



CMT Multilevel System Assembly Manual



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CMT Multilevel System Pre-installation Requirements

Please complete this form to verify that proper consideration has been given to design and borehole specifications for each CMT Multilevel System to be installed. (CMT tubing 1.7" OD, Guide Point Port 1.75" OD, Guide Point Port with Anchor 3.75" OD).

1/ Minimum information required for effective design of the CMT Multilevel System:

Accurate borehole depth _____ Borehole Angle _____

Depth to which CMT System is to be installed _____

Borehole geology _____

Drilling Method _____

Casing size (minimum ID) _____

Depth to base of well casing _____

Number of Monitoring Zones _____

Approximate Depth to Static Water Level _____

Expected Maximum Pressure Heads at each Port location _____

Site Conditions (eg. dry field, bush, swamp, paved, etc.) _____

Any special surface requirements for completion of installation (eg. flush mounted, angled, etc) _____

Solinst can assist the client in the design and component selection for the CMT Multilevel System based on the above requested information, but final design and installation details remain the responsibility of the purchaser.

2/ Ensure that these additional items are available on site during installation:

- CMT Installation Toolkit (as shown at right)
- Measuring tape
- Hacksaw
- Marking pen or wax pencil
- Model 103 Tag line for checking backfill depths
- Model 101M or 102 Water Level Meters
- At least two client representatives to supervise and assist with installation. Solinst can provide a technician to assist with the installation upon request.
- Support stand (if purchased separately)
- Adjustable wrench





Tip: Practice making one or two ports in a short section of CMT before starting out on the real thing.

Introduction

The Solinst Model 403 CMT Multilevel monitoring well system represents a revolution in multilevel groundwater monitoring. The CMT System provides the simplicity of a bundle type installation with the benefits of backfilling or sealing around a single tube.

This manual describes the above-ground assembly of CMT wells. This consists of creating intake ports in the various channels at the desired depths, installing water-tight plugs below each intake port, adding mesh screens, sealing the bottom of the tubing, and attaching low-profile borehole centralizers to the tubing. For installations in bedrock or cased 2" wells, inflatable packers can be attached to the CMT tubing to seal the borehole between the various intake ports.

Assembling CMT wells is straightforward and can be performed by either drilling contractors or environmental consultants. The wells can be assembled on site after the borehole is being drilled or off site and then transported to the job location. While the assembly of CMT wells is not difficult, it is important to follow all of the steps described in this manual. It is especially important when creating the monitoring ports to avoid cutting into one of the adjacent channels. Doing so creates a hydraulic connection between the two channels that cannot be repaired. Please read this manual carefully before assembling your first CMT well. In addition we suggest that you practice making one or two ports in a short section of CMT tubing before starting out on the real thing.

Preparation

Before making any ports in the CMT tubing, make a sketch of the desired well design. Show the depths of the desired monitoring zones and centralizers (if used) in feet/meters below ground surface. Also, show the depths of the desired lifts of sand and bentonite graphically on the figure. This will come in handy when you are measuring the depths of the backfill materials when you are building the well. If you are building a CMT well where alternating layers of sand and bentonite backfill are added from the surface, try to allow for two feet or more of sand above and below the monitoring ports to ensure that the bentonite does not cover the monitoring ports.

Remember to allow sufficient wellhead access when you install the protective cover over the well. Plan on using a large well cover (greater than 4" diameter is recommended) to allow plenty of room to access the wellhead. A diagram showing suggested dimensions of the wellhead and protective cover is shown in Figure 1 for flushmount and above ground completions.

