



Designation: D 6725 – 01

Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers¹

This standard is issued under the fixed designation D 6725; 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 is based on recognized methods by which direct push monitoring wells may be designed and installed for the purpose of detecting the presence or absence of a contaminant, and collecting representative ground water quality data. The design standards and installation procedures herein are applicable to both detection and assessment monitoring programs for facilities.

1.2 The recommended monitoring well design, as presented in this practice, is based on the assumption that the objective of the program is to obtain representative ground water information and water quality samples from aquifers. Monitoring wells constructed following this practice should produce relatively turbidity-free samples for granular aquifer materials ranging from gravels to silty sand. Strata having grain sizes smaller than the recommended design for the smallest diameter filter pack materials should be monitored by alternative monitoring well designs which are not addressed in this practice.

1.3 Direct push procedures are not applicable for monitoring well installation under all geologic and soil conditions (for example, installation in bedrock). Other rotary drilling procedures are available for penetration of these consolidated materials for well construction purposes (Guide D 5092). Additionally, under some geologic conditions it may be appropriate to install monitoring wells without a filter pack (EPA 1991). Guide D 724 may be referred to for additional information on these and other methods for the direct push installation of ground water monitoring wells.

1.4 The values stated in inch-pound units are to be regarded as standard. The values in parentheses are for information only.

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.*

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgement. 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 the 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.

2. Referenced Documents

2.1 ASTM Standards:

- D 1452 Practice for Soil Investigation and Sampling by Auger Borings²
- D 1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes²
- D 2488 Practice for Description and Identification of Soils Visual-Manual Procedure²
- D 3694 Practice for Preparation of Sample Containers and for Preservation of Organic Constituents³
- D 4043 Guide for Selection of Aquifer-Test Method in Determining of Hydraulic Properties by Well Techniques²
- D 4044 Test Method for (Field Procedure) for Instantaneous Change in Head (Slug Tests) for Determining Hydraulic Properties of Aquifers²
- D 4104 Test Method for (Analytical Procedure) for Determining Transmissivity of Nonleaky confined aquifers by Over-damped Well Response to Instantaneous Change in Head (Slug Test)²
- D 4448 Guide for Sampling Ground Water Monitoring Wells⁴
- D 4700 Guide for Soil Sampling from the Vadose Zone²
- D 5088 Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites²
- D 5092 Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers²
- D 5314 Guide for Soil Gas Monitoring in the Vadose Zone²
- D 5521 Practice for Development of Ground-Water Monitoring Wells in Granular Aquifers²
- D 5778 Test Method for Performing Electronic Friction

¹ This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water. Current edition approved Nov. 10, 2001. Published January 2002.

² *Annual Book of ASTM Standards*, Vol 04.08.

³ *Annual Book of ASTM Standards*, Vol 11.07.

⁴ *Annual Book of ASTM Standards*, Vol 11.04.



Cone and Piezocone Penetration Testing of Soils²

- D 5781 Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices⁵
- D 5782 Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices⁵
- D 5783 Guide for Use of Direct Rotary Drilling with Water Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices⁵
- D 5784 Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices⁵
- D 5785 Test Method for (Analytical Procedure) for Determining Transmissivity of Confined Nonleakey Aquifers by Underdamped Well Response to Instantaneous Change in Head (Slug Test)⁵
- D 5786 Practice for (Field Procedure) for Constant Drawdown Tests in Flowing Wells for Determining Hydraulic Properties of Aquifer Systems⁵
- D 5787 Practice for Monitoring Well Protection⁵
- D 5881 Test Method for (Analytical Procedure) Determining Transmissivity of Confined Nonleakey Aquifers by Critically Damped Well Response to Instantaneous Change in Head (Slug)⁵
- D 5912 Test Method for (Analytical Procedure) Determining Hydraulic Conductivity of an Unconfined Aquifer by Overdamped Well Response to Instantaneous Change in Head (Slug)⁵
- D 6001 Guide for Direct-Push Water Sampling for Geoenvironmental Investigations⁵
- D 6282 Guide for Direct Push Soil Sampling for Environmental Site Characterizations⁵
- D 6285 Guide for Locating Abandoned Wells⁵
- D 6634 Guide for Selection of Purging and Sampling Equipment for Ground Water Monitoring Wells⁵
- D 6724 Guide for Installation of Direct Push Monitoring Wells

3. Terminology

3.1 *Definitions*—Refer to ASTM D 653 for definitions of terminology.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *prepacked screen*—a manufactured well screen that is assembled with a slotted inner casing and an external filter media support. The external filter media support may be constructed of a stainless steel wire mesh screen or slotted PVC that retains filter media in place against the inner screen. The filter media is usually composed of graded silica sand.

