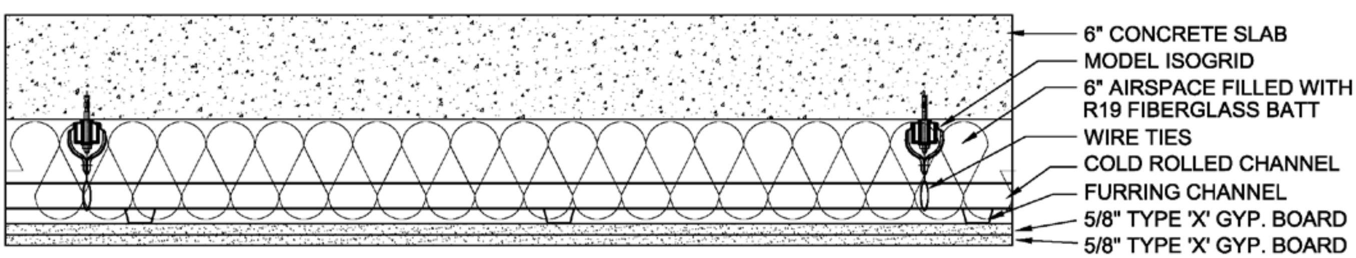
KINETICS NOISE CONTROL TEST REPORT # AT001084

- **KINETICS NOISE CONTROL PRODUCTS:**
  - ISOGRID
- **ACOUSTICAL RATINGS:**
  - STC 63
  - IIC 50
- **TESTING AGENCY & REPORT NUMBER:**
  - NRC-CNRC
  - B-3463.6



KINETICS DRAWING NUMBER: AT001084

6300 IRELAN PLACE, DUBLIN OH
PHONE: 800.959.1229
FAX: 614.889.0540
WEB: WWW.KINETICSNOISE.COM
EMAIL: ARCHSALES@KINETISNOISE.COM

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National Research Council of Canada

Client Report

B-3463.6

Airborne Sound Transmission Loss and Impact Sound Transmission Measurements Performed on One Floor Assembly

for

Kinetics Noise Control
6300 Ireland Place
Dublin, OH USA
43017-0655

6 December 2007

National Research Council Canada
Conseil national de recherches Canada
Canada

Airborne Sound Transmission Loss and Impact Sound Transmission Measurements Performed on One Floor Assembly for Kinetics Noise Control

Author

N.L. Brunette

Quality Assurance

J.D. Quirt, Ph.D.
Group Leader

Approved

M.R. Atif, Ph.D.
Director, Indoor Environment

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Program:	Indoor Environment

6 pages
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Client: Kinetics

Specimen: Floor assembly - NRC concrete slab with ceiling

Specimen ID: B3463-6F

Construction Date: May 29, 2007

Test Specimen:

BASE ASSEMBLY

NRC concrete reference slab: The 150 mm reference concrete slab, provided by NRC, was installed in the floor test frame on May 9th, 2007. The perimeter of the reference concrete slab was sealed at the top with insulation and covered with metal tape and at the bottom with mortite then covered with metal tape. The density of the concrete slab was 2446 kg/m³.

CEILING ASSEMBLY

Drop ceiling system: Kinetic Noise Control IsoGrid 105 ceiling hangers supplied by the client were installed on the underside of the concrete slab, using 1/4" 20 hex head bolts. The IsoGrid 105 ceiling hangers were spaced 1118 x 1067 mm on center. The Cold-rolled C channels were attached with 12 ga steel wire to the IsoGrid ceiling hangers. The distance between the underside of the concrete slab and the bottom of the Cold-rolled C channels was 150 mm (6").

Cavity insulation: One layer of glass fiber insulation batts (Owens Corning R19) having nominal dimensions of 150 x 610 x 1220 mm was held in place by the Cold-rolled C channels.

Channels: Drywall Hat channels with a « H profile » were installed perpendicular to the Cold-rolled C channels. The Drywall Hat channels were spaced 610 mm on center and secured to the Cold-rolled C channels using 13 mm long self drilling pan head screws, spaced 610 mm on center.

