



Standard Practices for Preserving and Transporting Soil Samples¹

This standard is issued under the fixed designation D4220/D4220M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 These practices cover procedures for preserving soil samples immediately after they are obtained in the field and accompanying procedures for transporting and handling the samples.

1.2 *Limitations*—These practices are not intended to address all requirements applicable to transporting of soil samples known or suspected to contain hazardous materials.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The slug unit is not given, unless dynamic ($F = ma$) calculations are involved.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. See Section 7.*

1.5 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

¹ These practices are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Evaluations.

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2. Referenced Documents

2.1 *ASTM Standards*:²

- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D1452 Practice for Soil Exploration and Sampling by Auger Borings
- D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
- D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- D2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method
- D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
- D5079 Practices for Preserving and Transporting Rock Core Samples
- D6282 Guide for Direct Push Soil Sampling for Environmental Site Characterizations
- D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling
- D6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations
- D6519 Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler
- D7015 Practices for Obtaining Intact Block (Cubical and Cylindrical) Samples of Soils

3. Terminology

3.1 *Definitions*—Terminology in these practices is in accordance with Terminology D653.

4. Summary of Practices

4.1 The various procedures are given under four groupings as follows:

4.1.1 *Group A*—Samples for which only general visual identification or profile logging is necessary.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

4.1.2 *Group B*—Samples for which only water content, classification, compaction, and/or bulk samples for laboratory-prepared test specimens is required.

4.1.3 *Group C*—Intact, naturally formed or field fabricated samples for density determinations, swell pressure, percent swell, consolidation, hydraulic conductivity, shear including dynamic and cyclic or any tests requiring intact specimens.

4.1.4 *Group D*—Samples that are fragile or highly sensitive for which tests in Group C are required.

4.2 The procedure(s) to be used should be included in the project specifications or defined by the designated responsible person. Detailed sampling methods using drill rigs are presented in Guide [D6169](#).

5. Significance and Use

5.1 Use of the various procedures recommended in these practices is dependent on the type of samples obtained, the type of testing and engineering properties required, the fragility and sensitivity of the soil, and the climatic conditions. In all cases, the primary purpose is to preserve the soil samples in such a way that the laboratory testing will accurately reflect the field conditions.

5.2 The procedures presented in these practices were primarily developed for soil samples that are to be tested for engineering properties. However, they may be applicable for samples of soil and other materials obtained for other purposes.

5.3 For rock core samples, Practice [D5079](#) should be used.

6. Apparatus

6.1 The type of materials and containers needed depend upon the conditions and requirements listed under the four groupings A to D in Section 4, and also on the climate, mode of transportation and distance.

6.1.1 *Sealing Wax*, includes microcrystalline wax, paraffin, beeswax, ceresine, carnaubawax, or combinations thereof.

6.1.2 *Wood Disks*, coated in wax, about 25 mm [1 in.] thick and having a diameter slightly less than the inside diameter of the liner or tube.

6.1.3 *Plastic Bags*, 0.08 mm [3 mil] or thicker.

6.1.4 *Plastic Buckets*—For Group A or B samples. These samples may have been obtained using Practice [D6151](#) or other sampling techniques. If the plastic bucket lids are not airtight and water content is required, tape shall be used to seal the lid to the bucket.

6.1.5 *Tape*, either waterproof plastic, adhesive friction, or duct tape.

6.1.6 *Cheesecloth*, to be used with wax in alternative layers for intact exposed samples (Practice [D7015](#)).

6.1.7 *Caps*, either plastic, or rubber, to be placed over the end of thin-walled tubes (Practice [D1587](#)), liners and rings (Practice [D3550](#)), together with tape or wax.

6.1.8 *Expandable Packers* used to seal the ends of samples within cylindrical tubes, by mechanically expanding against the tube wall.

NOTE 1—Plastic expandable packers are preferred. Metal expandable packers seal equally well; however, long-term storage may cause corrosion problems.

6.1.9 *Jars*, glass or plastic, wide mouthed, with rubber-ringed lids or lids lined with a coated paper seal and of a size to comfortably receive the sample, commonly 250 mL [$\frac{1}{2}$ pt], 500 mL [1 pt], and 1 L [1 qt].

6.1.10 *Bags*, either plastic, burlap with liner, burlap or cloth type (Practice [D1452](#)).

