

A simple system to quantify the improvement of impact sound insulation by floor coverings

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Summary

In the Netherlands the impact sound insulation of floors is directly related to the sound insulation of the mostly concrete or wooden floors, without any influence of the floor coverings. This situation is originated after the discrepancy between the Dutch single number quantity I_{co} of 1962, based on a SNQ like L'_{nw} and the results of perception survey in the sixties of the past century. In the seventies investigations of Schwirtz and Gerretsen solved this discrepancy by developing a new SNQ the I_{co} of 1976, a quantity that is simply related to $L_{nT;A}$.

In the period before 1975 nearly everyone in the Netherlands had all kinds of carpets on the floor, on concrete as well as wooden floors. The use of carpets solved that problem, but after 1975 hard floor coverings become more and more popular and that caused again problems because the new SNQ was not suitable for this situation. In this paper the way to solve this problem is dealt with various organisations: the Dutch standardisation committee, the Dutch government, the the unions of owners of apartments, the Unity of notaries, the social housing associations. Because it was difficult to get a simple method, the Dutch standardisation committee united acousticians and representatives of Dutch and Belgian producers of under floors and floor coverings. The result is a new Dutch technical agreement NTA 5098 that introduces a unique star system for the acoustical quality of combinations of under floor and the floor coverings and the basic floor of concrete or wooden and the floating floors. With this system it will be easier to get the right combination of under floor and (hard) floor coverings.

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1. Introduction

In the Netherlands the impact sound insulation in the building regulations is always related to the bare floor construction without any influence of the floor coverings. This led to discrepancies between the objective acoustic parameters and the subjective experience of the inhabitants. In the late sixties this was the case because of the overall use of carpets in the Netherlands. Schwirtz [1] and Gerretsen [2] therefor transformed the old I_{co} of 1962, which was a SNQ like L'_{nw} , into the I_{co} of 1976, with the so called “springtouw” curve. This SNQ is simply related to the nowadays $L_{nT;A}$, as defined in ISO 717 part 2, by equation 1.

$$L_{nTA} \approx 59 - I_{co} (1)$$

The reference international and Dutch curves inter are given in figure 1

Before 1975 the carpet was the very most favorite floor covering, but after 1975 hard floor coverings such as flags, parquet came in use, later also laminate, different kinds of vinyl, marmoleum, and epoxy coatings/layers came into use. The discrepancy between the objective SNQ and subjective experience started again.

In this paper the effects on the impact sound insulation of hard floor coverings will be described, and the actions that several actors involved in housing (social and particular landlords and unions

of apartment owners) which culminates in a new Dutch Technical Agreements NTA 5098:2017.[3]

2. The difficulties in practice with the influence of floor coverings

In the Netherlands the legal requirements involve only the bare floor without the influence of floor coverings. After 1975 it became clear that new hard floor coverings such as directly glued flags and parques on concrete or wooden floors seriously gave no improvement of the impact sound insulation, that is the case with carpets. (de Roo [3]) In 1976 the Dutch Standardization committee has foreseen a needed improvement of the impact sound insulation of 5 dB, but after investigations by de Roo [4] and Bezemer[5] she came to the conclusion that 5 dB was not enough and it had to be 10 dB better.

The new Dutch building code of 1992 persist in requirements of the impact sound of floors just before delivery, thus without influence of the floor coverings. The Dutch institution of noise(NSG) put forward a 10 dB improvement of impact sound insulation on base of I_{co} by floor coverings on a private base. From that time on several rules were used in regulations of building owners and in lease contracts. The following problems we have to deal with during the last 25 years.

1. Because the Dutch building code 1992 asks $I_{co} \geq 0$ dB ($L_{nT;A} \leq 59$ dB) we see with an improvement of 10 dB, that an I_{co} of +10 dB is needed ($L_{nT;A} \leq 49$ dB). This level is not reachable for older buildings with solid floors with a mass ≤ 500 kg/m².
2. The improvement for the most floor coverings is only known for stony constructions after ISO 717 part 2 and is not known for wooden floors. Investigations had to be done for wooden floors
3. The (big) difference between ΔL_{lin} and ΔL_w . The ΔL_{lin} is in most cases ca 11 dB lower than the ΔL_w . People think that they have a much better product then the 10 dB, but the improvement is related to ΔL_w .
4. Also in case of floating floors an improvement of 10 dB is asked and is normally not reachable.
5. In regulations of building owners the total floor inclusive the floor coverings must fulfill the Dutch Building Code. The bare floor must already fulfill the Dutch building code. So no

