Performance Details of Metal Stud Partitions

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STC (Sound Transmission Coefficient) test results are presented for a variety of drywall partitions. Stud configurations and spacing were evaluated relative to design guidelines for hospital and health care facilities. The data showed that using partitions with studs installed 406 mm on center will significantly reduce the sound transmission loss provided in the lower frequencies. However, if the stud is less than 25 gauge, the change for the measured STC was relatively insignificant.

Within the acoustical consulting community, relatively little is heard about exact values of sound transmission loss changes for drywall partitions as the metal studs become heavier or the distance between studs changes. In published guidelines, stiffer wall requirements dictated by structural codes are not always translated to recommended STC requirements published by professional associations. As an example, the draft "Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities" drafted by members of the Joint Subcommittee on Speech Privacy of the ASA recommends STC 50 partitions between exam rooms with no masking sound provided. In hospitals, with 4.75-m floor-to-floor heights, 16-gauge studs installed 406 mm on center can be a requirement for structural reasons.

To help provide exact numbers to the change caused by stiffer wall construction sound transmission loss (STC) tests were performed on a variety of drywall partitions. The tests show that there was a measurable decrease in STC values as the stud becomes heavier and as the spacing between studs decreases. The measurements indicate that when comparing similar partitions, a 25-gauge metal stud wall was usually 4-5 STC points higher than 20- and 16-gauge stud walls. Comparing similar partitions, there is a 3-4 STC point drop between walls when studs are installed 406 mm on center rather than 610 mm on center. There was little difference in STC value between partitions with 16-gauge studs and 20-gauge studs. Based on the measurements to comply with the STC guideline for partitions between exam rooms referenced here, a double-stud partition would be required.

Most public data on the acoustical characteristics of a wall show that tests were performed with 25-gauge studs that are 610 mm on center. Tests for stiffer studs (16 and 20 gauge) are usually performed with resilient channels to increase acoustic values. Resilient channels can be significantly less effective in the field due to limitations with installation such as using drywall screws that are too long, installing cabinets, shelves, pictures, etc., that short circuit the resilient channel and cause direct attachment to the stud.

Increasing seismic requirements dictate stiffer partition constructions. For projects with 4.75-m floor-to-floor heights, such as hospitals, it is not uncommon to find partitions constructed with 16-gauge studs, 406 mm on center. Because of the limited information presented for stiffer studs, it is not commonly known that these changes will have a significant impact on the acoustical value of the partition. With the absence of clear test data, it is difficult to explain to the end user that the performance of these partitions will be less than that of partitions constructed with lighter gauge studs.

For these reasons, the Paul S. Veneklasen Research Foundation funded testing for standard, single-stud wall construction partitions using 25-, 20-, and 16-gauge, 92-mm studs on center spaces of 406 mm and 610 mm.

Method

The tests were performed in the acoustical laboratories at Western Electro-Acoustic Laboratory, a NAVLP-accredited facility. The transmission loss (TL) was measured in accordance with ASTM E-90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions."[2] The test specimen was mounted in an opening between two reverberation chambers. The dimensions of the receiving chamber were 6.3 × 4.53 × 5.18 m. The dimensions of the source chamber were 6.55 × 5.09 × 6.10 m. As required by the ASTM standard, broadband noise was generated on one side of the specimen, and then the space/time average of the noise was measured in 1/3-octave bands on both sides of the partition. Using the absorption of the receiving room, the area of the specimen, and the measured noise reduction (NR), the transmission loss (TL) was calculated. From that, the STC was determined using ASTM E 413-87 (reapproved 1999).[3] The test measured spectral information in 1/3-octave bands from 63 Hz to 5000 Hz.

The noise was produced using an electronic noise source, filters, an amplifier and a large loudspeaker. The noise levels were measured using continuously rotating microphone systems and an analyzer. The decay rates in the receiving room were also measured using the rotating microphone system.

