OVERVIEW - OIML TC 13

Legal metrology and standardization: an effective cooperation in acoustics

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1 Acoustics and legal metrology

Acoustic instruments to measure sound (sound level meters - see Fig. 1) and related equipment such as sound calibrators (see Fig. 2), as well as instruments to measure human hearing functions, (audiometers - see Fig. 3), are not usually subject to legal control. In Europe, only a few countries (for example Austria, Czech Republic, France, Germany, Poland and Switzerland) prescribe type approval based on pattern evaluation and/or regular verification of individual instruments. The situation is similar outside Europe, which is surprising considering that millions of people suffer from excessive noise, especially in industrialized countries. Manufacturers and communities spend large sums reducing noise, but for this to be effective any action must be based on precise noise measurements.

These were good reasons to include sound measuring instruments used for official traffic noise measurements in the scope of legal metrology in Germany in 1972. Later on, the use of verified sound level meters and related equipment was also prescribed for other types of environmental noise. Results of pattern evaluations carried out at the PTB and of verifications of individual instruments fully justified these regulations [1].

Similarly, noise-induced hearing loss of workers in industry is still one of the most frequent occupational hazards and insurers frequently end up paying out compensation. Such compensation is based on the exact measurement, by means of pure-tone or speech audiometers, of the hearing impairment due to noise.

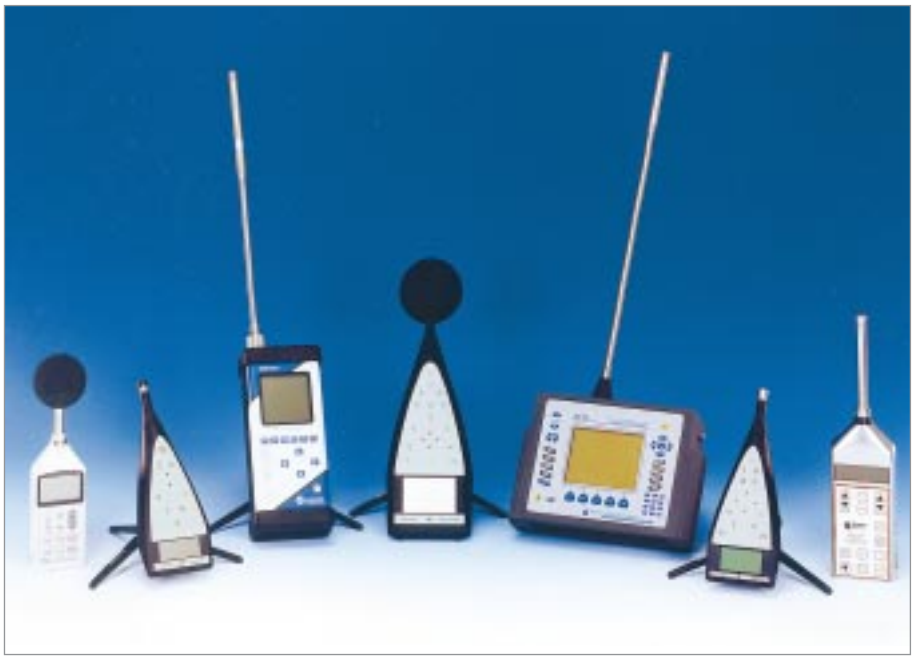

Photo: PTB Ref. 3518

Fig. 1

Collection of sound level meters meeting the essential requirements of OIML R 88 (1998) and/or OIML R 58 (1998)

Photo: PTB Ref. 3519

Fig. 2

Collection of sound calibrators meeting the essential requirements of OIML R 102 (1992).