3.2.2 *tremie pipe or tube*—a pipe or tube that is used to transport filter pack materials and/or annular sealant materials from the ground surface into the borehole annulus or between casings and casings or riser pipe of a monitoring well.

4. Summary of Practice

4.1 This practice provides information for installing a prepacked screen monitoring well using direct push techniques. When constructed following this Standard Practice the direct push installed monitoring wells can meet most state regulations and federal guidelines (EPA 1986, 1991, 1992) for well construction (Fig. 1) and protection of the aquifer and ground water resources.

4.2 Initially the outer casing (or probe rod) is advanced to depth using direct push methods. The monitoring well is constructed inside the casing with prepacked well screens and riser pipe. The casing is retracted to set the well at the desired depth in the formation. Bottom up tremie installation of the annular seal and grout is conducted through the outer casing as it is retracted. This grouting method is required to obtain the highest integrity well construction. Commonly available types of above ground or flush mount well protection are installed to physically protect the well and prevent tampering. The small diameter wells may be developed using bailers, peristaltic pumps, bladder pumps or an inertial check valve system. The inertial check valve and tubing system is especially effective when used for development in medium to coarse-grained aquifers. This development method simultaneously surges and purges fines from the screen interval. Slug testing of the wells can be conducted to determine local aquifer properties and verify that development has been successful. Low flow and other sampling techniques may be used to obtain representative water quality samples. Clear and accurate documentation of the well construction is required.

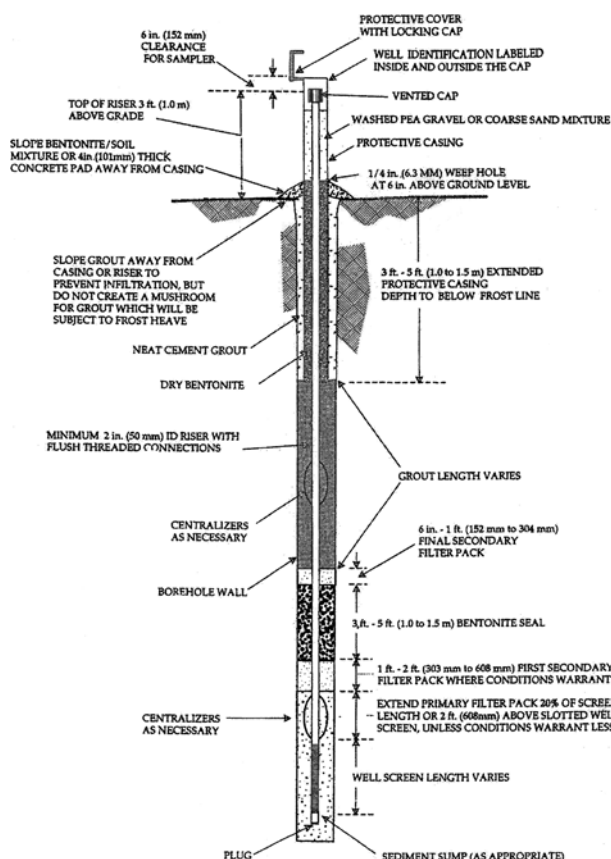
5. Significance and Use

5.1 This practice is intended to provide the user with information on the appropriate methods and procedures for installing prepacked screen monitoring wells by direct push methods. The monitoring wells may be used to obtain representative water quality samples for aqueous phase contaminants or other analytes of interest, either organic or inorganic (Kram et al. 2000, McCall 2000, McCall et al. 1997). The monitoring wells may also be used to obtain information on the potentiometric surface of the local aquifer and properties of the formation such as hydraulic conductivity or transmissivity.

