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HEAVY CEE PACKAGING (IMPROVED) FOR CEMENT

CEMENT RESEARCH INSTITUTE OF INDIA

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A Monograph

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CEMENT RESEARCH INSTITUTE OF INDIA
M 10 South Extension Part II Ring Road
New Delhi 110 049

PROJECT TEAM

Project Manager & Group Manager

Dr (Mrs) Reena Ramachandran
M Sc (Chem); D Phil; Doctrat d' University (France); MA AA Sc

Members

Shri V K Srivastava
BE (Chem Engg); AMIIChE

Shri J D Bapat
B Tech (Chem Engg); ME (Chem Engg)

Shri Naresh Kumar
B Tech (Chem Engg)

Shri Pradeep Otto
B Sc Engg (Mech)

Shri A K Bhatia
DME; AMIE (Mech, Elec, Chem); Dip PPEC;
AMIIW; AMII ChE (India)

Shri M Ravindranathan
ME (Chem Engg)

Group Manager

Dr A K Mullick
B Sc (Engg) (Hons); M Sc (Engg);
Ph D; MIE (Ind)

Director General

Dr H C Visvesvaraya
Ph D (Lond); DIC (Lond); BE (MYS)
FIE (IND); M Am CI; MPCI; MSESA

Editor

Shri S S Kalra
MA (Eng) ; JD

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PREFACE

Quite often attention has been drawn to loss of cement from jute bags due to seepage. Seepage of cement not only causes loss of material but also is a source of dust nuisance. Another difficulty incidental to the supply of cement in jute bags is the ingress of atmospheric moisture into the bags under unsatisfactory storage conditions with consequent deterioration in the quality of cement.

Numerous experimental trials on several varieities of bags which were conceived, designed and developed in CRI in close collaboration with the Indian Jute Mills Association, were conducted. These took into account the various parameters, such as availability of alternate raw materials, the packing requirements of Indian cement industry, such as temperature of cement for packing, size of package, method of handling, economics of re-use etc. This led to CRI developing a number of alternative designs which were first put to laboratory trials followed by trials in the plant and extensive field investigations. CRI's improved heavy cee bag of closer weaving pattern 8×10 was considered an appropriate substitute for the conventional heavy cee bags.

The improved CRI heavy cee bag has since been adopted by the cement industry as a substitute to the conventional bag and is presently using the new and old bags in the ratio of 90:10. The Government has decided that effective 1 October, 1982 the usage of improved CRI heavy cee bag for packing cement should be 100 %.

Indian Standards Institution is presently reviewing the Indian Standard Specifications for jute bag IS:2580 with a view to incorporating the improved version and to bring out a Standard to ensure conformity of these bags to quality requirements. This monograph presents the construction details, sampling, inspection and testing procedures and other particulars of CRI improved bags.

Dr H C Visvesvaraya
Director General

HEAVY CEE PACKAGING (IMPROVED) FOR CEMENT

1. INTRODUCTION

1.1 Keeping in view the basic requirements of a packaging system for cement under Indian conditions, CRI developed Improved Heavy Cee (8 × 10 Weaving) bags. These bags established their technical superiority over the existing packaging system through laboratory trials, followed by trials in 12 cement plants and lastly large scale industrial trials in 4 cement plants using around 1,00,000 bags.

1.2 Industrial Trials—The industrial trials were conducted after having established the techno-economic aspects of the bags and as a first pre-commercialisation exercise to facilitate their ultimate use for regular packaging of cement. In this exercise, data were collected from both cement manufacturers who used the bags for packing and consumers who received the cement in bags. A comprehensive questionnaire was sent to the four cement plants who used these bags on an economical scale and the feedback regarding their experience with the bags obtained.

1.3 Industrial Application of the Technology—Industrial trials having been successful from the point of view of both manufacturers and users, commercial use of these bags upto 90 percent has since been notified for adoption in the cement industry.

