

EVERYTHING YOU WANTED TO KNOW ABOUT SOUND BUT WERE AFRAID TO HEAR.

WHAT IS SOUND?

Sound waves travel through the air in the form of very small changes in atmospheric pressure. Sound pressure (which we perceive as volume) is the average deviation in the atmospheric pressure above or *below* the static value. We also hear sound as a pitch which is the frequency of its change or its cycle. The faster the change (frequency) the higher the pitch. Our ear drum is vibrated by these waves and we hear "sound"!

HOW IS SOUND MEASURED?

The loudness or volume of sound (which is what we are most concerned with here) is measured in decibels (db). The dynamic range of human hearing is from 0 to 120db. The pitch of sound is measured in cycles per second (cps). Note: A cycle per second is now referred to as a "Hertz" (Hz). The frequency range humans normally can hear is from 125 to 4000 cycles per second.

WHAT IS NOISE?

The dictionary defines noise as "loud, confused, or disturbing sound of any kind". In our terms, noise is what we want to keep on the other side of the wall. Sound is ok, noise is not! In other words, when the sound from one area of a building is loud enough to disturb what is happening in an adjoining area it is "noise".

COMMON NOISE LEVELS.

Refer to Table No. 1.

HOW LOUD IS TOO LOUD?

When sound pressure exceeds 120db it becomes painful, that is too loud or....

When the general sound pressure reaches levels over 65 to 70db, ordinary speech communication becomes difficult and that is too loud if you want to understand what another person is saying.

Therefore, "too loud" depends on what you want to do.

HOW DO WE CONTROL NOISE?

There are two general ways we control noise:

1. We stop it from going from one area to an adjoining area – i.e. stop the "transmission" of sound. How effective a wall is in doing this is reported as its "Sound Transmission Class" (STC). The higher the number, the better the wall is performing.

2. We stop it from bouncing back at us in the same room in which it is produced -that is the "absorption" of sound. We measure the effectiveness of reducing this reverberation or "slap-echo" by the "Noise Reduction Coefficient" (NRC) of materials within the room.

STC - HOW DO WE MEASURE IT?

STC is a single number expression of how much sound is stopped by a wall in frequencies ranging from 125 to 4000 cycles per second. The actual test results are graphed and then compared to a standard "STC profile". No more than 32 deficiencies below this profile are allowed. When properly adjusted on the graph the point where the profile crosses the 500 cycles per second line is the "STC". The higher this number the more effective the wall is in stopping the broad range of sound. All tests should be performed in accordance to the ASTM E90 standard for fully operable walls in a 14'-0 by 9'-0 opening.

SOUND TRANSMISSION CLASS FOR COMMON BUILDING MATERIALS.

[Refer to Table No. 2.](#)

SOUND TRANSMISSION CLASS FOR COMMON BUILDING WALL CONSTRUCTION.

[Refer to Table No. 3.](#)

IT'S THE DIFFERENCE THAT COUNTS!

Equal levels of sound in adjoining areas tend to cancel each other out. Also all areas have ambient or background noise level which aids in masking sound from adjoining areas; but if you have 80db of sound in one room and 40db of sound in an adjoining room you have 40db of "noise" to deal with. A wall with an STC value of 40 would solve this problem.

NRC – HOW IT IS MEASURED, WHEN YOU WANT TO USE IT.

"NRC" stands for "Noise Reduction Coefficient" and expresses as a decimal the effectiveness of an absorptive material or surface as compared to a theoretically perfect absorber. A sound absorber is designed to deaden sound within a room, to eliminate the reverberation of sound and to reduce the build-up of sound within an enclosed space. The higher the number the better the absorption. It has relatively little effect upon the transmission of sound into an adjoining area.

NIC - HOW DOES IT DIFFER FROM STC?

"NIC" stands for "Noise Isolation Class" and it is a single number (like STC) expressing the actual degree of sound control between two adjoining areas measured at various frequency levels (pitches), *on site* in a building and is commonly referred to as a "Field Test". The higher the number the better the control. Such tests try to take into consideration the entire environment and not just the primary wall or barrier. (See below.) The test is conducted according to the ASTM procedure E366.

NOT JUST THROUGH, BUT OVER, UNDER, AND AROUND.

