#### 2 REFERENCES

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

#### 3 TYPES

3.1 According to source of power, the sugarcane crushers shall be of the following types:

- a) Animal-driven, and
- b) Power-operated.

3.1.1 Animal-driven crushers shall be of vertical type (see Fig. 1), whereas power-operated crushers may be of horizontal or vertical type (see Fig. 2 and 3).

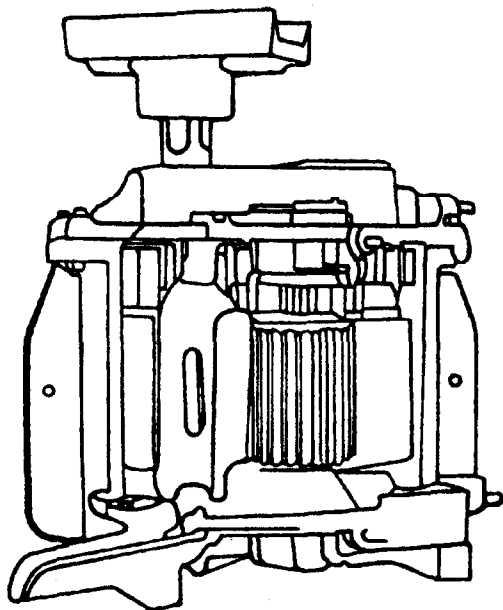


FIG. 1 ANIMAL-DRIVEN SUGARCANE CRUSHER

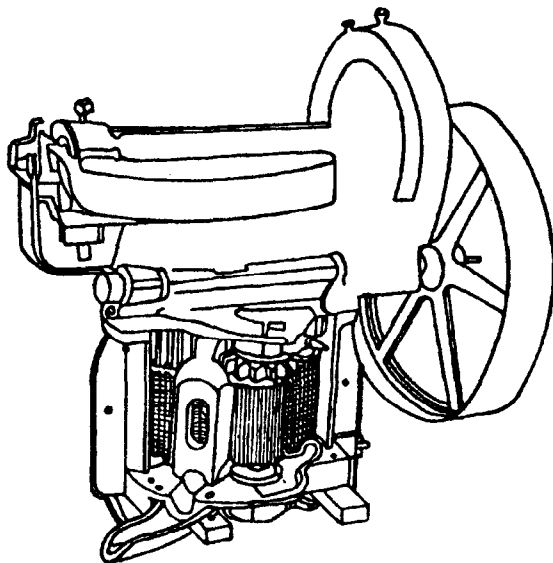


FIG. 2 POWER-OPERATED SUGARCANE CRUSHER,  
VERTICAL TYPE

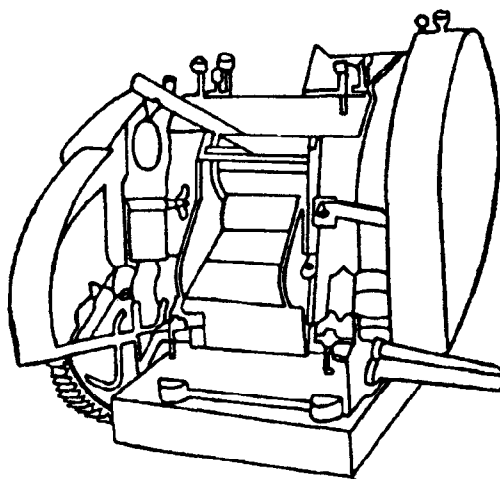


FIG. 3 POWER-OPERATED SUGARCANE CRUSHER,  
HORIZONTAL TYPE

#### 4 MATERIALS

4.1 The material of construction for the various parts of the crushers shall be selected from among those given in col 3 of Table 1. The material should conform to the relevant Indian Standards and grade as stipulated in col 4 and 5 of Table 1.