Each partition tested was 3.048 m × 2.44 m. The partitions were constructed out of Type X drywall in sheets of 1.22 m × 2.44 m. The drywall was installed vertically with screws 0.20 m on center at the joints and 0.30 m on center on the perimeter. The partitions were isolated from the source chamber using neoprene waffle pads that were 9.5 mm thick. All partitions included R-11 unfaced-batt insulation in the cavity. All studs used had a depth of 92 mm. For partitions with more then one layer of drywall, the additional layer of drywall was installed so joints were offset by 610 mm allowing no gaps to overlap.

The partitions were caulked with silicone caulk and taped with aluminum tape. This method of filling the joints was used because of time constraints and based on information provided by the NRC lab in its publication "Summary Report for Consortium on Gypsum Board Walls: Sound Transmission Results." Based on these studies, they concluded that ". . . caulking joints and covering them with aluminum tape gave sound transmission performance at all

Table 1. Description of partitions tested.

Drywall Layers, Source Chamber	Stud Gage	Stud Spacing	Drywall Layers, Receiving Chamber
1	25	610 mm	1
1	25	610 mm	2
2	25	610 mm	2
1	20	610 mm	1
1	20	610 mm	2
2	20	610 mm	2
1	16	610 mm	1
1	16	610 mm	2
2	16	610 mm	2
1	25	406 mm	1
1	25	406 mm	2
2	25	406 mm	2
1	20	406 mm	1
1	20	406 mm	2
2	20	406 mm	2
1	16	406 mm	1
1	16	406 mm	2
2	16	406 mm	2

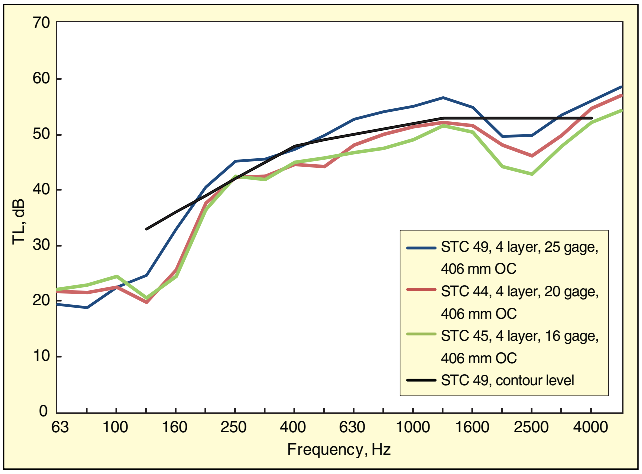

Figure 1. Transmission loss per frequency for a 2+2 layer partition with studs installed at 406 mm OC for various stud gages.

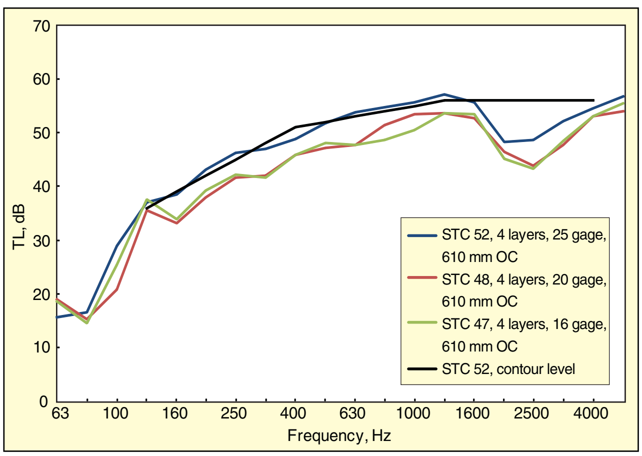

Figure 2. Transmission loss per frequency for a 2+2 layer partition with studs installed at 610 mm OC for various stud gages.

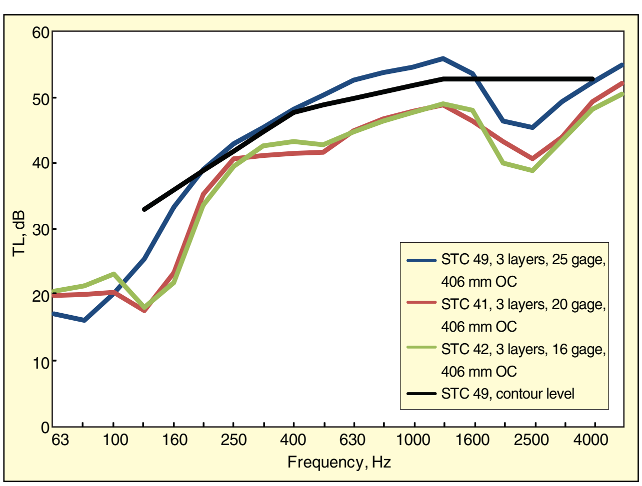

Figure 3. Transmission loss per frequency for a 2+1 layer partition with studs installed at 406 mm OC for various stud gages.

