INNOVATIVE MONITORING EQUIPMENT FOR PROFESSIONALS

Manual PROFOUND PDA-USB Conditioner

Part III - Mounting of PDA-transducers and junction box

Version 2.20



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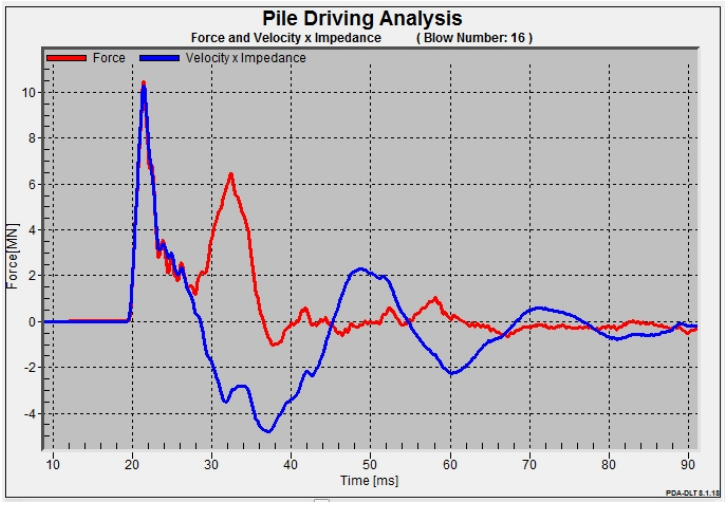
A) **Transducer mounting methods**
B) **Mounting the transducers on a concrete pile**
C) **Mounting the PDA-junction box**
D) **Mounting the transducers on a steel pile**
E) **Removing the transducers**

A) Transducer mounting methods

The PDA/DLT transducers need to be mounted at a distance of minimal 1.5 pile diameters from the pile top in order to record a uniform stress wave with sufficient energy. The minimum value defined in the ASTM D4945 – 12, is at least 1.5 times the pile width.

A distance of 2 times the pile diameter from the top is a good mounting position for the transducers to equalize the stress distribution over the complete pile cross section. As well, transducers should be attached far enough from the pile top to avoid pile head defects influencing the measurement, but close enough to avoid damage from the ground at final penetration. Local contact stresses can be reduced with cushioning.

Shown below is a measurement signal with low shaft resistance.



Please note:

- Mount the transducers at least 1.5 times the pile width from the pile top
- For re-strikes, the pile should be excavated 3 pile diameters in order to prevent damage to cable and/or sensor
- Take EXTRA care not to damage transducers during mounting on the pile.
- Ensure that transducers are always below the helmet or sleeve
- At final penetration, transducers should be above ground or water level. During high water level, standard PDA transducers must remain above water level. For underwater measurements, specially designed transducers can be used.

Blows must be given with a minimum of eccentricity. This can be observed during the PDADLT measurement by comparing the force left with the force right in the graph in the PC software.

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There are three options for mounting the transducers:

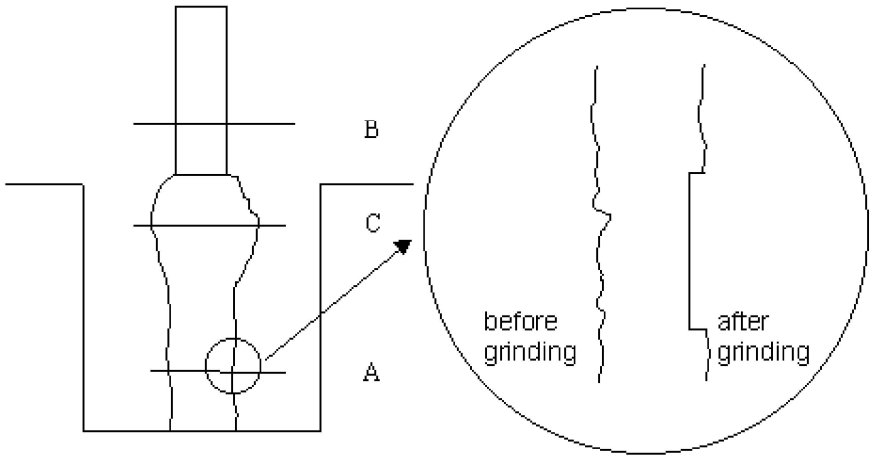
1. Mount transducers and connect cables before stabbing the pile
2. Mount transducers before stabbing the pile and connect cables after stabbing the pile
3. Mount transducers and connect cables after stabbing the pile

