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# GUIDE FOR UNDISTURBED SAMPLING OF SANDS

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# *Indian Standard*

# GUIDE FOR UNDISTURBED SAMPLING OF SANDS

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 28 February 1978, after the draft finalized by the Soil Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** Undisturbed sampling of soil is a common feature in the field of soil mechanics and foundation engineering for finding *in situ* characteristics of soils. In nature soils are found in variety and in different states of compactness and samplers have been designed to collect soils with least disturbance within practical limitations. Cohesionless soils are still problematic as far as undisturbed sampling is concerned, and hence *in situ* testing is more common for these soils. Samples of coarse or loose sand readily fall out when ordinary sampling equipment with an open end is used. This guide has, therefore, been prepared to provide guidance in obtaining undisturbed samples in sand and covers two important techniques of undisturbed sampling in uncemented sands, namely, stationary piston sampling with drilling fluid circulation technique and compressed air technique. However, even with these methods the sample obtained may be considered to be only relatively undisturbed. These samples are generally used for the determination of *in situ* density. It also briefly mentions the technique of rotary core drilling in cemented sands.

**0.3** Special techniques in sampling of sand have not been covered in this guide as these techniques are costly and are employed on a limited scale in very special cases. Some of such techniques in use are mentioned in **0.3.1**.

**0.3.1** Freezing or impregnation form special techniques beneficially used in sampling sands under favourable conditions. Freezing ensures solidification of the lower part of the sample to retain it in the sampler tube. Solidification can also be achieved in some cases by impregnating a chemical such as kerosene at subzero temperature in place of drilling fluid, mixing alcohol with dry ice, emulsified asphalt and grout, etc.

**0.4** 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 this field in this country.

## 1. SCOPE

**1.1** This standard covers the following two techniques of undisturbed sampling in uncemented sands:

a) Stationary piston sampling with drilling fluid circulation technique, and

b) Compressed air technique.

## 2. STATIONARY PISTON SAMPLING WITH DRILLING FLUID CIRCULATION TECHNIQUE

**2.1 Equipment** — Figure 1 illustrates the various components of equipment apart from drilling equipment and pump. There are as follows:

a) A thin walled sampler conforming to IS : 2132-1972*.

b) An airtight piston with a vacuum breaking arrangement.

c) The sampler head comprising the following:

1) Suitable set screws to join the sampling tube to the head of the sampler,

2) A vent hole, and

3) A clamping arrangement to prevent the piston rod from falling down during lowering or withdrawal.

d) Sturdy and straight piston rods with 1 m joint to joint spacing.

e) A storage tank wherein drilling fluid ( generally bentonite slurry ) of required consistency is kept constantly agitated by paddle or any other suitable arrangement.

f ) A tank to receive the efficient ( drilling fluid ) to separate the sand particles from the drilling fluid to allow for recirculation of the latter.

### 2.2 Description of Technique and Procedure of Sampling

**2.2.1** *General* — In this method, partial vacuum is created above the sample while withdrawing the stationary piston sampler. The coating of drilling fluid at the shoe keeps the sand sample intact during withdrawal. Since the piston will be at the shoe of the sampler at the beginning of the sampling operation, no shavings can enter the tube during sampling. The consistency of the drilling fluid shall depend on the grain size of sands, the relative density and the position and condition of water table. For fine sand, a drilling fluid with a specific gravity of 1·05 will be satisfactory.

*Code of practice for thin-walled tube sampling of soils ( *first revision* ).

