SPONSOR: **ClarkDietrich**
West Chester, OH

Impact Sound Transmission
RAL™-IN21-006

CONDUCTED: 2021-01-25

ON: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC)

TEST METHODOLOGY

Riverbank Acoustical Laboratories™ is accredited by the U.S. Department of Commerce, National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP) as an ISO 17025:2017 Laboratory (NVLAP Lab Code: 100227-0) and for this test procedure. The test reported in this document conformed explicitly with ASTM E492-09: "Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine." The single number rating of the specimen was calculated according to ASTM E989-18: "Standard Classification for Determination of Single-Number Metrics for Impact Noise." A description of the measurement procedure and room specifications are available upon request. The results presented in this report apply to the individual test specimen as described and assembled.

INFORMATION PROVIDED BY SPONSOR

The test specimen was designated by the sponsor as 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC). The following nominal product information was provided by the sponsor prior to testing. The accuracy of such sponsor-provided information can affect the validity of the test results.

Products Under Test

Isolating Clips

Trade Name:	ClarkDietrich Sound Clips™ (CDSC)
Manufacturer:	ClarkDietrich

Furring Channel

Trade Name:	087F125-18 (33ksi, G40EQ)
Material:	7/8 in. Furring/Hat Channel – 25 ga (18 mils)
Manufacturer:	ClarkDietrich

SPECIMEN MEASUREMENTS & TEST CONDITIONS

The construction contractor (Seth Priser) and RAL staff compiled a detailed construction specification as follows, in order of installation:

Concrete Slab

Material:	Wire-reinforced concrete
Dimensions:	4 @ 610 mm (24 in.) x 4267 mm (168 in.)
Thickness:	203 mm (8 in.)
Overall Weight:	5023.08 kg (11074 lbs)
Mass per Unit Area:	482.75 kg/m^2 (98.875 lbs/ft^2)
Installation:	Laid in test opening over 152.4 mm (6 in.) wide knee walls constructed from isolated wood framing Joint undersides sealed with acoustical caulk and tape Top of joints filled with general purpose sand, sealed with premixed masonry joint compound

Ceiling Assembly

Isolating Clips

Material:	Metal, rubber (see Products Under Test)
Dimensions:	76 mm (3 in.) long by 35 mm (1.375 in.) wide
Thickness:	32 mm (1.25 in.)
Installation:	Fastened through center to anchor holes in underside of concrete slabs Staggered array, spaced 1219 mm (48 in.) on center, 16 pieces total
Overall Weight:	1.02 kg (2.25 lbs)

Furring Channel

Material:	Steel furring channel (see Products Under Test)
Dimensions:	7 @ 2463.8 mm (97 in.) long by 69 mm (2.72 in.) wide
Formed Depth:	22.2 mm (0.875 in.)
Steel Thickness:	0.49 mm (0.019 in.)
Installation:	Clipped in to isolating clips, oriented perpendicular to concrete slab
Overall Weight:	6.58 kg (14.5 lbs)
Mass per Unit Length:	0.38 kg/m (0.26 lbs/ft)

Ceiling Assembly (continued)

Insulation

Material:	R-6.7 unfaced fiberglass insulation
Dimensions:	406.4 mm (16 in.) wide by 1219.2 mm (48 in.) long pieces
Thickness:	51 mm (2 in.)
Installation:	Draped over furring channel
Orientation:	Length of pieces perpendicular to furring channel
Overall Weight:	4.31 kg (9.5 lbs)
Density:	8.78 kg/m^3 (0.55 lbs/ft^3)

Gypsum Layer 1

Material:	Type X gypsum board
Manufacturer:	USG
Brand name:	Sheetrock® brand, Firecode® core (type X)
Dimensions:	1219 mm (48 in.) wide by 2616 mm (103 in.) long 1219 mm (48 in.) wide by 2584.5 mm (101.75 in.) long 1219 mm (48 in.) wide by 1384 mm (54.5 in.) long 1219 mm (48 in.) wide by 1346 mm (53 in.) long
Thickness:	15.9 mm (0.625 in.)
Installation:	Fastened to furring channel at center flange
Fasteners:	Type S bugle head drywall screws @ 31.8 mm (1.25 in.)
Fastener Spacing:	610 mm (24 in.) on center
Overall Weight:	105.23 kg (232 lbs)
Mass per Unit Area:	10.88 kg/m^2 (2.23 lbs/ft^2)