**Table 1 Material of Construction**  
( Clause 4.1 )

Sl No.	Part	Material	Applicable Standards	Grade
(1)	(2)	(3)	(4)	(5)
i)	Frame	Cast iron Mild steel	IS 210 IS 2062	FG 150 —
ii)	Stand	Cast iron Mild iron	IS 210 IS 2062	FG 150 —
iii)	Cover, trash and base plates	Cast iron Mild steel	IS 210 IS 2062	FG 150 —
iv)	Bearings	Cast iron Tin bronze Leaded tin bronze	IS 210 IS 306 IS 318	FG 200 — 4
v)	Bearing holder	Cast iron	IS 210	FG 200
vi)	Gears	Cast iron Mild steel Alloy cast iron Cast steel	IS 210 IS 2062 IS 4771 IS 1030	FG 200 — — —
vii)	Feed plate/chute	Cast iron Mild steel	IS 210 IS 2062	FG 150 —
viii)	Spout	Cast iron Galvanized plain sheet	IS 210 IS 277	FG 150 —
ix)	Beam socket	Cast iron	IS 210	FG 150
x)	Adjusting and foundation bolts	Mild steel Carbon steel	IS 2062 IS 1570	— C35
xi)	Rollers	Cast iron Alloy cast iron Cast steel	IS 210 IS 4771 IS 1030	FG 200 2 3
xii)	Axle	Mild steel Hot rolled bar	IS 2062 IS 7283	— C40

4.1.1 Besides the materials given in Table 1, the following materials may also be used for stand and bearing intended to be used in animal driven sugarcane crushers:

- a) *Stand* — Seasoned wood ( see IS 399 ), and
- b) *Bearings* — Seasoned wood impregnated with oil or grease [ (see *Acaia-Arabia* (Babul) of IS 399 ].

## 5 CONSTRUCTIONAL REQUIREMENTS

### 5.1 Frame

The frame shall be able to hold the rollers in position and keep the crusher stable.

### 5.2 Rollers

Three rollers, namely, king, crushing and extracting, shall be used. In some animal-driven crushers only two rollers, namely, king and extracting, are used. Power-operated crushers may have five rollers, namely, one king, three crushing and one extracting.

5.2.1 The king and extracting rollers may be of the

same diameter. The face length of all the rollers in power-operated crushers shall be the same irrespective of their diameter.

5.2.2 The rollers shall have hardness of 180 HB to 220 HB on machined surface.

5.2.3 The outside diameter and face length of the rollers ( see *A* and *B* in Fig. 4 ) shall be between 125 mm to 315 mm and 150 mm to 355 mm respectively. The diameters and length shall be declared by the manufacturer. The actual dimensions shall not differ by more than 2 percent of the dimensions declared by the manufacturer.

5.2.3.1 Some recommended diameters and face length for different rollers are as follows:

a) *Diameters* (mm):

- 1) King — 212, 224, 236, 250, 265, 280, 300 and 315.
- 2) Crushing — 125, 150, 165, 212, 224, 236, 250 and 265.
- 3) Extracting — 125, 150, 180, 224, 236, 250, 300 and 315.