"Pistonphone" type sound calibrators are equipped with a barometer for ambient pressure correction

Fig. 3

Combined pure-tone and speech audiometer equipped with earphones and bone vibrator, meeting the essential requirements of OIML R 104 (1993) and OIML R 122 (1996)

Photo: PTB Ref. R1123-3

Audiometers were subject to legal metrology control in Germany from 1988 to 1998. The results of pattern evaluations carried out at the PTB again clearly underlined the need for tests by an independent laboratory [2]. This activity ended when the European Directive on medical devices came into force substituting any national regulations which were considered to hinder the free market within Europe. Unlike the preceding German regulations, the Directive does not provide for any third party conformity assessment of audiometers but essentially relies on manufacturers' declarations instead. The main emphasis is therefore put on safety rather than on metrological aspects.

The performance of sound level meters is not yet covered by any European Directive and the Measuring Instruments Directive (MID) will not specify sound level meters either. The reasons for such omissions are not that obvious, bearing in mind that noise limits and noise measurements are specified in a number of European directives [3, 4]. To a certain extent it might not be considered logical that noise limits are fixed in European legislation while the accuracy of measuring instruments used to verify such limits is not catered for. The same arguments hold for measuring instruments for mechanical vibrations. Anyhow, measuring instruments for acoustics and vibration have not yet been

allocated a high priority by the European Commission. Therefore, national regulations are still allowed for such devices which in Germany (and in some other countries) are considered as essential to improve the accuracy of sound and vibration measurement results.

2 History of OIML activities in acoustics

The decision to start activities in the field of acoustics within the general scope of the OIML was taken over 20 years ago. A "Pilot Secretariat" OIML-SP14 *Acoustics and vibrations* was established under Germany's responsibility, together with the "Reporting Secretariats" SP14-SR1 *Sound measuring instruments* (Switzerland), SP14-SR2 *Audiometers* (Germany) and SP14-SR3 *Mechanical vibrations and shocks* (Denmark). At a later stage China and the former GDR took over responsibility for SR1 and SR3 respectively.

An inaugural meeting of SP14 and its three Reporting Secretariats was held at the PTB in February 1982. The scope and detailed work programs for each Secretariat were discussed and agreed upon, and at that meeting the general decision was taken to avoid any duplication of technical work and to rely on International Standards prepared by the IEC and/or ISO, whenever applicable and possible. A first draft, later to become the first edition of R 58 *Sound level meters*, was discussed and a general framework was agreed upon which has been maintained since then (with slight amendments) for all later Recommendations issued under the responsibility of OIML-SP14 and its successor OIML TC 13. This framework contained a main body of one and a half pages of text, referring to the relevant International Standard and adding a small number of specifications, essential for legal metrology, for example on maximum permissible errors on verification and in service, on the stability of the device, on inscription and markings and on seals. In addition to that, it was decided to provide a one-page appendix, specifying the recommended extent of the pattern evaluation and verification procedures for the kind of instrument concerned. This new information was not usually included in the relevant standard and was based, in the case of R 58, on the extensive experience gained at the PTB with type testing and testing of individual sound level meters. Annexes of this kind have been included in each OIML Recommendation on measuring instruments for acoustics and vibration since then.

Several further meetings of SP14 and its Reporting Secretariats were held since 1982, resulting in the adoption of other OIML Recommendations (R 88, R 102, R 103 and R 104), all following the same general principle described above. Participation in these meetings by non-European countries and the general response from OIML Members to drafts circulated were, however, rather limited.

As this situation was not that different in many other OIML Pilot and Reporting Secretariats, there were good reasons to carefully reconsider the structure of the OIML and its procedures for technical work starting in the late 1980's. In parallel, the new OIML Certificate System for Measuring Instruments [5] was introduced, requiring broader consensus of OIML Recommendations for the purpose of mutual acceptance of pattern evaluations. This was another strong motivation for completely reorganizing OIML work.

3 Policy of OIML TC 13

Following the CIML decision to completely restructure ongoing OIML technical work and to adopt ISO/IEC technical work rules wherever appropriate, OIML TC 13 *Measuring instruments for acoustics and vibration* was established to succeed OIML-SP14. TC 13 was one of the first OIML Technical Committees to hold an inaugural meeting: this took place in Oslo on 26 May 1993 in conjunction with a meeting of the related IEC TC 29 *Electroacoustics*, taking advantage of the fact that acoustics experts from a number of countries met on this occasion with considerable overlapping interests both in legal metrology and in standardization. Correspondingly, the TC 13 meeting was attended by 21 delegates from 14 different countries and three International Organizations - a far better participation than in any meeting of the former SP14.

