Designation: ~~D7764 – 12~~ D7764 – 20

Standard Practice for Pre-Installation Acceptance Testing of Vibrating Wire Piezometers[1]

This standard is issued under the fixed designation D7764; 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~~ Scope*

1.1 This practice describes two acceptance tests for a vibrating wire piezometer: a zero test and a down-hole test. The two tests can help a user verify that the piezometer is operating properly before it is installed.

1.2 *This practice offers an organized collection of information or a series of options and does not recommend a specific course of action. 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.*

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard. Reporting of test results in units other than SI shall not be regarded as nonconformance with this standard.

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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of common technical terms in this standard, refer to Terminology D653.

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.23 on Field Instrumentation.

Current edition approved ~~July 1, 2012~~Aug. 1, 2020. Published ~~October 2012~~August 2020. Originally approved in 2012. Last previous edition approved in 2012 as D7764–12. DOI: ~~10.1520/D7764-12.~~ 10.1520/D7764-20.

[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**

3.2 ~~*Definitions:*~~*Definitions of Terms Specific to This Standard:*

~~3.1.1 For general definitions, see Terminology D653.~~

~~3.1.2 *absolute pressure, n*—a pressure value that includes the effect of atmospheric pressure.~~

~~3.1.3 *gauge pressure, n*—a pressure value that excludes the effect of atmospheric pressure.~~

3.2.1 *vibrating wire piezometer, n*—a type of pressure sensor that is used to monitor pore-water pressure. ~~Vibrating wire refers to the mechanism by which pressure on the sensor's diaphragm is converted to an electrical signal that is transmitted to a readout device. A typical vibrating wire piezometer reports absolute pressure, rather than gauge pressure. In this standard, the words "vibrating wire piezometer," "piezometer," and "sensor" will be used interchangably.~~

3.2.1.1 *Discussion—*

"Vibrating wire" refers to the mechanism by which pressure on the sensor's diaphragm is converted to an electrical signal that is transmitted to a readout device. A tensioned wire connected to the diaphragm is plucked by an electromagnetic pulse, and the resulting natural frequency is monitored by the readout. Any change in pressure on the diaphragm changes the tension of the wire and the resulting frequency. A typical vibrating wire piezometer reports gauge pressure, rather than absolute pressure. In this standard, the words "vibrating wire piezometer," "piezometer," and "sensor" will be used interchangeably.

4. Significance and Use

4.1 Vibrating wire piezometers are typically not recoverable after installation. Replacement, which involves drilling a new borehole, is expensive and sometimes impossible. Thus it is important to be certain that the sensor is operational before it is installed.

4.2 Lacking sophisticated testing facilities, field testers must use equipment that is at hand. But in so doing, field testers should not expect to achieve the same accuracy and precision that manufacturers state on the sensor calibration record. Instead, field testers should look for obvious non-conformances, as explained in the procedures.

4.3 This standard practice is not meant to restrict the use of other appropriate acceptance tests and procedures.

NOTE 1—~~Notwithstanding the statements on precision and bias contained in this practice, the precision of this practice~~ The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective ~~testing.~~testing/sampling/inspection/etc. Users of this ~~practice~~standard are cautioned that compliance with Practice D3740 does not in itself ~~ensure~~assure reliable ~~testing.~~results. Reliable ~~testing depends~~results depend on many factors; Practice D3740 provides a means of evaluating some of ~~these~~those factors.

5. Equipment

5.1 A ~~readout in good working condition and~~ vibrating wire readout compatible with the sensor to be tested. Consult manufacturer's user manual to verify compatibility of the readout.

5.2 The calibration record for the sensor to be tested. Vibrating wire sensors typically have unique calibrations, so it is important to match the calibration record to the sensor.

6. Zero-Reading Test Procedure

6.1 This procedure is used to verify that the sensor reads approximately zero when only atmospheric pressure is applied.

6.2 Ideally, this procedure is conducted in a temperature-stable location, since changes in temperature can affect the sensor. At minimum, ensure that the sensor is kept out of direct sunlight and away from other sources of heat.