5.2 Use of direct push methods to install monitoring wells can significantly reduce the amount of potentially hazardous drill cuttings generated during well installation at contaminated sites. This may significantly reduce cost of an environmental site investigation and ground water monitoring program. Minimizing generation of hazardous waste also reduces the exposure hazards to site workers, local residents, and the environment.

5.3 Direct push methods for monitoring well installation are limited to use in unconsolidated formations such as alluvial/stream sediments, glacial deposits, and beach type sediments. Direct push methods are generally successful at penetrating clays, silts, sands and some gravel. Deposits such as soils with thick caliche layers, or glacial tills with large cobbles or boulders may be difficult or impossible to penetrate with

⁵ Annual Book of ASTM Standards, Vol 04.09.



NOTE 1—This well design is consistent with most state regulatory requirements promulgated prior to development of direct push techniques (after Practice D 5092)

FIG. 1 Specifications for Conventional Monitoring Wells Installed with Rotary Drilling Methods.

desired depth. Direct push methods are not designed for penetration of consolidated bedrock such as limestone, granite or gneiss.

6. Site Characterization and Well Placement

6.1 *Characterization*—Understanding the project goals as well as the subsurface geology, hydrogeology, and contaminant distribution at a site is necessary before installation of monitoring wells can be completed successfully. Steps in a site characterization program may include investigating site history, literature search, site reconnaissance, and field investigation and sampling efforts. The field investigation may include completion of borings to collect soil and ground water samples and to determine the ground water flow direction. Geophysical methods may also be applied to obtain an understanding of the subsurface geology. Several ASTM standards are available for use in conducting the site characterization and sampling efforts; these include Guide D 6001, Guide D 6282, Practice D 5088, Standard Test Method D 5778, Standard Test Method D 4044, Practice D 1452, Test Method D 1586, Practice D 1587, Practice D 2488, Practice D 3694, Guide D 4448, Guide D 4700, Method D 4750, and Guide D 5314. Other important sources of information include state and local agencies having responsibilities for ground water protection and regulation. A list of state geological surveys are included in Guide D 6285. Depending on site conditions, when direct push

methods are used for site characterization (for example, D 6001 and D 6282) it may be possible to complete the site characterization and monitoring well installation activities in one mobilization. Practice D 5092 provides further details on site characterization necessary for successful installation of monitoring wells and development of a site conceptual model.

6.2 *Well Placement*—The well location, depth and length of screen interval should be based on project requirements, information obtained during the site characterization activities and background research. In general at least one well is placed at a depth and location considered to represent undisturbed background water quality conditions. The length and depth of the screened interval for the background well(s) should reflect those of the wells installed hydraulically down gradient of the site. Information obtained during site characterization regarding local hydrogeology, water level(s), contaminant distribution, and ground water flow direction should be used to determine appropriate well placement. If multiple aquifers separated by aquitards are present beneath the site monitoring wells with screened intervals at multiple depths may be required at each location. The purpose for installation should be considered in selecting the locations of the monitoring wells. Purposes may include detection monitoring, long term monitoring, or data collection to determine the presence, extent, and concentrations of potential contaminants. Guidance on selection of well locations, screen lengths and intervals are

found in several references, some of which are: EPA 1986, 1991, 1992, 1998, Nielsen 1991, Fetter 1994, and USGS 1997.

