NATIONAL PHYSICAL LABORATORY OF INDIA (NPLI)
Short Report to CCAUV, September , 2006

I. About the Organisation

The National Physical Laboratory of India (NPLI) is one of the major constituents of a chain of national laboratories set up under the Council of Scientific and Industrial Research (CSIR) under the Department of Scientific and Industrial Research, Government of India. Its main objective is to strengthen and advance Physics-based R&D for the overall development of Science & Technology in the country. The main charter of NPL is to establish, maintain and improve continuously by research, for the benefit of the nation, National Standards of Measurement and to realize the 'units' based on International system. NPL provides apex level calibration to users in all sectors of economy and security related organizations. The laboratory undertakes advanced research and development in standards, material science & characterization, radio & atmospheric sciences and cryogenics & superconductivity. In addition to in-house projects, the laboratory also undertakes sponsored projects, consultancy assignments and contract research.

NPLI has been engaged in acoustical research right from inception in 1947. In the earlier days attention was given to ultrasonic propagation characteristics in solids and liquids. The scope was later diversified to include acoustical standards, calibration, testing & evaluation of electro-acoustic equipments & acoustic products for the Indian industry. It offers consultancy in Building Acoustics, Noise & Vibration Control, EIA studies, ultrasonic applications, SODAR etc. and undertakes sponsored projects in Applied Acoustics. NPL was the first to initiate scientific evaluation of environmental noise pollution in the country. It is a member of the National Committee on Noise Pollution Control constituted by Central Pollution Control Board (CPCB), New Delhi and has contributed substantially towards framing noise pollution standards and regulations in the country.

I. Status of National Standards

A. Acoustical Standards

1. **Sound Pressure:** The primary standard of sound pressure is maintained through absolute calibration of standard condenser microphones by the reciprocity technique in the coupler cavity in the frequency range 25 Hz to 25 kHz with an overall uncertainty of ± 0.15 dB ($k = 2$ and 95 % confidence level).

2. **Vibration Amplitude:** The primary standard of vibration amplitude is maintained through absolute calibration of standard accelerometers by laser interferometer technique as per ISO 16063-11 (method 3) :Sine approximation method in the frequency range 5 Hz – 5 kHz with an

overall uncertainty of better than ± 1.0% (*k* = 2 and 95 % confidence level).

B. Ultrasonic Standards

1. **Ultrasonic Pressure:** The standard for the measurement of ultrasonic pressure is maintained through a membrane hydrophone calibrated by phased locked laser interferometer technique in the pressure range 50 kPa to 5 MPa and frequency range (0.5 to 1.5) MHz with an overall uncertainty of ± 7.5% (*k* = 2 and 95 % confidence level).

2. **Ultrasonic Total Power:** The standard for the measurement of ultrasonic total power is maintained through the radiation pressure from a standard immersion transducer in the power range 10 mW to 10 W and frequency range 1 to 10 MHz with an overall uncertainty of ± 4.5% (*k* = 2 and 95 % confidence level).

3. **Ultrasonic Velocity:** The standard for the measurement of ultrasonic velocity is maintained through inter-comparison between pulse echo overlap method and auto-convolution method in the frequency range (1 to 20) MHz with an overall uncertainty of ± 0.01% (*k* = 2 and 95 % confidence level).

4. **Vibration Amplitude:** The standard of measurement of vibrational amplitude in the amplitude range of (1.5 to 150) nm and frequency range (0.2 to 15) MHz by phase locked laser interferometer with an overall uncertainty of ± 7.5% (*k* = 2 and 95 % confidence level.)

III. Calibration / Testing / Evaluation Activities

NPLI undertakes calibration / testing / evaluation activities in both Acoustics & Ultrasonics.

Acoustics

1. Calibration of secondary standards from Echelon II, Echelon III and industrial laboratories are undertaken as per the relevant standards / specifications. These include standard condenser microphones, standard accelerometers, sound level and vibration meters, sound calibrators, acceleration generators, pre-amplifiers, tachometers, reference sound sources etc.

2. Acoustical evaluation of various electro-acoustical equipments and acoustic products are undertaken under controlled environmental conditions as per both national and international standards.

3. Noise and vibration measurement, analysis and control activities are undertaken to ensure the safety and integrity of built up structures.

4. Industrial and environmental noise surveys are undertaken to ensure that industrial workers and residents are not exposed to hazardous noise levels.

5. Environmental Impact Assessment (EIA) studies are undertaken prior to initiation of major projects in the country.

6. Noise labeling of electrical appliances are undertaken to ensure competitiveness among local manufacturers and customer satisfaction.

7. Evaluation of Diesel Generator Sets as per relevant Central Pollution Control Board (CPCB) New Delhi norms towards arresting industrial noise pollution in the country.

8. Testing of firecrackers as per CPCB norms to arrest community noise pollution during festival seasons.

9. Evaluation of acoustical materials under controlled mounting conditions towards promoting indigenous manufacturers.

10. Acoustical evaluation of auditoria, lecture halls, workplaces, built up structures etc., to ensure speech intelligibility, structural integrity etc. in these spaces.

B. Ultrasonics

1. Calibration of ultrasonic medical scanners for various modes to ensure the generated acoustic pressure, intensity, pulse duration, acoustic waveform, beam width, beam / scan profile etc to ensure safety of the exposed patients.

2. Calibration of non - Destructive Testing equipment such as ultrasonic flaw detectors, calibration blocks, NDT probes, thickness gauges, concrete testers etc. for various properties as per relevant standards and specifications.

IV. Research and Development Activities

The ongoing / recent R&D projects are :

1. Design of Environmental Noise Barriers
2. Noise Control Measures for MRTS
3. Acoustical Materials and Material Combinations
4. Community Noise Control
5. Dispersion Modeling of Atmospheric Boundary Layer
6. Detection of Seismic Activities by Sodar
7. Improved ultrasonic measurement techniques for acoustic impedance, hydrophone calibration in closed chamber, new methods to calibrate NDT probes etc.

8. Development of new ultrasonic transducers, calibration blocks, absorbers, targets etc.
9. Refinement in ultrasonic power measurement, calibration of medical scanners
10. Development new NDT testing techniques in respect of improved S/N ratio, cluster analysis, thin samples of composite materials etc.

V. **Bibliography** (Last three years)

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Remarks

1. NPLI has recently participated in the APMP Key Comparison AUV.AK-K1 for the pressure sensitivity of laboratory standard condenser microphones

2. The Internal Peer Review of Ultrasonic Standard is already over and the CMCs are being processed for entry into Appendix C of CIPM. The International Peer Review of Acoustics Standards is scheduled for October, 2006