6.1.11 *Packing Material*, to protect against vibration and shock.

6.1.12 *Insulation*, either granule (bead), sheet or foam type, to resist temperature change of soil or to prevent freezing.

6.1.13 *Sample Cube Boxes*, for transporting cube (block) samples. Constructed with 13 to 19 mm [$\frac{1}{2}$ to $\frac{3}{4}$ in.] thick plywood exterior type.

6.1.14 *Cylindrical Sample Containers*, somewhat larger in dimension than the thin-walled tube or liner samples, such as cylindrical frozen food cartons.

6.1.15 *Shipping Containers*, either box or cylindrical type and of proper construction to protect against vibration, shock, and the elements, to the degree required.

NOTE 2—The length, girth and weight restrictions for commercial transportation must be considered.

6.1.16 *Identification Material*—Pens, tags, and labels needed to properly identify the sample(s).

7. Precautions

7.1 Special instructions, descriptions, and marking of containers must accompany any sample that may include radioactive, chemical, toxic, or other contaminant material.

7.2 Transportation, containment, storage and disposal of soil samples may be regulated by government agencies. These regulations should be researched so that compliance can be assured.

7.2.1 Samples shipped by way of common carrier or U.S. Postal Service must comply with the Department of Transportation Hazardous Materials Regulation, 49CFR Part 172.

7.3 Sample traceability records (see example in [Fig. 1](#)) are encouraged and should be required for suspected contaminated samples.

7.3.1 Possession of all samples must be traceable, from collection to shipment to laboratory to disposition. Samples should be handled by as few persons as practical.

7.3.2 Sample collector(s) should be responsible for initiating the sample traceability record; recording the project, sample identification and location, sample type, date, and the number and types of containers.

7.3.3 A separate traceability record shall accompany each shipment.

7.3.4 When transferring the possession of samples, the person(s) relinquishing and receiving the samples shall sign, date, and check for completeness of the traceability record.

NOTE 3—Interstate transportation containment, storage, and disposal of soil samples obtained from certain areas within the United States and the transportation of foreign soils into or through the United States are subject to regulations established by the U.S. Department of Agriculture, Animal, and Plant Health Service, Plant Protection and Quarantine Programs.

NOTE 4—Samples shipped by way of common carrier or U.S. Postal Service must comply with the Department of Transportation Hazardous Materials Regulation, 49CFR Part 172.



Sample Identification/Traceability Record (Controlled Document)

Project:
Shipped by:
Shipped to:
Comments:

Work Order #:
Attention of:
Hazardous materials suspected? (yes/no)

Table with 8 columns: Sampling Point, Location, Field ID, Date, Sample Type, No. of Containers, Analysis/Test Required, Lab ID (optional)

Sampler(s) (signature):

Table with 8 columns: Field ID, Relinquished by: (signature), Date, Time, Received by: (signature), Date, Time, Comments

Shipment prepared by (signature):
Shipment method:
Date/Time:

Comments:

Receiving Laboratory: Please return original form after signing for receipt of samples.

FIG. 1 Example Layout of Record Form

NOTE 5—When using wooden shipping containers, some countries require ISPM 15 treatment and the IPPC stamp.

8. Procedure

8.1 All Samples—Properly identify samples with tags, labels, and markings prior to transporting them as follows:

- 8.1.1 Job name or number, or both,
8.1.2 Sampling date,
8.1.3 Sample/boring number and location,
8.1.4 Depth or elevation, or both,
8.1.5 Sample orientation (Groups C and D),
8.1.6 Subdivided samples must be identified while maintaining association to the original sample.

8.2 The following information should be transmitted or identified with each sample shipment:

- 8.2.1 Special shipping or laboratory handling instructions, or both,
8.2.2 Sampling methods information including penetration test data, if applicable (Test Method D1586),

- 8.2.3 Sample traceability record, if required,
8.2.4 Comments regarding any possible contamination,
8.2.5 Groundwater observation and weather condition, if applicable, and
8.2.6 Name of person responsible for initiating shipment.

8.3 Group A—Transport samples in any type of container by way of available transportation. If transported commercially, the container need only meet the minimum requirements of the transporting agency and any other requirements necessary to assure against sample loss, , damage, or contamination.

