# Geoprobe® Pneumatic Slug Test Kit
# (GW1600)

## Installation and Operation Instructions for USB System

**Instructional Bulletin No. MK3195**

**Revised: September 2022**

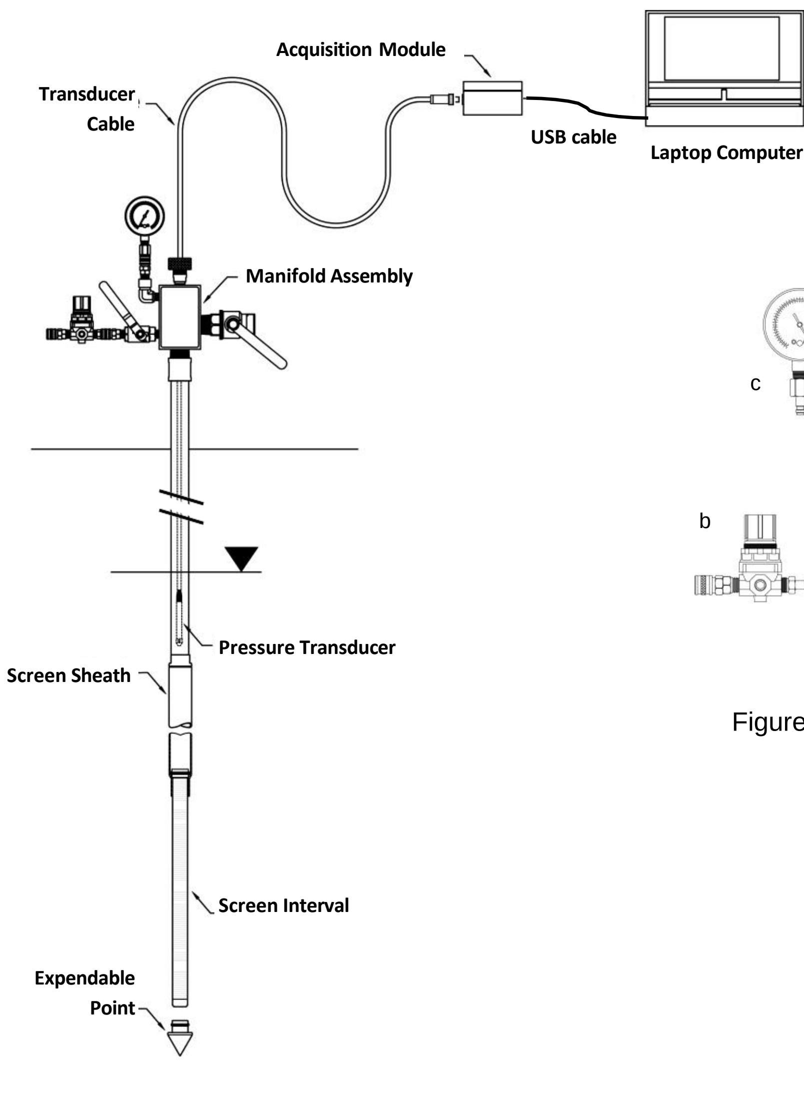



Figure A: Typical field setup with SP16/19 groundwater sampler

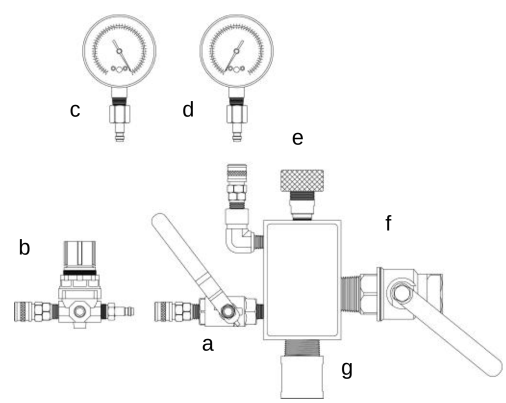



Figure B: Manifold Assembly with:

(a) inlet valve

(b) regulator

(c) vacuum gauge

(d) pressure gauge

(e) transducer port

(f) release valve

(g) 1.25" rod adapter

## Operating the Pneumatic Slug Test Kit

### 1.0 Objective

The Geoprobe® Pneumatic Slug Test Kit is used in conjunction with direct push (DP) groundwater sampling tools (SP16, SP19, SP22, etc.) or monitoring wells to perform slug tests. The slug test responses are modeled and used to determine the hydraulic conductivity (K) of the screened aquifer (Butler 1997, Butler and Garnett 2000, Butler et al. 2002, McCall et al. 2002). This bulletin identifies the tools and basic techniques required to successfully operate the Pneumatic Slug Test Kit. The DP groundwater samplers or wells (Geoprobe® 2006 a,b,c, 2009a, 2010) may be installed at multiple depths (profiling) and locations across a site to define the spatial variations in K and contaminant distribution (McCall et al. 2002, 2006, 2009 ). The procedures outlined below conform to the ASTM Standard Practice D 7242 (ASTM 2013a) for performing pneumatic slug tests with DP methods.

### 2.0 Required Equipment

All the primary components of the Pneumatic Slug Test kit are provided in a carrying case for ease of transportation. The major components of the kit (Figure 1) include the pneumatic head assembly, pressure transducer, data acquisition module and accessories needed to complete the slug testing process. When slug testing PVC wells additional PVC adapters will be required (214039 for sch. 40 PVC wells ≤1-inch, 207304 for sch. 40, 2-inch PVC wells). Pneumatic slug testing of larger diameter wells may be performed with custom adapters. It is important that the air/pressure release valve on the pneumatic head be of equal or greater diameter than the inside diameter of the well being tested.

### 3.0 Preparation Before Slug Testing

The groundwater sampling tools (Figure A, cover; Geoprobe® 2006, 2010, ASTM 2013b) or monitoring wells (Geoprobe® 2006b, 2006c, 2009a, ASTM 2013c) must be installed properly before slug testing can be performed. For both wells and DP groundwater samplers O-rings (or equivalent) must be used on each casing or rod joint respectively, to provide for an airtight system needed for pneumatic testing. Once installed the groundwater samplers or wells **must be adequately developed** (Figure 2) (ASTM 2013d, Geoprobe® 2002a) to obtain representative slug test results. When installed in sandy formations many groundwater samplers and wells may be adequately developed with a simple check valve (Figure 2) (GW4210, GW4220 or GW4230) to assure that representative slug tests and K-values are obtained. Water quality sampling usually requires more stringent methods for well development (Geoprobe® 2002a, ASTM 2013d).