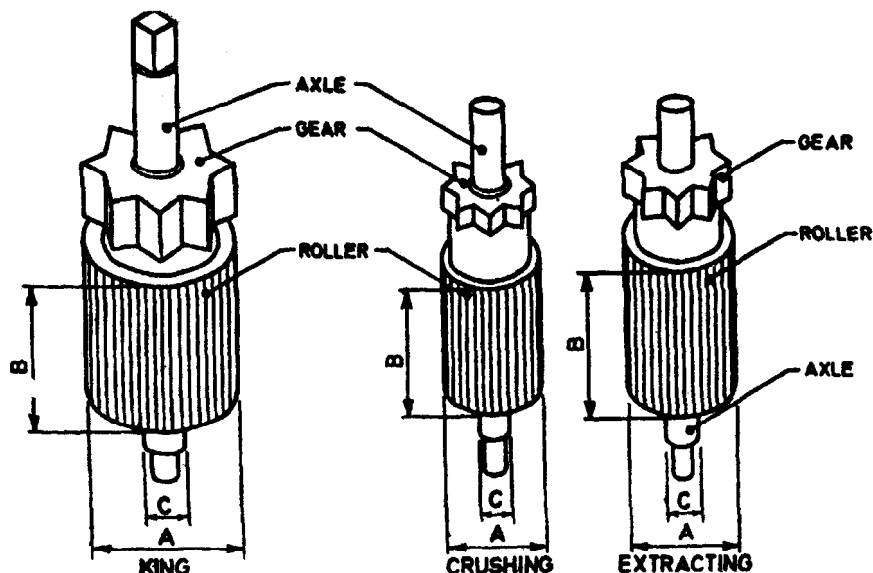


FIG. 4 ROLLERS AND AXLES

## b) Face Length (mm):

- 1) King and Extracting — 150, 165, 212, 224, 250, 280, 315 and 355.
- 2) Crushing — 150, 165, 190, 212, 224, 250, 315 and 355.

**5.2.4** The surface of the rollers shall be grooved for proper gripping of canes. The grooves may be circumferential or vertical or both. The circumferential groove in crushing roller may have 'V' shape.

**5.3 Axles**

The axles shall be finished to close tolerance at the bearing and shall be properly aligned.

**5.3.1** The axle diameter for all the rollers in power-operated crushers shall be the same irrespective of their diameter, whereas in animal-driven crushers, the axle diameter may be the same for rollers of the same diameter.

**5.3.2** The axle diameter (see C in Fig. 4) shall be calculated on the basis of the formula given below. Allowable shearing stress shall be 30 percent of the elastic limit but not more than 10 percent of the ultimate strength in tension for axle without keyway. This value shall be reduced by 25 percent, if keyways present.

$$d^3 = (16/\pi S_s) \sqrt{(k_b M_b)^2 + (k_t M_t)^2}$$

where

- $d$  = axle diameter in cm,  
 $S_s$  = allowable shearing stress in N/cm<sup>2</sup>,  
 $k_b$  = combined shock and fatigue factor applied

to bending moment (1.5 to 2.0),

$M_b$  = bending moment in N.cm,

$k_t$  = combined shock and fatigue factor applied to torsional moment (1.0 to 1.5), and

$M_t$  = torsional moment in N.cm.

The next higher standard size of axle in accordance with relevant standard shall be chosen. The design of the axle shall also take into consideration the critical speed of the shaft which shall differ from the actual working speed by at least 10 percent on either side.

**5.3.2.1** Some recommended diameters of steel bars used for axle are 50, 63, 65, 71, 75, 80, 90 and 110 mm. The total tolerance for bars shall be 2 percent of the diameter.

**5.3.3** The axle shall be securely fixed to the roller.

**5.3.4** The axle to be fitted in socket of animal-driven crushers shall be tapered at top up to a distance of 75 mm with 5 percent taper.

**5.4 Bearings**

Provision shall be made for lubrication of bearings, except where pre-lubricated bearings are used. Lubricating nipples shall be easily accessible. All exposed bearings shall be suitably sealed or shielded. Provision for protection of bearings from entry of juice shall be provided.

**5.5 Gears**

The gears shall be properly meshed, ensuring noiseless and smooth running and shall be tightly fastened with axles. Gears may be cast integrally with rollers. Keys,



