

6101

OPERATING INSTRUCTIONS

The "Slammer" Heavy Duty Waveguide Connector

December 1997



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1. YOUR NEW “SLAMMER” HEAVY-DUTY WAVEGUIDE CONNECTOR

Unpacking

Remove all packing materials and check the Slammer for any damage that may have occurred during shipment.

Not Liable for Improper Use

Soilmoisture Equipment Corp. is not responsible for any damage, actual or inferred, for misuse or improper handling of this equipment. The Model 6101 Slammer Heavy-Duty Waveguide Connector is to be used solely as directed by a prudent individual under normal conditions in the applications intended for this equipment.

2. OPERATING PRINCIPLES

The Slammer Waveguide Connector is much like any other “balanced” connector used in TDR. The objective of a connector, like the Model 6101, is to provide a low impedance pathway for the stepped electromagnetic TDR pulses generated by Trase. The 50 Ohm high frequency path within the connector delivers maximum power to Waveguides that may be inserted into the soil or other material being measured. Figure 2.1 shows the Model 6101 Slammer with the Connector Cable attached to Trase. The “x” and “y” regions are noted for reference to Figure 2.2.

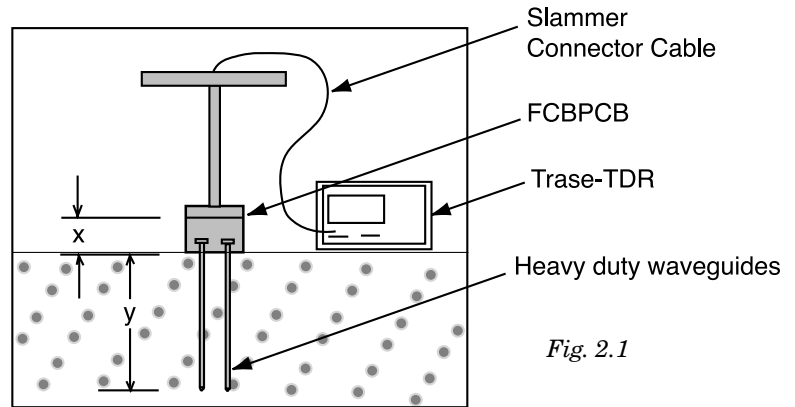


Fig. 2.1

A 50 Ohm broadband electromagnetic pulse enters the Field Connector Printed Circuit Board (FCPCB). A small patented capacitive mismatch is purposefully developed in the waveform (see figure 3.2). The horizontal line entering Figure 2.2 is at 50 Ohm, but sharply dips to values less than 50 Ohm as the TDR pulse passes the FCPCB. This descending feature denotes a notch that indicates the beginning of the waveform travel along the Waveguides. Since the upper portion or first 1-1/2" of the metallic Waveguides are housed in a low dielectric (high impedance) plastic material, the waveform shows an ascending feature as the impedance exceeds the 50 Ohm level. This region is shown as the “x” region in both figures 2.1 and 2.2. As the electromagnetic energy continues past the plastic Bottom Cap, it enters a region of different dielectric value. In this example we have illustrated a waveform as it enters a typically wet soil. Wet soils have high dielectric (low impedance) properties. The “y” region is illustrated in both Figures 2.1 and 2.2. The waveform continues to dip downward as the electromagnetic pulse encounters impedance levels less than 50 Ohm. The electromagnetic pulse “reflects” back to the Trase pulser-analyzer as it travels to the end of the Waveguides (Figure 2.2). The end point reflection terminates the “y” region.

