Airborne Sound Transmission Loss and Impact Sound Transmission Measurements Performed on One Floor Assembly for Pliteq Inc. with Single FF25 Interlayer

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Report Date:	November 26, 2010
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Reference:	Agreement dated June 07, 2010 (Amended Sept 01, 2010)
Program:	Indoor Environment

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Client	Pliteq Inc.
Specimen	150 mm concrete floor with GENIEMAT™ FF25 interlayer and 100 mm concrete topping
Specimen ID	B3483-08F
Construction Date	November 24, 2010

Specimen Description

150 mm concrete reference floor slab installed in test frame with client GENIEMAT™ FF25 interlayer covering entire floor area and 100 mm precast concrete topping installed on top of interlayer. GENIEMAT™ FF25 interlayer was placed with dimples down. Joints between pieces of GENIEMAT™ FF25 interlayer were taped together using sheathing tape. The upper cavity between the specimen and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
100 mm concrete slab (REF004100)	100	246	4800
GENIEMAT™ FF25 interlayer	25	9.6	184
150 mm concrete floor (REF013150)	152	378	7460
Total	**277**	-	**12444**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
100 mm concrete slab (REF004100)	4010	4920	19.7
150 mm concrete slab (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The opening area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2m^2 smaller than the specimen area).

Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements"

Client: Pliteq Inc.

Specimen ID: B3483-08F

Test ID: TLF-10-038

Date Tested: November 24, 2010

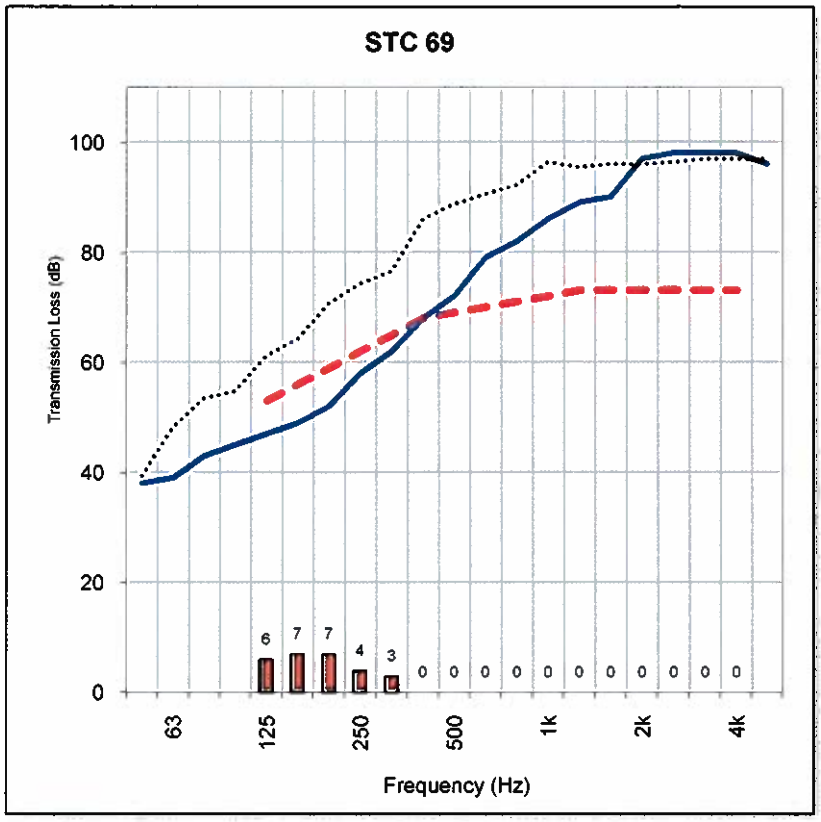
Upper Volume: 174.2 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**22.4**	**22.5**	**20.6**	**21.6**
Lower	**18.8**	**18.8**	**29.6**	**31.0**

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limits
50	38	
63	39	
80	43	± 2.9
100	45	± 2.2
125	47	± 1.6
160	49	± 1.2
200	52	± 1.5
250	58	± 1.2
315	62	± 0.8
400	68	± 0.6
500	72	± 0.5
630	79	± 0.5
800	82	± 0.5
1000	86	± 0.6
1250	89 c	± 0.5
1600	90 c	± 0.6
2000	97 *	± 0.7
2500	98 *	± 0.5
3150	98 *	± 0.5
4000	98 *	± 0.5
5000	96 *	± 0.7
Sound Transmission Class (STC) =		**69**



In the graph:

Solid line is the measured sound transmission loss for this specimen. Dashed line is the STC contour fitted to the measured values according to ASTM E413-04. The dotted line is 10 dB below the flanking limit established for this facility. For any frequency where measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are less than the reference contour, are counted in the fitting procedure for the STC, defined in ASTM E413.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values provide an estimate of the lower limit of airborne sound transmission loss.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine"

Client: Pliteq Inc.

