

## PHYSICO MECHANICAL STANDARDS

### LENGTH & DIMENSIONS

#### 1. LENGTH

Facilities were developed to calibrate commercially available 633 nm frequency stabilised He-Ne lasers against the iodine stabilised He-Ne laser. Improvements were made in the laser interferometric system for calibration of line gauges using photo-electric microscope. The uncertainty in the calibration of line scale of  $\pm 1.0$   $\mu\text{m}$  per metre was achieved. In the sponsored project of photolithographic mask aligner, it was possible to achieve an alignment accuracy of the order  $\pm 50$  nm using methods based on Moire interferometric technique and computer.

The precision optical components like, laser mirror blanks, optical flats etc. were made and tested. The calibration of precision length measuring machines, using laser interferometer was carried out.

#### 2. DIMENSIONAL METROLOGY

The facility for angle measurement using laser interferometer was established. A three coordinate measurement centre model UPMC 850 ZEISS, of range 850 x 1200 x 600mm in x-y-z directions was installed. The calibration of long end bars, using laser interferometer and 4m bench was tried and results compared.

Intercomparison of gauge block was undertaken with PTB Germany and the results agreed within 15 nm. The calibration of heavy items was done at site.

### MASS

The maintenance and recalibration of standards of mass was continued. Facility for testing of weighing machine for model approval was developed and the test procedure was drawn taking into consideration various international specifications. Viscometers of different ranges and calibrated at NPL, were calibrated

at PTB and the results were compared. The measurement of density of silicon along with the study of water absorption using I.R. Technique was continued.

One secondary standard weight box of the Nepal Bureau of Standards and Metrology, was calibrated. The calibration of hydrometers of different types, viscometers, weights, measures etc., were done for state departments and industry.

### FORCE

The 1 MN hydraulic multiplication system manufactured under FIE-NPL collaborative programme was installed at NPL. The accuracy of the application of force is better than  $\pm 0.02$  percent in the range of 100 kN to 1000 kN. This machine would now be used for calibration of all types of force measuring devices including precision load cells. The calibration for the industry was done as usual.

### TEMPERATURE

Electronic circuitry was developed for automation in calibration of thermocouples using PC/AT. Studies on noble metal thermocouples at the fixed points were continued. The spherical furnace and automatic ice point cells received from PTB were installed and used. The development of software and hardware for automatic control of furnace temperature was done. The performance tests on the thermal conductivity apparatus were carried out and results compared.

Two standard platinum resistance thermometers and two triple points of water cells were fabricated. A new assembly for the realisation and establishment of Cd point was completed. The platinum resistance thermometers work was granted accreditation with reproducibility of  $\pm 1$  mK, in the range 630.74°C to -219°C

### OPTICAL RADIATION

The photometry and radiometry laboratories were

being upgraded by installing new, automatic goniophotometer and spectroradiometer with the assistance of PTB, Germany. Basic research on spectral changes induced due to source correlation during propagation of radiation was continued. Calibration and testing were provided to the luminaire industry, educational and R & D institutions.

Under the sponsored project for the indigenous manufacture of retro-reflective sheeting/tapes, the method for characterizing beads was standardized. Detailed investigations with cost analysis of retro-reflecting properties of tapes embedded with indigenous, imported and blended types were made.

## INFRARED RADIATION

The irradiance scale in the spectral region of 0.8 to 15  $\mu\text{m}$  was set up and the irradiance of a few sources were measured. The detector and preamplifier parts of the infrared line scanner of a firm were calibrated for various target temperatures.

The transmittance and reflectances of a few samples of one surface polished and both surfaces polished silicon and germanium single crystals were measured in 2.5 to 25  $\mu\text{m}$  spectral region and their values were computed and compared.

## ACOUSTICS

Experimental studies, under reverberant conditions were conducted to evaluate roofing sheets for their relative sound insulation properties for use in the auditoria etc. The FRP sheets were found to have higher sound insulation (10dB) compared to GI sheets.

While that for asbestos sheets the sound insulation was only 5 dB higher. Noise power levels of room heaters, food mixers and washing machines, were determined for formulating specifications.

Sodar structures of the atmospheric boundary layer collected during the monsoon period of 1990 at Jodhpur were analysed for their characteristic features.

A monostatic sodar was installed at Nimbahera, Chittorgarh for studies of mixing height. A proposal was submitted to the Deptt. of Environment for undertaking environmental impact assessment studies in respect of noise pollution under Indian conditions.

The accuracy of primary standards of sound pressure and vibration amplitude was maintained through periodic checking/calibration. Secondary standards from regional laboratories including tachometers, vibration measuring systems, sound level meters and calibrators were periodically calibrated.

## UNDERWATER ACOUSTICS

Three reference transducers and four high pressure hydrophones were fabricated and their transmitting response and receiving sensitivity measured. The variation of the relative sensitivity of a Bruel's Kjaer hydrophone upto hydrostatic pressures of 1000 psi was studied. The design of various components of the complete pinger device was completed. The acoustical performance characteristics of the 45kHz pinger tag was evaluated for frequency response and directional response and tested at the Badkhal lake, Faridabad. Calibration of transducers for transmitting and receiving sensitivity response was carried for KDIMPE, Dehradun. Exploratory studies in thermoacoustics and acoustic characterization of turbulence were carried out.

The investigations on displacement amplitude measurement of ultrasonic transducers using phase lock laser interferometer were made. Measurement of ultrasonic displacement over the transducer surface radiating in water was done using 1MHz transducer. Ultrasonic flaw detection system (C Scan) was used for characterization of various types of defects in steel bar. Extensive measurements were made on the ultrasonic velocity and attenuation of different piezoelectric ceramic poled and unpoled samples at 7.5 MHz. Acoustic field parameters of various transducers for ATL ultramark of medical diagnostic equipment were measured at AIIMS and UCMS, New Delhi.

## CS PROGRAMME & FLOW MEASUREMENT

The Calibration Service Programme, under the NCTCF scheme of DST, was coordinated. Several accreditation documents and guide books were developed and updated to ensure complete alignment with European Community standards on laboratory accreditation. The number of accredited industrial calibration laboratories (public & private sector) account for 21 out of 52 under this scheme. Consultancy assistance

was provided to more than 30 laboratories in different areas of measurement. Technical collaborations were held with IIT's, defence labs., DOE, DST, CSIR labs., BARC, public & private sector industries and universities for various expert panels, working groups and membership of accredited fraternity.

The civil works were continued. The details of the major equipment, to set up the primary standards facilities based on two-master-meters measurement assurance techniques were finalised.