8.4 Group B:

8.4.1 Preserve and transport these samples in sealed, moisture proof containers. All containers shall be of sufficient thickness and strength to prevent breakage and moisture loss. The container types include:

8.4.2 Plastic Bags—Place the plastic bags as tightly as possible around the sample, squeezing out as much air as possible.

8.4.3 *Glass or Plastic Jars*—If the jar lids are not rubber ringed or lined with new waxed paper seals, seal the lids with wax.

8.4.4 *Plastic Buckets*—If the lid for the plastic bucket is not airtight, seal it with wax or tape.

8.4.5 *Thin-Walled Tubes*, (Practice **D1587**, Guide **D6282**, Practice **D6519**), drive cylinders (Test Method **D2937**), liners or rings (Practice **D3550**) sealed as follows:

8.4.5.1 *Expandable Packers*—The preferred method of sealing sample ends within tubes is with plastic, expandable packers.

8.4.5.2 *Wax*—For short-term sealing, paraffin wax is acceptable. For long term sealing (in excess of 3 days) use microcrystalline waxes or combine with up to 15 % beeswax or resin, for better adherence to the wall of the tube and to reduce shrinkage. Several thin layers of wax are preferred over one thick layer. The minimum final thickness shall be 10 mm [0.4 in.].

8.4.5.3 *Wax with Wood Disks*—The wax wood disk must be flush with the soil surface and sealed into position using additional wax.

8.4.5.4 *End Caps*—Only used when the sample is flush with the end of the thin-walled tube or in conjunction with the expandable packer or wax above. Do not allow a void between the sample and the end cap. Where necessary, spacers or appropriate packing materials, or both, must be placed in the tube prior to sealing the tube ends to provide proper confinement. Packing material must be nonabsorbent and stable such that it provides consistent continuous sample support. Seal rubber or plastic end caps with tape. For long-term storage (longer than 3 days), also dip them in wax, applying two or more layers of wax.

8.4.5.5 *Cheesecloth and Wax*—Use alternating layers (a minimum of two each) of cheesecloth and wax to seal each end of the tube and stabilize the sample. Do not allow a void between the sample and the wax.

8.4.6 Transport samples by any available transportation. Ship samples as prepared or placed in larger shipping containers, including bags, cardboard, or wooden boxes or barrels.

8.5 *Group C:*

8.5.1 These samples will be intact and either in tubes or exposed samples. Preserve and seal these samples to maintain the intact condition of the sample. In addition, they must be protected against vibration and shock, and protected from extreme heat or cold.

8.5.2 Thin-walled tube samples, liners, and rings shall be sealed as described in **8.4.5**.

8.5.3 Cylindrical and cube samples shall be wrapped in plastic such as polyethylene and polypropylene or foil. The sample can then be placed in a supporting container and the voids between the sample and container filled with wax. Alternatively, the sample can be wrapped with layers of cheesecloth and wax using a minimum of three layers.

8.5.4 Samples transported by the sampling or testing agency personnel on seats of automobiles and trucks need only be placed in cardboard boxes, or similar containers into which the sealed samples fit snugly, preventing bumping, rolling, dropping, etc.

8.5.5 For all other methods of transporting samples, including automobile trunk, bus, parcel services, truck, boat, air, etc., place the sealed samples in wood, metal, or other type of suitable shipping containers that provide cushioning or insulation, or both, for each sample and container. Avoid transporting by any agency whose handling of containers is suspect.

8.5.6 *Shipping Containers* (see **Figs. 2-7** for typical containers)—The following features should be included in the design of the shipping container for Groups C and D:

8.5.6.1 It should be reuseable.

8.5.6.2 It should be constructed so that the samples can be maintained, at all times, in the same position as when sampled or packed, or both. When required, the samples should be shipped in the same orientation in which they were sampled. Non-sensitive cohesive samples may not require vertical shipment. Otherwise, special conditions shall be provided such as freezing, controlled drainage, or sufficient confinement, or a combination thereof, to maintain sample integrity.

8.5.6.3 It should include sufficient packing material to cushion or isolate, or both, the tubes from the adverse effect of vibration and shock. The cushioning material (sawdust, rubber, polystyrene, urethane foam, or material with similar resiliency) should completely encase each sample. The cushioning between the samples and walls of the shipping containers should have a minimum thickness of 25 mm [1 in.]. A minimum thickness of 50 mm [2 in.] shall be provided on the container floor.

8.5.6.4 It should include sufficient insulating material to prevent freezing, sublimation and thawing, or undesirable temperature changes.

