Developing and Communicating Acoustics Standards

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This article is intended to help increase understanding and participation of users with others involved in acoustics standards. Issues that have come into focus include: a) Lack of awareness in much of the industrial community about standards status and activity and what mechanisms could exist for industrial users of standards to be aware of and participate actively in standards development; b) How to achieve balanced multi-directional participation and information flow via full, open communications and discussion from all perspectives with all interested parties at the table; c) How industrial users can influence management to participate directly in the standards process (including operational imperatives such as paying to participate); and d) How awareness can be improved in and between the standards offices of different professional organizations about important standards that may be undergoing a change?

Acoustical and other measurement standards are anchors to assure appropriate, repeatable, documented and traceable test methodologies. They are developed, introduced and evolved by volunteer practitioners in their fields of use, then used by a wider world of other practitioners in both academic and industrial communities. Standards developers are standards users, and as has always been the intent, complete reciprocity should exist, meaning that any standards users are also potential if not active standards developers. The framework to make this work is mutual communication and knowledge of how standards are developed and codified, any current activity concerning revision of standards, current uses of standards (and associated economic realities) and freedom to participate.

Unfortunately, the very success of a standard may attenuate or even sever this vital bidirectional communication/understanding chain. A case in point is the focus of this article: the recent updating process of the psychoacoustic standard ISO 532 A/B (1975): Method for Calculating Loudness Level.

Due to widespread use and reliance, standards may engender opposing attitudes, and the communication chain may fail. These are independent yet mutually exacerbating issues. As the state of knowledge and technical calculation improve, the option of evolution and updating must exist. At the same time, continuity is a central part of the "anchor" aspect and can develop deep economic implications, tending to maintain a status quo, a valid circumstance for effective and well-established, even if imperfect, standards in industrial use.

In large industries such as automotive, many users of an acoustical standard may have had little schooling in acoustics, having entered the field as an ancillary necessity of their engineering jobs. They may rely on an acoustical standard as a "black box," with no awareness of how it originated, what might be happening regarding its modification, or their potential involvement. A sizeable percentage of engineering managers may be similarly unaware. In this manner, a large community can develop effectively outside the conventional acoustical community, leading to a lack of information in the opposite direction as well; those working principally in acoustics and closer to the procedures of standards management and evolution may be insufficiently aware of an isolated yet economically very significant user group.

As is now clear, through the recent ISO 532 update process, these issues became apparent. The good aspect is that a "big picture" is now seen, with opportunity to learn and to improve the connection of standards and their processes with the totality of the "practitioner world."

Our discussion will include:

- A brief description of what has happened to date with the update process of ISO 532.
- How the standards process works and is intended to work – and how this intent is currently not met throughout the user base.
- Present insufficiency of international standards communication throughout the user base.
- Responsibilities and mechanisms for more thorough and universal communication.
- Importance of seeking, submitting and collecting user feedback.
- Influencing industrial management to become aware, to participate, and to encourage engineering staff to participate.
- Improving awareness in different relevant professional organizations of the status and process of mutually important standards.

The Story of Updating ISO 532 . . . So Far

Loudness is the first standardized psychoacoustic metric. The most widely-used current method, that of Zwicker (first codified in 1967 as the German standard DIN 45631:10.67x[1]) was incorporated as one of two normative methods in the international standard ISO 532 (1975)[2]: Method A is Stevens loudness, based on octave bands; method B is Zwicker loudness, based on critical bands.

The DIN 45631 standard was updated in 1991[3] to improve low-frequency representation, then extended in 2010 (DIN 45631/A1)[4] for time-varying loudness.

In 2007, the American standard ANSI S3.4[5] was introduced, employing a method by Moore and Glasberg, whose principal difference from the Zwicker method is the use of equivalent rectangular bands (ERB). Like critical bands, these widen on a logarithmic Hertz frequency scale toward low frequencies but, particularly in the low frequencies, are narrower and more numerous than critical bands. The audible frequency range encompasses about 40 adjacent ERBs or 24 adjacent critical bands.

