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Standard Guide for Selection of Methods of Particle Size Analysis of Fluvial Sediments (Manual Methods)[1]

This standard is issued under the fixed designation D 4822; 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 This guide covers the selection of methods for determining the size distribution of fluvial sediments particles in the range greater than 0.45 µm using manual methods. Manual methods are defined as those methods that require the operator to do some actual measurements and calculations. An automated method would be one which after the sample is prepared and inserted into an instrument, the instrument (machine) does the measuring and calculations, not the operator. Not all manual methods are presented in this guide. However, where available, at least two methods for each particle size range are given.

1.2 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 422 Test Method for Particle-Size Analysis of Soils[2]

D 1129 Terminology Related to Water[3]

D 4410 Terminology of Fluvial Sediment[4]

D 4411 Guide for Sampling Fluvial Sediment in Motion[4]

E 20 Practice for Particle Size Analysis of Particulate Substances in the Range of 0.2 to 75 Micrometers by Optical Microscopy[5]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this guide, refer to Terminologies D 1129 and D 4410.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 For descriptions of terms used in this guide, refer to Terminology D 4410.

3.2.2 *particle count*—a method of particle size analysis in which the number of particles in the various size ranges are counted manually.

3.2.3 *particle size*—the diameter, usually the intermediate diameter, of a particle measured by settling, sieving, micrometric, or direct measurement methods (see 5.2).

3.2.4 *particle size distribution*—the relative amount of a sediment sample in a range of specific sizes in terms of percentages by mass, volume, or number, finer than a given particle size.

4. Summary of Guide

4.1 This guide consists of suggested manual test methods for analyzing fluvial sediment samples for particle size distribution.

5. Significance and Use

5.1 This guide is general and is useful in helping the user to determine an appropriate manual test method for determining the particle size distribution of fluvial sediments. The suggested test methods are not described in this guide, but references are given so that the user may obtain more information about each test method.

5.2 It should be noted that different test methods may and often times do produce different particle size distributions for the same sample. This is due in part to the different test methods requiring native or distilled water, differences in dispersion methods used, and differences in what the test method is measuring, that is, physical or sedimentation diameter.

6. Sampling

6.1 Collect the samples in accordance with Guide D 4411 or "Field Methods for Measurement of Fluvial Sediments" **(1)**.[6]

7. Procedure

7.1 Visually inspect the sample or streambed to estimate particle size ranges contained in the sample.

7.2 Enter Table 1 from the left. Determine the test methods that are appropriate for: (*1*) the estimated particle size contained in the sample, and (*2*) the desired reporting units.

7.3 Details on each test method are given in the references

[1] This guide is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.07 on Sediments, Geomorphology, and Open Channel Flow.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

[4] *Annual Book of ASTM Standards*, Vol 11.02.

[5] Discontinued; see 1995 *Annual Book of ASTM Standards*, Vol 14.02.

[6] The boldface numbers in parentheses refer to the list of references at the end of this guide.

TABLE 1 Guide for Selection of Particle Size Analysis of Fluvial Sediments Using Manual Methods

NOTE 1—Not all test methods will give complete distribution for the size range indicated, some will only give percent finer for one or two sizes in the indicated range. See references for more detail on each test method.

M =	Results in percent by mass	PC =	Particle count
N =	Results in percent by number of particles	OPC=	Optical particle count, non-microscopic
V =	Results in percent by volume	H =	Hydrometer
BW =	Bottom withdrawal	M =	Microscopic
P =	Pipet	D =	Decantation
VA =	Visual accumulation	EW =	Elutriator, water
WS =	Wet sieve	EA =	Elutriator, air
DS =	Dry sieve	C =	Centrifugal

Methods/Sizes	BW **(2,3)** [A]	P **(2,3)**	VA **(2,3,4)**	WS **(2,3)**	DS **(2,9)**	PC **(2)**	OPC **(5)**	H **(3,6), Test Method D 422** [B]	M **(6,7), Practice E 20** [B]	D **(6,8)**	EW **(7,8)**	EA **(7,8)**	C **(6,7)**
Clay 0.00045-0.004 mm	M	M			M			M	V N	M		M	M
Silt 0.004-0.062 mm	M	M		M	M			M	V N	M	M	M	M
Sand 0.062-2.0 mm			M	M	M	N	V N		V N	M	M		
Gravel 2.0-64 mm					M	N	V N						
Cobbles 64-256 mm						N	V N						
Boulders >256 mm						N	V N						

[A] Numbers in parentheses indicate applicable reference.
[B] See Referenced Documents section for complete title and location.

listed under each test method.

7.4 Use Table 2 to estimate quantities of sediment needed for each type of analysis.

8. Precision and Bias

8.1 The test methods suggested in this guide have different precision ranges and biases. See references **(2-7)** , Test Method D 422, and Practice E 20 for precision and bias information applicable for each test method.

9. Keywords

9.1 particle size; sediment

TABLE 2 Ranges in Optimum Quantity of Sediment for Different Methods of Particle Size Analysis

Method		Range in Optimum Quantity or Concentration of Sediment
(BW)	Bottom withdrawal	0.5-1.8 g
(P)	Pipet	1.0-5.0 g
(VA)	Visual accumulation	0.05-15.0 g
(WS)	Wet sieve	0.05>g
(DS)	Dry sieve	>0.05 g
(PC)	Particle count	>100 particles
(OPC)	Optical particle count	>1000 particles
H)	(Hydrometer	40 000 mg/L [A]
(M)	Microscopic	>750 particles
(D)	Decantation	1.0-5.0 g
(EW)	Elutriator, water	10 g
EA)	(Elutriator, air	0.1-20 g
(C)	Centrifugal	0.5-2.0 volume% [A]

[A] Quantity of sediment needed to obtain this concentration will vary depending upon size of container needed to perform test method.

REFERENCES

(**1**) Edwards, T. K., and Glysson, G. D.," Field Methods for Measurement of Fluvial Sediment,'' *U.S. Geological Survey Techniques of Water-Resources Investigations*, Book 3, Chapter 2, 1988.

(**2**) Guy, H. P., "Laboratory Theory and Methods for Sediment Analysis,'' *U.S. Geological Survey Techniques of Water-Resources Investigations*, Book 5, Chapter C1, p. 58, 1969.

(**3**) Vanoni, V. A., "Sedimentation Engineering,'' American Society of Civil Engineering, *Manuals and Reports on Engineering Practice*, No. 54, p. 745, 1975.

(**4**) U.S. Inter-Agency Committee on Water Resources, Subcommittee on Sedimentation," Operators Manual on the Visual-Accumulation-Tube Method for Sediment Analysis of Sands", *Report K of Sediment Loads in Streams*, p. 28, 1958.

(**5**) Ritter, J. R., and Helley, E. J., "Optical Method for Determining Particle Size of Course Sediment,'' *U.S. Geological Survey Techniques of Water-Resources Investigations*, Book 5, Chapter C3, p. 33, 1969.

(**6**) Allen, T., *Particle Size Measurement*, Chapman and Hall Ltd., London, England, p. 454, 1975.

(**7**) Stockman, J. D., and Fochtman, E. G., "Particle Size Analysis,'' *Ann Arbor Science*, Ann Arbor, MI, p. 140, 1977.

(**8**) U.S. Inter-Agency Committee on Water Resources, Subcommittee on Sedimentation, "Measurement and Analysis of Sediment Loads in Streams", Report No. 4, *Methods of Analyzing Sediment Samples*, p. 203, 1941.

(**9**) *Symposium on Particle Size Measurement*, *ASTM STP 234*, ASTM, 1958, p. 310.