

IS : 2720 ( Part XXIX ) - 1975  
(Reaffirmed 2005)

*Indian Standard*

METHODS OF TEST FOR SOILS  
PART XXIX DETERMINATION OF DRY DENSITY OF  
SOILS IN-PLACE BY THE CORE-CUTTER METHOD

*( First Revision )*

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard*

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PART XXIX DETERMINATION OF DRY DENSITY OF  
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Soil Engineering Sectional Committee, BDC 23

*Chairman*

PROF DINESH MOHAN

*Representing*Central Building Research Institute (CSIR),  
Roorkee*Members*SHRI G. R. S. JAIN ( *Alternate to*  
Prof Dinesh Mohan )

PROF ALAM SINGH

University of Jodhpur, Jodhpur  
Cementation Co Ltd, Bombay

DR A. BANERJEE

SHRI S. GUPTA ( *Alternate* )

SHRI K. N. DADINA

In personal capacity ( *P-820 New Alipore,*  
*Calcutta 700053* )

SHRI A. G. DASTIDAR

In personal capacity [ *Inter-State Equipment (P) Ltd,*  
*3/1 Loudon Street, Calcutta 700017* ]

SHRI R. L. DEWAN

Irrigation Research Institute, Khagaul, Patna

DR G. S. DHILLON

Indian Geotechnical Society, New Delhi

DIRECTOR

Land Reclamation, Irrigation & Power Research  
Institute, AmritsarRESEARCH OFFICER  
( GEOTECHNICAL SECTION )  
( *Alternate* )

DIRECTOR

Indian Institute of Technology, New Delhi

DR SHASHI K. GULHATI ( *Alternate* )

DIRECTOR ( CSMRS )

Central Water Commission, New Delhi

DEPUTY DIRECTOR ( CSMRS )

( *Alternate* )

SHRI A. H. DIVANJI

Rodio Foundation Engineering Limited; and  
Hazarat & Co, BombaySHRI A. N. JANGLE ( *Alternate* )

SHRI V. G. HEGDE

National Buildings Organisation, New Delhi

SHRI S. H. BALCHANDANI ( *Alternate* )( *Continued on page 2* )

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## *Indian Standard*

### METHODS OF TEST FOR SOILS

#### **PART XXIX DETERMINATION OF DRY DENSITY OF SOILS IN-PLACE BY THE CORE-CUTTER METHOD**

*( First Revision )*

#### **0. FOREWORD**

**0.1** This Indian Standard ( Part XXIX ) ( First Revision ) was adopted by the Indian Standards Institution on 22 September 1975, after the draft finalized by the Soil Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** With a view to establishing uniform procedure for the determination of different characteristics of soils and also for facilitating comparative studies of the results, the Indian Standards Institution has brought out this Indian Standard methods of test for soils ( IS : 2720 ) which is published in parts. This part [ IS : 2720 ( Part XXIX ) - 1975 ] deals with the determination of dry density of soil in-place by using a core-cutter. The in-place density of soil is needed for stability analysis, for the determination of the degree of compaction of compacted soil, etc. The core-cutter method covered by this part is suitable for fine-grained soils free from aggregations. It is less accurate than the sand-replacement method and is not recommended, unless speed is essential or unless the soil is well compacted. Other parts relating to in-place determination of density of soils are:

Part XXVIII Determination of dry density of soils in-place by the sand replacement method

Part XXXIII Determination of the density in-place by the ring and water replacement method

Part XXXIV Determination of density of soil in-place by the rubber-balloon method

**0.2.1** This standard was first published in 1966. In this revision, the test has been made applicable to soil 90 percent of which passes the 4.75-mm IS Sieve. The dimensions and requirements of the core-cutter have been modified. Detailed requirements for the steel rammer required for the test have been spelt out.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by basing the standard on the following publications:

BS 1377:1974 Methods of testing soils for civil engineering purposes.  
British Standards Institution.

INDIA. MINISTRY OF IRRIGATION AND POWER. CBIP Publication  
No. 42. Standards for testing soils, 1963. Central Board of Irrigation and Power, Delhi.

0.4 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\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

1.1 This standard ( Part XXIX ) covers the method for the determination of the in-place density of fine-grained natural or compacted soils free from aggregates using a core-cutter.

