3T Installation Methods

Installation Manual

Part No. MAN -030-0004

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Issue A 2009-04-01

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1 Installation Methods

1.1 Installing In Vaults

You can install a 3T sensor in an existing seismic vault with the following procedure:

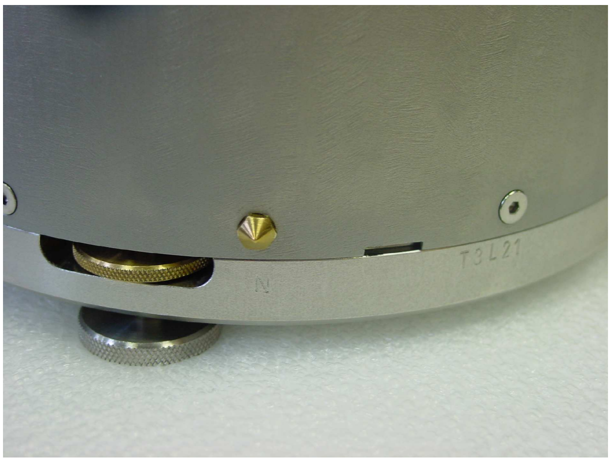
1. Unpack the sensors from their container, saving the shipping boxes for later transportation.

2. Prepare the mounting surface, which should be smooth and free of cracks. Remove any loose particles or dust, and any pieces of loose surfacing. This ensures good contact between the instrument's feet and the surface.

3. If it is not already present, inscribe an accurate North-South line on the mounting surface.

4. Place the sensor over the scribed line, so that the brass and steel pointers are aligned with the marked directions, with the brass pointer facing North. This can be done by rotating the base of the sensor whilst observing it from above. The brass pointer can be found next to one of the feet.

5. If a granite base is used it is recommended that the granite is orientated so that one edge of the granite is along the N/S direction . When the sensor is placed on the granite the pointers on the sensor can then be orientated to align with the granite so that the pointers on the sensor are N/S facing. As seen in the fourth picture in section 1.3.



If you cannot easily see the pointers, you should align the sensor using the north arrow on the handle. However, the alignment of the handle with the sensors inside is less accurate than the metal pointers, so they should be used wherever possible.

6. The top panel of the 3T includes a spirit level.

Level the sensor using each of the adjustable feet of the instrument in turn, until the bubble in the spirit level lies entirely within the inner circle. (The instrument can operate with up to 2 ° of tilt, but with reduced performance.)

The feet are mounted on screw threads. To adjust the height of a foot, turn the brass locking nut anticlockwise to loosen it, and rotate the foot so that it screws either in or out. When you are happy with the height, tighten the brass locking nut clockwise to secure the foot.

When locked, the nut should be at the *bottom* of its travel for optimal noise performance.

7. Connect a 12 V fused power supply to the breakout box.

8. Connect the data cable to a PC. Run Scream!, and check that data is being produced. Optionally, also check the mass position outputs (streams ending M8, M9 and MA.) These streams are digitized at a slower rate, and may take up to 15 minutes to appear.

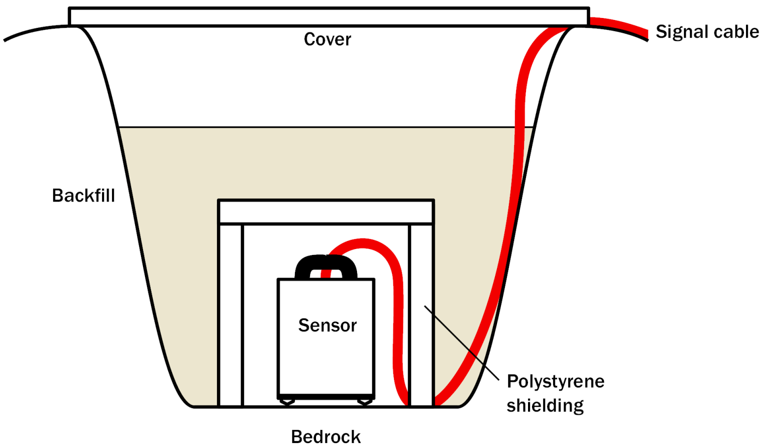
9. Cover the instrument with thermal insulation, for example, a 5 cm expanded polystyrene box. This will shield it from thermal fluctuations and convection currents in the vault. It also helps to stratify the air in the seismometer package. Position the thermal insulation carefully so that it does not touch the sensor package.