Mounting the transducers and connecting the cables before stabbing the pile is easiest, but increases the risk of damage to the transducers and cables during stabbing. For a DLT re-drive, transducers can be left on the pile (with the test engineer's approval), always protect the cables.

The distance between the transducer mounting holes is 65 mm. For concrete piles, the transducers are mounted on the pile using anchor bolts (Hilti HKD M8 bolts), the Profound drilling tool and sensor caliber. For steel piles, the transducers are mounted using threaded holes, the Profound drilling tool and sensor caliber.

B) Mounting the transducers on a concrete pile

The transducers should always be mounted on a flat smooth surface. Bending or torsion during mounting will deform and as a result damage the strain sensor. Rough surfaces must be flattened with a hammer and chisel or with an electrical grinding disc and finished with a polishing disc.



Mounting the transducers on a concrete surface

Transducers should never be mounted near a pile discontinuity (cross sectional change, etc.).
In the above figure, position A is the best possible position, the soil conditions along the pile will not be significantly different because of the excavation.
Position B is also acceptable. Note that in signal matching for position B, different cross sections of the pile must be considered. The cross sectional changes cause reflections from the pile and should not be mistaken for reflections from the soil. The pile diameter changes can be modelled in DLTWave.
Position C should not be used to mount the transducers because of the diameter change.

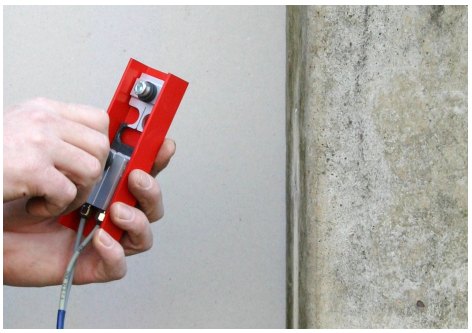
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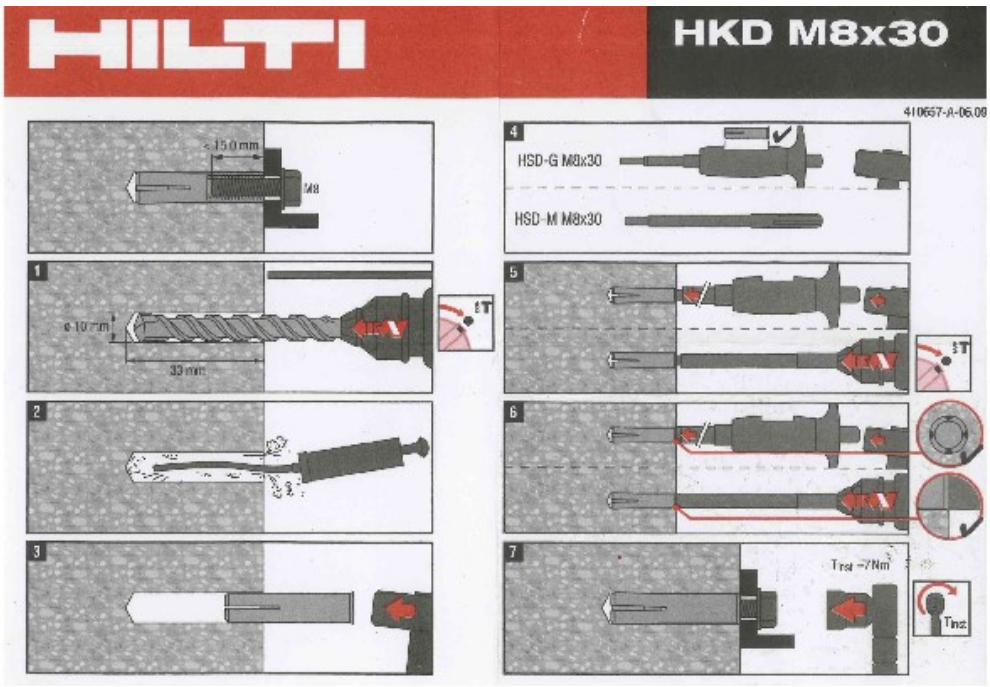
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General notes:

- Always store and transport the transducers in the red transport bracket in order to protect the transducer. The bolts and washers are then also immediately at hand for mounting on the pile.