1.1.1 For the purpose of the tests described in this standard, a soil shall be termed as fine-grained soil if not less than 90 percent of it passes a 4.75-mm IS Sieve.

## 2. APPARATUS

2.1 **Cylindrical Core-Cutter** — of seamless steel tube, 130 mm long ( see Note 1 ) and 10 cm internal diameter, with a wall thickness of 3 mm, bevelled at one end, of the type illustrated in Fig. 1. The cutter shall be kept properly greased or oiled.

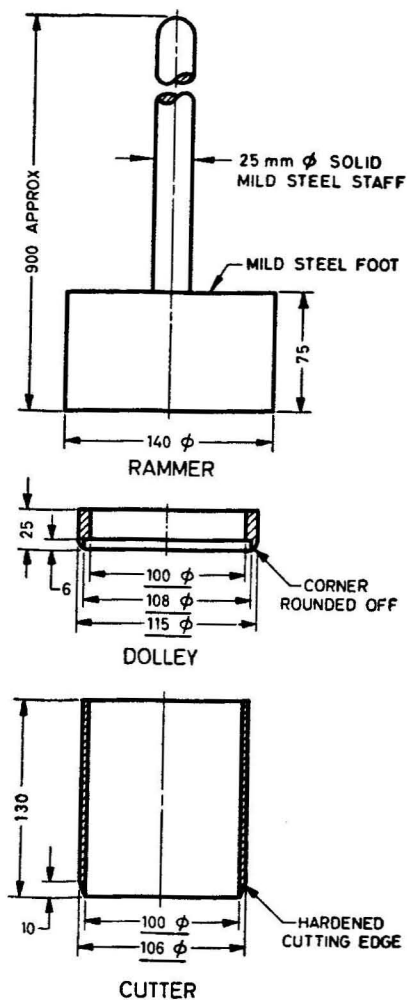
NOTE 1 — *Length of Cutter* — If the average density over a smaller depth is required then the appropriate length of cutter should be used.

NOTE 2 — Where situations permit, for quality control purposes smaller size cutters have also been used.

2.2 **Steel Dolly** — 2.5 cm high and 10 cm internal diameter with a wall thickness of 7.5 mm with a lip to enable it to be fitted on top of the core-cutter ( see Fig. 1 ).

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



NOTE 1 — These designs have been found satisfactory, but alternative designs may be employed provided that the essential requirements are fulfilled.

NOTE 2 — Essential dimensions are underlined. ( Tolerance on all essential dimensions shall be  $\pm 0.25$  mm ).

All dimensions in millimetres.

FIG. 1 CORE-CUTTER APPARATUS FOR SOIL DENSITY DETERMINATION

## IS : 2720 ( Part XXIX ) - 1975

**2.3 Steel Rammer** — With solid mild steel foot 140 mm diameter and 75 mm height with a concentrically screwed 25 mm diameter solid mild steel staff. The overall length of the rammer including the foot as well as the staff should be approximately 900 mm. The rammer ( foot and staff together ) should weigh approximately 9 kg ( see Fig. 1 ).

**2.4 Balance** — Accurate to 1 g.

**2.5 Palette Knife** — A convenient size is one having a blade approximately 20 cm long and 3 cm wide.

**2.6 Steel Rule**

**2.7 Grafting Tool or Spade or Pick Axe**

**2.8 Straight Edge** — A steel strip about 30 cm long, 2.5 cm wide and 3 to 5 mm thick, with one bevelled edge will be suitable.

**2.9 Apparatus for Extracting Samples from the Cutter** — Optional.

**2.10 Apparatus for Determination of Water Content** — In accordance with IS : 2720 ( Part II )-1973\*.

### 3. PROCEDURE

**3.1** The internal volume ( $V_c$ ) of the core-cutter in cubic centimetres shall be calculated from its dimensions which shall be measured to the nearest 0.25 mm.

**3.2** The cutter shall be weighed to the nearest gram ( $W_c$ ).

**3.3** A small area, approximately 30 cm square of the soil layer to be tested shall be exposed and levelled. The steel dolly shall be placed on top of the cutter and the latter shall be rammed down vertically into the soil layer until only about 15 mm of the dolly protrudes above the surface, care being taken not to rock the cutter ( see Note ). The cutter shall then be dug out of the surrounding soil, care being taken to allow some soil to project from the lower end of the cutter. The ends of the soil core shall then be trimmed flat to the ends of the cutter by means of the straight edge.