Ceiling board – base layer: The base layer consisted of a single layer of CGC Type X brand gypsum panels with nominal dimensions 1.22 m wide and 16 mm thick. Panels were oriented with the long axis perpendicular to the Drywall Hat channels with staggered butt joints. The gypsum panels were fastened to the Drywall Hat channels using Type S drywall screws 41 mm long and spaced 305 mm on center at both the perimeter and in the field of the panels.

Ceiling board – face layer: The face layer consisted of a single layer of CGC Type X brand gypsum panels with nominal dimensions 1.22 m wide and 16 mm thick. Panels were oriented with the long axis perpendicular to the Drywall Hat channels with staggered butt joints. The butt joints of the gypsum panels were also staggered from the base layer of gypsum panels. The gypsum panels were fastened to the Drywall Hat channels using Type S drywall screws 51 mm long and spaced 305 mm on center at both the perimeter and in the field of the panels. Exposed joints between the gypsum board panels were caulked and covered with an aluminum foil tape.

Specimen Properties

Element	Actual Thickness (mm)	Surface weight (kg/m²)	Mass (kg)
NRC Reference Concrete Slab		351.50	7030.0
Drop Ceiling System (IsoGrid 105 ceiling hangers, wire and Cold-rolled C channels)			12.2
Drywall Hat Channels			12.6
Glass Fibre Batts		0.87	15.5
Gypsum Board - Type X		11.06	196.4
Gypsum Board - Type X		11.09	196.8
Total	354		7463.5

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 m². The perimeter of the specimen was sealed on both sides with caulking and then covered with a metal tape.

Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-04, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".

Client: Kinetics

Specimen ID: B3463-6F

Test ID: TLF-07-037

Tested: 31-May-07

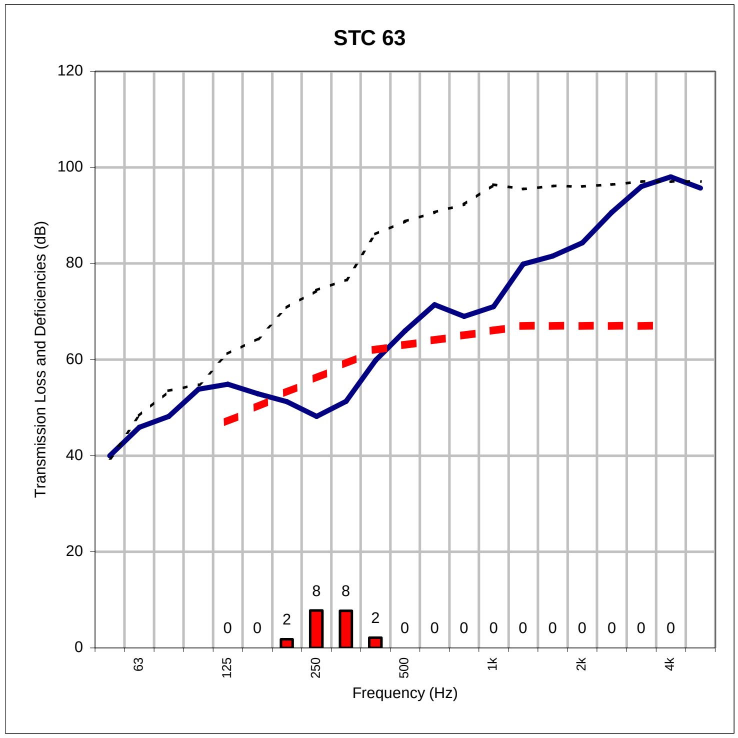
Upper Volume: 176.7 m³

Lower Volume: 173.9 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	23.0	23.1	55.0	55.5
Lower	21.2	21.2	51.8	51.8

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limits
50	40 *	
63	46 c	
80	48	± 4.2
100	54 c	± 1.5
125	55	± 1.5
160	53	± 2.0
200	51	± 1.5
250	48	± 0.9
315	51	± 0.9
400	60	± 0.9
500	66	± 0.8
630	71	± 0.5
800	69	± 0.5
1000	71	± 0.5
1250	80	± 0.5
1600	82	± 0.4
2000	84	± 0.5
2500	91 c	± 0.5
3150	96 c	± 0.3
4000	98 *	± 0.4
5000	96 c	± 0.4
Sound Transmission Class (STC) =	63	



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 E90-04.

