Routine verification of sound level meters

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Introduction.

With the coming of IEC 61672 : 2002 part 1, the real accuracy of sound level meters underwent a step change improvement. Most apparent changes from the older standards IEC 60651 and 60804 were minor, perhaps the most obvious being the mandated increase in the linear range from 30 to 60dB. However, a far more important addition was the fact that in 61672, the measurement uncertainty was included in the specified tolerances. This even led to an apparent loosening of a few tolerances, but the reality is that most tolerances were made tighter, but more importantly they were now sensibly specified. This is as it should be, as electronic technology has improved a great deal since IEC 651 in 1979.

When IEC 61672 was published, most professionals assumed that in future sound level meters would become mainly digital – and so it proved. However, while a digital design is usually intended for automatic testing and calibration, these same techniques can also be used when testing analogue instruments. Indeed as long ago as 1998 K. D. Frankish of Cirrus Research published an Internoise paper on the then new technology of fully automatic computer testing. Today, virtually all the major reputable sound level meter companies test their instruments by such fully automatic means. Not only is this far less costly in terms of manpower, it also allows many more parameters to be tested without human interference or even worse, human error. For example, the CR:800A, series a typical first generation, fully Pattern Approved, but relatively old 61672 sound level meter, has over 150 parameters tested and reported on; all without operator involvement. The precise number of the tests and their extent is a closely guarded commercial secret for each company, but it is very probable that they use very similar methods. At these major companies, the number of tests is similar to those used by National Test Houses when performing IEC 61672 part 2 Pattern Approval tests; indeed, in some very new instruments, the manufacturers tests have become even more complex – and more automatic than part 1 tests.

Major manufacturers test systems not only checks the instruments to the full electrical performance of IEC 6172, but also can electronically adjust them to give optimum performance for the user. Some of these adjustments can then loaded into the operating system part of the instrument's memory and also filed in a log file. In this way, things that traditionally would need mechanical adjustment by a manual potentiometer can now simply be a number in a register and the individual instrument's performance is enhanced.

This automatic testing has other advantages in that manual fault finding – once a major cost in instrument manufacturing - can be almost eliminated with the result that the reliability has increased to the point where the major companies can now safely offer much longer guarantees on their instruments. A further very significant advantage of automatic testing is that every test parameter is recorded and thus, when an instrument is returned for its annual calibration, the new data can be compared with the old and any significant change investigated. This advantage is of course nullified if the annual calibration or “periodic tests” are done by a third party - however competent they may be - as only the manufacturer can have the original setting up data.

IEC 61672 : Part 3

IEC 61672 part 3 is now available, entitled “Periodic tests” and this describes a test regime that either annually or bi-annually re-tests each meter with a sub-set of the full Pattern Approval tests as described in IEC 61672 part 2. To quote the Scope in IEC 61672-3 *“The extent of the tests in this part of IEC 61672 is deliberately restricted to the minimum considered necessary for periodic tests.”* Part 3 proved very difficult to produce as agreement was hard to reach on what parameters were critical for these routine tests, in other words what the minimum tests should be. The two extreme views were that the sub-set should only miss out the tests for things that cannot easily change, such as physical shape that after the microphone mainly determines if the sound level meter meets the directional requirements. Some suggested that such things as temperature, humidity and vibration susceptibility should be routinely checked as well. While this view is logical, it is clear that any increase in the complexity of the tests may well lead to the cost of an annual test being of the same order as buying the meter in the first place, especially for Class 2 meters. Such a cost is not likely to be acceptable to most users.