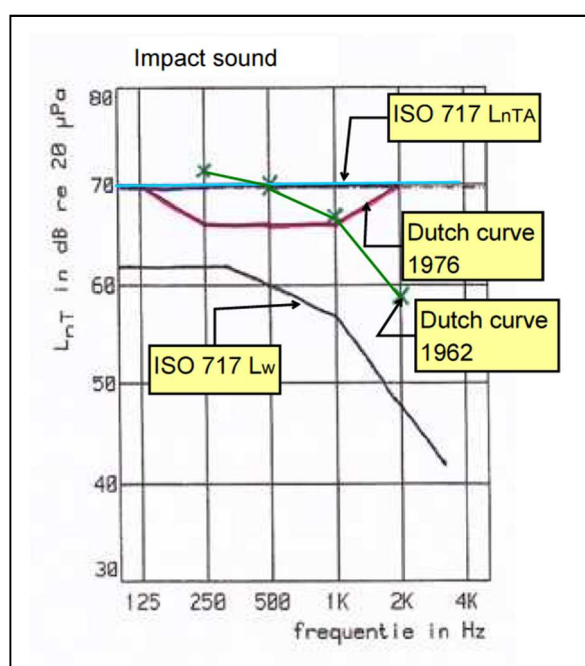


Figure 1 : The international and Dutch reference curves

improvements by floor coverings are necessary.

6. In combination with floating floors the improvement of most hard floor coverings is much lower than with solid concrete floors
7. If there are some mistakes in making the floating floor the impact sound insulation is too low in case of flagstones, parquet floor directly connected to the floating floor.
8. The improvement of floor coverings on solid floors is much better than on wooden floors.

Figure 2 The improvements of impact sound for floor coverings on solid floors

These were the reasons to investigate a method to make a simple and correct method to characterize the influence of floor coverings and under floors on impact sound insulation in a simple way. This resulted in a Dutch technical agreement NTA 5098

3. The various effects of floor coverings on three types of floors

In the Netherlands three types of bare floors are in use:

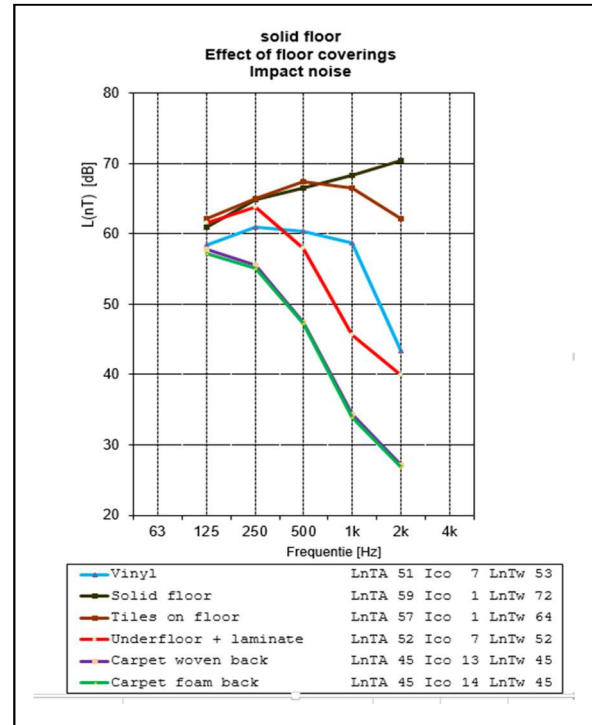
1. Solid concrete floors in use since ca 1955
 2. Wooden floors, characteristic for dwellings until 1970.
 3. Floating floors coming into use since ca 1995
- Investigations into the influence of floor coverings for these three types of floors are the subject of the next paragraphs

3.1 Solid concrete floor

This type of floor is the most common one between 1955 and now. Many measurements on floor coverings were done in laboratories on marmoleum, vinyl, laminate and carpets with and without under carpet. Most popular at the moment are laminate and parquet with various types of underfloors. Nearly every underfloor realized a $\Delta L_{lin} \approx 10$ dB ($\Delta L_w \approx 21$ dB) improvement with laminate and parquet. Most common are 10 mm softboard, 3 to 5 mm foam, and because of the popularity of floor heating, materials with a low $R_c \leq 0,1$ m²K/W such as heat foil. Also underfloors for marmoleum and vinyl were developed such as combinations of foam with hardboard. For flags such marble, travertine and flagstone only underfloors with a very thick rubber mixed with cement were developed. Because of these thickness this y are seldom used in spite of an improvement of $\Delta L_{lin} = 16$ dB. Some results of field measurements are given in figure 2.