Three basic decisions were taken at this first meeting, which have guided TC 13's work since then:

1 The practice of the former SP14 and its Reporting Secretariats of basing draft Recommendations on existing IEC and/or ISO Standards would be maintained wherever possible. The need for close cooperation between TC 13 and the relevant IEC/ISO TC's was emphasized to ensure that International Standards are compatible with the specific needs of legal metrology.

2 Instead of establishing Subcommittees corresponding to the previous Reporting Secretariats, temporary Working Groups for well-defined tasks were established and a convener appointed for each of them with a view to disbanding the WG's as soon as their tasks were completed.

3 Whenever feasible, further meetings of TC 13 should be held at the same venue and coinciding with

meetings of IEC TC 29, thus enabling experts of both Organizations to participate in each other's meetings without incurring extra traveling costs.

Furthermore, the TC 13 work program was discussed and adopted, resulting in the general conclusion that OIML Recommendations would be prepared in the format as prescribed by the OIML Certificate System [5], especially requesting the inclusion of test requirements and detailed test report formats. It was recognized that this would result in extensive additional work compared with the previous practice.

These basic decisions were, without exception, consequently implemented in the following years and are still considered as being the most economic and effective way to organize OIML work in a technical field in which the number of experts interested in legal metrology and in standardization world-wide is limited, and at a time when universal restrictions in manpower and budgets are becoming the rule. The advantages of this policy (as seen after several years of experience) can be described as below.

Any duplication of technical work was avoided. The development of technical specifications was exclusively carried out within IEC TC 29 while OIML TC 13 contributed by adding special aspects of legal metrology and, especially, elaborating test report formats as required by the OIML for the inclusion of a Recommendation in the Certificate System. The reason for this is that the acceptance of test results is certainly much higher if they are presented in a harmonized and transparent way. These formats have evoked great interest in IEC TC 29 and are likely to be included in future IEC Standards.

The benefit for manufacturers of acoustic instruments is obvious. They are not obliged to produce different instruments for legal purposes in some countries according to special OIML requirements while in other countries users merely request that IEC Standards are met.

Considering the quality of documents, IEC TC 29 (through its cooperation with OIML TC 13) certainly became more aware and took greater note than before of metrological aspects such as the extent of testing required, test procedures and measurement uncertainty. This resulted in a marked improvement of standards recently developed within IEC TC 29.

Experts from OIML Member States who did not show much interest in IEC work before now participate actively in TC 29 work while, vice versa, experts from TC 29 member bodies who were not present at OIML TC 13 meetings before now attend and contribute considerably. Thus, participation and expertise has been broadened in both Organizations. This is of benefit especially for the OIML, which is the lesser recognized of the two Organizations in the field of acoustics. However, by continuous reporting on OIML activities at TC 29 meetings, the standardization community in acoustics is now well aware of the OIML, its scope and its activities.

The substructure within OIML TC 13 is as lean and flexible as possible, avoiding any formalism linked with subcommittees. Meetings are usually limited to one-day Committee meetings following the sequence of IEC TC 29 meetings of roughly every 18 months. Working Groups meet, if at all, in close connection with related IEC meetings, most of their work being done by correspondence. The establishment and disbanding of Working Groups can be completely dealt with within the Technical Committee, thus avoiding any delay by time-consuming decision processes at another level.

To summarize, OIML TC 13 - IEC TC 29 cooperation can be considered as being quite successful, resulting in a reasonable number of good quality documents as described below.