Specimen ID: B3483-08F

Test ID: IIF-10-048

Date Tested: November 24, 2010

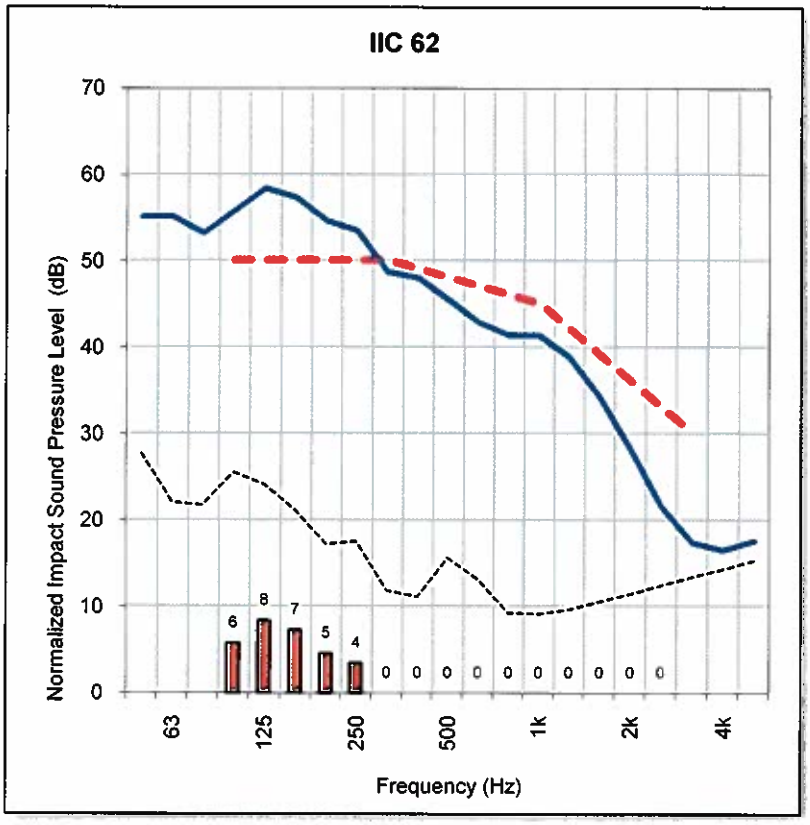
Upper Volume: 174.2 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**22.3**	**22.7**	**17.2**	**18.9**
Lower	**18.1**	**18.6**	**24.4**	**29.8**

Frequency (Hz)	NISPL	95% Confidence Limits
50	55	
63	55	
80	53	
100	56	± 1.9
125	58	± 1.2
160	57	± 1.5
200	55	± 1.0
250	54	± 0.8
315	49	± 0.6
400	48	± 0.5
500	46	± 0.4
630	43	± 0.4
800	41	± 0.3
1000	41	± 0.4
1250	39	± 0.3
1600	34	± 0.4
2000	28	± 0.3
2500	22 c	± 0.2
3150	17 *	± 0.2
4000	17 *	
5000	18 *	
Impact Insulation Class (IIC) =		**62**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

APPENDIX:
Airborne Sound Transmission Floor Facility

National Research Council Canada
Institute for Research in Construction
Acoustics Laboratory
1200 Montreal Road, Ottawa, Ontario K1A 0R6
Tel: 613-993-2305 Fax: 613-954-1495

Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the rooms. Both rooms have approx. volume of 175 m^3. In each room, a calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made in both rooms using an 8-channel National Instrument NI4472 system installed in a desktop PC-type computer. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase randomness of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions". Airborne sound transmission loss tests were performed in the forward (receiving room is the lower room) and reverse (receiving room is the upper room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at nine microphone positions in each room and then averaged to get the average sound pressure level in each room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 5000 Hz. Within those ranges, reproducibility has been assessed by inter-laboratory round robin studies. The standards recommend making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 to 5000 Hz range has not been established, but is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): was determined in accordance with ASTM E413-04, "Classification for Rating Sound Insulation". The Sound Transmission Class (STC) is a single-figure rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the rating, the better the performance. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E90-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX:
Impact Sound Transmission Floor Facility

National Research Council Canada
Institute for Research in Construction
Acoustics Laboratory
1200 Montreal Road, Ottawa, Ontario K1A 0R6
Tel: 613-993-2305 Fax: 613-954-1495

Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. To increase randomness of the sound field, there are fixed diffusing panels in each room. Both rooms have approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. A calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made using an 8-channel National Instrument NI 4472 system installed in a desktop PC-type computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and incoherent noise sources.

Test Procedure: Impact sound transmission was measured in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This test uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the room; these nine reverberation times were averaged to get the spatial average reverberation times for the room. The spatial-average sound pressure levels and reverberation times of the receiving room were used to calculate Normalized Impact Sound Pressure Levels. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". These measurements are also in accordance with ISO 140-6, "Laboratory Measurements of Impact Sound Insulation of Floors", except that the tapping machine positions are not randomly selected; this difference usually has little effect. The Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) was determined in accordance with ISO 717-2.

Significance of Test Results: ASTM E492 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 3150 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC) and Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$): The Impact Insulation Class (IIC) (ASTM E989) and the Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) (ISO 717-2) are single-figure rating schemes intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the IIC, the better the floor performance. The ASTM E989 and the ISO 717 rating curves are identical. A major difference in the fitting procedure is that the ISO standard allows unfavorable deviations to exceed 8 dB; the ASTM E989 standard does not. When this 8 dB requirement is not invoked, the two ratings are related by the equation $IIC = 110 - L_{n,w}$

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E492-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

Measurement of the Effectiveness of a Floor Covering in Reducing Impact Sound Transmission Performed on One Floor Assembly for Pliteq Inc. with Single FF25 Interlayer

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Report No:	B3483.3
Report Date:	November 26, 2010
Contract No:	B3483
Reference:	Agreement dated June 07, 2010 (Amended Sept 01, 2010)
Program:	Indoor Environment

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Client	Pliteq Inc.
Specimen	150 mm concrete floor with GENIEMAT™ FF25 interlayer and 100 mm concrete topping
Specimen ID	B3483-08F
Construction Date	November 24, 2010

Specimen Description

150 mm concrete reference floor slab installed in test frame with client GENIEMAT™ FF25 interlayer covering entire floor area and 100 mm precast concrete topping installed on top of interlayer. GENIEMAT™ FF25 interlayer was placed with dimples down. Joints between pieces of GENIEMAT™ FF25 interlayer were taped together using sheathing tape. The upper cavity between the specimen and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
100 mm concrete slab (REF004100)	100	246	4800
GENIEMAT™ FF25 interlayer	25	9.6	184
150 mm concrete floor (REF013150)	152	378	7460
Total	**277**	-	**12444**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
100 mm concrete slab (REF004100)	4010	4920	19.7
150 mm concrete slab (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2 m^2 smaller than specimen area).

Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine"

Client: Pliteq Inc.

