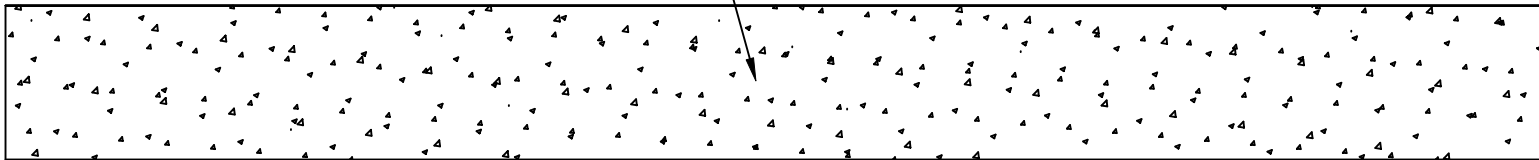


**STC 53**  
**IIC 27**

**6" CONCRETE SLAB**



TITLE

**TEST B10**

LAST DATE  
REVISED  
**11-10-04**

REVISED BY  
**JAE**

DRAWING NO.

**B10**

**National Research Council of Canada**

**Client Report**

**B-3448.7**

**Airborne Sound Transmission Loss and  
Impact Sound Transmission Measurements  
Performed on One (1) Floor Assembly with  
NRC Reference Concrete Slab**

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for

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

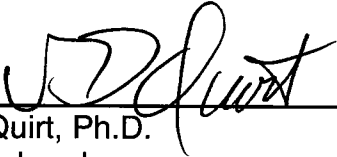
01 May 2007

Airborne Sound Transmission Loss and Impact  
Sound Transmission Measurements Performed on  
One Floor Assembly with NRC Reference Concrete  
Slab for Kinetics Noise Control

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## INTRODUCTION

Airborne and impact sound transmission measurements were performed on one floor assembly. For report purposes, the specimen is identified as Specimen B3192-6. Please note that this floor assembly was tested under contract B3192, but an individual report for this specimen was not requested or issued as part of that contract.

## SPECIMEN DESCRIPTION

The 150 mm reference concrete slab, provided by NRC, was installed in the floor test frame on September 1, 2004. 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  $2446 \text{ kg/m}^3$ .

### ***Specimen B3192-6***

Construction on the floor assembly began on September 22, 2004. The airborne and impact sound transmission loss tests were performed on September 22, 2004. The following table gives the element of the specimen.

Table 1: Element breakdown of Specimen B3192-6.

Element	Surface weight (kg/m <sup>2</sup> )	Mass (kg)
150 mm NRC reference concrete slab	356	7030
<b>TOTAL</b>		<b>7030</b>

Total thickness: 150 mm

The test specimen was mounted in the IRC acoustical floor test opening which measures 4.70 m x 3.78 m. The area used for the calculations of impact transmission and airborne sound transmission loss was  $17.85 \text{ m}^2$ .

The measured temperature and relative humidity in the upper chamber during testing were  $21.4^\circ\text{C}$  and 46.7%, respectively. The measured temperature and relative humidity in the lower chamber during testing were  $21.5^\circ\text{C}$  and 44.6%, respectively.

## RESULTS

Results of the airborne sound transmission loss measurements of Specimen B3492-6 are given in Table 2 and Figure 1. Results of the impact sound transmission measurements of this floor construction are given in Table 3 and Figure 2.

The Tables also give the 95% 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 and E492 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 to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility).

Table 2: Airborne sound transmission loss measurements of Specimen B3192-6, TLF-04-035/036.

