Standards of Japanese Geotechnical Society for Soil Sampling

— Standards and Explanations —

(English Version)

- **JGS 1221-1995**: Method for Obtaining Undisturbed Soil Samples using Thin-walled Tube Sampler with Fixed Piston
- **JGS 1222-1995**: Method for Obtaining Undisturbed Soil Samples using Rotary Double-tube Sampler
- **JGS 1223-1995**: Method for Obtaining Undisturbed Soil Samples using Rotary Triple-tube Sampler
- **JGS 1224-1995**: Method for Obtaining Soil Samples using Double-tube Sampler with Sleeve
- **JGS 1231-1995**: Method for Obtaining Undisturbed Soil Block Samples

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FOREWORD

As the world's interest in soil sampling methods is distinctly evident in recent years with a visible movement towards international standardization, this booklet compiles five Japanese Geotechnical Society's Standards in English concerning soil sampling methodologies and procedures including supplementary explanation documents.

Since the 1960's, the Japanese Geotechnical Society has published more than eighty issues of the Standards of Japanese Geotechnical Society (JGS), and the Society has borne the substancial responsibility for the Japanese Industrial Standards (JIS) related to geotechnology ever since their establishments inaugurated in the 1950's. Currently, these JGS Standards and JIS are being translated to English with the primary objective of promoting and disseminating the practical use of these publications overseas. It should be noted that the Japanese text must be considered as the standard manuscript and the English version provides only as a reference.

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Designation: JGS 1222-1995

Method for Obtaining Undisturbed Soil Samples using Rotary Double-tube Sampler

1. GENERAL

1.1 Purpose

The purpose of this method is to recover undisturbed soil sample suitable for laboratory tests.

1.2 Scope of Application

This standard is applicable to recover cohesive soil of medium to hard stiffness.

1.3Definition of Terms

Rotary Double Tube Sampler consists of an outer tube system which employed to cut soil by rotation with drilling fluid, and an inner sampling tube assembly which is free from the rotation of the outer tube system to recover stiff cohesive soil.

Undisturbed Soil Sample is defined as that whose soil structures and mechanical properties are kept as close as possible to those of in-situ soil.

[Notes]

1. In case the method employed is partly different from this standard, details shall be recorded clearly in the report.

1.2 SPT *N*-value as an indication of stiffness / density of the soil suitable for this sampler ranges 4 to 15, generally speaking.

1.3 Rotary Double Tube Sampler is sometimes called as Denison type sampler.

2. APPARATUS

2.1 Drilling Equipment

A drilling machine and other drilling equipment shall be used that provide a borehole of a required diameter and of a required depth without disturbing soils to be sampled.

2.2 Sampler

Sampler consists of sampler head, outer tube, drill bit and sampling tube, as described below;

(1) ***Sampler Head*** : Upper part of sampler head can be connected to the drill rod, and the lower outside part can be connected to the outer tube, and the lower inside part can be connected to the inner sampling tube assembly. The following functions should be possessed:

① Rotation of the drill rod is only to be transmitted to outer tube, while the inner tube is to be free from the rotation by a swivel mechanism.

② To prevent drilling fluid flowing into the sampling tube, drain hole with one way valve should be installed at the top of the inner system.

③ The protruding length from the drill bit to the cutting edge of sampling tube should be adjustable.

④ A spring mechanism, which is to give a fine adjustment of the protruding length of cutting edge during sampling should be installed in the inner assembly sampling tube.

(2) ***Outer Tube*** : Outer tube is generally made of a seamless steel pipe and shall have a thread to fit a drill bit at the lower end.

(3) ***Metal Crown*** : The drill bit is a tubular shaped bit with embedded tips of super hard metals. The drill bit is screwed to the lowered of the outer tube and is used to cut the soil ground.

(4) ***Sampling Tube*** : Sampling tube is made of stainless steel pipe, it must be rigid to resist the penetration force, and a specified cutting edge must be prepared.

