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Standard Guide for Sampling Wastewater With Automatic Samplers[1]

This standard is issued under the fixed designation D6538; 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.

ε1 NOTE—Reference (7) was updated in March 2006.

1. Scope

1.1 This guide covers the selection and use of automatic wastewater samplers including procedures for their use in obtaining representative samples. Automatic wastewater samplers are intended for the unattended collection of samples that are representative of the parameters of interest in the wastewater body. While this guide primarily addresses the sampling of wastewater, the same automatic samplers may be used to sample process streams and natural water bodies.

1.2 The guide does not address general guidelines for planning waste sampling activities (see Guide D4687), development of data quality objectives (see Practice D5792), the design of monitoring systems and determination of the number of samples to collect (see Practice D6311), operational details of any specific type of sampler, in-situ measurement of parameters of interest, data assessment and statistical interpretation of resultant data (see Guide D6233), or sampling and field quality assurance (see Guide D5612). It also does not address sampling groundwater.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1129 Terminology Relating to Water
D3694 Practices for Preparation of Sample Containers and for Preservation of Organic Constituents
D3856 Guide for Good Laboratory Practices in Laboratories Engaged in Sampling and Analysis of Water
D4687 Guide for General Planning of Waste Sampling
D4840 Guide for Sample Chain-of-Custody Procedures
D5088 Practice for Decontamination of Field Equipment Used at Waste Sites
D5283 Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation
D5612 Guide for Quality Planning and Field Implementation of a Water Quality Measurement Program
D5792 Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives
D5851 Guide for Planning and Implementing a Water Monitoring Program
D5956 Guide for Sampling Strategies for Heterogeneous Wastes
D6233 Guide for Data Assessment for Environmental Waste Management Activities
D6311 Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design
E856 Definitions of Terms and Abbreviations Relating to Physical and Chemical Characteristics of Refuse Derived Fuel

3. Terminology

3.1 *composite sample*, *n*—a combination of two or more samples. **(D1129)**

3.2 *representative sample*, *n*—a sample collected such that it reflects one or more characteristics of interest (as defined by the project objectives) of a population from which it was collected. **(D5956)**

3.3 *sample*, *n*—a portion of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity. **(E856)**

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[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.

TABLE 1 Advantages and Disadvantages of Manual versus Automatic Sampling of Wastewater (3)

Type	Advantages	Disadvantages
Manual	Low capital cost	Increased variability due to sample handling
	Personnel can compensate for various situations	Inconsistency in collection
	Personnel can document unusual conditions	High cost of labor assuming composite or multiple grab samples are collected
	No maintenance	Repetitious and monotonous task for personnel
	Extra samples can be collected in a short time if necessary	
Automatic	Consistent samples	Considerable maintenance for batteries and cleaning; susceptible to plugging by solids
	Decreased variability caused by sample handling	Restricted in size to the general specifications
	Minimal labor requirement for sampling	Greater potential for sample contamination
	Capable of collecting multiple grab and multiple aliquot composite samples	May be subject to damage by vandals
		High capital cost

4. Significance and Use

4.1 This guide provides persons responsible for designing and implementing wastewater sampling programs with a summary of the types of automatic wastewater samplers, discusses the advantages and disadvantages of the different types of samplers and addresses recommended procedures for their use.

5. Automatic Versus Manual Sampling (1, 2)[3]

5.1 The advantages and disadvantages of manual and automatic sampling are summarized in Table 1. The decision as to whether to use manual or automatic sampling involves many considerations in addition to equipment costs. In general, manual sampling is indicated when infrequent samples are required from a site, when biological or sediment samples, or both, are also required, when investigating special incidents, where sites will not allow the use of automatic devices, for most bacteriological sampling, where concentrations remain relatively constant, etc. The use of automatic samplers is indicated where frequent sampling is required at a given site, where long-term compositing is desired, where simultaneous sampling at many sites is necessary, etc. Automatic sampling is often the method of choice for storm-generated discharge studies, for longer outfall monitoring, for treatment plant efficiency studies, where 24-h composite samples are required, etc. The user should review 7.1.22 before selecting manual or automatic sampling.

