National Institute of Standards

EGYPT

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The National Institute for Standards (NIS) was established in 1963 by a governmental Decree under The Ministry of Scientific Research. The principal functions of NIS are to maintain National /Primary Standards, provide tractability to laboratories in different fields. These laboratories disseminate the standards by further calibration of working standards which in turn are used for quality control and other purposes in such areas as defense, safety, health, legal metrology,..etc.
Functions & Objectives

• Realization and dissemination of SI Units.

• Maintaining the Egyptian National Measurement Standards.

• Offering Traceability of Measurement to the SI Units.

• Operate the national laboratory accreditation scheme

• Conduct Research & Development in Metrology and Advanced Measurement Technology.
Functions & Objectives

• Provide calibration services to end user in the area that are not available in other laboratory.

• Training courses in measurement technologies and related Subjects, consultancies and courses. These activities are all end user oriented and run on economic basis.

• To share, and organize international, regional and national metrology programs, quality and accreditation activities.

• To be an Internationally Recognized Institute for Meteorological Activities.
Management Systems

NIS has already prepared a management system based on ISO 17025. The system is now implemented at some of the laboratories such as mass, pressure, force and length. Other laboratories such as thermometry and electricity are about to put the system in place as well.
Links Between NIS and International Metrology Organization

- BIPM
- NIS
- EUROMET
- APMP
- SADCMET
International Key or Supplementary Comparison

A number of NIS laboratories have participated in International key and supplementary comparisons through APMP, EUROMET, and SADECMET. Bilateral comparison with NPL in force was also conducted and the results are published on the BIPM web. Other bilateral comparisons with NIST in Thermometry and Electricity are currently carried out. Results of these comparisons will be published at the BIPM website.
<table>
<thead>
<tr>
<th>Scope</th>
<th>Type of Comparison</th>
<th>status</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS</td>
<td>APMP.M.M-K1, APMP.M.M-K2, APMP.M.M-K6, SADCMET.M.M-K5, SADCMET.M.M-S1</td>
<td>Approved for Equivalence, In progress, In progress, In progress</td>
</tr>
<tr>
<td>PRESSURE</td>
<td>APMP.M.P-K1.c, APMP.M.P-K7.TRI, APMP.M.P-K7</td>
<td>Approved for Equivalence, Report in progress, Approved for Equivalence</td>
</tr>
<tr>
<td>FORCE</td>
<td>Bilateral comparison with PTB EUROMET.M.F-S1 with NPL CCM.F-K2.b, APMP.M.F-K4</td>
<td>Completed, Completed, In progress, In progress</td>
</tr>
</tbody>
</table>
Mass and Force Metrology Division

- Force and Material Metrology Dept
- Mass, Pressure and Density Dept.
- Ultrasonic Dept
- Acoustic Dept.
- Volume & Flowmetry Dept (under establishment)
* under establishment
Dead-Weight Machines

50 kN Force Standard Machine

Loading range: 500 N – 50 kN (Comp./Ten.)

Loading steps: 500 N

With uncertainty of 0.002% (20 ppm)
500 kN Force Standard Machine

Loading range: 10 kN – 500 kN
(Comp./Ten.)

Loading steps : 5 kN

With uncertainty of 0.002% (20 ppm)

The load can be amplified to 1 MN through a substitute loading system

With uncertainty of 0.01% (100 ppm)
5 MN Force Standard Machine

Loading range: 100 kN – 5 MN (Compression)

Loading steps: 50 kN

With uncertainty of 0.02% (200 pp)
The first inter-comparison with PTB Force Primary Standards 2000-2001

En values for the 1000 kN range
Bilateral comparison of national force standard machines of Egypt (NIS) and the United Kingdom (NPL) 2006