For short screen groundwater samplers and wells in sandy formations purging as little as 1 to 5 gallons (4 to 20 liters) is often sufficient for development. A Useful rule of thumb is purging approximately 1 gallon (4 liters) of water per foot (30 cm) of screen length. Be sure to document well construction parameters (screen length, boring diameter, casing radius, etc.) so that K may be correctly calculated. Information about aquifer thickness and whether the aquifer is confined or unconfined will need to be determined to enable correct K calculation. In order for pneumatic slug tests to be successfully performed the static water level must be above the screened interval of the well, prior to and during the pneumatic slug test. If this is not the case mechanical slug tests may be performed on the well using the transducer,

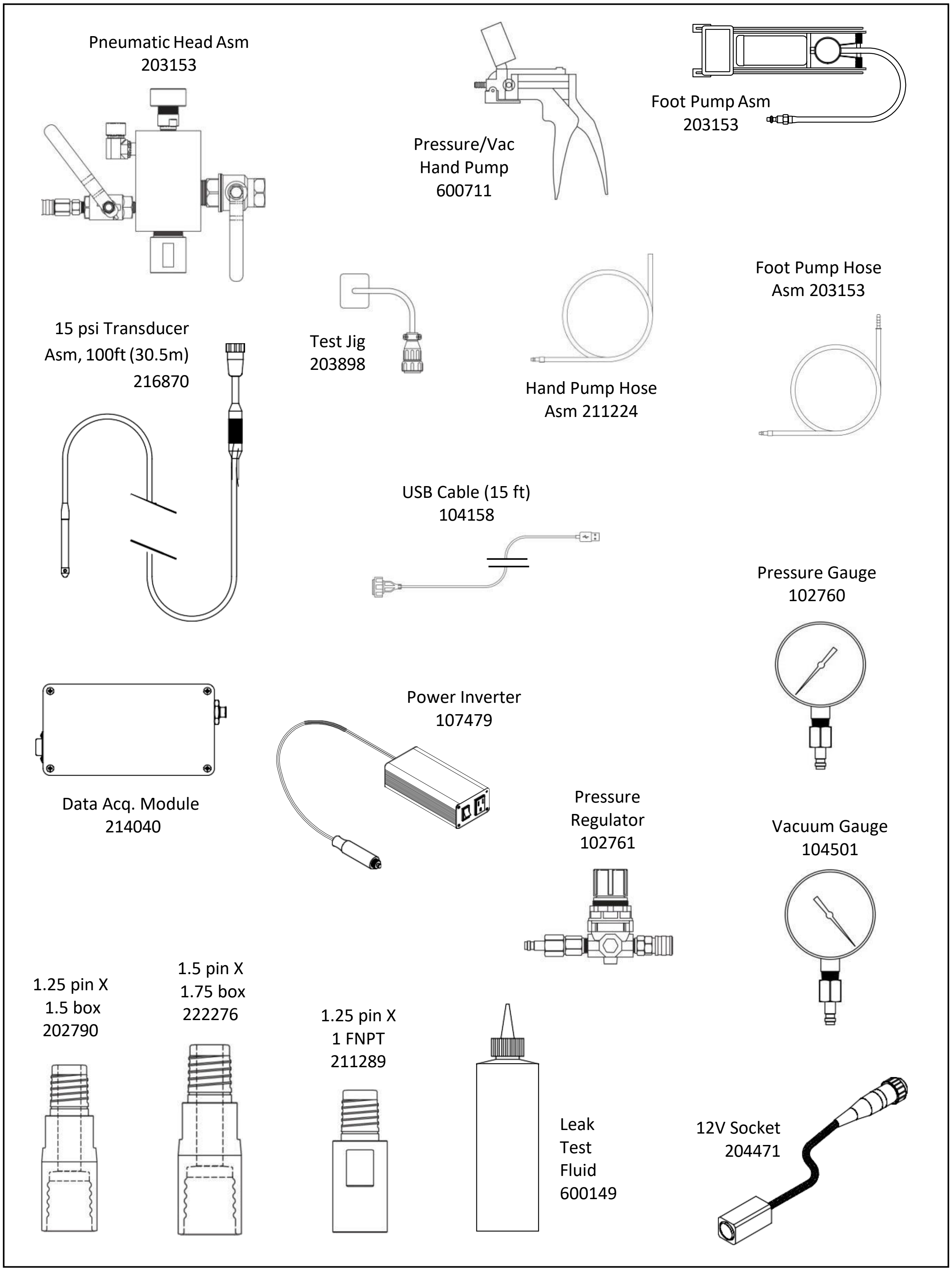



**Figure 1: Major components of the GW1600 Pneumatic Slug Test Kit (not to scale).**

acquisition module and software included with the kit. A mechanical slug is not included with the GW1600 kit.

Development of fine-grained formations (silty-clays, etc.) is typically not performed by purging the screen. Often a core of the formation material is removed before placing a screen over the desired interval. If the cored formation is cohesive it may be brushed with a steel or nylon brush (e.g. MN 600998, MN 600999, or MN601002 depending on the OD of the core hole) to relieve smearing. A screen (typically filled with sand) may then be set in the core hole with riser. Filling the screen with sand minimizes flow of fines into the screen during testing and reduces the potential of data bias. This process is often accomplished through a dual-tube groundwater sampling system such as the SP22 (Geoprobe 2010). Tests of fine-grained materials may take hours or days to complete. These tests are often performed as simple falling head tests by filling the riser with water and monitoring the falling water level. Any small leaks in the system may be significant. Results should be considered qualitative estimates of localized hydraulic conductivity.

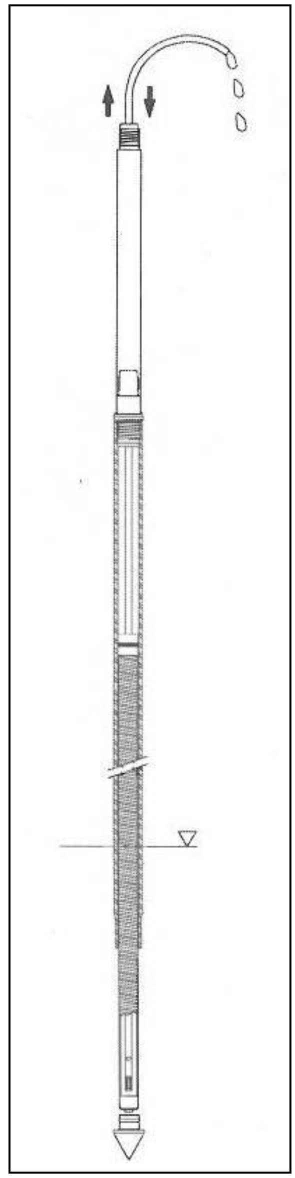


**Figure 2: Development of an SP16 groundwater sampler with a check valve (214061, 214062 or similar) by surging and purging. This may be conducted manually or the 12V Mechanical Actuator (214106) may be used when water levels are < 15ft/5m. Older wells may require redevelopment to obtain accurate slug test results.**

### 4.0 Installation of the Pneumatic Head and Transducer

The pneumatic head is installed on the probe rod using the appropriate adapter (Figure 3). When slug testing PVC wells additional PVC adapters will be required to attach the pneumatic head to the well casing (Geoprobe® 2002b (Appendix I). Use appropriate O-rings, plumber's tape or bushing to obtain an airtight seal between the pneumatic head and probe rod or PVC casing. When the pneumatic head is installed unthread the knurled fitting from the transducer port and remove the copper washer and split bushing (Figure 4). Replace the copper washer and knurled fitting on top of the transducer port. Next lower the transducer down through the pneumatic head and well until it is submerged about 6 feet (2 m) below the static water level. Allow the transducer to cool to the ambient groundwater temperature (usually 3 to 5 minutes) before zeroing or slug testing is started. Reinstall the split bushing (Figure 4) to complete the seal after the transducer is zeroed at atmospheric pressure (see below) and installed at the desired depth.