Specimen ID: B3483-08F

Test ID: IIF-10-048

Date Tested: November 24, 2010

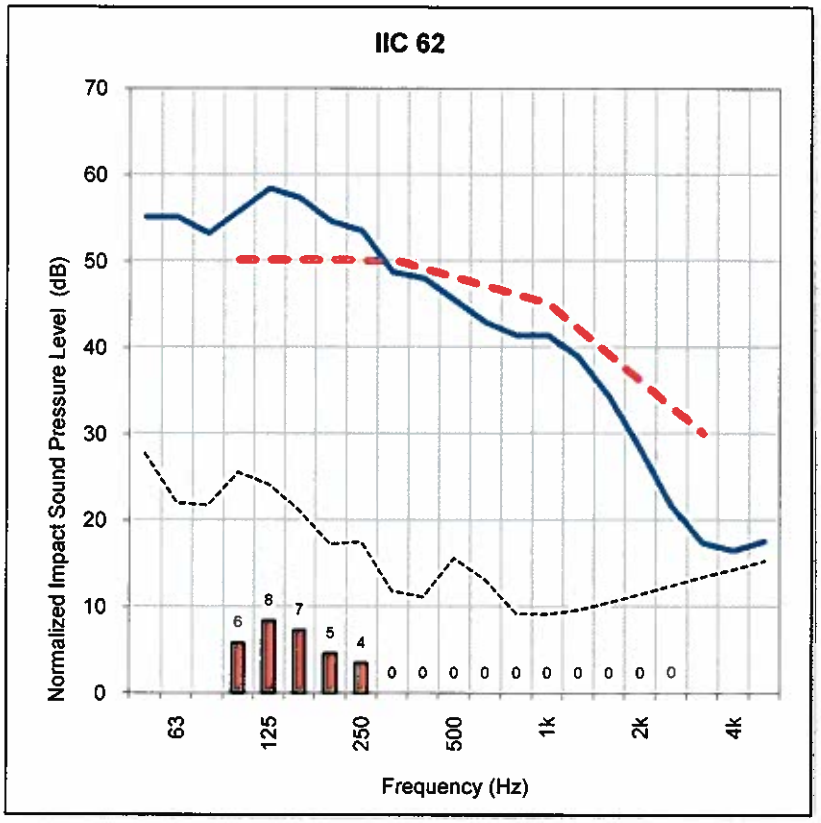
Upper Volume: 174.2 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**22.3**	**22.7**	**17.2**	**18.9**
Lower	**18.1**	**18.6**	**24.4**	**29.8**

Frequency (Hz)	NISPL	95% Confidence Limits
50	55	
63	55	
80	53	
100	56	± 1.9
125	58	± 1.2
160	57	± 1.5
200	55	± 1.0
250	54	± 0.8
315	49	± 0.6
400	48	± 0.5
500	46	± 0.4
630	43	± 0.4
800	41	± 0.3
1000	41	± 0.4
1250	39	± 0.3
1600	34	± 0.4
2000	28	± 0.3
2500	22 c	± 0.2
3150	17 *	± 0.2
4000	17 *	
5000	18 *	
Impact Insulation Class (IIC) =		**62**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

Client	Pliteq Inc.
Specimen	150 mm reference concrete floor
Specimen ID	B3483-07F
Construction Date	November 22, 2010

Specimen Description

150mm concrete floor slab installed in test frame. The upper cavity along the perimeter between the 150mm concrete floor slab and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
150 mm concrete floor (REF013150)	152	378	7460
Total	**150**	-	**7460**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
150 mm concrete floor (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The opening area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2 m^2 smaller than specimen area).

Measurements of the improvement in impact sound pressure level were conducted in accordance with the requirements of ASTM E2179-03, "Standard Test Method for Laboratory Measurement of Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors"

Client: Pliteq Inc.

Specimen ID: B3483-07F

Test ID: IIF-10-047

Date Tested: November 24, 2010

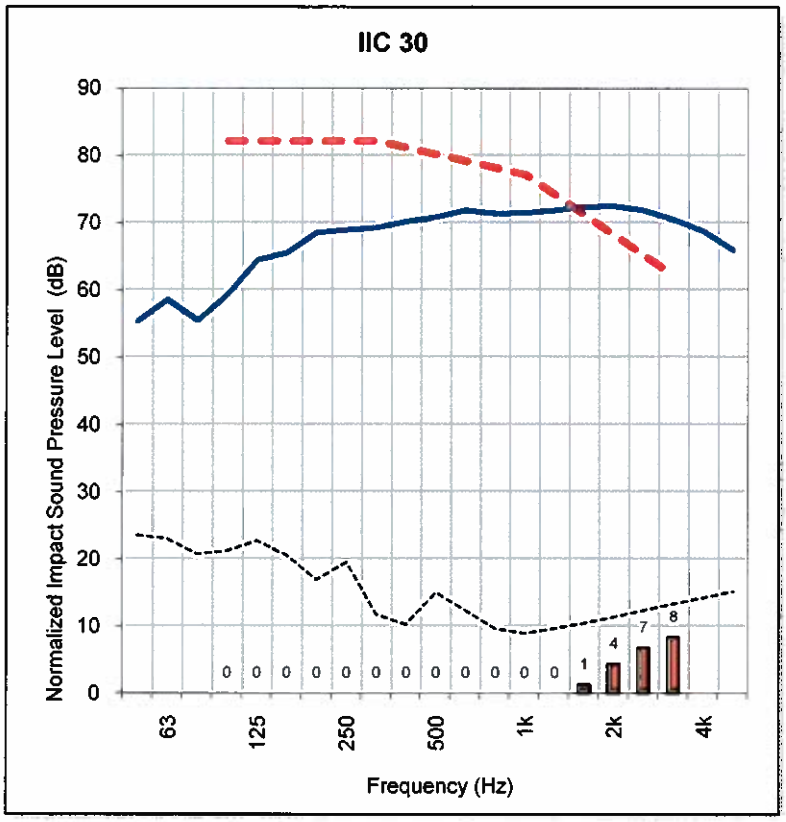
Upper Volume: 176.5 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**21.7**	**22.0**	**34.2**	**35.2**
Lower	**18.6**	**19.3**	**42.1**	**44.2**