Frequency (Hz)	Airborne Sound Transmission Loss (dB)	95% Confidence Limit	Deviation Below the STC Contour
50	39		
63	38		
80	40		
100	39		
125	40	± 1.2	
160	40	± 0.8	
200	37	± 0.9	6
250	40	± 0.7	6
315	43	± 0.5	6
400	47	± 0.5	5
500	49	± 0.5	4
630	51	± 0.5	3
800	55	± 0.3	
1000	58	± 0.3	
1250	62	± 0.2	
1600	65	± 0.3	
2000	67	± 0.3	
2500	70	± 0.2	
3150	72	± 0.3	
4000	75	± 0.4	
5000	77		
Sound Transmission Class (STC) <sup>1</sup> = 53			
Weighted Sound Reduction (R <sub>w</sub> ) <sup>2</sup> = 53			

<sup>1</sup> Sound Transmission Class (STC) calculated according to ASTM E413.

<sup>2</sup> Weighted Sound Reduction (R<sub>w</sub>) calculated according to ISO 717.

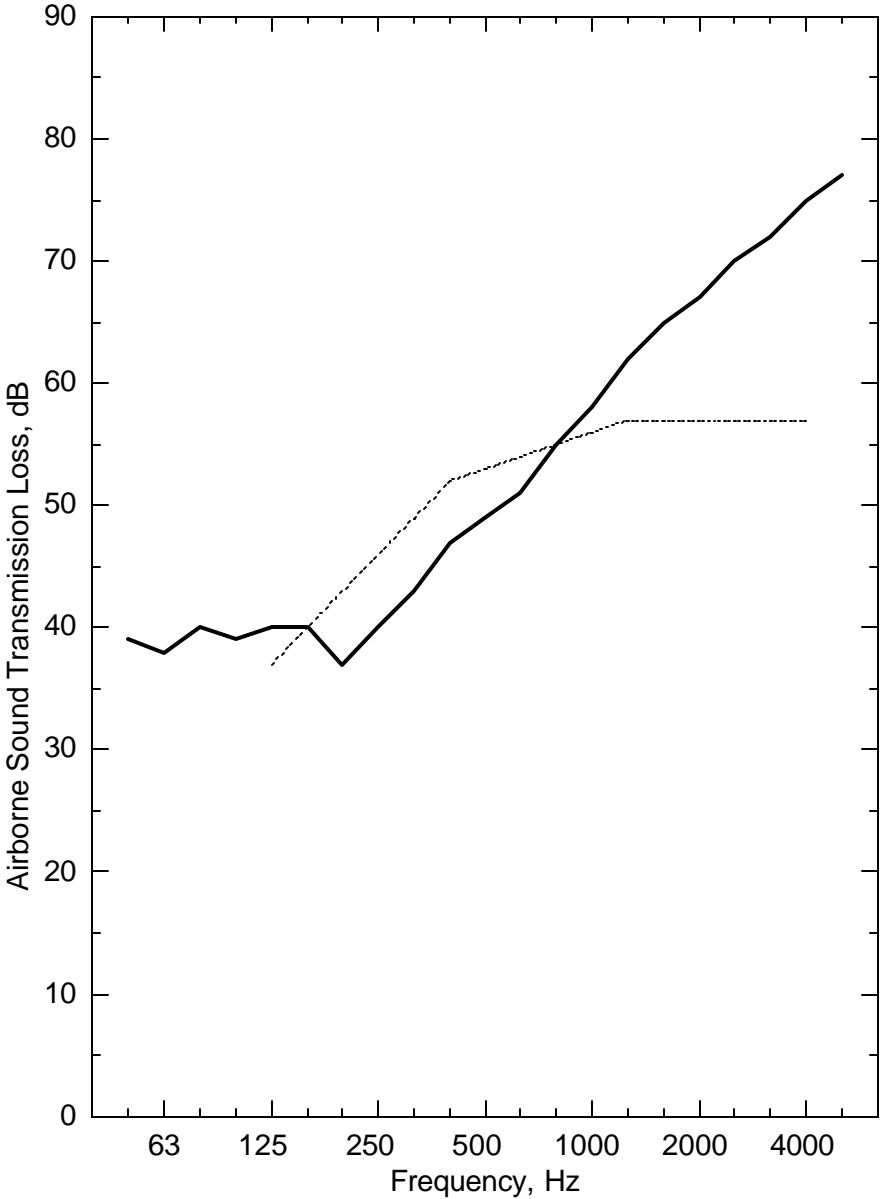


Figure 1: Airborne sound transmission loss measurements of Specimen B3192-6. The solid line is the experimental data and the dotted line is the STC 53 contour.