8.5.6.5 *Wood Shipping Containers:*

(1) Wood is preferred over metal. Exterior plywood having a thickness of 12 to 19 mm [$\frac{1}{2}$ and $\frac{3}{4}$ in.] may be used. The top (cover) should be hinged and latched, or fastened with screws.

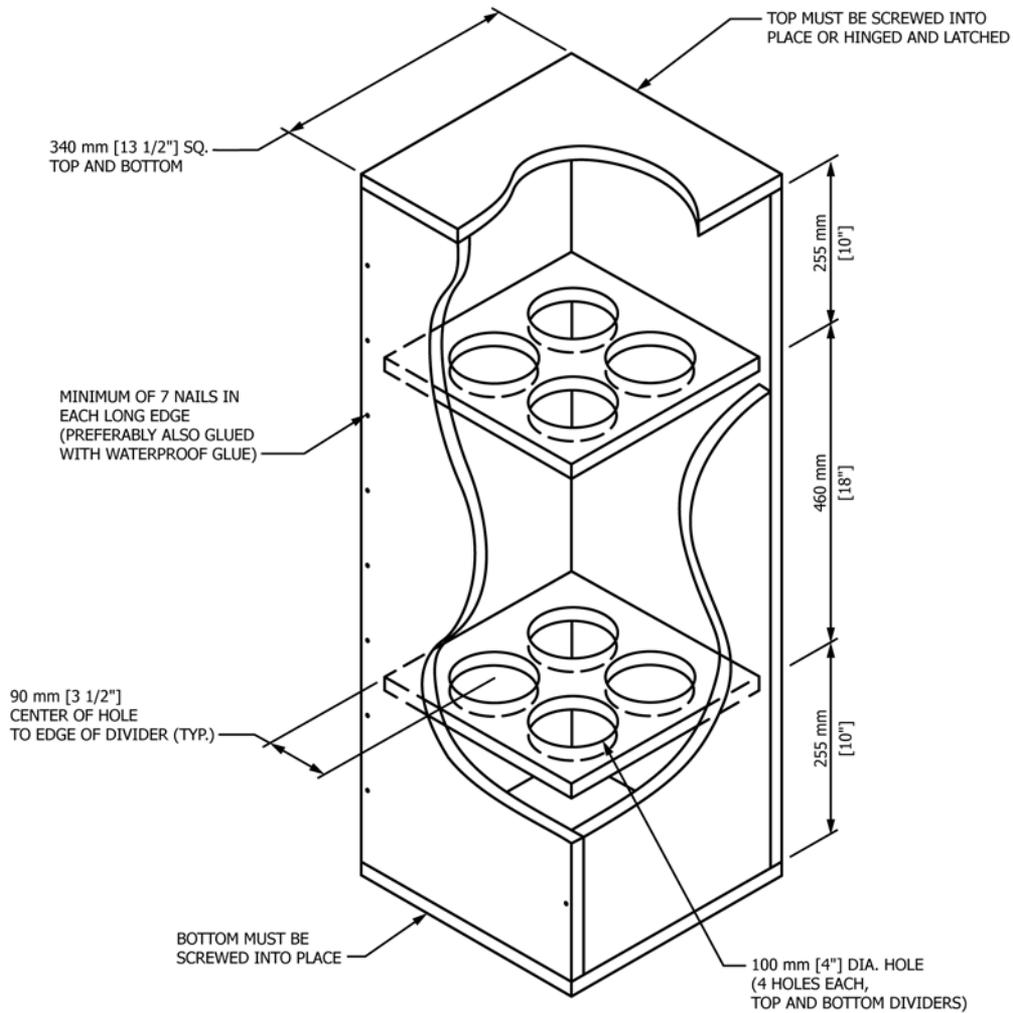
(2) For protection against freezing or extreme temperature variation, the entire shipping container should be lined with a minimum insulation thickness of 50 mm [2 in.].

8.5.7 *Metal Shipping Containers*—The metal shipping containers must incorporate cushioning and insulation material to minimum thicknesses in accordance with **8.5.6.3**, although slightly greater thicknesses would be appropriate. Alternatively, the cushion effect could be achieved with a spring suspension system, or any other means that would provide similar protection.

