

Instructions for handling of the HD2-Set, please note!

Thank you for deciding to purchase the HD2-Set. This important information will help you achieve the best possible accuracy when using the HD2-Set.

1. HD2 system presets:

- a. The system is delivered with pre-calibrations for various size and density sand, gravel and crushed stone (**see figure 1**). All calibrations were prepared under laboratory conditions with different varieties of sand, gravel and stone. These calibrations cover a range of materials but do not by any means define the operational limits of the HD2-set. So depending on site-specific conditions (fine fraction, cleanliness and type of rock) measurement deviations of > 1% from a single calibrations are possible.
- b. To operate the HD2-set with the best possible accuracy of $\pm 0.2.0...0.3\%$ (**absolute moisture content in %/gravimetric**), it is recommended to perform a 2-point calibration as described in the handbook (see also point 2), with your local sand, gravel or crushed stone. If this is not accomplished, compromise in accuracy must be taken into account!

Cal.	Name	Cal.	Name	Cal.	Name
1	Sand 94 lbs./ft ³	6	Gravel 5/16" to 5/8"	11	Crushed Stone 7/16" to 5/8"
2	Sand 100 lbs./ft ³	7	Gravel 5/8" to 1-1/4"	12	Crushed Stone 5/8" to 7/8"
3	Sand 106 lbs./ft ³	8	Crushed Stone 1/16" to 3/16"	13	Crushed Stone 7/8" to 1-1/4"
4	Sand 112 lbs./ft ³	9	Crushed Stone 3/16" to 5/16"	14	Mixed Crushed Stone 0" to 5/8"
5	Gravel 1/16" to 5/16"	10	Crushed Stone 5/16" to 7/16"	15	1/10tp

Figure. 1: List of 15 selectable probe calibrations

2. Creation/adaption of material specific calibrations:

To adapt the system to the best possible accuracies, depending on site specific conditions, it is necessary to calibrate the system with two different moisture values (**2-point calibration**). In practice please observe the following:

- a. The lower of the two calibration points may not be at 0%, because the systems shows a different sensitivity in absolutely dry material at exactly 0% (please note also point 3c).
- b. The upper of the two calibration points may not be at the highest saturation point of the material, because this could falsify the measurements due to too much free water.
- c. Optimal solution for a 2-point calibration is, to find the two calibration points at **20% and 80% saturation** of the aggregate. That means, for sand with a maximum moisture content of 10%, these calibration points are ideally at 2% and 8% moisture content.
For gravel with maximum moisture content of 5%, these calibration points are ideally at 1% and 4% moisture content.

3. Remarks concerning handling and accuracy

- a. If the pre-installed calibration number inside the SONO-M1 probe has been validated, or if a precise 2-point calibration has been done, attaining accuracies of $\pm 0.2...0.3\%$ (**absolute moisture content in %/gravimetric**) are possible, compared with kiln drying results.
- b. To reach the highest possible accuracy it is also important to perform the measurements using a standardized procedure, in order to prevent the effects of an individual “techniques” influencing the results. Make sure all users understand how to handle the system to avoid personalizing the calibrations. You can find more details on standardized measuring procedure in the HD2 manual on page 22-24.
- c. Please also note, when working with very dry materials with measurement ranges lower 15% of the maximum moisture saturation, the measurement results are being distorted in a small amounts in the lower range, Fig 2. This distortion is caused from a very low internal friction of the aggregates as the moisture tends to 0%, therefore causing the materials density to become a little higher. This small distortion can be corrected by using a simple empirical formula:
 Subtract a correction value “**Maximum moisture content / 100 * 3**” from the measured value.
 - i. Example: Measured moisture value in dry sand is 1.2% (this means 12% saturation at a maximum saturation value of 10% in sand):
 1. 1.2% - (**Maximum moisture content / 100 * 3**)
 2. 1.2% - (10% / 100 * 3)
 3. 1.2% - 0.3% = 0.9% (corrected moisture value in dry sand)

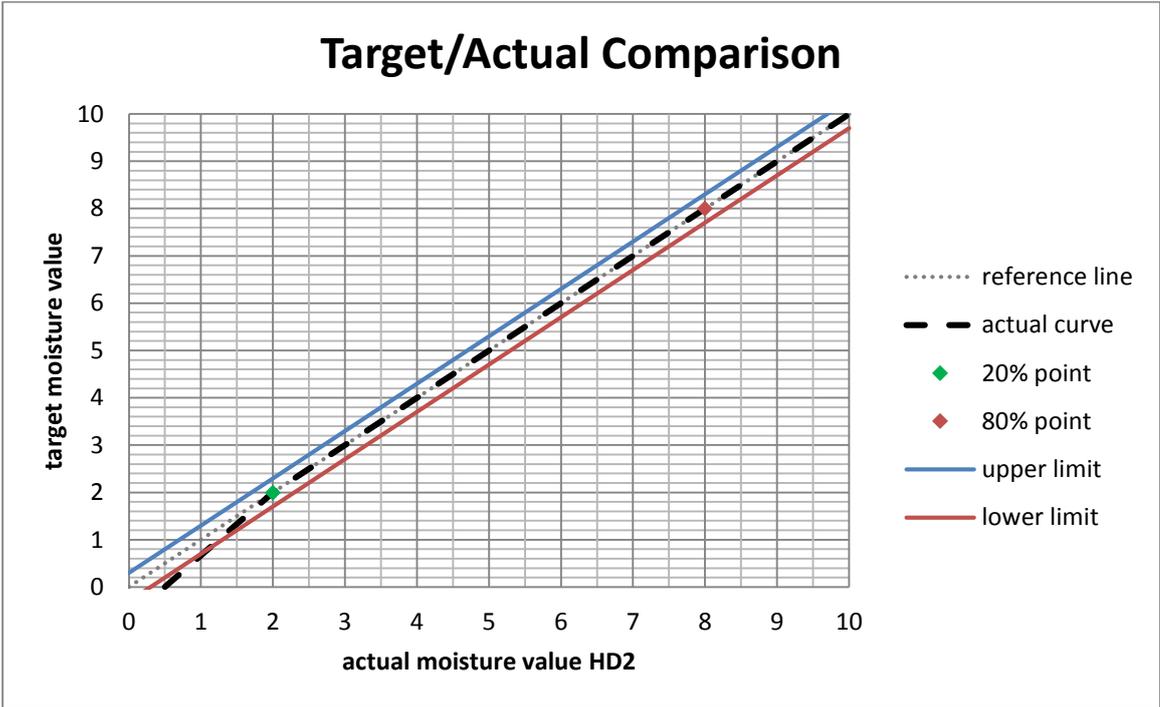


Fig2: The diagram shows a small deviation in the drier moisture range.

Please note: The absorbed water is also measured with the SONO-M1. Depending on aggregate type, adsorbed moisture can be greater than 0.5%. This should be taken into consideration when calculating the water/cement ratio, because the absorbed moisture is not relevant for the w/c-ratio.