



Designation: E 1469 – 02

Standard Practice for Collecting Benthic Macroinvertebrates with Multiple-Plate Samplers¹

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1. Scope

1.1 This practice covers the procedures for obtaining qualitative and quantitative samples of macroinvertebrates on an artificial substrate sampler in rivers, streams, lakes, and reservoirs. The device can be used in areas where no other method is feasible.

1.2 Multiple-plate samplers are usually colonized by a wide variety of macroinvertebrates that actively and passively enter the current or the water column.

1.3 This practice facilitates standardization of collection procedures at sampling sites and is excellent for water quality purposes. Standardized sampling is especially desirable when the results from different investigators and from different environments are to be compared.

1.4 Multiple-plate samplers are devices of standard composition and configuration placed in the water for a predetermined exposure period and depth for colonization by macroinvertebrates.

1.5 The multiple-plate sampler can be used either alone or can effectively augment bottom substrate sampling because many of the physical variables encountered in bottom sampling are minimized (for example, variable depth and light penetration, temperature differences, and substrate types).

1.6 *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. For specific precautions, see Section 7.*

2. Referenced Documents

- 2.1 *ASTM Standards:*
D 1129 Terminology Relating to Water²

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology D 1129.

¹ This practice is under the jurisdiction of ASTM Committee E47 on Biological Effects and Environmental Fate and is the direct responsibility of Subcommittee E47.08 on Biological Field Testing.

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² *Annual Book of ASTM Standards*, Vol 11.01.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *benthos*—the community of organisms living in or on the bottom of other substrate in an aquatic environment.

3.2.2 *habitat*—the place where an organism lives, for example, mud, rocks, shoreline, twigs, riffle, pool, and so forth.

3.2.3 *macroinvertebrates*—benthic or substrate dwelling organisms visible to the unaided eye and retained on a U.S. Standard No. 30 (0.595-mm mesh openings) sieve. The standard sieve opening for marine benthic fauna is also 0.595 mm (U.S. Standard No. 30 sieve). To accommodate some historical data bases, a 1.0 mm, U.S. Standard No. 18 sieve may be used. Examples of macroinvertebrates are aquatic insects, macrocrustaceans, mollusks, annelids, nematodes, and echinoderms.

3.2.4 *microhabitat*—a smaller and more restricted habitat, for example, certain positions on a rock, certain particle size sediment, and so forth.

3.2.5 *multiple-plate sampler*—constructed of 8 or more tempered hardboard or ceramic material cut in 76 mm (3 in.) square or circular plates and separated by a specific arrangement of spacers. The plates and spacers are placed on a ¼inch eyebolt.

3.2.6 *substrate sampler*—any collecting device that is made of natural or artificial substrate materials for the colonization of macroinvertebrates.

4. Summary of Practice

4.1 Multiple-plate samplers consist of standardized, reproducible artificial substrate surfaces (tempered hardboard or ceramic plates) for colonization by indigenous aquatic organisms. Their uniform shape and texture compared to natural substrates greatly simplifies the problem of sampling. The sampler can be purchased or constructed from readily available materials.

4.2 Total surface area of the 8 plate sampler is approximately 939 cm² (0.09 m²), and the 14 plate sampler is 1160 cm² (0.116 m²). The 14 plate, tempered hardboard, multiple-plate sampler weighs about 1 lb (0.45 kg).^r

4.3 The recommended exposure period for multiple-plate sampler is six weeks, and the time of exposure may be critical to development of a relatively abundant and diverse community of organisms. Three replicate samples at each station are an absolute minimum. Collecting five replicate samples at each station will increase statistical precision and accuracy.

5. Significance and Use

5.1 The multiple-plate sampler is a highly effective device for evaluating the biological integrity of surface waters and for studying macroinvertebrate communities (**Refs 1-22**).³ Multiple-plate samplers are used to collect qualitative and quantitative samples from lentic and lotic waters containing benthic macroinvertebrates living on various types of substrates.

5.2 The organisms in the sampler are used to define macroinvertebrate community characteristics in water quality studies and ecological assessments.

5.3 Physical factors such as stream velocity and depth may variably affect degree of colonization. The sampling method is selective for drifting organisms (biased for insects) and for those which preferentially attach to or live on hard surfaces.

5.4 Multiple-plate samplers are excellent for water quality monitoring, contain uniform substrate type at each station for better comparison, give quantitatively comparable data, contain negligible amounts of debris permitting quick laboratory processing, but may require additional weight for stability.

5.5 Multiple-plate samplers sample a known area at a known depth for a known exposure period. Multiple-plate samples provide no measure of the biota and condition of the natural substrate at a station. They record only biota accumulated during exposure period.

5.6 The distinct advantages of the multiple-plate sampler are its small size and light weight. It is the most adaptable of the recommended benthic invertebrate artificial substrate devices.