4 State of the work

So far, six International Recommendations have been issued, elaborated by TC 13 and its predecessor SP14. Each is based on the relevant IEC/ISO Standards as applicable but (with one exception - R 103) considerably amended by specification of the extent of procedures for pattern evaluation and verification together with a detailed test report format. These Recommendations are the following:

- R 58 *Sound level meters*, 2nd edition 1998: Refers to IEC 60651, *Sound level meters*, 1st edition 1979 with amendment No. 1-1993;
- R 88 *Integrating-averaging sound level meters*, 2nd edition 1998: Refers to IEC 60804, *Integrating-averaging sound level meters*, 1st edition 1985 with amendments Nos. 1-1989 and 2-1993;
- R 102 *Sound calibrators*, 1st edition 1992, together with Annexes B & C, 1st edition 1995: Refers to IEC 60942, *sound calibrators*, 1st edition 1988[1];
- R 103 *Measuring instrumentation for human response to vibration*, 1st edition 1992: Refers to ISO 8041, *Human response to vibration - Measuring instrumen-*

[1] OIML TC 13 decided not to accept the 2nd edition of IEC 60942 (1997) for its purposes, mainly due to the large number of tests required. This was one reason for IEC TC 29 to immediately begin a further revision of this Standard and is an indicator of the fruitful communication between the two committees.

tation, 1st edition 1990, and ISO 5347-0, *Methods for the calibration of vibration and shock pick-ups*, Part 0: Basic concepts, 1st edition 1987, with Technical Corrigendum 1: 1990, and ISO/DIS 5347-3, *Methods for the calibration of vibration and shock pick-ups*, Part 3: *Secondary vibration calibration*, 1987;

- R 104 *Pure-tone audiometers*, 2nd edition 1993, together with Annex F, 1st edition 1997: Refers to IEC 60645-1, *Audiometers* Part 1: *Pure-tone audiometers*, 1st edition 1992, and various other related IEC or ISO Standards, e.g. IEC 60126, IEC 60303, IEC 60318, IEC 60373, IEC 60711, ISO 389, ISO 7566 and ISO 8798; and
- R 122 *Equipment for speech audiometry*, 1st edition 1996, together with Annex C, 1st edition 1999: Refers to IEC 60645-2, *Audiometers* - Part 2: *Equipment for speech audiometry*, 1st edition 1993, and various other related IEC or ISO Publications, e.g. IEC 60303, IEC 60318, IEC 60373 and ISO 8253-3.

A seventh Recommendation, *Octave-band and one-third octave-band filters*, referring to IEC 61260, *Octave-band and fractional-octave-band filters*, 1st edition 1995, has reached approval stage.

From the nearly 60 active OIML Technical Committees and Subcommittees, fewer than 10 % have issued an equal or higher number of Recommendations. TC 13 might, therefore, be considered as relatively productive and effective which is doubtless a result of its cooperation with standardization organizations. Looking at the large number of IEC/ISO Standards referred to and bearing in mind the magnitude of each of them, a comparable result in the given period could certainly not have been achieved in the OIML if this technical work had been started from scratch, regardless of the other obvious disadvantages that such an approach would entail.

TC 13's ongoing work is nearly completed, and the approval of the seventh Recommendation mentioned above is expected in the course of 2000. It has, however, to be noted that most of the IEC/ISO Standards referred to in the corresponding OIML Recommendations are presently under revision within the respective committees, due to technical progress; this will require revision of the corresponding OIML Recommendations in the near future. This situation, together with the fact that Germany (PTB) is no longer in a position to maintain the TC 13 Secretariat, gave reason to thoroughly reflect on the established cooperation with IEC/ISO and to consider even more effective solutions. This was done at the last meeting of TC 13 in March 1999 and led to the conclusions explained in section 6. It might, however, be appropriate first to explain some of the problems as they occurred in the present stage of cooperation.

