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FORCE MAGNITUDE DEVELOPMENT IN LATIN AMERICA TRIANGULAR PROJECT "REGIONAL COOPERATION TO IMPROVE METROLOGICAL SERVICES IN ANDEAN COUNTRIES AND URUGUAY, PARAGUAY AND PANAMÁ".

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Abstract - At regional level, Chile is part of the Interamerican Metrology System (SIM) that is the result of the achieved agreements among the 34 member countries of the Organization of American States (OEA) to promote metrology. The SIM consists of five sub regions NORAMET, CARIMET, CAMET, ANDIMET and SURAMET. This last sub region comprises Argentina, Brazil, Chile, Paraguay and Uruguay.

1. INTRODUCTION

The development and recognition of Chile's Laboratorio Custodio de Patrones Nacionales de Fuerza (National Force Standards Custodian Laboratory) together with PTB's technical cooperation activities in other Latin American countries have contributed to generate training activities for technicians in third countries providing them knowledge and experiences in the area of force magnitude.

This way an alliance has already been developed that allows the triangular and punctual cooperation with the national institutes of metrology of several Latin American countries (Bolivia, Colombia, Chile, Ecuador, Panamá, Paraguay, Peru and Uruguay).

Keywords: Force, Triangular Project, ANDIMET

2. DEVELOPMENT OF WORK

International workshop in Santiago to approve the approaches, explanations and to establish and unify criteria for calibration testing machines according to ISO 7500.

Training and practical works in the usage of different transducers and amplifiers to be used in force calibration.

Technical assessment in each participant country according to ISO 17025 and ISO 7500.

Bilateral comparisons between LCPN-F (Chile) and other participant countries in calibration of testing machines by means of application of methods and procedures evaluated and studied.

International comparison in the 50 kN testing machine calibration in compression, in Santiago- Chile.

3. RESULTS

The paper presents the main results obtained during the development of Phase 1 of this Triangular Project.

3.1 Comparison in Chile

Members out of eight force laboratories of the countries: Bolivia, Colombia, Ecuador, Panamá, Paraguay, Peru, Uruguay as well as the host, the National Force Laboratory

of Chile at IDIC, were involved. The workshop was supported by experts of Physikalisch-Technische Bundesanstalt (PTB), the National Metrology Institute of Germany.

The metrological equipment of the most participating laboratories consists of so-called measuring chains. Force calibration machines (FCM) are available only in two laboratories.

The metrological experiences are very different in the field of the force measuring. Some participants stand at the beginning of working in the field of force calibration. Their equipment was used for the very first time during this workshop while others have already quite extensive practical activities.

Due to the these facts it was arranged on the last meeting that all participants shall calibrate a material testing machine (MTM) with their own equipment.
The calibration was carried out in accordance with ISO 7500-1. After the calibration all participants calculated the resulting measurement uncertainty.

This measuring can not be equated with a comparison measuring. This action represents a snapshot which shall show the present metrological possibilities of the involved countries.

3.1.1. The Material Testing Machine

The MTM on which the measurements took place was designed for testing metallic specimen. The applied force is not constant during the measurement reading but the speed is reduced to a minimum.
The working range is 15000 kgf or approximately 150 kN. The resolution of the indicator switches automatically at approx. 2800 kgf.

3.1.2. The Measurement Equipment

The used force transducers and amplifiers was quite heterogeneous. The amplifiers varied between DK38, MGC with different measuring units, SCOUT 55 and last but not least a proving ring as a passive, analogous instrument. The nominal range of all force transducers was 50 kN except the proving ring (22 kN). All amplifiers work with carrier frequency which depends on the different types (225 Hz, 600 Hz and 4,8 kHz).

3.1.3. Force Transducers

The force transducers (measuring chains) were recalibrated in different force standard machines (FSM) with different measurement uncertainties. The classification of a force transducer is no property of the device but is the result of a measuring. It is supposed that all force transducers are of class 1 (even if the result in the FSM was better).