Sound can go around corners, over the top of walls, under the wall, through duct work as well as through a wall. It's the "end run" of the sound business. If careful attention is not paid to these "flanking paths", the effectiveness of an expensive operable wall with a high sound transmission rating can be devalued. The pathways that allow sound to get around an operable wall must be blocked with construction equal to the acoustical rating of the operable wall. Refer to the ASTM E557 Standard "Architectural Applications and Installation of Operable Walls".

HOW TO SELECT THE PROPER LEVEL OF SOUND CONTROL FOR AN OPERABLE WALL.

The beginning point is to examine the types of activities you are going to have in adjoining areas separated by an operable wall. If the activities are similar in nature and will generate fairly equal levels of noise then the STC requirements can be moderate (around 38 to 45 STC). However when dissimilar activities are anticipated and greater differences in sound levels are present, then the STC requirement should be higher (45 to 52 STC). Only when widely different levels of sound are present and particular care is taken with surrounding construction and flanking paths, should walls above 52 STC be specified.

WHY THE NUMBERS CHANGE BETWEEN A LABORATORY TEST AND IN -FIELD PERFORMANCE.

Because of the many variables involved in the construction of a building and the presence of flanking paths as compared to the controlled environment of the laboratory setting, the results of a field test (NIC) will always be lower than that of a laboratory test (STC). In very good design and construction this difference might be as little as 6 but may go as high as 12 or higher. A rule of thumb is to expect the NIC to be 8 to 10 below the STC. Remember, in a field test, the NIC can never be higher than the NIC of the flanking paths no matter how good the operable wall.

THE VALUE OF THE LABORATORY TEST FOR SPECIFICATION PURPOSES.

The laboratory test gives you a way of comparing the sound performance of different wall constructions by the same and different manufacturers under a controlled set of conditions. It is a beginning point in the selection and an aid in matching other construction to the same sound requirements. It also provides you with the square foot weight of the panels tested for comparison with actual field installed units. See the "Poor Man's" Infield Test below.

THE "POOR MAN'S" IN-FIELD TEST.

THE LIGHT TEST.

Since sound can go where light can go, in most cases a simple and effective method to assure good sound control is to require light leaks to be eliminated in a wall. The test is simple. Turn the lights on in one room and examine the wall from the adjoining darkened room.

GOING FOR BROKE WITH A FULL SCALE IN--FIELD SOUND TEST (NIC).

In major projects you may want to have the operable wall installation field tested to assure the performance you have specified. This is an expensive process and should be done only when care was taken to eliminate the

flanking paths that can devalue the effectiveness of the operable wall. In many cases only a certain number of the total walls on the project are tested to keep the cost reasonable. The walls to be tested are selected by the architect and owner just prior to the test. See sample "[NIC – Field Test Specifications](#)".

HOW MUCH IS ONE DB WORTH?

Because of the way that an STC is calculated, one (1) decibel(db) difference at any frequency level in the test has the potential of changing an STC class. (For example, from a 45 to a 46 STC or from a 46 to a 45 STC.) This small change has no real impact upon the effectiveness of the tested wall. In fact, a person cannot perceive any significant difference in levels until a change of 3 to 4 STC takes place in the normal speech range of sound. Hence the practice of setting a specific Sound Transmission Class number and stating "no less than" may well be closing out a competitive product with no real gain in performance.

WHAT IS A REASONABLE STC SPREAD FOR LABORATORY TESTS?

The NSSEA Operable Wall Section (see front of booklet for list of member manufacturers) recommends that a baseline STC be chosen and then specified as "STC + or -- 1". This would allow all operable walls that fall within this range to be considered as providing equal performance as far as sound control is concerned. This is a more realistic approach.

HELP!- PROPER DESIGN AND LAYOUT.

Help is available! Because of the many kinds of operation, variations of layout and storage, the specification and layout of operable walls has become a complex problem. Many design professionals desire input to aid them in making the correct decisions when incorporating operable walls into their overall design. Most operable wall manufacturers are happy to provide this type of consultation and assistance at no cost. This is a win-win situation since problems can be avoided at this stage of a project at far less cost than after a project is under construction.

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ADDENDUM # 1

(FOR OPERABLE WALLS/PARTITIONS)

WHEN SHOULD YOU SPECIFY AN STC (SOUND TRANSMISSION CLASS) ?