<table>
<thead>
<tr>
<th>Test</th>
<th>Force</th>
<th>NIS uncertainty</th>
<th>NPL uncertainty</th>
<th>$E_n$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>5 kN</td>
<td>0.002 4</td>
<td>0.003 8</td>
<td>1.00</td>
</tr>
<tr>
<td>A2</td>
<td>20 kN</td>
<td>0.002 3</td>
<td>0.003 5</td>
<td>0.14</td>
</tr>
<tr>
<td>A3</td>
<td>50 kN</td>
<td>0.002 4</td>
<td>0.003 7</td>
<td>0.07</td>
</tr>
<tr>
<td>B1</td>
<td>200 kN</td>
<td>0.002 1</td>
<td>0.003 5</td>
<td>0.54</td>
</tr>
<tr>
<td>B2</td>
<td>500 kN</td>
<td>0.002 5</td>
<td>0.006 7</td>
<td>0.12</td>
</tr>
<tr>
<td>B3</td>
<td>1 MN</td>
<td>0.012 3</td>
<td>0.007 4</td>
<td>1.16</td>
</tr>
<tr>
<td>C1</td>
<td>500 kN</td>
<td>0.020 5</td>
<td>0.021 0</td>
<td>0.08</td>
</tr>
<tr>
<td>C2</td>
<td>1 MN</td>
<td>0.020 2</td>
<td>0.020 7</td>
<td>0.18</td>
</tr>
<tr>
<td>C3</td>
<td>5 MN</td>
<td>0.024 0</td>
<td>0.050 3</td>
<td>0.65</td>
</tr>
</tbody>
</table>

*En* value NPL uncertainty

![Graph showing force ratio and uncertainty values](image-url)
The laboratory acquires the two Torque calibration Machines (secondary standard torque machines) with uncertainty of 0.05%

2 kN.m Torque Standard Machine

20 N.m Torque Standard Machine
FMMD Running Project

• Construct primary torque standard M/C capacity 5 kNm
• Construct small dead M/C capacity 1 kN
• Construct primary hardness testing M/C (Vickers)

Required Activities:
Participate in Key Comparison in Force Measurements.
( From 0.5 kN up to 5000 kN )
Participate in Key Comparison in Torque Measurements.
(From 1 Nm up to 10 Nm)
(from 20 Nm up to 2000 Nm)
Mass, Density and Pressure Lab.

Mass Department

Mass Lab.
- Mass Calibration Sub-Lab
- Balances Calibration Sub-Lab.

Pressure Lab.
- Low pressure (Gas Pressure) Sub-Lab
- High Pressure (Oil Pressure) Sub-Lab

Volume Lab.
- Small Volume Sub-Lab
- Glass Sub-Lab
- Metallic Sub-Lab
- Large Volume Sub-Lab

Density Lab.
- Secondary Liquid Density Measurements Sub-Lab.
NIS Standard masses and their traceability to the National kilogram

National Prototype Pt-Ir kilogram No.58

3 standard kilograms
$E_1$ (OIML)

$E_1$ Set of masses from 1 mg to 50 kg

$E_2$ Set of masses from 1 mg to 50 kg

2 standard kilograms cylinder shape

Set of masses from 1 mg to 10 kg

$E_2$ Set of masses from 1 mg to 20 kg

2 standard kilograms cylinder shape with knob

Set of masses from 10 mg to 20 kg
Current Status of Mass Lab - NIS

Mass:

• Copy No 58 Pt-Ir
• Several sets of masses from 1mg to 50 kg of E1 and E2 classes and disk weights as well.
• 10 ton of masses for industrial needs.
• Set of comparators to cover the range from 1 mg to 50 kg with E1 capability
• Susceptometer for measuring the magnetic properties of the masses to be comply with the new version of OIML R111
Pressure:

- Several pressure balances for absolute and gauges modes.
- Two PCA of 10 cm$^2$ dimensionally characterized.
- Several PCAs of different ranges up to 40 MPa gas and 500 MPa gauge.
- Systems for measuring the environmental conditions of the lab for correcting the results.
Density:

Two systems were installed for measuring the densities of solid (mass standards):

1- Hydrostatic system to measure the density of masses from 1 g to 1 kg.