Gypsum Layer 2

Material:	Type X gypsum board
Manufacturer:	USG
Brand name:	Sheetrock® brand, Firecode® core (type X)
Dimensions:	1 @ 1219 mm (48 in.) wide by 2019 mm (79.5 in.) long 1 @ 1219 mm (48 in.) wide by 1962 mm (77.25 in.) long 1 @ 610 mm (24 in.) wide by 2616 mm (103 in.) long 1 @ 610 mm (24 in.) wide by 2572 mm (101.25 in.) long 1 @ 610 mm (24 in.) wide by 1365 mm (53.75 in.) long 1 @ 610 mm (24 in.) wide by 1403 mm (55.25 in.) long
Thickness:	15.9 mm (0.625 in.)
Installation:	Fastened through Gypsum Layer 1 to center flange of furring channel
Fasteners:	Type S bugle head drywall screws @ 41.3 mm (1.625 in.)
Fastener Spacing:	610 mm (24 in.) on center

Ceiling Assembly (continued)

Gypsum Layer 2

Overall Weight: 103.87 kg (229 lbs)
Mass per Unit Area: 10.70 kg/m^2 (2.19 lbs/ft^2)

Note: Joints and screw heads on the exposed face of the gypsum board in the receive room were treated with a thin bead of acoustical sealant and metal tape (0.23 kg (0.5 lbs) total).

Overall Specimen Measurements

Size:	2.44 m (96.0 in) wide by 3.86 m (152.0 in) long
Thickness:	286 mm (11.25 in)
Weight:	5244.32 kg (11561.75 lbs)
Transmission Area:	9.414 m² (101.33 ft²)
Mass per Unit Area:	557.07 kg/m² (114.10 lbs/ft²)

Test Aperture

Opening Size:	4.27 m (14.0 ft) x 6.10 m (20.0 ft)
Filler Wall:	Yes
Aperture Size:	2.44 m (96.0 in) wide by 3.86 m (152.0 in) long
Transmission Area:	9.414 m² (101.33 ft²)
Sealed:	Entire periphery (both sides) with dense mastic

Test Environment

Source Room

Volume:	130.84 m³
Temperature:	22.2 °C ± 0.0 °C
Relative Humidity:	48.5 % ± 1.0 %

Receive Room

Volume:	81.9 m³
Temperature:	22.8 °C ± 0.0 °C
Relative Humidity:	47.5 % ± 1.0 %

Requirements

Temperature:	22º C +/- 5° C, not more than 3° C change over all tests.
Relative Humidity:	≥ 30% RH; not more than +/- 3% change over all tests.