- Mount the transducers ***at least 1.5, preferably 2 times from the pile top*** for a homogeneous stress distribution in the pile.
- Mount on a flat surface (if necessary, use a grinder to flatten the surface).
- Always use the Profound drilling tool and sensor caliber to ensure that the holes are perpendicular to the pile surface and parallel to the pile axis.
    - Use appropriate bolts and washers (see details as described in step 7).
    - Go through the specific Hilti instruction below for the anchors and bolts. These steps are also further explained in step 1 – 8.



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Step 1: First drill the **upper** 10 mm diameter hole for your anchor (the M8x25 mm bolts). The drilling depth is 33 mm (see the above Hilti drawing).

Use the drilling tool to ensure that the hole is ***perpendicular*** (at a 90 degree angle) to the pile surface.



Step 2: Clean the bored hole.



Step 3: Place the Hilti mechanical anchor (HKD M8x30) in the hole.

Please note: the anchor has to be completely countersunk in the pile!



Step 4: Use a hammer with a setting tool to fasten the anchor. It is important to secure it well, as large forces are generated during pile driving.



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Step 5: Fasten the drilling tool to the pile with a M8x25 bolt using the Alan key. The tool should be placed parallel to the pile axis in the direction of the stress wave. The tool simplifies drilling perpendicularly.





Drill the second hole.

Remove the drilling tool.

Repeat Step 2,3,4



Step 6: Bolt the PDA-sensor caliber to the pile by hand. If you need to use force to bolt the caliber, the holes have not been drilled correctly!



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Step 7a: Take the PDA transducer set from the red transport holder.



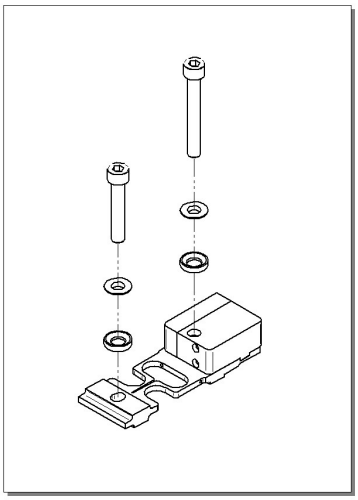
Check the correct bolts and washers, as shown in the drawing.

- First, lower anchor:

M8x40 bolt with:
M8 spherical washer
M8 conical seat washer

- Second, top anchor:

M8x25 bolt with:
M8 spherical washer
M8 conical seat washer



Step 7b: Use the bolts and washers, as specified and shown, to bolt the PDA-transducer loosely to the pile by hand.

Hand tighten the lower bolt (M8x40) and then the top bolt (M8x25) by turns.





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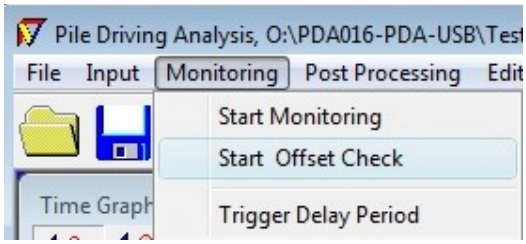
Step 7c: During mounting check whether the transducer is mounted stress free. Always use the drilling tool to drill the holes and use the caliber to test the holes drilled, as shown in step 1 - 6.



You should still be able to move the sensors after you inserted the bolts to the pile.

