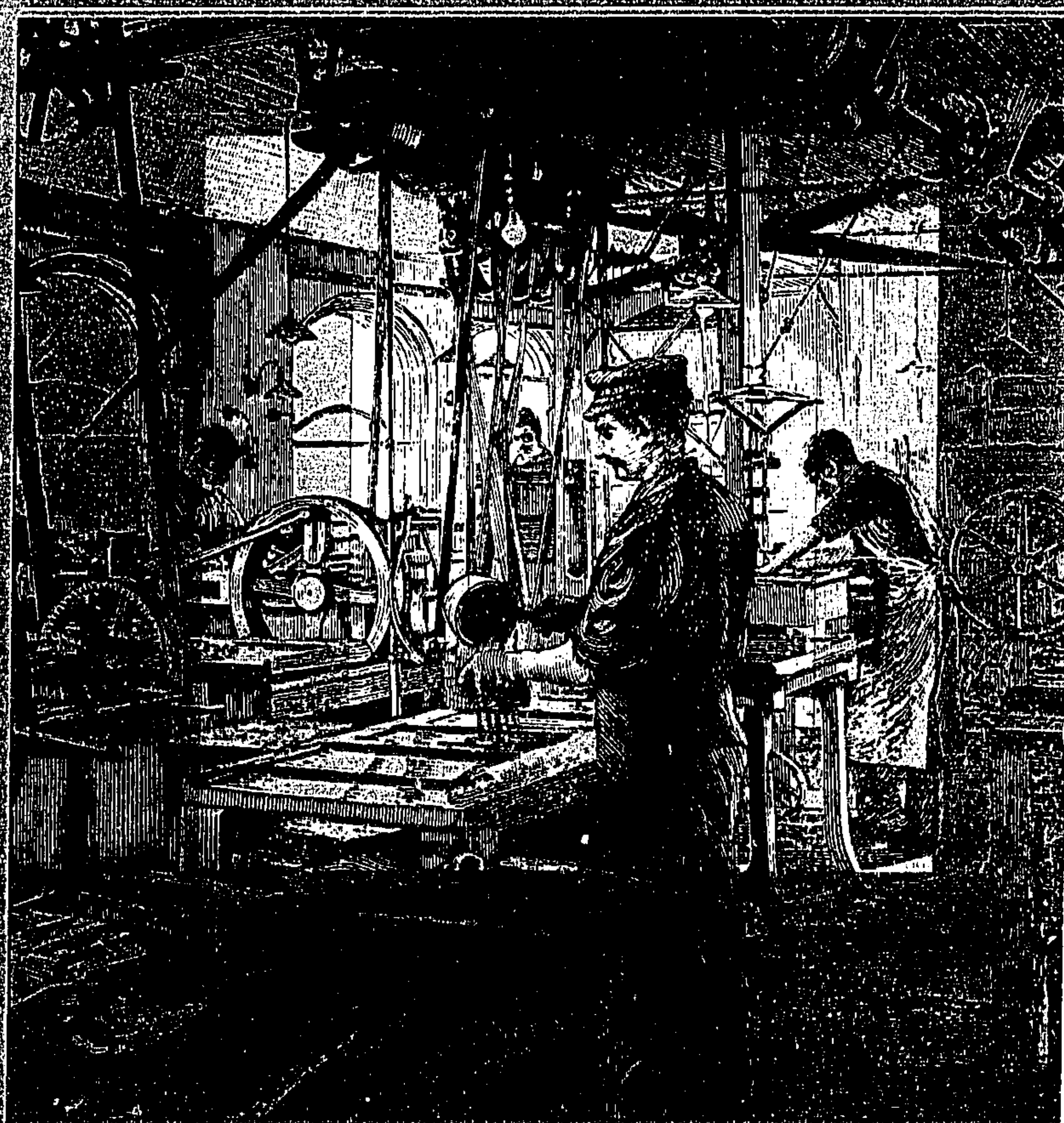
Noise Control Manual

Guidelines for problem-solving in the industrial/commercial acoustical environment

SECOND EDITION



Noise control

Basic techniques of quieting with Owens-Corning acoustical materials

Contents

Notes to the Second Edition:

Since this manual was first published in early 1978, Owens-Corning Fiberglas Corporation has maintained a large scale program of development, manufacture, and marketing of products useful in noise control applications. This program has included the development of new products as well as the improvement of existing ones. Keeping pace with acoustical product development, the Owens-Corning Fiberglas Technical Center has continued to evaluate new products and to generate acoustical data helpful to the plant engineer or acoustical consultant.

This second edition includes acoustical data developed since late 1977, including single number ratings (STC, NRC, NIC values) for most products and for many typical constructions.

Photos on pages 4, 7, 8, 9, and 15 courtesy of HRA Inc., Dayton, Ohio.

To supplement the nomogram on page 13 which may be used in determining barrier sound attenuation, a new methodology has been developed for the control of reverberant sound such as may be encountered in auditoriums, gymnasiums, stores, and other commercial and industrial spaces as well as in industrial facilities. This methodology is presented on pages 18 through 20 of this second edition. It will be helpful to the engineer or acoustical consultant when dealing with problems of reverberant noise levels and/or reverberation time.

Whereas the first edition of this manual was almost exclusively directed to the industrial noise control audience, with the addition of new methodology plus acoustical performance data for commercial and institutional application, this second edition will be useful for general applications in nearly any kind of occupied space where noise presents a problem.

Information in this manual is the best currently available on the subject. As new technology develops, Owens-Corning Fiberglas Corporation has taken all reasonable care to include accurately all relevant information, but because it has no control over the use of products referred to in this manual it can assume no liability for results obtained by use of this information.