Figure 1 – Specimen mounted in test chamber, as viewed from source room

Figure 2 – Specimen mounted in test chamber, as viewed from receive room

Figure 3 – Detail of isolating clip

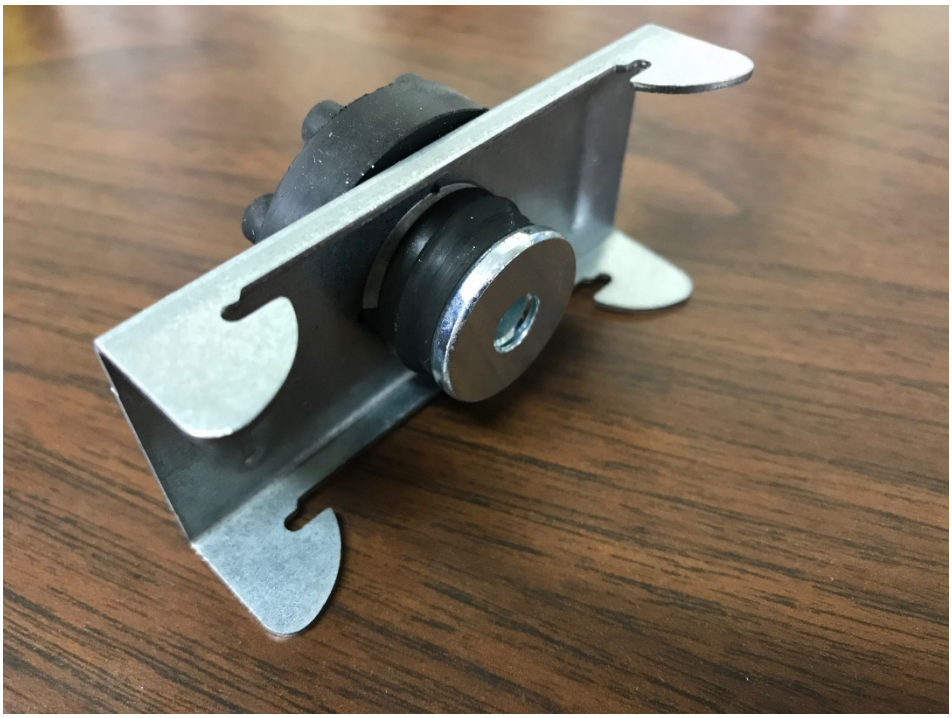

Figure 4 – Detail of isolating clip

Figure 5 – Isolating clips installed to bottom of concrete slabs

Figure 6 - Furring channel being installed to isolating clips

Figure 7 - Furring channel and insulation installed below slabs

Figure 8 – First layer of gypsum board partially installed to furring channel

TEST RESULTS

The averaged sound pressure levels, normalized to a receive room reference absorption of 10 m^2, are tabulated at the sixteen standard frequencies. A graphic presentation of the data and additional information appear on the following pages. The 95% confidence interval for the sound pressure level in the receive room is below the limits specified in Section A1.4 of ASTM E492-09.

FREQ.	Ln	ΔLn	DEV	FREQ.	Ln	ΔLn	DEV
100	57	1.53	6	800	38	3.00	0
125	52	2.71	1	1000	37	2.36	0
160	52	1.57	1	1250	35	3.47	0
200	50	2.88	0	1600	36	4.38	0
250	53	2.45	2	2000	43	3.78	6
315	46	1.89	0	2500	41	2.43	7
400	44	1.69	0	3150	37	4.94	6
500	40	2.51	0				
630	36	3.42	0				

IIC=61

ABBREVIATION INDEX

FREQ. = FREQUENCY, HERTZ, (cps)
Ln = NORMALIZED SOUND PRESSURE LEVEL, dB
ΔLn = 95% UNCERTAINTY LIMIT FOR Ln, dB
DEV. = DEVIATION FROM SHIFTED IIC CONTOUR, dB (SUM OF DEV = 29)
IIC = IMPACT INSULATION CLASS
* = LEVEL CORRECTED DUE TO BACKGROUND NOISE PER E492 SEC 10.2.2
** = LEVEL CORRECTED DUE TO BACKGROUND NOISE PER E492 SEC 10.2.3