The opposing view was that on cost grounds, only a very small sub-set of parameters should be tested annually: for example A-frequency-weighting, perhaps by means of spot checks at low-mid and high frequencies, followed by a simple linearity test, from the lower to the upper specified measuring range. Finally an acoustic “user calibration” with the specified calibrator. It is clear that such an attenuated test will 'pass' many instruments that are non-compliant, but as before 61672 there was little or no formal annual testing, the average user may be better served and such a regime would at least be affordable by most users. An even bigger argument was “Should only Pattern Approved Instruments be tested?”; eventually it was agreed that part 3 would not mandate this. The argument for not permitting the routine periodic testing of non-pattern-approved meters was basically, that non-compliant instruments could well pass the short test, but not even be close to passing the full part 2 tests. For example, instruments may be electrically 'reasonable' but have a very poor acoustic performance because of things like case reflections or poor sealing against humidity and so could never pass the part 2 test. In the end this was 'solved' by the wording in the scope that *“because of the limited extent of the periodic tests, if evidence of pattern approval is not publicly available no general conclusion about conformance to the requirements of IEC 6167-1 : 2002 can be made, even if the results of the periodic tests conform to all the applicable requirements of this part I IEC 61671.”.* Clearly, passing part 3, is simply not an indication that the meter complies with the full 61672 requirements. In fact, logic suggests that people might assume – and perhaps even claim –

that their instrument is compliant if it passes the part 3 tests.

What militates against the of testing every parameter in periodic testing, is of course the labour cost - especially in government controlled test houses, where the overheads are usually large when compared with a commercial company. This leads to the question “If testing is so expensive, is the manufacturer testing it properly initially?”, in other words how do the manufacturers get round this time and cost dilemma? The answer is of course given above. All the major manufacturers automatically computer test their instruments in manufacture, leading to huge savings. A number of reputable manufacturers will set their test limits tighter than Class 1 of IEC 61672 for several reasons. Customers do not always treat their instruments carefully and it is important that such usage does not put the instruments 'out of limit' during the period between calibrations. Further many test houses can underestimate their own measurement uncertainty and reputable manufacturers therefore tighten the tolerance limits so that randomly selected instruments will pass their local tests.

Who to use for part 3 tests?

Because of the power of such computer testing, most professional users today tend to send their instruments back to the original manufacturer for their annual calibration. This has many advantages but probably one of the most important is that only the manufacturer will have the dedicated software to set-up each model to “as new” standards. Even if each manufacturer passes their software to approved test houses, this is not helpful unless the test house has an identical test rig. As the reality is that all the top companies have different and very specialised systems, this is impractical. At most major companies, each instrument undergoing any servicing, or simply being submitted for an annual calibration, is put though exactly the same procedure as the initial manufacturing test. At the end of the test procedure, the data is compared with the original test data and any difference has to be resolved; and of course such detailed work can only sensibly be done by the original manufacturer, as only they have the original data. Being fully automatic, the cost of annual testing by the original manufacturer, while not inconsiderable, is far less than the purchase cost of the instrument, yet the test performed is far nearer to a Pattern Approval test than IEC 61672 part 3 demands and is close to the “maximum testing” vision originally proposed. To give some scale order; the cost of having a sound level meter, tested to 'Pattern Approval' standards can be up to twenty times the purchase price of the instrument; whereas the “part 3” testing at most major manufacturers tends to be a small fraction of the instrument's purchase price.

To get the lowest price for periodic testing, users can send their meter to a commercial test house, or a smaller competitor that does not have formal UKAS or similar National Accreditation. These unapproved types of organisation tend to offer test prices significantly less than either the major manufacturers or approved test houses – the reason may well be that they skip many of the important tests. The question is “Will such testing meet formal requirements?”.

Users can also send their units to an “Approved” test house that has full UKAS approval and these organisations will be able to carry out the exact procedure mandated in part 3 and issue a formal certificate; exactly as “officialdom” desires. From such an approved test house, the test will be correctly carried out, with known and stated uncertainties, but will probably be limited to the very small sub-set of tests in part 3, without any automatic adjustments made.

The third alternative is to send the instrument back to the original manufacturer, who will usually re-test and automatically set up the instrument to the exact original performance; effectively putting the instrument back to its “new” condition. If the instrument was claimed to meet IEC 61672 part 1 when new, logic suggests that it will continue to be meet the standard and from some major manufacturers the guarantee will be extended - up to 12 years in some cases.