Table 3: Impact sound transmission measurements of Specimen B3192-6, IIF-04-019.

Frequency (Hz)	Normalized Impact Sound Pressure Level (dB)	95% Confidence Limit <sup>1</sup>	Deviation Above the IIC Contour
50	58		
63	57		
80	63		
100	62	± 0.5	
125	65	± 0.7	
160	69	± 0.5	
200	72	± 0.5	
250	71	± 0.3	
315	73	± 0.4	
400	73	± 0.2	
500	74	± 0.2	
630	74	± 0.2	
800	74	± 0.2	
1000	73	± 0.1	
1250	73	± 0.1	
1600	73	± 0.1	
2000	73	± 0.1	2
2500	73	± 0.1	5
3150	73	± 0.2	8
4000	72	± 0.2	
5000	70		
Impact Insulation Class (IIC) <sup>3</sup> = 27 Weighted Normalized Impact Sound Pressure Level (L <sub>n,w</sub> ) <sup>4</sup> = 79			

<sup>3</sup> Impact Insulation Class (IIC) calculated according to ASTM E989.

<sup>4</sup> Weighted Normalized Impact Sound Pressure Level (L<sub>n,w</sub>) calculated according to ISO 717.

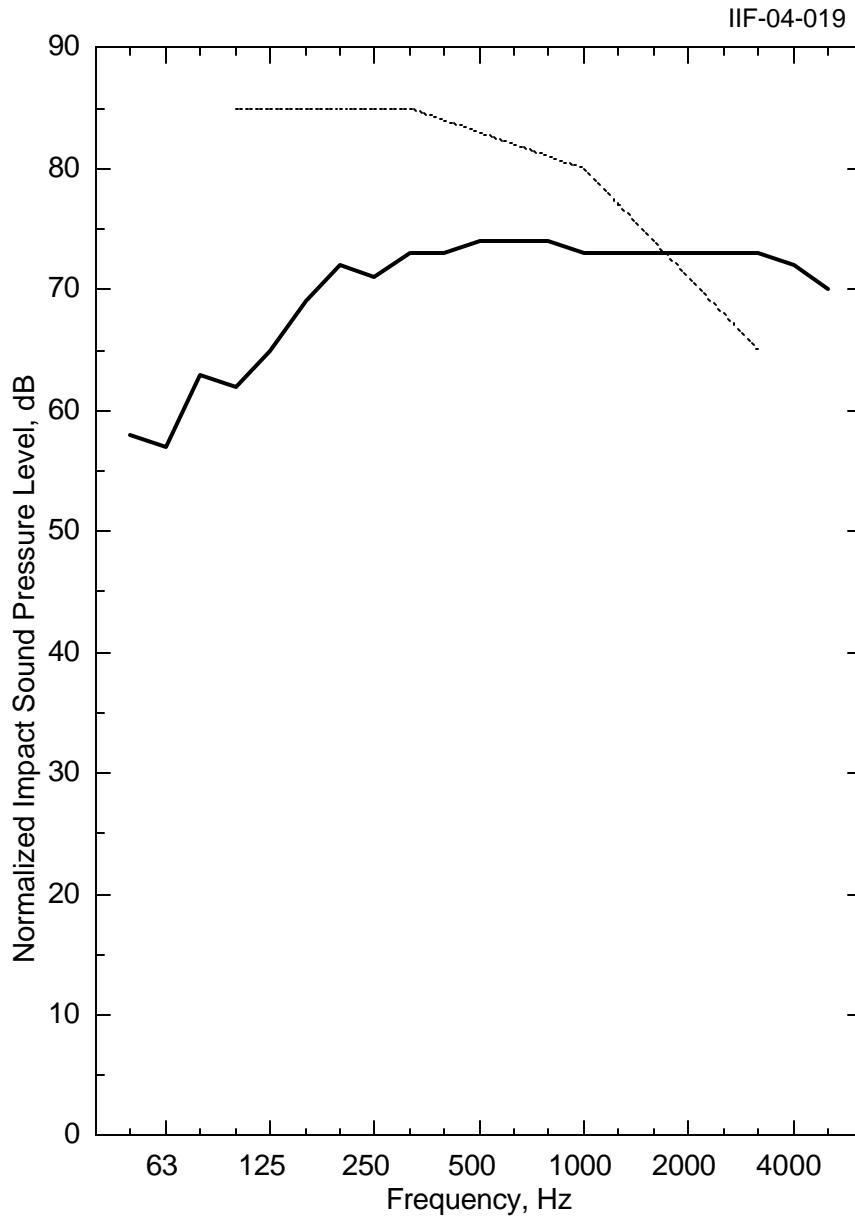


Figure 2: Impact sound transmission measurements of Specimen B3192-6. The solid line is the experimental data and the dotted line is the IIC 27 contour.

## NOTES ON THE SIGNIFICANCE OF TEST RESULTS

### ***Sound Transmission Class And Weighted Sound Reduction Index***

The Sound Transmission Class (STC) and Weighted Sound Reduction Index ( $R_w$ ) are single-figure rating schemes intended to rate the acoustical performance of a partition element under typical conditions involving office or dwelling separation. The higher the value of either rating, the better the floor performance. Thus, the rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, office machines and similar sources of noise characteristic of offices and dwellings. In applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise), the STC and  $R_w$  are of limited use. Generally, in such applications it is desirable to consider explicitly the noise spectra and the insulation requirements.

### ***Impact Insulation Class And Weighted Normalized Impact Sound Pressure Level***

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

$$IIC = 110 - L_{n,w}$$

### ***Extended Frequency Range***

Standard test procedures require measurements in 1/3-octave bands over a specified frequency range (125 to 4000 Hz for ASTM E90 and 100 to 3150 Hz for ASTM E492). 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 standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

## **FACILITIES AND EQUIPMENT**

The acoustics floor test facility comprises two reverberation rooms with a moveable test frame between the two rooms. Both rooms have a volume of 175 m<sup>3</sup>.

