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Introduction

In Europe, national acoustic classification schemes for housing exist in about ten countries. The schemes specify a number of quality classes, reflecting different levels of acoustic protection, and include class criteria concerning several acoustic aspects, main criteria being about airborne and impact sound insulation between dwellings, facade sound insulation and service equipment noise. The schemes have been implemented and revised gradually since the 1990es.

However, due to lack of coordination, there are significant discrepancies, implying obstacles for exchange of experience and for further development of design tools. Due to the high diversity in Europe, the European COST Action TU0901 "Integrating and Harmonizing Sound Insulation Aspects in Sustainable Urban Housing Constructions" was established in 2009 with preparation of a proposal for an acoustic classification scheme for housing as one of the main goals. The proposal – based on studies of existing, national schemes and discussions about needs – was approved by ISO/TC43/SC2 as the new work item ISO/WI 19488, and WG 29 was established in 2014, developing further the structure and details. The paper introduces ISO/2ndCD 19488:2016 and compares the main characteristics with the German VDI 4100 and DEGA Recommendation 103.

Acoustic classification of housing – overview schemes in Europe

Acoustic regulations for housing specify minimum requirements aiming at protecting health for "normal" people with "normal" neighbours. Such regulations exist in most countries in Europe, cf. [1, 2, 3], and define criteria for acoustical conditions in new housing. However, complying with regulatory requirements does not guarantee satisfactory conditions for the occupants, and since the mid 1990'es, several countries have developed and introduced acoustic classification schemes with classes reflecting different levels of acoustical comfort/protection. The purpose is to make it easier for developers to specify and for users to require a standardized acoustic quality better than the quality defined by regulations.

Defining a classification scheme as having minimum three classes, there are acoustic classification schemes in ten countries in Europe, see Figure 1. This paper describes the overall characteristics of the schemes, incl. VDI 4100 and DEGA 103, and compares the classification criteria for sound insulation between dwellings and quality class ranges with the national acoustic regulations and the ISO/2nd CD.

Figure 1: Front pages of acoustic classification schemes in Europe, all – except DEGA 103 – published by national standardization organizations. The ISO/CD is shown to the left.

An overview of existing national acoustic classification schemes for dwellings [4-14] and ISO/2ndCD 19488 [15] is found in Table 1. For each scheme listed, the class denotations and the relation to the national building code are indicated.

Information about ISO/WI 19488 dealt with by WG 29 is found in [15] and [16]. The WG has 50 members from 23 countries, 19 of these European, four overseas countries, and typically around half of the members attend meetings. The acoustic characteristics dealt with in the ISO/WI are in general the same as for most national regulations and classification schemes, see introduction, but more issues, like e.g. sound insulation internally in dwellings and sound absorption in stairwells, are still under discussion. Among other important decisions made already during the preparatory work in COST TU0901 were that the total range (from lower to upper class limits) should preferably be sufficient to include all current regulations in Europe and that no verbal class descriptions like excellent and bad etc. should be used. Sound insulation requirements in Europe are found in [1], although some minor changes have been made since then.

Specific class criteria and quality class ranges for airborne and impact sound insulation are found in [17] and [18], although some data need to be updated. As an alternative or supplement to extensive classification schemes, some countries have defined a simple set of criteria for increased acoustical comfort, see [19], for example added in an annex to the document describing the regulatory requirements. Such criteria are found in e.g. Austria and Germany. The Austrian criteria are described as improvements in dB compared with the regulatory minimum requirements: (1) for airborne sound insulation between dwellings and for airborne sound insulation of facades, an improvement of 3 dB is defined; (2) for impact sound insulation between dwellings, an improvement of 5 dB is required; (3) noise level limits for technical installations are reduced by 5 dB. Increased comfort criteria are, see [19], inherent in the Swiss regulations and in the Belgian acoustic requirements.

Table 1: European schemes for acoustic classification of dwellings, relation to building codes and information about number of classes. ISO/2ndCD 19488 (Dec. 2016) has been included for comparison. Status February 2017.