8.5.8 *Styrene Shipping Containers*—Bulk styrene with slots cut to the dimensions of the sample tube or liner. A protective outer box of plywood or reinforced cardboard is recommended.

8.5.9 *Other Containers*—Containers constructed with laminated fiberboard, plastic or reinforced cardboard outer walls, and properly lined, may also be used.

8.6 *Group D:*



PADDING

MINIMUM OF 100 mm [4"] OF URETHANE FOAM (OR EQUIVALENT) IN THE BOTTOM OF THE BOX, 12 mm [1/2"] AROUND THE TUBES OR PADDING THE CUT HOLES, AND 25 mm [1"] OR MORE ON TOP.

MATERIAL

19 mm [3/4"] THICK PLYWOOD (EXTERIOR GRADE)

HANDLES

HANDLES MAY BE FASHIONED FROM TWO PIECES OF ROPE BY DRILLING TWO HOLES INTO BOTH THE FRONT AND BACK FACE, 355 mm [14"] FROM THE TOP AND 50 mm [2"] FROM EACH EDGE, AND THEN THE ROPE IS PASSED THROUGH AND EACH END KNOTTED. HANDLES MAY ALSO BE PRECONSTRUCTED HARDWARE SUITABLE FOR THE INTENDED LIFTING WEIGHTS.

FIG. 2 Example of Shipping Box for 76-mm [3-in] Thin-Walled Tubes

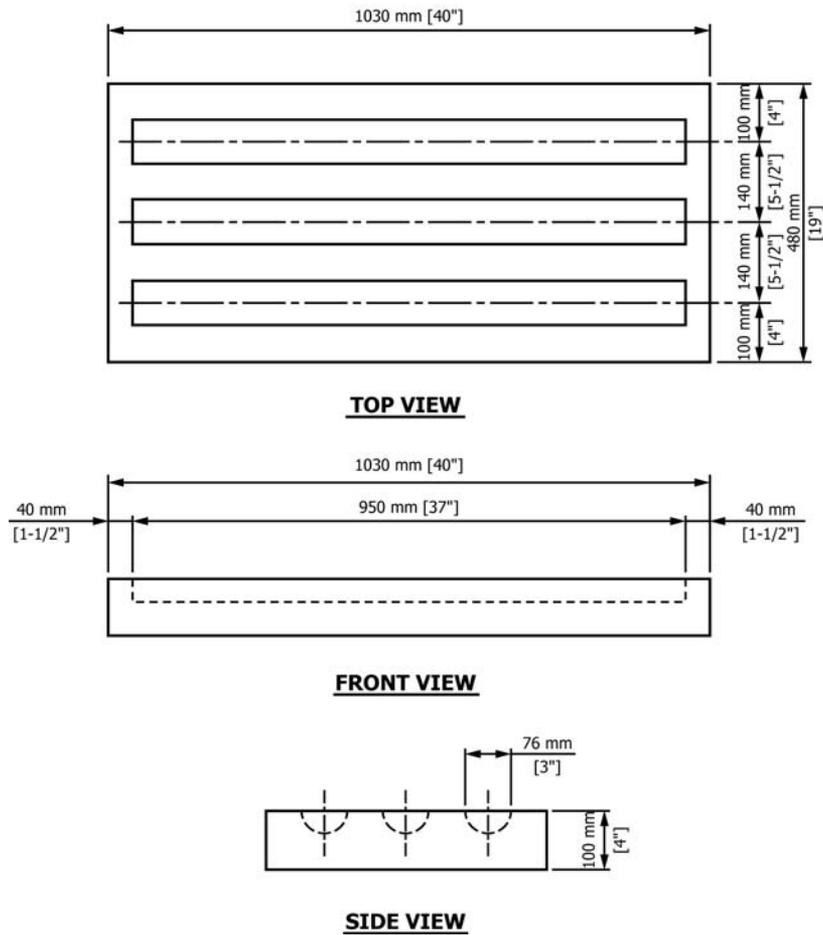
8.6.1 The requirements of 8.5 must be met, in addition to the following:

8.6.1.1 Samples should be handled in the same orientation in which they were sampled, including during transportation or shipping, with appropriate markings on the shipping container.

8.6.1.2 For all modes of private or commercial transportation, the loading, transporting and unloading of the shipment containers should be supervised as much as practical by a qualified person.

