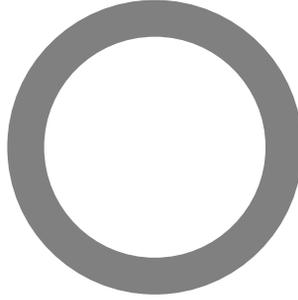


ASTM E 90: Laboratory Measurement of Airborne Sound Transmission of Building Partitions and Elements
ASTM E 492: Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine

Orfield Laboratories Inc



Design Research Testing

Acoustics / Vibration / Vision / Lighting / Architecture / Market Research

TEST

Client: **Green Glue Company, L.L.C.**
Report Date: **October 17, 2008**
Test Date: **May 18, 2007**
Test Number: **OL07-0515**

ACCREDITATION



For the scope of accreditation under NVLAP code 200248-0

PREPARED BY

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RESULT SUMMARY

STC=58
IIC=52

CLIENT ADDRESS

Green Glue Company, L.L.C.
710 11th Avenue Northeast
West Fargo, ND 58078
Phone: (866) 435-8893
email: info@greengluecompany.com

Prepared by:


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REPRODUCED
SIGNATURE

David M. Berg
Laboratory Manager

Signatures are required on this document for an official laboratory test report. Copies of this document without signatures are for reference only.



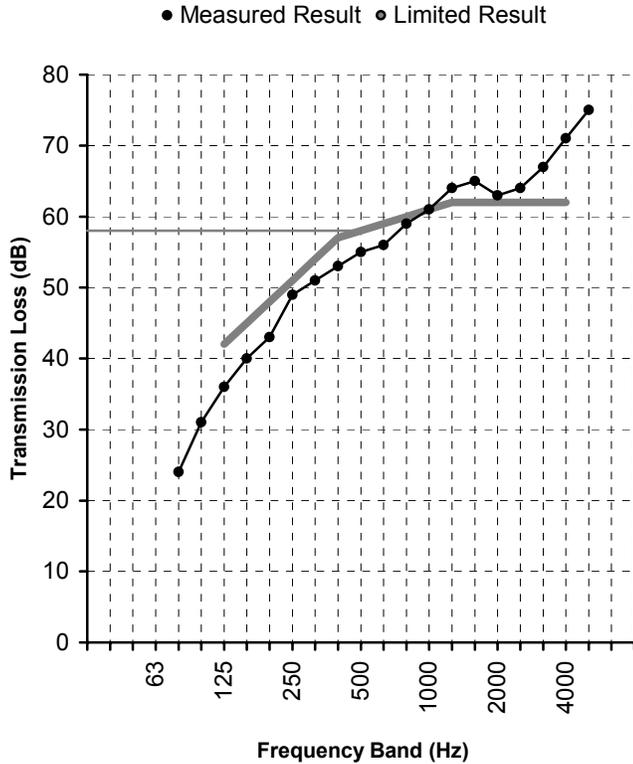
Project **Sound/Impact Transmission** **2**
 Client **Green Glue Company, L.L.C. of 11**
 Test **OL 07-0515**



Orfield Laboratories Inc

Test Date May 18, 2007 **Method** ASTM Standard E90
Specimen Interior Floor Ceiling Assembly

Single Number Rating
STC = 58



| Freq. (Hz) | TL (dB) | Def. (dB) |
|------------|---------|-----------|
| 80 | 24 | |
| 100 | 31 | |
| 125 | 36 | 6 |
| 160 | 40 | 5 |
| 200 | 43 | 5 |
| 250 | 49 | 2 |
| 315 | 51 | 3 |
| 400 | 53 | 4 |
| 500 | 55 | 3 |
| 630 | 56 | 3 |
| 800 | 59 | 1 |
| 1000 | 61 | - |
| 1250 | 64 | - |
| 1600 | 65 | - |
| 2000 | 63 | - |
| 2500 | 64 | - |
| 3150 | 67 | - |
| 4000 | 71 | - |
| 5000 | 75 | - |

Total Deficiencies **32**

* Estimate of lower limit

Assembly Elements (listed in order from floor to ceiling)

- 0.3125" (5/16") engineered laminate flooring
- 0.875" (7/8") OSB/OSB sandwich with Green Glue™
 damping adhesive @ 1.75 oz. per sq. ft.; 2" screw @ 12" O.C.
- 18" deep wood web truss @ 16" O.C.
- 6.5" R19 glass fiber batts
- resilient channel @ 24" O.C.; 1.63" screw @ 16" O.C.
- 0.625" (5/8") gypsum board; 1.625" screw @ 12" O.C.

