
Supplemental Technical Specification for

Vibrating-Wire Piezometer

SCDOT Designation: SC-M-203-6 (07/17)

1.0 DESCRIPTION

1.1 Furnish all necessary supervision, labor, material, equipment, and related services necessary to furnish, install and maintain vibrating-wire piezometers in accordance with the lines, grades, dimensions, and designs shown on the plans, this Supplemental Technical Specification (STS), the project Specifications and Special Provisions, or as directed by either the Resident Construction Engineer (RCE) or the Geotechnical Engineer-of-Record (GEOR). In addition, furnish the piezometer readout system (i.e. data logger). Measure, record and provide to the RCE and GEOR the elevations of the vibrating-wire piezometers as required in this STS. This item includes the furnishing of "As-Built" drawings of actual locations where instrumentation was installed, survey data recorded during instrumentation installation, and installation field reports. Install piezometers in the presence of the RCE and/or the GEOR. Accommodate the RCE and GEOR in the monitoring of piezometers, as required. A piezometer as described in this STS is a device that is sealed in the ground so that the piezometer only responds to the groundwater pressure at the elevation of the piezometer and not groundwater pressures at other elevations. Figure 1 depicts the installation of a single piezometer in a borehole; however, multiple piezometers may be placed in the same borehole and are not shown for clarity.

2.0 MATERIALS

2.1 At the conclusion of the project the data logger equipment shall become the property of the Contractor. All other items placed in the field shall become the property of the Department. Provide incidental hardware, fasteners, tools, and the like, as necessary to install the system in accordance with this STS. In addition, supply an Excel[®] spreadsheet prepared by the vibrating-wire piezometer manufacturer that converts field readings to elevation data.

3.0 SUBMITTALS

3.1 **Vibrating-Wire Piezometer Installation Plan:** At least 30 calendar days before beginning vibrating-wire piezometer installation, submit to the RCE for review a plan for the vibrating-wire piezometers indicating the model and name of manufacturer of the vibrating-wire piezometer. Include with the manufacturer name, the manufacturer cut sheets for the specific piezometer, cables and data loggers to be used and the manufacturers operations manuals for both the piezometer and data logger. Obtain any and all permits required for the installation of the piezometers in the ground from the appropriate government agency, whether federal, state or local. Include a copy of the permit or statement indicating no permit was required in the Vibrating-Wire Piezometer Installation Plan. Include in the Vibrating-Wire Piezometer Installation Plan the means to replace/repair any damaged piezometers. Identify a land surveyor licensed in the State of South Carolina who has been responsible for collecting elevation data to the nearest 0.01 feet for at least 5 projects in the last 5 years. The land surveyor shall be present at the work site at all times during collection of elevation data. The Contractor shall provide a detailed resume of the land surveyor's experience and qualifications. The land surveyor, as well as any replacement for the land surveyor, will be subject to the acceptance of the Department. Select a Geotechnical Engineering Consultant (GEC) to install the vibrating-wire piezometer. Select the GEC from those firms who are currently on the

SCDOT Geotechnical On-Call Contract. Contact the RCE for the list of GEC firms or see the SCDOT website for the current list of Geotechnical On-Call Contracts.

3.2 Submittal Reviews: Acceptance of the personnel qualification and installation plan by the GEOR shall not relieve the Contractor of its responsibility to successfully install the vibrating wire piezometers in accordance with the plans and specifications. Approval by the GEOR of the vibrating wire piezometer installation plan shall be contingent upon satisfactory demonstration that the vibrating wire piezometer is meeting the objectives of the Department's Geotechnical Instrumentation Monitoring Plan. If, at any time, the GEOR in consultation with the RCE considers that the vibrating wire piezometer does not produce satisfactory results, alter the method and/or equipment as necessary to comply with this STS and Department's Geotechnical Instrumentation Monitoring Plan. The RCE and the GEOR will be the sole judge in determining the adequacy of the Contractor's vibrating wire piezometer.

