New Hungarian room acoustics standards – the MSZ 2080 series

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Summary
Room acoustic descriptors are often standardized on a national level. Since there used to be no room acoustics standard in Hungary, a national standardization process has been initiated. This paper reviews the ongoing process and the background of the standardization as well as its planned contents, and gives a brief insight into further expected related regulatory changes in Hungary.

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1. Introduction

In late 2016, a standardization procedure has been initiated to create a national standard – that became series of standards during the process – for room acoustic descriptors in Hungary. Since there is no corresponding international or regional (European) standard in place, and many of the EU member states already have their own national standards as a policy tool for setting room acoustic requirements, and since there is no sign of broad harmonization in the foreseeable near future, it was evident that a national standard would be an important – and perhaps temporary, gap filling – step of catching up. This series standards is in line with the majority of European standards in that they are industry-initiated and financed. The purpose of initiating this standard set was to help ensure a higher level of consumer and environmental protection, fostering more innovation and social inclusion.

This paper is about an on-going standardization process in Hungary. Note that by the time this paper is published, it may already be partially obsolete. Nevertheless, it is aimed here that a detailed overview and perhaps a useful insight to this standardization process is provided so that it may be used in similar situations elsewhere. Forward looking statements of this paper shall be treated cautiously as they may involve risks and uncertainties, which could cause actual results or outcomes to differ materially from those expressed.

1.1. Related regulatory framework

The regulatory framework related to architectural acoustics in Hungary is derived from those that of the construction industry. The framework has basically two types of policy tools. 1: legislation produces laws and decrees which are obligatory and enforceable, and 2: industry actors openly produce (national) standards which are generally voluntary and are mostly enforced in contracts. A supplementary, third type of policy tool was introduced to the regulatory system in 2016 in the form of ‘technical directives’ which are entirely voluntary and may be enforced if contracts reference them. These directives are expected to be effective in cases when no requirements in the relevant laws or standards exist, but when creating a standard would also be impractical or unfeasible due to cost, administrative or time constraints, for example. When standards are issued in a field where a technical directive was present, the directive has to be withdrawn. Technical directives for room acoustics have not been published yet.

2. Standardization in Hungary, in brief

Standardization in Hungary dates back to 1875 when the first ‘standards’ for building materials were released. The first committee for standardization was later created in 1921, and in 1933, the Hungarian Standards Institute was founded. This institution was reorganized in 1941 and then in 1948 dissolved to put standardization under the central control of the Ministry for Industrialization. In 1951 the Standardization