6.3 Prior to establishing a zero reading on site, the filter tip of the sensor should be saturated.

6.3.1 Remove the filter tip of the sensor by its twisting and pulling the filter end from the body of the instrument.

6.3.2 Once the filter tip end is removed, hold the body of the instrument upright with cable end down, and fill the upper chamber with clean water.

6.3.3 Slowly push the filter tip back into the body of the instrument, allowing the water to force itself through the filter stone of the tip. This process should be done carefully and slowly, so as to not over-range the pressure sensor.

6.4 ~~Suspend the sensor in air by its signal cable~~ Place the instrument into a water-filled container and allow approximately one hour for the sensor to reach thermal equilibrium with the ~~surrounding air. Do not handle the sensor during this time or during the test.~~water in the container.

6.5 Prior to installation, connect the signal cable to the readout and suspend the sensor in air by its signal cable just above the water-filled container. Do not handle the sensor during this time or during the test.

6.6 ~~Connect the signal cable to the readout and obtain a~~ Obtain a gauge and termperature reading according to the manufacturer's instructions. Typically, the reading will be in Hz or $Hz^2/1000$. Check that the reading is stable and repeatable. Readings that vary ±2 Hz or ±12 $Hz^2/1000$ should be regarded as unstable. If the reading is unstable, check that the excitation setting is correct. Also check if other sensors of the same type return similar readings. If only one sensor is unstable, it ~~should probably~~ shall be rejected. If other sensors are unstable as well, the environment may be electrically noisy. Try moving to a different location. Do not lay signal cable near AC power cords, as they produce a 50 to 60 Hz signal that can interfere with sensor signal.

6.7 Convert the Hz or $Hz^2/1000$ reading to units of pressure by applying the calibration factors supplied by the ~~manufacturer.~~ manufacturer (typically, pressure equals some sensor-specific factor "K" times $Hz^2/1000$). Apply temperature correction as noted on manufacturer's calibration document. The result will be called a "zero reading."

6.8 ~~Correct the zero reading for elevation, as necessary.~~ Corrections for differences in elevation between calibration elevation and installation site elevation shall be applied. Calibration records are ~~typically~~ referenced to sea level ~~or 1 atmosphere,~~ (or 1 atmosphere) or atmospheric pressure observed during calibration, but atmospheric pressure decreases at elevations above sea level. Thus a zero reading at sea level is likely to be negative value at higher elevations. To correct for this, add 1.15 kPa for every 100 m of elevation above sea level. This correction factor is suitable to elevations of 1500 m above sea level.

6.9 If the calibration record indicates barometric pressure instead of elevation, barometric pressure corrections shall be applied. Local barometric pressures will need to be determined at the time of the zero-readings. Follow correction procedures as described in manufacturer manuals.

6.10 Compare the ~~elevation-corrected~~temperature-and-elevation-corrected zero reading with zero. If the value differs by more than 1 % of the rated range of the sensor, the sensor should not be ~~set aside.~~ used. For example, a difference of 3.5 kPa is at the limit for a sensor rated to 350 kPa. The 1 % limit allows for variations barometric pressure, temperature, and the sensitivity of various ranges of sensors.

~~6.8 Sensors that exceed the 1 % limit may still be usable. The sensors may have experienced a one-time zero-shift during shipping, but are otherwise functioning correctly. Since piezometers are generally used to monitor changes in pressure, rather than absolute pressure, the zero-shift is of little concern in practice. Assuming that they produce stable readings, as defined above, such sensors are still candidates for the downhole test.~~

7. Downhole Test Procedure

7.1 The downhole test is used to verify that the sensor performs adequately over its range. Ideally, this procedure is performed in a water-filled borehole that is deep enough to test the full range of the piezometer. If the water table is well below the surface, then only a partial range can be tested.

7.2 Flush the borehole with clean water to remove heavy drilling mud.

7.3 Determine the depth to the water surface, as measured from a selected index, such as the top of the drill casing.