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Airborne Sound Transmission Loss Measurement of Skyfold Mirage 33 Rw

Skyfold Inc.

Report No. A1-011025.4

13 June 2017

SKYFOLD MIRAGE®

National Research Council Canada
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Report No:	A1-011025.4
Report Date:	13 June 2017
Contract No:	A1-011025
Agreement date:	23 February 2017
Program:	Building Regulations for Market Access

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Client:	Skyfold Inc. 325 Lee Avenue Montréal, Québec, CANADA H9X 3S3
Specimen:	Skyfold Mirage
Specimen ID:	A1-011025-1X4 Single-8W
Construction Date:	May 12, 2017

Specimen Description:

The size of the 2.44 m x 3.66 m NRC facility test opening was reduced to accommodate the specimen by constructing a filler element as follows: The test opening was lined with a layer of sill gasket. A header consisting of a steel beam measuring 77 mm x 305 mm x 3667 mm covered on both sides with 2 layers of plywood with dimensions of 19 mm x 305 mm x 3667 mm and 6 layers of CGC SHEETROCK gypsum panels with dimensions of 16 mm x 305 mm x 3667 mm was constructed. The header housed the motor and other operable parts of the lifting mechanism. The header assembly was supported at each end by 39 mm x 89 mm wood studs 2439 mm long and spaced 89 mm apart and fastened to the test frame using Type S screws 51 mm long spaced every 200 mm on centre. The space between the studs, which measured 39 mm x 89 mm, was filled with fiberglass insulation and the supports were then enclosed with 3 layers of 13 mm CGC SHEETROCK gypsum board on the face and sides. The supports had a finished measurement of 76 mm deep x 380 mm wide and 2362 mm high. Two layers of CGC Type X gypsum board each measuring 13 mm x 189 mm x 3581 mm and 16 mm x 189 mm x 3581 mm were placed on the bottom portion of the test frame. Exposed joints between pieces of gypsum board were caulked and covered with metal foil tape.

The Skyfold Mirage operable partition was installed by the client. It consisted of 4 single laminated glass panels, mounted in a lifting mechanism that was supported from the top. The glass panels measured 460 mm high x 3290 mm wide. The panels were supported by horizontal aluminum "beams" attached to moveable “pantographs” that folded when raised and lowered for operation. A non-moveable aluminum channel measuring 2172 mm high x 127 mm thick x 25 mm wide was attached to each side of the opening, to guide the raising and lowering of the partition. The overall dimensions of the partition, including these channels, were 2172 mm high x 3508 mm wide x 127 mm thick.

The client reported that each single laminated glass panel was constructed as follows: a laminated pane of 5 mm (3/16”) annealed glass, 1 mm (1/16”) film, 5 mm (3/16”) annealed glass. The total thickness of each glass panel was 11 mm (7/16”). The mass of each glass panel was 38.1 kg. The total mass of all 4 glass panels was 152.4 kg. The total mass of the lifting mechanism including the pantographs, beams, trim, and seals was 83.9 kg. The total mass of the specimen was 236.3 kg.

The client reported the highlights of the specimen as follows: Backing rod around glass; foam gasket between slash cuts; foam in bulb seals at corner; added 1/2 in x 2 in open cell foam strip

between large sweep seals; added 2 strips 3/4 in x 1 in open cell foam behind large brush seals. Proprietary details of the specimen are withheld from this report at the request of the client.

Specimen Properties:

Element		Actual thickness (mm)	Mass (kg)	Mass/area
Skyfold Mirage 1X4 Single	Each glass panel: laminated pane of 5 mm annealed glass/1mm film/5 mm annealed glass	11	38.1	25.2 kg/m²
	Lifting mechanism: Pantographs, beams, trim and seals	127	83.9	
Total		127	236.3	31.0 kg/m²

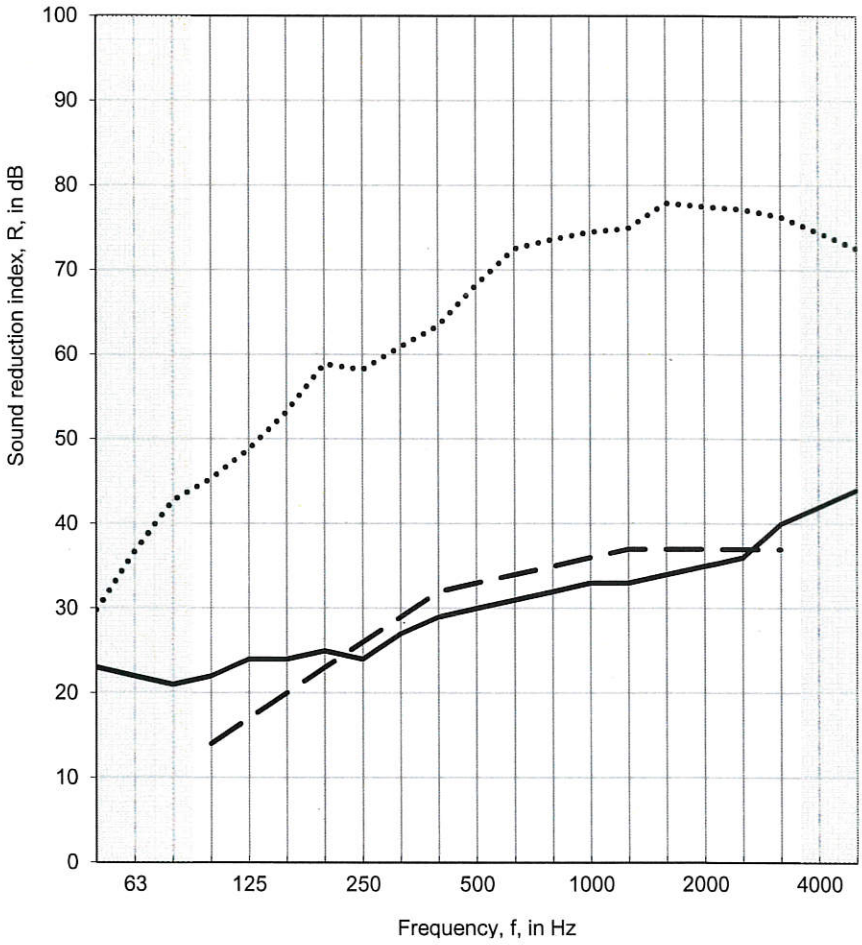
Airborne sound transmission loss measurements were conducted in accordance with the requirements of ISO 10140-2, "Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurement of airborne sound insulation"

