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Client Report

October 6, 2010

Measurement of Sound Absorption in Accordance with ISO 354, Performed on a Skyfold Classic Operable Partition (in Testing Configuration "4E")

B3484.6

SKYFOLD® classic NRC™

SKYFOLD zenith® NRC

National Research Council Canada
Conseil national de recherches Canada

Canada

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A Client Report based on the results of the IRC Research Project on:

Measurement of Sound Absorption in Accordance with ISO 354, Performed on a Skyfold Classic Operable Partition (in Testing Configuration "4E")

for

Railtech Ltd.,
Skyfold Division of Railtech
325, Lee Avenue
Baie d'Urfé
Montréal, QC
H9X 3S3

6 October 2010

SKYFOLD® classic NRC™ SKYFOLD zenith® NRC

Measurement of Sound Absorption in Accordance with ISO 354, Performed on a Skyfold Classic Operable Partition (in Testing Configuration "4E") for Skyfold Division of Railtech Ltd.

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Testing Laboratory:	National Research Council Canada Institute for Research in Construction Acoustics Laboratory 1200 Montreal Road Ottawa, Ontario K1A 0R6
Client:	Skyfold Custom Powerlift Partitions, Railtech Ltd. 325 Lee Ave, Baie D'urfe Montreal, Quebec H9X 3S3
Specimen:	Skyfold Classic "4E" SKYFOLD® classic NRC™ SKYFOLD zenith® NRC
Specimen ID:	B3484-32W
Manufacturer:	Client
Construction Dates:	August 19, 2010 to August 20, 2010

Specimen Description:
The specimen B3484-32W was identified by the client as a Skyfold Classic operable partition, with panels, seals, and clearances in configuration "4E". SKYFOLD® classic NRC™ SKYFOLD zenith® NRC

The Skyfold Classic operable partition was installed by the client and consisted of 8 panels, mounted to a lifting mechanism that was supported from the top. Four panels were installed on each side of the mechanism. The overall dimensions of the partition, including seals, were 3508 mm wide by 2172 mm high. The overall thickness of the partition was 299 mm.

The client reported that each panel consisted of an honeycomb cellulose core between a fabric covered perforated steel plate on the outer face, and a backer plate of sheet steel on the inner face. The steel-core-steel part of each panel was 19 mm thick, 3457 mm wide and 510 mm high. The inside surface of each panel had a layer of 38 mm fiberglass duct liner.

Each panel had lined rubber "end" seals on the vertical edges that retracted and extended for operation. The width of these vertical end seals when fully extended was nominally 25 mm. All panels sealed to each other with horizontal "lip" seals that compressed a strip of foam when the partition was closed. The top panel sealed to the header with a lined extruded rubber "bulb" seal 57 mm high. The bottom panel sealed to the floor with a lined extruded rubber "bulb" seal 57 mm high.

The total mass of all 8 panels including seals was 229.9 kg. The total mass of the specimen was 342.7 kg.

Proprietary details of the specimen are withheld from this report at the request of the client.

The size of the 2.44 m by 3.66 m facility test opening was reduced to accommodate the specimen by constructing a filler element as follows: A header consisting of a steel beam (C12 x 20.7) 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 2 layers of 16 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. 2 strips of a single layer of CGC Type X gypsum board each measuring 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.

Test Specimen Installation:

The test specimen was installed in a rectangular opening also used for measuring sound transmission of wall specimens. The facility test opening measures 2.44 m by 3. 66 m. The area was reduced by constructing filler elements, as described above. The perimeter of the filler elements was sealed on both sides to the facility test opening with latex caulk and covered with metal foil tape. The opening in the filler elements for the test specimen measured 3508 mm wide by 2172 mm high.