Figure 2 Effects of various floor coverings on solid floors

3.2 Wooden floors



For this type of floor less data were available. A special investigation was therefore done in practice in a typical apartment building from before 1940. The results are given in figure 3 in terms of ΔL_{lin} , ΔL_w for various different floor coverings. The results are given for the base floor C1 of ISO 10140 part 5:

For the common combinations of floors and underfloors special with laminate and parquet give $\Delta L_{lin} = 5$ dB instead of 10 dB for solid floors.

- An extra improvement of 5 dB can be reached with an extra mass of 14 kg/m² directly on the wooden base floor.
- Special constructions show that an improvement of 10 dB is possible.
- Carpets with a high mass or pole give the best results.
- For wooden floors the differences between ΔL_w and ΔL_{lin} much lower than for solid concrete floors (ca 2 dB against 11 dB)

3.3 Floating floors

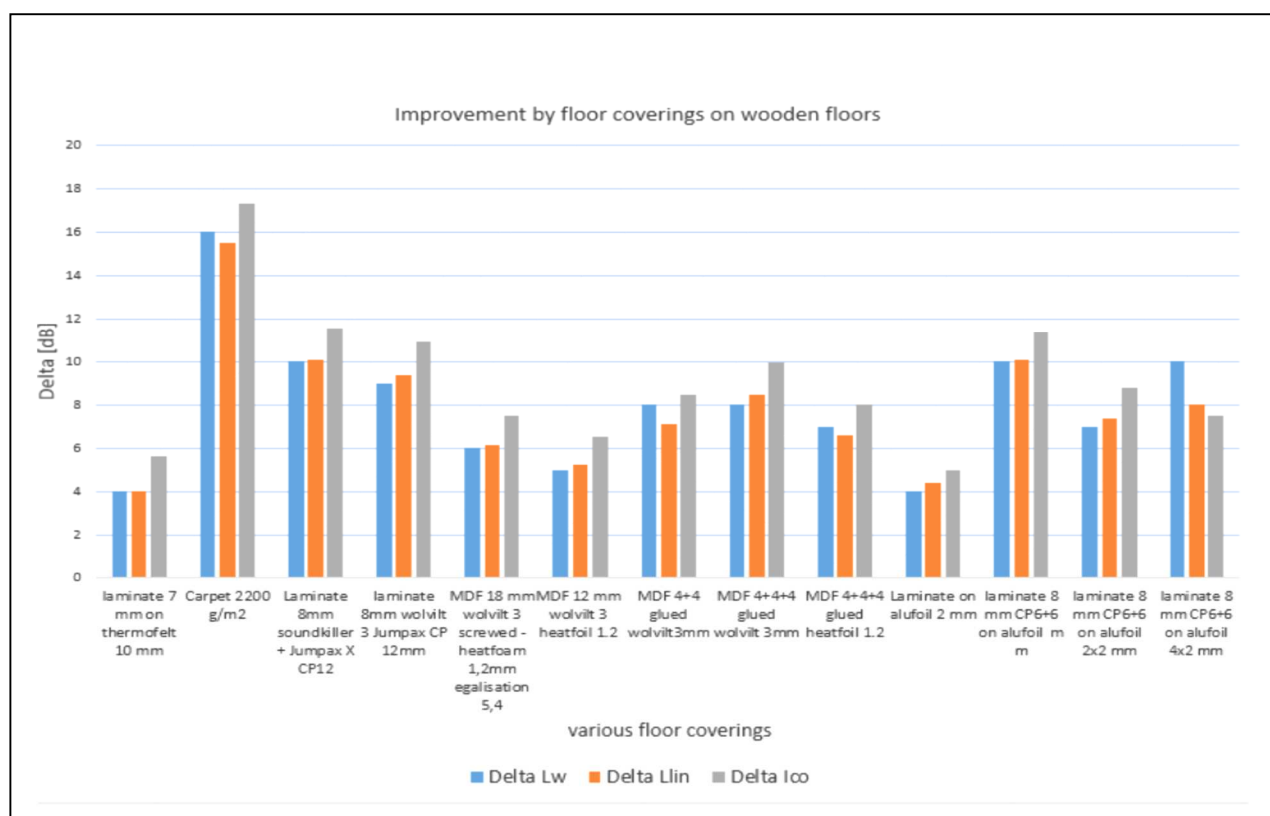


Figure 3. Improvement of impact sound insulation for wooden base floors for various floor coverings. See that for wooden floors ΔL_w and ΔL_{lin} are nearly equal.