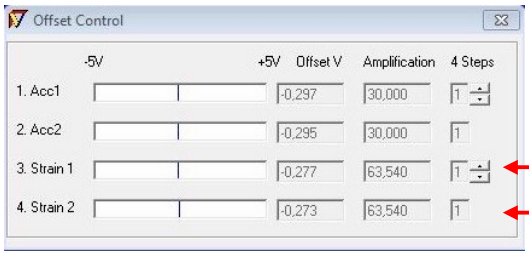
IMPORTANT CHECK:
During mounting check the mounting stress of the strain transducer in the PDA PC software. Checking is very important, as the mounting stress can damage your strain transducer.

Connect the sensor cables to the PDA junction box and the junction box cable to the PDA USB conditioner (connected to the PC). Open the PDA PC software. Create a *New Pile* or choose *Open Pile*. Choose the option *Start Offset check* in the *Monitoring* menu.



The mounting stress of the strain transducer is being displayed in the *Offset Control* Window. This is the stress that cannot be corrected in the software, as this is the internal stress of the mounted sensor.

Please note that for the acceleration transducers the signals displayed are not relevant.



The V_{mount} of a strain transducer should be between the maximum values displayed on the right.
If not, than the mounting of the sensor should be changed.

Typical offset values of new sensors:
V_{offset} (A=63,540): $-0.25 < V_{offset} < +0.25$ V
V_{mount} (A=63,540): $-1.25 < V_{mount} < +1.25$ V

Loosen and tighten again and if not improved, check the following:

- the distance between the sensor mounting holes should be 65 mm and the holes should be perpendicular to the pile. Drilling tool and caliber should always be used.
- the pile surface should be flat. If the surface is not flat enough, regrind the pile surface

If the above cannot be improved, it is better to drill new holes.

Warning!
Do not distort the transducer, this will irreversibly change the offset and possibly damage your transducer.

Step 8: Use the Alan key to tightly fasten the bolts by turns and with continuously low mounting stress.

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Step 9: The first transducer combination is now in place.



Step 10: At a position diametrically opposite the first transducer, mount the second transducer as described in steps 1-9 above.





C) Mounting the PDA-junction box

Step 1: Drill the 10 mm diameter hole for the junction box. Use the drilling tool to ensure that the hole is perpendicular (at a 90 degree angle) to the pile surface.

Clean the bored hole and place the Hilti mechanical anchor (HKD M8x30) in the hole.

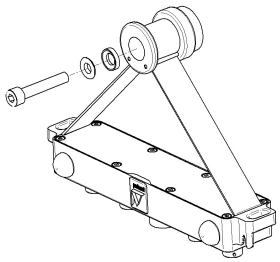
PLEASE NOTE: the anchor has to be completely countersunk in the pile.

Use a hammer with a setting tool to fasten the anchor, thus securing it well.
(identical to step 1 to 4 of part C)



Step 2: Fasten the junction box to the pile with a M8x40 bolt, spherical washer and conical seat washer, as shown.

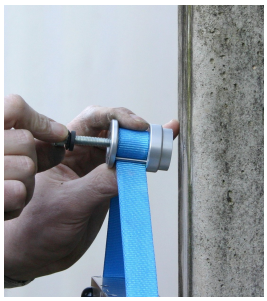
This is the same set as used for bolting the lower anchor of the transducer set.



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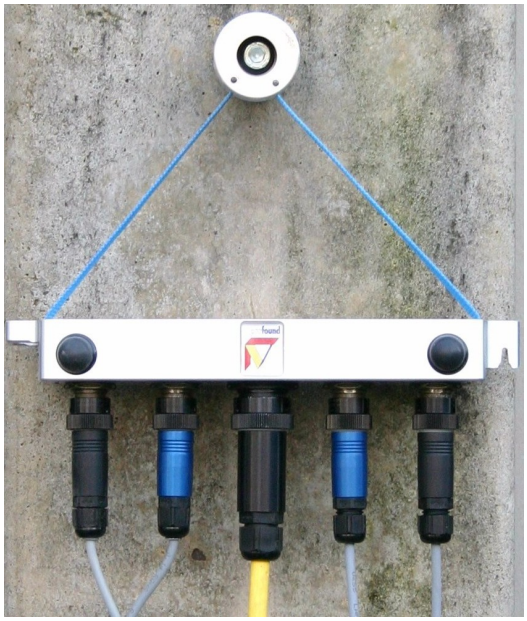
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Step 3: Connect the PDA-USB conditioner cable and the 4 PDA-transducer cables to the junction box.