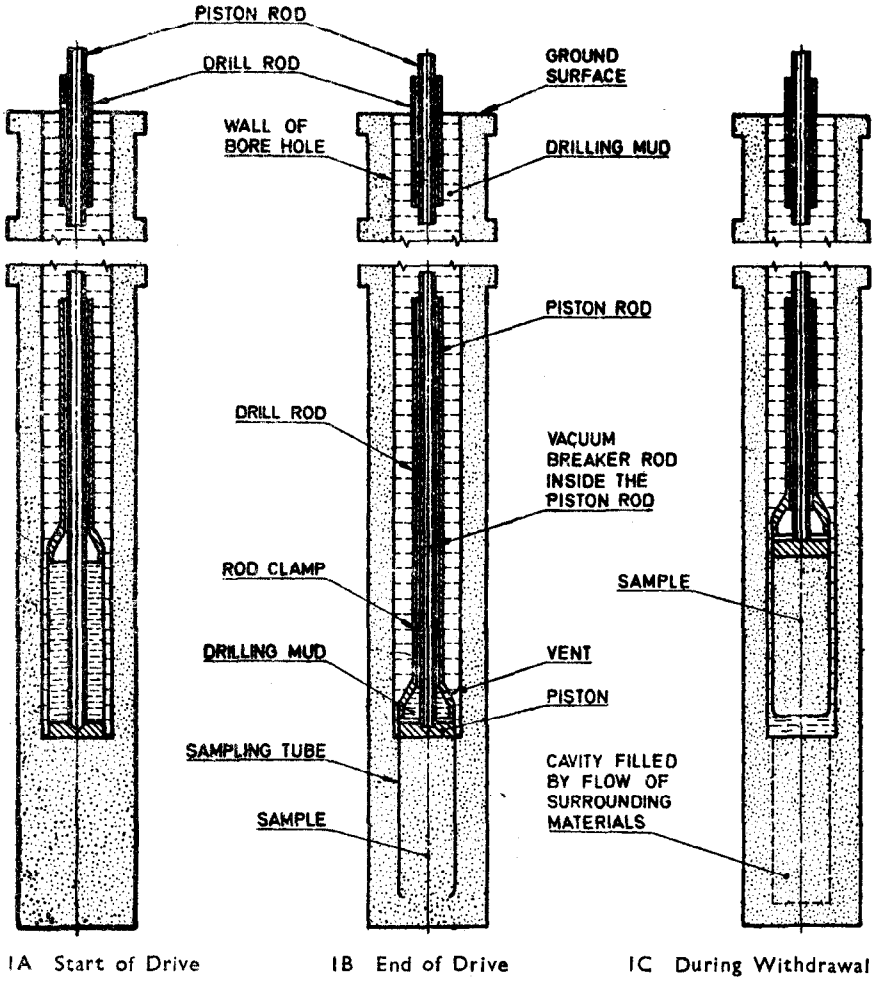



FIG. 1 CROSS SECTION ( DIAGRAMMATIC ) THROUGH BORING DURING SAMPLER DRIVE AND WITHDRAWAL

**2.2.2** *Procedure of Sampling*

**2.2.2.1** The bore hole shall be advanced with any suitable technique. It is preferable to use rotary drilling in combination with drilling fluid for advancement of bore hole; particularly, for deeper depths which limits the lengths of casing to the upper depths.

**2.2.2.2** In case of rotary drilling, using drilling fluid, the drilling fluid of required consistency shall be kept continuously agitated in a tank by paddle or any other arrangement. This fluid shall be circulated through a drill rod during drilling operation. It is advantageous to use fish tail bit for such drilling.

**2.2.2.3** The outcoming fluid shall be collected in a separate tank and the sand particles allowed to settle down. The supernatant fiuid shall then be used for re-circulation.

**2.2.3** *Sampling Technique*

**2.2.3.1** Having advanced the drill hole, the sampler, with the rod in extended position, shall be lowered. The drill rods and the piston rods help reaching down to the surface of contact where sampling is to be done. The piston rod shall be clamped to the drilling machine or tripod and the sampling tube shall be pushed continuously into the virgin soil.

**2.2.3.2** Before withdrawal of the sample, it shall be given a rotary motion to shear the sample at the bottom of the tube. The piston shall be locked so that it does not move downwards while the sample is being cut. Both the drill rods and the piston rods shall be removed in stages.

**2.2.3.3** Necessary precaution shall be taken to prevent the piston or piston rod from falling down. This shall be ensured by a suitable piston rod locking device such as a conical catch, which shall be checked to be in satisfactory working condition prior to use.

## 3. COMPRESSED AIR TECHNIQUE

**3.1 Equipment** — The equipment is shown in Fig. 2. It shall have the following components apart from the drilling equipment and casing pipes ( 152 mm diameter ):

a) Compressed air bell to house the sampler tube connected through a hose to a foot pump at the ground surface.

b) Sampler tube ( 63 mm diameter and 1·7 mm wall thickness ).

c) A special head comprising the follwing:
   1) Set screws to connect the sampler head to sampling tube,
   2) Rubber sealing rings,
   3) Water exit ports,
   4) A rubber diaphragm valve,
   5) A relief valve,
   6) A bronze bushing,
   7) Special sealing ring ( *Angus* type ), and
   8) A steel head for the bell.

d) A removable spacer block.

e) Guide rod.

f) A socket block encasing guide rod along with a shackle to push the sampler tube.

g) Lifting cable.

### 3.2 Description of Technique and Procedure of Sampling

**3.2.1** *General* — In this technique compressed air is used to keep the ground water separated from the sample in order to avoid dispersion of sampled sand. This is done by withdrawing after sampling, the sampler tube into a bell where the ground water has been displaced by compressed air through a continuous pumping process. The depth of water in the drill holes govern the pressure of compressed air. The method is suitable for sampling sand under water table.