Alternatively, if GSL noise reduction enclosure is available this can be used as detailed in section 1.3.

10. Ensure that the sensor cable is loose and that it exits the seismometer enclosure at the base of the instrument. This will prevent vibrations from being inadvertently transmitted along the cable.

1.2 Installing In Pits

For outdoor installations, high-quality results can be obtained by constructing a seismic pit.



Note: GSL Noise reduction enclosures can also be used in pits.

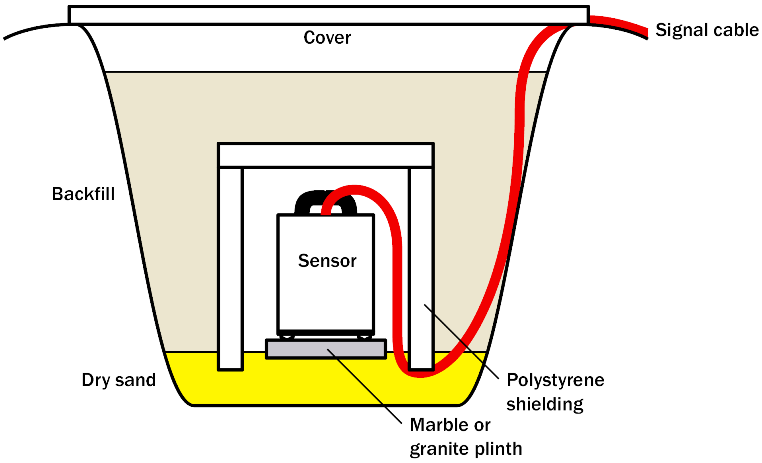
Depending on the time and resources available, this type of installation can suit all kinds of deployment, from rapid temporary installations to medium-term telemetered stations.

Ideally, the sensor should rest directly on the bedrock for maximum coupling to surface movements. However, if bedrock cannot be reached, good results can be obtained by placing the sensor on a granite pier on a bed of dry sand.

1. Prepare a hole of 60 – 90 cm depth to compacted subsoil, or down to the bedrock if possible.

2. *On granite or other hard bedrock*, use an angle grinder to plane off the bedrock at the pit bottom so that it is flat and level. Stand the instrument directly on the bedrock, and go to step 7.

3. *On soft bedrock or subsoil*, you should install a pier as depicted below.



4. Pour a layer of loose, fine sand into the pit to cover the base. The type of sand used for children's sand-pits is ideal, since the grains are clean, dry and within a small size range. On top of the sand, place a smooth, flat granite plinth around 20 cm across, and shift it to compact the sand and provide a near-level surface.

Placing a granite plinth on a sand layer increases the contact between the ground and the plinth, and improves the performance of the instrument. There is also no need to mix concrete or to wait for it to set.

5. *Alternatively,* if time allows and granite is not available, prepare a concrete mix with sand and fine grit, and pour it into the hole. Agitate ("puddle") it whilst still liquid, to allow it to flow out and form a level surface, then leave to set. Follow on from step 7.

   Puddled concrete produces a fine-textured, level floor for emplacing the seismometer. However, once set hard, the concrete does not have the best possible coupling to the subsoil or bedrock, which has some leeway to shift or settle beneath it.

6. *Alternatively,* for the most rapid installation, place loose soil over the bottom of the pit, and compact it with a flat stone. Place the seismometer on top of this stone. This method emulates that in step 3, but can be performed on-site with no additional equipment.

7. Set up the instrument as described in Section 1.1, page 3 (steps 4 to 9).

8. The instrument must now be shielded from air currents and temperature fluctuations. This is best done by covering it with a thermal shield.

   An open-sided box of 5 cm expanded polystyrene slabs is recommended. If using a seismic plinth on sand (from steps 3–4 or 5), ensure that the box is firmly placed in the sand, without touching the plinth at any point. In other installations, tape the box down to the surface to exclude draughts.

9. *Alternatively,* if a box is not available, cover the instrument with fine sand up to the top.

   The sand insulates the instrument and protects it from thermal fluctuations, as well as minimizing unwanted vibration.

10. Ensure that the sensor cable is loose and that it exits the seismometer enclosure at the base of the instrument. This will prevent vibrations from being inadvertently transmitted along the cable.