Frequency (Hz)	NISPL	95% Confidence Limits
50	55	
63	59	
80	55	
100	59	± 1.7
125	64	± 1.3
160	66	± 1.1
200	69	± 0.6
250	69	± 0.6
315	69	± 0.7
400	70	± 0.6
500	71	± 0.5
630	72	± 0.4
800	71	± 0.4
1000	71	± 0.3
1250	72	± 0.3
1600	72	± 0.3
2000	72	± 0.3
2500	72	± 0.3
3150	70	± 0.4
4000	69	
5000	66	
Impact Insulation Class (IIC) =		**30**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

Measurements of the improvement in impact sound pressure level were conducted in accordance with the requirements of ASTM E2179-03, "Standard Test Method for Laboratory Measurement of Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors"

The improvement rating requires a measurement of the impact sound levels generated below the bare NRC concrete slab and below the NRC slab with the test specimen in place. The differences are used to calculate an improvement rating. The test method requires two measurements in accordance with ASTM E492; hence the procedure is the same as those given for that test method. Installation of the test specimens is described elsewhere in this report.

Frequency (Hz)	L_0 Bare NRC 150 mm slab	L_c Specimen on NRC 150 mm slab	$L_d = L_0 - L_c$ Improvement (Δ NISPL)	L_{ref} E2179 Reference Floor	$L_{ref,c} = L_{ref} - L_d$ Calculated for Specimen
50	55.3	55.1	0.2		
63	58.5	55.1	3.4		
80	55.4	53.2	2.2		
100	59.2	55.8	**3.4**	67.0	63.6
125	64.4	58.4	**6.0**	67.5	61.5
160	65.5	57.3	**8.2**	68.0	59.8
200	68.5	54.6	**13.9**	68.5	54.6
250	68.9	53.5	**15.4**	69.0	53.6
315	69.2	48.7	**20.5**	69.5	49.0
400	70.1	48.0	**22.1**	70.0	47.9
500	70.8	45.5	**25.3**	70.5	45.2
630	71.8	42.9	**28.9**	71.0	42.1
800	71.3	41.4	**29.9**	71.5	41.6
1000	71.4	41.4	**30.0**	72.0	42.0
1250	71.8	38.9	**32.9**	72.0	39.1
1600	72.3	34.3	**38.0**	72.0	34.0
2000	72.4	28.3	**44.1**	72.0	27.9
2500	71.8	21.7 c	**50.1 c**	72.0	21.9
3150	70.4	17.4 *	**53.0 ***	72.0	19.0
4000	68.7	16.5 *	52.2 *		
5000	65.9	17.6 *	48.3 *		
Rating	**IIC_0**	**IIC**	**$\Delta IIC = IIC_c - IIC_{ref}$**	**IIC_{ref}**	**IIC_c**
Value	**30**	**62**	**28**	**28**	**56**

The improvement in IIC rating calculated for the specimen on the reference floor, ΔIIC, is 28.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.
Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

APPENDIX:
Impact Sound Transmission Floor Facility

National Research Council Canada
Institute for Research in Construction
Acoustics Laboratory
1200 Montreal Road, Ottawa, Ontario K1A 0R6
Tel: 613-993-2305 Fax: 613-954-1495

Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. To increase randomness of the sound field, there are fixed diffusing panels in each room. Both rooms have approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. A calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made using an 8-channel National Instrument NI 4472 system installed in a desktop PC-type computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and incoherent noise sources.

Test Procedure: Impact sound transmission was measured in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This test uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the room; these nine reverberation times were averaged to get the spatial average reverberation times for the room. The spatial-average sound pressure levels and reverberation times of the receiving room were used to calculate Normalized Impact Sound Pressure Levels. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". These measurements are also in accordance with ISO 140-6, "Laboratory Measurements of Impact Sound Insulation of Floors", except that the tapping machine positions are not randomly selected; this difference usually has little effect. The Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) was determined in accordance with ISO 717-2.

Significance of Test Results: ASTM E492 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 3150 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC) and Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$): The Impact Insulation Class (IIC) (ASTM E989) and the Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) (ISO 717-2) are single-figure rating schemes intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the IIC, the better the floor performance. The ASTM E989 and the ISO 717 rating curves are identical. A major difference in the fitting procedure is that the ISO standard allows unfavorable deviations to exceed 8 dB; the ASTM E989 standard does not. When this 8 dB requirement is not invoked, the two ratings are related by the equation $IIC = 110 - L_{n,w}$

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E492-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

Airborne Sound Transmission Loss and Impact Sound Transmission Measurements Performed on One Floor Assembly for Pliteq Inc. with Double FF25 Interlayer

Author

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Quality Assurance

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Approved

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Report No:	B3483.4
Report Date:	November 26, 2010
Contract No:	B3483
Reference:	Agreement dated June 07, 2010 (Amended Sept 01, 2010)
Program:	Indoor Environment

6 pages
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Client	Pliteq Inc.
Specimen	150 mm concrete floor with 2 layers of GENIEMAT™ FF25 interlayer and 100 mm concrete topping
Specimen ID	B3483-09F
Construction Date	November 25, 2010

Specimen Description

150 mm concrete reference floor slab installed in test frame with two layers of client GENIEMAT™ FF25 interlayer covering entire floor area and 100 mm precast concrete topping installed on top of interlayers. Two layers of GENIEMAT™ FF25 interlayer were placed one above the other, with dimples down. Joints between pieces of GENIEMAT™ FF25 interlayer were taped together using sheathing tape. The upper cavity between the specimen and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
100 mm concrete slab (REF004100)	100	246	4800
GENIEMAT™ FF25 interlayer	25	9.6	184
GENIEMAT™ FF25 interlayer	25	9.6	184
150 mm concrete floor (REF013150)	152	378	7460
Total	**300**	-	**12628**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
100 mm concrete slab (REF004100)	4010	4920	19.7
150 mm concrete slab (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2 m^2 smaller than specimen area).

Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements"

Client: Pliteq Inc.

Specimen ID: B3483-09F

Test ID: TLF-10-039

Date Tested: November 25, 2010

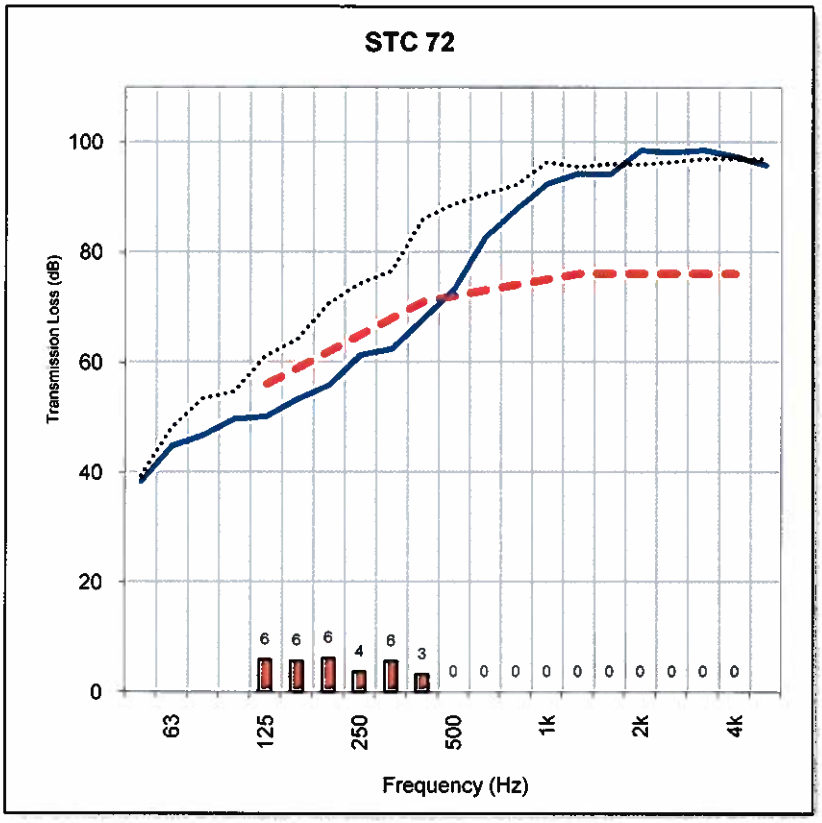
Upper Volume: 173.8 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**23.6**	**23.6**	**19.5**	**20.5**
Lower	**19.2**	**19.3**	**24.2**	**26.0**

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limits
50	38	
63	45	
80	47	± 3.0
100	50	± 2.5
125	50	± 1.8
160	53	± 1.4
200	56	± 1.1
250	61	± 1.1
315	62	± 1.0
400	68	± 1.0
500	73	± 0.7
630	83	± 0.6
800	88 **c**	± 0.4
1000	92 **c**	± 0.5
1250	94 **c**	± 0.3
1600	94 *	± 0.6
2000	99 *	± 0.6
2500	98 *	± 0.6
3150	99 *	± 0.5
4000	97 *	± 0.5
5000	96 *	± 0.7
Sound Transmission Class (STC) =		**72**



In the graph:

Solid line is the measured sound transmission loss for this specimen. Dashed line is the STC contour fitted to the measured values according to ASTM E413-04. The dotted line is 10 dB below the flanking limit established for this facility. For any frequency where measured transmission loss is above the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are less than the reference contour, are counted in the fitting procedure for the STC, defined in ASTM E413.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values provide an estimate of the lower limit of airborne sound transmission loss.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine"

Client: Pliteq Inc.

Specimen ID: B3483-09F

Test ID: IIF-10-049

Date Tested: November 25, 2010

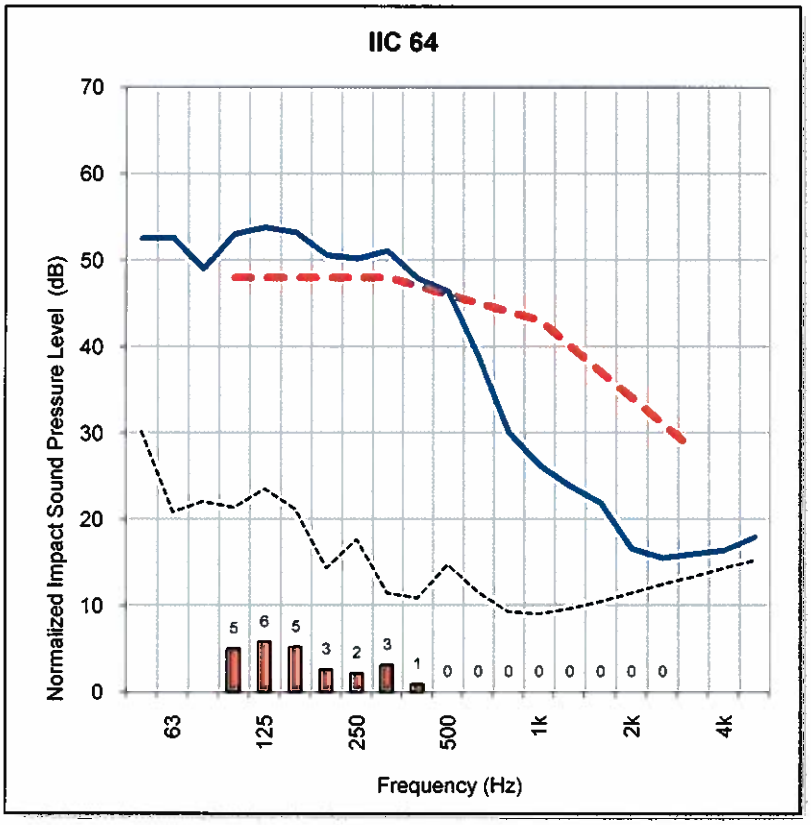
Upper Volume: 173.8 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**23.5**	**23.5**	**17.2**	**18.2**
Lower	**18.1**	**18.9**	**16.6**	**19.0**