1.4 CRI Bags as Substitute for Conventional Heavy Cee Bags

1.4.1 The technical superiority of CRI bags *vis-a-vis* heavy cee bags being currently used for packing cement having been established through industrial trials, efforts were directed towards creating an awareness, both among the public and the industry, in respect of the techno-economic advantages of the former and these bags have now been accepted by the Government, the industry and the consumers.

1.4.2 The technology for making these bags exists in the industry which is concentrated in the eastern part of the country in view of the easy availability of the main raw material, namely jute.

1.5 In view of the above, there is an obvious and urgent need for standard specificaton to ensure the quality of CRI Improved Heavy Cee Bags. In this context, CRI has brought out the present monograph, to ensure their conformity to quality requirements.

1.6 The monograph deals with the constructional details and other particulars of CRI Heavy Cee Bags of dimensions 71 × 48 cm.

2. TERMINOLOGY

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

2.1 Lot—All bales of jute bags purporting to be of specified dimensions and quality, containing one definite number of bags, delivered to one buyer against one despatch note.

2.2 Bale—A rectangular or square pressed, rigid package, containing jute bags, covered with bale covering with outer layer stitched and bound by metal hoops in conformity with IS : 2873-1969*

2.3 Contract Weight (Bale)—The weight as obtained by multiplying the nominal weight of a bag and specified number of bags per bale.

2.4 Corrected Net Weight (Bale) — The weight obtained by adjusting the actual net weight on the basis of actual regain to the contract regain.

*Specification for packaging of jute products in bales.

2.5 Contract Regain—The contract moisture regain is the percentage regain on the basis of which the corrected net weight is calculated.

2.6 Ends—The warp threads of a fabric.

2.7 Porter—The value obtained by counting, in bags made of jute sacking as marketed, the number of warp threads per full gauge length of 47 mm (or 37/20 in) and dividing it by the number of warp threads per split, which here is 4.

2.8 Picks (or Shots)—The weft or filling threads of a fabric.

2.9 Joined Bag—A bag made out of two pieces of jute sacking.

3. GENERAL REQUIREMENTS

3.1 Sacking—The bags shall be made from single pieces (joined bags being not permitted) of double warp plain weave jute sacking of uniform construction and of 71 cm width ; the weft running along the length of the bags.

The weight per square metre of sacking used in the fabrication of the bags shall be 690 g. The valve shall also be made from sacking of the same construction as used for the manufacture of bags.

3.2 Seam

3.2.1 At the side of the bags, the raw edges shall be turned to a depth of 3 cm and sewn with overhead stitches through four layers of sacking (*see* Fig 1) using two strands of 3-ply jute twine of 380 tex × 3 (or 11 grist ×3). The stitching shall be of even tension throughout with all the loose ends securely fastened. The number of stitches per 10-cm at the side shall be between 9 and 11.