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Authority was created, still controlled centrally by the government.
From 1948, application of standards was obligatory in Hungary for 47 years, but since 1995, according to the rules effective within the EU, the application of standards is generally voluntary, although theoretically some standards may be referenced in laws as obligatory. Currently, partly due to copyright matters, in Hungarian law there is no such ‘obligatory standard’, only indirect references appear allowing to fulfill lawful technical requirements by implementing those standards, or direct references when providing definitions of requirements. In some decrees ‘accordance with relevant standards’ are mentioned in a given field of application, such as, for example in case of noise and vibration, which relates to sound insulation. Practically, this means the applicable standard is still voluntary, but either the requirements of that standard have to be implemented or an equivalent or better solution must be provided. This indirect reference is also useful in preventing the need to update laws triggered by a standard’s update as under indirect references, new versions of the standard will automatically apply. On the other hand, standards indirectly referenced are often applied in industry practice in a de facto obligatory manner and they also appear in private contracts in a similarly broad context, to fulfill all lawful requirements.
Today, standards in Hungary are published solely by the Hungarian Standards Institution (Magyar Szabványügyi Testület, MSZT), founded in 1995. The Institution works in a service provider fashion more than an authority. Therefore, it is an open, independent legal entity only co-financed by the government. When compared to the European counterparts, the legal form of the Hungarian Standards Institution is in many ways similar to the Austrian, Bulgarian, Croatian, Finnish, German, or Swiss relevant institution, but different from other European entities where it is sometimes an authority (e.g., in Malta), a not-for-profit entity (e.g., in The Netherlands or in the UK), or a governmental entity (e.g., in Poland or Slovakia).
Standardization in Hungary effectively takes place in committees with delegates of members of the institution. Any legal entity can become a member of the standardization institution, including governmental bodies, just by accepting its rules and by paying the annual fee of membership, which is proportionate of the net income in case of companies. There is no technical, expertise, degree or other professional requirement in place to join a committee. The work committed by the delegates are financed by their delegating host institution. In order to publish a standard, related costs covering the specific activities of the institution for that standard should be readily made available – although in rare cases the Institution may decide to finance the creation of a new national standard at its own cost. Costs associated to national standards without an international source standard are the highest. In many cases, such ‘pure’ national standards are initiated and financed by commercial companies, and the procedure takes about 2-3 years, if successful. The initiation of standards does not require a consensus, but the end result, to become a standard, does require that. Consensus is often reached when two thirds of voting members agree and no more than 25% of all the members in a committee would disagree. National standardization in a 16-step activity including initial notification to CEN/CENELEC/ETSI as relevant, producing the initial draft by the initiator and iterative committee meetings discussing and voting on the draft.
There are approximately 30 thousand standards in effect in Hungary, of which about one tenth is related to construction. Of these - and all - standards, only about a third is available in Hungarian language. The remaining majority, due to cost constraints, is in fact in English. By contrast, a recent self-assessment survey found that about 63% of the Hungarian population speaks no foreign language.
This translation costs problem is common to countries not native English, German or French, since more than a thousand European standards (EN) are issued each year with a generally 6-months timeframe to publish them in the member states so multiple European initiatives are dealing with this issue (see, for example [1]). Consequently, the national standard is prepared in Hungarian language, to be potentially translated to English in the future.

1.2. Motivation for room acoustics standards in Hungary

There were several factors that were motivating for initiating a room acoustic standard.
First, there is no legal regulation or standard in Hungary in effect at the moment specifying room acoustic requirements. The term ‘acoustics’ is not defined in the legal framework either; but several laws and decrees exhibit various definitions based

on their actual subject. If acoustics is considered, it is mostly for the purpose of controlling noise (health and environmental) and sound insulation. Among building material properties, however, the room acoustic related 'sound absorption' is already mentioned (see in [2])**,** and there are certain so-called pre-standards that contain qualitative requirements such as 'proper room acoustic treatment', 'careful acoustical design and considerations', and similar, for example in schools and pre-schools. No quantitative or enforceable requirements, not even guidelines are given, therefore, currently, implementing adequate room acoustics is up to the contracting parties. Sometimes proper room acoustics is only a 'nice-to-have' feature that is easily omittable when facing costs constraints, but in other times it may be considered very seriously. In a related law [3] the term 'concert hall' is defined as 'an enclosed theater with a seating capacity of at least 100, which is acoustically and technically suitable for performing concerts under this Act', and indeed, many of the recent major construction and reconstruction projects for such musical performance spaces employed acoustical consultants, and for the most prestigious ones, also hired acoustical consultants from abroad. This may result in a design with room acoustic considerations of different depth in place but makes no guarantee that the design will be implemented or tested.
On the other hand, since there is no local BREEAM of LEED office in Hungary at the moment, only international guidelines apply which has reference to - currently non-existing - Hungarian national standards, but also give some basic room acoustic parameter limits.

In actual development projects, room acoustics is looked after mostly by the architect, the interior designer or the acoustical consultant if the project budget allows inviting one. Sometimes the treatment of room acoustics is considered late in the design phase or during the construction phase, or perhaps sometime after the development has completed when problems appear. The acoustical consultancy as a market in Hungary has less than 10 key players and is mostly practiced by self-employed businesses, partnerships or part time consultants. The median age of acoustical consultants with room acoustics experience or relevant licenses in Hungary is currently 46 years.

