Proceedings of the Institute of Acoustics

TYPE APPROVAL AND OFFICIAL CALIBRATION OF SOUND LEVEL METERS IN THE FEDERAL REPUBLIC OF GERMANY

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Although the principle of "caveat emptor" is well established in our Society it needs some reinforcement in law to ensure that fair and reasonable standards prevail. The ensuing controls that we exercise to ensure that standards are maintained seems to stem from this basic premise and is basically reactive in nature. The complaint from an agrieved Anglo-Saxon customer will send the inspector hurrying forth to check that the vendors claims are reasonable be it a physical measurement of a quantity of goods sold or a claim of "exceptional" performance. It follows that when a measured quantity is central to a legal proceeding it is not unusual for their to be lengthy submissions from both Plaintiff and Defendents representatives as to the true magnitude of the quantity in question and to why their assessment of the uncertainties happen to be the correct ones. It is a system that has evolved from a long history of commodity trading and rests reasonably well in the high technology world that we all now live in given that we all understand the unwritten rules and that the commercial pressures within the market are free to excert their full force. Moves towards "total quality concepts" and the maturity of the technical community have resulted in the NAMAS system of regulation and control in our Industry.

It is not however the only way of doing things. Within the German speaking nations of Europe a different system has evolved that is more proactive in its approach in that it requires measurement systems used for "legal" metrology to be positively vetted for both accuracy, stability and for suitability to the particular tasks in question prior to any official calibration being carried out. Initially these arrangements appear to make more work for the competent authorities and put a blanket of bureaucracy over the market but on the other hand creates a climate of positive quality and endows legal status on the measuring systems. Positive vetting therefore puts a front end quality bias onto the manufacturers of the metrology system, the need for periodic calibration focuses the operators mind on the fundamental objective of a measurement sequence whilst the endowment of "legal" status on the results provides a statement of value to all involved in the process, not to say a great saving of expensive legal time. The concept requires that any instrument that will be used for a legal metrology application will require to undergo pattern evaluation (type approval) to establish that its basic design will render it suitable for intended application in terms of accuracy and stability. This pattern evaluation is concerned with the accuracy of the measurements to be made from both a practical and theoretical basis but does not include safety or

other attributes of the instrument which are subject to separate regulations. Once the pattern evaluation is completed the instrument will be "allowable for official calibration". An essential part of the evaluation therefore is the preparation of a procedure that instructs the various local calibration offices on how to perform an accurate calibration on the instrument in question.

The regulations are made under the Federal Metrology and Verification Act or the Verification Ordinance which make the Physikalisch-Technische Bundesanstalt, PTB, responsible for the pattern evaluation and a schedule of the basic categories of instrumentation covered by their laboratories in Braunschweig is shown in fig. 1. Of particular interest to us are the categories 1.51 Audiometers and 1.52 Acoustic Instrumentation. These controls are in the form of what we term a frame work regulation; they are activated by specific regulations. To date a number of these have so far been promulgated for example since 1972 the regulations for the quantification of traffic noise have required an approved instrument followed in 1979 for Noise Emission Measurements and more recently measurements to determine workers safety have also been included (1987). The scheduled of "permitted instruments" is issued to the Calibration Authority (Eichamt) in each of the States (Laender) that make up the Federal Republic who then perform a bi-annual calibration on instruments submitted to them.

The procedure for obtaining a type approval in respect of sound level meters runs as follows:

- following the application by the manufacturer a review meeting between them and PTB technical staff will decide the test protocols to be applied. The procedures used follow the recommendations of OIML publication R-88 1989 however the rapid advances in acoustic instrumentation technology require new test protocols to be continually developed to measure the required attributes of the instruments.

- five samples of production standard instruments are submitted for test and evaluation. A "carnet de mesure" as used in France is not required but is a common sense precaution as any discrepancies between the results obtained by PTB and the manufacturer will need to be explained. Testing is very detailed and includes a number of audit check sequences and is therefore by nature very time consuming.

