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Standard Practice for Calibrating a Fathometer Using a Bar Check Method[1]

This standard is issued under the fixed designation D6318; 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 practice provides the user with procedures used in manually calibrating the fathometer or electronic depth sounder. This narrative describes calibration terminology, describes acceptable environmental conditions for calibration, and describes the calibration procedures.

1.2 The references cited contain useful information in the construction and the correct operation of the calibration equipment.

1.3 Any references cited in this narrative to specific products or brand names are made for information only, and is intended to be descriptive, but not restrictive, of products that will perform satisfactorily.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *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

D5073 Practice for Depth Measurement of Surface Water

3. Terminology

3.1 *Definitions*—Refer to Terminology D1129 for terms used in this guide.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bar*—a section of metallic channel, I-beam, T-beam, pipe, plate, or ball that will reflect sound waves produced by a fathometer.

3.2.2 *bar-check*—a method for calibrating a fathometer by setting a sound or accoustic reflector (bar) below a survey vessel to a known depth below a sounding transducer.

3.2.3 *draft (transducer draft)*—the vertical distance from the bottom of the transducer to the surface of the water.

3.2.4 *fathometer*—An electronic device for registering depths of water by measuring the time required for the transmission and reflection of sound waves between a sonic transducer and the lake or river bottom.

3.2.5 *sound*—to determine the depth of water.

3.2.6 *sounding scroll*—the chart record of an underwater cross section or profile of the bottom.

3.2.7 *transducer*—a device for translating electrical energy to acoustical energy and acoustical energy back to electrical energy.

4. Significance and Use

4.1 The accuracy of depth measurements made by a fathometer or echo sounder requires a number of corrections because of the variability of sound or acoustic velocity in water with changes in temperature, salinity, and depth of water. In addition instability of the equipment can also result in significant errors. For additional information see Practice D5073.

4.2 Calibration of echo sounding instruments is absolutely critical in assuring the adequacy of depth measurements. When an echo sounder has been accurately calibrated, any observed (recorded) depth can be related to the true depth of water. Since the intended purpose of echo sounding is to measure the “true” depth, an independent “true” reference must be used.

4.3 A bar-check is the most wide-spread, easiest to construct, and most economical mechanical method to determine corrections for instrument and velocity errors.

4.4 This procedure explains the calibration of a fathometer or electronic depth sounder using a bar-check.

4.5 Bar-checking techniques and equipment are general in nature and may need to be modified for use in specific field conditions.

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

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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.

5. Apparatus

5.1 The device used for bar-checking must be a sound-reflecting surface that can be lowered to a known depth below the transducer of the survey vessel. See Fig. 1. These sounding-refecting surfaces (or sounding targets) can be a bar made out of a section of metallic I-beam or T-beam, pipe, a rectangular section of sheet metal, or a section of metal screen.

5.2 Bars used in depths greater than 30 ft (10 m) should be at least 9 in. (23 cm) wide. The dimensions of the target depend on the type of survey vessel, location of the transducer, and the depth range to be covered during the survey. Usually, the length of the bar is equal to the beam or width for small survey vessels. For larger vessels, a spherical metal ball or steel plate is lowered through a well in the hull.

5.3 The weight of the bar will be dependent on the type of currents experienced, typical project depths, and beam of the vessel. Typical weights range from 40 to 100 lb (20 to 50 kg). In deep water areas with large currents, a heavy bar is essential because subsurface currents will pull to light a bar from the transducer's vertical plane. On small, shallow inland or protected bodies of water, a lighter weight may be used provided the bar can be maintained directly beneath the transducer.

5.4 The lines used for lowering the bar should be made of flexible steel wire or chain. They must be easy to handle and must not stretch. In addition, they should be at least 100 ft long with either easily visible markings at every 10 ft starting at the top of the bar or carried on a calibrated reel. The bar check suspension lines must be periodically checked to ensure the accuracy and stability of the graduated marks on the line

6. Condition Requirements

6.1 The preferred environmental conditions for bar-checking are calm water, wind velocity less than 5 mph, and depths less than 100 ft. Reasonable results, however, can be obtained during wind velocities between 5 and 15 mph. But when wind velocities are greater than 15 mph and depths greater than 100 ft, some error will exist in the soundings.

6.2 Bar checks should always be made when and where water conditions are calmest; observations taken during rough water conditions or when differential current causes the bar to be displaced from a position vertically below the transducer are subject to unacceptable magnitudes of error.

6.3 For best results where salinity and temperature of the water are unknown, the fathometer should be calibrated before the start, at midday and at the end of each day's work to check the accuracy of the soundings. However, if stable water conditions are known to exist, it is possible to limit the number of bar-checks to one per day before the start of the work.

6.4 A survey vessel operating in exposed rough water or windy conditions should run to a protected area for the bar check. Bar checks, however, should not be made in areas where salinity, temperatures, and suspended sediment concentrations vary significantly from those at the area to be surveyed.

7. Bar-check Procedure

7.1 Turn the fathometer on about 10 min before beginning the calibration process to allow the machine to warm up.

7.2 Set initial fathometer settings (tide and draft, speed of sound, etc.) according to the fathometer manufacturer's specifications.

