TECHNICAL PROTOCOL

SUPPLEMENTARY FORCE COMPARISON IN THE CALIBRATION OF A COMPRESSION TESTING MACHINE

SIM.M.F-S12 (1 000 kN)

Pilot Laboratory

Instituto Nacional de Metrología de Colombia, (INM)

INM
Force Laboratory

(Version 4)
February 2025

Table of Contents

1 Introduction

The SIM (Inter-American Metrology System) working group, SIM-MWG7- MASS AND RELATED QUANTITIESE - FORCE & TORQUE, decided to make a comparison in order to evaluate the degree of equivalence between SIM NMIs in the calibration of 500 kN and 1000 kN compression testing machines. The participants are the National Metrology Institutes of Ecuador, Bolivia, Chile, Peru, Panama, Uruguay, Paraguay, Mexico, and Colombia, the final two being the comparison's reference and pilot laboratories respectively..

2 Objective

Demonstrate the compatibility of the results obtained by the SIM participants in the calibration of the compression materials testing machines. The reference values will be the results of the reference laboratory (CENAM).

3 Item Object of Comparison (IOC)

For this comparison, the instrument under test is a testing machine with the following characteristics.

Table 1. Item to be compared

Manufacturer	DONGGUAN LIYI ENVIROMENTAL TECHNOLOGY CO., LTD	
Model	LY-WAW-1000D	
Series	2012309	
Capacity	1000 kN	

The test machine (IOC) will be operated only by the laboratory technician, none of the participants in the comparison is authorized to do so.

4 Organization

The organization is coordinated by the Force Laboratory from INM, Colombia, with the support of IDIC, Chile.

The technical protocol was developed by the pilot laboratory, with a review by CENAM and IDIC. The final protocol will be sent to all participants before starting the comparison.

4.1 Requirements for participation

Participating laboratories must have the appropriate equipment to provide calibration services for compression materials testing machines and must offer this calibration service on a regular basis to their customers.

A schedule will be established later in the organization of the comparison. Each laboratory participating in the schedule will be allotted two (2) hours for measurement and one (1) week for delivery of measurement results.

4.2 Participants

The reference value for this comparison will be provided by the CENAM force laboratory from Mexico, and the pilot laboratories are the force laboratories of INM (Colombia) and IDIC (Chile). Contact details for the coordinators and each participant are given in Table 2.

Table 2. Participants

Institute	Address	Contact Person
IDIC - Chile	Avda. Pedro Montt 2136, Santiago	Christian Villarroel Poblete (cvillarroel1@gmail.com)
CENAM - Mexico	km 4.5 Carretera a Los Cués Municipio El Marqués 76246 Querétaro	Jorge Torres Guzmán (jtorres@cenam.mx) Alejandro Cárdenas (acardena@cenam.mx)
INM – Colombia (Pilot)	AV carrera 50 # 26-55 INT 2 CAN	Juan Alberto Arias Prieto (jarias@inm.gov.co) Iván Betancur Pulido (ibetancur@inm.gov.co)
INACAL – Peru	Calle de la Prosa 150, Lima 41 San Borja. Lima-Perú	Leonardo de la Cruz García (ldelacruz@inacal.gob.pe) Ricardo Sánchez (rsanchez@inacal.gob.pe)
INEN – Ecuador	Baquerizo Moreno E8-29 y Diego de Almagro	Wilson Guillermo Angulo - (wangulo@normalizacion.gob.ec) Sebastian Vicente (svicente@normalizacion.gob.ec)
IBMETRO – Bolivia	Av. Camacho N° 1488 – Edificio Anexo La Paz - Bolivia	José Luis Chura (jchura@ibmetro.gob.bo)

LATU – Uruguay	Avda. Italia 6201 – C.P. 11500 Montevideo - Uruguay	Oscar Rafael Vidal (ovidal@latu.org.uy)
INTN - Paraguay	Avda. Gral. José Gervasio Artigas 3973, Asunción 1706	Roque Arnaldo Baez Génez (rbaez@intn.gov.py)
CENAMEP - Panamá	Ciudad del Saber, Calle Luis Bonilla, Edificio 206. Panamá – Panamá Ancon	José Kuruc (jkuruc@cenamep.org.pa)

4.3 Comparison Schedule

The comparison is organized with two petals. Each laboratory will have two (2) hours to make their measurements and leave the machine in the initial conditions so that the next participant can make the measurements.

The measurement scheme can be seen in Table 3. It is also important to note that participating NMIs must strictly respect the time allotted for their participation.

Table 3. Comparison Schedule

INM	Country	Date and time
INM	Colombia	2023-10-16 / 08:00
IBMETRO	Bolivia	2023-10-16 / 14:00
INACAL	Peru	2023-10-16 / 16:00
INEN	Ecuador	2023-10-17 / 08:00
CENAMEP	Panama	2023-10-17 / 10:00
INM	Colombia	2023-10-17 / 14:00
LATU	Uruguay	2023-10-17 / 16:00
INTN	Paraguay	2023-10-18 / 08:00
IDIC	Chile	2023-10-18 / 10:00
CENAM	Mexico	2023-10-18 / 14:00
INM	Colombia	2023-10-18 / 16:00

4.4 Environmental Conditions

Preferably, the measurements should be carried out at the ambient conditions given below:

- Temperature: (20.0 ± 2.0) °C
- Relative humidity: (50 ± 10) %RH

The air temperature near the force transducer in ºC will be recorded with each measured value, excluding preloads. The relative humidity in % and the air pressure in hPa will be recorded at the beginning and at the end of measurements.