**NOTE** — The cutting edge should be kept sharp. The cutter should not be used in stony soils.

**3.4** The cutter containing the soil core shall be weighed to the nearest gram ( $W_s$ ).

**3.5** The soil core shall be removed from the cutter and a representative sample shall be placed in an air-tight container and its water content ( $w$ ) determined as in IS:2720 ( Part II )-1973\*.

\*Methods of test for soils: Part II Determination of water content ( second revision ).

NOTE — It is necessary to make a number of repeat determinations (at least three) and to average results, since the dry density of the soil varies appreciably from point to point. The number of determinations should be such that an additional one would not alter the average significantly.

#### 4. CALCULATIONS

4.1 The bulk density  $\gamma_b$ ; that is, the weight of the wet soil per cubic centimetre shall be calculated from the following formula:

$$\gamma_b = \frac{W_s - W_c}{V_c}, \text{ g/cm}^3$$

where

$W_s$  = weight of soil and core-cutter in g,

$W_c$  = weight of core-cutter in g, and

$V_c$  = volume of core-cutter in  $\text{cm}^3$ .

4.2 The dry density  $\gamma_d$ , that is, the weight of the dry soil per cubic centimetre shall be calculated from the following formula:

$$\gamma_d = \frac{100 \gamma_b}{100 + w}, \text{ g/cm}^3$$

where

$\gamma_b$  = bulk density ( see 4.1 ), and

$w$  = water content of the soil ( percent ) to two significant figures.

#### 5. REPORTING OF RESULTS

5.1 The results of the test shall be recorded in a suitable form. A recommended *proforma* for the record of the results of this test is given in Appendix A.

5.2 The following values shall also be reported:

- a) Dry density of the soil to second place of decimal in  $\text{g/cm}^3$ , and
- b) Water content of the soil ( percent ) to two significant figures.



## APPENDIX A

( Clause 5.1 )

DETERMINATION OF DRY DENSITY OF SOIL IN-PLACE  
( CORE-CUTTER METHOD )

A-1. The test results shall be tabulated as follows:

PROJECT:

TESTED BY:

LOCATION:

DATE:

1. Determination No.	1	2	3
2. Weight of core-cutter + wet soil ( $W_s$ ), in g			
3. Weight of core-cutter ( $W_c$ ), in g			
4. Weight of wet soil ( $W_s - W_c$ ), in g			
5. Volume of core-cutter ( $V_c$ ), in $\text{cm}^3$			
6. Bulk density $\left( \gamma_b = \frac{W_s - W_c}{V_c} \right), \text{ in g/cm}^3$			
7. Water content container No.			
8. Weight of container with lid ( $W_1$ ), in g			
9. Weight of container with lid and wet soil ( $W_2$ ), in g			
10. Weight of container with lid and dry soil ( $W_3$ ), in g			
11. Water content ( $w$ ), in percent $w = \frac{W_2 - W_3}{W_3 - W_1} \times 100$			
12. Dry density $\left( \gamma_d = \frac{100}{100 + w} \gamma_b \right), \text{ in g/cm}^3$			

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*Members*

DR R. K. BHANDARI  
 SHRI T. N. BHARGAWA  
 SHRI A. S. BISHNOI ( *Alternate* )  
 DR A. K. CHATTERJEE

DR B. L. DHAWAN ( *Alternate* )  
 SHRI R. L. DEWAN  
 DEPUTY DIRECTOR RESEARCH  
 ( SOIL MECHANICS )-I, RDSO  
 ASSISTANT DIRECTOR  
 RESEARCH ( SOIL  
 MECHANICS )-I, RDSO  
 ( *Alternate* )

DIRECTOR ( CSMRS )  
 DEPUTY DIRECTOR ( CSMRS )  
 ( *Alternate* )

SHRI H. K. GUHA  
 SHRI N. N. BHATTACHARAYA  
 ( *Alternate* )

DR SHASHI K. GULHATI  
 SHRI G. R. S. JAIN

SHRI AMAR SINGH ( *Alternate* )  
 SHRI R. K. JAIN

DR P. K. DE ( *Alternate* )  
 SHRI O. P. MALHOTRA  
 DR I. S. UPPAL ( *Alternate* )  
 DR V. V. S. RAO