- a review of the documentation is carried out including the operator's handbook (in German) and the instrument marking.

- any accessories that are essential to the correct operation of the instrument are included in the approval whilst other optional accessories may be included in the approval at the manufacturers

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request (windshields, extension cables etc).

- on satisfactory completion of the testing programme an approval number is assigned and the procedure for the calibration authorities is prepared. This includes a listing of the test equipment they require and they are officially notified of the instrument type and variant numbers that are now allowable for official calibration.

Approvals are granted in three categories under the Eichordnung 1983. Section 21.1 is for sound level meters, section 21.2 for Ingegrating Sound Level Meters and Section 21.3 for sound measuring systems. These latter systems comprise instruments of various types assembled for special applications but must include key elements from equipment approved under sections 1 and 2. There is a separate procedure for single instrument approval "Einzelpruefung" but this does not confer the same legal status as a type approved instrument. It is however widely used as a quality verification procedure, as a precursor to a full type approval or for a calibration certification in "research" work.

Approved instruments are identified by an approvals plate that carries the necessary information for the user and the calibrating authority. An example is shown in Figure 3. This plate must be affixed prior to submission to the calibrating authority who will perform the necessary work and then place seals on the equipment to prevent the case being opened. If the instrument is submitted with an approved calibrator the calibration control is left open but in any other circumstances this is also sealed. Special arrangements are made with manufacturers repair centres to allow the instrument to receive minor attention that would not invalidate the calibration for them to reseal the instruments.

Once approval has been granted the design has to be "frozen" as any change could render the approval invalid. In practice only any change that affect "form function of fit" needs to be notified and hence any organisation with a "BS-5750" or "Ex" manufacturing control system would be in a position to exercise the necessary notification system. A review meeting would determine the significance of any change and the degree of retest required or if the approval should be withdrawn. In practice official requests by manufacturers to withdraw obsolete instruments are rare and a number of instruments appear on the lists that are no longer in production, but have to remain on the list as they are still in service and will as such require recalibration. The most recent list published by PTB shows 62 separate approved instruments 32 of which date before 1986.

To date Lucas Acoustic Instruments have achieved type approval on four type 1 Integrating Sound Level Meters (CEL-393, 275 and 266 plus Dawe D-1426). Two type 2 Integrating Sound Level Meters (CEL-328 and 383) plus one Audiometer (GSI-17). A large number of instruments have also been submitted through the "Einzelpruefung" procedure and these cover simple dB(A) only

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type 2 instruments through to type 1 computing sound level meters. The hard money costs of obtaining a type approval is around DM25,000 per instrument. In addition there are soft money costs associated with the preparation of the equipment and the various review and progress meetings that are held. It is expected that these costs are similar for all manufacturers submitting their equipment to the type approval procedure. These costs are recovered in the selling price of the equipment, the degree of surcharge is difficult to quantify due to exchange rate variations but it appears that for CEL and Bruel & Kjaer equipment prices are some 5% to 10% higher in Germany. The periodic calibrations performed by the Eichamt seem to be a similar price to those charges levied in the UK for NAMAS calibration.

More important perhaps than price is the effect that the approvals procedure has on the rate at which new instruments are introduced into the German market. There is a delay of around 12 to 18 months from the announcement of new equipment to it being available for use in the regulations driven applications segments of the German market. It appears that European manufacturers are well versed in the procedures with approved instruments from CEL, Norsonic and Bruel & Kjaer and that the Japanese are learning fast. (Rion and Ono Sokki). To date however none of the major US Sound Level Meter manufacturers have come to market with approved equipment, in the Audiometric market however Lucas Acoustic Instruments have achieved approval for the GSI-17 which originates in the USA.

With the strict requirements in German Regulations placed upon both the quality of the measuring instrument and the validity of its calibration it is interesting to note there is very little mention of the degree of "competence" needed on the part of the operator. There is very little doubt that in the complex art of quantifying noise levels both the equipment and the operator are key elements. Harmonisation of Regulations as we move towards a single European market will therefore quite possibly manifest itself with the UK adopting German style pattern evaluation and periodic verification with Germany requiring more formal certification for the competence of technicians undertaking measurements.