Please review the following notes to be sure you obtain valid data and to minimize potential damage to kit components:

**NOTE:** The inside diameter of the release valve used to initiate the test should be of equal or greater ID than the well casing to assure free flow of air from the well and that no interference or noise occurs to degrade data quality. The release valve on the pneumatic head has an ID of 1.0 inches (25.4 mm). A pneumatic head adapter (207304) is available for 1.5-inch and 2-inch (38 and 50mm) PVC wells (Appendix I). Custom adapters can be fabricated for larger wells.

**CAUTION:** The transducer is delicate. Do not step on or strike the transducer as it may be damaged. Do not submerge the 15 psi transducer more than 20 ft (6 m) below the static water level and do not apply more than 10psi of air or water pressure to the transducer. Do not place the transducer in water with high concentrations of solvents or where free product is present as it can be damaged.

**CAUTION:** The transducer is vented by a small tube running through the cable. Do not kink the transducer cable as the vent tube may be pinched. This can result in an inoperable transducer.

**NOTE:** Keep the transducer cable out of direct sunlight before and while tests are being performed. Sunlight will warm the air in the vent tube and may cause noticeable drift of the baseline (Cain et al., 2004). This can interfere with modeling of the slug test response and accurate calculation of K. Foam pipe insulation may be placed around exposed sections of transducer cable to prevent solar heating and baseline drift on sunny days. Keep excess loops of transducer cable in the shade, (e.g. inside a box or sample cooler)

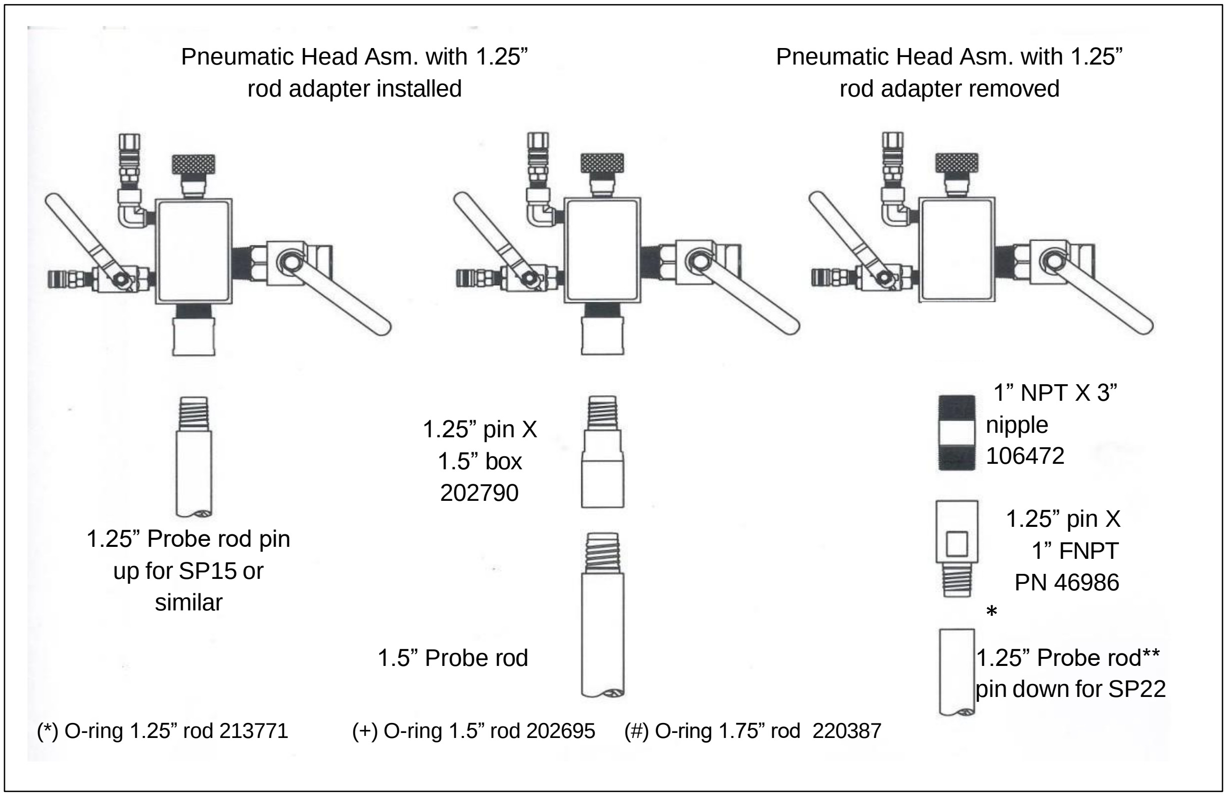



**Figure 3: Installation of the pneumatic head on different probe rod/groundwater sampler configurations. When slug testing PVC wells additional PVC adapters will be required to attach the pneumatic head to the well casing (Geoprobe® 2002b). ** Because of radius change in ID of 1.25" light weight rods they cannot be used for slug testing.**


Figure 4: Transducer seal assembly showing the knurled cap, copper washer and split bushing on the transducer cable after the transducer is lowered to depth.


Figure 5: The 15ft USB cable is used to attach the data acquisition module (GW2610) to the laptop computer for signal transmission. The USB cable also provides power from the laptop computer to operate the acquisition module and the transducer downhole. If needed the 12V power inverter (Figure 1, 107479) included with the kit may be attached to the Power Point of a Geoprobe® unit or vehicle to recharge the computer battery.

## 5.0 Acquisition Software and Acquisition Module

The Slug Test Acquisition software (V 4.0) is provided on a USB drive with the kit. Install the drive in one of the USB ports of the computer and follow the onscreen instructions for installation. This usually requires less than 2 minutes. The data files (*.dat) generated by slug testing are saved in a user created folder on the computer. The files are then available for later retrieval, viewing and modeling.

The USB cable (Figure 5, above) is used to connect the acquisition module (GW2610, Figure 6) to the computer for signal transmission. The USB cable also supplies power to the acquisition module and transducer. The power inverter (MN 107479) supplied with the kit may be plugged into a vehicle or Geoprobe® unit 12V power point to provide the electrical current required to operate the computer and slug test system. The transducer is attached to the sensor port on the acquisition module (Figure 6). The acquisition module converts the analog signal from the transducer to digital signal that is received by the computer for live-time display and storage in data files.


Figure 6: The USB cable and transducer cable are connected to the GW2610 Acquisition Module (214040).

### 6.0 Initiate Software

When the software is started a blank graphing window opens showing the CONNECT icon onscreen (Figure 7). The software automatically searches the active com ports on the computer and locates the port the Acquisition Module is connected to and makes the connection. Be sure the acquisition Module is connected to the computer before starting the software. Once the Connection is made simply click on the START icon to proceed with system operation.

