



**ACCREDITATION
DOCUMENT**

F-06/02
Issue Date: 25/05/08
Rev. No: 05
LAB 001

Calibration Laboratory

Accreditation Scope of National Physical & Standards Lab (NPSL), Islamabad, Pakistan.

Permanent laboratory premises

FIELD OF MEASUREMENT: I) TIME AND FREQUENCY

Measured quantity	Range	Best Measurement Capability expressed as an uncertainty (\pm)	Brief description of Measurement and Equipment used
Frequency (Hz)	i) 9.0 kHz - 2.4 GHz.	4.1×10^{-10} MHz	Different types of counters, Generators, Frequency standard, Measuring Receivers, Oscilloscope, and Attenuator are calibrated.
	ii) 0.1 Hz – 18.0 GHz.	4.7×10^{-7} MHz	Following Equipments are used during the calibration of above items: (i) Atomic Frequency Standard (ii) Frequency Generator (iii) Frequency Counter (iv) Calibration Generator (v) Time Mark Generator (vi) Phase Comparator/ Meter (vii) Range calibrator.
Time (s)	24 hrs.	6×10^{-3} s	All types of mechanical and digital stopwatches and items are calibrated. Following Equipments are used during the calibration of above items: (i) Atomic frequency standard (ii) PST Master clock
II) LENGTH AND DIMENSION			
Length	(i) 0.0 mm – 1000 mm	0.1 mm (point to point comparison) & 0.01 mm (end to end comparison)	Meter Scales, Measuring Tapes, steel rulers, One meter Gauge Blocks, Length Bars using Length Comparator & Double Image Comparator

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Measured quantity	Range	Best Measurement Capability expressed as an uncertainty (\pm)	Brief description of Measurement and Equipment used
Length	(ii) 0.0 mm - 300 mm	0.1 μ m	Gauge Blocks sets up to 100 mm range normally End Standards, Feeler Gauges, Snap Gauges, Dial Gauges Using Mechanical Measuring Machine & Universal Measuring Machine
	(iii) 0.0 mm - 300 mm	0.1 mm	Vernier caliper, Dial calipers, External Micrometers, Thickness gauges and Mandrel Using Standard Gauge Blocks set.
Diameter External	10 mm - 300 mm	0.1 μ m	Master Plug Gauges, Pin Gauges and Cylinders using Mechanical Measuring Machine & Universal Measuring Machine
Diameter Internal	10 mm - 205 mm	0.1 μ m	Master Ring Gauges Using Mechanical Measuring Machine & Universal Measuring Machine
Flatness	25.4 mm - 220 mm	$\lambda/2$ (where λ is the wavelength of green light used)	Optical Flats, Polished Surface of gauge blocks
(III) MASS MEASUREMENTS			
Mass (Secondary)	i) 1 mg - 30 g ii) 30 mg - 200 g iii) 200 mg- 1000 g iv) 2 kg - 5 kg v) 10 kg - 20 kg	1 μ g 100 μ g 1 mg 3 mg 15 mg	Calibration and measurement of class E ₂ , secondary standard masses, F ₁ class masses and class - 1 weighing balances using E ₂ class standard masses and series of precision balances of direct reading digital and two pan mechanical balances.

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Measured quantity	Range	Best Measurement Capability expressed as an uncertainty (\pm)	Brief description of Measurement and Equipment used
Mass (Working)	i) 1 mg - 30 g ii) 30 mg - 200 g iii) 200 mg - 1000 g iv) 2 kg - 5 kg v) 10 kg - 20 kg	5 μ g 300 μ g 3 mg 5 mg 30 mg	Calibration and measurement of class E ₂ , working standard masses F ₂ class masses and class II weighing balances of direct reading and two pan mechanical balances using E ₁ class standard masses and series of precision balances of direct reading digital and two pan mechanical balances.