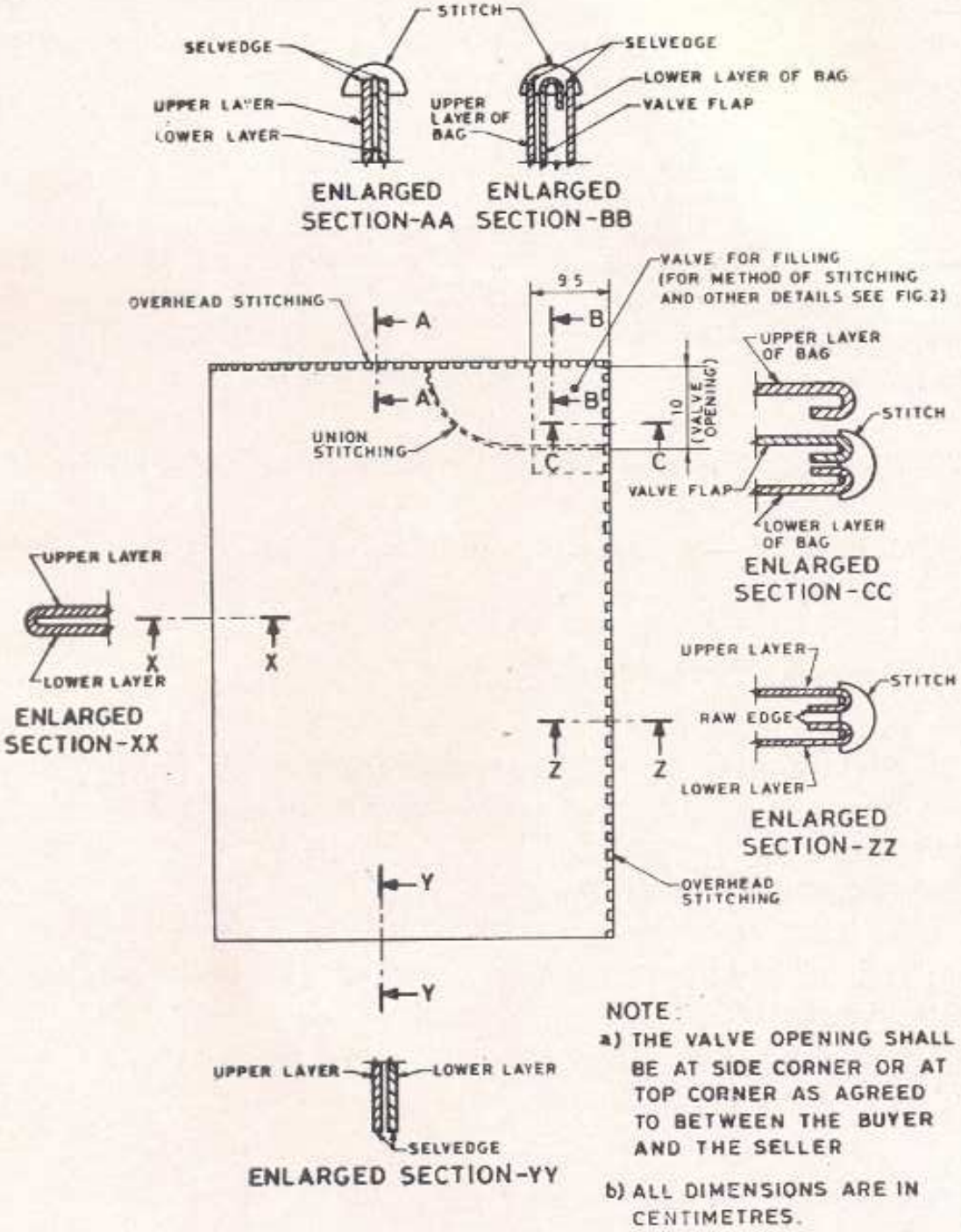


Fig 1 Jute bag for packing cement (with valve opening at side corner).

3.2.2 At the top of the bags, the selvedge shall be sewn with overhead stitches through two layers of sacking (*see* Fig 1) using 3-ply jute twine of 380 tex × 3 (or 11 grist × 3). The stitches shall be of even tension throughout wtih all the loose ends securely fastened. The number of stitches per 10 cm shall be between 9 and 11.

3.2.3 The bottom of the bags shall be left open or stitched as agreed to between the buyer and the seller. If stitched, it shall be with overhead stitches on selvedge through two layers of sacking, using two strands of 3-ply jute twine of 380 tex × 3 (or 11 grist × 3). The stitches shall be of even tension throughout with all the loose ends securely fastened. The number of stitches per 10-cm shall be between 9 and 11.