[Notes]

2.1 Taking into account of the stiffness of soil which is to be recovered, the drilling machine to be used should have sufficient capacity to resist to the rebound force while a sampling tube is penetrating into ground.

2.2 A spring mechanism to control a pushing force of the sampling tube into ground as well as to have fine tuning of the protruding length of the cutting edge should be installed as illustrated in Fig.1.

(1)

④ whose spring loaded swivel mechanism to produce fine tuning of the protruding length of cutting edge is generally installed, even it could be also designed a combination of spring and air pressure.

(4) A standard specifications of sampling tube is illustrated in Fig.2.and Table 1.

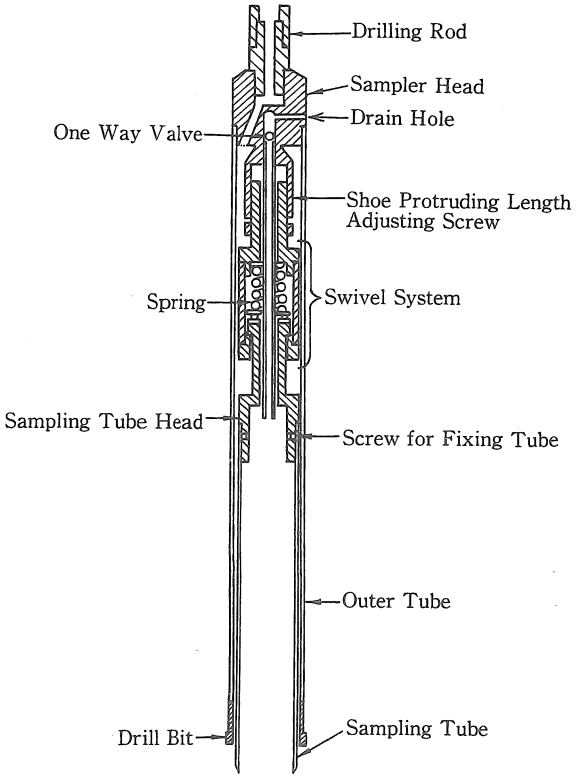


Fig.1 An Example of Rotary Double Tube Sampler

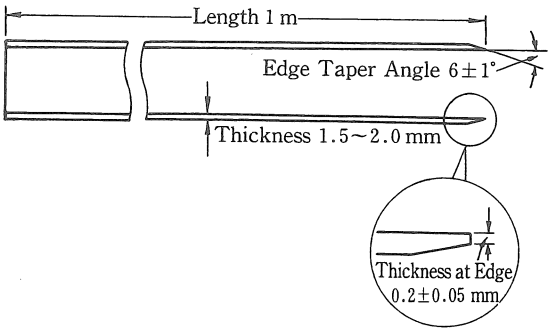


Fig.2 Sampling Tube

Table 1 Specifications of Sampling Tube

Quality of Material	Stainless steel
Inside Diameter	75 mm
Thickness	1.5~2.0 mm
Edge Taper Angle	6±1°
Blade Thickness	0.2±0.05 mm
Length	1 m
Degree of diarchric distortion	*De*(max) – *De*(min)<1.5mm

De(max),*De*(min) are the maximum outside diameter and the minimum outside diameter at an arbitrary cross section respectively.

3. PROCEDURE

3.1 Drilling

Cuttings should be removed from the bottom of drill hole after drilling to the required depth had been reached. The drilling diameter shall always be larger than 116mm in principle. During drilling and cuttings removal, careful operation to not disturb soils below the bottom of drill hole shall be taken.

3.2 Sampling

(1) A sampler should be assembled after inspecting every parts of sampler and confirming every mechanism is in order.

(2) An assembled sampler should be connected to the drill rod, the drill rod should be continuously added until the sampler is lower down to the bottom of the hole, the depth should be measured and used as the initial depth of sampling.