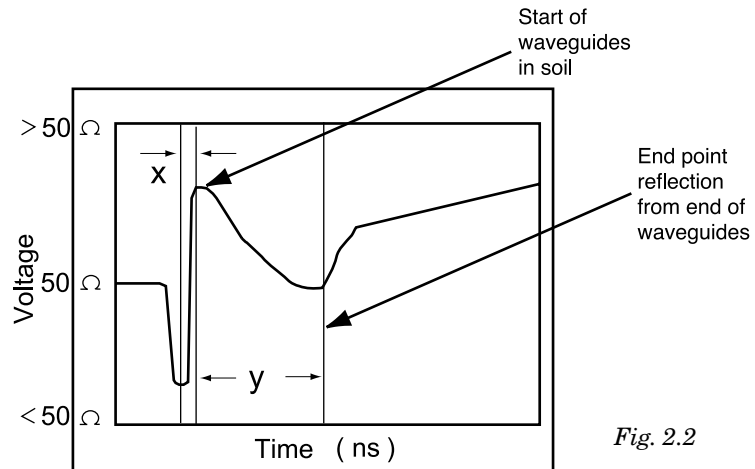


Fig. 2.2

The Soilmoisture Equipment Corp. Trase System - TDR has patented firmware that analyzes the waveform described in Figure 2.2. The “x” region is subtracted from the overall travel time (measured in nanoseconds) to obtain the electromagnetic pulse traveling down the Waveguides in the material to be measured (“y”). While travel time (dT) is the measured value by Trase System, this value is then used to calculate the Apparent Dielectric Constant as shown below.

$$K_a = \left[\frac{dT \cdot C}{L} \right]^2$$

Where, dt = difference in Time (ns)
 C = speed of light (30 cm/ns)
 L = length of waveguide (cm)
 Ka = the apparent dielectric of air-water-soil complex

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3. ACQUAINT YOURSELF WITH THE PARTS

Top Handle Assembly

The top of the Handle Assembly contains the recessed Male BNC Connector for attachment to the Slammer Connector Cable. The cushioned Handle Grips provide a convenient holding surface for hard “push” insertions, “lift” for removals, or “steady” guidance when using the sliding Hammer. Welded stainless steel construction provides optimum strength and durability for long term use (See Figure 3.1).

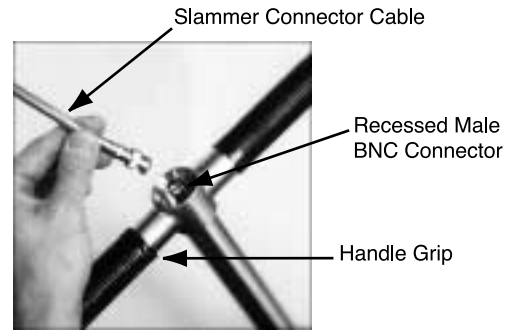


Fig. 3.1

Hammer

The simple but effective 3.88 lb. Hammer can be of immense help when working in hard or dry soils. Slide the Hammer up and down the stem of the Handle Assembly and strike blows against the Hammer Plate to “drive” the Waveguides into the soil. The Hammer may be semi-permanently attached to the stem using the two Spring Pins supplied with the Hammer (see Figure 3.2). This option is handy when hard or dry soils are frequently encountered. Use the Hammer without Spring Pins when the sliding Hammer is needed only occasionally. Simply remove the Spring Pins with a Pin Punch, 3/16" (see Accessories List, page 15). Remove the Hammer from Handle Assembly stem (Refer to Figure 3.2).

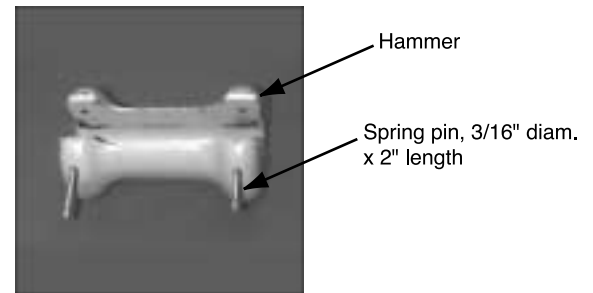


Fig. 3.2

Lower Handle Assembly

Figure 3.3 shows the lower Handle Assembly of the Slammer. Here you can see the Hammer Plate bolted to the top of the welded “Top Cap” portion of the Handle Assembly. Removing the Hammer Plate will reveal 4 screws that allow disassembly of the Slammer and the ability to change Waveguides. Once the Bottom Cap has been removed, you may insert new Waveguides and reassemble in reverse order (see Figure 3.4).