These newer developments led to suggestions to revise ISO 532. The intent evolved over a series of meetings of Working Group 9 (Method for Calculating Loudness Level) of ISO Technical Committee 43 (Acoustics). The first plan was to replace the seldom-used Stevens method (ISO 532A) with the method of the American Standard ANSI S3.4-2007 and to update ISO 532B (still the 1975 version) with the incremental improvement of DIN 45631-1991. It was also initially suggested to divide ISO 532 into a stationary loudness part (as just described) and another part (ISO 532 Part II) for time-varying loudness. The first CD draft (CD 1 532) suggested both the Moore-Glasberg and Zwicker methods as standards (normative) in Parts A and B, respectively. However, the ISO preferred not to define two different methods in one standard despite precedents of the ISO standards 532 A/B and others (for example ISO 7779,[6] which contains two normative prominent-tone assessment methods). To support continuity, it was suggested to choose one method as the standard (normative) and provide information about the other (informative). If this were to be deemed unacceptable, then tolerance criteria were to be defined that both methods should be able to fulfill.

Based on these recommendations, a second CD draft (CD 2 532) was created. It suggested a slightly modified Moore and Glasberg loudness, including a binaural loudness as the standard, and included the Zwicker method in an informative manner. This draft

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triggered significant discussion worldwide. The advocates of the Moore and Glasberg method argued that this method matches the contours of equal loudness according to ISO 226:2003[7] better than Zwicker loudness, which is closer to the equal-loudness contours of ISO 226:1987.[8] The revised ISO 226 (2003) contains a significantly lower (up to 10 dB) sensitivity for low-frequency signals than the version from 1987; this result is also being discussed internationally on a scientific level.[9] The well-known A-weighted sound pressure level also does not comply with the ISO 226 contour for 40 phons.

Despite the unclear scientific situation and worldwide urgings to maintain DIN 45631 (Zwicker) loudness both by manufacturers of psychoacoustic software solutions and by users of psychoacoustic parameters, a new draft DIS 532 was finally released based on the Moore and Glasberg methodology similar to but not identical to their version standardized in the American ANSI S3.4-2007 and does not mention the German DIN 45631. (Many users in industry learned of the new standardization late in the process.) This draft DIS was voted on by the member bodies of ISO TC43 and was not approved.

How the Process Should Work vs. Reality

There are several points that the reader needs to know to intelligently choose how to participate. To illustrate, we refer to the ISO 532 revision issue

The United States is one country out of about 20 that together decided to begin the work effort on revising ISO 532; the United States is one country out of 11 actively participating in this international effort.

In this example regarding loudness revision, there was not one automotive industry representative on the committee that developed the new ANSI/ASA loudness standard, and not one on the TAG (Technical Advisory Group) that proposed the new ANSI/ASA standard for international adoption. We would not be in this situation today if the automotive industry had not, for whatever reasons, abdicated its opportunity to participate. This loudness issue was specifically raised to the Society of Automotive Engineers (SAE) by the ASA standards manager, and SAE reported back that the Ground Vehicles Standards and the Acoustic Materials Committees of SAE said that SAE had no interest or need to participate. So, this appears to be an industry problem in addition to a failure to communicate the procedures.

The way to be heard, to participate, to voice an opinion and to affect the outcome of ISO standards is to join the TAG for ISO TC 43 (Acoustics). This is the method established by the American National Standards Institute (ANSI) for use in the USA, and it is used for hundreds of ISO committees and subcommittees. Any party in the United States with direct and material interests can participate in any or all of the TAGs and committees administered by the ASA under the auspices of ANSI (listed in Table 1). Participation requires two ingredients: (1) a commitment by the company, government agency, or organization (e.g., a trade organization, a professional society) to have an employee or representative take the time to participate, and (2) the company or entity actually must join the TAG or standards committee of interest and pay their annual dues. The ANSI pathway is open to all; it is, through the TAG, any standards user's window to ISO and to involvement and influence.

Members of a TAG pay dues. In the United States, standards development is a private sector function rather than a governmental function as it is in some other countries.

Several government laboratories and agencies are members of the various TAGs and are part of the balanced mix of users of standards. They participate with technical experts who attend meetings, join working groups, and frequently take on leadership roles just the same as commercial, industrial, academic, trade association, and professional society members; and they pay dues just like any other member. But in other countries, the national member body (counterpart to ANSI) is funded at least in part by the government, and their delegates to international meetings often receive travel funds from the government. In the U.S., ANSI is a non-governmental organization to which ASA pays more than $40,000 a year, while delegates to international meetings pay their own way or are funded by their employer.