ANY TIME THE PURPOSE OF PROVIDING A SEPARATION OR DIVISION OF AREA IS TO SERVE AS AN ACOUSTICAL BARRIER AS WELL AS A SIGHT BARRIER IT IS APPROPRIATE TO SPECIFY HOW EFFECTIVE YOU EXPECT THAT BARRIER TO BE IN STOPPING SOUND. IF THAT REQUIREMENT IS NOMINAL OR THE PARTITION IS NOT TO BE A COMPLETE WALL TO WALL BARRIER, IT MAY BE APPROPRIATE TO MERELY SPECIFY THAT THE WALL BE PROVIDED WITH TOP AND BOTTOM SEALS. IF HOWEVER, THE PARTITION IS TO PROVIDE A SEPARATION THAT WILL ALLOW ACTIVITIES TO TAKE PLACE ON BOTH SIDES OF THE PARTITION WITHOUT SIGNIFICANT INTERFERENCE WITH THOSE ACTIVITIES CAUSED BY SOUND (NOISE) GENERATED ON THE OTHER SIDE OF THE PARTITION, YOU WILL WANT TO SPECIFY HOW EFFECTIVE THAT PARTITION SHOULD BE IN STOPPING THE TRANSMISSION OF SOUND FROM ONE AREA TO THE OTHER. *THIS IS THE PURPOSE OF THE 'STC' RATING.* THE LEVEL OF THE "STC" REQUIREMENT SHOULD BE BASED UPON THE ACTIVITIES TAKING PLACE IN THE ADJOINING AREAS. SEE "**IT'S THE DIFFERENCE THAT COUNTS!**" IN ANY CASE THE OPERABLE WALL/PARTITION IS ONLY PART OF A SYSTEM AND THE "STC REQUIREMENT" SHOULD BE IN LINE WITH THE OTHER CONSTRUCTION ELEMENTS OF THE AREA.

WHEN SHOULD YOU SPECIFY AN NRC (NOISE REDUCTION COEFFICIENT) ?

THE BRIEF ANSWER TO THE ABOVE QUESTIONS IS ONLY WHEN DEALING WITH THE EFFECT OF SOUND *WITHIN THE ROOM IN WHICH IT IS GENERATED!* IT HAS TO DO WITH REVERBERATION, DISTORTION AND THE "LIVENESS" OR "DEADNESS" OF THE SOUND ITSELF WITHIN THE ROOM IN WHICH IT IS GENERATED. IT HAS LITTLE TO DO WITH THE TRANSMISSION OF SOUND INTO ADJOINING AREAS. IT USUALLY COMES INTO PLAY, IN THE CASE OF OPERABLE WALLS/PARTITIONS WHEN A LARGE AUDITORIUM IS BEING DIVIDED INTO SMALLER "LECTURE" AREAS WHILE AT THE SAME TIME THE PORTION OF THE AUDITORIUM ADJOINING THE STAGE IS ALSO TO BE UTILIZED. BECAUSE THE TOTAL SOUND PATTERN OF THE AUDITORIUM IS BASED UPON THE LARGE VOLUME OF SPACE INVOLVED, WHEN THAT TOTAL VOLUME IS REDUCED DUE TO THE INTRODUCTION OF A HARD SURFACE (THE OPERABLE WALL/PARTITION), NOW MUCH CLOSER TO THE STAGE, THE INCLUSION OF "NRC" ON THE PANEL FACE, FACING THE STAGE, CAN BE A SIGNIFICANT HELP IN PROVIDING CLEAR AND UNDERSTANDABLE SPEECH IN THAT AREA. IN SMALLER AREAS THE ABSORPTION PROVIDED BY THE CLOTHING OF THE PEOPLE PRESENT, ALONG WITH CARPET AND DROPPED TILE CEILINGS SEEM TO BE ABLE TO HANDLE THE REDUCTION OF VOLUME CAUSED BY INTRODUCTION OF THE OPERABLE WALL/PARTITION. WHEN IN DOUBT, CONSULT AN ACOUSTICAL CONSULTANT.