Acoustic classification of dwellings - Schemes in Europe and relation to building codes – Status February 2017							
Coun-try	Year of publication	CS Reference (latest version)	Class denotations(1)	BC link to CS	BC ref. to CS & Comments	No. of classes	No. of classes < BC
DK	2001/2007	DS 490 (2007)	A / B / C / D	+	Class C	4	1
FI	2004	SFS 5907 (2004)	A / B / C / D	–	N/A (BC = Class C)	4	1
IS	2003/2011/2016	IST 45 (2016)	A / B / C / D	+	Class C	4	1
NO	1997/2005/2008/2012	NS 8175 (2012)	A / B / C / D	+	Class C	4	1
SE	1996/1998/2004/2015	SS 25267 (2015)	A / B / C / D	–	N/A (See note(4))	4	1
LT	2003	STR 2.01.07 (2003)	A / B / C / D / E	+	Class C	5	2
IT	2010	UNI 11367 (2010)	I / II / III / IV	–	N/A (BC ~ Class III	4	1
DE	1994/2007/2012	VDI 4100 (2012)(2)	III / II / I	–	N/A (BC ~ Class I(2))	3	0
DEGA	2009/Entwurf2017	DEGA Empfehlung 103 (E2017)(3)	A*/ A / B / C / D / E / (F)	–	N/A (BC ~ Class D(3))	6+npd	1+npd
AT	2012	ÖNORM B 8115-5(2012)	A / B / C / D / (E)	–	N/A (BC = Class C)	4+npd	1+npd
NL	1999	NEN 1070 (1999)	I / II / III / IV / V	–	N/A (BC ~ Class III)	5	2
ISO/WI	ISO/WI 19488 since 2014	ISO/TC 43/SC 2 N 1371 ISO/2ndCD 19488 (Dec. 2016)	A / B / C / D / E / F and npd	N/A	N/A (See note(5))	6+npd	N/A

Abbreviations: BC = Building Code (regulatory requirements); CS = Classification scheme

(1) Classes are indicated in descending order, i.e. the best class first. Denotations in brackets correspond to npd.

(2) The revised version of VDI 4100 published in 2012 changed descriptors from R'_w and $L'_{n,w}$ to $D_{nT,w}$ and L'_{nT} (as had been discussed for years for the regulations), and class criteria were made stricter, i.e. above and regulations. After tightening of DIN 4109-1 in 2016, the basic criteria for the lowest class I for MS-housing are again similar to regulations, but VDI 4100 has additional criteria, e.g. on internal sound insulation.

(3) In addition to VDI 4100, the German Society of Acoustics (DEGA) has published a recommendation, DEGA-Empfehlung 103, "Schallschutz im Wohnungsbau – Schallschutzausweiz". For MS-housing, Class D criteria in general correspond to regulations, but there are additional criteria.

(4) SS 25267 (2015) does not include class C criteria, but refers to values in the BC as class C.

(5) Original proposal prepared by COST TU0901 in 2013. ISO/WI 19488 from 2014, ISO/CD in 2016.

In Figures 2 and 3 are found graphical comparisons of lowest and highest classes for the existing classification schemes [4-14]. The regulatory requirements in the same countries have been added with data from [1] updated. More information is found in the same references and [15].

Comparing the data from the classification schemes in Europe, see Table 1, Figures 2-3, detailed class criteria in [4-14] and explanations in [17-18], several differences are found, e.g. the following:

- Number of quality classes (3 to 6) and denotations (see table 1). Note: "npd" not counted as a class.
- Descriptors used for sound insulation criteria.
- Use of low-frequency spectrum adaptation terms according to ISO 717:2013.
- Intervals between classes.
- Range of quality classes (~ 8 to 22 dB for airborne, ~ 14 to 30 dB for impact) and position, see Figures 2-3.
- Relation to regulatory requirements. See Table 1 and Figures 2-3.