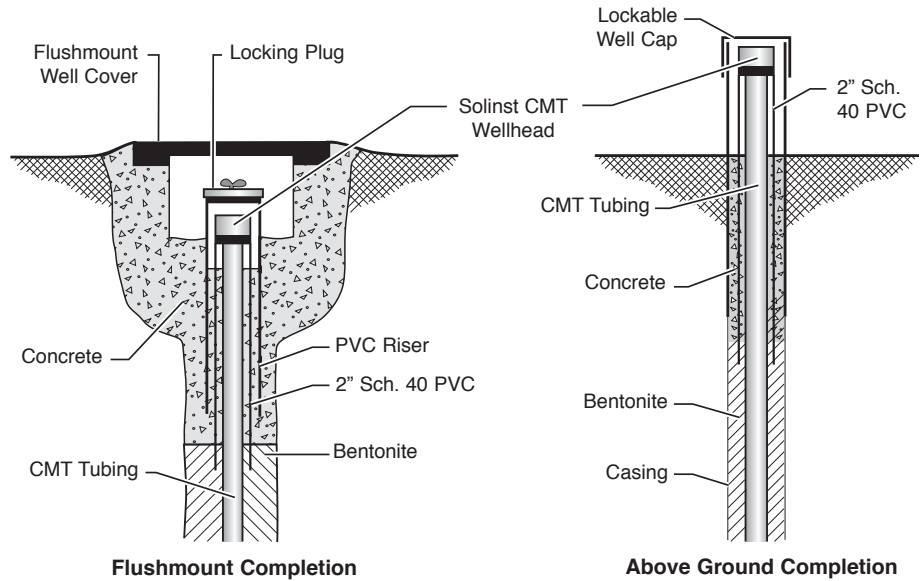


Figure 1

Example 1: Assembling Standard CMT Multilevel Systems

Table 1 shows the design of a hypothetical CMT Multilevel System designated well "ML-1." Each channel in this well can be used for both collecting a groundwater sample (with either a peristaltic pump, inertial pump or micro double valve pump) and measuring the depth to water. Each channel therefore functions both as a sampling port and an observation port.

Table 1
Hypothetical Design for a Standard CMT Well (Well ML-1)

Example

Monitored Zone	Channel Number	Depth to Center of Port (from ground surface)
1	1	23
2	2	34
3	3	48
4	4	55
5	5	69
6	6	77
7	7	92



Note: Newly uncoiled CMT tubing has a memory which can make it difficult to lay out straight. Sand bags help to hold down the ends of the tubing. The "memory" goes away relatively quickly, especially in warm weather. Placing the tubing on black plastic sheeting can warm the tubing, helping it straighten out more quickly.



Note: The channel identifier on the CMT tubing is intentionally subtle to avoid being a conduit for vertical leakage.



Note: The Channel 1 identifier is a low profile repetitive marking "<< CMT >>".

Marking the CMT Tubing with the Locations of the Monitoring Ports and Cutting the Tubing to the Proper Length

Uncoil the CMT tubing on the ground or other flat surface. Stretch out a measuring tape at least as long as the depth of the well, next to the CMT tubing.

Allowing for your desired wellhead stick up (2-3 feet above ground surface), place the end of the measuring tape below the length of tubing you want above ground. This is your measuring point which represents ground surface and all depths below this point use depths below ground surface.

3) The next step is to make marks on the CMT tubing at the depths corresponding to the midpoint of the desired monitoring ports. Before you do this, you will note that there is a faint channel identifier, a low profile repetitive marking "<< CMT >>" that runs along the entire length of the CMT tubing opposite one of the outer channels. This channel identifier facilitates identification of the various internal channels anywhere along the length of the tubing. The channel that has the identifier is always Channel 1. By convention, Channel 1 corresponds to the shallowest monitoring zone. The other five outer channels are numbered clockwise from 2 through 6 as you are looking down on the completed well from above. The center channel is Channel 7 and is always the deepest monitoring zone.

4) Make a mark across Channel 1 on the exterior of the CMT tubing at the depth corresponding to the center of the uppermost monitored port (23 feet below ground surface in our hypothetical example; Figure 2). A permanent marker or a "China marker" wax pencil works well for this. Write "Port 1" on the CMT tubing about 6 inches above the mark.



Figure 2

5) Next, draw a line along the Channel 1 identifier (i.e., parallel with the tubing) extending approximately 6" above and 6" below the depth mark (Figure 3). You will use this line (and other similar lines drawn at the other port depths) to index the Port Cutting Guide. This ensures that you cut holes only in the intended channels corresponding to the desired monitoring zones (as shown in Table 1).



Figure 3

6) Make similar marks at the depths corresponding to the next five monitoring zones (i.e., 34, 48, 55, 69, and 77 feet below ground surface). Make the marks identical to the ones you drew at Port 1. That is, draw the depth mark across Channel 1 and draw the longitudinal line along the Channel 1 identifier. The Port Cutting Guide has been indexed so that it always references the Channel 1 identifier when it is used to cut holes in the five other outer channels. Label these depth marks as Port 2, Port 3, etc..... about 6 inches above each mark. Finally, make a mark at the depth of the deepest monitoring port (i.e., the internal channel, Port 7), which is also the bottom of the well, at 92 feet. Cut the CMT tubing at this mark using a hacksaw, sharp knife, or PVC cutter.



Figure 4

7) The design of the well has now been transferred to the CMT tubing.

Cutting the Outer Ports and Vent Holes

8) Slide the Port Cutting Guide over the CMT tubing down to Port 1. Align the notch stamped "1" on the Port Cutting Guide with the line you drew along the Channel 1 identifier. Position the Port Cutting Guide so that the depth mark "+" (indicating the centre of the Port) is visible in the window in the center of the Port Cutting Guide (Figure 5). Secure the Port Cutting Guide to the CMT tubing by tightening the knurled Locking Bolts on the underside of the guide (Figure 6). Tighten the bolts, **by hand only**, to prevent the Port Cutting Guide from moving.