TABLE NO. 1

COMMON NOISE LEVELS

SOURCE	DB
HUMAN BREATHING.....	0 - 10
SOFT WHISPER.....	30
AVERAGE HOME AMBIENT.....	40
AVERAGE OFFICE AMBIENT.....	50
CONVERSATIONAL SPEECH (3 FEET).....	60
QUIET TYPEWRITER.....	70
AVERAGE STREET NOISE.....	70
BUSY RESTAURANT.....	80
AVERAGE FACTORY.....	80 - 90
POWER LAWN MOWER.....	100
CONSTRUCTION BULLDOZER.....	110
LOUD MOTORCYCLE.....	110
ROCK BAND.....	110 - 120
THRESHOLD OF PAIN.....	120

TABLE NO. 2

STC VALUES FOR BUILDING MATERIALS

MATERIAL	STC
5/16" PLYWOOD	25
24 GAUGE STEEL.....	26
1/2" Gypsum BOARD.....	26
5/8" Gypsum BOARD.....	28
1/16" LEADED VINYL.....	29
1/8" PLATE GLASS.....	28
1/4" PLATE GLASS.....	30
3/16" STEEL PLATE.....	35
1" THICK WOOD PANEL.....	36
4" TWO CELL CONCRETE BLOCK.....	41
8" LIGHTWEIGHT HOLLOW CONCRETE BLOCK.....	46
8" HOLLOW CORE CONCRETE BLOCK.....	50
4" BRICK-WALL WITH 1/2" PLASTER.....	50
8" BRICK WALL.....	52
6" DENSE CONCRETE.....	54
12" BRICK WALL.....	59

TABLE NO. 3

STC VALUE FOR STANDARD WALL CONSTRUCTION

<u>TYPE OF CONSTRUCTION</u>	<u>STC VALUE</u>
1. STANDARD WOOD STUD 1/2" GYPSUM BOARD BOTH SIDES OF 2" x 4" WOOD STUDS 16" OR 24" ON CENTER.....	32
2. SLIT WOOD STUD WOOD STUDS SLIT WITH STANDARD SAW BLADE WITHIN 6" OF TOP & BOTTOM. WITH 1/2" GYPSUM BOARD BOTH SIDES WITHOUT INSULATION.....	40
WITH FIBERGLAS INSULATION.....	43
3. 3 5/8" STEEL CHANNEL STUD 5/8" GYPSUM BOARD BOTH SIDES WITHOUT INSULATION.....	39
WITH FIBERGLAS BLANKET.....	42
4. 6" CONCRETE BLOCK WALL.....	44
5. 2 5/8" STEEL CHANNEL STUD TWO LAYERS 5/8" GYPSUM BOARD ONE SIDE, ONE LAYER 5/8" GYPSUM BOARD OTHER SIDE WITHOUT INSULATION.....	40
WITH FIBERGLAS INSULATION.....	46
6. 2 5/8" STEEL CHANNEL STUD TWO LAYERS OF 5/8" GYPSUM BOARD BOTH SIDES WITHOUT INSULATION.....	45
WITH FIBERGLAS INSULATION.....	55

N I C

FIELD TEST SPECIFICATIONS

1.4 ACOUSTICAL PERFORMANCE - FIELD TESTING

After operable wall installation is completed to the satisfaction of the manufacturer or its designated representative, the operable walls shall be set up by the manufacturer or its representative and then field tested by a qualified Acoustical Engineer. Prior to the test the Acoustical Engineer will examine flanking paths through the surrounding building construction to determine if they will significantly affect the performance of the operable walls. The manufacturer or its representative shall be on hand to observe the field testing and to make adjustments to the operable wall as required.

1.4.1 The construction surrounding each operable wall must meet or exceed the STC of the operable wall and be per the project specifications. Such operable walls must not be significantly flanked by the building construction. Noise reduction shall be as described by NIC ____ or greater.

1.4.2 Noise reduction measurements will be made in general conformance with the current ASTM E336 Standard as it applies to measurement of isolation between rooms. The NIC rating will be calculated in accordance with the current ASTM E413.

1.4.3 Cost for the initial field testing shall be borne by the owner. If any operable wall does not initially meet the NIC requirements as stated above, it shall be modified and/or adjusted by the manufacturer and re-tested as required. Costs for additional testing shall be borne by the operable wall contractor.