7.3 Two depths are chosen that correspond to the minimum and maximum calibration range, such as 10 ft and 50 ft.

7.4 Lower the bar into the water to the 10 ft mark on the lowering line. (**Warning—**make sure feet are clear of the lowering lines to prevent entanglement. Make sure that the bar

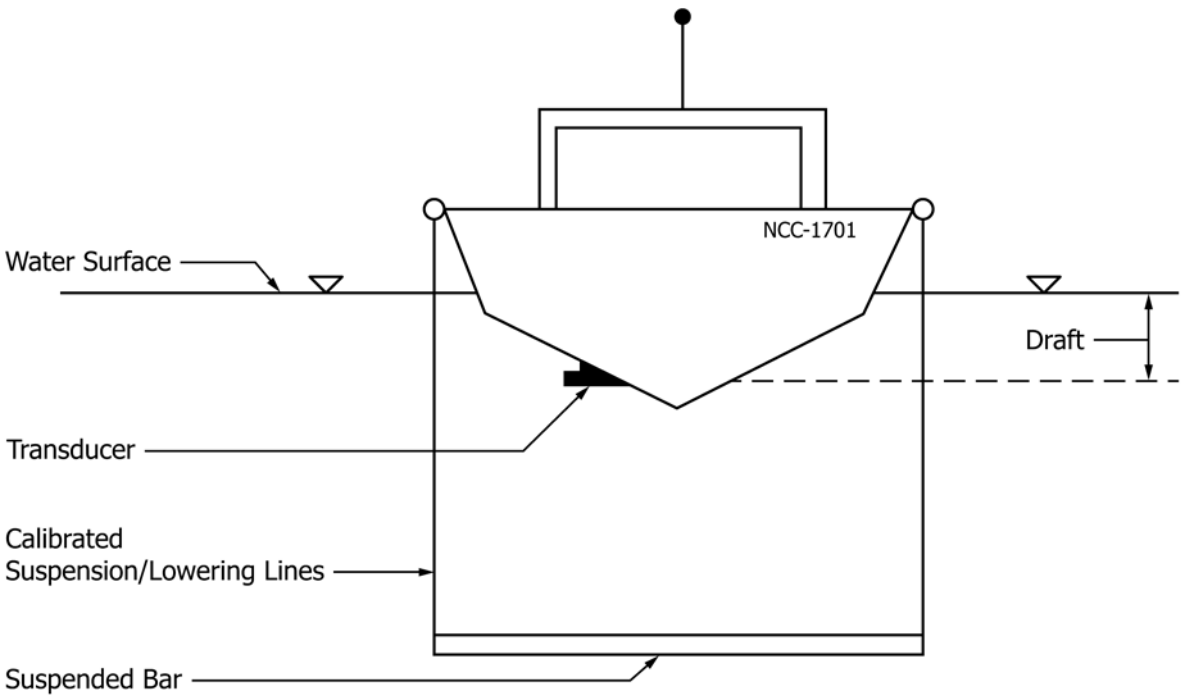

FIG. 1 Calibration Bar Apparatus

is centered directly underneath the transducer. Failure to do so will result in false or erroneous readings.)

7.5 Adjust the "draft" fathometer settings so that the depth tracing on the sounding scroll or digital reading matches the 10 ft depth reading.

7.6 Lower the bar to the increment mark on the lowering line closest to the greatest anticipated sounding depth, such as 50 ft.

7.7 Adjust the "sound velocity" fathometer settings so that the depth tracing on the sounding scroll or digital reading matches the 50 ft depth.

7.8 Raise the bar to the 10 ft position. If there is no change the echosounder is calibrated. If there is a difference, readjust the "draft" fathometer settings to match 10 ft.

7.9 Repeat steps 7.4 – 7.8 as necessary until the correct fathometer settings are obtained for both deep and shallow water.

7.10 Upon completion of calibration intermediate readings should be checked to compare fathometer readings with known bar depths. For this example readings could be taken at ten-foot increments such as 20, 30, and 40 ft depths.

7.11 If the velocity of sound is not relatively constant throughout the working depth range, it will not be possible to adjust the instrument so that it reads equal the bar check at each depth increment. In such cases, an alternative approach may be that after calibration, to record the error at 5 or 10 ft incremental depths and apply corrections during post-processing. An additional approach is to not adjust the initial manufacturer's fathometer settings, but to record the error at 5 or 10 ft incremental depths and apply corrections during the post-processing process.

8. Velocity Profiler

8.1 As an alternative to bar checking, consideration can be given to use of a velocity profiler.

8.2 Velocity profiler meters usually consist of an underwater probe attached by cable to a hand held unit that directly measures the velocity of sound.

8.3 A major advantage of a velocity profiler meter over a bar check is the ability to perform rapid calibrations in rough water and currents.

8.4 Cable is numerically labeled at intervals in feet or meters.

8.5 Some models use a pressure sensor for depth determination which minimizes cable slant errors.

8.6 Output typically is speed of sound as function of water depth.

8.7 Sound velocity should be recorded at even increments in feet or meters taken to the nearest foot per second or meter per second.

8.8 Readings usually are entered into a table in processing software measured velocity at incremental depths.

8.9 Velocity profiler data can be used to obtain an average sound velocity over given range and be used to adjust a fathometer as done with bar check calibration.

8.10 The velocity profiler must be initially and periodically calibrated with a bar check.

9. Keywords

9.1 bathymetric surveys; depth sounding; echo sounders; fathometers; hydrography; reservoir surveys; sediment surveys; velocity profiler

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