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 E492-04, “Standard Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine”.

Client: Kinetics

Specimen ID: B3463-6F

Test ID: IIF-07-043

Tested: 31-May-07

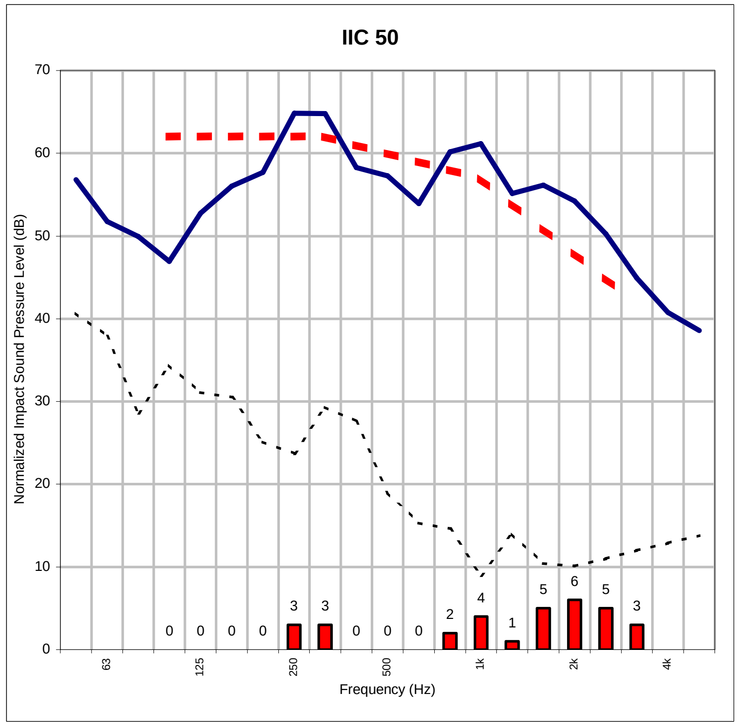
Upper Volume: 176.7 m³

Lower Volume: 173.9 m³

Measured Temperature and Relative Humidity During Testing

	Temperature, °C		Humidity %	
Room	Min	Max	Min	Max
Upper	23.0	23.1	55.0	55.5
Lower	21.1	21.2	51.5	51.5

Frequency (Hz)	NISPL	95% Confidence
50	57	
63	52 c	
80	50	± 2.0
100	47 c	± 1.9
125	53	± 1.5
160	56	± 1.7
200	58	± 0.7
250	65	± 0.6
315	65	± 0.7
400	58	± 0.6
500	57	± 0.5
630	54	± 0.4
800	60	± 0.3
1000	61	± 0.3
1250	55	± 0.3
1600	56	± 0.3
2000	54	± 0.2
2500	50	± 0.2
3150	45	± 0.2
4000	41	± 0.3
5000	39	± 0.4
Impact Insulation Class (IIC) = 50		



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 E492-04.

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 normalised impact sound pressure level, according to the procedure outlined in ASTM E492-04.

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

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 two rooms. Both rooms have a 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 E90-04, “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 large room) and reverse (receiving room is the small 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 times were averaged to get the average reverberation times for the room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-04 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 E90-04 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.

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 a 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 NI4472 system installed in a desktop PC-type computer. The room has 4 bi-amped loudspeakers driven by separate amplifiers and noise sources.

Test Procedure: Impact sound transmission measurements were made in accordance with ASTM E492, "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 times were averaged to get the spatial average reverberation times for the room. The space average sound pressure levels and the spatial average reverberation times of the receiving room were used to calculate impact transmission values. The Impact Insulation Class (IIC) was determined in accordance with ASTM E989, "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 deviation 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 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 rating, the better the floor performance. The ASTM E989 and the ISO 717 rating curves are identical. The 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 E492-04 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.