If you use the PDA cable reel, use the connector with the black protection cap to connect to the junction box. Use the connector with the yellow protection cap to connect to the PDA-USB conditioner.

As an optional accessory a special DLT cable of 12 meter length is also available.



Please note the different colouring of the sensor connector, the coloured ring on the junction box and the text for the strain and for the acceleration transducers:

A1/A2 - blue: acceleration
S1/S2 - black: strain

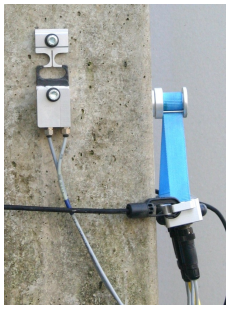
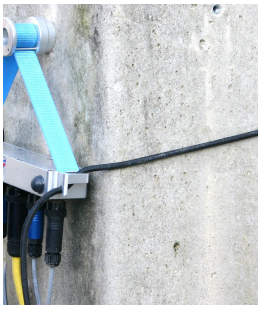
When the sensors are properly connected, all LED's will turn green on the PDA-USB conditioner.



black strain | *blue* acc | *main* junc box | *blue* acc | *black* strain

If the sensors are incorrectly connected (that is the strain to the acceleration channels and vice versa), the LED's of the acceleration transducers will be red instead of green on the PDA-USB conditioner.

Step 4: Use the fastening elastic with one hook and one loose end to fix the junction box on the pile.

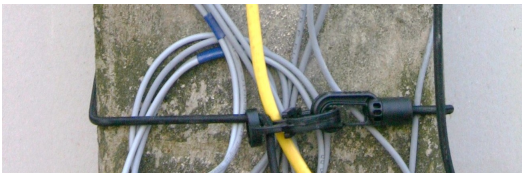



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Step 5: Use the fastening elastic with the two hooks to fix the sensor cables on the pile.



You are now ready to carry out a PDA-measurement

D) Mounting the transducers on a steel pile

The transducers are usually connected to a steel pile by drilling two Ø 6.8 mm diameter holes about two pile diameters below the pile top using the Profound drilling tool and thread each hole (for 8 mm bolts). Use the drilling tool to ensure that the distance between the holes is exactly 65 mm and that **the holes are perpendicular to the pile surface** and vertical along the pile. Mount the transducers at least 1.5 diameters and preferably **2 pile diameters from the pile top** for a homogeneous stress distribution.

Step 1: Drill a Ø 6.8 mm hole about two pile diameters below the top of the pile. For your convenience you can mark a centre point before drilling. Use the Profound drilling tool to ensure that the hole is ***perpendicular*** to the pile surface.



Step 2: Thread the hole for the 8 mm bolt, using thread oil.



Step 3: Fasten the Profound drilling tool to the pile with a M8x25 bolt using the Alan key. The drilling tool must be aligned with the pile axis.



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Step 3: Drill the second Ø 6.8 mm hole ***parallel*** to the pile axis.



Step 4: Thread the second hole for the 8 mm bolt, using thread oil.



Step 5: Follow step 6 – 10 of part C *"Concrete pile transducer mounting"* of this manual to bolt the PDA transducer sets correctly to the steel pile, followed by part D for the junction box.

Remark: As an alternative, you can weld two steel mounting blocks to the pile, using a welding jig. The two blocks each contain a threaded hole and accommodate one combined sensor. Ensure that the blocks are vertical along the pile. Correct the calibration factors of the strain transducers by the appropriate correction factor.

E) Removing the Transducers

After pile driving, the transducers must be removed: gently first release the top bolt, then the lower bolt. Transport the transducers including the bolts and washers in proper order in the red transport bracket as shown in § B – step 7A. The transducer set will be ready for the next measurement.
If approved by the test engineer, transducers can be left for a **DLT** re-drive. Note that the transducers must always remain above water level when left for any period.

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