6. Types of Samples Collected by Automatic Samplers

6.1 *Grab Samples*—As defined under the U.S. Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination Program, grab samples are individual samples collected over a period of time not exceeding 15 min and are representative of conditions at the time of sampling (**4**). Grab samples are sometimes also called individual or discrete samples (**5**). Sequential grab samples are a series of grab samples collected at constant increments of either time or flow and provide a history of variation. Grab samples are appropriate when samples are needed to:

6.1.1 Characterize an effluent that is not continuous,

6.1.2 Provide information about instantaneous concentrations of pollutants,

6.1.3 Allow collection of samples of varied volume,

6.1.4 Corroborate composite samples,

6.1.5 Monitor parameters not amenable to compositing (for example, pH, temperature, dissolved oxygen, chlorine, purgeable organics (unless a specialized sampler is used), oil and grease and others specified by a permit which may include phenols, sulfites and hexavalent chromium).

6.1.6 Characterize a waste stream in detail where rapid fluctuations of parameters occur (sequential grabs).

6.2 *Composite Samples*—Composite samples are collected over time, either by continuous sampling or by mixing discrete samples, and represent the average characteristics of the waste stream during the compositing period. Composite samples are collected when stipulated in a permit, when average pollutant concentration during the compositing period is to be determined, and when wastewater characteristics are highly variable. There are four types of composite samples.

6.2.1 *Time Composite Samples*—This method requires discrete sample aliquots be collected in one container at constant time intervals. The method is appropriate when the flow of the stream is constant (flow rate does not vary more than ±10 % of the average flow rate (**4**)) or when flow monitoring equipment is not available. The EPA allows time-proportional sampling and requires samples be collected every 15-min, on average, over a 24-h period.

6.2.2 *Flow-Proportional Composite Samples*—There are two methods used for this type of sample (**4**). The most commonly used method with automatic samplers collects a constant sample volume at varying time intervals proportional to stream flow based on input from a flow monitor (for example, a 200-mL aliquot is collected for every 5000 L of flow). In the other flow-proportional compositing method, the sample is collected by varying the volume of each aliquot as the flow varies, while maintaining a constant time interval between the aliquots.

6.2.3 *Sequential Composite Samples*—A sequential composite sample is composed of a series of short-period composites, each of which is held in an individual container, for example, four sample aliquots are composited (one every 15 min) to form hourly composites (**4**). The 24-h sequential composite is then manually made by compositing the individual 1-h composite sample.

6.2.4 *Continuous Composite Samples*—This method requires that the sample be collected continuously at a constant rate or proportional to flow (**4**). This method is seldom used with automatic samplers.

7. Attributes of Automatic Samplers

7.1 The EPA (**6**) developed a list of attributes of the ideal automatic sampler for their use and EPA Region 4 (**7**) and

[3] The boldface numbers given in parentheses refer to a list of references at the end of the standard.

others (3) have noted other important attributes. These attributes and requirements may be specific to EPA's use and were primarily directed at suction lift type automatic samplers. Not all these sampler characteristics will be important to all users but their consideration may guide persons selecting automatic samplers. The desirable features of automatic samplers listed below have been summarized and combined from the referenced documents.

7.1.1 Capable of AC/DC operation with adequate dry battery energy storage for 120-h operation at 1-h sampling intervals.

7.1.2 Suitable for suspension in a standard manhole yet still accessible for inspection and sample removal. A secure harness or mounting device if the sampler is placed in a sewer.

7.1.3 Total weight, including batteries, less than 18 kg. Compact and portable enough for one-person installation.

7.1.4 Sample collection interval adjustable from 10 min to 4 h.

7.1.5 Capable of collecting a single 9.5-L (2.5-gal) sample and/or collecting 500-mL (0.13-gal) discrete samples in a minimum of 24 containers. The individual sample aliquot must be at least 100 mL.

7.1.6 Capable of multiplexing repeated aliquots into discrete bottles.

7.1.7 One intake hose with a minimum inner diameter of 0.64 cm (0.25 in) and a weighted, streamlined intake screen which will prevent accumulation of solids.