5 Cooperation problems

Though very effective, the present cooperation procedure still has some inherent disadvantages:

- There is a considerable time delay (4–5 years on average) between the publication of an IEC/ISO Standard and the issuing of the corresponding OIML Recommendation. This is due to the extra work needed for OIML purposes, i.e. the elaboration of a test report format, and the necessary discussion and approval procedure within the OIML; experience shows that IEC/ISO Standards may already be under revision before the corresponding OIML Recommendation is actually issued. Manufacturers and users, however, usually do not accept legal requirements which do not immediately follow technical progress in a field.
- During the elaboration of a test report format, it appeared in a few cases that the test conditions as specified in the IEC Standard referred to were partially ambiguous. It would therefore be preferable if test conditions and test report formats are elaborated simultaneously and by the same group of experts.
- It was sometimes only during the elaboration of the test report format that experts really became aware of the number of detailed tests required in the IEC Standards. Such tests result in testing costs which are not likely to be acceptable for manufacturers unless there is a legal requirement for type approval in a country. Problems of this kind might have been avoided if test conditions and test report formats had been worked out in parallel.
- Another problem which might be inherent to the OIML Certificate System became obvious in this context: while during pattern evaluation in a national type approval procedure the testing laboratory usually has the competence and is given the necessary flexibility to omit or to simplify certain tests if evidence is provided that the instrument under test will easily meet the requirements, this is not allowed within the OIML Certificate System. Therefore, OIML certificates are usually much more expensive than a corresponding type approval for the same model of instrument. This may be one of the reasons why no applications for OIML certificates for acoustic instruments have yet been received[2]; manufacturers are used to advertising their products with national (e.g. PTB) type approval certificates in countries where no legal requirements exist for this kind of instrument.

[2] Up to date information on OIML certificates is provided on the OIML web site (http://www.oiml.org)

6 Recent developments

After thorough discussions, at its meeting in Frankfurt on 5 March 1999 TC 13 decided to initiate a new and even more extensive phase of cooperation with IEC and ISO. Correspondingly, the following resolution was unanimously adopted:

> "OIML TC 13 *Measuring Instruments for Acoustics and Vibration* at its 5th meeting on March 5 1999 in Frankfurt am Main, Germany
>
> - considering that the development of OIML Recommendations on electroacoustics with reference to IEC TC 29 standards, although mostly satisfactory, nevertheless creates some duplication of efforts and does not allow for simultaneous issuing or revision of IEC standards and OIML Recommendations,
> - considering that the agreement between IEC/ISO and the OIML provides for the possibility of developing joint publications,
>
> REQUESTS its chairman to suggest to IEC TC 29 to consider the possibility of having its drafts developed with the participation of OIML TC 13 with a view to issuing joint IEC/OIML publications in fields of interest for both Organizations (with the possibility for each Organization to develop and issue addenda to cover topics of specific interest),
>
> REQUESTS the BIML to discuss this matter with the IEC Central Office in case of a positive reaction from IEC TC 29, with a view to a rapid implementation of the joint IEC TC 29-OIML TC 13 decision."

A similar resolution was adopted addressing the wish of OIML TC 13 to cooperate with ISO TC 108 in the field of measuring instruments for vibration.

It happened to be of great advantage that several delegates at the TC 13 meeting were equally involved in IEC TC 29 activities - including the Chairman of TC 29 as well as the conveners of those IEC Working Groups responsible for acoustic instruments that are of most relevance to the OIML, i.e. sound level meters and sound calibrators. The Secretariat of IEC TC 29 had been informed in advance and had also indicated its agreement.

Therefore, it was without any objection that at its plenary meeting the following week IEC TC 29 unanimously accepted the proposal made by TC 13 and took the following decision:

> "TC 13 requests the Secretariat to contact the IEC/CO in order to establish a procedure for establishing joint Working Group's with the OIML and to issue common IEC/OIML publications in areas of interest for both Organizations".

A few months later, this decision was submitted to the IEC Committee of Action for approval, who "noted with satisfaction the joint work undertaken by IEC TC 29 and OIML TC 13. The Central Office is requested to develop with OIML a voting/approval procedure for joint IEC/OIML documents resulting from Joint Working Groups for publication with a double logo and single IEC prefix standard".