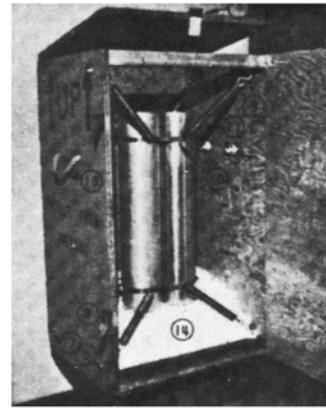
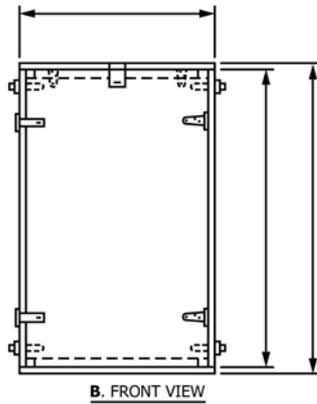
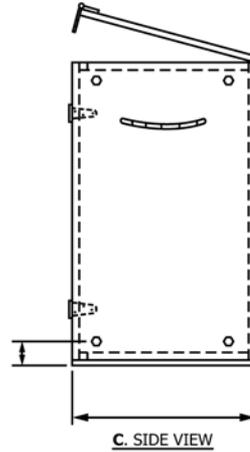
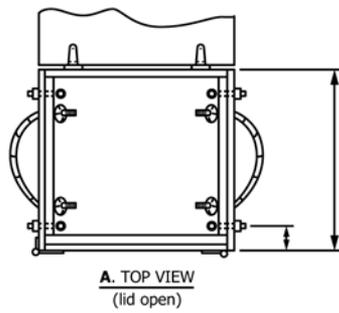


Photo of Open Box for 127-mm [5-in] Tubes



NOTE 1—Top and bottom halves are identical.

FIG. 3 Example of Styrene Shipping Container for 76-mm [3 in] Thin-Walled Tubes



		BILL OF MATERIALS			
Item No.	Description of Item	Quantity	Item No.	Description of Item	Quantity
1	Plywood, [1220 mm by 2440 mm by 19 mm [4 ft by 8 ft by 3/4 in.] exterior, Grade AC	1 Sheet	13	Rope, nylon, 12-mm [1/2-in.] diameter, solid braided	1.5 m [5 ft]
2	Hinge, strap [100 mm [4 in.], heavy duty with screws	4 Each	14	Cushioning Material, expanded polystyrene foam	0.3 m ³ [10 ft ³]
3	Hasp, hinged, [114 mm [4-1/2 in.], with screws	3 Each	Notes—		
4	Screw, Wood, Steel, Flathead, 5 mm by 45 mm [No. 10 by 1 3/4 in.]	72 Each	(a)	All wooden components can be sawed from one sheet of plywood.	
5	Bolt, Machine, 10 mm [3/8 in.], with nut to secure hasps	3 Each	(b)	This shipping box will accommodate approximately three 76-mm [3-in.] diameter tubes or two 127-mm [5-in.] diameter tubes up to 760 mm [30 in.] in length. For longer tubes the inside height of the box must be a minimum of 150 mm [6 in.] greater than the length of the tube.	
6	Washer, flat, 10 mm [3/8 in.]	3 Each	(c)	All joints to be glued and fastened with screws.	
7	Eye Bolt, 6 mm by 50 mm [1/2 by 2 in.], zinc-plated, with nut	8 Each	(d)	Stencil all sides as follows:	
8	Washer, flat, 6 mm [1/4 in.], for hasp bolt	8 Each		UP ↑	
9	S Hooks, 50 mm [2 in.], open, zinc-plated	8 Each		PROTECT FROM FREEZING	
10	Clamp, adjustable, hose, steel, worm screw adjustment	2 Each	(e)	After suspending samples as indicated above, all void space must be filled with a suitable resilient packing material.	
11	Spring, expansion	8 Each			
12	Adhesive, woodworking	500 g [1 lb]			

FIG. 4 Example of Suspension System Container for Thin-Walled Tubes

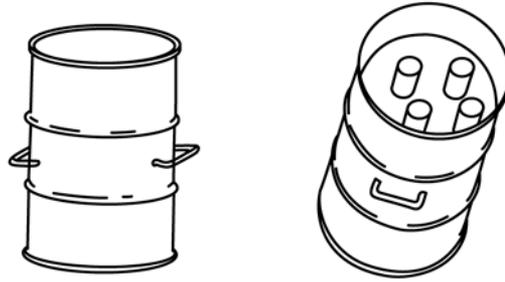
NOTE 6—A qualified person may be an engineer, geologist, soil scientist, soils technician or person designated by the project manager.