The last academic book on room acoustics in Hungarian language was published some 32 years ago and there are no programmed courses, perhaps some electives, in any Hungarian university at this time of writing, focusing on room acoustics. The last elective courses held the author is aware of date back to about 10 years ago. Clearly, the lack of awareness of the room acoustics phenomena, is partly due to the lack of up-to-date education and localized content. In recent years, however, there seems to be a noticeable change in trends. In public buildings and in some private developments also, an increase of demand can be subjectively noticed. It seems that the motivation for creating a room acoustic standard is in line with the recent trends of this region of Europe.

1.3. Standardization process and the evolution of the initial draft

The initial draft of the standard was based on the then-current just-released DIN 18041:2016 [4] and was extended with speech intelligibility and open office requirements, which are also missing from the Hungarian regulatory framework. The first draft was created between September and November 2016 within a very small special interest group of acoustical consultants. Following the required procedures, it was made available for the first public debate in the ad-hoc standardization committee that launched initially – based on not only the legally required announcements but also on invitations, as wide and as democratic as it can be – with 15 members, in December 2016. Although the purpose of creating the standard was commonly shared by all consultants involved, there was a differing opinion in the tools of how to achieve this goal. The first reception of the text was mixed but rejective in average, and complaints were received that the initial text was too long and complex. In the forthcoming 6 committee and 8 internal meetings, the text was revised multiple times and following a major overhaul was finally simplified to provide reverberation time requirements only in the form of limits. The rest of the text was put to informal appendices or fully omitted, for example design guidelines, proof of compliance, etc. The draft is running under the identification number MSZ 2080-1 indicating that parts of the original draft that were either removed or put aside temporarily, may become part of a next or future standard.
Since there is a clear recent international trend that room acoustics standards and requirements are aiming more than setting reverberation time limits or targets, and also address other objective

parameters, such as STI or open office criteria based on ISO 3382-3 [5], another draft text targeted towards speech intelligibility was developed and was submitted to the standards institute late 2017. This is intended to become the second part of the MSZ 2080 series, but depending on the internal procedures of standardization, it may obtain a different identification number in the end. A third part is also in preparation covering classification schemes, but originators agreed that it will not be submitted even as an initial draft before the outcome of ISO 19488 [6] becomes evident.

Parallel to these activities a draft of a room acoustical technical directive was also developed, prepared by an independent committee outside the standardization procedures. In case the room acoustic standard text becomes effective the technical directive may be obsolete.

3. Part 1 draft

1.4. Reverberation time requirements of the draft MSZ 2080-1

The draft of the standard text, as of February 2018, aims at setting reverberation time requirements only. Since committee members were wishing for keeping the 'freedom of expression' in design, the concept of 'target values' found in DIN 18041:2016 [4] or 'value ranges' found in classification standards of Baltic countries were discarded and single valued 'limits' were chosen similar to what is found in Building Bulletin 93 [8] of the UK for schools.

With respect to social inclusion and specialized acoustical parameters for the hearing impaired, no strategy has been fixed yet whether all parameters should take into account social inclusiveness or specific designs in special cases would be preferred.

The core requirements of the standard draft are set out in basically two tables. The first table would contain single reverberation time limit values applicable only under certain volume limits, for different types of rooms. Currently the following room types are considered:

- teleconference rooms
- call centers
- classrooms mostly used by the hearing impaired
- classrooms for foreign language
- classrooms (regular)
- childcare
- meeting room
- office (30+, 3-30, 1-2 people)
- healthcare facilities (patient room, operating room, examination, preparation, separate waiting room)
- silent/resting room
- common traffic areas, including of health facilities' with shared volume of public corridors and paths
- restaurant or canteen
- common usable foyer, lobby or staircase.

Requirements are set out in the following structure.

Table I. Requirement structure for single valued reverberation time limits.

Room type	Volume limit [m^3] of $T_{m,max}$ [s] applicability	$T_{m,max}$ [s]

The $T_{m,max}$ reverberation time limit parameters are interpreted as T20 or T30 as applicable, and limit requirements are not dependent on room height. They are considered between the 250 – 2000 Hz octave bands, spatially and frequency averaged. Some may find that the frequency range is narrower than what can be found in current national standards of other countries, and indeed, this may be a point of possible improvement in the final text. The comparison of the limit values of the current draft to the current NS 8175:2012 [7] can be found in Table II.