7.1.8 Intake hose liquid velocity adjustable from 0.6 to 3 m/s (2.0 to 10 ft/s) with dial setting.

7.1.9 Minimum lift capacity of 6.1 m (20 ft).

7.1.10 Explosion proof construction.

7.1.11 Watertight exterior case to protect components in the event of rain or submersion.

7.1.12 Exterior case capable of being locked, including lugs for attaching steel cable to prevent tampering and to provide security.

7.1.13 An integral sample container compartment capable of maintaining samples at 4 to 6°C for a period of 24 h at ambient temperatures up to 38°C.

7.1.14 Capable of operating in a temperature range from–10 to 40°C with the exception of the intake hose.

7.1.15 A purge cycle to flush the sample intake tubing before and after each collection interval, and a mechanism to sense and clear a plugged sample line and then collect the complete sample.

7.1.16 Capable of collecting flow-proportional and time-composite samples.

7.1.17 Materials of construction that contact the sample must not compromise the integrity of the sample for the intended use.

NOTE 1—Some references prohibited sample contact with metal (6) and contact with plastic or metal parts when parameters to be analyzed could be impacted by these materials (7).

7.1.18 Water velocity in intake hose (greater than 0.6 m/s [2.0 ft/s]) and aliquot volume are independent of lift heights experienced during the sampling event.

7.1.19 Overall construction, including casing, of materials resistant to corrosion (plastics, fiberglass, stainless steel).

7.1.20 Exterior surface a light color to reflect sunlight.

7.1.21 Low cost, availability of spare parts, warranty, ease of maintenance, reliability and ruggedness of construction, and capable of being repaired in the field.

7.1.22 *Other Factors*—Other factors (3) that should be considered in selecting an automatic sampler are the:

7.1.22.1 Expected variation in water or wastewater composition with time,

7.1.22.2 Variation of flow rate with time,

7.1.22.3 Specific gravity of the liquid

7.1.22.4 Concentration and density of suspended solids of interest,

7.1.22.5 Presence of floating materials,

7.1.22.6 Characteristics of the site where the sampler will be placed,

7.1.22.7 Range of intended use (a permanent site or traveling sampler),

7.1.22.8 Skill level required for installation and operation of the sampler, and

7.1.22.9 The level of accuracy desired.

8. Types of Automatic Samplers (1,2,3)

8.1 There are three main types of automatic samplers, suction lift, pressure or forced flow, and mechanical. Each has its advantages and limitations and all types are available in models designed to preserve samples via cooling (iced or refrigerated). While all automatic samplers can collect samples through time, some samplers are designed to be triggered by inputs from online devices measuring flow, pH, temperature, conductance, etc., and collect samples under specific conditions (for example, pH >9.0).

8.2 *Suction Lift*—Suction lift devices can be further subdivided into peristaltic and vacuum type samplers. Peristaltic pump devices are the most commonly used type in the United States and use a rotating head to pinch a flexible hose creating a vacuum to transport the sample to the container. Vacuum devices (8) are more popular in Europe and use a vacuum pump to transport the sample to the sample container. Suction lift samplers are portable, versatile due to their light weight and can purge the transport line between samples. Their main limitation is that their lift capacity which is claimed to range up to 9 m but may be significantly less. Also, since suction lift devices use a vacuum to transport samples, they cause some degassing of the sample and are generally unsuitable for sampling dissolved gases and volatile organic compounds (VOC). Peristaltic pump samplers can be used to collect pressurized line samples if the pressure is less than 100 kPa (15 psi). Vacuum systems must use a flow-through cell which adds cost to the system.

8.3 *Pressure or Forced Flow*—With pressure or forced flow systems, a submersible pump or pneumatic pressure is used to force the sample from the source to the collection container. Because the sample is under positive pressure during collection, gases and VOC are less likely to be lost than in suction lift systems. Pressure systems can be used to lift samples considerable heights.

8.4 *Mechanical*—Mechanical systems use scoops, or cups on a chain or paddle wheel to remove a sample from the source and transfer it to the collection container. Some mechanical