4. SPECIFIC REQUIREMENTS

4.1 The bags made out of the sacking shall conform to the requirements laid down in Table 1.

4.2 The bales containing the bags shall conform to the provisions laid down in Table 2.

4.3 Contract Regain—The contract moisture regain shall be 20 percent.

4.4 Sacking—The sacking from which bags are made, shall conform to the requirements laid down in Table 3.

5. PACKING AND MARKING

5.1 Packing—The bags shall be packed in bales as laid down in IS : 2873-1969, or as may be agreed to between the buyer and the seller.

5.2 Marking—The bales shall be marked as laid down in IS : 2873-1969. Additional markings shall be made as stipulated by the buyer or as required by the regulations or law in force.

6. SAMPLING AND INSPECTION

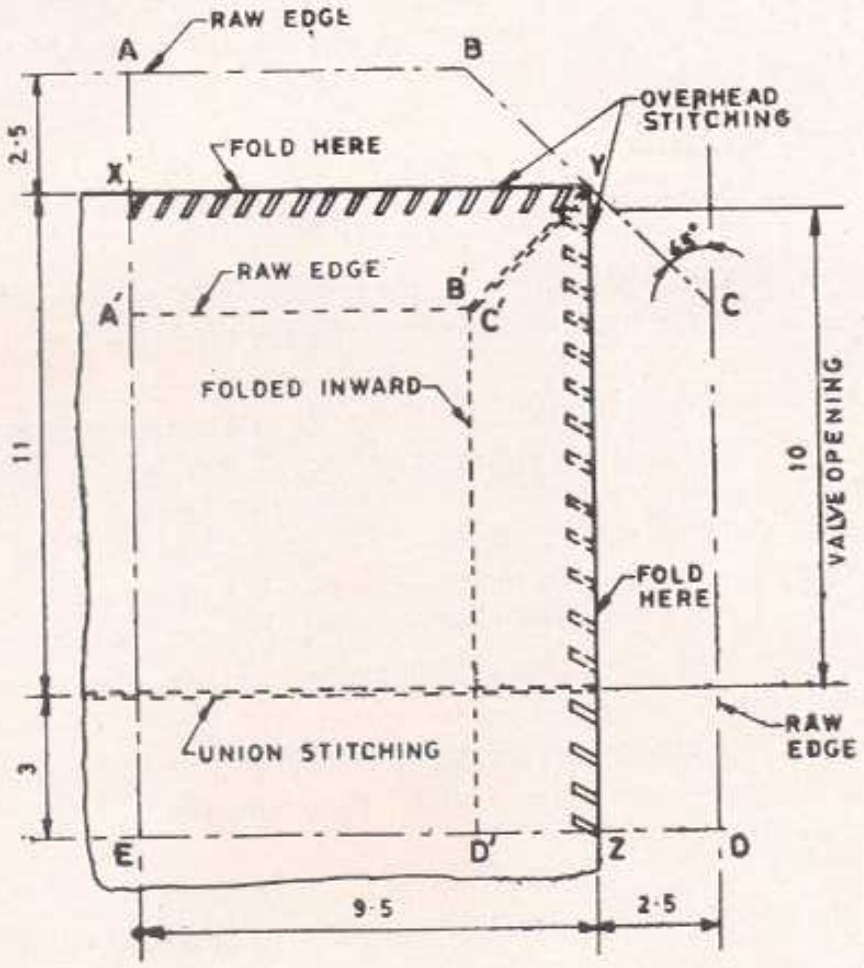
6.1 Unless otherwise agreed to between the buyer and the seller, the procedure for sampling shall be as given in Appendix A and the procedure for testing and inspection as given in Appendix B.