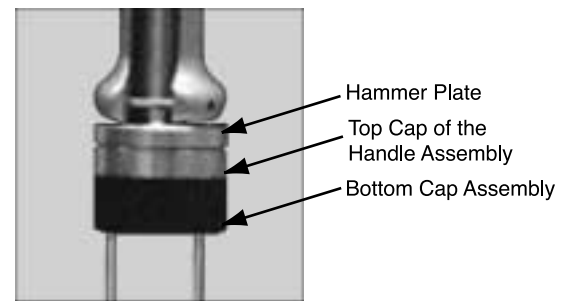


Fig. 3.3

(Note: Figure 3.4 is shown completely disassembled to illustrate all components.)

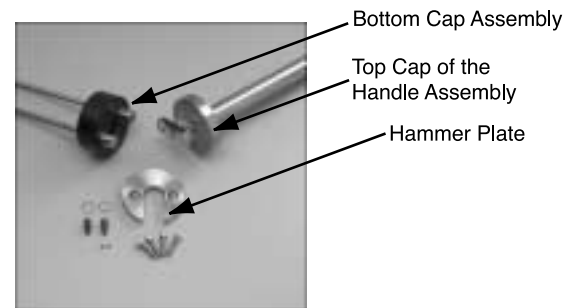


Fig. 3.4

4. REQUIREMENTS PRIOR TO USE

Removal or Attachment of the Hammer

The Hammer (see Figure 4.1) is a 3.88 lb iron casting used to aid the insertion of the Slammer Waveguides into difficult soils or materials. In many applications the user may find the Hammer more of a nuisance than a help. If this is the case, simply use a Ball Peen Hammer and the 3/16" Pin Punch to drive the Spring Pins from the Hammer end holes. After the two Spring Pins are removed from the end holes, the Hammer will slip free of the Handle Assembly stem for storage with the Spring Pins for later use.

Installing the Hammer is just as easy. Place the Hammer fully against the stem of the Hammer Assembly, twisting the Hammer to present the Hammer end holes. Align the Spring Pins in their end holes and, with gentle taps from the Ball Peen Hammer, "start" the pins (see Figure 4.2). With continuing gentle taps from the Ball Peen Hammer, completely insert the Spring Pins until they are flush with the end holes. You may want to finish the job using the Pin Punch to fully recess the Spring Pins. If the Hammer Plate has been removed, do not forget to REINSTALL the HAMMER PLATE prior to using the Hammer. Failure to protect the Top Cap of the Handle Assembly will damage the Slammer.

Installing the Waveguides

If a set of Waveguides is not already installed, then it will be necessary to remove the Hammer Plate. This is done by inserting the 3/16" Allen Wrench into the Socket Head Screws. Remove the screws holding the Hammer Plate to the Top Cap, and simply remove the Hammer Plate (see Figure 4.3).

Next you will need to remove the Bottom Cap from the Top Cap by unscrewing 4 ea. 1-1/8" long Socket Head Bolts using the same 3/16" Allen Wrench (see Figure 4.4).

Carefully remove the Bottom Cap. This will reveal the sensitive Field Connector Printed Circuit Board assembly (FCPCP) that is attached to the Top Cap (see Figures 4.5 and 4.6).