**3.2.2** *Procedure of Sampling*

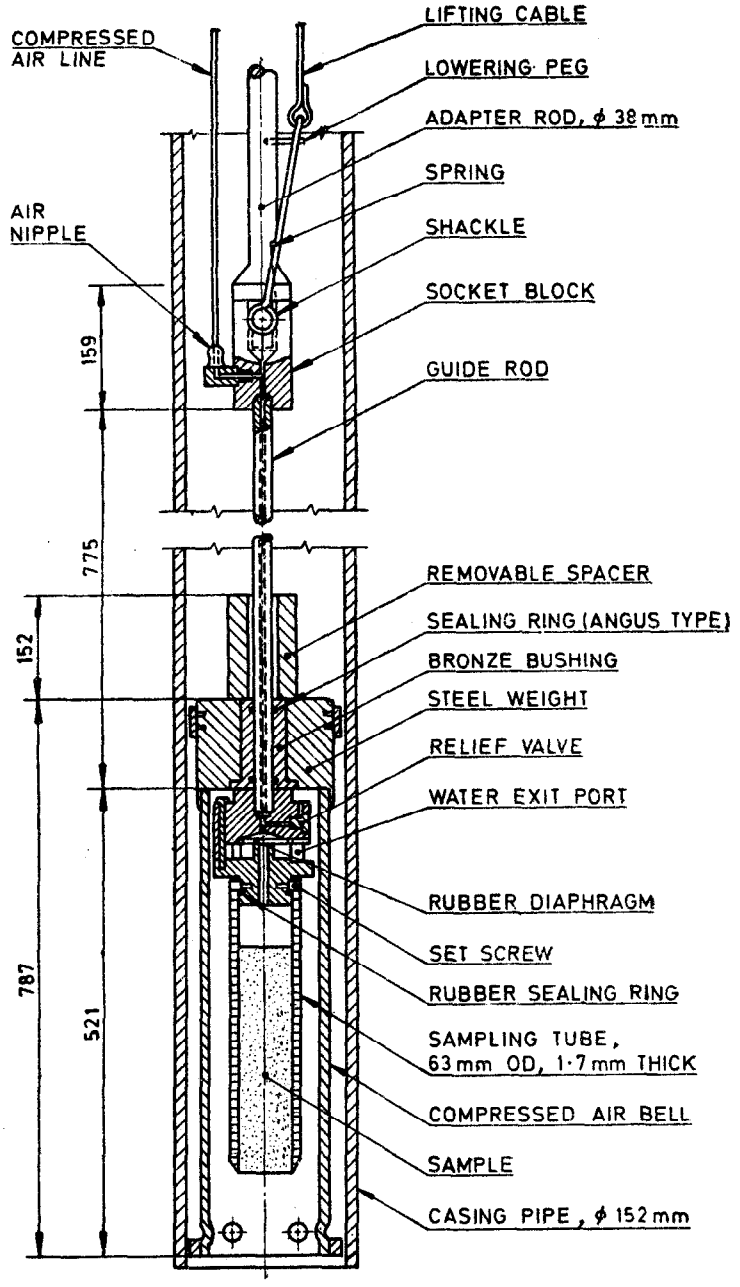
**3.2.2.1** The drill hole shall be advanced with a suitable boring method using 152 mm diameter casing down to the depth of sampling.

**3.2.2.2** Having reached the required depth, the sampler shall be pushed into soil by means of a drill rod and the spacer block and shackle arrangement. The spacer block above the bell limits the length of sampling stroke, thus, avoiding overdriving.

**3.2.2.3** The drill rod shall then be withdrawn. Compressed air shall be forced into the bell by means of a foot pump. The air in turn pushes the diaphragm of the relief valve so as to maintain an excess pressure of 140 kN/m$^2$ ( 1·4 kgf/cm$^2$ ) thus closing the diaphragm check valve.

**3.2.2.4** Having expelled the water in the bell, as indicated by the rising air bubbles, the sampler shall be withdrawn into the bell and the entire assembly raised to the surface by means of a cable. During raising of the assembly to the surface, water should be poured continuously to keep the drill hole full. The foot pump shall be continuously operated during withdrawal.

**3.2.2.5** The spacer block above the bell shall then be removed so that the sampler is pushed out of the bell and sampling tube disconnected. A filter plug shall be placed in the lower end. The suction created by check valve shall then be released and undisturbed sample obtained.




All dimensions in millimetres.

FIG. 2 GENERAL LAYOUT OF SAND SAMPLER WITH AUXILIARY BELL FOR COMPRESSED AIR

## 4. SAMPLING IN CEMENTED SANDS

**4.1** Slow rotary technique using core barrels may be used to obtain undisturbed cores in cemented sand. If necessary, drilling fluid may be used during advancement for stabilization of the hole. In certain cases, where drilling is susceptible to cave in double tube core barrels may be used. If such cemented sands exist at shallow depths, preferably block samples may be obtained, by isolating a 200-300 mm square column of soil followed by covering it by a slightly larger hollow box open at top and bottom. The annular space between the rock and box shall then be filled by paraffin. The sample shall be trimmed by a spade and then covered at top and bottom also by paraffin so as to preserve its moisture.

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