(IV) ELECTRICAL MEASUREMENTS

DC Voltage	0.1 mV - 1050 V (10 Hz to 1.5 MHz)	3×10^{-4} V	Calibration of Voltmeters, digital multi- meters, potentiometers, volt ratio boxes using voltage calibration system/ standard
	1.018000 V	1×10^{-7} V	Comparison measurement of standard cells using reference electrochemical & electronic standard cells.
AC Voltage	0.1 mV - 1050 V (10 Hz to 1.5 MHz)	1×10^{-6} V	Calibration of voltmeters, digital multi- meters, ac voltage calibration etc using voltage calibration system/ standard, reference ac voltmeters.
DC Current	1.0 m A - 20 A	3×10^{-4} A	Calibration of digital / analog dc ammeters, current sources, power supplies, current shunts, clamp meters, current ranges of digital multi meters, using multi function calibration system.
AC Current	10 mV - 20 A (10 Hz to 30 KHz)	3×10^{-3} A	Calibration of digital / analog dc ammeters, current sources, power supplies, current shunts, clamp meters, current ranges of digital multi meters, using multi fiction calibration system

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Measured quantity	Range	Best Measurement Capability expressed as an uncertainty (\pm)	Brief description of Measurement and Equipment used
Capacitance	0.01 μ F - 1 μ F	1x10 ⁻⁵ μ F	Standard capacitors, digital/ analog capacitances meters, decade capacitors etc using standard capacitors & universal calibration system.
Resistance	(i) 1.0 m Ω - 100 K Ω (ii) 100 K Ω - 40 M Ω	1x10 ⁻⁴ Ω (for 2- Terminal) 1x10 ⁻⁴ Ω (for 4- Terminal)	2 & 4 terminal standard resistors. Decade resistance boxes, resistance calibrators, resistances meters, resistance parameters of LCR meters, meggers, insulation testers, clamp meters using universal calibration system, 2 & 4 terminal ref standard resistors.
Power(dc/ac)	1 mW - 10 KW	2x10 ⁻² W	Power meters, power sources using universal calibration system, electrodynamic watt meters.

(V) TEMPERATURE MEASUREMENT

Temperature (Direct)	i) -38 °C - 200 °C ii) 201 °C - 405 °C	0.1 °C 0.15 °C	Calibration measurement of a liquid in glass thermometer. Equipment used: ASTM Thermometers, Ice bath, Water bath, Oil bath, Dry block Comparator
Temperature (Direct)	0 °C - 900 °C	1 °C	Calibration measurement of various types of thermocouples Equipment used: Ref. Thermocouple, Zero point Dry Well, Digital Thermometer, Water bath, Dry block, Comparator and Muffle furnace

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Measured quantity	Range	Best Measurement Capability expressed as an uncertainty (\pm)	Brief description of Measurement and Equipment used
(VI) PRESSURE			
Pressure	i) 0.1 - 1100 bar	0.017 %	Pressure Gauge and dead weight testers are calibrated. Equipment used: Dead weight pressure tester and references gauges.
	ii) 10 psi - 18000 psi	0.0086 %	Pressure gauge and dead weight pressure testers are calibrated. Equipment used: HDWT and references gauges,
	iii) -1 bar - 20 bar	0.0086 %	Vacuums gauges, pressure gauges and pneumatic calibrators are calibrated. Equipment used: Digital Calibrator.
(VII) VISCOSITY MEASUREMENT			
Viscosity	1 cst - 20,000 cst	0.7 %	Calibration of viscometers by comparison method using UBBELOHDE type viscometers.
(VIII) CONDUCTIVITY MEASUREMENT			
Conductivity	0.01 $\mu\text{s/cm}$ - 10^{-6} $\mu\text{s/cm}$	3.98 $\mu\text{s/cm}$	Calibration of conductivity meters by using KCI standard solution.
(IX) PH MEASUREMENT			
pH	1-14	0.01	Standard Buffer solutions / Two point calibration method