The sound insulation descriptors applied are the following:
R'_w; $R'_w + C_{50\text{-}3150}$; $D_{nT,w}$; $D_{nT,w} + C$; $D_{nT,w} + C_{50\text{-}3150}$
$L'_{n,w}$; $L'_{n,w} + C_{I,50\text{-}2500}$; $L'_{nT,w}$; $L'_{nT,w} + C_I$; $L'_{nT,w} + C_{I,50\text{-}2500}$

The most striking differences between countries and between classes are found in impact sound criteria, e.g. the best class in IT's UNI 11367 [10] (grey arrow) is the same or "lower" than lowest class in DE's VDI 4100 [11], cf. Figure 3, thus illustrating the challenge on finding a common international ground for class criteria in a situation, where every country has struggled to make decisions themselves, when defining the class criteria. Thus, it should also be noticed that the ranges in ISO/2ndCD 19488 [15-16] do not include all national classification ranges completely, neither for airborne or for impact sound insulation.

For Germany, there is the somewhat chaotic situation with two different classification schemes with different sound insulation descriptors, different number of classes, different total range etc., and in addition proposals for increased requirements in the old DIN 4109, Beiblatt 2 (1989), and the new DIN SPEC 91314 (Jan. 2017). Furthermore, the German regulations and VDI 4100 have different criteria for multi-storey housing and row housing. For more information about the situation, see [20].

Several issues have been discussed repeatedly in WG 29, because there are more viewpoints to consider and no easy solutions. While there seems to be a reasonable wide preference for descriptors based on $D_{nT,w}$ and $L'_{nT,w}$, the limit values and the frequency ranges for sound insulation limits are (for good reasons) still a main discussion issue, as it is on one hand recognized that for some constructions, a frequency range down to 50 Hz is needed, but on the other hand several countries prefer 100 Hz as the lower limit due to measurement uncertainty or they don't see a need to include the low-frequency range in the sound insulation limit values. In addition, it's complicated to change regulations, which would in the long run be a consequence, if low frequencies are included. Furthermore, construction data are often missing for low frequencies.

Another topic being addressed and requested by some countries, is sound insulation internally in dwellings, which is already included in most existing schemes, but with mixed experience in practice. Examples of other important WG 29 discussions are about reaching consensus for sound absorption in stairwells and for guidelines on verification of compliance with an acoustic class.