3.1.4. General Specifications

The long term drift of all transducers is estimated to $u_D = 2 \cdot 10^{-4}$ (k=2).
The influence of the ambient temperature is estimated to $u_T = 5 \cdot 10^{-4}$ (k=2).
The contribution of the linear approximation is estimated to $u_A = 5 \cdot 10^{-4}$ (k=2).
The contribution of the linear approximation has to be taken into account only in case the “cubic” values are not used.
It may seem that the specified values are too big, but in comparison with other contributions the result is influenced marginally.
However completely different situations can be present in the practice. Hence the actual values may vary considerably.

In conclusion the following can be summarized:
Under consideration of the different equipment and the little practical experience of some participants the result is satisfactory. In the near future it is important that all involved persons improve their practical experiences. Hereby the competence can be achieved how it is required e.g. for a possible future accreditation.

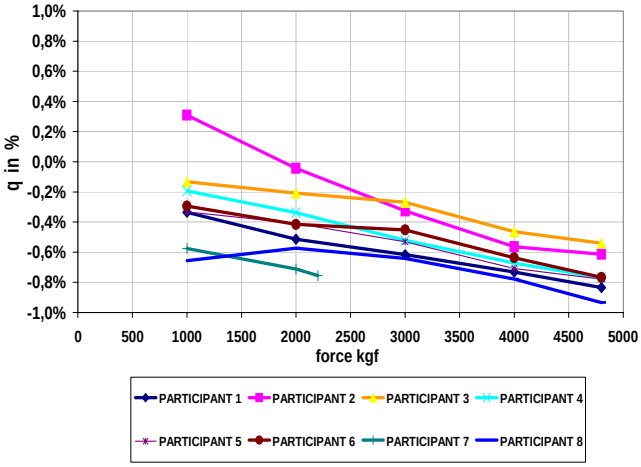

Fig.1 Deviation of the mean values

In Fig. 1 is shown how the mean values of the MTM indicator varies in relation to the standard (force transducer) of the particular participants. In this diagram no measurement uncertainty is included.

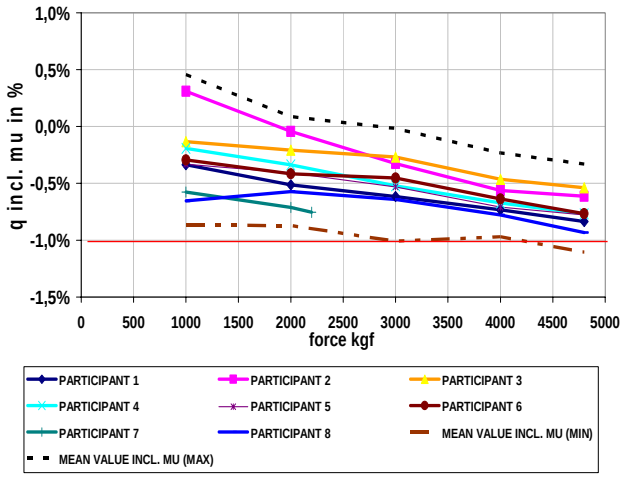

Fig.2 Deviation of the mean values incl. measurement uncertainties

In Fig. 2 is shown how the mean values of the MTM indicator varies in relation to the standard (force transducer) of the particular participants. The measurement uncertainty of all measurements is included. The results can vary between the upper and the lower border lines (chain-dotted lines). The red line at -1 % shows the limit for class 1 of the MTM. From aprox. 2800 kgf up to the end of the investigated range it is questionable if the MTM fit the requirements of class 1.
But, this picture is a summary of the measurements of **all** participants. This is no usual practice. It shall show how the results can differ if several persons with different equipment work on the same object.

4. CONCLUSIONS

This work allowed the following:

To approve technical approaches in the area of professionals of the participant laboratories by means of the understanding and real use of standards ISO 7500 part 1 and 2 and ISO 376.

To generate basic technical capacities in each participant laboratory to answer the respective technical requirements.

To have a trained professional group with domain in the area of calibration of force inside the SIM region.
A regional working net that allows reinforcing the working structure of the Interamerican Metrology System.

To have a technical auditor staff in the region.

In the future, to obtain the international recognition of all participant countries in this project by different ways.

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