TABLE 1
PARTICULARS OF BAG
(*see* **4.1**)

Sl No	Characteristics	Requirement	Tolerance	Method of Test (Ref to Clause No. of Appendix B)
1	Weight per bag :	538 g	+ 50 g − 40 g	B-3
2	Dimensions :			
	a) Outside length of bag	71·0 cm (or 28 in)	+ 3 cm − 0 cm	B-5
	b) Outside width of bag	48·0 cm (or 19 in)	+ 3 cm − 0 cm	
	c) Effective size of valve	10×9·5 cm (or 4×3 - 3/4 in)	+ 1 cm − 0·6 cm	B-7
	d) Size of valve flap (*see* Fig 2)	16·5×12 cm (or 6-1/2×4-3/4 in)	+ 1·0 cm − 0·6 cm	
3	Bursting Resistance :			
	a) Cumulative percentage number of bags bursting after 5 drops from the height of 1·85 m	2 max	—	B-12
	b) Cumulative percentage number of bags bursting after one subsequent drop from the height of 3·7 m	10 max	—	B-12
4	Seepage Resistance : Cumulative percentage weight of cement lost after 5 drops from 1·85 m height and sixth drop from 3·7 m height	1·2 max	—	B-12

Note 1—For length and width of different specified values, as agreed to between the buyer and the seller, the same tolerance of $+\ 3\ {}^{0}_{-\ 0}$ cm shall apply,

2—The position of valve opening shall be at the side corner or top corner as agreed to between the buyer and the seller,



NOTE :

a) The size and shape of the flap before folding and stitching is shown by ABCDE
b) The size and shape of the valve as in the bag is shown by XYZE
c) A' B' shows the side AB of the flap after folding
d) C' D' shows the side CD of the flap after folding
e) All dimensions are in centimetres

Fig 2 Method of making valve

7. CRITERIA FOR CONFORMITY

7.1 The lot shall be considered as conforming to the repuirements if the following conditions are satisfied :

a) The total of the corrected net weight of the bales under test is not less than the total contract weight of the bales (*see* Table 2).

b) The number of bags in each bale under test is not less than the specified number (*see* Table 2).

c) The average moisture regain percent of the bags under test is not more than the specified percentage (see Table 2).

d) The average oil content of the bags unber test is not more than the specified percentage (*see* Table 2).

e) The dimensions of at least 90 percent of the bags under test are in accordance with the requirements specified (*see* Table 1). In the remaining bags, no bag shall have dimensions less than 1·5 cm below the specified values.

f) All the values of length and width of valve and flap are in accordance with the specified requirements (*see* Table 1).

g) The weight of at least 90 percent of the bags under test is in accordance with the requirements specified (*see* Table 1). In the remaining bags, no bag shall have weight less than 10 percent below the specified value.

h) The average ends per decimetre of the bags under test is in accordance with the requirement specified (*see* Table 3).

j) The average picks per decimetre of the bags under test is in accordance with the requirement specified (*see* Table 3).

k) The average breaking load values of the bags under test for both warp and weft directions are not less than the requirements specified (*see* Table 3).

m) The average breaking load values of seam for side, and top (or top and bottom) of the bags under test are not less than the requirements specified (*see* Table 3).

n) Percentage of bags bursting after five drops from the height of 1·85 m and one subsequent drop from the height of 3·70 m is not more than the value specified (*see* Table 1).

p) Weight of cement lost after five drops from the height of 1·85 m and one subsequent drop from the height of 3·70 m is not more than the value specified (*see* Table 1).

TABLE 2
REQUIREMENTS OF PACKED BALES
(*see* 4.2)

Sl No	Characteristics	Requirement	Method of Test (Ref to Clause No. of Appendix 'B')
1	Corrected net weight of a bale	Not less than contract weight	B-1
2	Moisture regain	22 percent, Max	B-2
3	Total No. of bags per bale	500	B-4
4	Contract weight of a bale	269 kg	See note 2 below
5	Oil Content	8 percent, Max	B-10

Note 1—The number of bags per bale shall be 500 or as specified in an agreement between the buyer and the seller. The number of bags per bundle shall be 25 or 50 as agreed to between the buyer and the seller.

2—Contract weight of a bale is calculated as follows :

Contract weight of a bale = nominal weight of a bag × specified number of bags per bale

(Contract weight of a bale is specified in the table on the basis of 538 g per bag and 500 bags per bale).