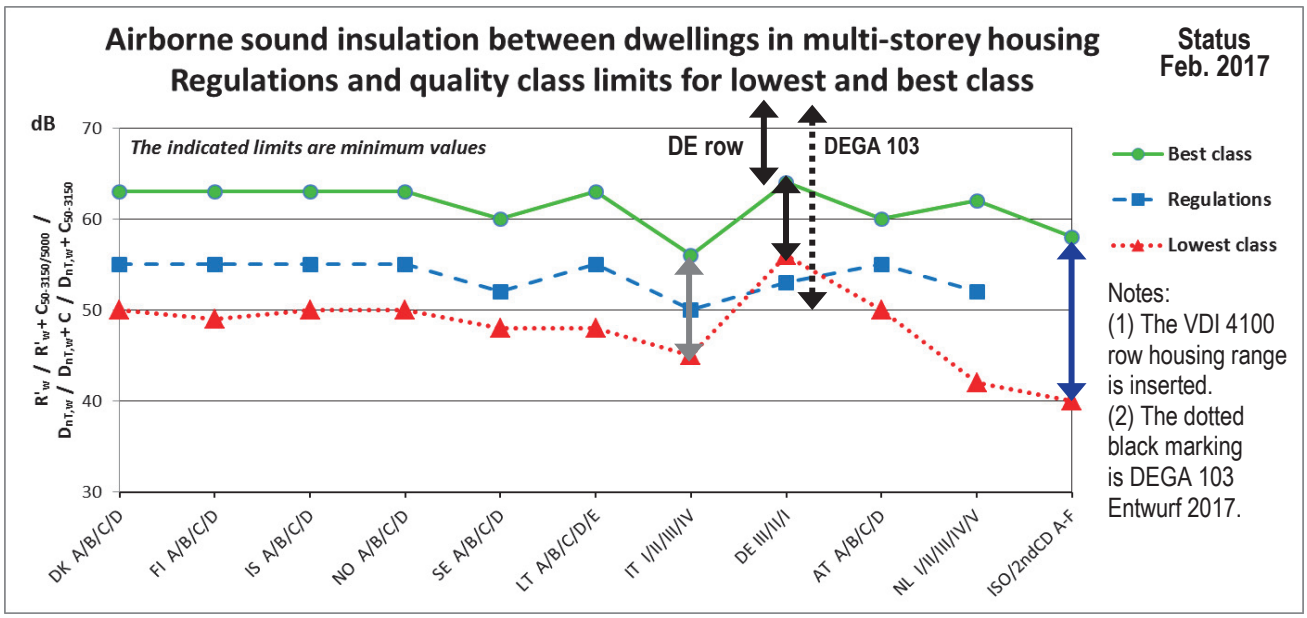

Figure 2: Airborne sound insulation limits for highest and lowest classes in classification schemes in Europe and regulatory requirements for the same countries. ISO/2nd CD 19488 class limits [16] are shown in the right side for comparison.
Note: The diversity of descriptors appears from the Y-axis label. The graphs present the numbers only. No conversions between descriptors applied.

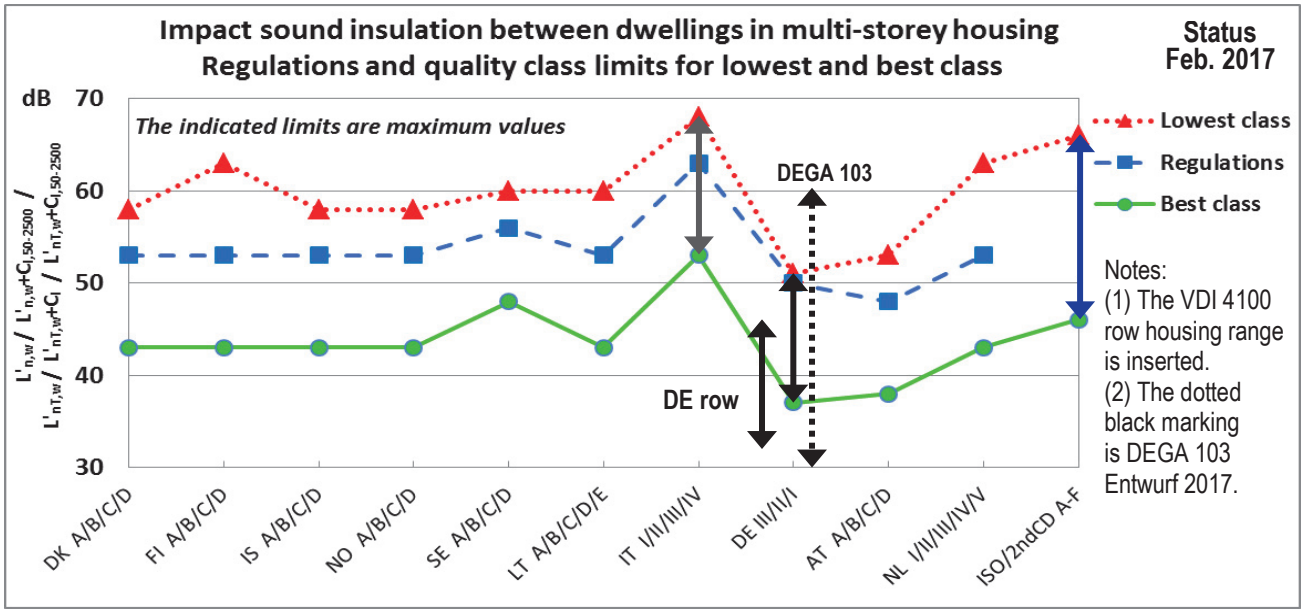

Figure 3: Impact sound insulation limits for highest and lowest classes in classification schemes in Europe and regulatory requirements for the same countries. ISO/2nd CD 19488 class limits [16] are shown in the right side for comparison.
Note: The diversity of descriptors appears from the Y-axis label. The graphs present the numbers only. No conversions between descriptors applied.