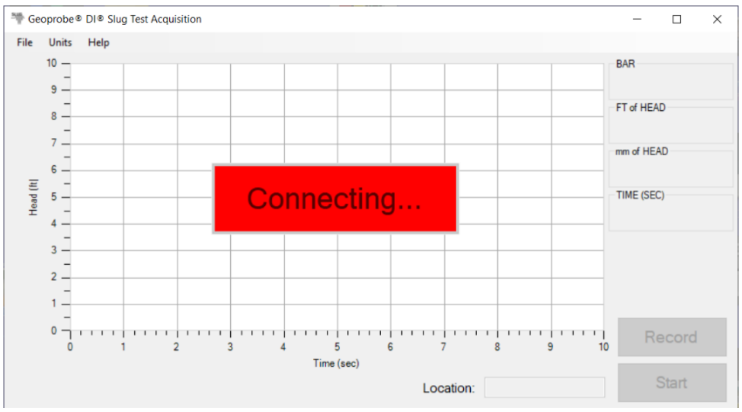



**Figure 7: When the Acquisition Software is started the CONNECT icon pops up on the software window and the software will automatically search for the com port where the Acquisition Module is connected with the USB cable. The CONNECTING icon flashes red while searching for the correct com port. The icon disappears when the connection to the correct com port is made. This search and connection usually requires less than a minute.**

Next, the SENSOR CONFIGURATION window opens (Figure 8). Select the sensor pressure range (10psi or 15psi) to match the pressure range of the sensor being used. Look at the sensor body to verify the pressure range of the sensor. Also select the frequency of data collection for the series of tests to be performed. For overdamped responses that require several minutes or longer a frequency of 1Hz or 2Hz is usually adequate. For fast recovering formations, especially those exhibiting oscillatory (underdamped) responses a frequency of 5Hz or 10Hz may be needed. A preliminary test may be run to determine which data collection frequency is best for a given well/formation.

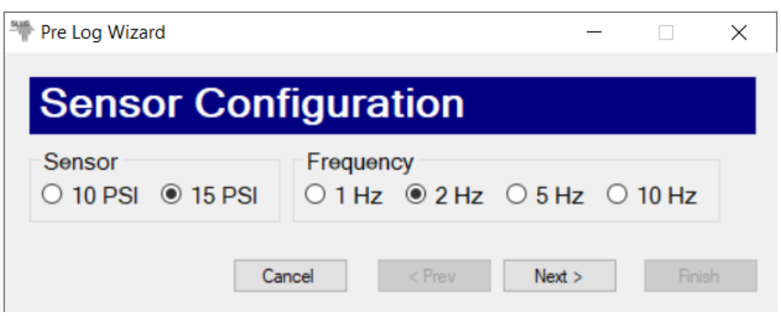



**Figure 8: Select the correct pressure range for the sensor being used (see label on sensor body). Also select the optimum data collection frequency for the formation being tested.**

Allow the transducer to cool to ambient groundwater temperature in the well for at least 3 to 5 minutes. Then gently raise the transducer above the water level (voltage readout drops and then stabilizes) and click on the SET ZERO VALUE icon (Figure 9) and the transducer will be zeroed. Some fluctuation in the last couple of digits on the transducer readout is expected while zeroing, especially for higher frequency settings (e.g. 10Hz). Zeroing the transducer at atmospheric pressure lets the operator know how deep the transducer is below the water level in the well prior to testing and between tests. If you want to keep the previous zero level you can choose to BYPASS the zero function (recommend re-zeroing after moving to a new location). Now lower the transducer below the water level to the desired depth for slug testing. Usually the transducer is set at about 6 ft (2 m) below the water level for slug testing. Initial head values of greater than 5 ft (1.5 m) are usually not required for slug testing and larger head values may cause some errors of measurement in fast or oscillatory responding (underdamped) wells. Smaller initial head values are usually preferred.

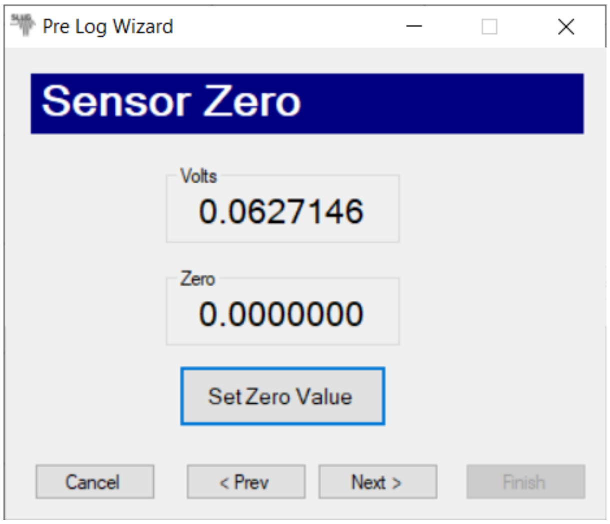



**Figure 9: Allow the transducer to cool to ambient groundwater temperature in the well. Then raise the transducer above the water level and click on "Set Zero Value" to zero the transducer at atmospheric pressure. Fluctuation in the last 3 digits of the voltage readout is typical, especially at higher sampling frequencies. The selected zero value will be posted in the zero window. Click Next to proceed.**

Once the pressure transducer is zeroed the FILE CONFIGURATION window opens (Figure 10). Browse to the desired folder and enter a file name for the test(s) to be run. Clicking on the "Auto-number file name" option will allow the program to save individual slug tests sequentially (e.g. MW3-01, MW3-02, MW3-03, etc.) without the operator restarting and renaming files. Simply click on the START and STOP icons in the software window to automatically augment the file number at a given well. Click the FINISH icon to proceed with testing.

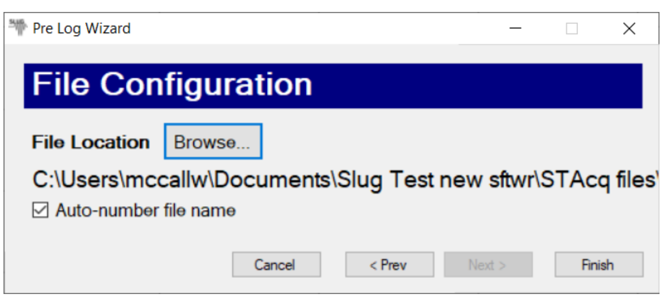



**Figure 10: Browse to the desired folder and enter the filename. Select "Auto-number" to sequentially number a series of slug tests at one location. Select the "Finish" icon to proceed with slug testing.**

When the FILE CONFIGURATION window closes the "Head versus Time" screen becomes active to begin testing (Figure 11). When the graph window first opens the auto scale function often magnifies the baseline and you may see what appears to be large noise spikes (Figure 11 Inset). Lowering the transducer into the water will auto-adjust the vertical scale so that the apparent noise is reduced. When you are prepared to start saving data click on the RECORD icon (window will change from gray to white background) and data will be saved to the file. You may prefer to perform some initial leak testing and perform an initial slug test to assess formation response before recording data.

The operator may click on the RECORDING icon to stop saving data to the file, the screen will turn gray. Clicking on RECORD again will automatically augment the file number and start saving data to the new file. In this way multiple slug tests may be saved to separate, like-named files at one location, (e.g. MW4-01, MW4-02, etc.) if desired. The operator may also choose to run multiple slug tests in a single file. When testing is complete click STOP to close the file.