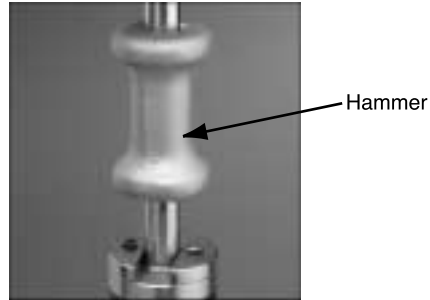


Fig. 4.1

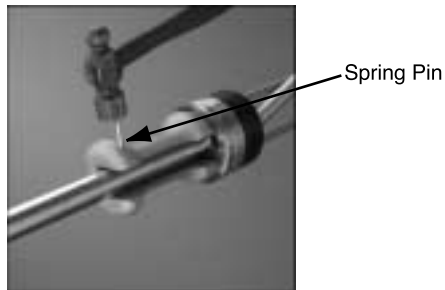


Fig. 4.2

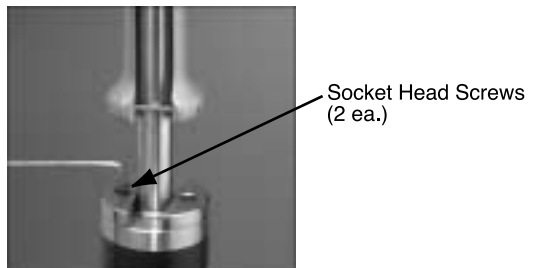


Fig. 4.3

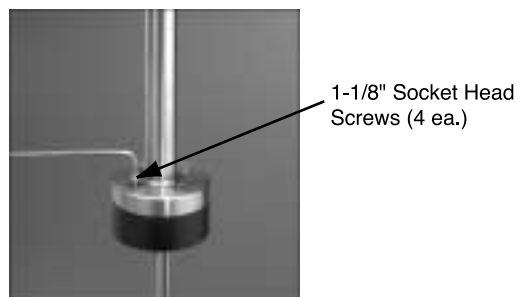


Fig. 4.4

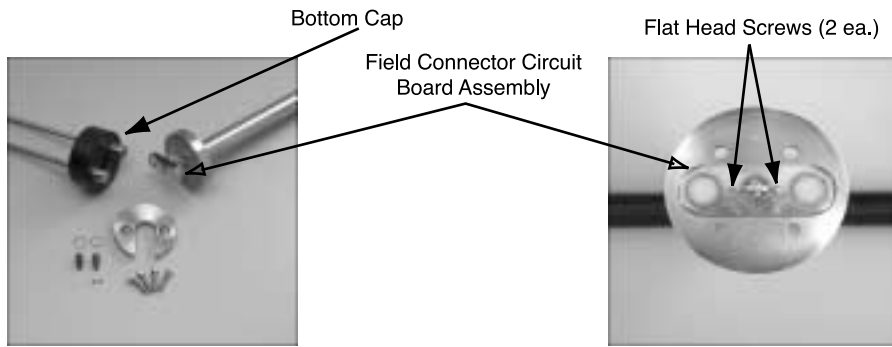


Fig. 4.5

Fig. 4.6

CAUTION: Improper handling will damage the FCPCB. When changing Waveguides, lay the Handle Assembly on its side and protect the circuit board from damage (as shown in Figure 4.5). Do not stand the Handle Assembly on the circuit board.

Figure 4.5 shows the FCPCB disassembled from the Top Cap. This procedure is only necessary when changing the FCPCB. Figure 4.6 shows the FCPCB as it is normally attached to the Top Cap with two flat head screws.

To install new Waveguides or exchange Waveguides, simply slip the O-Ring (M802X012) over the tip of each Waveguide and insert both Waveguides through the two large recessed holes in the Bottom Cap (see Figures 4.7 and 4.8).

