Research Journal of Applied Sciences 9 (12): 1106-1108, 2014
ISSN: 1815-932X

Calibration of the Weight Measuring Systems by Means of a Strain-Gage Model

Alexei N. Davidenk and Pavel N. Davidenk
Armavir State Pedagogical Academy, 352901 Armavir, Russia

Abstract: The structure of the control system for weight measuring system is considered; the procedure of calibration of the weight measuring system on the basis of the reference scales model while in service was suggested.

Key words: Strain gage, strain-gage sensor, maximum weighing capacity, minimum weighing capacity, weight measuring system, number of the calibration divisions, calibration, balance weights, platform, resolution, rated loading

INTRODUCTION

Calibration of the wright measuring systems is performed on the basis of the procedure described in (GOST 53228-2008, 2010; Vishnyakov, 1985; Davidenko *et al.*, 2011; GOST OIML R 76-1-2011, 2011) with the use of the balance weights and control (standard) weights.

Calibration of the weight measuring systems is performed at a few points using the platform weight as a dummy zero, the minimum weighing capacity (NmPV)-maximum weighing capacity (NPV) and intermediate points formed with the use of the balance weights.

This method is time consuming and expensive. In order to eliminate the shortcomings of the existing method we suggest using the Strain-Gage Model.

DESIGNING OF THE BLOCK DIAGRAM OF THE WEIGHT MEASURING SYSTEM

The Strain-Gage Model is designed by means of processing of the strain-gage calibrator (TD) technical parameters.

In order to implement the Strain-Gage Calibrator Model, it is needed to review the structure of the control system for the weight measuring system since the necessary condition includes the processing of the signal from each TD and further generation of a database (Fig. 1).

Using a TD standard in the form of a Strain-Gage Calibrator Model, it is possible to design a reference scales model by taking the full-range specifications of a weight measuring system.

The resolution of setting the weight values for taking the specifications of the Strain-Gage Calibrator Model

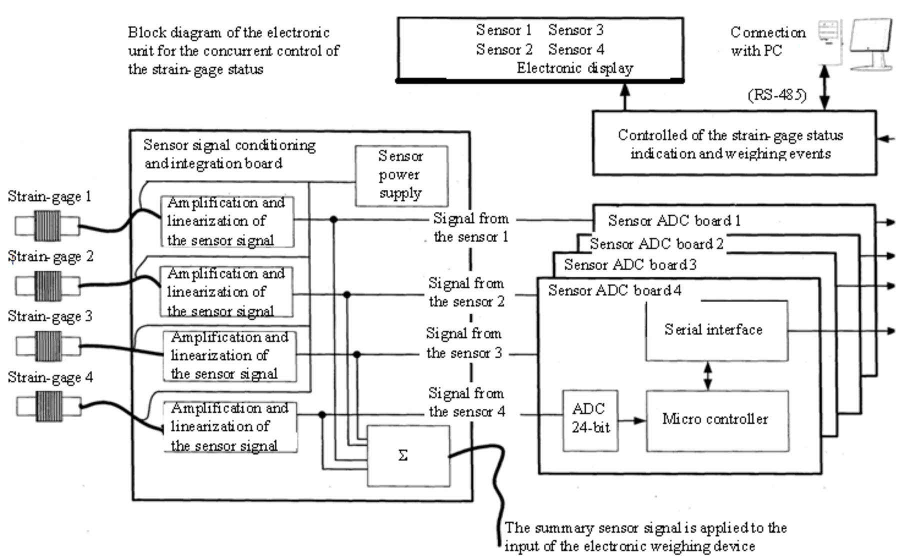

Fig. 1: Electronic unit structure

Corresponding Author: Alexei N. Davidenk, Armavir State Pedagogical Academy, 352901 Armavir, Russia

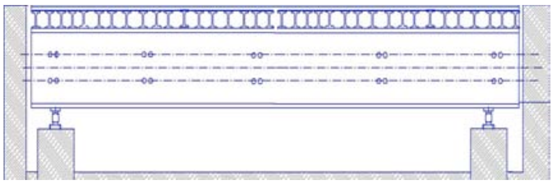

Fig. 2: Motor truck scales NPV 30000 kg

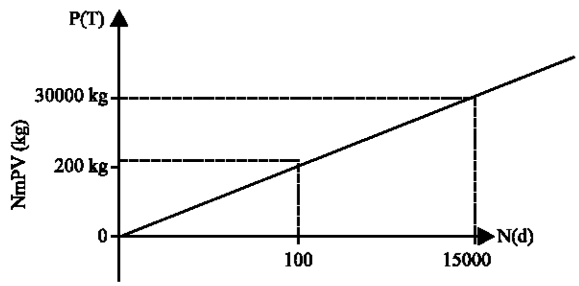

Fig. 3: Reference Scales Model

shall be set by the values of the binary power function which will allow generating the parameters with the specified resolution.

The scales are calibrated according to the conventional method (GOST 53228-2008, 2010; Vishnyakov, 1985; GOST OIML R 76-1-2011, 2011). For the purpose of further construction of the reference scales model it is needed to design the Strain-Gage Calibrator Model. Researchers take for consideration the wide-spread motor-truck scales with the NPV 30,000 kg (Fig. 2) on 4 (TD).