The noise problem

Excessive noise levels are generally acknowledged to have adverse effects on the occupants of buildings where they occur. Studies indicate that excessive noise levels can cause fatigue in exposed individuals, lower efficiency and productivity, impair speech communication, and even cause hearing loss. Excessive noise is almost everywhere today—in the office, in schools, hospitals and other institutional facilities, in all classes of public buildings, and in our factories.

Industrial noise

High noise levels in factories can make speech communication in the plant difficult and, at times, impossible. Foremen are often unable to give simple instructions to workers in noisy environments. Because of high noise levels, many workers risk injury when they are unable to hear warning shouts from co-workers.

The problem of hearing loss due to excessive noise exposure is of particular concern to industry, and to the Federal Government. In the early 1970's, the United States Congress passed the Occupational Safety and Health Act (OSHA) which sets criteria for health hazards as well as establishing limits for noise exposure of industrial workers. This act is expected to be enforced with increasing vigor in the 1980's.

Noise in commercial and institutional buildings

While noise levels in offices, stores, schools, and other commercial and institutional buildings seldom reach those encountered in many industrial environments, they often reach levels which are distracting to the occupants of such buildings. Impairment of speech communication among workers, and the concomitant lack of speech privacy, are both deterrents to efficiency and productivity as well as to the occupants' comfort and sense of well-being.

The noise problem could be particularly troublesome in the increasingly-used "open office" environment, where the efficiencies and cost benefits of this space concept may be largely negated without careful and professional attention to the acoustical properties of the space.

The problem extends outside the plant

Excessive noise levels are often experienced by individuals beyond plant boundaries. Nearby residents, office personnel, and visitors to noisy plants are often similarly exposed to excessive noise, and are similarly subject to the adverse effects of such noise on health and well-being.

In such cases, especially when noisy plants are located adjacent to residential areas, community relations problems arise. Often, such plants may be found in violation of local codes governing noise. And new government requirements provide neighbors of noise-producing industries with a powerful weapon against objectionable noise.

The problem has answers

Hazards of hearing impairment or loss, of lessened employee productivity and morale, of diminished worker health, and of community action arising as a result of excessive plant noise emissions, can be effectively reduced or eliminated by proper acoustical treatments.

Most noise control problems can be resolved by one or more of the following:

- Treating the *source* of the noise—either by mechanical corrective action or by application of acoustical material.
- Treating the *path* taken by noise as it travels directly and/or via reflecting routes from the source to the listener.
- Treating the *receiver* (i.e., the position of the listener) by constructing an acoustically efficient enclosure.

Often, a combination of these three treatments may be required.

Owens-Corning solutions to noise control problems

Owens-Corning Fiberglas Corporation manufactures a wide range of products that can be effectively employed to reduce excessive noise levels. This brochure describes these products, provides specific examples of their use, and includes acoustical values for these products derived from laboratory test conditions. In actual applications, effective values can be influenced by many variables. With this information, plus the brief and practical approach to understanding and controlling noise presented in this brochure, engineers should be able to deal effectively and economically with many simple sound control problems.

Contractors and consultants can help

Often the noise control problem that may seem difficult for the engineer will be familiar to an experienced contractor, or for an architect or engineer experienced in solving acoustical problems. Many such firms, located in all parts of the United States, can be found with experience and expertise that may relate to specific industrial noise control problems. They can be valuable members of the acoustical control design team.

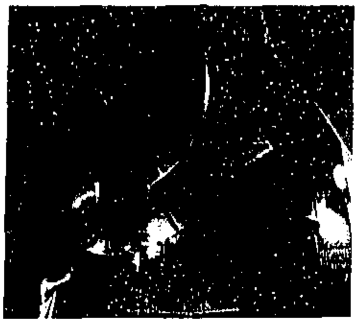
Owens-Corning can complement an acoustical expert's skills in industrial noise control with proven acoustical materials whose performance properties are tested and documented, and for which application guidelines are available.

For all but the most elementary approaches to industrial noise control, however, a professional acoustical consultant should be asked to propose solutions.

The Owens-Corning Acoustical Laboratory

A major resource in solving problems of noise is the Owens-Corning Fiberglas Acoustical Research Laboratory. Located at the Fiberglas Technical Center in Granville, Ohio, it is one of the outstanding acoustical research and testing facilities in the world. The laboratory was built in 1959 to help investigate and overcome the intricate problems posed by unwanted sound. Under the guidance of recognized acoustical specialists the facilities and information processing methods employed by this laboratory can provide useful, authoritative data to anyone involved in the area of noise control. The laboratory's equipment, which is regularly calibrated with that of other independent testing laboratories, is used in testing all kinds of Owens-Corning acoustical products and systems so that published performance properties are accurate and meaningful.

The versatile testing facilities at the Owens-Corning Fiberglas Acoustical Research Laboratory's can provide test data to the acoustical consultant who wishes to evaluate several solutions to a noise control problem.



What is noise?

Definitions

Decibel—A logarithmic measure of the ratio of like power quantities as used in describing levels of sound pressure or sound power.

Diffraction—The bending or reflection of sound waves around an obstacle or barrier.

Frequency—The number of cycles per second measured in units of hertz (Hz). A frequency of 1000 Hz means 1000 cycles per second.

Noise—An unwanted, bothersome, or distracting sound.

Octave band—A frequency band with an upper frequency limit equal to twice the lower limit.

Sound absorption coefficient—The percentage of sound energy incident on the surface of a material that is absorbed by the material.

Sound transmission loss—The reduction in sound pressure level measured in decibels as sound energy passes through a material or composite construction.

Sound insertion loss—The reduction in sound pressure level measured in decibels after a barrier, enclosure, or treatment is placed between the source of sound and an observation point.

Sabins of absorption—The amount of sound absorption provided by a product or system. It is equal to the sound absorption coefficient times the surface area of the product or system.

STC—Sound Transmission Class: A single number rating based on sound transmission loss measurements of a partition between adjacent closed rooms.