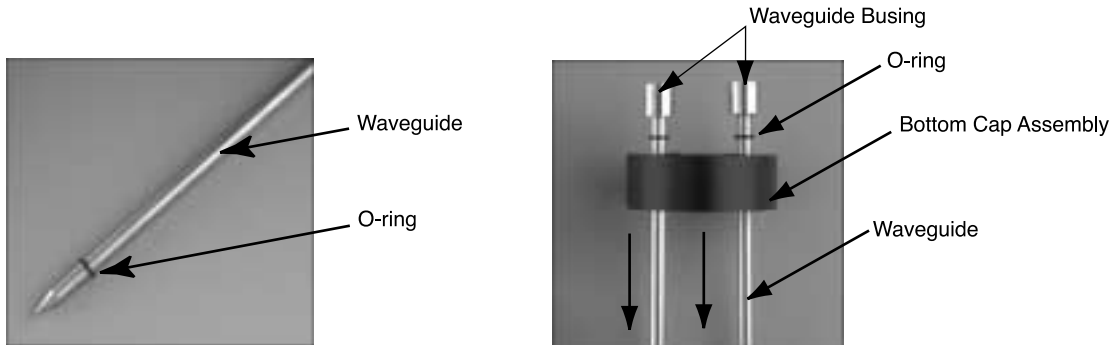


Fig. 4.7

Fig. 4.8

Prior to rebolting the Top and Bottom Caps together, **it is extremely important to install the Wave Washers on top of each Waveguide Bushing** (see Figure 4.9). Each Waveguide Bushing has a tooled shoulder for the Wave Washer to seat. Without these washers, good electrical contact is not assured. Check the Bottom Cap O-rings. Make sure the large outer O-ring and 4 smaller bolt O-rings are in place (see Figure 4.9). These O-rings, together with the Waveguide O-rings, provide a seal against dust and water intrusion that may damage the Field Connector.

Once the O-rings and Wave Washers are installed correctly, reassemble the Slammer using the reverse order used to disassemble the unit. Insert the 4 ea. 1-1/8" long Socket Head Bolts and tighten these bolts gently, using your fingers. Be very careful not to strip the threads in the Bottom Cap Assembly. Once you are assured that the bolts are threading easily, then the 3/16" Allen Wrench may be used to completely tighten these bolts. Use good procedure. Do not firmly tighten one bolt before proceeding to the next. This may pinch the O-ring and provide a bad seal. Tighten all bolts uniformly, and screw together the

black plastic Bottom Cap to the welded stainless Top Cap of the Handle Assembly (see Figure 4.10). Screw the two sections together tightly to assure proper O-ring seating and sealing.

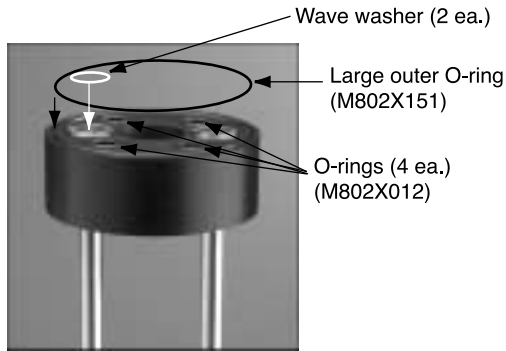


Fig. 4.9

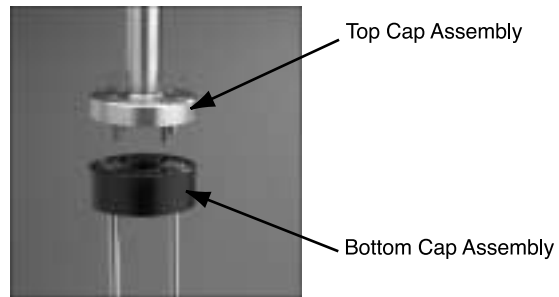


Fig. 4.10

5. CONFIGURING TRASE FOR USE WITH THE SLAMMER

For Trase Systems Using Firmware Versions through the 2000 Series

If you are using an older Trase system, you cannot take full advantage of the Slammer Heavyduty Waveguide Connector as the firmware (software inside Trase) does not support this new Waveguide Connector. However, the captured waveform may be analyzed using WinTrase™ software also offered by Soilmoisture Equipment Corp. We suggest, however, that the proper firmware be used to capture the waveforms and analyze these for moisture content. For older Trase System TDR units, please notify your sales representative of your Trase System serial number and firmware version, and request the firmware version that supports the Slammer.

For Trase Systems Using 2100 Series Firmware Setting Up Your Trase System

You'll want to start up your Trase system in the normal mode, scroll to the MEASURE SCREEN (see Figure 5.1).