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FIGURE 1

RESPONSIBILITIES OF THE PTB LABORATORIES ISSUING PATTERN APPROVALS

Physikalisch-Technische Bundesanstalt
Bundesallee 100, W-330 Braunschweig, Germany

1.11	Masseneinheit	Unit of Mass
1.12	Selbsttätige Waagen	Automatic weighing, Automatic filling machines
1.13	Nichtselbsttätige Waagen	Non-automatic weighing machines
1.22	Längen-und Flächenmeßmaschinen	Length and area measuring machines
1.23	Kraftverkehrsmeßgeräte	Measuring instruments for motor vehicles and traffic control
1.32	Flüssigkeitsmeßgeräte	Liquid meters
1.33	Gasmeßgeräte	Gas Flow Meters
1.51	Audiologische Meßtechnik	Audiological measuring technique
1.52	Geräuschmeßtechnik	Noise measuring technique
2.31	Meßwandler	Instrument transformers
2.33	Elektrizitätszähler	Electricity meters
3.13	Druckmessung	Pressure measurement
3.22	Kalorische Größen	Thermal quantities
3.32	Flüssigkeitseigenschaften	Liquid properties
3.33	Analytische Meßtechnik	Analytical measuring technique
3.34	Dichte	Density
4.21	Bildoptik	Imaging Optics
4.41	Zeiteinheit	Unit of time
5.11	Maßteilungen	Line standards
6.21	Strahlenschutzdosimetrie	Radiation protection dosimetry
6.41	Dosimetrie der Röntgenstrahlung	Dosimetry of X-ray radiation
6.42	Dosimetrie der Gammastrahlung	Dosimetry of gamma radiation

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FIGURE 2

APPROVALS PLATE

21.21
91.51

Integrierender Oktavband-
Schallpegelmesser
nach DIN IEC 651 Kl.1l
und DIN IEC 804 Kl.1

PTB Zulassungs-
Nr. zur amtlichen
Eichung

Lucas CEL Instruments Ltd.
GB-SG5 1RT

Typ CEL-266/3A
Nr.
Baujahr.
Mikrofon Typ CEL-192/2F
Nr.

Lucas CEL Akustik GmbH
PSF 1623
Moenchengladbach
D-W 4050

Vorverstärker Typ CEL-225/3
Nr.

Wahlfreies Zubehoer

Kabel CEL Typ C4493/5
Windschirm Typ CEL-2962

Kalibrator Typ CEL-284/2
Nr.
Pegel 114,0 dB

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FIGURE 3

LUCAS ACOUSTIC INSTRUMENTS

"BAUARTGEPRÜFT" EQUIPMENT

21.21 88.38	CEL-393 Computing Sound Level Meter complete with CEL-186 microphone, CEL-229 Preamplifier and R05001 Pistonphone.
21.21 91.51	CEL-266/3A Precision Integrating Octave Band Sound Level Meter complete with CEL-225/3 Preamplifier and CEL-192/2F microphone.
21.21 91.52	CEL-328/2A or CEL-328/3A Integrating Octave Band Sound Level Meter complete with CEL-230 microphone assembly.
21.21 92.53	CEL-275/3A or CEL-275/3B Precision Integrating Sound Level Meter complete with CEL-225/3 Preamplifier and CEL-192/2F microphone.
21.21 92.54	CEL-383/2A, CEL-383/2B, CEL-383/3A or CEL-383/3B Integrating Sound Level Meter complete with CEL-230 microphone assembly.
21.21 92.55	Dawe D-1426 Precision Octave Band Sound Level Meter complete with CEL-192/2F microphones and CEL-225 Preamplifier.
15.11 93.24	GSI-17 Audiometer (Zulassung in Vorbereitung).