Frequency (Hz)	NISPL		95% Confidence Limits
50	53		
63	53		
80	49		
100	53		± 1.7
125	54		± 1.0
160	53		± 1.0
200	51		± 1.0
250	50		± 1.0
315	51		± 0.6
400	48		± 0.4
500	46		± 0.4
630	39		± 0.3
800	30		± 0.2
1000	26		± 0.3
1250	24		± 0.2
1600	22	**c**	± 0.3
2000	17	*	± 0.3
2500	16	*	± 0.2
3150	16	*	± 0.3
4000	16	*	
5000	18	*	
Impact Insulation Class (IIC) =			**64**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

APPENDIX:
Airborne Sound Transmission Floor Facility

National Research Council Canada
Institute for Research in Construction
Acoustics Laboratory
1200 Montreal Road, Ottawa, Ontario K1A 0R6
Tel: 613-993-2305 Fax: 613-954-1495

Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the rooms. Both rooms have approx. volume of 175 m^3. In each room, a calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made in both rooms using an 8-channel National Instrument NI4472 system installed in a desktop PC-type computer. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase randomness of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions". Airborne sound transmission loss tests were performed in the forward (receiving room is the lower room) and reverse (receiving room is the upper room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at nine microphone positions in each room and then averaged to get the average sound pressure level in each room. Five sound decays were averaged to get the reverberation time at each microphone position in the receiving room; these reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 5000 Hz. Within those ranges, reproducibility has been assessed by inter-laboratory round robin studies. The standards recommend making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 to 5000 Hz range has not been established, but is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): was determined in accordance with ASTM E413-04, "Classification for Rating Sound Insulation". The Sound Transmission Class (STC) is a single-figure rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the rating, the better the performance. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E90-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX:
Impact Sound Transmission Floor Facility

National Research Council Canada
Institute for Research in Construction
Acoustics Laboratory
1200 Montreal Road, Ottawa, Ontario K1A 0R6
Tel: 613-993-2305 Fax: 613-954-1495

Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. To increase randomness of the sound field, there are fixed diffusing panels in each room. Both rooms have approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. A calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made using an 8-channel National Instrument NI 4472 system installed in a desktop PC-type computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and incoherent noise sources.

Test Procedure: Impact sound transmission was measured in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This test uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the room; these nine reverberation times were averaged to get the spatial average reverberation times for the room. The spatial-average sound pressure levels and reverberation times of the receiving room were used to calculate Normalized Impact Sound Pressure Levels. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". These measurements are also in accordance with ISO 140-6, "Laboratory Measurements of Impact Sound Insulation of Floors", except that the tapping machine positions are not randomly selected; this difference usually has little effect. The Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) was determined in accordance with ISO 717-2.

Significance of Test Results: ASTM E492 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 3150 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC) and Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$): The Impact Insulation Class (IIC) (ASTM E989) and the Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) (ISO 717-2) are single-figure rating schemes intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the IIC, the better the floor performance. The ASTM E989 and the ISO 717 rating curves are identical. A major difference in the fitting procedure is that the ISO standard allows unfavorable deviations to exceed 8 dB; the ASTM E989 standard does not. When this 8 dB requirement is not invoked, the two ratings are related by the equation $IIC = 110 - L_{n,w}$

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E492-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

Measurement of the Effectiveness of a Floor Covering in Reducing Impact Sound Transmission Performed on One Floor Assembly for Pliteq Inc. with Double FF25 Interlayer

Author

I. Sabourin
Technical Officer

Quality Assurance

S. Schoenwald, Ph.D.
Research Officer

Approved

T.R.T Nightingale, Ph.D.
Acting Director, Indoor Environment

Report No:	B3483.5
Report Date:	November 26, 2010
Contract No:	B3483
Reference:	Agreement dated June 07, 2010 (Amended Sept 01, 2010)
Program:	Indoor Environment

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Client	Pliteq Inc.
Specimen	150 mm concrete floor with 2 layers of GENIEMAT™ FF25 interlayer and 100 mm concrete topping
Specimen ID	B3483-09F
Construction Date	November 25, 2010

Specimen Description

150 mm concrete reference floor slab installed in test frame with two layers of client GENIEMAT™ FF25 interlayer covering entire floor area and 100 mm precast concrete topping installed on top of interlayers. Two layers of GENIEMAT™ FF25 interlayer were placed one above the other, with dimples down. Joints between pieces of GENIEMAT™ FF25 interlayer were taped together using sheathing tape. The upper cavity between the specimen and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
100 mm concrete slab (REF004100)	100	246	4800
GENIEMAT™ FF25 interlayer	25	9.6	184
GENIEMAT™ FF25 interlayer	25	9.6	184
150 mm concrete floor (REF013150)	152	378	7460
Total	**302**	-	**12628**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
100 mm concrete slab (REF004100)	4010	4920	19.7
150 mm concrete slab (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2 m^2 smaller than specimen area).

Measurements of the improvement in impact sound pressure level were conducted in accordance with the requirements of ASTM E2179-04, "Standard Test Method for Laboratory Measurement of Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors"

Client: Pliteq Inc.