MAJ K. M. S. SAHASI  
 SHRI P. PUTHISIGAMANI ( *Alternate* )  
 SHRI H. C. VERMA

PROF T. S. NAGARAJ ( *Alternate* )

*Representing*

Central Road Research Institute ( CSIR ), New Delhi  
 Roads Wing, Ministry of Transport & Shipping

Public Works Department, Government of Uttar  
 Pradesh

Irrigation Research Institute, Khagaul, Patna  
 Railway Board ( Ministry of Railways )

Central Water Commission, New Delhi

Geologists' Syndicate Private Ltd, Calcutta

Indian Institute of Technology, New Delhi  
 Central Building Research Institute ( CSIR ),  
 Roorkee

United Technical Consultants Private Ltd, New  
 Delhi

Building & Roads Research Laboratory, Punjab

In personal capacity ( *F-24 Green Park, New  
 Delhi 110016* )

Engineer-in-Chief's Branch, Army Headquarters

Associated Instrument Manufacturers ( India )  
 Private Ltd, New Delhi

## BUREAU OF INDIAN STANDARDS

### Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 23230131, 23233375, 23239402

Fax: 91+011 23239399, 23239382

E-Mail: info@bis.org.in

website: http://www.bis.org.in

### Central Laboratory:

Plot No. 20/9, Site IV, Sahibabad Industrial Area, SAHIBABAD 201010

Telephone

277 0032

### Regional Offices:

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

2323 7617

\*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Kankurgachi, KOLKATA 700054

2337 8662

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022

260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113

2254 1984

†Western: Manakalaya, E9, MIDC, Behind Marol Telephone Exchange,  
Andheri (East), MUMBAI 400093

2832 9295

### Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001

560 1348

Peenya Industrial Area, 1<sup>st</sup> Stage, Bangalore-Tumkur Road, BANGALORE

839 4955

Commercial-cum-Office Complex, Opp. Dushera Maidan, Arera Colony,  
Bittan Market, BHOPAL 462016

242 3452

62-63, Ganga Nagar, Unit VI, BHUBANESHWAR 751001

240 3139

5<sup>th</sup> Floor, Kovai Towers, 44 Bala Sundaram Road, COIMBATORE 641018

221 0141

SCO 21, Sector 12, Faridabad 121007

229 2175

Savitri Complex, 116 G.T. Road, GHAZIABAD 201001

286 1498

53/5 Ward No. 29, R.G. Barua Road, 5th By-lane, Apurba Sinha Path,  
GUWAHATI 781003

245 6508

5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001

2320 1084

Prithavi Raj Road, Opposite Bharat Overseas Bank, C-Scheme, JAIPUR 302001

222 3282

11/418 B, Sarvodaya Nagar, KANPUR 208005

223 3012

Sethi Bhawan, 2<sup>nd</sup> Floor, Behind Leela Cinema, Naval Kishore Road,  
LUCKNOW 226001

261 8923

H. No. 15, Sector-3, PARWANOO, Distt. Solan (H.P.) 173220

235 436

Plot No A-20-21, Institutional Area, Sector 62, Goutam Budh Nagar, NOIDA 201307

240 2206

Patliputra Industrial Estate, PATNA 800013

226 2808

Plot Nos. 657-660, Market Yard, Gultkdi, PUNE 411037

2427 4804

"Sahajanand House" 3<sup>rd</sup> Floor, Bhaktinagar Circle, 80 Feet Road,  
RAJKOT 360002

237 8251

T.C. No. 2/275 (1 & 2), Near Food Corporation of India, Kesavadasapuram-Ulloor Road,  
Kesavadasapuram, THIRUVANANTHAPURAM 695004

255 7914

1<sup>st</sup> Floor, Udyog Bhavan, VUDA, Siripuram Junction, VISHAKHAPATNAM-03

271 2833

\*Sales Office is at 5 Chowringhee Approach, P.O. Princep Street, KOLKATA 700072

2355 3243

†Sales Office (WRO) Plot No. E-9, MIDC, Rd No. 8, Behind Telephone Exchange,  
Andheri (East), Mumbai-400 0093

2832 9295