ASA earns virtually nothing on the sale of International Standards, but it pays ANSI $40,000 a year to be the "U.S.A.'s window" to international standards dealing with acoustics. Also, ASA funds the rent, staff salaries, office equipment, etc., associated with providing this service to industry. Those who benefit should pay their fair share by joining the TAG and paying the TAG fee, which is modest and scaled to the size of the company or organization. (Waivers to the fees are available and are granted if some entity is unable to pay.)

Every party with a direct and material interest has the right to be a member, and every member has the right to be heard, to participate, and to influence the outcome. But every party with a direct and material interest also has the obligation to participate and to become a supporting member of the U.S. TAG if they expect the TAG to represent their interests (applying for a waiver of fees if needed). No one is given the right to go around the process; it is not fair to the U.S. TAG members that have chosen to devote their time and resources to participate within the system; it is not fair to the members of ASA.

The result of choosing not to participate, or not knowing that participation is available, is (in the cited case of ISO 532 revision) that the automotive industry has effectively chosen to allow others to determine the content of a standard important to it.

For parties in the U.S. to join a TAG or get further information please contact the Acoustical Society of America Standards Manager, Susan Blaeser, at 631.390.0215.

For those interested in more technical detail, a discussion of technical issues is on the standards web site at www.acousticalsociety.org/standards .

Insufficient Communication Throughout the User Base

Many users of standards discover updates by accident or only when another user of the standard points out that there is a more recent version. Would it be useful if part of the service for purchasing an international standard is to be notified when it is being revised or replaced? In many cases, this would be helpful. While the task might be daunting, it potentially could be automated with registration when one purchases a standard online.

Those not having purchased copies of the standards can be divided into two groups. One group is composed of users of measurement systems and software performing analyses based on specifications in standards. Many of these users may not even be aware of the particular standard on which these analyses are based. Such users cannot directly modify the software being used in the majority of cases. Therefore, instrument manufacturers should be part of the standards development or revision process and provide appropriate updates to their instruments or software when changes are made to the standards. With their knowledge of how their products are being used, these vendors can provide

Table 1. The ANSI-accredited standards committees and the related U.S. technical advisory groups administered by ASA.

ANSI-Accredited Standards Committee (ASC)	U.S. Technical Advisory Groups (TAGs)
ASC S1, Acoustics	U.S. TAG to IEC/TC 29, Electroacoustics U.S. TAG to ISO/TC 43, Acoustics
ASC S2, Mechanical Vibration and Shock	U.S. TAG to ISO/TC 108, Mechanical vibration, shock and condition monitoring U.S. TAG to ISO/TC 108/SC 2, Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures U.S. TAG to ISO/TC 108/SC 3, Use and calibration of vibration and shock measuring instruments U.S. TAG to ISO/TC 108/SC 4, Human exposure to mechanical vibration and shock U.S. TAG to ISO/TC 108/SC 5, Condition monitoring and diagnostics of machines
ASC S3, Bioacoustics ASC S3/SC 1, Animal Bioacoustics	U.S. TAG to IEC/TC 29, Electroacoustics U.S. TAG to ISO/TC 43, Acoustics
ASC S12, Noise	U.S. TAG to ISO/TC 43/SC 1, Noise

valuable insight to the standards development process and crucial reviews of the impact of changes.

The other group who may not have purchased copies of the standard would include those supplying data to customers based on testing specifications that they have not been informed are based on international standards. Who is responsible for knowledge of changes to the standards is a more difficult to define in this case. Clearly if the individual using the test procedure is not aware of the connection to a standard, a general announcement of planned changes has little value. The responsibility falls to the organization that drafted the test specification to incorporate the changes and update the specification. There must be multiple groups taking responsibilities for the necessary participation and communication – knowledgeable parties in the standards organizations, in professional societies, and in industry that take the responsibility to monitor standards activities and provide communications to their colleagues and throughout their respective organizations. The standards organizations must be responsible for providing information about their activities and collecting input from interested parties. Much of this is currently done on the ANSI web site, but like almost anything else, there is certainly room for improvement.

Mechanisms for More Thorough Communication

As an example of the responsibilities and mechanisms, consider a story about the communication problems with another standard. About 10 years ago, Standard, S12.60 on classroom acoustics was developed. One member of the S12 committee with a representative of the working group was what was then the American Refrigeration Institute, which represented manufacturers of Heating, Ventilating and Air Conditioning (HVAC) equipment. Unfortunately, the person assigned did not effectively represent the membership.