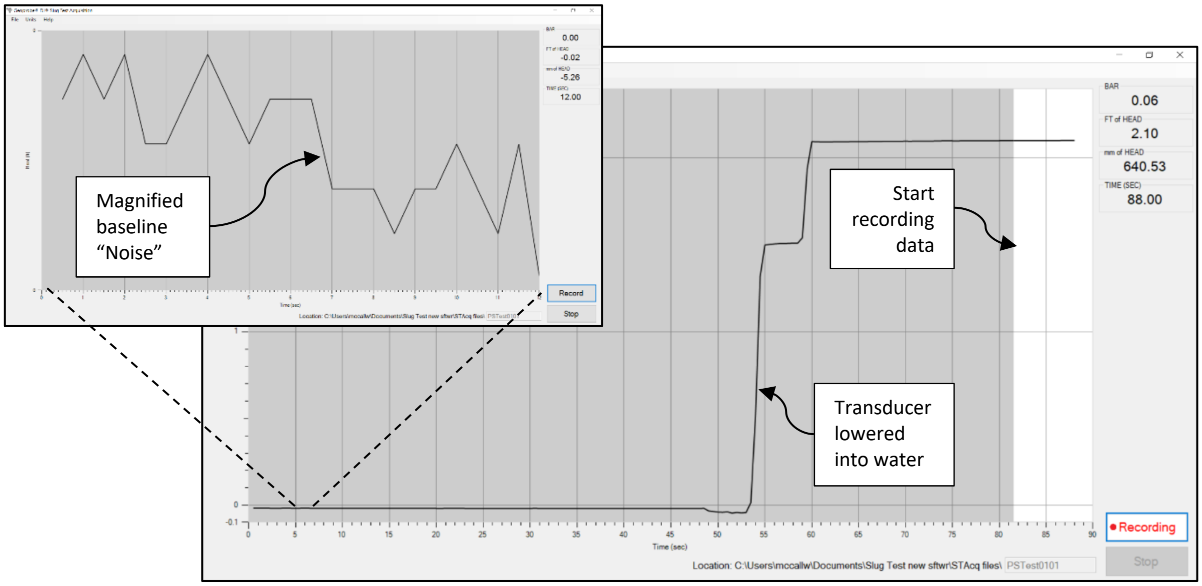



**Figure 11: When the active data screen first opens the baseline may be magnified, simply lower the transducer into the water to reduce the apparent noise. When you are prepared to start saving data to the file click on "Record" to start recording data to the file. The screen changes from gray to white when data is being saved to the file.**

### 7.0 Leak Testing

To verify that rod or casing joints and the pneumatic head are air-tight a leak test should be performed (Figure 12). Insert the pressure gauge in the upright quick connect and attach the hand pump (or other air pressure source*) to the horizontal quick connect (Fig. B, cover). If a higher-pressure air source is used place the pressure regulator assembly (102761**) between the source and the inlet valve to prevent damage to the gauge and jetting air into the formation. Pressurize the well head to about 20 inches (50 cm) of water pressure (this is < 1 psi). This will require several pumps on the hand pump and will result in increased pressure readout on the computer screen (Figure 13) that will return to the original baseline pressure. The total air pressure + water pressure over the transducer will return to equilibrium with the formation

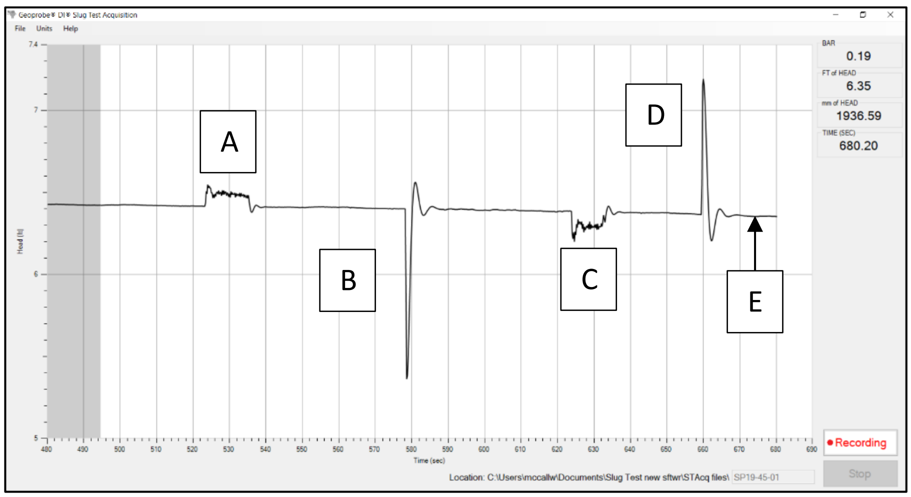
**Figure 12: Setup for leak test and rising head tests with the pressure gauge and hand pump. The gauges are graduated in inches and centimeters of water pressure (outer and inner marks respectively). Close the inlet valve after pressurizing.**

***NOTE**: An electric pressure/vacuum pump may be substituted for the manual pump for testing larger diameter/deeper wells and piezometers. Small 12V pumps (e.g. Cole Parmer model EW-79200-40) are convenient for operation in the field. Compressed gas cylinders may be used (e.g. air or $N_2$) but a regulator to reduce the pressure to ~10 psi will be required. **Handling and transportation of compressed gas cylinders requires special safety precautions.** Review requirements with your supplier to assure compliance with DOT and local regulations.

****NOTE:** the pressure regulator is only a 10 psi unit, applying excess pressure may damage the regulator.

hydrostatic/piezometric pressure. If excess air pressure is applied the water level will drop below the transducer and the stabilized pressure observed onscreen will exceed the ambient water pressure observed by the transducer. Reduce excess air pressure so that valuable early time response data is not missed when the test is started.

**Figure 13: Performing a rising head test and a falling head test. A: air pressurization peaks. B: rising head test. C: evacuation peaks. D: falling head test. E: stable baseline is about 6.4 ft (185 cm) for these tests, i.e. the static water level is that distance above the transducer. These are examples of under-damped (oscillatory) tests.**




***Observe the pressure gauge for leak testing***. Air pressure observed on the gauge (and computer screen, Figure 13) will bounce up and down as air is pumped into the well head and water flows out of the screen. Once pumping is stopped the air pressure should stabilize and the gauge readout indicates how far (inches/centimeters) the water level has been lowered in the well. Add more air if a larger initial head ($H_o$) displacement is desired. If the air pressure readout on the gauge continues to fall and returns to zero there is a system leak. (Remember, lower K formations will recover slowly from pressurization and may require several minutes to stabilize.) While the well head is pressurized use the leak check fluid (600149), included with the kit and apply it to exposed joints and fittings, watch for small bubbles to appear at leaks. Tighten any leaky fittings until an airtight system is obtained (Teflon tape or plumbers putty may be applied as appropriate). Once the system is airtight slug tests may be conducted.

Leaks may occur down-hole at probe rod joints or well casing joints. Use a pipe wrench to snug the probe rod tool string and seal joints (**O-rings or equivalent must be used on all rod and casing joints**). If down-hole leaks cannot be sealed the pressure regulator and air supply may be used to stabilize **slow** leaks so that a successful slug test may be obtained. Install the regulator at the inlet valve and use the air supply to provide a steady air flow to offset small air leaks downhole.

## 8.0 Performing Slug Tests

Once leak testing is completed, the transducer zeroed and the file has been named (Sections 5, 6 & 7) you are ready to perform slug tests. Be sure to click on the **RECORD** icon so the data is saved to file (Figure 11).

The pressure required to perform a successful slug test is relatively low, not more than 1 to 2 psi (~7 to 14 kPa) maximum. Higher pressures and larger initial head values are generally not required to obtain a representative slug test as the calculated K value is independent of initial head magnitude (Butler 1997). (Larger $H_o$ values may be preferred when unsaturated filter packs are present.) For underdamped (oscillatory) responses larger $H_o$ values may actually result in attenuation of the test response and an under-estimation of K. Usually, $H_o$ values between about 5 – 40 inches (~10 – 100 cm) of water pressure are used for pneumatic slug tests. For slow recovering overdamped responses (e.g. 15+ minutes) it may be useful to allow the test to recover only to about 90% before starting pressurization or evacuation for the next test, note this in the log book. For moderate to fast overdamped recoveries and all under-damped tests it is best to allow the formation to fully recover between tests. This is necessary so that accurate modeling and calculations can be obtained for these shorter duration tests.