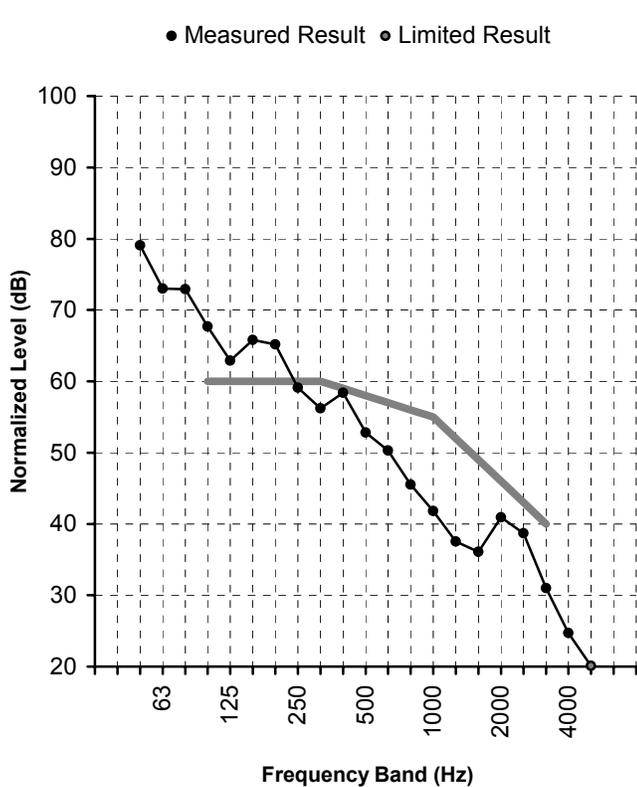




Test Date May 18, 2007
Specimen Interior Floor Ceiling Assembly

Method ASTM Standard E492

Single Number Rating
IIC = 52



| Freq. (Hz) | L _n (dB) | Dev. (dB) |
|------------------|---------------------|-----------|
| 50 | 79 | |
| 63 | 73 | |
| 80 | 73 | |
| 100 | 68 | 8 |
| 125 | 63 | 3 |
| 160 | 66 | 6 |
| 200 | 65 | 5 |
| 250 | 59 | - |
| 315 | 56 | - |
| 400 | 58 | - |
| 500 | 53 | - |
| 630 | 50 | - |
| 800 | 45 | - |
| 1000 | 42 | - |
| 1250 | 38 | - |
| 1600 | 36 | - |
| 2000 | 41 | - |
| 2500 | 39 | - |
| 3150 | 31 | - |
| 4000 | 25 | - |
| 5000 | 20* | - |
| Total Deviations | | 22 |

* Limited by noise

Assembly Elements (listed in order from source room side to receiver room side)

- 0.3125" (5/16") engineered laminate flooring
- 0.875" (7/8") OSB/OSB sandwich with Green Glue™
 damping adhesive @ 1.75 oz. per sq. ft.; 2" screw @ 12" O.C.
- 18" deep wood web truss @ 16" O.C.
- 6.5" R19 glass fiber batts
- resilient channel @ 24" O.C.; 1.63" screw @ 16" O.C.
- 0.625" (5/8") gypsum board; 1.625" screw @ 12" O.C.





SPECIMEN DESCRIPTION

The specimen under test was one floor-ceiling assembly. The elements in the assembly are described below the results table and chart. Additional information regarding the specimen may be found in the appendices.

Test results pertain to this specimen only.

INSTALLATION AND DISPOSITION

Independent contractors fabricated the floor-ceiling assembly in the specimen opening. Qualified representatives of Orfield Laboratories observed the installation progress, and visually inspected the specimen prior to testing.

TEST METHODS

The methods followed these published standards:

ASTM E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*

ASTM E413: Classification for Rating Sound Insulation

ASTM E492: Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine*

ASTM E1332: Standard Classification for Determination of Impact Insulation Class (IIC)

ASTM E2235: Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods

** Orfield Laboratories, Inc. has been accredited by the U.S. Department of Commerce, National Institute of Standards and Technology (NIST) under their National Voluntary Laboratory Accreditation Program (NVLAP) for this test procedure. This report shall not be used to claim product endorsement by NVLAP or any agency of the U.S. Government.*

CONFIDENTIALITY

The client has full control over this information and any release of information will be only to the client. The specific testing results are deemed to be confidential exclusively for the client's use. Reproduction of this report, except in full, is prohibited.