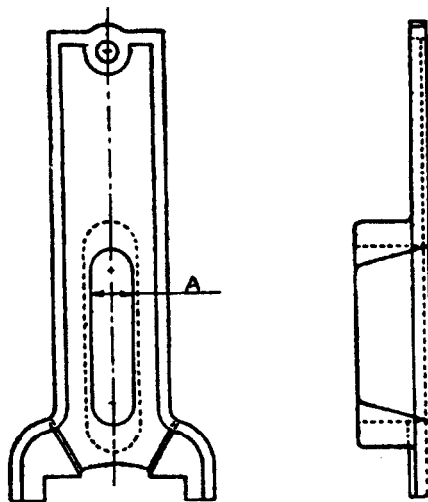


FIG. 5 A TYPICAL FEED PLATE

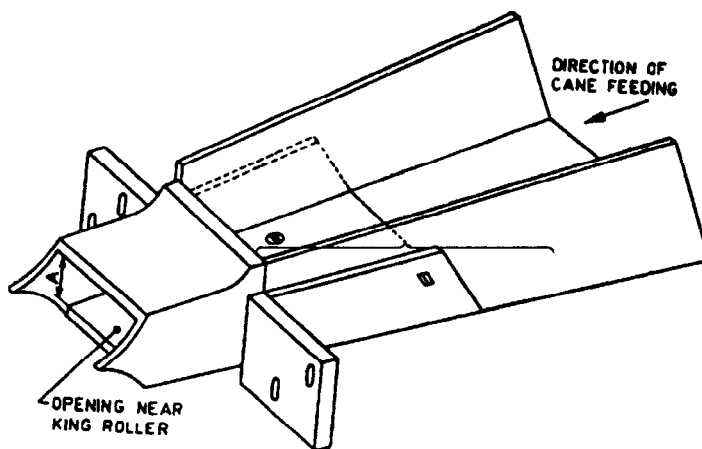


FIG. 6 A TYPICAL FEED CHUTE

if provided, shall be so fitted and secured that they cannot work loose. All gearings in power-operated crushers shall be provided with means for lubrication.

5.5.1 The gears shall be selected in such a way that the peripheral velocity of all the rollers shall be the same irrespective of their diameters.

5.5.2 Couplings, if provided, shall be properly aligned and firmly secured to the axles.

**6 SAFETY REQUIREMENTS**

**6.1 Feed Plate/Feed Chute**

For ensuring proper and safe feeding of canes, feed plate or feed chute shall be provided in vertical and horizontal type crushers respectively. A typical feed plate and a feed chute are shown in Fig. 5 and 6 respectively.

6.1.1 The opening for feeding the cane in feed plate or chute in Fig. 5 and 6 shall be not more than 60 mm. The feed chute shall be covered on the front side up to a distance of 450 mm.

6.1.2 The feed plate/feed chute shall be so fixed or fitted with the crushers that it is not possible to remove it easily.

**6.2 Guards**

In the case of power-operated crushers the drive system shall be provided with safety guards 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.

6.2.1 It is preferable that all guards are either permanently attached or firmly secured to prevent their removal without the aid of tools. The servicing and adjustment

of the crusher should be possible without complete removal of the guards.

6.2.2 The guards shall be so designed as not to hinder easy adjustment, servicing and operation of crushers.

## 7 POWER REQUIREMENTS

7.1 When tested in accordance with the method given in 9.2.1 of IS 6997, the animal-driven crushers shall require a maximum pull of 1 250 N.

NOTE — This test shall be a type test.

7.2 The power-operated crushers shall be designed primarily to suit a power source having rated output of 3.7, 5.5, 7.5, 11, 15 and 20 kW.

7.2.1 When tested in accordance with the method given in 8.1 to 8.3 of IS 6997, the power at no-load of power-operated crushers shall not be more than 15 percent of the rated output of the power source.

NOTE — This test shall be a routine test.

## 8 PERFORMANCE REQUIREMENTS

### 8.1 Crushing Capacity

When tested in accordance with the method given in 9.3 of IS 6997, the crushing capacity of the:

- a) animal-driven crusher shall be not less than 120 kg of cane per hour, and
- b) power-operated crusher shall be not less than 80 kg of cane per kWh at rated speed of the prime mover.

### 8.2 Reduced Juice Extraction

The juice extraction corrected for 12.5 percent fibre content in the sugarcane is called reduced juice extraction. It is calculated by the formula given in 9.6.1 of IS 6997. When tested and calculated in accordance with the method given in 9.4 and 9.6.1 of IS 6997 respectively, the reduced juice extraction percentage shall be not less than 60 percent and 65 percent of the absolute juice present in the cane for animal-driven and power-operated crushers respectively.

NOTE — The requirements at 8.1 and 8.2 shall be for type test.