Note: When using the Port Cutting Guide, ensure that the cutting bolts are located below the number 1 on the front of the Guide. The locking bolts go below the number 4 on the back of the Port Cutting Guide.



Figure 5



Figure 6

9) Next, cut three holes, as described below into Channel 1 using the cutting bolts screwed into the Port Cutting Guide.

Start by threading a cutting bolt into one of the holes located on the same side as the window. Use the hex wrench to tighten the Cutting Bolt. Tighten the bolt a few revolutions, then loosen it one revolution. Continue doing this until the Cutting Bolt "bottoms out" (Figure 7). Remove the Cutting Bolt. There should be a plastic disk inside of the cutting bolt. If there isn't, re-insert the cutting bolt and repeat the cutting process (make sure that the knurled Locking Bolts are tight). Push out the piece of plastic from the inside of the Cutting Bolt by inserting an Allen wrench through the small hole drilled in the head of the Cutting Bolt (Figure 8). Repeat this process to cut all three holes. The two upper holes will provide the port plug access and the lowest hole is the vent hole (Figure 9).



Figure 7



Figure 8



Figure 9



Note: The two upper holes allow you to use snips to cut

away a panel of plastic between the two holes, creating a 3-inch-long port in Channel 1. The bottom hole is a vent hole. A vent hole is needed to allow air to escape from the channel beneath the monitoring port when the CMT tubing is inserted into the water-filled borehole during well installation.



Note: The vent hole does not allow cross connection with

other monitoring zones because the bottom of the channel is sealed with a water-tight plug.

10) Loosen the cutting tool and move it “down” the CMT and out of the way. Next, use the snips as shown in Figure 10 to cut out the panel of plastic between the upper two port holes. **Do this carefully and keep the snips parallel to the channel side wall to avoid cutting into the walls separating Channel 1 from Channels 2 and 6.** Make the opening as large as possible to facilitate the insertion of the expansion plug as described in the next step.



Figure 10

11) Insert an expansion plug through the opening (Figure 11) so that it seals Channel 1 below the monitoring port and above the vent hole. If necessary, use the torque driver to gently push the plug into place (Figure 12). Use the snips to trim the port opening if you have difficulty inserting the plug. Tighten the plug to a torque of 10 inch-pounds using the supplied torque driver.



Figure 11



Figure 12

12) The last step in making the Channel 1 port consists of wrapping the stainless steel mesh around the port, forming a well screen over the opening. Center the mesh over the port opening and wrap it tightly around the CMT tubing (Figure 13). Use the low profile Oetiker clamps and pliers to firmly secure the mesh to the tubing. Use two clamps for each monitoring port (Figure 14). Construction of Port 1 is now finished. You are now ready to make Port number 2.



Figure 13



Figure 14



Note: To avoid installing ports in the wrong channels start by positioning the Port Cutting Guide so that the depth mark is visible in the window, then rotate the guide so that the appropriate number (corresponding to the port number) is indexed against the line you drew earlier along the longitudinal Channel 1 identifier. This step is very important



Note: At some sites, you may decide that it is not necessary to monitor every channel. In that case, only cut ports in the desired channels.

When constructing the bottom assembly, only insert the expandable plugs into the monitored channels, leaving the other channels open so that they can fill with water as the CMT tubing is inserted into the borehole (e.g. If only three channels are monitored, only those channels should have plugs inserted at the base.) This reduces buoyancy during well installation.

13) Slide the Port Cutting Guide down to Port 2. Position the Port Cutting Guide exactly as you did for Port 1. The depth mark should be visible in the window of the Port Cutting Guide and the longitudinal Channel 1 identifier should be indexed to the number "1" stamped on the guide (Figure 15). Now, rotate the Port Cutting Guide (without moving its position along the CMT tubing) so that the longitudinal line is now indexed to the number "2" stamped on the guide (Figure 16). This positions the Port Cutting Guide so that the cutting bolts will cut holes only into Channel 2. Secure the Port Cutting Guide using the knurled Locking Bolts as before. Cut the two port holes and one vent hole into Channel 2. Next, loosen the cutting tool and slide it down the tubing out of the way.



Figure 15



Figure 16

14) Snip away the panel of plastic between the upper two holes, creating an opening for Port 2.

15) Next, insert an expansion plug through the opening, positioning it below the monitoring port, and tighten it to 10 inch-pounds as before. Finally, wrap a piece of stainless steel mesh around the opening and secure it with two stainless steel clamps. You have now finished constructing Port 2.

16) Continue the steps described above for Ports 3 through 6.

Configuring the Bottom of the CMT Tubing (Zone 7)

17) Insert an expansion plug into each of the six channels. (Figure 17) Tighten each to a torque of 10 inch-pounds using the torque driver.