APPENDIX A: MEASUREMENT SETUP

Environment

| | |
|-------------------|---------------|
| Temperature | 70°F [21.1°C] |
| Relative Humidity | 55% |

Specimen Area

| | |
|---------------|---|
| Specimen Area | 182.1 ft ² [16.92 m ²] |
|---------------|---|

Chamber Volume - Airborne Transmission

| | |
|-----------------------|--|
| Source Room Volume | 1488 ft ³ [42.1 m ³] |
| Receiving Room Volume | 8281 ft ³ [234.5 m ³] |

Chamber Volume - Impact Transmission

| | |
|-----------------------|--|
| Source Room Volume | 8281 ft ³ [234.5 m ³] |
| Receiving Room Volume | 1488 ft ³ [42.1 m ³] |

INSTRUMENTATION

| Description | Brand | Model | S/N |
|-----------------|-----------------------|-----------|---------|
| Microphone | Brüel & Kjær | Type 4134 | 1478843 |
| Preamplifier | Brüel & Kjær | Type 2639 | 1202479 |
| Microphone | Brüel & Kjær | Type 4134 | 558007 |
| Preamplifier | Brüel & Kjær | Type 2639 | 1312237 |
| Analyzer | Brüel & Kjær | Type 2133 | 1389369 |
| Tapping Machine | Norwegian Electronics | 211R | 11314 |



APPENDIX B: AIRBORNE CALCULATION RESULTS

| Freq. Band (Hz) | Specimen T.L. (dB) | 95% Conf. (dB) | Flanking Limit (dB) | STC Defic. (dB) |
|---|--------------------------|----------------------|---------------------------|-----------------------|
| 25 | | | | |
| 31.5 | 26.6 | | | |
| 40 | 21.0 | | | |
| 50 | 21.6 | | | |
| 63 | 26.5 | | | |
| 80 | 23.8 | ±1.63 | | |
| 100 | 31.0 | ±1.15 | | |
| 125 | 35.6 | ±0.95 | | 6 |
| 160 | 39.7 | ±1.27 | | 5 |
| 200 | 42.5 | ±1.24 | | 5 |
| 250 | 49.2 | ±0.65 | | 2 |
| 315 | 51.4 | ±0.65 | | 3 |
| 400 | 53.0 | ±0.62 | | 4 |
| 500 | 54.9 | ±0.40 | | 3 |
| 630 | 56.0 | ±0.50 | | 3 |
| 800 | 59.1 | ±0.40 | | 1 |
| 1000 | 61.4 | ±0.25 | | - |
| 1250 | 64.0 | ±0.25 | | - |
| 1600 | 64.5 | ±0.32 | | - |
| 2000 | 62.6 | ±0.44 | | - |
| 2500 | 64.0 | ±0.35 | | - |
| 3150 | 67.2 | ±0.31 | | - |
| 4000 | 71.1 | ±0.49 | | - |
| 5000 | 75.5 | ±0.35 | | - |
| 6300 | 76.4 * | | | |
| 8000 | 74.8 * | | | |
| 10000 | 72.3 * | | | |
| Total deficiencies below STC contour (dB) | | | | 32 |
| STC contour [ASTM E413] | | | | 58 |

* Actual transmission loss of specimen may be higher than measured at this frequency band. Signal-to-noise in the receiving room less than 5 dB, therefore the result is "an estimate of the lower limit".

Note: 95% Confidence from room qualification data. Data is available upon request. Extended frequency results below 80Hz and above 5000Hz for reference only.