## 9 OTHER REQUIREMENTS

9.1 The clearance between the rollers as given below shall be adjustable in the crushers:

- a) King and crushing — up to 10 mm, and
- b) King and extracting 0.4 to 1.0 mm.

9.2 The crusher shall withstand the test given at 9.2.1.

9.2.1 The crushers properly installed shall be run idle

(without load) for half an hour. During and after the run, the following shall be observed:

- a) There shall not be any undue sound or noise in any component,
- b) The rollers and axle shall run smoothly in their respective bearings,
- c) There shall not be any marked wear or slackness and loosening of any components,
- d) The bearings shall not become warm, and
- e) Gears shall run smoothly.

### NOTES

1 In the case of power-operated crushers, the observations given at (a) to (e) may be made during the test as given under 7.2.1 and crusher need not be run separately.

2 The observations mentioned under (a) to (e) above shall also be made during test as given in 8.1.

9.3 Each crusher shall be provided with an instruction sheet containing full information on method of installation and safe operation of the crusher. Some instructions are given in Annex B for the guidance of the users.

9.4 The crusher shall also be provided with a manual containing maintenance instructions and information regarding ordering of replacement parts.

9.5 The crushers shall be provided with necessary tools.

## 10 ACCESSORIES

### 10.1 Essential

- a) Socket (for animal-driven),
- b) Oil or grease applicator, and
- c) Flexible coupling or pulleys.

### 10.2 Optional

- a) Stand/base plate,
- b) Foundation bolts and nuts, and
- c) Trash plates.

## 11 WORKMANSHIP AND FINISH

11.1 Rollers and axles shall be machined properly.

11.2 The rollers axles and other components shall be free from blow holes, cracks seam and visual defects.

11.3 Welding of various components shall not be porous.

11.4 The exposed metallic parts shall be free from rust and shall have a protective coating which will prevent surface deterioration in transit and storage.

**12 MARKING**

**12.1** Each crusher shall be marked with the following information on a metallic plate rigidly attached at prominent place on the crusher:

- a) Manufacturer's name and trade-mark, if any;
- b) Model, code and serial number;
- c) Capacity;
- d) Power requirement (for power-operated only); and
- e) Recommended rotation of king roller in rpm and its direction of rotation.

**12.2** Each roller fitted with axle shall be marked clearly with the following particulars:

- a) Manufacturer's name and trade-mark (if any),
- b) Size (diameter and length),
- c) Diameter of axle, and
- d) Code or batch number.

**12.3** A minimum cautionary notice worded as under shall be written in *vernacular* language legibly and prominently on a label fixed on the crusher:

- a) **DO NOT OPERATE CRUSHER WITHOUT FEED PLATE/CHUTE, GUARDS AND OTHER SAFETY DEVICES;**
- b) **DO NOT MAKE ADJUSTMENTS WHEN CRUSHER IS IN OPERATION;**
- c) **DO NOT WORK UNDER THE INFLUENCE OF INTOXICANTS LIKE LIQUOR, OPIUM, ETC;**
- d) **DO NOT CROSS OVER THE RUNNING BELTS OR BEAM; AND**
- e) **DO NOT PUT OR TAKE OFF BELT WHILE PULLEY IS RUNNING.**

**NOTES**

**1** Under item (d) use the word belt or beam as the case may be.

**2** Item (e) should be written on crusher operated by belt-pulley power drive.

**12.4 BIS Certification Marking**

Each crusher may also be marked with BIS Certification Mark.

**12.4.1** The use of the Standard mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

**13 PACKING**

Packing of the crusher and its components shall be done as agreed to between the supplier and the purchaser.

**14 SAMPLING AND TESTS**

**14.1** One crusher of each model shall be tested for requirements for type test.

**14.2** Each crusher of a model shall be tested for requirements given under 7.2.1, 9.1, 9.2 and 11 for routine tests.

**14.3** Unless otherwise agreed to between the purchaser and the supplier, the sampling of the crusher and criteria for conformity for lot acceptance shall be as given in 3 of IS 7201(Part 1).