9. Precision and Bias

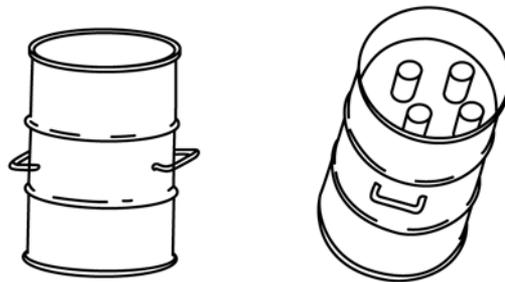
9.1 This practice provides qualitative and general information only. Therefore, a precision and bias statement is not applicable.

10. Keywords

10.1 preservation; soil samples; transportation



(a) 200-L [55-gallon] barrel with sections of



Styrofoam insulation; welded handles on each side

(b) Same as **(a)** showing barrel ready for shipment.
Steel lids bolted on to provide tight seal.

NOTE 1—Bottom of barrel is covered with a 50 mm [2 in] thick styrofoam overlaid with 50 mm [2 in] thick foam rubber. A layer of 25 mm [1 in] of foam rubber is placed on top of the tubes and the remaining space to the lid is filled with styrofoam.

FIG. 5 Example of Shipping Barrel for Thin-Walled Tubes

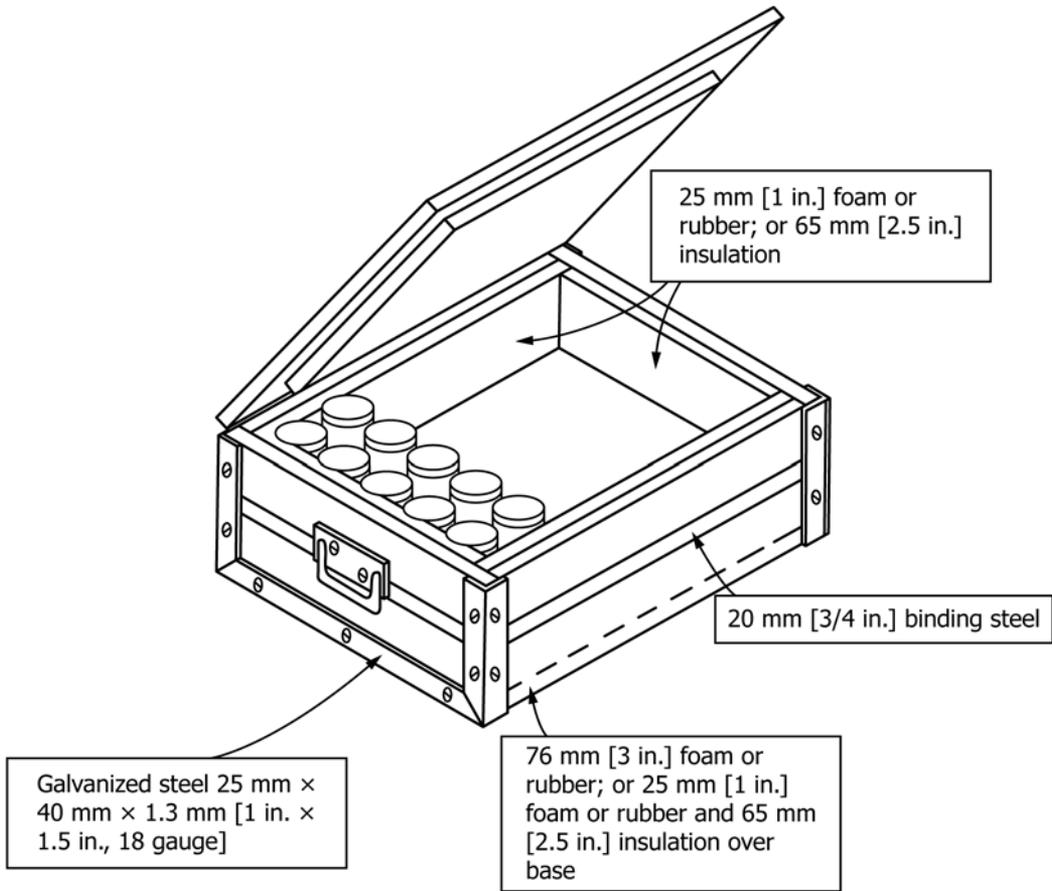
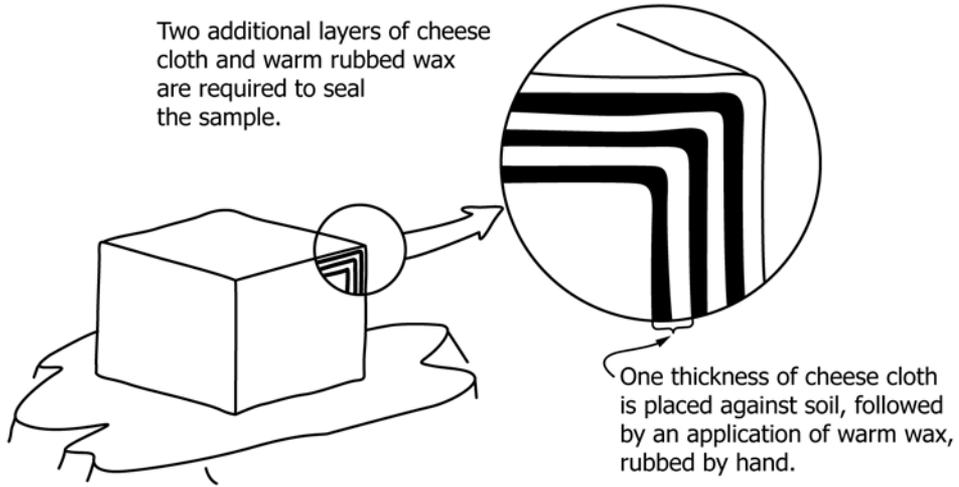