Comparison of ISO/CD 19488 with VDI 4100, DEGA 103 (Entwurf 2017)

In the previous Section, both in the text, Table 1 and Figures 2-3, several differences between the two German classification schemes have been indicated and also between these and the ISO/2nd CD 19488 and the other classification schemes in Europe. VDI 4100 is the only scheme with a complete, but unnecessary, distinction between criteria for multi-storey hosing and row housing. A classification could be more appropriate by considering only the "acoustic quality" without thinking about type of housing or possible construction solutions, but having more classes describing acoustic protection. Thus, it is recommended in the future to have just one set of classes and specify the class with the relevant acoustic protection.

VDI 4100 and DEGA 103 have stricter high-end classes than all others, incl. the ISO/2nd CD, see Figures 2-3. It could be interesting to know how much they are used in practice? In the below Table 2 are found examples of other comparisons, where a summary of the German experience could be useful for further discussions, also in WG29.

Table 2: Other comparisons between ISO/2nd CD, VDI, DEGA

Characteristic	ISO/2nd CD	VDI	DEGA
Sound insulation internally in dwellings	no	yes	yes
Sound absorption in stairwells	yes	no	yes
Outdoor noise levels	no	yes	yes
Classification certificate (Schallschutzausweis)	no	no	yes

Many other issues could be interesting for further discussions, e.g. the use of verbal explanations of perception of various noises for different acoustic classes as have been applied in both VDI 4100 [11] and DEGA 103 [14]. This idea has been applied also in ISO/2ndCD 19488 [15], but several countries objected and asked for deleting the actual table due to the lack of "scientific proof" for the statements instead of appreciating the idea of making explanations understandable for typical non-acoustic people, e.g. occupants and architects.

However, the key question is to ask Germany to reconsider the sound insulation descriptors again. In the past, some smaller countries (like e.g. Denmark) changed descriptors to R'_w and $L'_{n,w}$ based on the confidence of the German decisions. Is it time for changing again?

Discussion and suggested initiatives

Considering efforts during decades to prepare national acoustic classification schemes for housing (in Germany even more schemes), it seems as if acoustic protection in housing could benefit from joint efforts, both nationally and internationally, by cooperating more on the issue.

It is important to be aware of that sound insulation is not only a question of comfort, but also about protection of health. Furthermore, insufficient sound insulation may be the cause of conflicts between neighbours, and not least lack of privacy and renouncing own activities, thus reducing quality of life.

Most classification schemes have as the main purpose improvement of acoustic protection in new housing and with no or few classes for old housing. Thus, like for the building regulations, little attention seems to be given on improving the sound insulation in existing housing, even if extensive renovation takes place with several upgrades "for the future", including especially the energy consumption, but also several other qualities. More awareness on sound insulation in general could be reached by including lower acoustic classes in acoustic classification schemes and make acoustic labelling mandatory for dwellings on sale – like energy labelling in some countries. The DEGA 103 Schallschutzausweis (Classification certificate) could be an idea for wider use in other countries.

Acoustic mapping of the housing stock in Europe using a harmonized acoustic classification scheme – similar to principles for mapping environmental noise – could help increasing attention to neighbour noise and sound insulation ☺

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References

[1] Rasmussen, B., Machimbarrena, M., *Existing sound insulation performance requirements and classification schemes for housing across Europe*. Ch. 2 in COST Action TU0901 – Building acoustics throughout Europe. Volume 1: Towards a common framework in building acoustics throughout Europe. DiScript Preimpresion, S. L., 2014. p. 31-54.

[2] Rasmussen, B. (2010). *Sound insulation between dwellings - Requirements in building regulations in Europe*. Applied Acoustics. 71(4):373-385. Available from: 10.1016/j.apacoust.2009.08.011

[3] Rasmussen, B. Rindel JH. (2010). *Sound insulation between dwellings - Descriptors applied in building regulations in Europe*. Applied Acoustics. 71(3), 171-180. Available from: 10.1016/j.apacoust.2009.08.011

[4] DS 490:2007, *Lydklassifikation af boliger*. (Sound classification of dwellings), DK. Under revision.