2- System using pycnometers to measure the density of masses from 2 kg to 50 kg is installed.
Pressure Traceability

Gas Pressure

- 10 MPa (PCA)
  - APMP Key comparrison No. APMP.M.P-K1.C

- 50 MPa (PCA)

Oil Pressure

- 20 MPa (PCA)
  - Traciability to BNM-LNE

- 50 MPa (PCA)
  - Calibration at NIST

- 100 MPa (PCA)
  - APMP Key comparrison No. APMP.M.P-K7

- 200 MPa (PCA)
  - APMP Tiatrial Compasion No. APMP.M.P-K7.TRI
Gray pistons : are applied in the upgrading plan
White pistons are the old used PCAs
PCA : Piston Cylinder Assembly

First verification group
Second verification group
Third verification group
Traceability group

Gas primary Pressure Standards calibrated traced to PTB dimensional standards

Pressure Levels:
- 1 MPa (PCA)
- 2 MPa (PCA)
- 5 MPa (PCA)
- 10 MPa (PCA)
- 20 MPa (PCA)
- 50 MPa (PCA)
- 100 MPa (PCA)
- 200 MPa (PCA)
- 500 MPa (PCA)

Oil Pressure
Gas Pressure

Dimensional Standards calibrated traced to PTB
<table>
<thead>
<tr>
<th>Calibration or Measurement Service</th>
<th>Measurand Level or Range</th>
<th>Measurement Conditions / independent Variable</th>
<th>Expanded Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>Instrument of Artifact</td>
<td>Instrument Type or Method</td>
<td>Value</td>
</tr>
<tr>
<td>Pressure P</td>
<td>Pressure Balance</td>
<td>Oil</td>
<td>$3 \times 10^{-5} - 1.2 \times 10^{-4}$ Pa</td>
</tr>
<tr>
<td>Pressure P</td>
<td>Pressure Balance</td>
<td>Gas</td>
<td>$2 \times 10^{-5} P - 1 \times 10^{-4} P$ Pa</td>
</tr>
<tr>
<td>Pressure P</td>
<td>Pressure measuring device</td>
<td>Oil</td>
<td>$3 \times 10^{-5} - 1.2 \times 10^{-4}$ Pa</td>
</tr>
<tr>
<td>Pressure</td>
<td>Pressure measuring device</td>
<td>Gas</td>
<td>$0.1 - 0.005$ %</td>
</tr>
<tr>
<td>Mass m</td>
<td>Weight</td>
<td>OIML Weights</td>
<td>$5 - 40 \mu g$</td>
</tr>
<tr>
<td>Mass m</td>
<td>Weight</td>
<td>OIML Weights</td>
<td>$2 - 10 \mu g$</td>
</tr>
<tr>
<td>Mass m</td>
<td>Weight</td>
<td>OIML Weights</td>
<td>$2 - 100 mg$</td>
</tr>
<tr>
<td>Density p</td>
<td>Density measuring device</td>
<td>Hydrometers</td>
<td>$0.05$ %</td>
</tr>
<tr>
<td>Volume V</td>
<td>Glassware</td>
<td>Mettler AT1005</td>
<td>$0.01$ %</td>
</tr>
<tr>
<td>Volume V</td>
<td>Metallic Volumes</td>
<td>One Volume Standards</td>
<td>$0.05$ to $2$ %</td>
</tr>
</tbody>
</table>
Running Projects

Acquiring a comparator for small masses automatically calibration for reducing the uncertainty as well as reduction of the time consuming in calibration.

Acquiring some instruments to complete static expansion system for vacuum gauges calibration.

Required activities:

Participate in Comparison in absolute pressure Measurements.
Participate in Comparison in solid density Measurements.
Thank You