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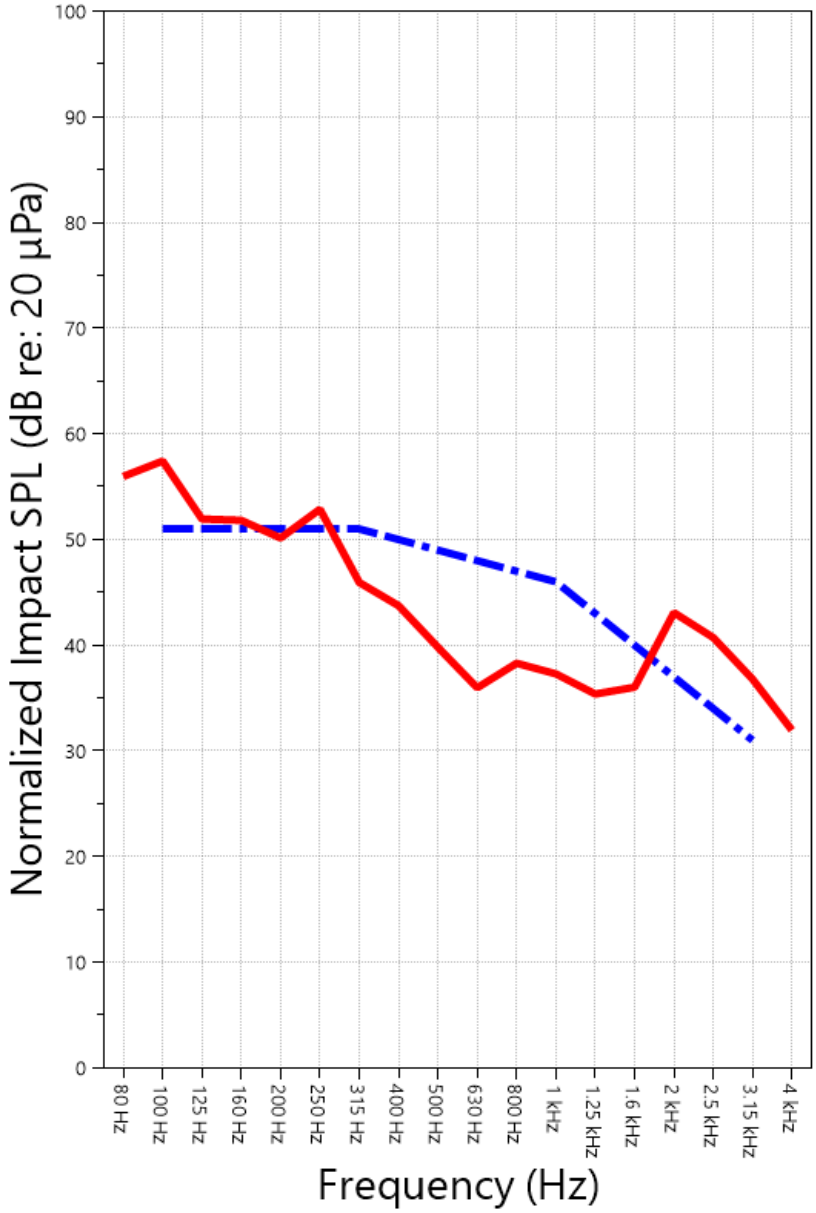
IMPACT SOUND TRANSMISSION REPORT

8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC)



IIC=61

IMPACT SOUND PRESSURE LEVEL

IMPACT INSULATION CLASS CONTOUR

APPENDIX A: Extended Frequency Range Data

Specimen: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC) (See Full Report)

The following non-accredited data were obtained in accordance with ASTM E989-06 (2012), but extend beyond the defined frequency range of 100 Hz to 3,150 Hz. These unofficial results are representative of the RAL test environment only and intended for research & comparison purposes.

1/3 Octave Band Center Frequency (Hz)	L_n (dB)	ΔL_n (dB)	Repeatability (dB)
31.5	50	6.63	4.45
40	62	3.04	3.47
50	64	2.88	2.55
63	69	2.97	5.07
80	56	4.05	2.23
100	57	1.53	3.47
125	52	2.71	2.85
160	52	1.57	2.46
200	50	2.88	1.93
250	53	2.45	0.73
315	46	1.89	0.79
400	44	1.69	2.17
500	40	2.51	1.93
630	36	3.42	0.21
800	38	3.00	1.41
1000	37	2.36	2.05
1250	35	3.47	1.49
1600	36	4.38	2.22
2000	43	3.78	2.51
2500	41	2.43	1.26
3150	37	4.94	1.51
4000	32	2.36	1.85
5000	28	2.49	1.82
6300	28	5.75	1.90
8000	23*	5.32	0.88
10000	15**	1.83	4.02
12500	10**	1.86	5.26

* *Level corrected due to proximity to background noise per E492 Section 10.2.2*

** *Level corrected due to proximity to background noise per E492 Section 10.2.3, represents lower limit of specimen performance*

APPENDIX B: Glossary for Variability Metrics

Specimen: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC) (See Full Report)

ΔL_n, the 95% confidence interval for the reported normalized sound pressure level, is calculated from the standard deviation of the set of sound pressure levels measured during this individual test. This metric is calculated in an effort to quantify the variability in measured levels due to the combined influences of varying sound pressure level in the receive room and changes in specimen response for different tapping machine locations.

