PRECISION MEASUREMENT LABORATORIES FOR VACUUM AND OPTICS IN THE PRECISION INSTRUMENT DEVELOPMENT CENTER, NATIONAL SCIENCE COUNCIL, REPUBLIC OF CHINA

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in

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OUTLINE

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1. Introduction

The National Bureau of Standards, Ministry of Economy, R.O.C. is the organization responsible of the standards and calibrations. Most basic standards or primary standards and the calibrations of basic quantities are provided by them or their authorized organizations. Some standards and calibrations of derived quantities are provided at several institutes due to historical and practical reasons, the Precision Instrument Development Center (PIDC) is one of the institutes among the others.

Optics and vacuum are two major research fields in the PIDC, from time to time, we found that optical and vacuum calibrations are demanded not only by our institute but also by the industrial and research institutes in Taiwan. So, the vacuum calibration laboratory was established in 1980 and the optical calibration laboratory was established last year in PIDC.

2. Vacuum calibration

Vacuum technology becomes very important in recent years in the industry and research units in Taiwan, Republic of China. Pressure range from atm to ultra-high vacuum is covered. However, in most applications the vacuum environment is dealt with pressure $>10^{-7}$mbar. For the promotion of technical level in industry, the need of more accurate vacuum measurement is increasing recently. PIDC started to set up a vacuum gauge calibration system few years ago, and began to offer this kind of service in Taiwan since then.

Now, the calibration range covering from 1 atm to 10^{-6}mbar with accuracy of 1%-25% can be made. The following table is the list of Instruments for vacuum gauge calibration in our laboratory.

INSTRUMENTS FOR VACUUM GAUGE CALIBRATION

Item : Instruments	Range (mbar)	Accuracy	Comment
1. U-Tube (Home made)	1000-1	1-10%	Reference
2. McLeod Gauge (L-H GMBH)	10^{-4}-10^{-1}	-	Reference
3. Expansion System (Home made)	10^{-6}-10^{-1}	5-25%	Reference
4. Capacitance Manometer 310CHS-10 (MKS Instruments, Inc.)	10^{-3}-10	0.08%±Temp. coeff. (Manufacturer's Specification)	Transfer
5. Capacitance Manometer 310BHS-1 (MKS Instruments, Inc.)	10^{-4}-1	0.08%±Temp. coeff. (Manufacturer's Specification)	Transfer
6. Spin Rotor Viscosity Gauge VM 210 (L-H GMBH)	10^{-6}-10^{-2}	$<\pm 1\times10^{-7}$ to $\pm 1\times10^{-4}$mbar (Manufacturer's Specification)	Transfer

3. Optical Measurement and Calibration

A. The precision measurements & calibrations laboratory provides following measurements.

(1) The measurements of refractive index of glasses and liquids at various wavelength, can be made with uncertainty within :

$\pm 1 \cdot 10^{-5}$ for index of refraction
$\pm 3 \cdot 10^{-6}$ for dispersion

(2) The measurements of radius of curvatuve can be made with uncertainty within $\pm 1 \mu m$

(3) The luminance & chromacity measurements can be made as follows :

Range : 0.0001 to 1999000 cd/m²
Accuracy : ±4%

The accuracy of chromacity can be made to ±0.3 (closely related to the C.I.E.)

B. Establishments of measurement standards are in progress. Some of them will be completed within 3 years. The following standards are included.

(1) Length Standard

Stability of laser frequency of better than the order of 10^{-8} will be established in the near future. The final aim is of the order of 10^{-12}, and will be calibrated against the ^{86}kr wavelength standard.

Laser interferrometers will be set up for the calibration of the gauge blocks and the line standards.

(2) Flatness Standard

The establishment of primary flatness standard is in progress. A flatness standard of accuracy of the order of $\lambda/50$ has been purchased from Zygo Company. Zygo Mark III interferometer is

planning to be purchased in this laboratory, hopefully with this instrument flatness standards of better than $\lambda/50$ accuracy can be made by our laboratory in the future.

(3) Luminance Standard

"Topcon" BM-5, luminance meter is used as secondary standard of luminance. The primary luminance standards will be established by a special order from "Topcon" luminance standards tracing to N.B.S.