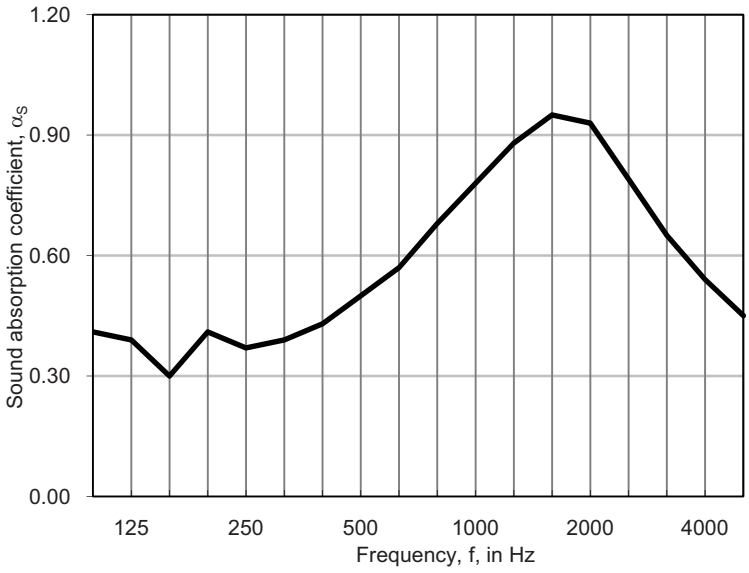
The area used for calculations of sound absorption coefficients was 7.66 m^2.

The specimen was opened and closed five times after installation was completed and was tested without further adjustments.

Sound absorption coefficient measurements were conducted in accordance with the requirements of ISO 354:2003, "Acoustics – Measurement of sound absorption in a reverberation room"

Client:	Skyfold Custom Powerlift Partitions, Railtech Ltd.	**Test ID:**	ABA-10-008
Specimen ID:	B3484-32W SKYFOLD® classic NRC™	**Date of Test:**	August 20, 2010
Room Volume:	250.9 m³ SKYFOLD zenith® NRC	**Area S of test specimen:**	7.66 m²
Air temperature, °C**:**	21.9 to 21.9	**Type of mounting used:**	Other
Air Humidity, %**:**	45.6 to 45.9	For a further description of the test specimen and mounting conditions see text pages before.	

Frequency f (Hz)	T_1 empty room (s)	T_2 with sample (s)	Sound Absorption Coefficient α_S
100	6.03	4.09	0.41
125	5.00 *	3.64	0.39
160	5.49	4.18	0.30
200	6.03	4.11	0.41
250	5.55	3.99	0.37
315	6.19	4.24	0.39
400	5.54	3.81	0.43
500	5.16 *	3.47	0.50
630	5.12 *	3.29	0.57
800	4.94 *	3.01	0.68
1000	4.81 *	2.80	0.78
1250	4.55 *	2.58	0.88
1600	3.98 *	2.31	0.95
2000	3.51 *	2.17	0.93
2500	3.26 *	2.19	0.79
3150	2.96	2.17	0.65
4000	2.55 *	2.03	0.54
5000	2.10 *	1.79	0.45



Values marked "*" indicate that the limit for the maximum equivalent sound absorption area of the empty room according to ISO 354:2003 is exceeded in this frequency range. The uncertainty of the measured sound absorption coefficient might be higher in this frequency range.

Rating according to ISO 11654:

Weighted sound absorption coefficient and shape indicator:

$\alpha_W = 0.65$

Sound absorption class:

C

Practical sound absorption coefficients:

Frequency, f (Hz)	α_P
125	0.37
250	0.39
500	0.50
1000	0.78
2000	0.89
4000	0.55

Evaluation based on laboratory measurement results obtained by an engineering method

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

APPENDIX:

Sound Absorption M-27 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 Procedure: The facility for absorption testing has a reverberation room with nominal volume of 250 m^3. The room has four loudspeakers driven by separate amplifiers and noise sources controlled by a computer. To increase the randomness of the sound field, there are fixed and moving diffusing panels in the room. In this room, a calibrated Brüel & Kjaer type 4166 microphone with preamp is moved under computer control to nine repeatable positions, and measurements of sound decays are made using an 8-channel National Instrument NI4472 system installed in a desktop PC-type computer. Sound absorption measurements are conducted in accordance with the requirements of ISO 354:2003 "Acoustics – Measurement of sound absorption in a reverberation room". Mean empty room reverberation times are obtained by averaging the measurements of ten decays at each of nine microphone positions. Similarly, mean reverberation times are obtained with the specimen in the chamber, at the same 9 microphone positions for each test specimen position; the latter depends on the specimen mounting (see below). The mean reverberation times are then used to calculate the absorption coefficient in each one-third-octave band.