Measurements are controlled by a desktop PC-type computer interfaced to a Norwegian Electronics type 830 real time analyser. Each room has a calibrated Bruel & Kjaer condenser microphone with a type 4166 cartridge that is moved under computer control to nine positions used for the acoustical measurements. Each room has four loudspeakers driven by separate amplifiers and noise sources. To increase the randomness of the sound field, there are also fixed diffusing panels in each room.

## **TEST PROCEDURE**

### ***Airborne Sound Transmission Loss***

Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90, "Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions", and of ISO 140-3, "Laboratory Measurement of Airborne Sound Insulation of Building Elements".

The Sound Transmission Class (STC) was determined in accordance with ASTM E413, "Classification for Rating Sound Insulation". The Weighted Sound Reduction Index ( $R_w$ ) was determined in accordance with ISO 717-1, "Rating of Sound Insulation in Buildings and of Building Elements, Part 1: Airborne Sound Insulation".

One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in each 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 receiving room. These times were averaged to get the average reverberation times for the room.

The average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room were used to calculate sound transmission loss values.

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.

A complete description of the test procedure, information on the flanking limit of the facility and reference specimen test results are available on request.

### ***Impact Sound Transmission***

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 used the standard tapping machine and the prescribed four impact positions on the floor. 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 difference is believed to be insignificant. The Weighted Normalized Impact Sound Pressure Level ( $L_{n,w}$ ) was determined in accordance with ISO 717-2, "Acoustics — Rating of Sound Insulation in Buildings and of Building Elements - Part 2: Impact Sound Insulation".

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 receiving 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. For impact sound transmission, the lower room is the receiving room.

A complete description of the test procedure is available on request.