[5] SFS 5907:2004, *Rakennusten Akustinen Luokitus*, Finland. English version "Acoustic classification of spaces in buildings" published in July 2005.

[6] IST 45:2016, *Hljóðvist - Flokkun íbúðar- og atvinnuhúsnæðis* (Acoustic conditions in buildings - Sound classifycation of various types of buildings), Icelandic Standards, Iceland.

[7] NS 8175:2012, *Lydforhold i bygninger - Lydklasser for ulike bygningstyper* (Acoustic conditions in buildings - Sound classification of various types of buildings), Standards Norway.

[8] SS 25267:2015, *Byggakustik – Ljudklassning av utrymmen i byggnader – Bostäder* (Acoustics – Sound classification of spaces in buildings – Dwellings). Swedish Standards Institute, Stockholm, Sweden.

[9] STR 2.01.07:2003, Dél Statybos Techninio Reglamento Str 2.01.07:2003, *Pastatu Vidaus Ir Isores Aplinkos Apsauga Nuo Triuksmo* (Lithuanian building regulations. Protection against noise in buildings). Patvirtinimo, Lithuania.

[10] UNI 11367:2010 *Acustica in edilizia – Classificazione acustica delle unità immobiliari – Procedura di valutazione e verifica in opera* (Building Acoustics - Acoustic classification of building units - Evaluation procedure and in-situ measurements)

[11] VDI 4100:2012, *Schallschutz im Hochbau - Wohnungen - Beurteilung und Vorschläge für erhöhten Schallschutz* (Sound insulation between rooms in buildings - Dwellings – Assessment and proposals for enhanced sound insulation between rooms". VDI-Handbuch Lärmminderung. Beuth, Germany.

[12] ÖNORM B 8115-5:2012. *Schallschutz und Raumakustik im Hochbau - Teil 5: Klassifizierung*. (Sound insulation and room acoustics in buildings - Classification). ÖNORM, Austria.

[13] NEN 1070:1999, *Geluidwering in gebouwen – Specificatie en beoordeling van de kwaliteit* (Noise control in buildings – Specification and rating of quality), Netherlands.

[14] DEGA-Empfehlung 103 (Entwurf 2017), "Schallschutz im Wohnungsbau – Schallschutzausweis", DEGA, Feb. 2017. Note: The first version was published in March 2009.

[15] ISO/TC 43/SC 2 N 1371 (2016), *Acoustics - Acoustic classification of dwellings*. ISO/CD 19488.2:2016-12.

[16] Rasmussen, B. (2014). *International proposal for an acoustic classification scheme for dwellings: background and perspectives*. Proceedings of Inter-Noise 2014, Australian Acoustical Society.

[17] Rasmussen, B. (2012). *Sound classification of dwellings - Quality class ranges and intervals in national schemes in Europe*. Proceedings of EuroNoise 2012. (s.1178-1183). European Acoustics Association - EAA.

[18] Rasmussen, B (2016). *Acoustic classification schemes in Europe – Applicability for new, existing and renovated housing. Proceedings of the Baltic-Nordic Acoustics Meeting 2016*. Stockholm: Nordic Acoustic Association. BNAM Proceedings, Vol. 2016).

[19] Austria: ÖNORM B 8115-2:2006-12-01
Germany: DIN 4109:1989, Beiblatt 2 (under revision)
DIN SPEC 91314 (Jan. 2017)
Switzerland: SIA 181:2006
Belgium: NBN S01-400-1: 2008

[20] Related papers at DAGA 2017, Kiel:
Schneider, M. Fischer, H-M. (2017). *Sind die Mindestanforderungen der DIN4109-1: 2016 zeitgemäß?*
Schäfers, M. (2017). *Konstruktive Umsetzung verschiedener Schallschutzniveaus im Massivbau.*
Burkhart, C. (2017). *DEGA-Empfehlung 103 - Neue Fassung 2017.*