7. Monitoring Well Construction Materials

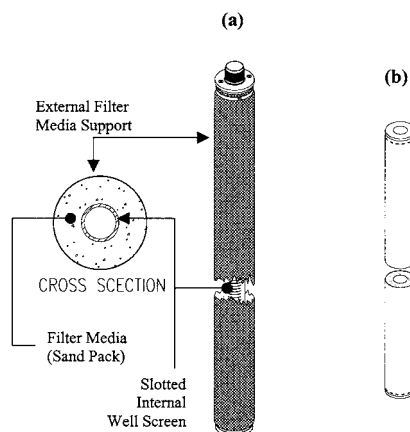
7.1 General—The materials that are used in the construction of a prepacked screen monitoring well should not measurably alter the chemistry of the ground water sample(s) to be collected when appropriate sample collection methods are used. Ideally, PVC should not be used when monitoring for neat organic solvents that are PVC solvents (Parker 1992). While conventional steel materials (for example, carbon steel or galvanized steel) are not suitable for use under most ground water monitoring conditions stainless steel has been found to perform well in most corrosive environments, particularly under oxidizing conditions (EPA 1991). In most cases Type 304 stainless steel will perform satisfactorily for many years (Driscoll 1986). Under highly corrosive and reducing conditions Type 316 stainless steel will perform better than Type 304 stainless steel (EPA 1991). The prepacked screens and well casing used in the well construction should be delivered from the manufacturer to the field site in a clean state sealed in protective wrapping. Any other equipment used in the well construction process (e.g. casing, measuring tapes, grout hoses, other down hole tools) that could impact the resultant water quality should be cleaned and decontaminated following appropriate methods (Practice D 5088) prior to use in the well installation. Additional guidance and information on well construction practices can be obtained from Practice D 5092, EPA 1986, 1991, 1992, Nielsen 1991, and USGS 1997. Always verify compliance with state and local regulations by contacting the appropriate agency or agencies.

7.2 Water—In general, little water is used in the construction of direct push installed prepacked screen wells other than in preparation of annular seal and grout mixtures. However, there are situations that may require addition of water to the well or borehole during installation. One of the most common situations that may require addition of water is under drilling conditions where formation blow-in may occur. Under these

conditions (most often saturated sands) water must be added to the boring to prevent blow-in and assure that the well is properly installed at the desired depth. When water is used in the well installation and construction process (to prevent blow-in, or mix grout) water of known quality must be used to assure that the sample integrity will not be compromised. The volume of water added to each well must be documented.

7.3 Prepacked Screen—There are three primary components of the prepacked well screen (Fig. 2). These are the internal well screen, the external filter media support, and the contained filter media (sand pack). Some prepack screens are assembled with the internal PVC screen as an integral part of the assembly (Fig. 2a). Alternatively, some prepack screens are available as sleeves or jackets (Fig. 2b) that may be installed over factory available casing. The components used in construction of the prepacked well screen must not adversely affect the ground water quality so that representative samples may be acquired. Subsurface conditions, including but not limited to site geology, geohydrology, ground water chemistry, and the analytes to be monitored must be considered to assure that the prepacked well screens are compatible with the system to be monitored. A sump may be attached to the base of the screen to capture any fines entering the well. The bottom of the screen or sump must be sealed with a plug constructed of compatible material. The prepacked well screen must be of sufficient strength to withstand the forces and stress of installation and development without being damaged or otherwise compromised. Some of the prepacked well screens are packed with filter media by the manufacturer. Other prepacked screens are shipped without filter media and are packed in the field with acceptable filter media materials just prior to installation.

7.3.1 Internal Well Screen—The most common material used for construction of this component is polyvinyl chloride (PVC). Other materials (for example, stainless steel or fluoropolymers) may be used where and when appropriate. Routinely used internal well screen diameters include nominal 0.5-inch, 0.75-inch, and 1.0-in. PVC. For optimum performance of the well the screen slot size should be determined



NOTE 1—The internal well screen is usually constructed of Schedule 40 or 80 PVC (a) with a factory cut 0.010 in. slots while some are available with 0.25 slots. The external filter media support is usually constructed with stainless steel wire cloth with pore size of approximately 0.011 in. and graded silica sand or equivalent material is used for the filter media. Some prepacked screens are available as sleeves or jackets (b) that slide over factory available slotted PVC.

FIG. 2 Typical Prepacked Well Screens.

relative to the grain size analysis of the stratum to be monitored and the gradation of the filter pack material. For further details on the selection of screen slot size refer to Practice D 5092. The most widely available slot size is 0.010-in. in the prepacked well screens. The slot size used for the internal well screen should retain at least 90 % of the filter media.

7.3.2 External Filter Media Support—The purpose of the external filter media support is two fold. The primary purpose is to retain the filter media around the internal well screen as the screen is being placed in the boring. Additionally the external filter media support assures accurate and complete placement of the filter pack media in the desired screen interval. Emplacement of the filter media in this fashion eliminates problems with formation collapse against bare screen or bridging and creation of voids around the bare screen as when gravity installation of the filter media is conducted. One of the most common materials used for construction of this screen component is a stainless steel wire mesh. Slotted PVC, fluoropolymers or other compatible materials may be used for construction of this screen component when and where appropriate. The external diameter of the prepacked screen ranges from about 1.4- to 3.0-in., depending on the inner well screen diameter and the inside diameter of the probe rods used to advance the boring.