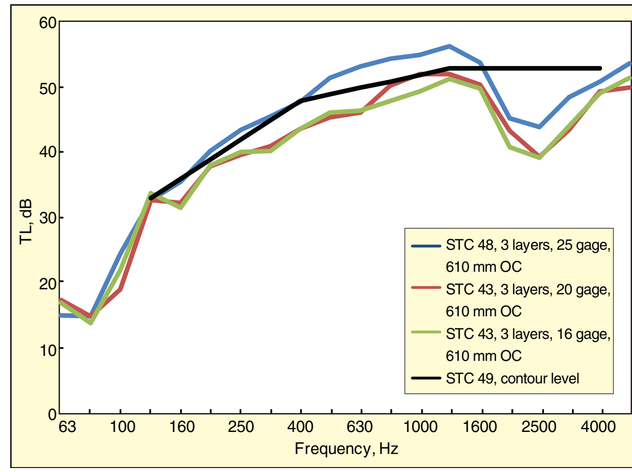

Figure 4. Transmission loss per frequency for a 2+1 layer partition with studs installed at 610 mm OC for various stud gages.

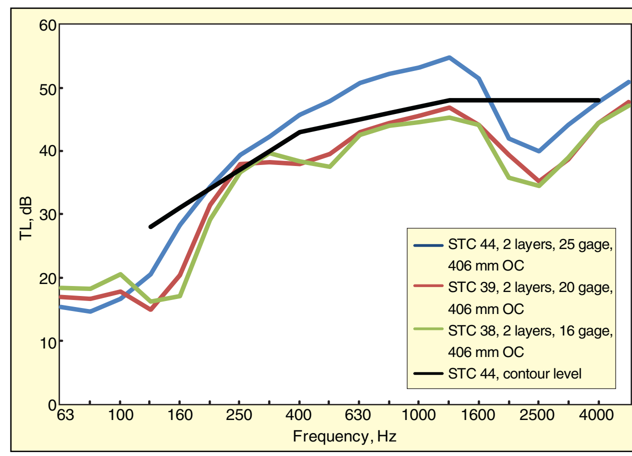

Figure 5. Transmission loss per frequency for a 1+1 layer partition with studs installed at 406 mm OC for various stud gages.

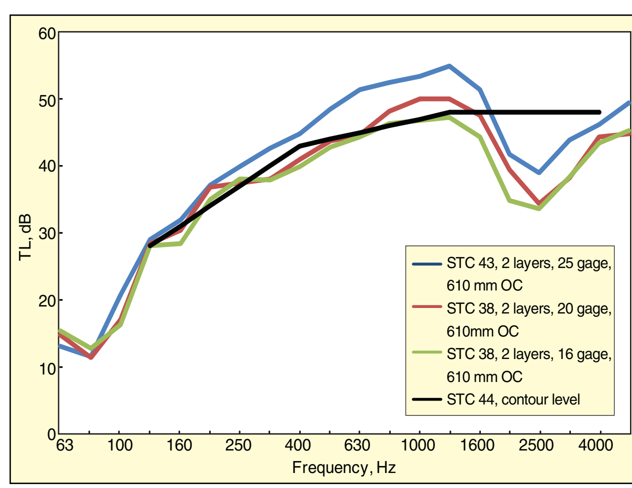

Figure 6. Transmission loss per frequency for a 1+1 layer partition with studs installed at 610 mm OC for various stud gages.

frequencies within a fraction of a decibel of that for standard finish with joint compound after curing; the STC was the same in all cases."[1]

The tests were conducted on typical single-stud partitions. For each stud configuration, partitions were tested with a single layer of drywall on each side, with two layers of drywall on each side, as well as with two layers of drywall on the receiving chamber side and a single layer on the source chamber side.