TABLE 3

PARTICULARS OF HEAVY CEE

Sl No	Characteristics	Requirement	Tolerance	Method of Test (Ref to Clause No. of Appendix 'B')
1	Picks per dm (or shots)	39 (or 10)	± 2	B-6
2	Ends per dm (or porter)	68 (or 8)	± 4	B-6
3	Breaking load of sacking [Strip method (10×20 cm)]			B-8
	a) Warp Way	160 kg		
	b) Weft Way	180 kg		
4	Breaking load of seam (Strip size : 5×20 cm)			B-9
	a) Side	60 kg		
	b) Top (or top and bottom)	67 kg		
5	Weight per sq metre	690 g	+ 5 percent — 2 percent	B-11

APPENDIX A

(Clause 6.1)

SAMPLING

A–1. SAMPLING FOR GROSS WEIGHT EVALUATION

A–1.1 For evaluating the gross weight of bales, 10 percent of bales selected from the lot, shall constitute the test sample.

A-2 SAMPLING FOR REQUIREMENTS OTHER THAN GROSS WEIGHT

A–2.1 For assessing the conformity to requirements other than gross weight of bales, the number of bales to be selected from the lot shall be as given below :

No of Bales in the Lot	*No of Bales to be Drawn and Opened for Inspection*
Up to 10	1
11 to 20	2
21 to 100	3
101 to 150	4
151 to 200	5
201 to 250	6
251 to 300	7
301 to 350	8
351 to 400	9
401 to 500	10

A-2.2 From the bales selected as in **A-2.1**, the test sample shall be drawn as follows :

Sl No	*Test*	*Test Sample*
1	Tare weight (of baling hoops, and all other packing materials)	Bale selected as in **A-2.1**
2	Total number of bags per bale	Two bundles of bags from each bale selected as in **A-2.1**

3 4 5	Moisture regain, percent Length and width Ends and picks	15 bags from each bale selected as in **A-2.1**
6 7 8 9	Size of valve & flap Breaking loadsacking Breaking loadseam Oil content, percent	One bag from each bale selected as in **A-2.1** subject to a minimum of three bags
10	Weight per bag	10 percent of bags from each bale selected as in **A-2.1**
11	Uniformity test	One bag from each bale selected as in **A-2.1** subject to a minimum of three bags

A-3. DROP TEST

A-3.1 Samples for drop test shall be drawn as specified below :

No of Bales Drawn and Opened for Inspection (Ref to **A-2.1**)	*Percentage of Bags to be Drawn from Each Bale*
1	25
2	25
3	10
4	10
5	10
6	9
7	9
8	8
9	8
10	8

APPENDIX B

(Clause 6.1)

TESTTNG AND INSPECTION

B-0 GENERAL

B-0.1 Testing and inspection of the lot shall be carried out on the samples drawn in accordance with Appendix A.

B-1 WEIGHT OF BALES

B-1.1 Determine the total gross weight (Wg) of the bales in the test sample (*see* **A-1**) from the gross weight of each bale taken up to the nearest kilogram.

Remove the baling hoops and all other packing materials of the bales (**A-2.2**) and weigh them together up to the nearest kilogram. Calculate the average tare weight of bale and multiply by the number of bales weighed (**B-1.1**) (Wt).

The total net weight of bales under test, $Wn = (Wg - Wt)$

B-1.2 Determine the total corrected net weight (W) of bales under test by the following formula :

$$W = \frac{Wn \times (\ 100 + \text{contract regain percent}\ )}{100 + (\ \text{average moisture regain percent of bales}\ )}$$

B-2 MOISTURE REGAIN

B-2.1 Determine the moisture regain in each bag (*see* **A-2.2**) on opening the bales (*see* **A-2.1**) by the use of a suitable moisture mater.

