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## CALIBRATION OF CONCRETE COMPRESSION TESTING MACHINES PRODUCTS

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**Abstract:** A wide spectrum of compression testing machines is used for strength testing of concrete pipes. The main specialty of the testing machine is the length (2-2.5 meters) of the tested product (pipes), which requires a loading beam with corresponding length. Non-parallelism of supporting and loading elements, unequal distribution of loads, a big parasite torque effort because of the loading elements' large size leads to another measurement errors and to increased uncertainties in calibration process according to ISO 7500-1:1999.

For making the right choice in using and setting measuring elements (load cells) and accessories, one must take into account the structure and technological specialties of the testing machines: how many pistons are in it, the method of pressure measurement, the arrangement of measuring and supporting elements in the machines.

In this paper we analyze in detail the different measuring methods and recommend choosing the best method of calibration, which most diminishes the uncertainty.

**Keywords:** calibration of testing machine, accessory, uncertainty.

### 1. INTRODUCTION



Picture 1

When measuring the force under a beam (Picture 1) how should we measure it? Using a cell placed under the middle of the beam or cells placed under its ends? How does the number of pistons affect the results of the measurement? Do we have to use accessories (spherical caps and alike)?

Picture 1 shows a real machine we've tested; the machine's beam has 3 pistons above it for the force creation. The actual force under the beam might (and actually does) vary.

Picture 2 is another type of machine, one which uses only 1 piston instead of 3. It's quite obvious that the tests for both of them are similar, yet there are some vital differences between the angular effects for 1 piston, 2 pistons and 3 pistons.

An additional problem arises in Picture 2 due to the existence of a spherical cap between the piston and the beam. In this case we had to do the test using 2 load cells, but no spherical caps, after some more tests we've reached the conclusion it was not the best possible method.



Picture 2

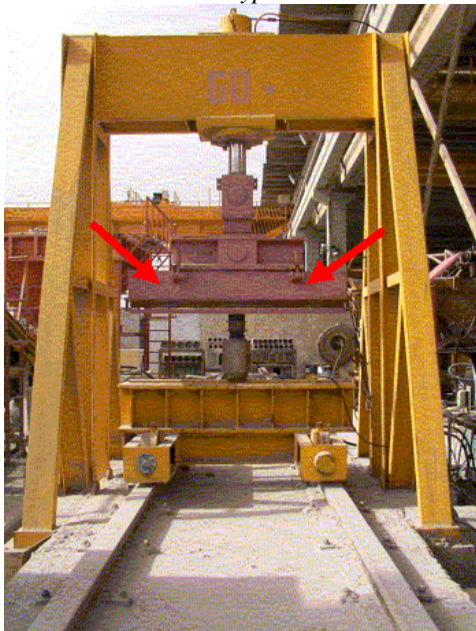
### 2. EXPERIMENTAL SETUP

*Type I*

One hydraulic piston statically placed over the beam, at the mid of it, an example for this type is Picture 2. The compression measurement is done by measuring the pressure in the hydraulic system. Experiences show that the best method is 1 load cell placed under the piston, on the same axis. Between them we put a spherical cap in order to prevent any parasite forces (non parallel). This method yields the lowest standard deviation, thus reducing the measurement uncertainty: 0.88kN at 800kN.

This type has 2 or 3 hydraulic pistons placed above the beam are supposed to press it down evenly, which it doesn't sometimes the beam reaches a tangent of 4 degrees. In this case we haven't found any real differences between putting 1 load cell in the middle of the beam or 2 load cells in a symmetric formation. Spherical caps are a must because of the beam's tangent. We prefer using the 2 load cells method because of its additional safety.

*Type II*



Picture 3 (the red arrows show where the load cells are)

This type has 2 load cells placed inside the ends of the beam and a digital display. In this case we've found that the best method is by putting 2 load cells placed under the machine's load cells, on the same axis, with spherical caps in between. The main advantage is adjustment is easier to conduct. The standard deviation is 0.66kN at 500kN.

*Type III*



Picture 5

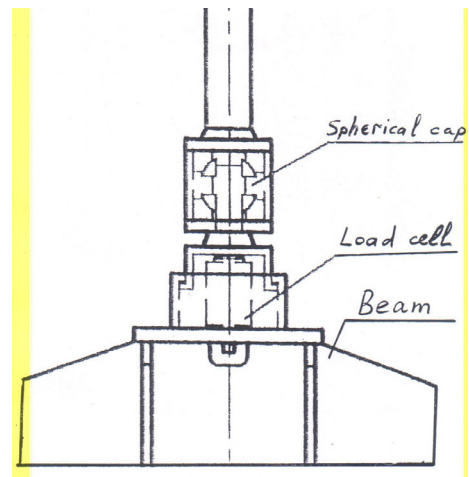


Picture 6

*Type IV*



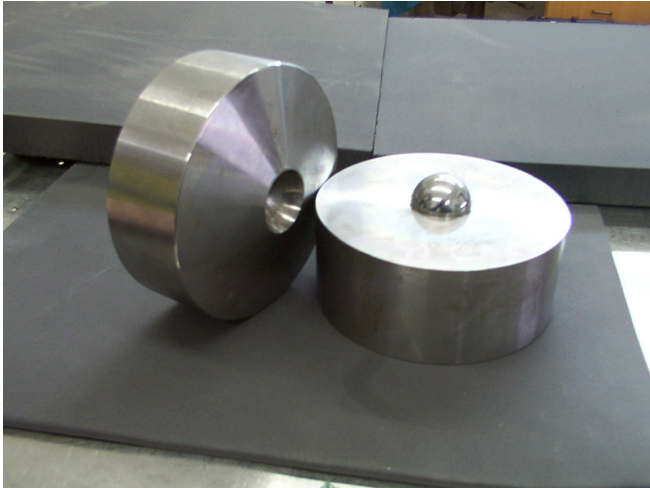
Picture 7



Picture 7a (the scheme of the system)

The compression force is due to a single hydraulic piston's pressure; the force measurement is installed in the loading mechanism with a spherical cap. We've found that 2 load cells yield standard deviation of 0.37kN at 400kN. In this case we didn't need the spherical caps on the load cells, but we had to put the load cells at a very accurate heights.

Accessories



Picture 9

When conducting the calibration at QCC Hazorea we preferred using the spherical caps of the fig 1 type because it has smaller contact-surface, thus it can be neglected when calculating the uncertainty. Moreover it reduces the scattering of the results (standard deviation), which reduces the uncertainty too. And it adds to the safety of the calibration process.



Picture 10

### 3. CONCLUSIONS

In this article we have considered the methods to calibrate various concrete testing machines. Recommendations based on the machine's type are in the article and include the testing method and the accessories for the calibration. The recommendations are based on results of the measurements and the calculations of uncertainties for those measurements. Applying those recommendations are guaranteed to lower the measurements' uncertainty.

### REFERENCES

- [1] ISO 7500-1: 1999 Verification of static uniaxial testing machine – verification and calibration of force measuring system.
- [2] EA – 10/04 (EAL-G22): 1996 Uncertainty of calibration results in force measurement

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