For each drywall configuration, partitions were tested with stud gauges of 25, 20, and 16 gauge. The stud spacing was tested at both 406 mm and 610 mm on center. Table 1 indicates the specific partitions tested.

Discussion

Figures 1 through 6 compare transmission losses. In general, the 25-gauge stud partitions showed a significant increase in transmission losses between 250 Hz and 2 kHz when compared to losses with the other stud gauges. This increase was less pronounced for the denser partition assembly, having two layers of 15.9-mm, Type X drywall on each side of the stud, than for the other two assemblies but was still apparent. There was also a significant drop in transmission loss provided by the 125- and160-Hz 1/3-octave bands in all the tested partitions when using 406 mm on center spacing rather than the 610 mm spacing. The tests showed that the reduction in transmission loss begins to extend up to the 200

Hz 1/3-octave band for the three-layer wall and becomes more significant for the two-layer wall.

While the difference in transmission loss between the 25-gauge studs and the other studs began to even out as the partition became heavier, the difference of transmission loss between the 406 mm and the 610 mm on center partitions remained fairly constant regardless of the partition tested.

Tables 2 and 3 show there was a fairly consistent 4-5-point drop in STC value for 20-gauge studs compared to 25-gauge studs across all the tested partitions. This proves to be true when the studs were installed both 406 mm and 610 mm on center. There was relatively little change in STC value – an average of only 1 point – when using 16-gauge studs instead of 20-gauge studs.

Table 4 shows that stud spacing mostly affects the STC value for the four-layer drywall partition, producing a 2-4 STC point change. The change in STC values for the lighter assemblies resulted in an undistinguishable trend, ranging from –2 to +1.

The 2+1 partition assembly showed a higher loss in STC value compared to the 1+1 partition, 5-8 points, when comparing the 25-gauge stud with the 16- and 20-gauge studs. The fact that the difference between the STC values was so significant can be attributed to the less pronounced coincidence dip around 2.5 kHz because of the additional layer of drywall.

Table 2. Comparison of STC value as stud gages change at 610 mm on center.

Total Number of Drywall Layers	Stud Gage	STC	Drop in STC Value
4	25	52	NA
4	20	48	–4
4	16	47	–5
3	25	48	NA
3	20	43	–5
3	16	42	–6
2	25	43	NA
2	20	38	–5
2	16	39	–4

Table 3. Comparison of STC value as stud gages change at 406 mm on center.

Total Number of Drywall Layers	Stud Gage	STC	Drop in STC Value
4	25	49	NA
4	20	44	–5
4	16	45	–4
3	25	49	NA
3	20	41	–8
3	16	42	–7
2	25	44	NA
2	20	39	–5
2	16	38	–6

Table 4. Comparison of STC value when stud gage remains constant and stud spacing changes.

Total Number of Drywall Layers	Stud Gage	Stud Spacing	STC	Drop in STC Value
4	25	610 mm	52	NA
4	25	406 mm	49	–3
4	20	610 mm	48	NA
4	20	406 mm	44	–4
4	16	610 mm	47	NA
4	16	406 mm	45	–2
3	25	610 mm	48	NA
3	25	406 mm	49	+1
3	20	610 mm	43	NA
3	20	406 mm	41	–2
3	16	610 mm	43	NA
3	16	406 mm	42	–1
2	25	610 mm	43	NA
2	25	406 mm	44	+1
2	20	610 mm	38	NA
2	20	406 mm	39	+1
2	16	610 mm	38	NA
2	16	406 mm	38	0

Summary

In general, using partitions with studs installed 406 mm on center will significantly reduce the sound transmission loss provided in the lower frequencies. However, if the stud is less than 25 gauge, the change for the measured STC was relatively insignificant.

Measurements showed a 4-5 point drop in STC ratings for the 16- or 20-gauge studs instead of 25-gauge studs. In addition, approximately a three-point drop in STC value occurred for the partitions that had 25-gauge studs when installing the studs 406 mm on center, rather than 610 mm on center.

Acknowledgement

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References

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