NOTE :—IJIRA (Indian Jute Industries' Research Association) moisture meter* may be used for the purpose. This meter works

*Mention of the name of the specific instrument is not intended to promote or give preference to the use of that instrument over others not mentioned.

on the principle of measuring the electrical resistance which changes with moisture content of the material. The specimen (Jute Product) is placed under the electrode gun having two poles of specially designed spring—loaded electrodes. The small amount of current passing through the electrodes is amplified and recorded on the meter calibrated against the actual moisture regain, based on oven-dry method, of the material. A separate chart calibrating the actual moisture regain, based on oven-dry method of the material may also be used. The instrument shall be operated according to the manufacturer's instructions.

B-3. WEIGHT PER BAG

B-3.1 Weigh each bag *(see* **A-2.2)** to the nearest 5 g after tests for **B-1** and **B-2.**

B-4. NUMBER OF BAGS PER BALE

B-4.1 Count the number of bundles of bags in each bale **(A-2.1)** and number of bags in each bundle **(A-2.2).** From the above, determine the total number of bags in each bale under test.

NOTE :—There should be no joined bag in any bale.

B-5. LENGTH AND WIDTH

B-5.1 Lay each bag **(A–2.2)** flat on a table, render it free from creases and wrinkles and measure the outside length and outside width about the centre to the nearest 0·5 cm.

B–6. ENDS AND PICKS

B–6.1 Count the ends and picks from each bag **(A-2.2)** in one and two places respectively with a suitable guage measuring 5 cm. Determine the average ends and picks per decimetre of the bags under test in accordance with IS : 1963-1961*.

*Method for determination of ends and picks per unit length in woven fabrics (since revised).

B-7. SIZE OF VALVE AND FLAP

B-7.1 From each bag **(A-2.2)** remove the stitches at the top of the bag near the valve. Lay the bag flat on the table ; turn the upper layer of the bag ; render the bag free from creases and wrinkles and measure the size of the valve to the nearest 0·2 cm.

B-7.2 Remove the stitches and separate from each bag the flap used for manufacturing the valve. Lay the flap flat on the table, render it free from creases and wrinkles and measure the size of the flap to the nearest 0·2 cm.

B-8. BREAKING LOAD OF SACKING

B-8.1 Test from each bag **(A-2.2)** two warp-way and two weft-way specimens for breaking load with 100 mm wide ravelled strips and 200 mm between grips of a strength tester having a constant rate of traverse of 460 mm (or 18 in) per minute as prescribed in IS:1969-1968*.

NOTE—Tests for breaking load of sacking may be carried out in the prevailing atmospheric conditions with relative humadity between 40 and 90 percent.

B-9. BREAKING LOAD OF SEAM

B-9.1 Test two specimens from the side and two from top (or top and bottom) of the bags **(A-2.2)** taking 200 mm between grips with the seam near about the centre, using a constant-rate-traverse machine operating at 460 mm (or 18 in) per minute.

Prepare the test specimens in the form of a double 'T' with 100 mm of seam and 50 mm width of fabric as shown in Fig 3

*Method for determination of breaking load and elongation at break of woven textile fabric (first revision).