(3) Penetration force, rate of rotation of drill rod, consistency of drilling fluid and rate of the drilling fluid circulation volume of etc. should be carefully decided taking into account of the soil condition, the sampler should be continuously penetrated at reasonable force.

(4) The length of sampler penetration should be recorded as the final depth of sampling after penetration is completed.

(5) After the recording is completed, the sampler should be carefully withdrawn, and any shock should not be given.

(6) Disassemble the sampler carefully, not given any shock to sample.

[Notes]

3.1 Generally, well controlled drilling fluid shall be used to protect borehole wall from its collapsed. When a collapse of the borehole wall is happened or anticipated, use casing pipes as a preventive measure.

3.2

(1) While assembling a sampler, the protruding length of cutting edge of sampling tube should be appropriately adjusted taking into account of the stiffness of soil.

(2) a. The penetration length of sampler should be controlled in 80 percent of that of sampling tube. An excess penetration force should not be applied.

b. In case of the penetration of sampler was becoming difficult, stop the sampling and withdraw the sampler after measuring its depth.

4. SAMPLE HANDLING

(1) Remove cuttings in the upper end of the sample, observe the condition of both ends of the sample and measure a length of the sample.

(2) Seal both ends of the sample in order to prevent the movement of the sample in the sampling tube and to avoid any change of the soil condition.

(3) Transport the samples to a laboratory as soon as possible. During the transportation, avoid any shock, vibration and temperature change which will affect the quality of the sample.

(4) When the sample is stored temporarily on site, avoid any shock, vibration and temperature change which will affect the quality of the samples.

[Notes]

4. The following information shall be recorded on the side of the sampling tube:
   a. Name of the project,
   b. Boring number and sample number,
   c. Sampling depth and
   d. Sampling date.

5. REPORT

The report shall include the following information:

(1) Details of an alternate method when the method employed is partly different from this standard,

(2) Name of the project,

(3) Boring number and sample number,

(4) Initial and final depths of sampling,

(5) The sampler type used,

(6) Sampling date and

(7) Other remarks and notations.

EXPLANATION OF THIS STANDARD

1. General

The Rotary Double Tube Sampler is defined as a standard in its structure and dimensions.

There are several types of open drive samplers which are being used in Japan besides the Rotary Double Tube Sampler to obtain medium to hard stiff cohesive soil, but the Rotary Double Tube Sampler is most popular and the operational procedures have been well established so that it is established as a standard.

2. Apparatus

2.1 Drilling Equipment Generally, rotary drilling machines are used for borehole drilling in sampling. It is important to chose the drilling machine which have sufficient capacity to provide required torque and drilling force depending on the type and stiffness of the soil. The selection of the capacity and structure of drilling machine may be referred in section 4. of Geotechnical Investigation Methods of the JGS, and the list attached as Appendix 2.

2.2 Sampler The components of the sampler should be well fabricated structurally and functionally for their functional purposes, also it is important for the sampler to be assembled and disassembled easily in the field.

The outer tube of the sampler should be connected to drill rod, and the soil outside of sampling tube can be cut by the rotation of outer tube with drill bit while the drilling fluid is circulated through it. At this time, the cutting edge of sampling tube should be penetrated in advance into the soil while it thrusts out of the drill bit of outer tube.

If noting the sampling tube itself, it is only one kind of open drive sampler. The outer tube can be rotated and cut the outside soil of the sampling tube which is mechanically free from the outer tube rotation by facilitating a ball-bearing thrust mechanism. Therefore, it is important to make sure the ball-bearing thrust mechanism is in good function to keep the inner sampling tube system free from the rotation of the outer tube.

3. Procedure

3.1 Drilling Sampling may be considered as the extraction of undisturbed sample from the sampler penetrated into the bottom of the borehole, so that it is important to maintain borehole diameter, keep not to disturb the sampling ground, and remove the cuttings.

For detail, refer to Section3.3.4 while drilling hole.