NIC—Noise Isolation Class: A single number rating derived from measured values of noise reduction or sound insertion loss.

NRC—Noise Reduction Coefficient: A single number rating that is the arithmetic average of the individual sound absorption coefficients at 250, 500, 1000 and 2000 HZ to the nearest .05.

Noise is unwanted sound. It may be sound produced by a punch press, or by a stereo system. What is pleasing sound to one individual may be disturbing noise to another person.

The intensity, or loudness, of a sound is expressed in decibels (dB). Figure 1 lists levels of typical environments or noise sources as measured by a sound level meter.

Sound or noise is usually composed of many frequencies or pitches. Frequency is measured in hertz, abbreviated Hz (and formerly called cycles per second, cps).

The human ear cannot hear all sound frequencies. For example, a child can usually hear frequencies from 20 Hz to 20,000 Hz. As an individual ages, loss of hearing acuity diminishes this range to about 70 to 14,000 Hz at age 50.

Also, the human ear is more sensitive to some frequencies than to others. The ear hears a 1,000 Hz tone louder than a tone at 200 Hz or at 8,000 Hz, even though these three tones may have the same dB level.

Sound Source or Environment	dB	Listener's Perception
Jet aircraft at take-off	120	Threshold of pain
Boiler factory	110	Deafening
Noisy factory, loud street noise	90	Very loud
Noisy office, average factory	70	Loud
Average office, noisy home	50	Moderate
Private office, quiet conversation	30	Faint
Whisper	10	Very faint

Fig 1. Typical sound levels of various noise sources & environments.

Measurement of sound

The sound level meter (photo below) is used to measure the loudness (in decibels) of sound. It is equipped with "weighting networks" or scales designated A, B, and C. The "A" scale provides sound level readings adjusted to correspond closely to those actually heard by the human ear. Figure 2 charts the "relative response" or attenuation in decibels across the range of 20 to 10,000 Hz. This "A" weighting takes into consideration the fact that the human ear is less sensitive to low frequencies, and is most sensitive to frequencies near 2000 Hz. Also, noise-induced hearing loss usually manifests itself in the frequency range from 1,000 to 5,000 Hz.

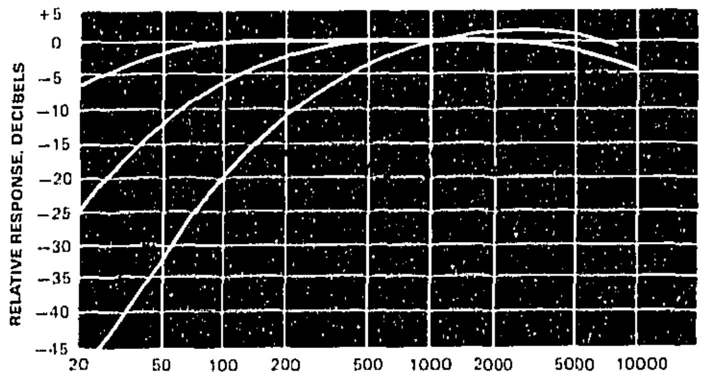


Fig 2. How sound frequencies are weighted on the "A" scale of the sound level meter.

For these reasons, the Occupational Safety and Health Act (OSHA) requires that industrial noise be measured using the "A" weighting scale of the sound level meter.

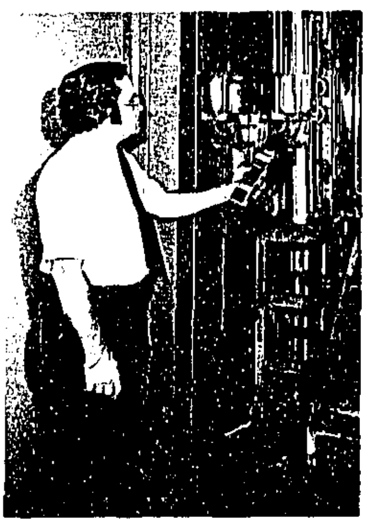
OSHA also establishes the periods of time to which an individual may be exposed to different noise levels in excess of 90 dbA. These time limits are shown in Figure 3. If a worker is exposed to several different noise levels during an 8-hour work day, the accumulative exposure for the day must be calculated.

Noise Level, dBA*	Allowable Daily Exposure
90	8 hours
92	6 hours
95	4 hours
97	3 hours
100	2 hours
102	1.5 hours
105	1 hour
110	0.5 hour
115	1 minute or less

Fig 3. Noise exposure levels allowable by OSHA.

*dBA indicates sound level measured on the "A" scale of a sound level meter (slow response).

The above daily exposure levels were in effect as of December 1979. If you are in doubt as to compliance with OSHA, or as to the more stringent compliance requirements which may have taken effect since publication of this data, check your nearest OSHA regional office for timely information and assistance.



The sound level meter is used to measure octave band sound pressure levels and dBA levels.

Proper design of effective noise control measures cannot be achieved just from "A" scale sound level meter readings alone, however. One must know the frequency content, as well as the sound level, of the offending noise, in order to ensure the satisfactory performance of noise control measures.

Therefore, in addition to taking "A" scale sound level meter readings, octave band noise level measurements should also be made (Figure 4). An octave band filter, used in conjunction with a sound level meter, measures the noise level of a group of frequencies (i.e., one octave). Octave bands usually have center frequencies of 125, 250, 500, 1000, 2000, 4000 and 8000 Hz. Thus, the product test data presented in the brochure is given in octave bands in order to aid in the proper selection and design of effective noise control measures.

How to calculate "A" weighted sound levels (dBA)

1. Measure the octave band sound pressure levels at 125, 250, 500, 1000, 2000 and 4000 Hz with a sound level meter set on the flat or linear frequency weighting scale.

2. Apply the following correction numbers to the octave band levels to obtain equivalent levels for A-weighted octave band analysis.