To perform rising head tests, install the pressure gauge on the pneumatic head and set the valve on the hand pump (600711) to pressure. For falling head tests install the vacuum gauge (Figure 14) on the pneumatic head and set the valve to vacuum on the hand pump.

Close the release valve (Figure B, cover) on the pneumatic head and pressurize or evacuate the well head to the desired $H_o$ value. Close the inlet valve (Figure B). Allow the pressure to stabilize on the gauge and computer screen. Then **quickly** open the release valve to initiate the slug test. The slug test response is observed onscreen in real time (Figure 13). Note the difference in the response of the rising and falling head tests.

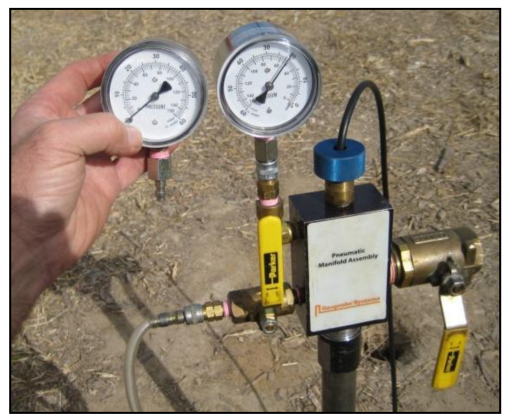
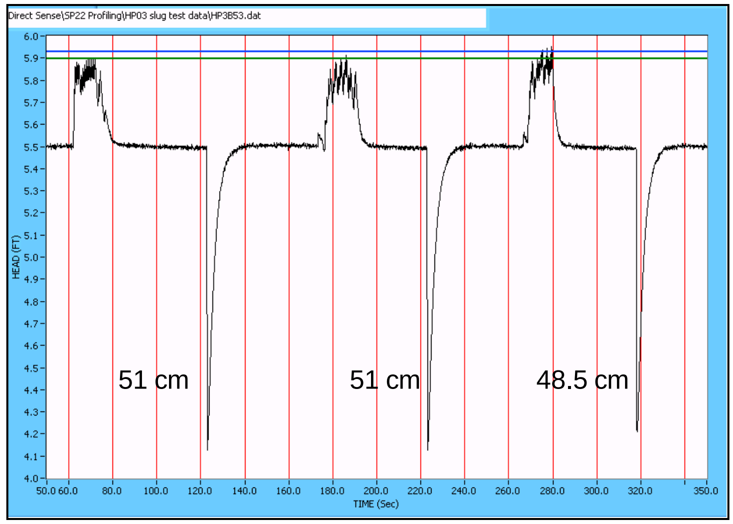


**Figure 14: Use the vacuum gauge to perform falling head tests or install the pressure gauge to conduct rising head tests and for leak testing.**

Basic field quality control may be performed by conducting repeat tests with the same initial head in the same data file (Figure 15). When this is done the operator can visually compare the peak height, symmetry, and recovery time of the repeat tests. If repeat tests with the same $H_o$ value show noticeable differences in peak height, symmetry or recovery time it is an indication that further development of the well is required. Additional quality control may be obtained by performing repeat rising or falling head tests with differing $H_o$ values (e.g. 10, 20 and 30 inches of water pressure). Later, these test responses can be normalized and overlaid to verify that the slug test responses were linear over the range of head values used to perform the slug tests. This also provides confidence that the results of the tests conform with the slug test model requirements (Butler 1997). Slug test procedures reviewed in this bulletin meet or exceed ASTM Standard Practice requirements (ASTM 2007a).

**Figure 15: Repeat of overdamped slug tests with approximately the same initial head value. These tests can be used for basic field QC. The $H_o$ values were 20, 20 and 19 inches of water respectively. The similarity of peak height, symmetry and recovery time indicates that good quality tests were obtained. If noticeable variations occur between repeat tests further well development may be required.**




## 9.0 Document Test Parameters

The field team should document how the slug tests were performed in the field so that modeling and calculations can be performed correctly once the field work is completed. The slug test field data can be documented in a simple table in the field book (Figure 16) or form (Appendix II). Field information about the well construction geometry (Figure 17) and aquifer type (confined/unconfined) also will be required to complete modeling of the slug test data and calculation of the formation K.