Table II. Equivalence of some of the drafted requirements with an existing standard.

Current draft requirements	Volume limit [m^3]	Equivalent NS 8175:2012 classification
Offices (30+ people)	1500	D (h = 3 m) C (h = 4 m) B (h = 5 m)
Offices (3-30 people)	500	D (h = 3 m) C (h = 4 m) B (h = 5 m)
Offices (1-2 people)	100	(Illegal) (h = 3 m) D (h = 4 m) C (h = 5 m)
Teleconference	250	D (h = 3 m) B (h = 4 m) A (h = 5 m)

For other room types the final draft has no proposed values yet. As can be seen, for low heights the

requirements either fall in the lowest quality category or even illegal, but as heights increase the proposed requirements become stricter. This condition may be improved in the final text, too.
The second type of table of requirements, currently under consideration, is used when a room cannot fall into any of the categories of the first table due to volume or category constraints. In this case, rooms would be classified by usage, such as speech, musical or sport purpose. There is a 'general' or 'other' type of category still in the draft, a remainder of what was class B in the DIN 18041:2016 [4] standard.
The application terms of frequency dependent tolerance curves for reverberation time has not yet been decided by the committee.

1.5. Informative annexes of the draft MSZ 2080-1

There are four informative annexes in the standard draft.
Annex A covers specifics of the interpretation of reverberation time, including spatial dependency, background noise, validity of single value representations, multi-slope decays and definition guidelines in large spaces such as stadiums.
Annex B is an informative annex about the statement of compliance. It covers both calculations and measurements, defines the applicability of diffuse field assumptions and computer models, and references EN 12354-6 [9] (the 2004 version, not yet the latest), in line with the DIN 18041:2016 [4]. Additionally, it proposes contents of the statement of compliance. This part was originally a core part of the standard but then moved to an informative annex being 'too restrictive'.
Annex C contains design guidelines and is written in a textbook style for a more general audience. It covers a broad range of topics including room geometry, material placement and is mostly equivalent to what is found in DIN 18041:2016 [4].
Annex D is a short description introducing 'other acoustical preconditions of speech intelligibility'. It may become redundant when the second part of the standard is released.
Annex E would contain tables directly usable for room acoustic treatment implementation cases with absorptive ceilings.

4. Part 2 draft

Part 2 of the room acoustic standard intends to address requirements beyond reverberation time both for passive acoustics and amplification concerning speech intelligibility and speech privacy. Originally part of Part 1, it is intended now to be offered as a separate standard.

In this context, passive acoustics shall mean non-electroacoustic and non-noise making devices used to absorb, direct or diffuse sound.

The draft is divided to the following chapters:

- Performance requirements of rooms without amplification systems
- Performance requirements of installed amplification systems
- Performance requirements of installed masking systems
- Design requirements and guidelines
- Requirements of statement of compliance.

The requirements of the draft are based on the following kinds of acoustic criteria:

- STI
- $D_{2,S}$ and $L_{p,A,S,4m}$
- r_D
- Maximum sound level $L_{max,RMS.}$

Requirements are largely based on [8] and [10]-[13].

1.6. STI requirements for passive acoustics

Speech-purpose rooms without amplification system, such as open plan classrooms, cellular classrooms and foreign language cellular classrooms are required to comply with STI minimum requirements. For the sake of designer convenience – not all room acoustic designers would consider computer modeling for designing a typical classroom – compliance of cellular classrooms can be provided by fulfilling a reverberation time requirement between 125-4000 Hz given that the classroom size is according to those specified in the corresponding building code (which effectively limits the size of the space) and absorptive wall panels as well as ceiling is implemented in a prescribed way. This convenience has been pre-tested in measurement-based (calibrated) Odeon simulations.
For the STI requirements the speech level and directivity to be used in the design phase is based on BB93[8].