Octave Band Center Frequency, (Hz)					
125	250	500	1000	2000	4000
Correction					
-16	-9	-3	0	+1	+1

3. Successively combine each octave band level with the next, using the following difference table:

If the difference between two levels is:	Add to the higher level:
0 dB	3 dB
1	2.5
2-3	2
4	1.5
5-7	1
8-9	0.5
10 or more	0

4. Round the final answer to obtain the total dBA level.

Example:

Frequency (Hz)	125	250	500	1000	2000	4000
Octave Band Level (dB)	108	103	99	104	101	85
Correction	-16	-9	-3	0	+1	+1
	92	94	96	104	102	86

(+2dB)..............96

(+3dB).........................99

(+1dB) 105

(+2dB) 107

(+0dB)..107

The result is 107 dB A.

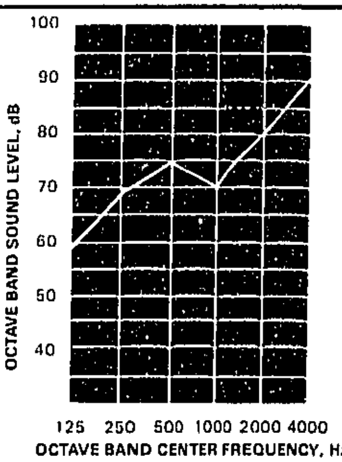


Fig. 4. Sound level varies with different octave band frequencies.

Basic principles of noise control

There are three basic elements to be considered in controlling noise:

- Controlling or attenuating noise at its source;
- Controlling or attenuating noise along its path from source to listener;
- Controlling or attenuating noise at the receiver (listener).

Thus, in industrial noise control, reference is made to SPR (source, path, receiver) control. Any noise control problem may require that one, two, or all three of these basic control elements be taken into consideration.

There are primarily three ways to control noise:

- The noise source can be selected, redesigned, or modified to operate more quietly, and/or resiliently supported to prevent the transmission of vibration.
- Sound energy can be absorbed by a porous acoustical material, or blocked along its path.
- Sound energy can be confined to, or excluded from, an enclosure.

One basic way to control noise is through the use of resilient materials or components which can efficiently isolate vibrating equipment from adjacent structures. An example of an efficient vibration isolator, commonly used to absorb vibrations emanating from heavy mechanical equipment, is a spring made of steel or Fiberglas*-reinforced plastic. Vibration isolators incorporating fibrous glass materials are also widely used, and are commercially available in many configurations.

To be effective in confining noise within an enclosure or in excluding it from an enclosure, the walls and ceiling of such an enclosure should have high *sound transmission loss* values. Sound transmission loss is expressed in dB at one-third or octave band center frequencies. Usually, materials that are good sound absorbers have low, or poor, sound transmission loss values. However, transmission loss can often be improved when a good sound absorber is added to the interior of the enclosure.

In order for a material to be an effective sound barrier, it should be as heavy and limp as possible. Sheet lead, often applied as a sound barrier material, fits this description very well.

The sound absorbing properties of a material are measured in octave bands and expressed in terms of the *sound absorption coefficient* of that material. The sound absorption coefficient is the decimal fraction of the sound energy striking the material that is absorbed by it. Sound absorption coefficients of acoustical materials will range from 0.01 to 1.00 or greater, with the higher number indicating the better absorber of sound. For example, a material having a sound absorption coefficient of 0.85 will absorb 85% of the incident sound energy striking its surface.

A sound absorption coefficient greater than 1.0 cannot occur in theory but can be measured for materials that are highly sound absorptive. Sound waves that strike the surface of the material are bent or diffracted at the edges and see an effective area that is greater than the area of the test specimen. As recommended by the ASTM test method, these sound absorption coefficients greater than 1.0 are reported as measured and are not adjusted. The corresponding NRC for a material may also be greater than 1.0 according to the ASTM test method. Sound absorption coefficients or NRC's greater than 1.0 for two different materials can be compared in order to select the material that absorbs the greater amount of sound. However, the sound absorption coefficient should always be rounded to 1.0 when used in calculating sabins of absorption.

The amount of noise reduction obtained in an area when sound absorption material is added depends on several factors, including the size and geometry of the area, the sound absorbing properties of existing materials in the area, the location of the noise source or sources, the amount of sound absorbing material added in the area, and the placement of such material. It is therefore impossible to determine precisely the degree of noise reduction that can be expected from acoustical treatments in such an area without taking into account the above factors. An acoustical consultant or other individual experienced and trained in solving noise control problems should be able to consider these factors and arrive at fairly accurate calculations of the effectiveness of noise control measures. While any noise control measure must be considered as a unique case, with effectiveness varying from case to case, the following can be regarded as a general guide:

If acoustical materials applied in an area have sound absorption coefficients in the range of . . .	The maximum amount of noise reduction that may be expected will be in the range of . . .
0.85 to 1.00	10 to 12 dB
0.65 to 0.85	7 to 10 dB
less than 0.65	less than 6 dB

*Trademark registered Owens-Corning Fiberglas Corp.

Step-by-step control of industrial noise

The worksheet presented on page 19 of this manual can be used to estimate the reduction in reverberant noise levels.

An acoustical material absorbs sound by converting acoustical energy into heat due to air friction in the cells or passages in the material. The porous structure of Fiberglas insulation is, therefore, an ideal medium for absorbing sound.

Duct lining materials absorb sound energy generated by fans or other air moving equipment and attenuate the sound as it propagates through the duct. This attenuation is a result of sound absorption occurring at the perimeter walls of the duct. The attenuation of sound throughout a continuous duct system prevents sound from being emitted at duct openings.