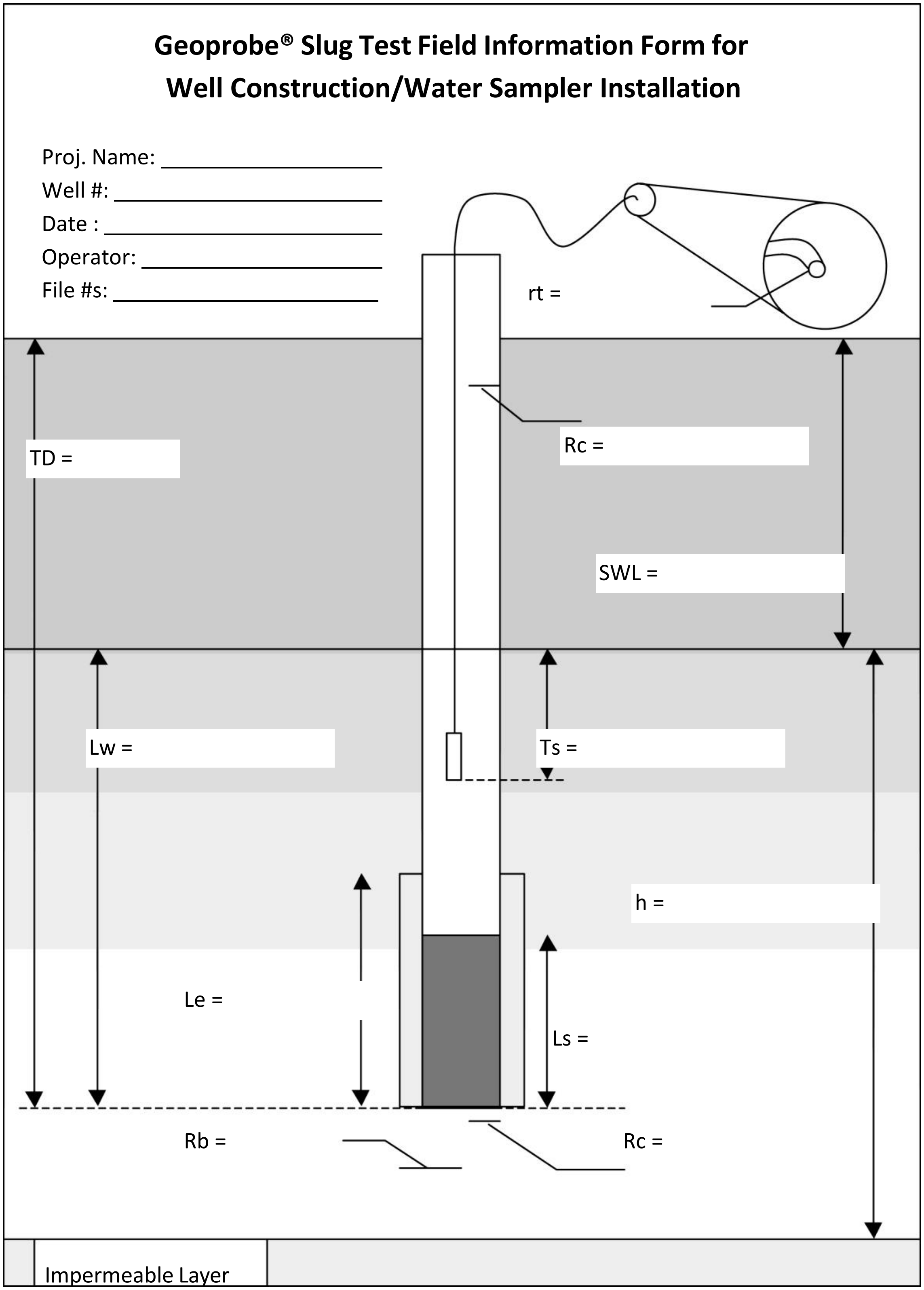
## 10 Modeling and Analysis

Geoprobe® provides the user-friendly Slug Test Analysis software package (GW1650 (MN 214042): Geoprobe 2009b) with the kit. This is for modeling (Figure 18) and calculation of the formation hydraulic conductivity (K) with the acquired slug test data. This package includes the Bouwer and Rice model (Bouwer and Rice, 1976) and the Hvorslev model (Hvorslev, 1951) for calculation of K. The software provides variants of these two basic models for confined or unconfined aquifers, partially or fully penetrating wells, and over or underdamped aquifer responses. A correction for oscillatory slug test responses in small-diameter wells (Butler 2002) also is included in the Geoprobe® analysis software.

Site: ABC Plating Corp
Well No: SP22A-53ft
Operator: Stephanie Jones
Date: Oct. 10, 2020 File: HP3A53

| FileTime (sec) | $H_o$ (in) | **R**ise **F**all | Notes |
|---|---|---|---|
| 120 | 20 | R | overdamped |
| 220 | 20 | R | Slow leak |
| 320 | 40 | R | Leak corrected |
| 450 | 10 | R | No leak |
| 550 | 20 | R | |
| 50 | 30 | F | New File = HP3B53 |
| 160 | 30 | F | overdamped |
| 280 | 10 | F | |
| 410 | 20 | F | No leaks |

**Figure 16: Example table for documentation of slug testing information in the field**



## Geoprobe® Slug Test Field Information Form for Well Construction/Water Sampler Installation

Proj. Name: ___________________
Well #: ________________________
Date : _________________________
Operator: ______________________
File #s: ________________________



**Figure 17: Field form for use in documenting well or groundwater sampler construction that is slug tested. This data required so K value can be calculated. Copy for field use. See below for parameter definitions.**

**Parameter definitions for Figure 17:**

Le = effective screen length
Lw = length of water column
Rb = borehole/filter pack radius
rt = radius of transducer cable
SWL = static water level
h = saturated thickness of aquifer

Ls = physical screen length
Rs = screen radius
Rc = casing radius
Ts = depth transducer submerged
TD = total well depth
$H_o$ = initial head change for slug test

In wells < 2 inch/50mm diameter the casing radius is corrected for the diameter of the transducer cable in the Slug Test Analysis software (see below). The corrected casing radius (Rcc) is calculated as follows:

$$Rcc = (Rc^2 - rt^2)^{1/2}$$ (after Butler et al. 2002)

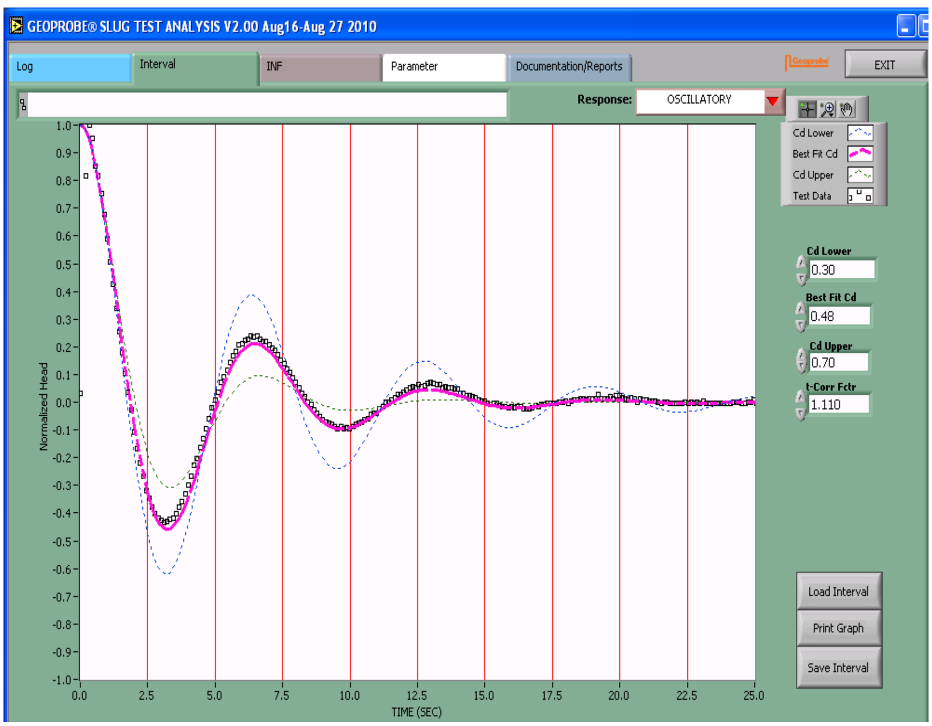



**Figure 18: Modeling an underdamped slug test response with the Geoprobe® Slug Test Analysis Software package (GW1650). The software provides for input of well construction parameters, modeling and calculation of K with graphical print outs. The analysis software is included with the slug test kit. A User's Guide is provided with the software.**

## 11.0 References

American Society of Standards and Methods (ASTM), 2013a. D 7242 Standard Practice for Field Pneumatic Slug (Instantaneous Change in Head) Tests to Determine Hydraulic Properties of Aquifers with Direct Push Ground Water Samplers. ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA. www.astm.org

ASTM, 2013b. D 6001 Standard Guide for Direct-Push Ground Water Sampling for Environmental Site Characterization. ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA. www.astm.org

ASTM, 2013c. D 6725 Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers. ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA. www.astm.org

ASTM, 2013d. D 5521 Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers. ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA. www.astm.org

Bouwer, Herman, and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Res. Vol. 12, pp 423-428.