3.3 Within 1 week following installation, submit an installation record for each vibrating-wire piezometer, which includes the vibrating-wire piezometer designation, station, offset, and elevation of the vibrating-wire piezometer. The vibrating-wire piezometer shall be located to an accuracy of 0.01 feet (both vertically and horizontally). In addition, indicate on the installation plan the benchmark(s) that will be used to measure settlement from. Establish the benchmark on stable ground that is not subject to settlement and is typically located away from any earthwork/construction activities.

4.0 DELIVERY, STORAGE, AND HANDLING

4.1 Check all materials and equipment upon delivery to ensure that the proper items are received and are not damaged. Store and maintain all materials in a clean, uncontaminated condition throughout the course of the project. Upon receipt of the vibrating wire piezometer, submit copies of the manufacturer's installation and instruction manual for review and acceptance by the GEOR, and make available the data logging system for inspection by the GEOR.

5.0 CONSTRUCTION REQUIREMENTS

5.1. Notify the RCE and the GEOR at least 5 working days prior to the installation of vibrating-wire piezometers.

5.2. Ensure a firm level base is present on site on which heavy equipment and/or other necessary equipment can be operated safely under its own power for installation of vibrating-wire piezometers.

5.3. Prior to installation of the vibrating-wire piezometers at the designated locations, demonstrate that the equipment, method and materials produce a satisfactory installation in accordance with this STS. If at any time the RCE or the GEOR determines that the method of installation does not produce a satisfactory piezometer, alter the method of installation and/or equipment as necessary to comply with this STS. The vibrating-wire piezometer shall be located in such a way not to harm other embankment instrumentations.

5.4. Protect the piezometers and benchmarks from damage for the duration of the Contract or as directed otherwise by the RCE. Immediately notify the RCE and GEOR if any piezometer or benchmark is damaged. Replace/repair the piezometer or benchmark in accordance with the previously accepted Vibrating-Wire Piezometer Installation Plan.

5.5. Accurately locate all piezometers in the field in accordance with drawings and ensure

that no conflicts exist between piezometers and existing and proposed structures, utilities or other construction proposed or present at the site. Piezometers may be adjusted by the Contractor, with the approval of the RCE and the GEOR, to avoid utilities, foundations, and all other underground construction.

5.6. Piezometer shall be installed from the working surface to the depths shown on the plans. These depths refer to the middle of the piezometer referenced to the original ground surface. The piezometer cables shall be protected as successive layers of embankment are placed.

5.7. The piezometer shall be installed per any recommendations of its manufacturer or supplier. As a general guideline, use a 4-inch diameter pilot hole. Eight inches of clean sand shall be placed below and above the piezometer; then the borehole shall be sealed with a 2-foot layer of bentonite. The remaining section of the borehole shall be backfilled to the embankment level with a sealing grout consisting of a sand-bentonite mixture. The Contractor shall protect the piezometer cabling at all times from damage by construction equipment. Damaged cables shall be replaced at Contractor's expense. A sketch showing the vibrating wire piezometer and the cabling is attached (Figure 1).

5.8. During roadway construction and any delay period for settlement, the piezometers will be read weekly by the RCE. The collected data will be analyzed by the GEOR. If the piezometers indicate excessive excess pore pressures at a given location during embankment placement operations, the placing of embankment material shall be suspended. The determination of excessive excess pore pressures will be made by the GEOR in conjunction with the RCE.

5.9. Protect the piezometers from damage and vandalism for the duration of the Contract and repair or replace damaged or inoperative piezometers as indicated in the Vibrating-Wire Piezometer Installation plan.

5.10. Accommodate the Engineer during construction to provide safe and timely access to piezometers for the purpose of obtaining measurements, as construction progresses, if required.

5.11. Evaluation of the piezometer data will be the responsibility of the GEOR.

6.0 ABANDONMENT OF VIBRAING WIRE PIEZOMETER

6.1. Once the RCE and GEOR have determined that the piezometers have served their purpose and are no longer needed, abandon the piezometers in-place. Remove as much of the signal cable as can be recovered and place 2 feet of properly compacted fill on top of the testing location.