FIG. 6 Example of Shipping Box for Liner (Short Tube) or Ring Samples

A. Method for sealing hand-cut intact samples



B. Encase easily disturbed samples in box prior to cutting
Box constructed with 13 to 19-mm [1/2 to 3/4-in.] exterior plywood.

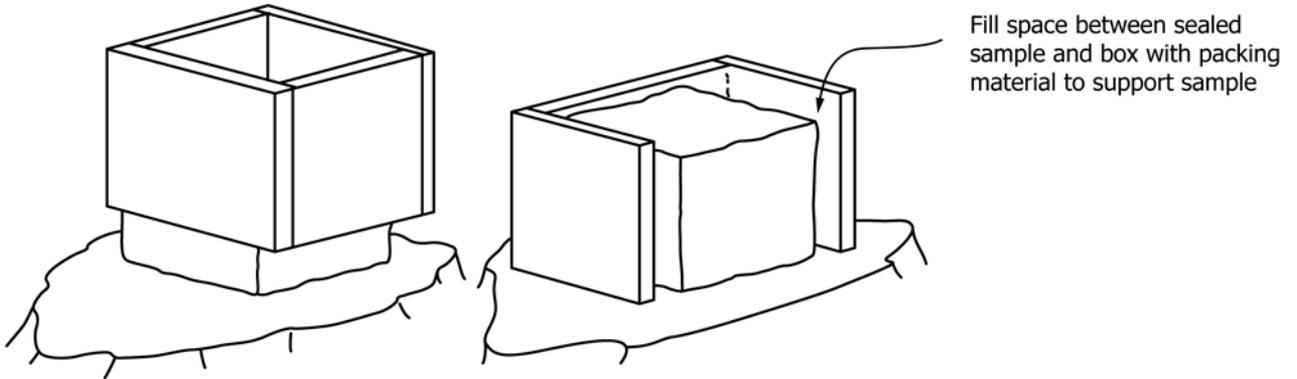


FIG. 7 Preparing and Packaging a Block Sample



SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (D4220 – 95 (2007)) that may impact the use of this standard. (Approved Feb. 1, 2014.)

- (1) Revised the standard into a dual measurement system with the units of measurement now stated in either inch-pound units or SI units.
- (2) Revised Section 1 to conform to D18 policy.
- (3) Revised Sections 4, 5, 6, 7, and 8.
- (4) Removed the Reporting Sections and renumbered subsequent sections accordingly.
- (5) Revised figures throughout.

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