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NEW AUTOMATIC CALIBRATION SYSTEM FOR LARGE MASSES

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Abstract – An automatic weight handler system for weights with masses up to 1000 kg has been designed and constructed. The system can be used with different commercial top loaded weighing platforms. This designed device has been focused on improving the eccentricity behaviour as well as the complete automation of the facility. This paper describes their main technical and metrological features.

Keywords: weight handler system, balance, automation.

1. INTRODUCTION

Centro Español de Metrología (CEM) has developed an automatic weight handler system for large standard weights. This project started in 2007 and will be finished at the end of 2008, beginning 2009.

In the 1000 kg range there is no automatic calibration system commercially available. On the other hand, manual calibrations on top load weighing platforms are very time consuming and require a lot of manpower. Besides, any measuring automation process usually improves repeatability and reproducibility of measurement results. That is the reason why the development of an automated calibration system is essential in order to improve measurement accuracy.

The aim of the project is the improvement of CEM calibration and measurement capabilities for 1000 kg standard weights, although this system will also be used for 200 kg and 500 kg standard weights and other masses in this range.

2. DESCRIPTION

This facility will be installed on a laboratory with temperature controlled in the interval 20 ºC ± 0,5 ºC.

It has been designed to allow the use of different top loaded weighting instruments that can be easily changed as required.

It consists of a robust aluminium fixed frame (a), which supports the weighing platform (c), a hanging loading plate (b) and a vertically and horizontally movable table (d) that allow the positioning of the weights on the loading plate and its alternation between test and standard weights. The top loaded weighting instrument rests on a thick stone plate (e).

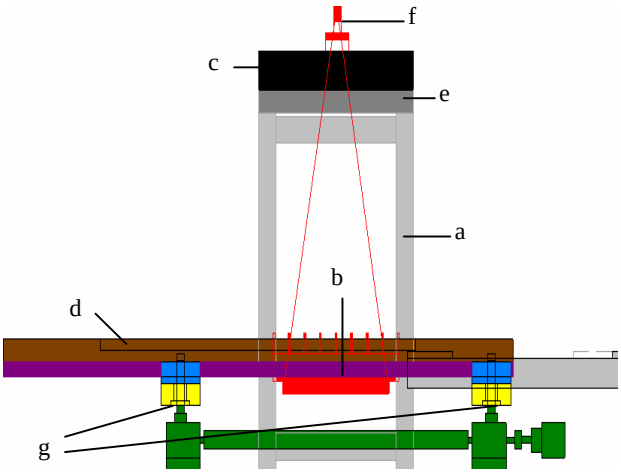

Fig. 1. Weight handler system (side view)

Fig. 2. Weight handler system photograph (side view)

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The loading plate is hanging from the central point of the weighing platform by means of a knife edge system and a loading pad (f). The loading plate is provided with special profiles that pass through the movable table profiles.

The alternation between test and standard weights is achieved by means of a movable table, which allows resting the appropriate weight on the loading plate as required. This table can drive horizontally to exchange the weights by means of an electric motor and vertically to position the weight on the loading plate by means of four ballscrew lifts (g) commanded by an electric motor.

The loading sequence is described as follows. When the movable platform is in its upper position, both weights rest on the movable table. When the movable table is its lower position, the weight which is wanted to be measured rests on the loading plate while the other weight rests on the movable table.

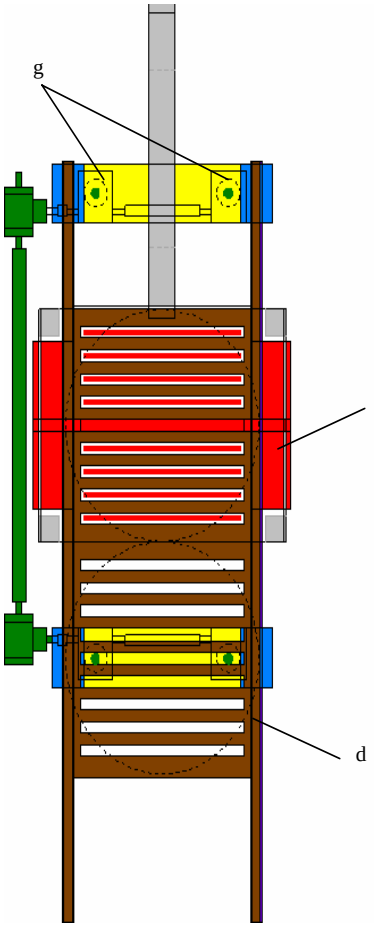

Fig. 3. Weight handler system (aerial view)

The facility is provided with an auto-centring system to reduce the pendulum movement of the hanging device. This system consists of four shock absorbers ended in steel fingers. The loading plate is provided with four holes in which the steel fingers are in. When the steel finger is pushed by the loading plate, this movement is absorbed. Different fitting can be inserted in the fingers in order to reduce the space inside the hole and make the movement absorption more efficient.

In order to reduce the system weight special aluminium has been used as much as possible. This is very important for the loading plate and its hanging system, which weight acts as a tare weight for top loaded weighing instrument and reduces its maximum capacity.

The facility will act as a completely automated comparator and the operator will only have to put the weights on the movable platform with the help of a crane.