APPENDIX B CONTINUED: IMPACT CALCULATION RESULTS

| Freq. Band (Hz) | Normalized Level (L_n) (dB) | 95% Confidence (dB) | IIC Deviations (dB) |
|------------------------------------|---------------------------------------|---------------------------|---------------------------|
| 25 | | | |
| 31.5 | 71.0 | | |
| 40 | 72.3 | | |
| 50 | 79.1 | ±0.5 | |
| 63 | 73.0 | ±0.6 | |
| 80 | 72.9 | ±0.7 | |
| 100 | 67.7 | ±0.4 | 8 |
| 125 | 62.9 | ±0.2 | 3 |
| 160 | 65.8 | ±0.8 | 6 |
| 200 | 65.2 | ±1.1 | 5 |
| 250 | 59.1 | ±0.5 | - |
| 315 | 56.2 | ±0.5 | - |
| 400 | 58.4 | ±0.4 | - |
| 500 | 52.8 | ±0.3 | - |
| 630 | 50.3 | ±0.2 | - |
| 800 | 45.5 | ±0.1 | - |
| 1000 | 41.8 | ±0.2 | - |
| 1250 | 37.5 | ±0.2 | - |
| 1600 | 36.1 | ±0.1 | - |
| 2000 | 40.9 | ±0.1 | - |
| 2500 | 38.7 | ±0.1 | - |
| 3150 | 31.0 | ±0.2 | - |
| 4000 | 24.7 | ±0.2 | - |
| 5000 | 20.1 * | ±0.3 | - |
| 6300 | 18.0 * | | |
| 8000 | 19.1 * | | |
| 10000 | 20.3 * | | |
| Total deviations above IIC contour | | | 22 |
| IIC contour (ASTM E989) | | | 52 |

* Actual impact isolation of specimen may be higher than measured at this frequency band. Signal-to-noise in the receiving room less than 5 dB, therefore the "background noise level was too high".

Note: 95% Confidence from room qualification data. Data available upon request. Extended frequency results below 50Hz and above 5000Hz for reference only.





APPENDIX C: SPECIMEN ASSEMBLY DESCRIPTION

The following table shows the elements in the floor-ceiling assembly, with the top-most element first and the bottom-most element last (from floor-top to ceiling-surface).

Overall Mass = 1819.1 lb [825.1 kg]
 Overall Surface Density = 9.99 PSF [48.77 kg/m²]

| Element | Mass lb [kg] | Surf. Dens. PSF [kg/m ²] |
|--|-----------------|---|
| 0.3125" (5/16") engineered laminate flooring | 265.0 [120.2] | 1.46 [7.11] |
| 0.875" (7/8") OSB/OSB sandwich with Green Glue™ damping adhesive @ 1.75 oz. per sq. ft.; 2" screw @ 12" | 573.0 [259.9] | 3.15 [15.36] |
| 18" deep wood web truss @ 16" O.C. | 520.0 [235.9] | 2.86 [13.94] |
| 6.5" R19 glass fiber batts | 49.9 [22.6] | 0.27 [1.34] |
| resilient channel @ 24" O.C.; 1.63" screw @ 16" O.C. | 16.5 [7.5] | 0.09 [0.44] |
| 0.625" (5/8") gypsum board; 1.625" screw @ 12" O.C. | 394.7 [179.0] | 2.17 [10.58] |

Independent contractors constructed and installed the specimen floor-ceiling assembly in the laboratory test opening. A qualified representative of Orfield Laboratories observed the installation in process and visually inspected the completed specimen and seal. All materials were weighed just before installation. Fasteners were not weighed.

All prefabricated OSB/OSB sandwiches were provided by the client. All other building materials were acquired by the contractors through construction material suppliers. The framing and ceiling were constructed for previous tests in this series for this client, and portions of this specimen assembly were used in subsequent tests in the series.

Trusses were installed 16" on center, bolted to the perimeter of the test opening frame with four, 6" lag bolts per truss. Truss installation is shown in Figure 1.

The OSB sub-floor panels were pre-laminated into sandwiches using Green Glue™ adhesive. Each sandwich was assembled by the client off-site. According to the client, two 28 oz. tubes of Green Glue™ were applied in a random pattern over each 4' x 8' 7/16" OSB (oriented strand board) panel resulting in an adhesive rate of 1.75 oz. per square foot. Then a second sheet of 7/16" OSB was applied over the adhesive. The sandwich was thoroughly compressed by methodically walking over the entire face. The assemblies were spaced out and stacked to dry with forced air ventilation. The completed panels were aged greater than the 14 days period stated in ASTM Standard E90 for water-based adhesives, according to the client.

The 7/8" thick OSB/OSB sandwich sub-floor panels were fastened to the trusses with 2" screws spaced 12" O.C. The seams of the sub-floor were sealed with 1/8" rope caulk.

The engineered laminate flooring was laid over the sub-floor. The laminate flooring was left floating. No fasteners were used. Figure 3 shows the installed engineered laminate flooring.