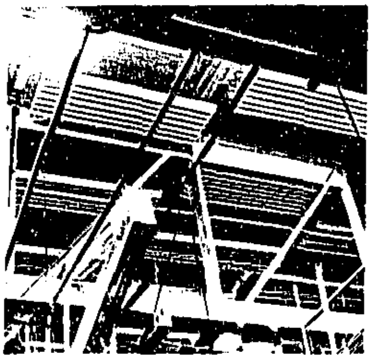
The following 4-step procedure will often yield satisfactory solutions to simple noise control problems.

Before initiating these procedures, "A" scale sound level readings should be taken to determine the degree of excessive noise exposure. It should be remembered that OSHA requirements only pertain to excessive noise exposure of workers, not to high noise levels to which workers are not exposed. For example: if a particular machine is noisy but no one is exposed to this noise, then acoustical control measures are not an OSHA requirement.

1. Take octave band noise level readings. These will reveal which frequencies are most objectionable from the listener's standpoint, and will provide a basis for selecting acoustical materials whose absorption coefficients and / or sound transmission loss properties are best tailored to solving the particular noise problem.

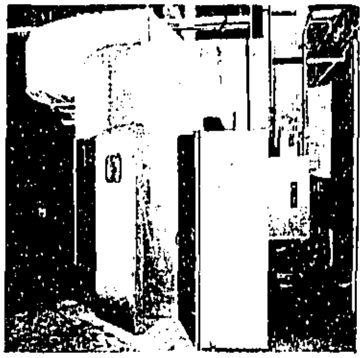
2. Determine the true source of noise. Many times, the source of noise is difficult to detect. Also, there are often multiple noise sources. For example: a pump might be perceived to be the noise source—but the underlying source of noise might be a worn gear, loose couplings, air in the fluid being pumped—or all three.

3. Determine whether the noise can be controlled at its source. It is most desirable, from an acoustical as well as an economic standpoint, to attenuate noise at the source before attempting means to reduce noise transmission along its path, or to solve the problem at the receiver end. Treatment of the noise source alone, however, is often impractical or undesirable; thus, the sound path and the receiver situation must generally be considered as well.



Overhead-mounted unit sound absorbers help control noise by treating its reflective paths.

This 290-foot-long barrier reduces noise from a cold-header facility by 25 dBA.



Fan housing and associated duct work are acoustically treated with Fiberglas materials.

4. Decide which of the three—source, path, receiver—are to be considered first for noise control measures. Factors influencing this decision will include initial cost, ease of installation, access to equipment, effect on productivity, safety, and possibly others.

Specific noise control measures may then be designed, with the assistance of the acoustical properties data included in this brochure (pages 22 thru 33).

Controlling noise at its source

The most effective means of reducing the noise level at a particular location is to reduce the noise emitted at the source. Noise reduction at the source may be accomplished in several ways:

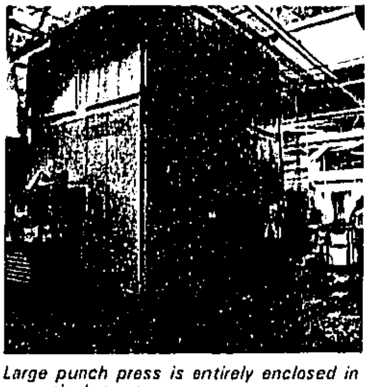
- The noise source may be replaced by quieter equipment; modified to effect the desired noise reduction; or repaired or adjusted to reduce noise.
- The noise source may be moved to a location sufficiently distant from the noise-sensitive (receiver) area to reduce the noise to an acceptable level.
- The noise source may be mounted on vibration isolators, if it is found that vibrations are being transmitted to a building structure or housing.
- The noise source may be coated with a damping compound to attenuate the sound energy radiating from vibrating surfaces.
- The noise source may be enclosed in an acoustically effective housing.

Owens-Corning Fiberglas Corporation manufactures many products that can be utilized in the design and construction of housings and enclosures to reduce the noise emitted by a source.

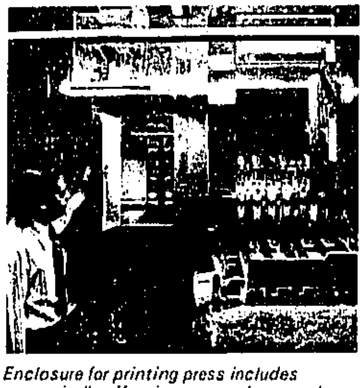
Housings for specific types of equipment may be built using Fiberglas-reinforced plastics (FRP). Such enclosures may be molded or shaped to almost any configuration and size, and can be made with various thicknesses as required for structural rigidity and noise reduction. With the addition of Fiberglas insulation batts or boards on the inside of a machine housing, the effective noise reduction of the housing can be improved substantially. The type of Fiberglas insulation used can be selected from a wide range of products, depending on temperature requirements, weight limitations, ability to conform to irregular shapes or contours, space limitations, and the amount of noise reduction required.

Pages 35 through 39 of this brochure list various Fiberglas insulations and suggest possible uses.

Where it is not feasible to build a noise reduction housing as part of the equipment, it may be feasible to build an enclosure around the entire equipment. Such enclosures are available from specialty manufacturers and are usually constructed from pre-fabricated metal panels with Fiberglas insulation between the faces. A wide range of products is available, depending on the specific requirements that must be met. Machinery enclosures may also be constructed in the plant using sheet metal, lead, gypsum wallboard, plywood, or masonry products.



Large punch press is entirely enclosed in acoustical structure.



Enclosure for printing press includes acoustically effective access doors and windows.

This enclosure will block noise generated by a large power plant turbine.

In the case of enclosures, Fiberglas insulation may be used in two locations: *First,* the insulation may be used between the two faces of an enclosure, as in a stud cavity. Used in this manner, the insulation will increase the transmission loss of the enclosure from 3 to 12 dB depending on the type of enclosure construction and the frequency band. *Second,* insulation may be placed on the interior face of the enclosure. In this location, the insulation will absorb sound within the enclosure, thus lowering the noise level within it. This increases the effective noise attenuating properties of the enclosure. Depending on the type of insulation, thickness of insulation, and frequency band, the effective noise attenuation of the enclosure can be increased up to 12 dB.