3.2 Sampling should include the following procedures: inspect the sampler, assemble and lower the sampler down to the hole bottom, rotate drill rod and the outer tube, penetrate the sampler, and withdraw the sampler up. Finally, disassemble the sampler, and observe the condition of sample.

(1) Inspection of Sampler and Assemble: It should be made as a rule to inspect and assemble the sampler before the sampling is to be carried out. The following items should be

carefully inspected.

① whether the sampling tube is damaged or deformed.

② if the swivel structure is functioning properly.

③ if the fluid drain hole is clean, and

④ if the one-way valve to prevent a reverse flow is in good function.

Then, the assembling of sampler should be carried out with the following steps:

① adjust the protruding length of sampling tube, and fix it by a nut, taking into account the stiffness of the soil to be sampled.

② set the sampling tube while confirming the O ring located in the sampling tube head, and fix the sampling tube to the head by the fixing screws.

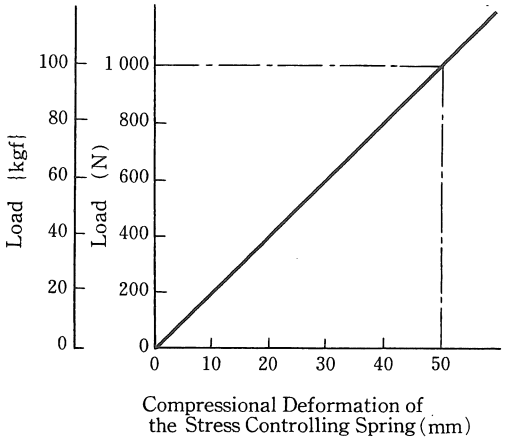
③ tighten the screws.

④ finish the assembling of sampling tube.

(2) Protruding Length of Sampling Tube: It is difficult to apply a fix rule to determine the protruding length of sampling tube, but it is a principle that extending the length while the ground is soft, and shortening the length while the ground is more stiff. Table5.4.1 may be a reference in selecting the length. However, the protruding length must be adjusted taking into account the maximum compression length of the stress controlling spring. A relation of load and compressive deformation of the stress controlling spring of the rotary double tube sampler is illustrated in Fig.5.4.1.

Table 5.4.1 A standard of Sampling Tube Protruding Length

Soil Stiffness (N-Value)	5	10	15	20	25
Protruding Length (mm)	20	11	4	4	3



Stress controlling spring

Spring coefficient

$K=(Gd^4)/(8ND^3) \fallingdotseq 20$N/mm {2kgf/mm}

Effective coil number $N=7$

Average coil diameter $D=35$ mm

Lateral Modulus $G \fallingdotseq 80$kN/mm^2 {8000kgf/mm^2}

Diameter of the spring material $d=5$ mm

Fig.5.4.1 An Example of Load and Compressive Deformation of the Stress Controlling Spring

(3) Sampling: The sampling procedure at this type of sampler is the same with other types of sampler, the lowering should be slowly, the drilling fluid should be circulated when the sampler reaching 3 meter upper of the bottom of the drill hole. After the sampler reached to the bottom of drill hole, the drill rod should be rotated, and the penetration force should be slowly increased, the penetration speed should be controlled at a rate of 5～10cm/min.. The rate of drilling fluid circulation and the rate of rotation may be respectively limited in 30～60 l/min. and 30～60 rpm.

Penetration of the sampler will be carried out using the spindle stroke mechanism of the drilling machine. Generally speaking, one stroke length of spindle of drilling machine is in a range of 25cm to 30 cm. Therefore, if a sample length of 70 to 80 cm was scheduled, at least 3 times of relocating of spindle to the drill rod must be taken. When such relocating is carried out with loosening and tightening of the chuck may produce some stress changes in the soil captured in the sampling tube particularly at the cutting edge portion. Therefore, a careful operation is required to minimize a potential disturbance which may be related with the change of stress.

4. Sample Handling

Handling of sample should be followed the procedures described in section 1.4 of Geotechnical Investigation Method of the JGS.