Specimen ID: B3483-09F

Test ID: IIF-10-049

Date Tested: November 25, 2010

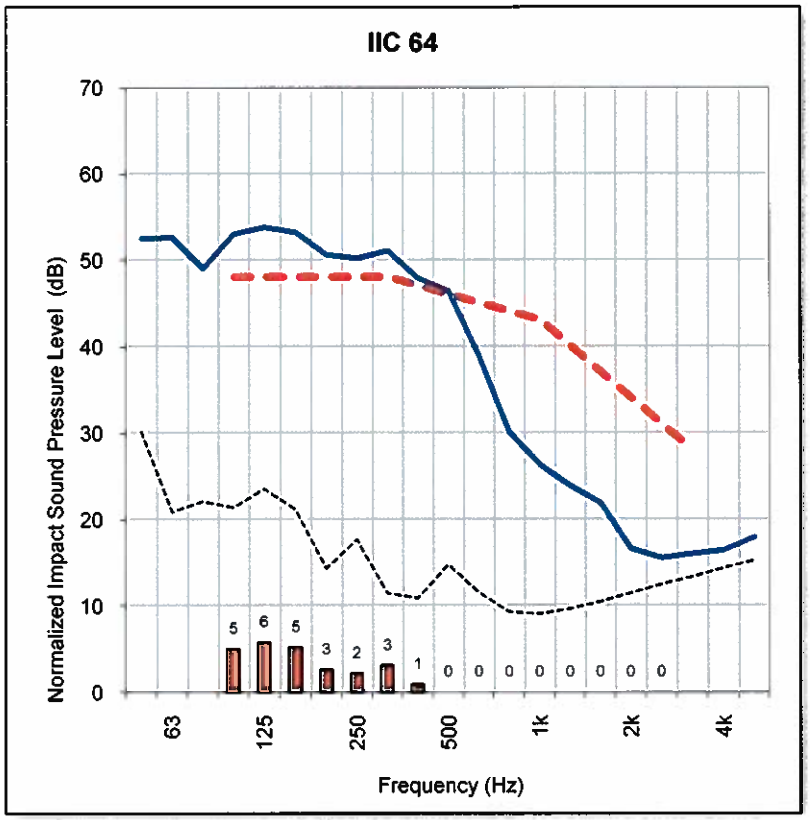
Upper Volume: 173.8 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**23.5**	**23.5**	**17.2**	**18.2**
Lower	**18.1**	**18.9**	**16.6**	**19.0**

Frequency (Hz)	NISPL	95% Confidence Limits
50	53	
63	53	
80	49	
100	53	± 1.7
125	54	± 1.0
160	53	± 1.0
200	51	± 1.0
250	50	± 1.0
315	51	± 0.6
400	48	± 0.4
500	46	± 0.4
630	39	± 0.3
800	30	± 0.2
1000	26	± 0.3
1250	24	± 0.2
1600	22 c	± 0.3
2000	17 *	± 0.3
2500	16 *	± 0.2
3150	16 *	± 0.3
4000	16 *	
5000	18 *	
Impact Insulation Class (IIC) =		**64**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

Client	Pliteq Inc.
Specimen	150 mm reference concrete floor
Specimen ID	B3483-07F
Construction Date	November 22, 2010

Specimen Description

150mm concrete floor slab installed in test frame. The upper cavity along the perimeter between the 150mm concrete floor slab and the test frame was filled with fibrous insulation and sealed with cloth tape. The lower cavity was filled with putty.

Specimen Properties

Element	Actual thickness (mm)	Surface weight (kg/m^2)	Mass (kg)
150 mm concrete floor (REF013150)	152	378	7460
Total	**150**	-	**7460**

Precast Concrete Slabs Dimensions

Element	Width (mm)	Length (mm)	Area (m^2)
150 mm concrete floor (REF013150)	4010	4920	19.7

Test Specimen Installation

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.71 m x 3.79 m. The area used for the calculations of impact transmission and airborne sound transmission loss was 17.85 m^2 (approximately 2 m^2 smaller than specimen area).

Measurements of the improvement in impact sound pressure level were conducted in accordance with the requirements of ASTM E2179-03, "Standard Test Method for Laboratory Measurement of Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors"

Client: Pliteq Inc.

Specimen ID: B3483-07F

Test ID: IIF-10-047

Date Tested: November 24, 2010

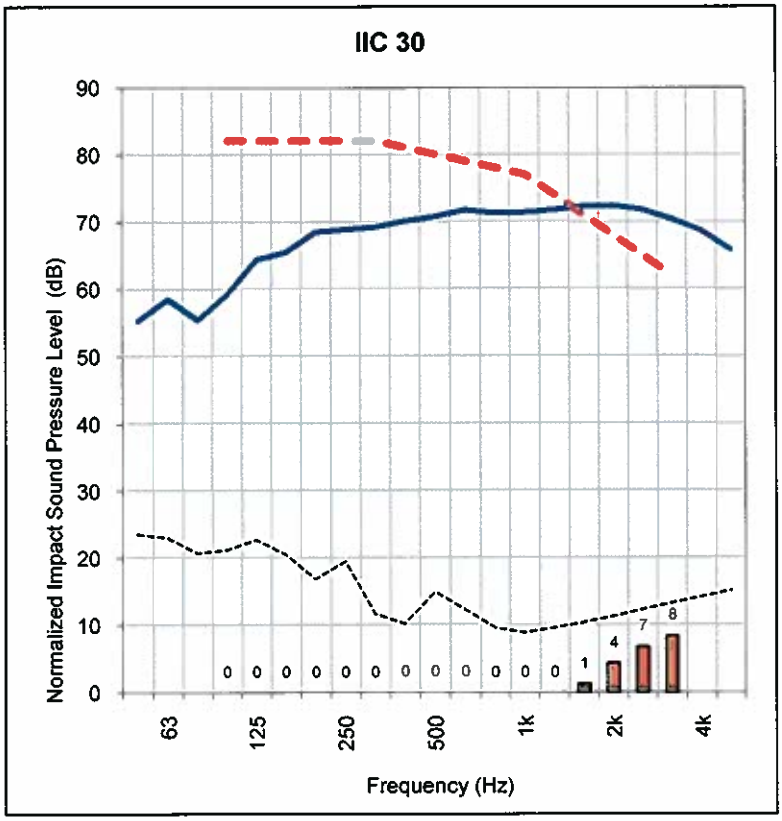
Upper Volume: 176.5 m³

Lower Volume: 177.6 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	**21.7**	**22.0**	**34.2**	**35.2**
Lower	**18.6**	**19.3**	**42.1**	**44.2**