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Testing Scopes

Materials / Products Tested	Types of test/ Properties measured	Range of measurement	Minimum detection limit	Uncertainty of Measurement (where applicable) MU (±)	Standard specifications/ Technique/ Equipment used
Electrical Conductivity of water	Measurement of conductivity	5.0 µmhos/cm - 5000 µmhos/cm	3.0 µmhos/cm	2.5 µmhos/cm	AWWA/APHA 2510 –B Conductometry /Conductivity meter
Viscosity of Oils	viscosity	5 cst – 20.0 cst	1.0 cst	1.8 %	ASTM D 445-97 Ubbelohde viscometers (kinematics viscosity)
pH of Water	Measurement of pH	1 to 14	0.01	0.03	ASTM D1293-99 Two point calibration (glass electrode method)
Water/ Wastewater and Industrial Effluents	Total Dissolved Solid (TDS)	3.0 mg/L - 200 mg/L	2.5 mg/L	3.0 mg/L	Gravimetric method, 2540 B, AWWA/APHA
	Total Suspended Solid (TSS)	3.0 mg/L - 200 mg/L	2.5 mg/L	3.0 mg/L	Filtration & Drying of residues,2540D, AWWA/APHA
	Total Hardness	5 mg/L - 1000 mg/L	2.0 mg/L	3.0 mg/L	EDTA Titrimetric method, 2340 C AWWA/APHA
	Alkalinity	20 mg/L - 500 mg/L	2.0 mg/L	2.0 mg/L	Titration method 2320 B AWWA/APHA
	Chloride	1.5 mg/L - 100 mg/L	1.0 mg/L	1.0 mg/L	Argentometric Method, 4500 CIB, AWWA/APHA
	Calcium	1 mg/L - 100 mg/L	0.8 mg/L	2.0 mg/L	EDTA Titric method, 3500-CaB AWWA/APHA
	Nitrate	0.2 mg/L - 11 mg/L	0.1 mg/L	0.1 mg/L	Phenoldisulphonic acid method 4500 NO ₃ B AWWA/APHA
	Phosphate	2.5 mg/L - 20 mg/L	0.2 mg/L	1.0 mg/L	Vanamolybdophosphoric, acid method, 4500 PC, AWWA/APHA
	Sulphate	15 mg/L - 200 mg/L	10.0 mg/L	3.0 mg/L	Gravimetric method, 4500 SO ₄ D, AWWA/APHA
	Chemical Oxygen Demand (COD)	10 mg/L - 900 mg/L	5.0 mg/L	8.0 mg/L	Open reflux method, 5220 B, conductivity meter
	Copper in water	0.2 mg/L –	0.05	0.1 mg/L	

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<p align="center">Water/ Wastewater and Industrial Effluents</p>	ASTM(D168 8-95) wavelength: 324.8nm	5 mg/L	mg/L		<p align="center">ASTM Standards/ Atomic Absorption Spectrometer, model A Analyst -100, Perkin Elmer-USA/ Direct method (Flame - AAS)</p>
	Iron in water ASTM(D106 8-96) wavelength: 248.3nm	0.3 mg/L - 5 mg/L	0.06 mg/L	0.1 mg/L	
	Potassium in water ASTM(D419 2-97) wavelength:7 66.5nm	1.0 mg/L - 4 mg/L	0.02 mg/L	0.8 mg/L	
	Sodium in water ASTM(D419 1-97) wavelength: 589.0nm	0.2 mg/L - 3 mg/L	0.02 mg/L	0.1 mg/L	
	Nickel in water ASTM(D188 6-84) wavelength: 232.0nm	0.1 mg/L - 10 mg/L	0.06 mg/L	0.6 mg/L	
	Magnesium in water ASTM(D511) wavelength: 285.2nm	0.25 mg/L - 3.5 mg/L	0.01 mg/L	0.15 mg/L	
	Chromium in water ASTM(D168 7-92)	0.5 mg/L - 10 mg/L	0.06 mg/L	0.24 mg/L	

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	wavelength:357.9nm				<p align="center">ASTM Standards/ Atomic Absorption Spectrometer, model A Analyst -100, Perkin Elmer-USA/ Direct method (Flame - AAS)</p>
	Lead in water ASTM(D355 9-96) wavelength:283.3nm	2 mg/L - 10 mg/L	0.28 mg/L	0.5 mg/L	
	Cadmium in water ASTM(D355 7-95) wavelength:228.8nm	0.5 mg/L - 2 mg/L	0.08 mg/L	0.12 mg/L	
	Zinc in water ASTM(D169 1-95) wavelength:213.9nm	0.5 mg/L – 2 mg/L	0.02 mg/L	0.2 mg/L	

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