As a part of developing this standard, unprecedented advertising of the work effort was done. Notice of the work effort was published twice in the Commerce Business Daily and was prominent on the U.S. Access Board web site. Articles about the problem and the development underway were put in several school administrator, school designer, and similar journals, as well as notices on related web sites, and on the web sites of groups representing those with hearing impairment and groups representing parents of children with hearing problems. Public meetings and presentations were held in several major cities. After enacting the standard, the complaint from many of the HVAC manufacturers was, "We did not know about this. No one told us." This story reveals the difficulties in communication and the need for some members to participate and take full responsibility for communication within their industries.

The HVAC industry has responded to the shortcomings uncovered in this example. In addition to the trade organization membership, two major manufacturers are members, and the representative from one of the manufacturers has been vice-chair and chair of the S2 committee, Shock and Vibrations, and the representative from the other manufacturer has just become vice-chair of the S12 committee, Noise. They are both members of the HVAC industry noise committee and provide an effective level of communication.

So, what are the communication responsibilities of the parties involved? As this example shows, great effort by the standards developer using existing methods of communication cannot be expected to produce overwhelming success.

Many, if not all, of the standards organizations have web sites with wide-ranging information on their standards activities. Much of the functionality noted here is provided on these sites. However, finding specific information can be quite difficult. Therefore, it is imperative that web sites provide information about current activities in a clear and concise manner. Possibly, this same web site could include a means for interested parties to sign up for communications.

Interested parties, those using the standards, also have responsibilities. At least some should be participating members of the TAG. If, for whatever reason, no entity within their circle participates, then they should be monitoring the ANSI web site for such documents as the product initiation notification sheet (PINS), which is specifically there to inform the public of the initiation of new projects (e.g., a new standard or a new revision to a standard). Also, because of the volume of activities and the sheer quantity of information, no one should be surprised that interested parties sometimes miss opportunities to make input.

By this point it should be clear that new methods must be developed to provide notification and to seek input. As the above example illustrates, there is a need to do more, but also a need to work smarter and understand these limitations. One of the major reasons that web sites are not fully effective is that they require too much effort. Web site notification methods can fail just because they require action on the part of the user; the user must make the effort to search.

One new concept that should provide relief would be a method to register those who purchase a standard and the means to notify them of initiation of work on revisions, etc., and when a revised standard has been approved. With care this could be an automated process and a valuable service provided by the standards organization.

E-mail notification can be done by a standards developer as described above, or by a trade association, etc. In either case, the user is notified. In contrast to web site notices, the user doesn't have to do anything except read his or her e-mail.

Perhaps additional mechanisms can be developed for standards organizations to seek interested parties and for interested parties to communicate their willingness to contribute with regard to standards in an area.

There is clearly a need for active and effective participation by the affected industries. At the same time, the standards organizations need to improve their communications. It is this combination of efforts that will minimize the recurrence of issues such as those cited.

Feedback is Important

Obtaining user feedback as part of the standards development process is crucial. When one is working with international standards that potentially apply to a broad range of applications, this is particularly important. Note that it is important to do this as part of the development process and not to simply send the draft out for comment when it is nearly complete.

Where there is the potential for diversity in applications, understanding how the standard is being used is vitally important to the development or revision process. Certainly, usage does not change the basic physics or the distinction between good and bad practices. However, understanding usage helps developers appreciate special cases that must be addressed and where examples or further explanation may be helpful to users.

At the very least, making users aware that there is a potential change or a new standard being developed helps them prepare for this and gives them the opportunity to make input with regard to their needs and issues. If there are other standards or industry practices built around the standard to be modified, such notification is vitally important.

Parallel to the burden of seeking input is the burden of making input. Users of standards have an obligation to use reasonable care in checking the status of standards and when the opportunity arises, making input. This input can be from individuals, corporations, other standards organizations, or professional societies. The larger organizations must implement policies and procedures that make participation and the collection and delivery of the required input possible. It should not be left to interested parties to gather feedback from the organization. There should be mechanisms in place to do this.

The ultimate goal in developing or revising a standard must go beyond technical accuracy. In most cases, the goal already is to provide useful tools for measurement or analysis. This is very difficult to accomplish if user input is not sought and if users are not making an effort to provide coherent and precise feedback to the developers.