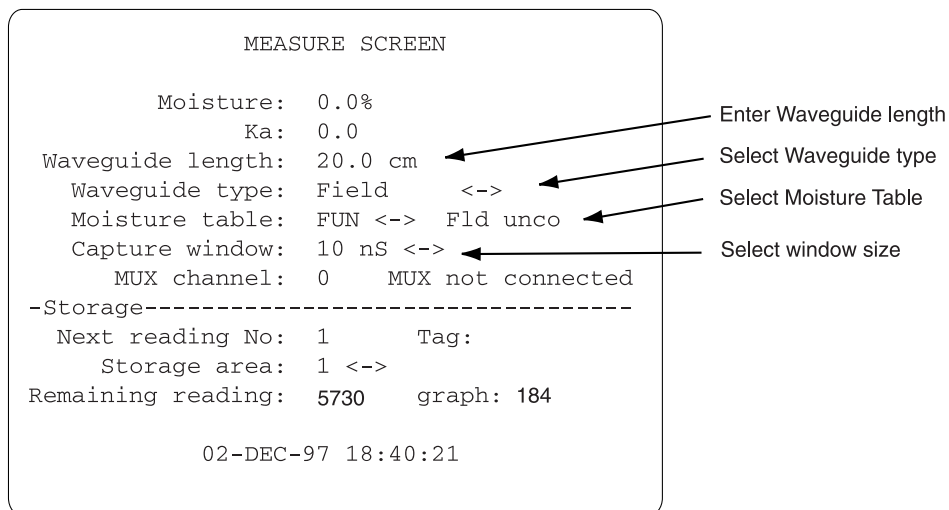


Fig. 5.1


Move the cursor to Waveguide length and enter the length that corresponds to the waveguides you will be using; the Slammer uses 20, 30, 40, 50, or 60 cm Waveguides. Next, move the cursor to Waveguide Type; use the up/down arrow to scroll to Field. Then move the cursor to Moisture Table; use the up/down arrow to scroll to FUN (Fld Unco-Field Connector, Uncoated Waveguide) or FCT (Fld Coated-Field Connector, Coated Waveguide).

Finally, scroll to the Capture window and select a window size. A choice of three window lengths are available: 10, 20, and 40 nS. The 10 nS length is set at the factory since this gives the greatest resolution when working with Waveguides of 20 or 30 cm lengths. When using longer (40-60 cm) Waveguides, you must select the 20 nS window. The 40 nS Capture size is used for saturated soils or unusual conditions.

6. OPERATING THE SLAMMER HEAVYDUTY FIELD WAVEGUIDE

Zero Set

Attach the Slammer Connector Cable to your Trase unit and to the Slammer (see Figure 6.1). Unlike our standard connector-type waveguide, the waveguides **MUST** be inserted in the Slammer during the zero setting process. With

the waveguides in air, press the  key.

The process takes a number of seconds and during this time the message, "Setting the Zero, wait.." will be displayed in the top left hand corner of the screen. When the process is complete, the message "Zero set" is displayed. During the zero setting process, the "time" display is not updated. However, the correct time will again be displayed when the process is complete.

Note

If for any reason you need to change the configuration of your Slammer setup, either changing cables, resetting the Capture Window Size, etc. you **MUST** zero set the system again.

Insertion

The Slammer was designed for rough use in agricultural environments where the soils vary in texture, structure, hardness, or moisture content. In moist soils, Waveguides up to 40 cm may be pushed into the soil without much difficulty. Most or all of the insertion may be achieved in one or two pushes. **It is important to apply the "pushing" force directly over and vertical to the Waveguides**, as all of this force is translated to the Waveguides. (see Figures 6.1 and 6.2).