4.5 Comparison development

Each of the participants will calibrate the IOC described in numeral 4 in the facilities of the laboratory of Ensayos y Calibración LABOMET SpA. De Chile, in the indicated interval, additionally, it shall estimate the measurement uncertainty according to its procedure. The calibration will be made on the dates established in the comparison schedule and the results must be sent to the pilot laboratory on the stipulated dates.

Each participant must send the measuring instruments to IDIC's strength laboratory at least two weeks before the beginning of the comparison. In case the participant brings his/her equipment with him/her, it is recommended that he/she deliver it to IDIC's strength laboratory at least one day before the measurements. It should be noted that the standard and auxiliary equipment used in the measurements are the property of each laboratory.

Each laboratory will have two (2) hours for the development of its measurements. The participation scheme of the comparison will be in the form of two (2) petals, comprised of a maximum of four (4) participants. The pilot laboratory will make measurements at the beginning and end of each of the petals.

5 Measurement protocol

The procedure to make the comparative measurements is described as one (1) increasing series in each position, making two (2) turns of 120° each, to have a total of 3 mounting

positions (0°, 120°, and 240°). The results of the IOC measurements shall be evaluated in the range of 50% to 100%, i.e. 500 kN and 1000 kN.

The measurements should be made following the general principles established in ISO 7500-1:2018. The measurement scheme can be seen in Illustration 1 (estimated time):

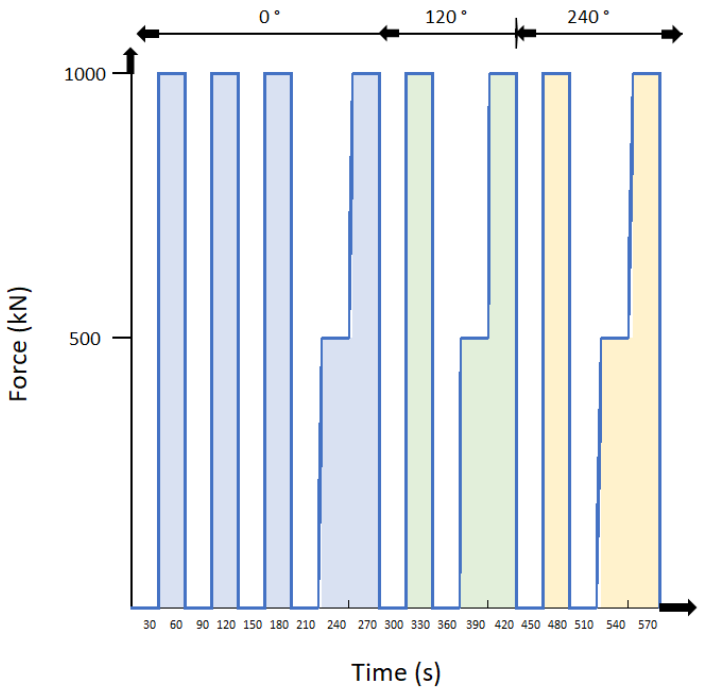

Illustration 1. Measurement scheme

The result of the measurements must be reported in the spreadsheet intended for this purpose, reporting the value of the readings, average readings, error of indication (q), repeatability error (b), and the uncertainty of the results of the calibration of the force system.

6 Reporting of results

The results should be prepared and sent to the pilot laboratory after completing the measurements.

- The report should contain as a minimum:
- Details of the participating laboratory.
- The measurement data.
- Environmental conditions during the measurements.
- Measurement results: the measurement results are in the corresponding Excel spreadsheet.

7 Final comparison report

The pilot laboratory is responsible for the preparation of a final comparison report.

The draft version of the comparison report will be issued within three months of the pilot laboratory's receipt of the participant's report. The draft report will be sent to all participants for discussion and approval. This draft will be confidential among the participants.

Participants will have one month to send their comments on the Preliminary Report. After approval, the Draft Report will become the Final Report which will be sent to to CCM-WGFT for comment and final editorial checking.

8 References

[1] CCEM Guidelines for Planning, Organizing, Conducting and Reporting Key, Supplementary and Pilot Comparisons, 2007 (available on the BIPM website: http://www.bipm.org/utils/common/pdf/CC/CCEM/ccem_guidelines.pdf)

[2] Evaluation of measurement data - Guide to the Expression of Uncertainty in Measurement (GUM), JCGM 100, First edition, September 2008 (available on the BIPM website: http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf)

[3] EA Publication EA-4/02, Expression of the Uncertainty of Measurement in Calibration

[4] ISO / IEC 17043 “Conformity assessment — General requirements for proficiency testing”, International Standardization Organization”, 2010

[5] EURAMET. (2022). *Guidelines on the Uncertainty of Force Measurements EURAMET Calibration Guide No. 4 Version 3.0 (02/2022).*

[6] CIPM MRA-G-11 − Measurement comparisons in the CIPM MRA, 2021

[7] ISO 7500-1:2018 Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system. Switzerland: ISO.