Ducts are often major noise contributors in an industrial plant. Owens-Corning offers a variety of duct wraps, liners, and other systems to reduce duct noise. These include two types of sound-attenuating duct liner materials, Aeroflex* flexible duct liner and Fiberglas rigid duct liner board. Fiberglas Duct Board may be used to replace existing sheet metal duct; an acoustically and thermally effective lining is an integral part of this system. Also, several types of Fiberglas Duct Wraps are available for application to the outside of ducts to reduce the transmission of noise to environments surrounding the duct. These products also provide effective, energy-saving thermal barriers.

Pipe insulation and pipe wraps are effective in reducing the noise that may emanate from pipes. Data on various Owens-Corning Pipe Insulations can be found on page 38 of this brochure. Depending upon temperature, fire safety, and durability requirements, a wide range of materials is available. These products also offer important energy-saving properties.

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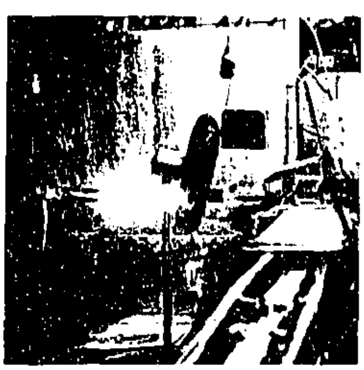
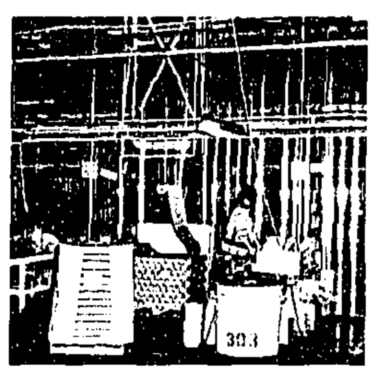


Modular enclosure blocks both noise and heat emanating from heat-treating operation.

Pre-engineered acoustical enclosure allows employes to work near noisy equipment.



Clear vinyl curtains can block noise, but not visibility, of the noise source.

Examples

Example 1.
Controlling noise at its source

A large electric motor produces the noise levels shown in Line 1 (at right) at a nearby worker's station.

Step 1(A):
A removable enclosure for the motor is to be built. To determine the approximate degree of noise reduction that can be expected, refer to the data on the following pages. Since ½" plywood is an economical and practical material with which to build an enclosure, we find in the insertion loss values for ½" plywood. These are shown on Line 2 in table, (above right, from II-4, page 29).

Subtracting these insertion loss values from the noise levels measured before acoustical treatment of the noise source, we find that the noise levels at the worker's station can be reduced by the enclosure to the levels shown on Line 3.

The 94 dBA sound level is determined by applying correction factors for the A-weighted levels, and combining octave band levels, as was described on page 5. This level is still above OSHA allowances for exposure during an 8-hour day; in fact, a worker may only be subjected to this level for 4 hours.* The sound enclosure must be made more acoustically efficient.

Step 1(B):
This can be done by adding 1" of Fiberglas 703 Insulation Board to the interior surface of the ½" plywood, thus increasing attenuation provided by the enclosure. The increased insertion loss values are shown in Line 5 at right. Subtracting these insertion loss values on Line 4, we find that the noise levels at the worker's station can be reduced to the levels shown in Line 6.

Example 1	OCTAVE BAND CENTER FREQUENCIES, Hz						
Step 1(A)	**125**	**250**	**500**	**1000**	**2000**	**4000**	**dBA***
1. Noise level before treatment	108	103	99	104	101	85	107*
2. Insertion loss, ½" plywood	-13	-11	-12	-12	-13	-15	
3. Noise level after treatment	95	92	87	92	88	70	94
Step 1(B)							
4 Noise level before treatment	108	103	99	104	101	85	107
5. Insertion loss, plywood + 703	-18	-17	-23	-30	-38	-40	
6. Noise level after treatment	90	86	76	74	63	45	81

*See page 5 for dBA calculation method.

The 81 dBA sound level is well within OSHA allowances for 8-hour-day exposure,* the example clearly shows the effectiveness of Fiberglas materials used in source noise control. (These results apply to an enclosure with no holes, seams, or other sound leaks. If leaks exist, these insertion loss values will not be achieved.)

If required, the inside surface of the enclosure could be covered with a plastic film to protect the insulation from oil or water vapor. However, such a film should not be more than 1 mil thick or it will have adverse acoustical effects.

*See Fig. 3, page 4

Other solutions that address themselves to treating the source of noise might be to:

- Relocate the motor further from the worker's station.
- Replace the noisy motor with a quieter one.
- Check and, as required, replace worn gears or other moving parts which might be the underlying cause of the excessive noise.

Controlling noise along its path

Sound, in traveling from a source to a listener, can take two paths. *First:* it may take a direct path, not striking any surface before arriving at the listener's position. *Second:* it may take an indirect path, being reflected from one or more surfaces. In most instances, both direct and indirect sound reaches the listener's position. (See Fig. 5.)

The most effective means of reducing indirect sound is to place sound-absorptive materials on the surfaces that the sound strikes. Thus, when the sound strikes these surfaces, most is absorbed and very little is reflected off the surface. Fiberglas materials are among the most efficient sound absorptive materials available. They can absorb up to 99% of the sound that strikes their surfaces. Owens-Corning Fiberglas Corporation manufactures a wide range of products, from building insulation to acoustical ceiling panels, that can be used to absorb reflected sound. Where possible, the installation of an acoustical ceiling in a room or plant is one of the most effective means of reducing indirect sound reflections. Various types and sizes of ceiling panels are available; refer to page 36 of this brochure. Ceiling panels with vinyl or glass cloth facings are available in sizes from 2X2 to 5X5 feet (with lengths of up to 16 feet available on special order). Sound absorption properties for various ceiling materials are presented on page 27 of this brochure.