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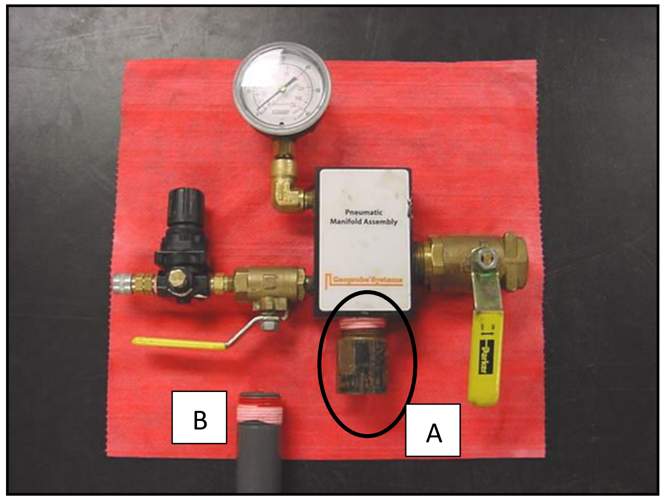
# Appendix I

**Instruction Sheet**
**2-inch PVC Adapter**
**(MN 207304)**
**for GW1600 Pneumatic Slug Test System**

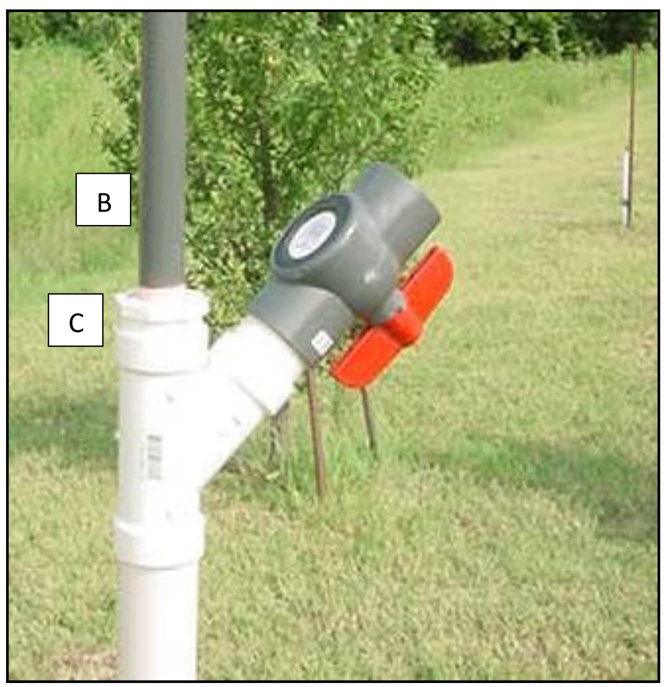
**Instruction Sheet**
**2-inch PVC Adapter (MN 207304) for GW1600 Pneumatic Slug Test System**

The following instructions provide guidance on how to attach the pneumatic manifold (MN 203153) to the 2-inch (50 mm) PVC Adapter assembly (MN 207304) for use in slug testing nominal 2-inch (50mm) PVC wells.

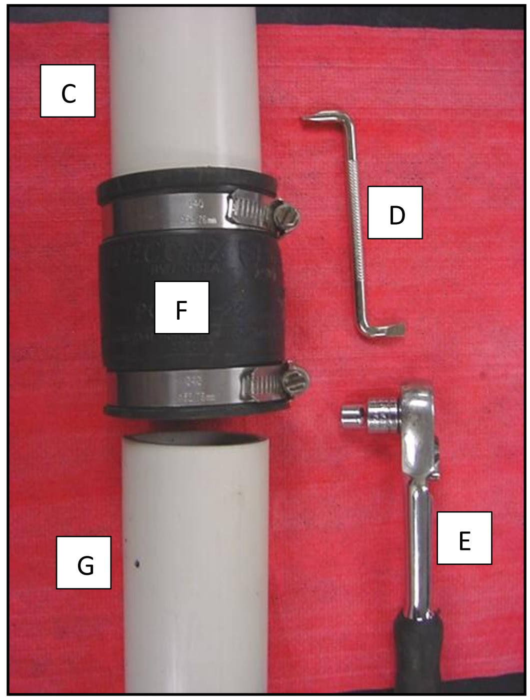
**STEP 1:** Remove the 1.25-inch probe rod adapter (A) from the base of the pneumatic manifold. Hold the base of the manifold (protected with cloth to prevent abrasion) in a large pipe wrench or vise. Use a pipe wrench to remove the probe rod adapter. Apply fresh plumber's tape to both ends of the 12-inch long by 1-inch diameter pneumatic head extension (B). Gently but firmly thread one end of the extension pipe into the base of the pneumatic manifold. Use care to prevent damage to threads on PVC.




**Step 2:** Thread the other end of the pneumatic head extension (B) into the threaded reducer on top of the 2" PVC adapter (C).



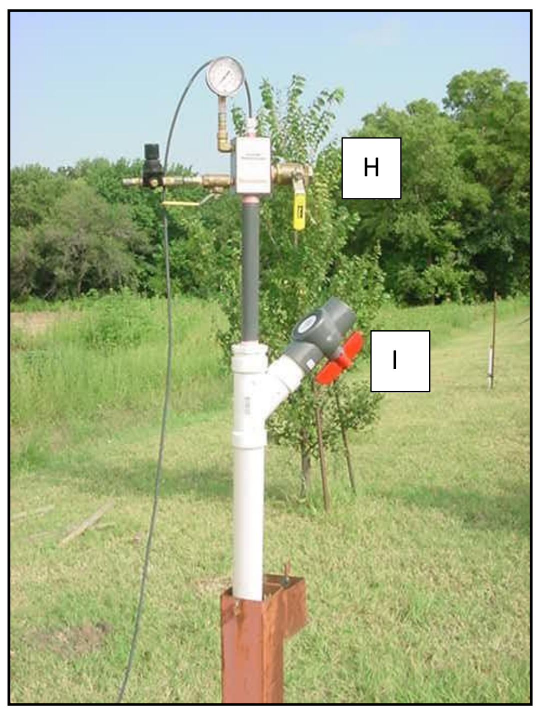
**STEP 3:** To install the 2-inch PVC adapter on the wellhead use a flat blade offset screw driver (D) or 5/16-inch socket on a small ratchet (E). Tighten the hose clamp on the flexible rubber coupler (F) to first seal the coupler to the base of the 2-inch PVC adapter(C). Next insert the assembly over the PVC well head (G). Use the offset screw driver or socket to tighten the rubber coupler to the well head. Be sure both fittings are airtight. As the PVC wellhead will be down inside an above ground or flush mount well protector tightening the lower hose clamp may be somewhat difficult.




NOTE: For smaller PVC wells a separate PVC Adapter Kit (MN 214039) is available. This includes adapters for nominal ½”, ¾”, 1” and 1.5” PVC casing.

NOTE: For larger diameter wells the operator will need to fabricate an adapter that has a release valve equal to or greater in diameter than the ID of the well casing. This is required to prevent interference with the release of air, noise in the data and possible bias in test results.

**STEP 4:** To perform slug tests on a 2-inch PVC well close the 1-inch relief valve (H) on the pneumatic head and leave it closed throughout testing. To pressurize the well head close the 2-inch valve (I) and proceed according to instructions in the Pneumatic Slug Test SOP to perform slug tests (Tech. Bulletin #19344). Use only the 2-inch valve to relieve air pressure in the well head to initiate the pneumatic slug tests. Open the 2-inch valve quickly to avoid interference with test initiation and noise from the air release.



# Appendix II

## Geoprobe® Slug Test Field Data Form

## Geoprobe® Slug Test Field Data Form

Site Name: ________________________________________
Well No: ________________________________________
Screen Interval: ________________________________________
Operator: ________________________________________
Date: ________________________________________
File Name(s): ________________________________________

| FileTime (sec) | $H_o$ (in/cm) | **R**ise **F**all | Notes |
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MIP/HPT/EC/OIP/CPT log filename: ________________________________________

Sample Nos. ____________________________________________________________

Aquifer Type: Unconfined Confined Leaky Confined Perched

Screen Penetration: Full Partial Aquifer Thickness______________

Geologic Formation/Soils: ________________________________________________

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