Using the Hammer Correctly

If rapid insertion is not permitted by the soil, then it is best to use the sliding Hammer to aid in the insertion process. Move the Hammer up and down the Handle Stem to "drive" the Waveguides into the soil. (See Figure 6.3). In the toughest situations, we have found it most effective to almost sit on the T-handle while using the sliding Hammer. The Hammer Plate must be attached to the



Fig. 6.1

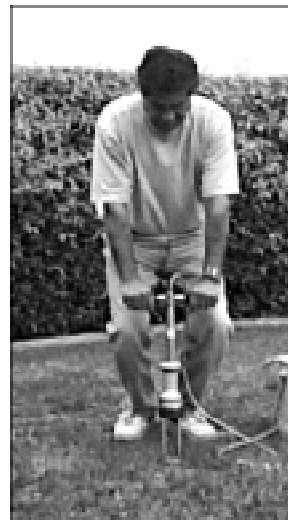


Fig. 6.2

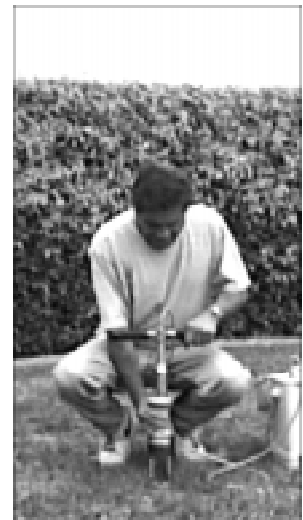


Fig. 6.3

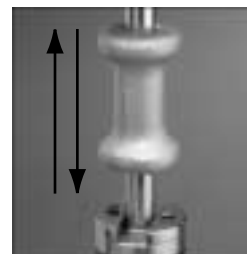



Fig. 6.4



Fig. 6.5

Top Cap of the Handle Assembly to prevent damage to the welded Handle Assembly. Make sure to grasp the Hammer tightly with **all** your fingers to prevent a finger being smashed under the Hammer's blow (see Figure 6.4).

Making a Measurement

Push the  key on the Trase front panel. Once Trase has completed the measurement cycle, you may want to save the reading or reading and graph by pushing the appropriate front panel keys.

7. HELPFUL HINTS

Pushing at an angle more or less than vertical causes additional friction and difficulty with insertion.

Prevent air gaps between the Waveguides and the soil. As with any measurement of soil moisture content using the TDR method, air gaps should be avoided. The TDR method will effectively average the error introduced by air gaps and return a moisture content that will be less than the undisturbed value. Use the sliding Hammer to reduce errors due to air gaps.

Make sure that the Waveguides are fully inserted in the soil without air gaps between the bottom cap and the soil.

Use the sliding Hammer to assist in removing the Waveguides from the soil. A couple of upward taps of the sliding Hammer against the T-handle will greatly aid the removal of the Waveguides from the soil.

8. PRECAUTIONS

Avoid over insertion from too many sliding Hammer impacts. Over insertion can cause soil compaction.

Do not use a hammer or mallet, other than the sliding Hammer, with the Slammer. While the Slammer is rugged, it was not designed to withstand hammer impacts other than with the Sliding Hammer.

We have designed the top of the T-handle to protect the BNC Connector. However, direct impacts to the BNC Connector will damage it.