Repeatability, expressed as a 95% confidence interval, is calculated from the standard deviation in normalized sound pressure level as obtained from a total of six consecutive tests conducted according to this test method by RAL from 2019-02-07 to 2019-02-12. The tests were performed on a specimen composed of 152.4 mm (6 in.) thick concrete slabs, which was left installed and unaltered between tests. This metric provides an estimate of the variation in results that might be observed if the test were repeated with no change to the installed specimen. Note that repeatability will vary with the construction type.

APPENDIX C: Instruments of Traceability

Specimen: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC) (See Full Report)

Description	Model	Serial Number	Date of Certification	Calibration Due
System 2	Type 3160-A-042	3160-106974	2020-08-13	2021-08-13
Bruel & Kjaer Mic And Preamp C	Type 4943-B-001	2311439	2020-04-07	2021-04-07
Bruel & Kjaer Tapping Machine	Type 3207	3151105	2020-10-27	2021-10-27
Bruel & Kjaer Pistonphone	Type 4228	2781248	2020-08-12	2021-08-12
EXTECH Hygro 662	SD700	A083662	2020-12-18	2021-12-18
EXTECH Hygro 663	SD700	A083663	2020-12-18	2021-12-18

APPENDIX D: Revisions to Original Test Report

Specimen: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC) (See Full Report)

Date	Revision
2021-02-16	Original report issued

END

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SPONSOR: **ClarkDietrich**
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Report Referenced: **RAL™-IN21-006**

CONDUCTED: 2021-01-25

ON: 8-Inch Concrete Slab with insulated dual-layer gypsum board ceiling on ClarkDietrich Sound Clips™ (CDSC) (See Full Test Report for Details)

Nonstandard Appendix E to ASTM E492-09 Impact Transmission Report

Current priorities in the architectural acoustics community involve the development of more nuanced impact insulation metrics. Acoustics consultants and end users have observed that assemblies with equal Impact Insulation Class (IIC) ratings can sound substantially different and prompt differing amounts of customer complaints. Impact insulation metrics that are newly standardized or still in development seek to quantify the performance of floor-ceiling assemblies within certain ranges of sound frequency. These metrics would ideally correlate more strongly to subjective user experience and predict how the nature of the impact source will affect the response of the floor-ceiling construction.

Standard Classification ASTM E3222-20a provides a method for calculating the **High-Frequency Impact Insulation Class (HIIC)**, using normalized impact sound pressure level (L_n) data at frequency bands from 400 Hz to 3150 Hz. In multi-family housing, high-frequency impact sound correlates to common sources such as the impacts of hard-heeled shoes, dragging furniture, dog toenails, and objects dropped on hard-surfaced flooring.

Methods for parametrizing insulation of low-frequency impact sound are still under deliberation; no calculation method has yet been standardized. A preliminary proposed method for calculating the **Low-Frequency Impact Insulation Class (LIIC)** uses normalized impact sound pressure level (L_n) data at frequency bands from 50 Hz to 80 Hz. Low-frequency impact noise correlates to the "thudding" of footfalls on lightweight structures. Refer to the ASTM Work Item referenced below for details.

A summary of impact insulation ratings for the specimen described in the referenced test report is given below.

Referenced Document	Rating	Calculated Value
Standard Classification ASTM E989-18	**IIC**	**61**
Standard Classification ASTM E3222-20a	**HIIC**	**61**
Nonstandard Work Item ASTM WK63897	**LIIC**	**50**

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