If the installation of a ceiling is not feasible because of the presence of pipes, lights, electrical wires, ducts, or other systems, then unit sound absorbers (i.e: baffles) may be used in the ceiling area; or acoustical treatments may be applied to side walls or to the underside of the roof deck. As in the case of insulation for enclosures, Owens-Corning offers a wide range of insulations that can be used for acoustical treatments depending on temperature, humidity, durability, density, and surface finish requirements. If desired, these insulations can be covered by porous facings such as pegboard, expanded metal or cloth fabrics with little loss of sound absorption values. Pages 26 and 27 of this brochure provide tables of sound absorption data and suggested construction details.

The worksheet on page 19 of this manual can be used to estimate the reduction in reverberant noise level (or in reverberation

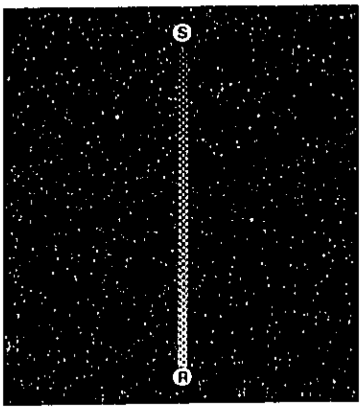


Fig. 5a. Direct path, source to receiver

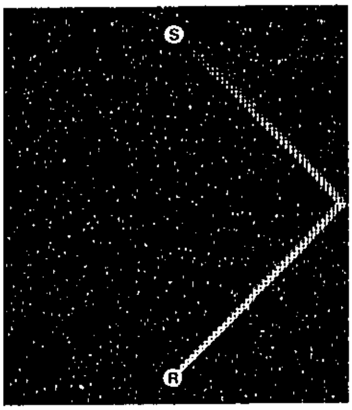


Fig. 5b. Single reflection sound path

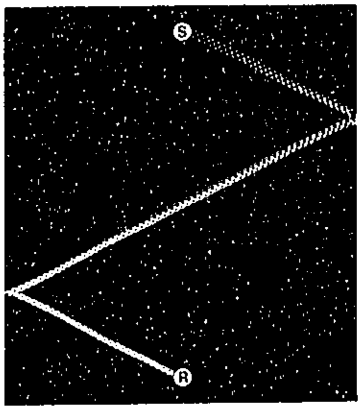


Fig. 5c. Double reflection sound path

time) that may be expected when sound absorbing materials are added to the space. Calculations should be done following this worksheet at each octave band to estimate the overall effect of treatment. Use of this worksheet is made clear in the example on page 20.

Direct sound cannot be reduced by the addition of sound-absorptive materials to surfaces, since by definition direct sound does not strike any surface before reaching the listener. The only effective means of reducing direct sound along its path is to install an acoustically effective barrier (i.e., a structure that is less than the full height and width of the noise path area) between the noise source and receiver.

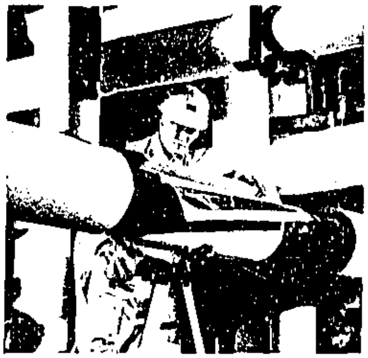
A sound barrier, to be most effective, must have two acoustical properties. *First,* the sound transmission loss or noise reduction capacity of the barrier must be high enough so that sound is attenuated in passing through the barrier. *Second,* it must be sound absorptive so that sound striking the barrier is absorbed and not reflected back into the area of the source. Since by definition a barrier is free-standing (i.e., does not extend from the floor to the ceiling or roof), sound will be diffracted around the barrier in a similar manner to that in which light is diffracted around the corner of a building.

Depending on the size of the barrier, the location of the noise source and receiver relative to the barrier, and the frequency content of the noise source, the noise reduction across a barrier due to sound diffraction may approach 24 dB—the practical limit that can be expected of such measures. Therefore, it is imperative that the sound transmission loss of the barrier be at least 24 dB so that sound doesn't pass through the barrier instead of being diffracted around the barrier.

For most barriers, a septum with a weight of more than 1.5 lb/ft^2 (½" plywood, ½" gypsum board, 20 gauge sheet metal), plus at least 2 inches of Fiberglas insulation on the source side of the barrier, should be sufficient. In some cases, it may be necessary to construct a heavier barrier in order to reduce low frequency noise.

Fiberglas baffles reduce excessive reverberant noise in large, open building areas.

Duct wraps and liners reduce transmission of noise through heating and ventilating systems.



Pipe coverings muffle noisy piping systems. They are also effective unit sound absorbers.

The nomogram (Figure 7) can be used to calculate the amount of sound attenuation in dB provided by a barrier blocking direct transmission of sound along a path from source to receiver. (Note: Barrier width should be twice its height to be effective).

In the nomogram, values for line (A+B−D) are determined by referring to the figure below.

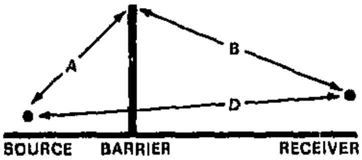


Fig. 6. Distances involved in determining barrier sound attenuation.

- Line A represents the distance from noise source to the top of the barrier, in feet.
- Line B represents the distance from the receiver to the top of the barrier, in feet.
- Line D represents the straight line distance from the source to the receiver position, in feet.
- Line F of the nomogram represents the octave band center frequency of the offending noise.
- The line at the right provides the attenuation in dB that is provided by the barrier.