18) Slide the Guide Point Port Assembly (Figure 18) over the end of the CMT tubing and secure it to the tubing with two stainless steel clamps (Figure 19). The end of the Guide Point Port Assembly is tapered to prevent the bottom of the CMT tubing from getting snagged on a rock ledge or casing joints as it is being inserted into a borehole.



Figure 17



Figure 18



Figure 19

19) If desired, an anchor (3.75" diameter) can be attached to the Guide Point Port using a hex bolt (Figure 20). An anchor is used during installations where it is helpful to secure the bottom of the CMT to keep it from moving during well construction. Once the tubing has been inserted, use sand placed on top of the anchor to secure the well. This will prevent it from being pulled up as drive casing or augers are withdrawn from the borehole. Holes have been drilled in the anchor to allow water in the borehole to pass through the anchor when the CMT well is inserted.



Figure 20



Note: Solinst has developed special tubing centralizers that ensure that the tubing is centered in the borehole during well construction. The fins on the centralizers are low-profile to prevent them from obstructing the tremie tube, or sand and bentonite pellets poured from the surface.

Attaching Tubing Centralizers

20) Place the centralizers over the CMT tubing at the desired depths. Centralizers are generally placed along the CMT tubing at intervals ranging from every 5 to every 15 feet. Attach the centralizers securely to the CMT tubing using two stainless steel clamps (Figure 21).

The CMT well is now ready to be inserted into the borehole.



Figure 21



Note: The Solinst Tag Line, (Model 103), is recommended for accurate sand and bentonite placement.



Note: On the underside of the wellhead is a groove to fit 2" dia. PVC riser pipe.



Figure 22

CMT Placement

21) Lower the assembled CMT System into the borehole slowly.

If buoyancy is a problem, wait, as the channels below water level will slowly fill and allow the system to be lowered further. To speed this process along, pour or pump clean water into the vent holes.

When the required depth is reached, suspend the system with the System Support Clamp to prevent it from moving during well construction (Figure 22).

22) Complete the installation by carefully pouring or using a tremie to place sand and bentonite at appropriate levels to seal the borehole annulus

Attaching the Standard Wellhead (after the well has been installed)

23) After the well has been built, cut the CMT tubing to the final elevation. You may choose to finish your CMT installation off above ground surface. If so, you can leave the CMT stick-up as is and install the standard wellhead or "house" the CMT inside a cut length of 2" dia. PVC riser pipe (not supplied). On the underside of the wellhead cap is a groove which is designed to allow a 2" dia PVC riser pipe to "key" into the wellhead. Locate Channel 1 and slide the Standard Wellhead over the tubing (Figure 22). Remember, Channel 1 has the identifier on the outside of the tubing. Secure the wellhead to the CMT tubing by tightening the hex screw on the side of the wellhead.

Optional Flow Control Monitoring Assembly

Under flowing artesian conditions or for vapor sampling, the CMT can be fitted with a special flow control monitoring assembly to allow the user to collect a sample, measure hydraulic or pneumatic pressure, and prevent uncontrolled flow from the well.



Well Completion

**Model 103
Tag Line**

The Model 103 Tagline is ideal to aid accurate placement of sand and bentonite during bor ehole completion.



**Model 403
Well Head
Seal Assembly**

For flowing conditions or vapor monitoring, Solinst offers a monitoring assembly, which applies a pressure seal to the individual CMT channel. This facilitates sampling through the well head at the surface.



Monitoring Options

Water levels and samples can be accurately obtained using the following high quality Solinst instruments:

Water Level Measurement

Model 102 Water Level Meter

A narrow coaxial cable Model 102 Water Level Meter with a 1/4 dia probe can be used to monitor water levels in any CMT Channel.



Sampling Methods

Depending on your sites depth to water and your sampling protocol, Solinst offers various sampling options.

Model 410 Peristaltic Pump

Ideal for sample retrieval from shallow water levels less than 30ft (9m).



Mini Inertial Pump

Mechanical pump used inside 1/4 LDPE tubing. Typical flow rates of 50 to 250mL/min. If your sites water level is deeper than 50ft (15m), PTFE/FEP tubing is recommended



**Model 408M 3/8" Dia. Flexible
Micro Double Valve Pump**

Small and flexible design makes this gas drive pump ideal for delivering high quality samples, in combination with the Model 466 Electronic Control Unit. Flow rates of 20 to 150mL/min make the 408M suitable for low flow sampling applications. Constructed of Stainless Steel and LDPE for lengths less than 50ft (15m) and PTFE/FEP tubing for any depths up to 200ft (60m) applications. This is the only viable option in wells with depth to water over 150 ft.



408 Accessories

**Multi-purge
Manifold**

A multi-purge manifold can be considered for purging multiple CMT channels simultaneously using 408M Micro Double Valve Pumps



**Model 466
Electronic
Control Unit**

The 408M is durable and easy to operate using the presets and fine tuning capabilities built into the Solinst Model 466 Electronic Control Unit.