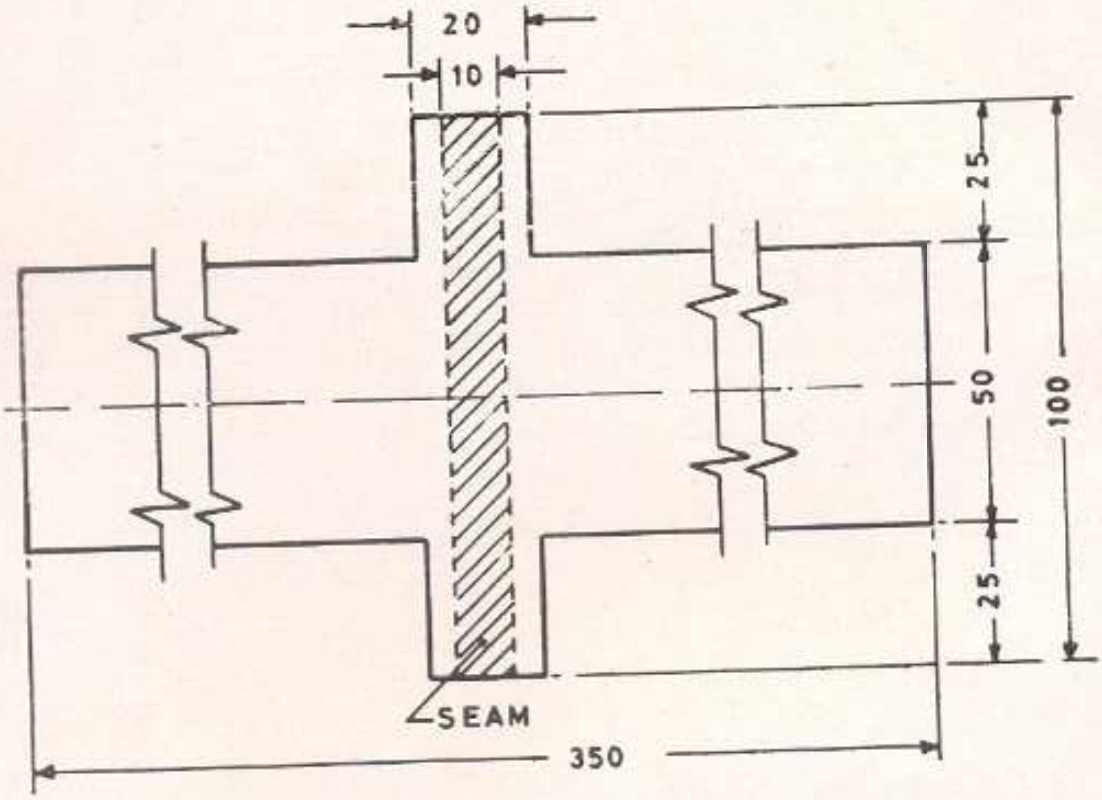


Fig 3 Size and shape of test specimen for seam strength

B-10. OIL CONTENT

B-10.1 From each bag take one representative strip **(A-2.2)** and determine oil content on dry de-oiled material basis by Soxhlet extraction using trichloroethylene as solvent, by the following formula :

$$\text{Oil content, percent on dry de-oiled material basis} = \frac{Wo}{Wd} \times 100$$

where Wo = weight, in g, of the extracted material (including natural fat and wax and batching oil) ; and

Wd = Oven-dry weight, in g, of the fabric after extraction.

B-11. UNIFORMITY

B-11.1 From each bag **(A-2.2)** take 3 strips of sack of 100 sq cm area as follows :

Sample I — Cut within a distance of 25 cm from top
Sample II — Cut within a distance of 25 to 50 cm from top
Sample III — Cut after a distance of 50 cm from top

Weigh each sample to the nearest of 0·1 g and take arithmatical average weight.

B-12. DROP TEST

B-12.1 Fill the bags **(A-3.1)** with cement, weigh each bag to the nearest 5 g. Subject the bags to five flat drops on hard flat surface from a height of 1·85 m and weigh the tested bags. Subject the bags which survive initial five drops to one drop from the height of 3·7 m and weigh it. Calculate the loss of cement due to seepage and also bursting of bags while droping.

.....Proforma

PROFORMA
RECORD SHEET FOR DROP TEST

Sl No	Tare Weight of Bag (Kg)	Filling Trial		Drop Test								Remarks
		Gross weight (Kg)	Net weight (Kg)	Observation after drop from 1·85 m height						Observation after drop from 3·7 m height		
				1st drop	*2nd drop*	*3rd drop*	*4th drop*	*5th drop*	*Weight after 5 drops*	*One drop*	*Weight of the bag after one drop*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)