**14.3.1** All the requirements of this standard shall be tested for lot acceptance. However, if cane is not available for conducting the requirements given at 8.1 and 8.2 these tests may not be conducted.

**ANNEX A**

( Clause 2 )

**LIST OF REFERED INDIAN STANDARDS**

IS No.	Title	IS No.	Title
210 : 1993	Grey iron castings ( <i>fourth revision</i> )	732 : 1989	Code of practice for electrical wiring installations ( <i>third revision</i> )
306 : 1983	Tin bronze ingots and castings ( <i>third revision</i> )	900 : 1992	Code of practice of installation and maintenance of induction motors ( <i>second revision</i> )
318 : 1981	Leaded tin bronze ingots and castings ( <i>second revision</i> )	1030 : 1989	Carbon steel castings for general engineering purpose ( <i>fourth revision</i> )
399 : 1963	Classification of commercial timbers and their zonal distribution ( <i>revised</i> )		

IS No.	Title	IS No.	Title
1570 : 1961	Schedules for wrought steels for general engineering purpose	6997 : 1979	Test code for sugarcane crushers
2062 : 1992	Steel for general structural purposes (fourth revision)	7201	Method of sampling for agricultural machinery and equipment : Part 1 Hand tools and hand operated/animal drawn equipment (first revision)
4771 : 1989	Abrasion-resistant iron castings (second revision)	1987	

## ANNEX B

( Clause 9.3 )

### INSTRUCTIONS FOR SAFE USE OF SUGARCANE CRUSHERS

#### B-1 INSTALLATION

- a) The crushing yard should be kept relatively free from all kinds of obstructions.
- b) The crusher should be properly anchored in the ground to ensure stability during the operation.
- c) The crusher should be set level both longitudinally and laterally.
- d) The main drive of the crusher should be aligned with the drive of the power unit.
- e) The direction of movement of the belt should be adjusted to suit the direction of rotation of rollers.
- f) All components, including guards and other safety devices, should be intact.
- g) In case the crushing is to be done at night, proper arrangement should be made for light. In the case of electrical installation, it shall be done in accordance with IS 732 and to the requirements of *Indian Electricity Rules*.
- h) As far as possible, the prime mover ( engine, motor, tractor or power tiller ) should be kept at a safe distance from the feeding inlet.
- j) The prime mover should be level both longitudinally and laterally.
- k) In the case of permanent installation of electrical motors, assistance should be taken from IS 900 even for temporary installation of motors, the points given under of IS 900 should be observed. The main switch of the motor should be fixed within easy reach of the operator.
- m) To avoid hitting on the head by the wooden beam of animal driven crushers, a pit should be dug near the feeding side, so that the operator feeding the cane could sit properly. The depth of the pit should be such that in operation there

is a clear gap of about 50 mm between the beam and the head of the operator.

#### B-2 SAFETY PRECAUTIONS IN OPERATION

- a) Do not tamper with or remove the guards or feed plate/chute.
- b) Do not wear loose dress, hand bangles wrist watch, etc, while feeding.
- c) Never do the feeding of canes under the influence of intoxicants like liquor, opium, etc.
- d) Do not stand on the crusher.
- e) Do not work if you feel tired.
- f) Do not cross over the belts or beam.
- g) Do not overfeed the crusher and avoid feeding small pieces of canes.
- h) Be always attentive while feeding the cane and avoid too much of talking.
- j) Due care should be taken to keep the hand at a safe distance while feeding.
- k) Except those adjustments which are required to be carried out when the crusher is being operated, any adjustment to be carried out should be done after stopping the crusher.
- m) Invalid, infirm, minor or sick persons should not operate the crusher.
- n) Regularly remove the heap of bagasse.
- p) Lubrication and other maintenance jobs should be done as recommended by the manufacturer.
- q) Check regularly the nuts and bolts and tighten them if necessary.
- r) In the case of bent canes, the canes should be chopped at one or two places to reduce the extent of bend.
- s) Do not encourage another person to sit in front of the person feeding the cane.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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