MAY SİSTEM MÜHENDİSLİK

Turkiye's first National big scale "Turkish Production" calibration machine with less than 4 x 10^{-4} accuracy

__Customer__

The customer is UME (National Metrology Institute of Turkiye). They are a Research and Development Institute working under the umbrella of TÜBİTAK (Turkish Scientific and Technological Research Institution). They are located in Kocaeli / TURKIYE. Their main purpose is to approve all measurement made in Turkiye and to assure all these measurement are comparable internationally; Improve new and existing measurement techniques to ensure the fidelity of all industrial and commercial measurements. For that, they create National Metrology System for increasing the quality of Turkish products and to help improvement of Turkish scientific and technological infrastructure. They create and preserve Turkish Measuring Reference Standards and they assure International Measurement System Traceability.

They were looking for a high capacity brand-new high technology product with very high precision and accuracy for the Force Laboratory. The reference of the machinery was 50kN - 3MN Force Standard Machine with Reference Force Transducer. There was no company in Turkiye producing this kind of machinery so they started to look for mechanical and automation companies capable of building it.

It is where MAYSISTEM is chosen for the automation part.

__Project__

The mechanical system of the machine was designed and built as a tripod and has two types of motors. First was for positioning the transducers and the second was for driving the pressure piston. While the machine was working, automation system had to measure the reference and the measured transducer at-once and frequently. Also automation had to be full automated.

The main problem for this machine was the accuracy. When you "squeeze" the machine with the pistons, you were applying a force up to equivalent ~300TonForce(Metric) = 337TonForce(US). To stable this force with ±4 x 10^{-4} accuracy means you have just a range of error ±120kgForce. We might not deliver the project without reaching this accuracy.

The customer also wanted customized computer software. This software was for controlling the machine, start and stops calibration, writes customized calibration procedures, manual machine control within parameters, ability to change the reference transducer, special positioning and pressure application and finally full calibration, data storage and "National Calibration Certification".


Machine infrastructure

__Solution__

Control panel and tests

We decided to create an automation system sitting on the machine and on the computer at the same time. The computer software was communicating with high precision transducer readers to read the pressures and was recording them. Also it was controlling online all sensors and motors through Schneider PLC (Programmable Logic Controller) and DC Servo Motor Controllers. It is using an AI (Artificial Intelligence) structure and is “learning” the curve of the machine in time and adjusts itself accordingly to ensure long term stability. Also AI controls all measured series, decide if there is a measurement error and repeat the calibration automatically. If all are correct, it creates printed “National Calibration Certificate”. The full long calibration takes 28 hours without human interaction.

While the computer was measuring the pressures, the hardware automation system was checking and ensuring the accuracy needed.

It took 1 year to create the software and firmware working together flawlessly. After finishing the system, we made over 30 “intercomparisons“ with other countries’ Calibration Institutes (e.g.: Germany) and we found out that we didn’t just ensure the necessary accuracy (±4 x 10^{-4}) but we also improved it down to ±1 x 10^{-4} means we were stabilizing the force at ±30kgForce.

Even at 5kN measurement range (1/10 of minimum scale), with a machine designed for 3MN calibration, the accuracy was within the expected accuracy (±4 x 10^{-4}).

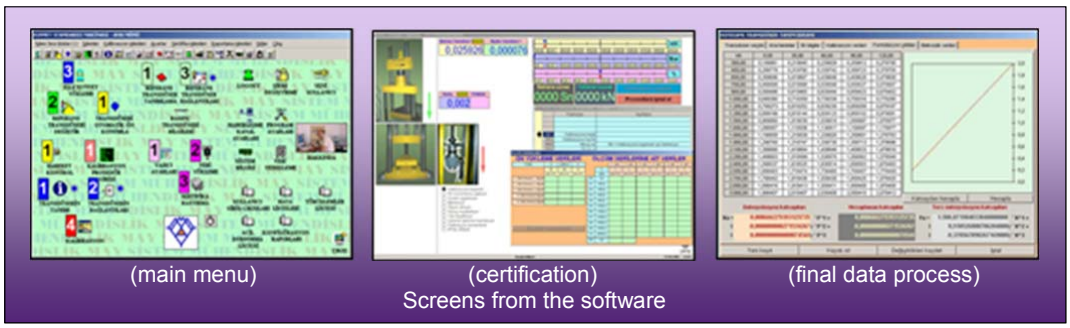
__Conclusion__

Since 2002, UME is using this standard machine as a Turkish National 50kN - 3MN Force Standard Machine with Reference Force Transducer.

At the construction of this automation system, we provided them two doctorate thesis subjects according to our research during the programming: “Zero shifting error of transducers on long term stay under pressure” and “Change of measurement results after many consecutive calibrations”. You can find detailed information about the force laboratory from this link: http://www.ume.tubitak.gov.tr/tr/laboratuvarlarimiz/kuvvet-laboratuvarlari

This machine is constructed in Turkiye with 1/5 of the cost of foreign machine builders and 4 times more accurate.

__Result__



(main menu) (certification) (final data process)

Screens from the software

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