

Equipment / Software:

Electrical cones / CPTest (any version)

Question:

What is the validity of the cone's calibration? How often or when should a cone be calibrated?

Clarifications:

In line with the latest standards the cone's calibration does not have an expiry date but is considered a snapshot of the cone's outputs.

Cones should be checked and calibrated at regular intervals. Below is an extract from ISO 22476-1:2012 as to the checks and calibration of cones:

"The calibrations and checks are specific to each cone penetrometer. They will show variations during a penetrometer's life caused by small changes in the function and geometry of the cone penetrometer. In such cases, a re-calibration of the cone penetrometer should be carried out. Calibration should be carried out regularly, at least every six months. If it appears from a track record that no significant deviations are registered, a longer period between calibrations can be applicable. Depending on application class requirements and zero drift at zero load, more frequent calibration can be required. During long term testing, calibration may be carried out more frequently."

"A new calibration should be carried out after a cone penetration test has been performed under difficult conditions if a significant zero shift has been recorded, for instance if the cone penetrometer has been loaded close to or over its maximum capacity."

The above can be interpreted in various ways and hence is not unambiguous. Geomil therefore recommends monitoring zero drift (i.e. drift of the zero load readings) as main indicator for the condition of the cone.

Should a drift occur beyond tolerances (see below for further details) the cone should be returned for service and recalibration. Obviously, beside monitoring zero readings any signs of physical damage of the cone (such as bending, cracks, excessive wear) should trigger the operator to consider service and recalibration of the cone.

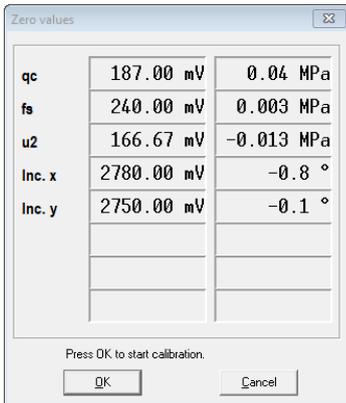
However, always consider the following possible effects that are not attributable to a faulty or damaged cone:

- Cone not properly cleaned or maintained. It is important that the dirt seals of the cone are properly cleaned, in other words there should be no "barrier" between the different elements (tip and friction sleeve) of the cone.
- Large differences between the temperature of the cone (prior to start of the CPT) and the soil. It is recommended to maintain the cone at a temperature as close as possible to the expected ground temperature.
- Erratic calibration of the cone at the start of the test. This may happen if the cone is already loaded (for example already placed on the ground) while the zero load readings are taken.
- A damaged cable may also lead to erratic readings. Use another cone and/or cable in order to exclude this problem.

As part of each CPT the CPTest software package performs two zero load readings checks (also known as baseline readings, zero shifts or zero offsets) of the cone. These can be subdivided in 2 different checks:

Absolute zero drift (drift at start of the CPT, comparison of current and calibrated zero load readings)

The main purpose of this check is to determine the condition of the cone before the test. It is recommended that the zero drift remains within 5 % of FSO (Full Scale Output). CPTest conducts an automatic check at the start of the CPT to determine if the actual readings are within this limit. When one or more of the actual zero load readings have drifted significantly from those during calibration, i.e. more than 5 % of FSO, the cone may have been subjected to overloading, bending or any other damage. The condition and quality of the cone is therefore questionable, and it is recommended to have the cone checked, repaired and recalibrated. The actual zero load readings are equaled to zero load at the start of the CPT, and as such used as baseline for the test.



The default settings for this check are as follows:

parameter	allowable drift
qc (electrical CPT)	5.0 % of FSO
qc (mechanical CPT)	5.0 % of FSO
fs	5.0 % of FSO
u	5.0 % of FSO

Example:

parameter	FSO (mV)	max. allowable drift (%)	max. allowable drift (mV)	calibrated zero load reading (mV)	actual zero load reading (mV)	actual drift (mV)	actual drift (%)
qc (electrical CPT)	8354	5.0	418	236	315	79	0.9%
fs	8489	5.0	424	253	715	462	5.4%
u	7954	5.0	398	207	246	39	0.5%

Relative zero drift (drift between zero load readings at start and end of the CPT)

The purpose of this check is to determine if the cone has been damaged during the just completed test as a result of overloading or bending, by comparing the zero values before the test with those after the test. If significant drifting has occurred, the operator or engineer should pay additional attention as to the reliability of this particular CPT. The second zero value readings are not used to correct the data.

The default settings for this check are as follows:

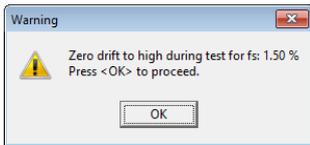
parameter	allowable drift
qc (electrical CPT)	0.5 % of FSO
qc (mechanical CPT)	1.0 % of FSO
fs	1.0 % of FSO
u	1.0 % of FSO

Example:

parameter	FSO	max. allowable drift		zero load reading before CPT	zero load reading after CPT	actual drift (%)	
	(mV)	(%)	(mV)	(mV)	(mV)	(mV)	(%)
qc (electrical CPT)	8354	0.5	42	315	317	2	0.0%
fs	8489	1.0	85	715	843	128	1.5%
u	7954	1.0	80	246	234	-12	-0.2%

Results

In case the measured drift exceeds the allowable value, CPTest generates a warning (regardless whether the absolute or the relative check exceeds allowable values). It is then up to the operator or engineer to decide whether or not to proceed with the test or the cone in question.



Note

Zero values should be taken while the cone is clean, ready for use and most important fully unloaded. The zero load readings at the end of the test should be conducted when the cone is fully retracted and preferably cleaned if soil remains on the cone.

Settings in CPTest

The zero drift checks can be switched off in the settings menu of CPTest. The allowable drifts can also be adjusted. The default settings (as below) are Geomil's recommendation and based on input of the Geotechnical Division of the Flemish Public Works Department.