9. TROUBLESHOOTING YOUR SLAMMER

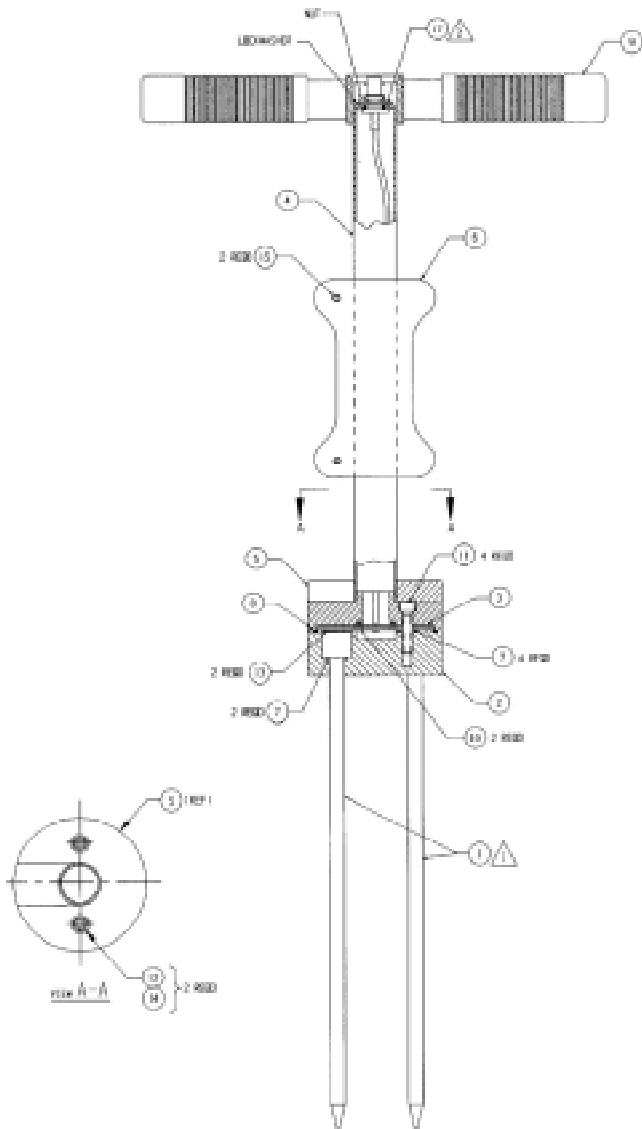
The most common reason for getting the error message, “Time Measurement Failure” is improper selection of the capture window size. A measurement can only be made if the entire “Transit time” lies within the Capture window. We suggest that you start over from the beginning, by carefully resetting all the parameters in the Measure Screen. Then zero set your Trase and make another measurement.

If you still receive the error message, “Time Measurement Failure”, Trase has an additional feature that will invoke a special filtering waveform analysis routine. Instead of pressing the Measure button, press the **SHIFT** key and then the **MEASURE** key. This special analysis routine does take much longer (up to 2 minutes additional computation time) to complete a measurement. Note that the clock will update itself every six seconds and the message “filtering” will appear on the screen during the computation process.

10. GENERAL CARE AND MAINTENANCE

Remember, soil is a corrosive environment. While we have used the best quality stainless steel construction for the Slammer, it remains the best practice to clean the Slammer after each use. A couple of minutes of preventative maintenance will provide years of service from the Slammer. Use warm soapy water to clean plant and soil debris from the Slammer.

11. SPARE PARTS AND ACCESSORIES



Spare Parts

Item	Part No.	Description
1	6009L#	Heavy Duty Waveguides (2 ea.)
2	6101-0000-01	Bottom Cap
3	6101-1000	Field Connector Circuit Board Assembly
4	6101-2000	Handle Assembly
5	6101-2000-05	Hammer Plate
6	6101-2000-06	Hammer
7	M802X012	O-ring (3/8" I.D. x 1/16" wall) (2 ea.)
8	M802X151	O-ring (2.96" I.D. x 0.10" wall)
9	MZL025	Handle Grip (2 ea.)
10	Q0440CAQ04	Screw, Flat head., 4"-40 x 1/4" (2 ea.)
11	Q2420CAF18	Screw, soc.hd. cap, 1/4"-20 x 1 1/8" (4 ea.)
12	Q2420SBM10	Screw, soc.hd. cap, 1/4"-20 x 5/8", self-locking (2 ea.)
13	RW100BAM	Wave Washer, copper (2 ea.)
14	RW040CAL	Lockwasher, 1/4"
15	MSL014-007	Spring Pin, (2 ea.) 3/16" dia. x 2" long
16	6101-3000	Slammer Connector Cable
17	M802X013	O-ring (7/16" I.D. x 1/16" wall)(4 ea.)

Accessories

Part No.	Description
6009L20	Heavyduty Waveguides, 20 cm (2 each)
6009L30	Heavyduty Waveguides, 30 cm (2 each)
6009L40	Heavyduty Waveguides, 40 cm (2 each)
6009L50	Heavyduty Waveguides, 50 cm (2 each)
6009L60	Heavyduty Waveguides, 60 cm (2 each)
6101-4000	Alignment Block
MSL045	Pin Punch, 3/16"
MSL046	Ball Allen Wrench, 3/16"





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