Resilient channel was fastened, perpendicular, to the under side of truss frame using 1-5/8" screws. The resilient channel was spaced 24" on-center. Finished ceiling was 5/8" gypsum board, type 'X', fastened to the resilient channel with 1-5/8" screws, spaced 12" x 24" on-center. Figure 2 shows a photograph of the resilient channel and partially installed ceiling. Care was taken to fasten the gypsum board panels only into the resilient channels and not into the trusses. Seams of the gypsum board panels were sealed with acoustic caulk.



Figure 1: open-web trusses



Figure 2: resilient channel and partial gypsum board ceiling



Figure 3: engineered laminate flooring



APPENDIX D: SINGLE-NUMBER CALCULATION TO ISO 717-1

| Freq. Band (Hz) | R_i ($R_i \equiv TL$) (dB) | Ref Curve (dB) | Unfav. Deviat. (dB) | L_{i1} Spectrum (dB) | $L_{i1} - R_i$ Level (dB) | L_{i2} Spectrum (dB) | $L_{i2} - R_i$ Level (dB) |
|-----------------|--------------------------------|----------------|---------------------|------------------------|---------------------------|------------------------|---------------------------|
| 50 | 21.6 | | | | | | |
| 63 | 26.5 | | | | | | |
| 80 | 23.8 | | | | | | |
| 100 | 31.0 | 38 | 7.0 | -29.0 | -60.0 | -20.0 | -51.0 |
| 125 | 35.6 | 41 | 5.4 | -26.0 | -61.6 | -20.0 | -55.6 |
| 160 | 39.7 | 44 | 4.3 | -23.0 | -62.7 | -18.0 | -57.7 |
| 200 | 42.5 | 47 | 4.5 | -21.0 | -63.5 | -18.0 | -60.5 |
| 250 | 49.2 | 50 | 0.8 | -19.0 | -68.2 | -15.0 | -64.2 |
| 315 | 51.4 | 53 | 1.6 | -17.0 | -68.4 | -14.0 | -65.4 |
| 400 | 53.0 | 56 | 3.0 | -15.0 | -68.0 | -13.0 | -66.0 |
| 500 | 54.9 | 57 | 2.1 | -13.0 | -67.9 | -12.0 | -66.9 |
| 630 | 56.0 | 58 | 2.0 | -12.0 | -68.0 | -11.0 | -67.0 |
| 800 | 59.1 | 59 | - | -11.0 | -70.1 | -9.0 | -68.1 |
| 1000 | 61.4 | 60 | - | -10.0 | -71.4 | -8.0 | -69.4 |
| 1250 | 64.0 | 61 | - | -9.0 | -73.0 | -9.0 | -73.0 |
| 1600 | 64.5 | 61 | - | -9.0 | -73.5 | -10.0 | -74.5 |
| 2000 | 62.6 | 61 | - | -9.0 | -71.6 | -11.0 | -73.6 |
| 2500 | 64.0 | 61 | - | -9.0 | -73.0 | -13.0 | -77.0 |
| 3150 | 67.2 | 61 | - | -9.0 | -76.2 | -15.0 | -82.2 |
| 4000 | 71.1 | | | | | | |
| 5000 | 75.5 | | | | | | |
| Sum = | | | 30.7 | $R_{A,1} =$ | 54.1 | $R_{A,2} =$ | 48.2 |
| $R_w =$ | | | 57 | $C =$ | -3 | $C_{tr} =$ | -9 |

$$R_w (C ; C_{tr}) = 57 (-3 ; -9)$$

$$R_w (C ; C_{tr} ; C_{50-3150} ; C_{tr, 50-3150}) = 57 (-3 ; -9 ; -6 ; -16)$$

$$R_w (C ; C_{tr} ; C_{100-5000} ; C_{tr, 100-5000}) = 57 (-3 ; -9 ; -2 ; -9)$$

$$R_w (C ; C_{tr} ; C_{50-5000} ; C_{tr, 50-5000}) = 57 (-3 ; -9 ; -5 ; -16)$$

Note: The calculations in ISO 717-1 are performed based on assumed equivalency of the ASTM and the corresponding ISO test methods. The test herein is performed according to ASTM standards.

The spectrum adaptation terms C and C_{tr} characterize performance against two specific sound sources, A-weighted pink noise and A-weighted traffic noise respectively. The standard ISO 717-1 includes a discussion of "Use of Spectrum Adaptation Terms" in Annex A (informative).

Each spectrum adaptation term may additionally be reported with extended frequency bands included. A calculation for the primary frequency range is shown above, but all available extended-frequency calculations were performed to compare against corresponding ratings of other specimens.