Floating floors are rather new in Dutch dwellings: In the sixties of the 20th century most projects with floating floors give disappointing results, because of the faults that were made. The last decade of the 20th century results in a reintroduction because of the fact that it is not possible to reach values of $L_{nT;A} \leq 49$ dB with solid floors. The solid mass for this level is at least 1070 kg/m² and is not practical when there is a tendency to be economical with building material. Also for this type of floor some experiments were done with various floor coverings. See Figure 4 and 5.

The results show small effects on the SNQ $L_{nT;A}$ and L_{co} . Only high pole carpets with undercarpet give a big improvement. For L'_w the effects are bigger than for $L_{nT;A}$. The effect on ΔL_{lin} in case of floating floors is much smaller (2 dB) then on solid floors (ca 10 dB). An improvement of 10 dB is not correct in case of floating floors. In this case the carpets on under carpets give the best results

Another problem with floating floors is when the floating floor is made with not-wanted connections between the floating floor and the base floor or the walls/facades. Much lower values of $L_{nT;A}$ can arise. When one thinks that it is a good floating

floor and decide to place hard floor coverings directly on the floating floor, then there is no further improvement of the impact sound insulation, and there is a great risk for annoyance. In that case improvements can realized with the measures necessary for solid floors.

For a good functioning of floating floors it is necessary that the $L_{nT;A}/L'_w$ results must be better than the result of a solid floor inclusive the desired improvement of the floor coverings.

Conclusions for the type of base floors

The three types of base floor need a special treatment for floor coverings. The overall conclusions are :

- In case of wooden floors the values of ΔL_{lin} are ≈ 5 dB less than for solid floors.
- This is overall the case. For floor coverings with only results for solid floors, 5 dB lower values can used for wooden floors. If both values are measured, both values can be used.
- For floating floors you know what you have to do with floor coverings when you know the quality of the bare floating floor. If it is all right you can use also hard floor coverings without underfloor, otherwise you have to take the measures needed for solid floors

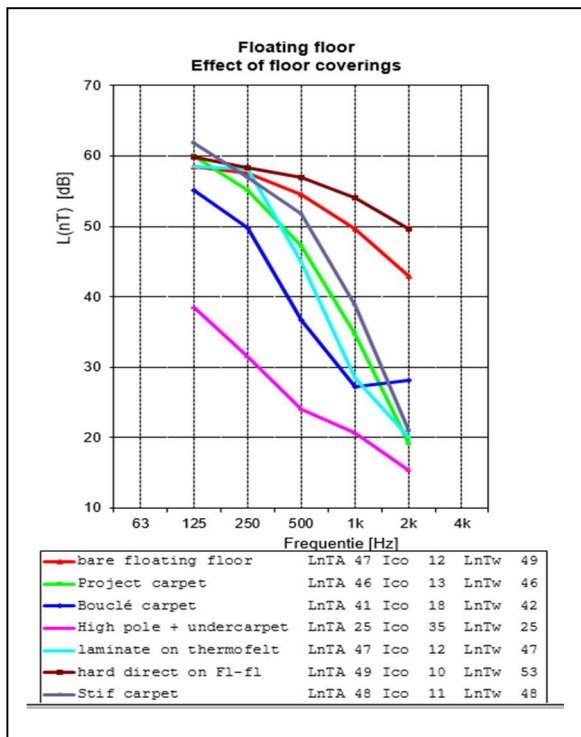


Figure 4 Various floor coverings on floating floors

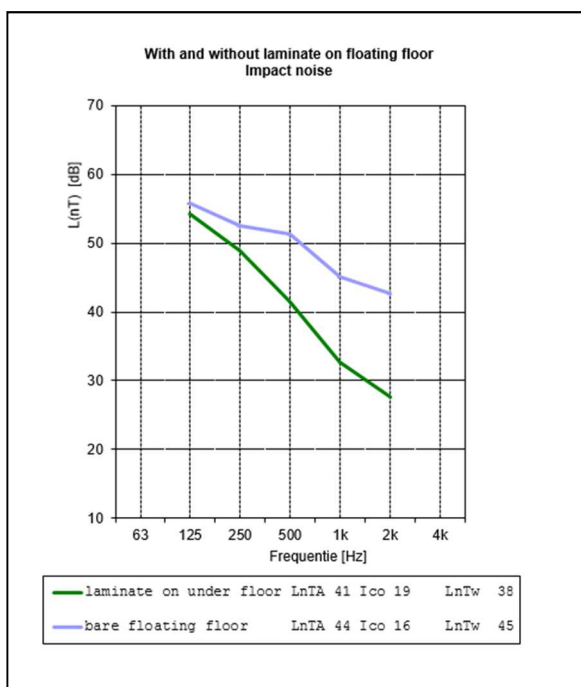


Figure 5 The improvement of an underfloor with laminate is 10 dB for solid floors but 3 dB for floating floors