7.3.3 Filter Media—The filter media or gravel pack most commonly consists of uniformly graded siliceous particles washed and screened to have the appropriate particle size distribution. Refer to Practice D 5092 for details on the selection of appropriate grain size distribution for the filter media. One of the most widely used grain size distributions for prepacked screen well filter media is 20-40 grade silica sand.

7.3.4 Sump—The sump is usually constructed of a length of well casing material ranging from a few inches in length to several feet in length depending on the well design and formation characteristics. It is attached to the base of the well screen and is plugged at the bottom. The sump provides a space for fine sediments entering the well to settle without obstructing a portion of the screen interval and interfering with recharge or sampling activities. The sump also allows for the collection of dense nonaqueous phase fluids (DNAPLs) at locations where they are present.

7.4 Casing or Riser—The well casing should be made of clean, new materials that will not alter the quality of the water samples being collected. Most casing or riser is made of PVC but other materials (for example, stainless steel, fluoropolymers, etc.) may be appropriate in some situations. The inside diameter and wall thickness of the casing should match that of the internal well screen of the prepacked well. Threaded and

flush jointed casing fitted with o-rings of appropriate material are generally recommended for the casing. Glued or solvent welded joints are not recommended as the glues and solvents generally contain hazardous chemicals that can cause contamination of the ground water to be sampled. The casing and casing joints must be of sufficient strength to withstand the forces of installation and development. Further information on the selection of appropriate casing materials can be found in Practice D 5092, EPA 1986, 1991 and 1992, Nielsen 1991, Ranney and Parker 1997, 1998a, 1998b, and USGS 1997.

7.5 Grout Barrier—The grout barrier serves to prevent the annular sealants from entering into the screen interval resulting in the alteration of the water chemistry, because common annular sealants and grouts (e.g. bentonite and Portland cement) can have a significant impact on the local ground water chemistry a grout barrier is emplaced immediately above the screened interval. The grout barrier may be constructed by gravity or tremie installation of fine sand or by installation of a mechanical or modular barrier.

7.5.1 Gravity or Tremie Installation—The grout barrier may be constructed with silica sand having the same or finer gradation than the materials used in the filter media. When the filter media is course-grained use of a finer grained grout barrier is recommended. The grout barrier usually extends one to two feet above the top of the screened interval. The granular material used for the grout barrier may be poured through the annular space in the well for installation (Fig. 9) or placed through a tremie tube if conditions permit.

NOTE 1—Slowly add the barrier material to prevent bridging and to allow time for the material to settle through the water column.

7.5.2 Modular Barriers—Some direct push well systems offer the option of installing a modular grout barrier (Fig. 10). This modular barrier is assembled with the screen and casing and lowered into the well annulus. When the outer casing is retracted this modular barrier expands and creates a seal above the prepacked screen. These modular barriers are constructed with polyurethane foam covered with a polyethylene sleeve. These modular barriers are not recommended for use below the water table because of potential for absorption and desorption of some contaminants.

7.6 Annular Seal and Grout—The annular seal and grout are prepared of materials that will eliminate or at least minimize the potential for surface or up-hole water (or fluids) from moving down the well annulus. This is important because these fluids could significantly alter the water quality or cause cross contamination in the zone being monitored.

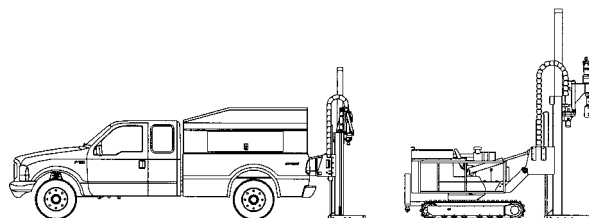


FIG. 3 Typical percussion type direct push units are often mounted in conventional pick-up trucks or more rugged track vehicles for access to difficult locations. Some percussion-type units, such as the track unit shown here, are fitted with optional rubber tracks.