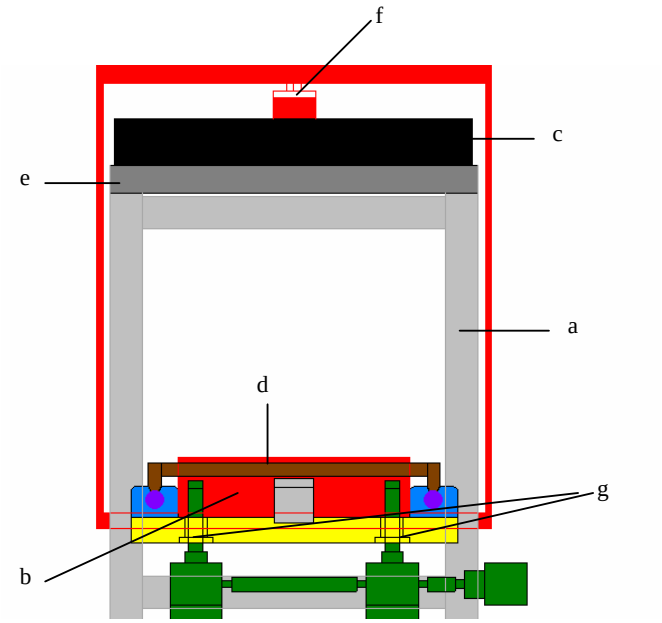

Fig. 4. Weight handler system (front view)

Figures 1 to 5 are different views of this weight handler system. Their main technical features are listed as follows:

- Weight range from 200 kg up to 1000 kg
- Testing load space: 800 mm diameter and 960 mm height

The software allows programming load test sequences, setting speed of load vertical and horizontal translation, and stabilization time and data acquisition. The electric motors include frequency drives which will be directly commanded by the computer.

This software allows operating in fully automatic or manual way. All commands, the programming and loading routines are activated by easy intuitive graphic mode via keyboard or mouse-click.

3. TEST RESULTS

Some studies of this system have being carried out with a 1000 kg top loaded weighing platform with 0.5 g resolution.

Fig 5. Weight handler system general view

The system repeatability has improved a lot as shown in table 1. The number of measurements which has been used in order to evaluate the repeatability is 10.

	Repeatability declared by the manufacturer	**Repeatability (standard deviation) obtained during manual calibration**	**Repeatability (standard deviation) obtained with our new automatic weight handler system**
200 kg	2 g	0.64 g	0.5 g
500 kg	3 g	0.99 g	0.6 g
1000 kg	3 g	1.74 g	0.7 g

Table 1. Improvement in repeatability

On the other hand, it is remarkable that, as a consequence of weight handler system design, eccentricity is completely avoided. Another important advantage is the fact that system automation, which allows loading and unloading times remain the same, makes creep effects completely compensated.

Actually the time required for a calibration has decreased more than 50 %, but the main advantage it the fact that the operator does not have to be present during tests.

Figures 6 and 7 show the 1000 kg top loaded weighing platform performance during the comparison of two 1000 kg weight for the calibration of one of them. It is clear that the indication variation performance is much better with the new automatic weight handler system.

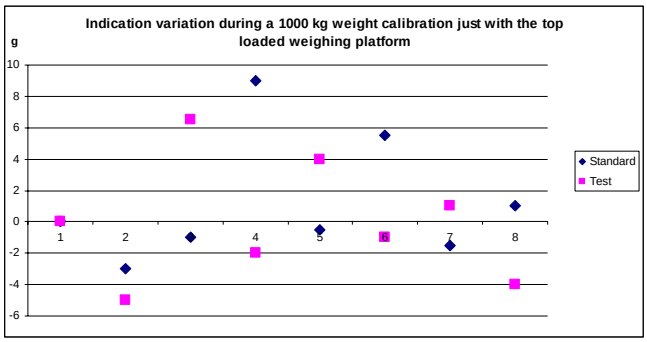

Fig 6. Performance of the 1000 kg top loaded weighing platform alone

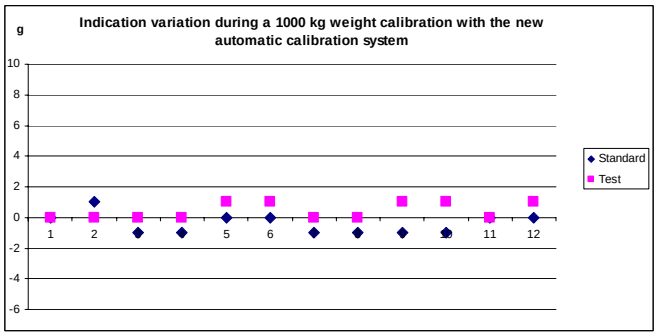

Fig 7. Performance of the 1000 kg top loaded weighing platform with the automatic weight handler system

4. CONCLUSION

This paper describes the relevant design features and metrological performance of the 1000 kg automatic calibration system that will improve CEM calibration and measurement capabilities in this range and reduces the time and manpower required for large weights calibration.

This system has been designed in order to avoid eccentricity, compensate creep and improve repeatability and, fortunately, this goal has been achieved. Results are especially good for 1000 kg where repeatability error has decreased up to 40% its initial value.

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