Researchers use as sensors for these scales the TD with the rated loading of 20,000 kg (E_{max}) according to the class C3 (Davidenko *et al*., 2011; Bosenko *et al*., 2013). Let's calculate the load on each of the strain-gages on the basis of the minimum calibration interval of the TD. Thus, the 20 t TD of the class C3 has the number of the minimum calibration intervals amounting to TD 10,000 (d). Consequently, we have 40,000 d (4 TD) for the scales in total. The number of the minimum calibration intervals of the scales N:

$$N = \frac{H\Pi B \cdot 4 \cdot d}{4 \cdot E_{max}} \qquad (1)$$
$$N = \frac{30000 \cdot 4 \cdot 10000}{4 \cdot 20000} = 15000$$

With due regard to the preloading of the TD with the platform weight (dummy zero) the reference scales model will be represented in Fig. 3.

DEVELOPMENT OF THE METHOD OF CALIBRATION OF THE WEIGHING SYSTEM BASED ON THE REFERENCE SCALES MODEL

In order to construct the reference scales model depending on the minimum discrete values, it is needed to calculate the value of the scales calibration division.

The scales NPV 30,000 kg according to the class C3 have the number of the calibration divisions amounting to n = 3000 which is equivalent to 10 kg (Kuleshov, 2008). The minimum calibration interval of the scales:

$$e_{min} = \frac{N}{NPV} = \frac{15000}{3000} = 5 \qquad (2)$$

where, N is the number of the minimum calibration divisions of the scales. Calibration of the scales for rating the reference performance based on the calibration division values shall be performed by the weights that are equivalent to the binary power function 2^{12}, minimum value e = 10 kg.

In the initial position upon absence of the weight on the platform the values are read from the TD through a conditioning board (Fig. 1) processed by the sensor ADC and transmitted to the PC through the RS-485 interface. The values received are the initial first point (zero) stored.

This method is the basic zero TD mode (Avdeeva *et al*., 2007). Then by loading the platform by the weights that are equivalent to the minimum weighing capacity (NmPV), we get the second calibration point. The next point is calculated by loading by the weights that are equivalent to the binary power function 5120 kg (2^9 e_{min} = 10 kg) thereby, we get 512 points.

These values are stored in the database for each TD after which the platform is unloaded. At the next stage the balance weights not >5129 kg and the control (standard) weights (GOST 7328-2001, 2001; Anoprienko, 1999) are loaded in order to get the next points. This step is repeated until we get the value that is equivalent to the NPV.

As the result, we get the reference model for each TD having implemented the Strain-gage Calibrator Model. During the further operation by the calibration the discrete weight values are entered and compared with the reference values as well as tolerances for the deviation between TD.

This method allows calibrating the weighing systems within the entire range with the specified precision as well as checking the basic TD parameters during operation of the weighing system using the minimum number of the control weights.

RESULTS

The calibration of scales according to this method allows performing calibration using the weights that are multiple of the minimum calibration interval with the minimum number of the control weights. The suggested method of calibration is implemented with the use of the Reference Scales Model.

CONCLUSION

A promising direction calibration weights in the process of operation is the use of digital AP integrated chip with the reference data of technical parameters, etc. This allows you to analyze real-world performance (variance) with reference during operation (for example when turning on or resetting the weight of the block). The results of this monitoring after a certain algorithm can be displayed in the form of recommendations for operation by the weighting unit that can detect faults in the work of the TD, the weighing system without calibration reference materials.

REFERENCES

Anoprienko, A.Y., 1999. From computing to understand: Cognitive computer modeling and experience of its practical application on the solution of the problem of the Phaistos disk. Proceedings of the Donetsk State Technical University Series Informatics, Cybernetics and Computer Science (IKVT'99), Donetsk State Technical University, Donetsk, pp: 36-47.

Avdeeva, Z.K., S.V. Kovriga and D.I. Makarenko, 2007. [Cognitive modeling for solving semistructured management systems (situations)]. Managing Large Systems. Institute of Control Sciences No. 16, Moscow, pp: 26-39.

Bosenko, V.N., A.G. Kravets and V.A. Kamaev, 2013. Development of an automated system to improve the efficiency of the oil pipeline construction management. World Applied Sci. J., 24: 24-30.

Davidenko, A.N., E.F. Zelenko, M.F. Serikova and V.M. Terekhov, 2011. Standard machine. The Utility Model Patent of the Russian Federation RU 2011 106 367 U1 G01L 25/00.

GOST 53228-2008, 2010. Non-automatic scales. Part 1. Metrological and technical requirements. Russian Standards and Regulations, Russia, pp: 1-145. http://runorm.com/product/view/2/37612.

GOST 7328-2001, 2001. Weights. General specifications. Interstandard, Russia, pp: 1-14 (In Russian). http://infostore.saiglobal.com/store/details.aspx?ProductID=518469.

GOST OIML R 76-1-2011, 2011. State system for ensuring uniform measurement: Non-automatic scales. Part 1. Metrological and technical requirements. Tests. pp:1-142 (In Russian). http://www.beuth.de/en/standard/gost-oiml-r-76-1/179619219.

Kuleshov, A.P., 2008. Cognitive technologies in adaptive models of complex objects. Inform. Technol. Comput. Syst., 1: 18-29.

Vishnyakov, A.S., 1985. Methods and Techniques of Automation, Calibration of Instruments and Testing the Force Measuring Devices. Standards Publishing House, Russia, pp: 25.