4. Description of the new system of NTA 5098

The Dutch standardization committee installed a working group to solve this problem. A broad working group started with three acousticians and several members representing the underfloor and floor-coverings industry. It took 7 years to make a Dutch Technical agreement (NTA 5098) The agreement has the following principles:

1. The improvement of impact sound insulation is expressed in a number of stars, in principle based on the improvement (ΔL_{lin} and/or ΔL_w) on solid floors according to the following definitions showed in table I.

Table I. Number of stars for under floors on a solid floor

Number of stars	Minimum $\Delta L_w [dB]$	Minimum $\Delta L_{lin} [dB]$
☆	13	5
☆☆	16	7
☆☆☆	20	10
☆☆☆☆	25	15
☆☆☆☆☆	30	20

2. The measurements according to ISO 10140 part 3 and 5 without a load on the floor covering.
3. As there are no data on wooden floors the combination get one star less. If there are results with the wooden floor, the measured value is used. See table II.
4. There are also requirements on the compressive creep, the compressive strength and the dynamic load according to CEN TS 16354:2012. This is done for the durability of the long term behavior of the under floors.
5. On the packing there is a symbol of NTA on which :
 - a. the stars for solid floors and for wooden floors are mentioned;
 - b. the floor covering for which the underfloor is meant.
6. In total there are 25 combinations for underfloor and floor coverings.

Table II. Number of stars for a wooden floor, if there are no measurement results on wooden floor

<i>Number of stars solid floors</i>	<i>Number of stars wooden floors</i>
☆	
☆☆	☆
☆☆☆	☆☆
☆☆☆☆	☆☆☆
☆☆☆☆☆	☆☆☆☆

An example of a label that is printed on the packing, is given in figure 6

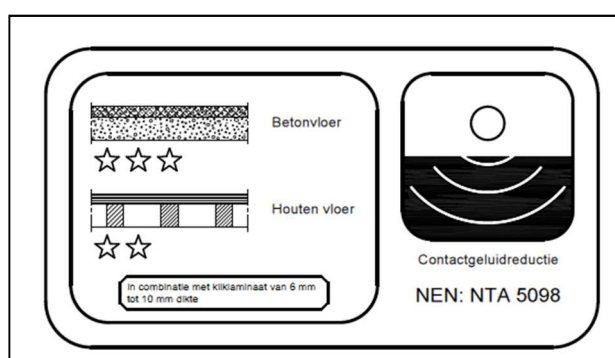


Figure 6 Example of a label with 3 stars for solid floors and 2 stars for wooden floors. The underfloor is meant for 6 to 10 mm laminate.

There is an agreement with the suppliers/ producers that there has to be an acoustical report of an independent acoustic institution concerning the improvement of the impact sound insulation, according to ISO 10140. The supplier/producer has to show the report to everyone that ask for it within two weeks. If the supplier/producer does not produce such a report, a committee of three independent experts, installed by the Dutch standardization organization can investigate the problem. If there is no such report at all, the committee can forbid the supplier/producer to use the NTA label. There is no control in advance because of the costs.

In this way the problem of choosing a good combination of an underfloor and a floor covering is made easy for consumers, landlords and unions of owners by a system of stars. For floating floors it is necessary to design and built a good and floating floor where all kinds of floor coverings are allowed. If not then the stony floor solutions have to be used with the right number of stars.

The NTA 5098 is published in November 2017. The next step is that the suppliers/producers start

with the NTA label on their products. Publications will be started to further introduce the system for the consumers, landlords and the unions of owners and the notary, that make the regulations for apartment buildings.

5. Conclusions

In the last 25 years there were many problems with choosing the right underfloor and floor coverings in order to avoid as much as possible annoyance because of impact sound in apartments. A simple system is developed with a number of stars especially for solid and wooden floors, avoiding the confusing different acoustic SNQ. Only the number of stars is necessary. If the quality of impact sound insulation of floating floors is good, then no other measures are necessary. If it is no good the floor coverings has to be treated as with a solid floor.

Acknowledgement

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Ing R.C. Muchall, ing J. Kramer of the standard committee, who both started the working group and the representatives of the producers of underfloors and floor coverings

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