11. Cover the pit with a wooden lid, and back-fill with fresh turf.

Other installation methods

The recommended installation methods have been extensively tested in a wide range of situations. However, past practice in seismometer installation has varied widely.

Some installations introduce a layer of ceramic tiles between a rock or concrete plinth and the seismometer (left):

However, noise tests show that this method of installation is significantly inferior to the same concrete plinth with the tiles removed (right). Horizontal sensors show shifting due to moisture trapped between the concrete and tiling, whilst the vertical sensors show pings as the tile settles.

Other installations have been attempted with the instrument encased in plaster of Paris, or some other hard-setting compound (left):

Again, this method produces inferior bonding to the instrument, and moisture becomes trapped between the hard surfaces. We recommend the use of fine dry sand (right) contained in a box if necessary, which can also insulate the instrument against convection currents and temperature changes. Sand has the further advantage of being very easy to install, requiring no preparation.

Finally, many pit installations have a large space around the seismometer, covered with a wooden roof. Large air-filled cavities are susceptible to currents which produce lower-frequency vibrations, and sharp edges and corners can give rise to turbulence. We recommend that a wooden box is placed around the sensor to protect it from these currents. Once in the box, the emplacement may be backfilled with fresh turf to insulate it from vibrations at the surface, or simply roofed as before.

By following these guidelines, you will ensure that your seismic installation is ready to produce the highest quality data.

1.3 Güralp Noise Reduction Enclosure

To install the noise reducing enclosure and base the following procedure should be used.

1. Open the cardboard packaging and remove the cables, thermal covering and granite plinth.

2. The cables consist of one 20m cable to go from the CMG-3T sensor

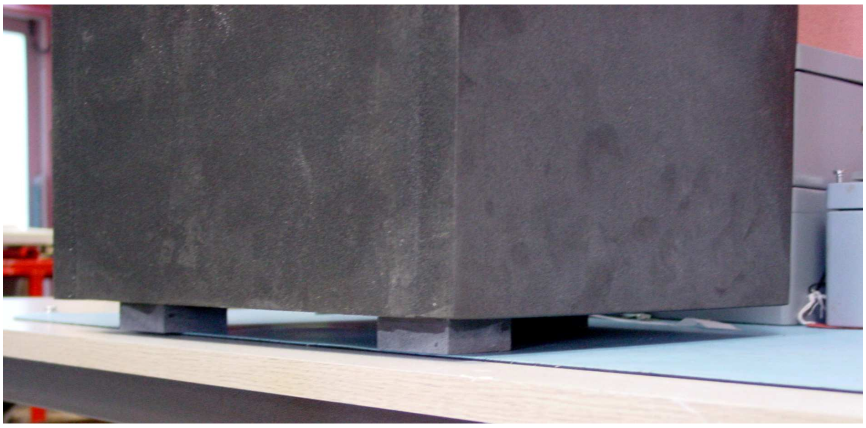
to a breakout box (supplied with sensor). A 1.5m power cable to go between the breakout box and a power supply and lastly a 5m cable to go between the breakout box and a Reftek 130 digitiser.

3. Place the granite base on firm and roughly level ground. Check the level of the base by placing on a bubble level, if the bubble is within the black circle then the sensor can be levelled easily using its feet.

4. If not, level the ground further or if the ground cannot be levelled, a layer of sand can be used as this increases the contact between the ground and the plinth, and improves the performance of the instrument. Do not put padding material under the feet as this will affect the sensors performance.

5. Fit the box over the base making sure that the box fits tightly over the granite plinth and the correct alignment noted for final fitting later.

   Note: The open end of the noise reduction enclosure has an L shaped lip so that when it is placed over the granite slab a seal is achieved.



6. Place the sensor on the granite base and connect the cable. To stop the sensor from moving around as the cable flexes the cable should have a loop at the top of the sensor with the cable ziptied to the side of the instrument.

7. Then the cable should be routed so it will easily pass though the notch in the side of the box. Ensure that the sensor cable is loose and that it exits the seismometer enclosure at the base of the instrument. This will prevent vibrations from being inadvertently transmitted along the cable. To ensure drafts of air do not pass through the slot around the cable put some cotton wool in the space as a seal.

8. Cover the pit with a wooden lid, and back-fill with fresh turf.

2 Revision history

2009-04-01	A	New document