This decision finally opened the door for a new type of cooperation between the OIML and IEC.

Meanwhile, and as a first step, the BIML has requested several TC 13 member countries to nominate delegates to the relevant IEC TC 29 Working Groups in order to establish formal liaisons on the working level. These delegates will represent the OIML and ensure that aspects of legal metrology are sufficiently covered by future IEC Standards. Especially, these should include those amendments, originally introduced by the OIML, dealing with the extent of pattern evaluation and verification as well as test report formats.

Since the rules for technical work and the various stages of development of documents are quite similar in the IEC and in the OIML, both Organizations may work completely in parallel. That means the following:

- Committee Drafts are circulated in parallel to IEC national committees and OIML TC 13 members for comments. Comments received will be discussed by the joint working groups.
- If sufficient consensus is reached among TC 29 and TC 13 members, the document is approved and circulated as a Committee Draft for Vote (CDV) to national committees within IEC or as a Draft Recommendation to CIML Members within the OIML. This stage is the last opportunity to submit minor technical comments in addition to a positive vote.
- A final vote is taken in IEC by a two months' ballot, in the OIML by a decision at a CIML Meeting.
- If approved, the document may be issued with the logos of both Organizations or, if timing does not permit this, with just a specific OIML cover page added to the IEC Standard.

Since each of the IEC Working Groups in question already started the revision of IEC Standards of relevance to the OIML some years ago, an advanced stage has been reached in some cases. It might therefore soon happen that parallel circulation of documents and parallel voting has to be organized.

Cooperation with IEC TC 29 is of high priority for the OIML since most of the OIML Recommendations within the scope of TC 13 are based on IEC Standards. There is one exception, however, and that is OIML R 103 specifying measurement instrumentation for human response to vibration. By convention, these instruments are dealt with in ISO/TC 108/SC 3 *Mech-*

anical vibration and shock - Use and calibration of vibration and shock measuring instruments. The request of OIML TC 13, as formulated in the resolutions of its last meeting, was consequently presented to this Committee (the TC 108/SC 3 Secretariat happens to be held by the same country, i.e. Denmark, as the IEC TC 29 Secretariat). ISO TC 108/SC 3 equally accepted the OIML's request and adopted a corresponding resolution at its meeting in September 1999. Further details of cooperation still have to be agreed upon and will be based on the experience with the corresponding OIML/IEC cooperation.

The matter is however of less urgency since the revision of the relevant ISO Standards is still at a less advanced stage. The fact that Germany (which was responsible for the drafting of R 103) is represented at ISO TC 108/SC 3 by the same expert as in OIML TC 13 ensures that appropriate steps will be taken as soon as necessary.

7 Final remarks

The decisions taken by the OIML in conjunction with the IEC or ISO, respectively, to establish joint working groups in the fields of acoustics and vibration and to issue documents with the logos of both Organizations may be considered a milestone in their mutual cooperation. It is most effective to optimize the use of limited expertise and resources and is certainly the quickest way to ensure equal requirements for measuring instruments both in the regulated and the non-regulated fields. Both manufacturers and users of instruments will benefit from this cooperation.

The authors, who have been responsible for the OIML TC 13 Secretariat from the beginning, sincerely hope that this cooperation will be successful and that other OIML Committees might feel encouraged to follow the example of TC 13. They would like to express their sincere thanks to all their colleagues both in the OIML and in IEC/ISO who have contributed to promoting mutual understanding in the respective Organizations and who supported the ideas which finally led to the agreements described above with great enthusiasm. ■

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[3] *Council Directive of 12 May 1986 on the protection of workers from the risks related to exposure to noise at work* (86/188/EEC), Off. J. Europ. Comm. (1986): L 137 pp. 28–34

[4] *Council Directive of 14 June 1989 on the approximation of the laws of the Member States relating to machinery (89/392 EEC)*, Off. J. Europ. Comm. (1989): L183 pp. 9–32

[5] OIML P 1: OIML Certificate System for Measuring Instruments (1991)