6. Description of the Modified Hester-Dendy Multiple-Plate Sampler

6.1 The modified multiple-plate (Fig. 1) is constructed of 0.25 in. (0.3 cm) tempered hardboard or ceramic material with 3 in. (7.6 cm) round or square plates and 1 in. (2.5 cm) round spacers that have $\frac{5}{8}$ in. holes drilled in the center (**6**) and (**13**). The plates are separated by spacers on a 0.25 in. (0.63 cm) diameter eyebolt, held in place by a nut at the top and bottom. A total of 14 large plates and 24 spacers are used in each sampler. The top nine plates are each separated by a single spacer, plates 9 and 10 are separated by two spacers, plates 11 and 12 are separated by three spacers, and plates 13 and 14 are separated by four spacers. The hardboard sampler is about 5.5 in. (14 cm) long, 3 in. (7.6 cm) diameter, exposes approximately 1160 cm² (0.116 m²) of surface area for the attachment of organisms, and weighs about 1 lb (0.45 kg). The ceramic sampler is 6.5 in. long and weighs 2.2 lbs (1 kg). The ceramic plates can be chemically cleaned, oven dried and reused indefinitely as they are stable and unaffected by long-term immersion in water. The sampler will not warp with time; therefore, the spacings between plates do not change, assuring replicate and efficient sampling. Each sampler is supplied with a 20 ft (6 m) long nylon suspension rope. The total weight is 2.2 lbs (1 kg). Sturdy wire stakes for holding the sampler above the riverbed are recommended accessories.

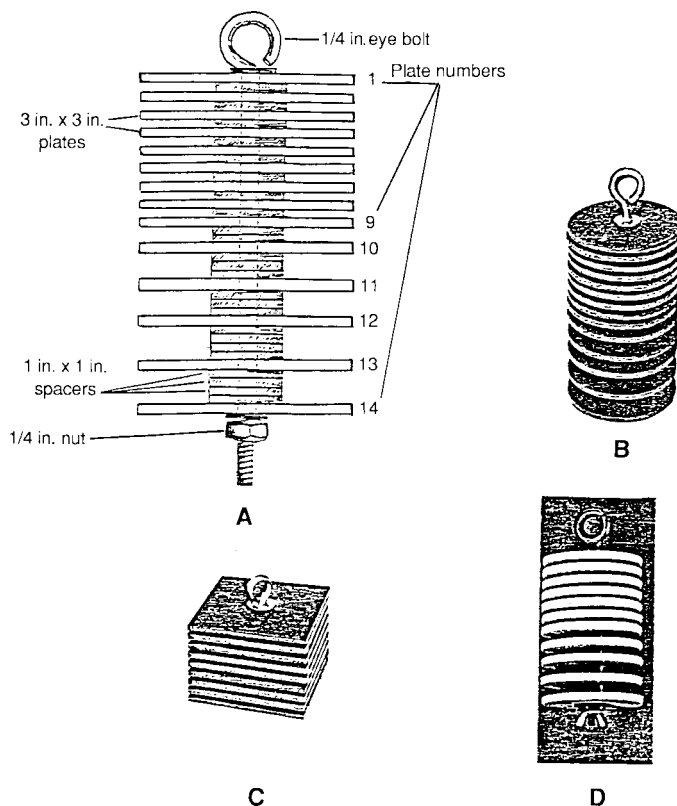


FIG. 1 Artificial multiple-plate samplers: (a) schematic drawing of multiple-plate sampler; (b) modified round; (c) original square, tempered hardboard, Hester-Dendy samplers; and (d) round ceramic multiple-plate macroinvertebrate sampler

6.2 Another type of modified Hester-Dendy multiple-plate artificial substrate sampler (Ohio EPA (**17**)) is constructed of $\frac{1}{8}$ in. tempered hardboard cut into 3 in. (7.6 cm) square plates and 1 in. (2.5 cm) square spacers. A total of eight plates and twelve spacers are used for each sampler. The plates and spacers are placed on a $\frac{1}{4}$ in. eyebolt so that there are three single spaces, three double spaces, and one triple space between the plates. The total surface area of the sampler, excluding the eyebolt, is 145.6 in.² (939 cm²) (0.09 m²). Five samplers are placed in streams tied to a concrete construction block which anchors them in place and prevents the multiple-plates from coming into contact with the natural substrates.

7. Precautions

7.1 Samplers and floats may be difficult to anchor; they may be a navigation hazard.

7.2 Samplers are susceptible to vandalism and often lost.

7.3 Recovery techniques are critical for ensuring the collection of all organisms retrieved in the sampler.

7.4 Caution should be exercised in the reuse of samplers that may be subjected to contamination by toxicants, oils, and so forth.

8. Procedures

8.1 In deep water three multiple-plate samplers are suspended from floats, cement structures, or rods driven into the stream-bed or lake-bed and positioned well up in the euphotic zone of good light penetration (1 to 3 ft, or 0.3 to 0.9 m).

³ The boldface numbers in parentheses refer to the list of references at the end of this practice.