Client:	Skyfold Inc.	**Test ID:**	TLA-17-106
Specimen ID:	A1-011025-1X 4 Single-8W	**Date of Test:**	May 12, 2017
Large Room Volume:	255.6 m³	**Area S of test specimen:**	7.62 m²
Small Room Volume:	140.5 m³	**Mass per unit area:**	31.0 kg/m²

Room	Air temperature, °C	Humidity, %
Large	21.7 to 21.9	40.6 to 41.1
Small	21.5 to 21.5	41.5 to 41.7

For a further description of the test specimen and mounting conditions see text pages before.
The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen.

f (Hz)	R 1/3-octave (dB)
50	23.3
63	22.0
80	21.2
100	22.2
125	23.5
160	23.5
200	24.6
250	23.9
315	27.3
400	28.6
500	30.3
630	30.6
800	32.2
1000	32.8
1250	33.4
1600	33.6
2000	34.9
2500	36.2
3150	40.0
4000	42.1
5000	43.8



In the graph: The solid line is the sound reduction index, R, for this specimen. The dashed line is the curve of reference values fitted to the measured values according to ISO 717-1. The dotted line is 15 dB below the flanking limit established for this facility. Shaded values are not accounted for the single number rating, R_w, according to ISO 717-1.

In the table: Values marked "≥" are to be taken as limits of measurement and the reported values provide an estimate of the lower limit of R. Values marked "*" indicate that the measured background level was 6 dB or less below the combined receiving room level and background level.

Rating according to ISO 717-1:

R_w ($C;C_{tr}$) = 33 (-1;-3) dB $C_{50\text{-}5000}$ = 0 dB; $C_{tr,50\text{-}5000}$ = -3 dB

Evaluation based on laboratory measurement results obtained by an engineering method

Appendix A - ISO 10140-2 Airborne Sound Transmission Loss Measurement Procedure

Facility and Equipment: The NRC Construction Wall Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the large and small rooms) with a moveable test frame between the two rooms. The large room has an approximate volume of 255 m^3 while the small room has an approximate volume of 140 m^3. The rooms of the acoustic wall test facility fulfill the requirements of ISO 10140-5. The movable frame is made from hollow steel beams filled with concrete, which conforms to the intent but not the specific wording of ISO 10140-5. In each room, a calibrated Brüel&Kjaer condenser microphone (type 4166 or 4165) with preamplifier is moved under computer control to nine positions, and measurements are made in both rooms using a National Instrument NI-4472 system installed in a computer. Each room has four 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 ISO 10140-2, "Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurements of airborne sound insulation". Airborne sound reduction index was measured 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 reduction index 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: ISO 10140-2 requires measurements in one-third octave bands in the frequency range between 100 Hz and 5000 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 100 Hz to 5000 Hz range has not been established, and is expected to depend on laboratory-specific factors.

Weighted Sound Reduction Index (R_W) and Spectrum Adaptation Terms (C, C_{tr}): The Weighted Sound Reduction Index and Spectrum Adaptation Terms were determined in accordance with ISO 717-1:2013, "Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation". The Weighted Sound Reduction Index (R_W) is a single-number 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 Spectrum Adaptation Terms (C, C_{tr}) are values to be added to the single-number rating and intended to correlate with subjective impressions of the sound insulation provided against sounds with different spectra. Two sound spectra are defined in ISO 717-1:2013. Spectrum Adaptation Term C is intended for sources like pink noise, such as living activities (talking, music, radio, TV, children playing), railway traffic at medium and high speed, highway road traffic (> 80 km/h), jet aircraft at short distance, or factories emitting mainly medium and high frequency noise. Spectrum Adaptation Term C_{tr} is intend for urban road traffic noise, but it is also suitable for other noise sources, such as railway traffic at low speed, propeller driven aircraft, jet aircraft at large distance, disco music, or factories emitting mainly low and medium frequency noise. The ratings above are of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers,..). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

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