Frequency (Hz)	NISPL	95% Confidence Limits
50	55	
63	59	
80	55	
100	59	± 1.7
125	64	± 1.3
160	66	± 1.1
200	69	± 0.6
250	69	± 0.6
315	69	± 0.7
400	70	± 0.6
500	71	± 0.5
630	72	± 0.4
800	71	± 0.4
1000	71	± 0.3
1250	72	± 0.3
1600	72	± 0.3
2000	72	± 0.3
2500	72	± 0.3
3150	70	± 0.4
4000	69	
5000	66	
Impact Insulation Class (IIC) =		**30**



In the graph:

Solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. Dashed line is the IIC contour fitted to the measured values according to ASTM E989-89. The dotted line is the background sound level measured in the receiving room during this test. For any frequency where measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below.

Bars at bottom of graph show deficiencies. At each frequency the difference between the shifted reference contour value and the measured data is calculated. Only deficiencies, that is, where the measured data are greater than the reference contour, are counted in the fitting procedure for the IIC, as defined in ASTM E989.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-

Measurements of the improvement in impact sound pressure level were conducted in accordance with the requirements of ASTM E2179-03, "Standard Test Method for Laboratory Measurement of Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors"

The improvement rating requires a measurement of the impact sound levels generated below the bare NRC concrete slab and below the NRC slab with the test specimen in place. The differences are used to calculate an improvement rating. The test method requires two measurements in accordance with ASTM E492; hence the procedure is the same as those given for that test method. Installation of the test specimens is described elsewhere in this report.

Frequency (Hz)	L_0 Bare NRC 150 mm slab	L_c Specimen on NRC 150 mm slab	$L_d = L_0 - L_c$ Improvement (Δ NISPL)	L_{ref} E2179 Reference Floor	$L_{ref,c} = L_{ref} - L_d$ Calculated for Specimen
50	55.3	52.5	2.8		
63	58.5	52.6	5.9		
80	55.4	49.0	6.4		
100	59.2	53.0	**6.2**	67.0	60.8
125	64.4	53.8	**10.6**	67.5	56.9
160	65.5	53.2	**12.3**	68.0	55.7
200	68.5	50.6	**17.9**	68.5	50.6
250	68.9	50.2	**18.7**	69.0	50.3
315	69.2	51.1	**18.1**	69.5	51.4
400	70.1	47.9	**22.2**	70.0	47.8
500	70.8	46.4	**24.4**	70.5	46.1
630	71.8	38.9	**32.9**	71.0	38.1
800	71.3	30.0	**41.3**	71.5	30.2
1000	71.4	26.3	**45.1**	72.0	26.9
1250	71.8	23.9	**47.9**	72.0	24.1
1600	72.3	21.9 c	**50.4 c**	72.0	21.6
2000	72.4	16.6 *	**55.8 ***	72.0	16.2
2500	71.8	15.5 *	**56.3 ***	72.0	15.7
3150	70.4	16.0 *	**54.4 ***	72.0	17.6
4000	68.7	16.4 *	52.3 *		
5000	65.9	17.9 *	48.0 *		
Rating	**IIC_0**	**IIC**	**$\Delta IIC = IIC_c - IIC_{ref}$**	**IIC_{ref}**	**IIC_c**
Value	**30**	**64**	**31**	**28**	**59**

The improvement in IIC rating calculated for the specimen on the reference floor, ΔIIC, is 31.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.
Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level. The reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09.

The results reported above apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

APPENDIX:
Impact Sound Transmission Floor Facility

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Facility and Equipment: The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. To increase randomness of the sound field, there are fixed diffusing panels in each room. Both rooms have approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. A calibrated Bruel & Kjaer condenser microphone (type 4166 or 4165) with preamp is moved under computer control to nine positions, and measurements are made using an 8-channel National Instrument NI 4472 system installed in a desktop PC-type computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and incoherent noise sources.

Test Procedure: Impact sound transmission was measured in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine". This test uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Five sound decays were averaged to get the reverberation time at each microphone position in the room; these nine reverberation times were averaged to get the spatial average reverberation times for the room. The spatial-average sound pressure levels and reverberation times of the receiving room were used to calculate Normalized Impact Sound Pressure Levels. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". These measurements are also in accordance with ISO 140-6, "Laboratory Measurements of Impact Sound Insulation of Floors", except that the tapping machine positions are not randomly selected; this difference usually has little effect. The Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) was determined in accordance with ISO 717-2.

Significance of Test Results: ASTM E492 requires measurements in 1/3-octave bands in the frequency range 100 Hz to 3150 Hz. Within this range, reproducibility has been assessed by inter-laboratory round robin studies. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC) and Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$): The Impact Insulation Class (IIC) (ASTM E989) and the Weighted Normalized Impact Sound Pressure Level ($L_{n,w}$) (ISO 717-2) are single-figure rating schemes intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the IIC, the better the floor performance. The ASTM E989 and the ISO 717 rating curves are identical. A major difference in the fitting procedure is that the ISO standard allows unfavorable deviations to exceed 8 dB; the ASTM E989 standard does not. When this 8 dB requirement is not invoked, the two ratings are related by the equation $IIC = 110 - L_{n,w}$

Confidence Limits: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty. By using enough microphone and loudspeaker positions, the uncertainty can be reduced and upper and lower limits assigned to the probable error in the measurement. These limits are called 95% confidence limits. They are calculated for each test according to the procedures in ASTM E492-09 and must be less than upper limits given in the standards. These confidence limits do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested (repeatability). Nor do they relate directly to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.