1.7. Speech privacy with passive acoustics

For the purpose of providing adequate speech privacy, $D_{2,S}$ and $L_{p,A,S,4m}$ parameters are used. Different requirements are set for open offices occupying more than 20 workspaces with acoustical separation priority and collaboration priority or general purpose. A separate requirement is set for call centers. For privacy compliance concerning sensitive personal data (e.g., medical) a parameter for r_D is set. Passive acoustical parameters instead of STI are used to prioritize passive acoustical solutions (absorption and blocking) instead of masking (covering) which is proposed to be used as a secondary option. Both natural sound sources and electroacoustic masking sources may be applied in the case they are unavoidable.

Table III. Proposed requirements for speech privacy and open plan spaces.

Type	Proposed requirement
Open office with 20+ workspaces with acoustical separation priority	$D_{2,S} \geq 8$ dB $L_{p,A,S,4m} \leq 52$ dB
Open office with 20+ workspaces with collaboration priority or general purpose	$D_{2,S} \geq 6$ dB $L_{p,A,S,4m} \leq 49$ dB
Open plan call center	$D_{2,S} \geq 7$ dB $L_{p,A,S,4m} \leq 49$ dB
Open plan customer service point handing sensitive personal information (e.g., pharmacies, student center, bank account)	$r_D \leq 5$ m
Open plan teaching space/classroom	STI ≤ 0,30 between adjacent spaces

1.8. Requirements of amplified systems

Requirements for amplified systems are based on STI to provide intelligibility and on maximum sound pressure level to protect hearing. It is understood and noted in the text that these may co-influence each other, and under certain cases may cause contradiction, but in general situations the requirement can be fulfilled. STI requirements are grouped into categories:

- minimum requirements
- quality speech system requirement
- high quality speech system requirement
- general purpose speech system requirement
- passenger public announcement system requirements
- quality passenger public announcement system requirements
- public announcement system requirements used in sport facilities.

It is understood that noted that in order to fulfill the STI requirements certain room acoustic conditions have to be met. The minimum requirements can only be used under especially unfavorable and unchangeable room acoustic conditions.

Requirements for each category are minimum requirements to be fulfilled at given areas in the space. STI requirements are meant to be fulfilled under the typical background noise conditions in an empty, furnished state. The designer is expected to document assumptions on the background noise.

Maximum levels of systems primarily used by people under 18 years of age is expected to be further limited ($L_{max,RMS} \leq 90$ dBA).

The use of RASTI is excluded and STIPA can be used on a case-by-case basis.

For optimum levels in passenger public address systems a recommendation of $L_{max,RMS} \leq 78$ dBA is proposed, based on recent studies [14].

1.9. Performance requirements of masking systems

The draft notes that masking systems nay be unavoidable, either electroacoustic or by use of other means, in certain conditions if the aforementioned requirements cannot be fulfilled due to engineering or legal restrictions.

For these systems a masking system providing 48 dBA sound pressure level at most, between 250 Hz – 4000 Hz within 5 dB of spatial level difference, may be required. A multizone system is preferred but at least a single zone system with multi-speaker systems are required if electroacoustic systems are used.

1.10. Part 3 and more

Further parts of the standard may be initiated depending on the acceptance and final contents of the first two parts. Since the current drafts of the first two parts contain only minimum requirements, a complex classification scheme – preferably harmonized with that of other countries', including building acoustics, noise and room acoustic descriptors – could be a useful introduction to the regulatory framework.

5. Final notes

The state of the current regulatory framework in Hungary for acoustics has broad, multiple and long-lasting gaps that needs to be filled while existing regulations need to be updated. A room acoustic standard is being drafted now as a first gap-filler with more items to follow in the future.

The standardization committee for building acoustics has now be revitalized following more than ten years of inactivity.

In the initiation of the Hungarian national standard for room acoustics, several international standards were taken into account.

It is hoped that the local standardization committee will conclude its work within reasonable time and will set up world-class requirements.

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