7.0 METHOD OF MEASUREMENT

7.1. The number of vibrating-wire piezometers will be as provided in the plans unless written authorization for additional and/or reduction of vibrating-wire piezometers has been provided by the RCE in conjunction with the GEOR. The contract unit price includes all equipment, including but not limited to the vibrating-wire piezometers; data loggers including Excel[®] spreadsheet; mobilization; labor; surveys; materials; incidentals and abandonment required by this STS. Replacement or repair of any vibrating-wire piezometer will be at no cost to the Department.

8.0 BASIS OF PAYMENT

8.1. The price and payment for this work shall be full compensation as measured in the prior Section of this STS based on the acceptance of the Vibrating-Wire Piezometer installation by the RCE and the GEOR.

8.2. Payments shall be made under:

Item No.	Long Description	Pay Unit
2038130	Monitoring Device – Piezometer – Vibrating-Wire	Each

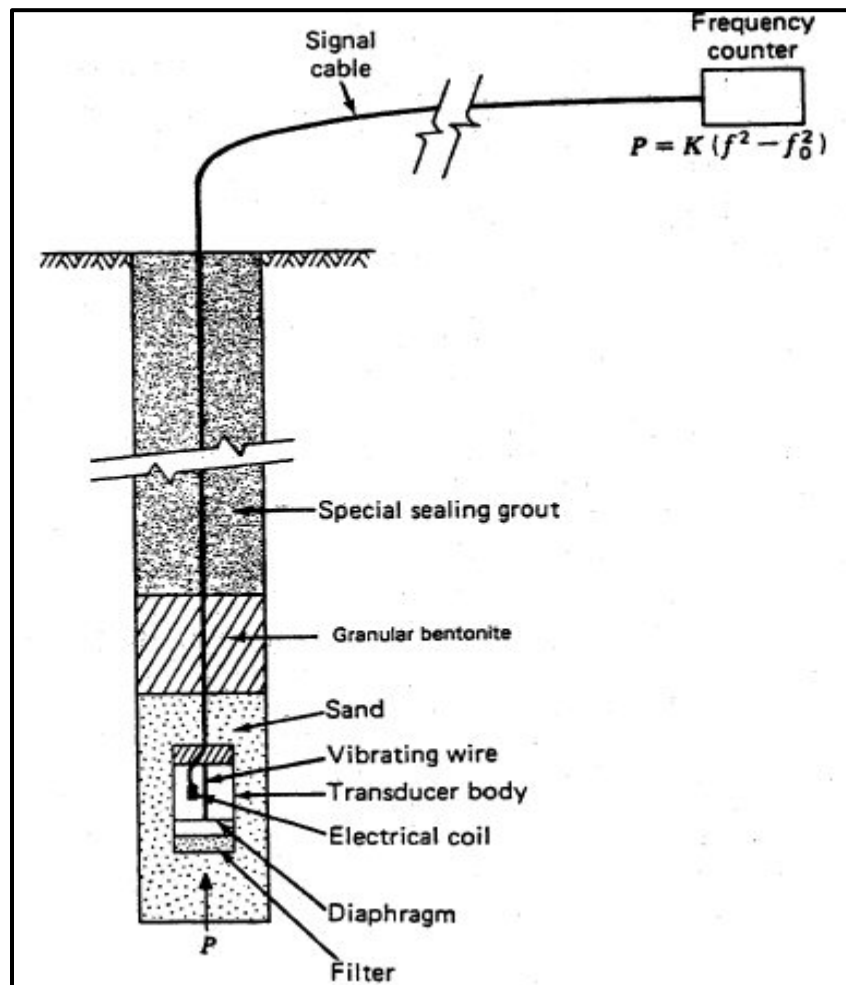


Figure 1 - Schematic of Vibrating Wire Piezometer Installed in a Borehole
 (Dunncliff, 1998 (After Dunncliff, 1988, 1993))

Dunncliff, J. (1998), Geotechnical Instrumentation, (FHWA HI-98-034), U.S. Department of Transportation, National Highway Institute, Federal Highway Administration, Washington D.C.