White Paper: Flooring Underlayment Acoustics: Impact Insulation Classification North American Laminate Flooring Association (NALFA)

The importance of acoustics is often forgotten until a building is completed. However, the 2010 California Green Building Standards Code (CalGreen Code) which took effect January 1, 2011 made it mandatory for all new construction in California (non-residential and residential up to three stories) to comply with certain acoustical control standards. The required sound mitigation performance is measured and classified in both of two standard methods defined as Sound Transmission Class (STC) and Impact Insulation Class (IIC). Why should you care – especially if you do not live or work in California? Well when it comes to building codes, as California goes, so does the rest of the country – at some point. [1]

Minimizing impact and airborne sound in multi-family dwelling begins in the design phase. A number of factors contribute to a room's sound insulating ability: 1) floor/ceiling/wall construction and room size and shape; 2) Interior décor, such as wall hangings and curtains and finishes and furnishings such as chairs, sofas, tables and rugs; 3) choice of floor covering material; 4) use of a flooring underlayment. The cumulative effect of all these components are what provides the final sound characteristics of the space. No single component can fulfill the requirements for building requirements, which consider the effects of the sum of these components.

Multi-family units are constructed using a variety of designs and material. The floor/ceiling area of a condominium could consist of a 4" to 12" reinforced concrete slab. The same suspended concrete subfloor could include a suspended ceiling. The suspended ceiling could include varying levels of sound insulating products like fiberglass or cellulose insulation. There may or may not be isolation barriers between the slab and the perimeter support walls. Wood frame construction may consist of just a plywood sub-floor over a solid plank or I-beam floor joist, or may include poured lightweight concrete on top and/or a suspended ceiling. Again fiberglass or cellulose insulation might also be included either between the floor joists or in the suspended ceiling or both.

An often overlooked, but important factor involved in the noise level within the living space of a condominium unit is what happens to the sound vibration after it enters the unit below. Smooth walls and hard surface furnishings will allow sound waves to deflect or "bounce" from the surface, resulting in elevated noise levels within the unit. Upholstered furniture, area rugs, wall and ceiling finishes, and textile window dressings will help diffuse and absorb in-room sound, which will tend to lessen the intensity.

[1] Source Thornburn Associates Inc. April 2011 Newsletter

The popularity of hard surface flooring such as laminate, wood, and ceramic tile has elevated the interest in improving sound insulation in condominiums and other multi-family dwellings. The use of a sound deadening underlayment for hard surface flooring is important for impact sound such as footfalls, objects dropped on the floor, etc.

There are a number of different types of underlayments available on the market. With the many types of condominium construction, getting accurate sound deadening comparisons among the different categories of underlayments in relation to their contribution to the sound isolation of an entire floor/ceiling assembly has been difficult.

The accepted sound test methods in North America are 1) Impact Isolation Class (IIC), ASTM E492/E989, for impact sound and 2) Sound Transmission Class (STC), ASTM E90/413 for airborne sound. Both tests are conducted in a laboratory setting and evaluate whole floor/ceiling assemblies, not just the underlayment involved in the test. Field test methods for testing actual condominium units are also available for each type of test (Field IIC/ Field STC).

An integral part of a sound test report for any given laboratory, whether it is a laboratory sound test or a field sound test, is a detailed description of the whole floor/ceiling assembly. When comparing IIC (impact) and STC (airborne) test results among the different types of underlayments it is important to make sure those underlayments were tested in identical floor/ceiling assemblies. In addition to the variables (listed above) involved in the floor/ceiling construction of condominium units, there may also be variations in construction among laboratory testing facilities. While physical dimensions of the floor/ceiling assembly and receiving chamber in a sound testing facility are fairly simple to measure, the exact density and quality of construction of the test floors along with the climatic conditions in those facilities are much more difficult to equalize. Additionally, some laboratories utilize a membrane to isolate the testing room slab. Those variations among the accredited sound testing laboratories make it difficult to accurately compare the results from one laboratory to the next, even when the description of the floor/ceiling assembly is the same.

One last variation to consider in sound test reporting is the margin of error or tolerance level involved in the execution of the test method. Most sound testing engineers will acknowledge a testing tolerance of a least +/- one IIC or STC unit to account for laboratory anomalies such as: 1) sample material variation, 2) slight differences in sample placement on the test surface 3) changes in temperature and/or humidity, 4) technique differences when more than one technician is used, etc.

The Delta IIC test (ASTM E-2179) is a variation of the IIC which can be used to isolate the contribution of the floor and underlayment to the total sound reduction. It can be performed with a standard concrete sub-floor and comparing the results

of two different IIC tests; one with just the concrete slab and the other with the floor covering material and underlayment included. When you subtract the "slab only" IIC test from the IIC test that includes the flooring materials and underlayment, the result is an IIC number representing the change in (or Delta) IIC. For comparing the impact sound isolation ability of underlayments, the Delta IIC test allows for much more control over the many test variables. Typically, when evaluating IIC, it is desirable to use a construction for the test in which all other components that affect the acoustic properties are minimized or eliminated. This allows the most accurate isolation of the effect of the individual component (underlayment) being evaluated. Because the other contributing components are eliminated from the test, the values obtained do not fully represent the sound reduction of the full typical construction that would be used for evaluation against the standards and is only used to create a common ground for comparison of the contribution of the underlayment materials themselves.

In an effort to more accurately evaluate the impact sound isolation characteristics of the various categories of laminate underlayments available to consumers, The North American Laminate Flooring Association (NALFA) recently conducted Delta IIC sound tests on eight different categories of laminate underlayments available in the market. The tests were conducted using the exact same testing facility, the exact same test floor ceiling assembly, and the exact same laminate flooring material. The only variable in the testing was the type of laminate underlayment.

Categories of underlayment included in the testing were: cork, crosslink polypropylene foam, polyethylene foam/film, froth urethane foam, synthetic fiber, crumbed rubber, beaded polystyrene, and extruded polystyrene. Representative samples for each category were submitted for testing.

Results are as follows:

Sample ID	Underlayment Type	Thickness	Density	Delta IIC
A	Cork	.08"	15.2lb/ft^3	20
B	XL PP Foam	.08"	3.1lb/ft^3	21
C	PE Foam/Film	.08"	2lb/ft^3	21
D	Froth Urethane	.08"	5.3lb/ft^3	22
E	Synthetic Fiber	.125"	13.3lb/ft^3	21
F	Crumbed Rubber	.08"	36lb/ft^3	21
G	Beaded Polystyrene	.094"	3.5lb/ft^3	23
H	Extruded Polystyrene	.094"	2.6lb/ft^3	21

With Delta IIC results of 20 to 23, all of the laminate underlayments proved to significantly improve the impact sound isolation of the concrete subfloor. With a

margin of error of +/- 1 unit, the difference among the eight categories appears to be statistically minimal.

For condominium residents interested in attaining accurate information regarding sound deadening characteristics of underlayments for hard surface flooring, the North American Laminate Flooring Association recommends the following:

1) Make sure that the sound test results reported by underlayment manufacturers have had actual sound tests conducted. Ask for test reports.
2) Make sure those reports include an accurate description of the floor/ceiling assembly used in the test.
3) Extremely high reported sound test values for any underlayment product should be closely scrutinized.