Specimen Mounting: Standard mounting conditions for absorption testing conform to ISO 354:2003, Annex B "Test specimen mountings for sound absorption tests". Standard mountings normally used for plane absorbers at this laboratory include:

- *Type A Mounting*—The test specimen is laid directly on the floor, with its perimeter edges covered by a wood frame that is sealed to the floor. Measurements are made for one standard position.
- *Type E-400 Mounting*—The test specimen is installed in a standard frame that supports the specimen 400 mm above the chamber floor. Measurements are made for two standard positions, with the frame sealed to the floor.

Different mounting conditions for plane absorbers, e.g. as required by the specifications provided by the producer, or as required by the application details provided by the user, are specified in the specimen description. Discrete objects (e.g. office screens, furniture, chairs, etc.) are installed during test in the same manner as they are typically installed in practice.

Sound Absorption Coefficients: The equivalent sound absorption area for a specimen is measured in square meters. "1 m^2 of absorption" may be thought of as one square meter of perfect absorber. Sound absorption coefficients are derived by dividing the sound absorption of a plane absorber or array of absorbers tested at each frequency by the total surface area of a specimen in square meters. Diffraction effects usually cause the effective area of a specimen to be greater than its geometrical area thereby increasing the measured absorption coefficient. When the coefficients are large, the measured values may exceed unity, but no adjustments to the measured coefficients are made. For discrete objects (e.g. office screens, furniture, chairs, etc.) the absorption is expressed as equivalent sound absorption area per object, by dividing the measured equivalent sound absorption area by the number of elements tested.

Practical Sound Absorption Coefficient, α_p, Weighted Sound Absorption Coefficient, α_w, Shape Indicator, and Sound Absorption Class are all determined according to ISO 11654:1997 "Acoustics – Sound absorbers for use in buildings – Rating of sound absorption". From the one-third-octave sound absorption coefficients measured according to ISO 354:2003, the practical sound absorption coefficient is calculated as the arithmetic mean value of the three values for each octave band, rounded to the nearest multiple of 0.05, and adjusted to 1.00 for all values exceeding unity. A reference curve is fitted to the practical sound absorption coefficient in the range from 250 Hz to 4000 Hz to obtain the single number rating (weighted sound absorption coefficient, α_W). The higher the α_w value, the greater the sound absorption. The shape indicator indicates that the practical sound absorption coefficient exceeds the fitted reference curve by 0.25 or more in three defined frequency ranges (Indicator L for 250 Hz, Indicator M for 500 Hz or 1000 Hz, and Indicator H for 2000 Hz or 4000 Hz). The sound absorption class according to ISO 11654:1997, Annex B is intended to be used for broad-band applications and rates sound absorbers from class A ($0.90 \le \alpha_W \le 1.00$) to class E ($0.15 \le \alpha_W \le 0.25$).

Precision: Acoustical measurement in rooms is a sampling process and as such has associated with it a degree of uncertainty influenced by different factors. One is the uncertainty in the measurement of the reverberation times. 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. The standard deviation of the measured reverberation time can be calculated according to ISO 354:1997 and in more detail according to ISO/TR 140-13. These uncertainties do not relate directly to the variation expected when a nominally identical specimen is built, installed and tested. Nor do they relate to the differences expected when nominally identical specimens are tested in different laboratories (reproducibility). Unfortunately, no guidance is given in ISO 354:2003 about the expected reproducibility of absorption coefficient measurement.