Influencing Management Participation

While it may be difficult to obtain, it is crucial that industrial organizations that use international standards make a commit-

ment to participate in the standards development and revision process. This commitment can be quite limited. It may simply be to provide input and comments when requested in the process. This would not take a major commitment of time and resources. If someone can be designated as the point of contact for existing and new standards, this would open lines of communication. A knowledgeable individual can sort out requests that might not be relevant and direct important requests to the appropriate individuals in the organization.

ISO 532 should serve as an excellent example of what happens when such communication does not occur. There are thousands of instances where industrial test standards, specifications, acceptance procedures, and other vital processes are dependent on international standards. It should be possible to make a good case that a situation like this can be costly and a small commitment to provide communication can be very valuable. As noted above, one prominent new method for communication is for registered users of a standard to be contacted and informed of planned and pending changes to a standard. Therefore, if the standard were included with the hardware or software documentation for these industrial tests, acceptance procedures, and other vital processes, then each user could become registered and communications would be greatly facilitated. Just imagine if everyone today who uses SQ (sound quality) hardware or software had been notified of the start and the scope of work for the revision of ISO532, the need for an article like this would probably not exist.

Of course this is a two-way street– the standards organizations and their working groups must seek and respond to input from industrial entities. The common complaint heard is, "we don't waste our time making input; they will never listen to us." As with most things, there must be receptiveness on both sides. Standards organizations must demand that working groups seek and be responsive to such input. The industrial users must support their side of the equation by participating and providing useful input in a timely manner.

When one considers the implications, the commitment is not large, but the rewards could be large if a situation as happened with ISO 532 could be avoided. A document once a year from the standards organizations describing upcoming standards and revisions, routed to potentially interested industrial entities, professional societies, and other groups would generate many inquiries by and commitments from those directly affected. This would be an excellent first step and might induce some to participate more fully in the process.

Improving Awareness

As noted previously, there needs to be a central web site or database where organizations can register their interests and define points of contact. Having such a mechanism is only a first step. Professional organizations have to take this first step, but then they must provide the necessary lines of communication within their internal organization and members to communicate the information received and gather and communicate responses to the standards organizations.

Many professional societies would say that such mechanisms have been established. However, the lines of communication are usually limited to only members of their internal standards committees. The case of ISO 532 is an excellent example of this failing. Since SAE has no standards committee working on this or a similar topic, no communication to the members occurred. This is unfortunate, since hundreds of members were using this standard and its predecessors.

Even a link on the professional organization's web site to specific standards organizations' sites where standards activities and contacts are provided would be a positive step. A summary of standards activities that would be of interest to members with contact information would be helpful, but it would be difficult for large professional organizations to be comprehensive in doing this. They are just too diverse in most cases.

Conclusions

This article is centered on the timely issue of the updating process of ISO 532 and aspects it has revealed. We have presented observations and perspectives on the use of, communication of and participation in standards.

Although standards have been used for many years, the advent of affordable advanced technical processing systems (the ubiquitous PC) and advanced technical software within the last 25 years has brought an evolution in widespread standards use and reliance. But at the same time, the communication/participation chain has been weakened. This evolution developed, perhaps unrecognized, from a simpler era, where standards required manual calculation or even running BASIC programs; an environment more conducive than today to communication and participation between users and developers – the two being interchangeable.

We have presented two aspects that are inherently separate but overlap, presenting challenges for finding the best working structure. One aspect, clearly necessary and presently insufficient, is communication. The other is participation. The overlap is that communication and participation both carry costs, and the costs should not be borne inequitably. The idea of the cost of a purchased standard delivering ongoing electronic access to notifications is one part of a solution. The cost of full participation in the standards process is another factor and, as has been pointed out, is differently funded in different parts of the world.

There are many operational questions of how the standards/users/developers universe can become more effective. For example in an industrial setting, who is the administrator of the purchased standard? How does that person convey ongoing e-notifications obtained through the purchase to the multiple users and get their feedback back to the standards organization? That question is similar to one encountered by vendors of technical software – how to get new software releases and notifications to flow from an administrator to "the engineering floor" and how to be kept aware of how tools are being used?

Perhaps vendors of acoustic and psychoacoustic software can or should serve more directly as conduits between an otherwise isolated industrial user base and the acoustics world where standards are derived and evolve. Vendors can inform users that they should be aware of new standards and give feedback, that users should participate, and that industrial administrations should assist with costs because if they do not, they are at economic risk as well as losing potential competitive advantage.

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