Use of the nomogram is made clear in the example, "Controlling noise along its path," on page 14 of this brochure.

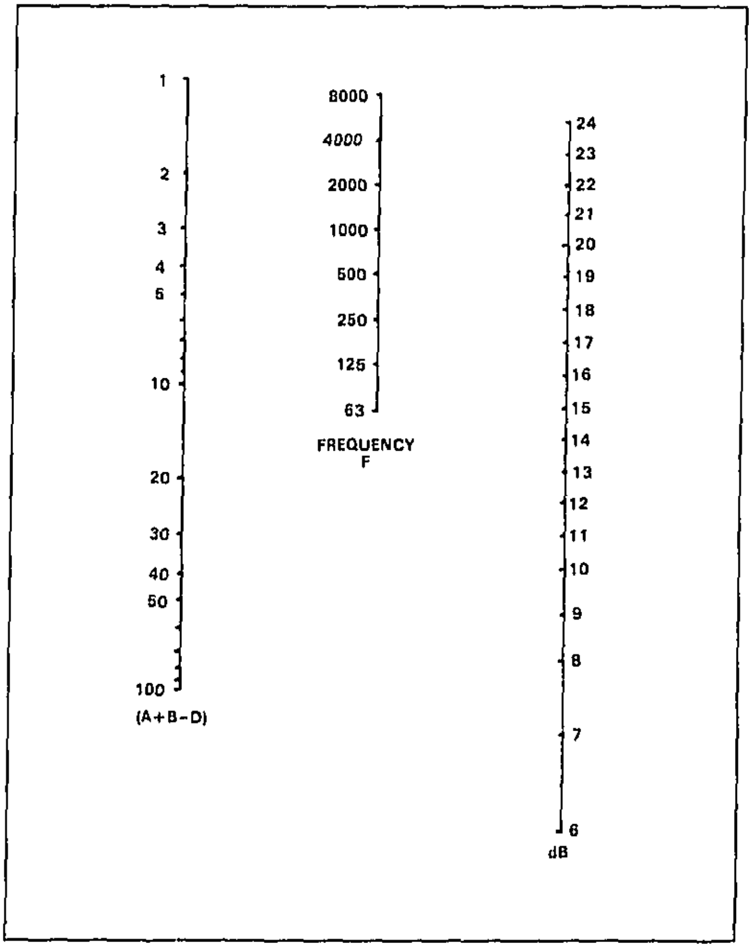
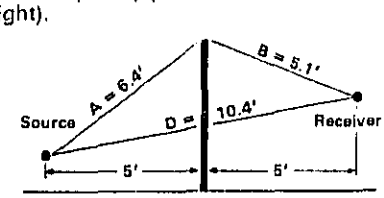


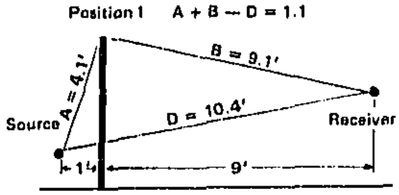
Fig. 7. Nomogram for determining barrier sound attenuation, in Db.

Example 2.
Controlling noise along its path

The same motor is producing the same noise levels at the worker's station (Line 1, right) but, for reasons of service accessibility, an enclosure is considered impractical. It is decided to treat the path of the noise by building a barrier between the motor and the worker's station, adjacent to the motor location. Noise paths have been studied and it has been determined that there is a good likelihood that reflected sound is not presenting a problem (i.e: walls and ceilings have absorption coefficients of .85 or better). The distance D from the motor to the worker's ear is 10.4 feet; the distance A from the motor to the top of the barrier is 6.4 feet; the distance B from the worker's ear to the top of the barrier is 5.1 feet. The value (A+B—D) is determined to be 1.1 (See position #1 below), and this value is located on the left-hand line of the nomogram (page 13). Lines are drawn from this point through the octave band center frequency values on the middle line of the nomogram and extended to cross the right-hand line, where barrier attenuation values in dB may be read for each frequency (Line 2, above right).



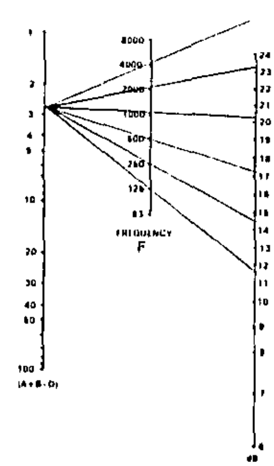
Position 1 A + B — D = 1.1



Position 2 A + B — D = 2.8

Example 2	OCTAVE BAND CENTER FREQUENCIES, Hz						
	125	250	500	1000	2000	4000	dBA
1. Noise level before treatment	108	103	99	104	101	85	107
2. Barrier attenuation, 1st location	-9	-11	-13	-16	-19	-22	
3. Noise level after treatment.	99	92	86	88	82	63	91
4. Noise level before treatment	108	103	99	104	101	85	107
5. Barrier attenuation, 2nd location	-11	-14	-17	-20	-23	-24	
6. Noise level after treatment	97	89	82	84	78	61	88

Subtracting these values from the octave band noise levels given in Example 1 and correcting for "A" scale weighting, the overall result is 91 dBA. This level exceeds OSHA allowances for 8-hour exposure, so the barrier nomogram is now used to determine the effect of placing the barrier closer to the noise source. When located 1 foot from the source, distance A becomes 4.1 and distance B 9.1 feet (distance D remains 10.4 feet). The value (A+B—D) is now 2.8 (See position #2 below.) Using the nomogram, barrier attenuation values are read as follows (Line 5).



Position #2 A + B — D = 2.8

Octave Band Center Frequency

	125	250	500	1000	2000	4000
Attenuation	11	14	17	20	23	24

When motor noise levels are attenuated by these amounts (Line 6, above) and corrected for "A" scale weightings, the level becomes 88 dBA, a level which is within OSHA exposure limits for an 8-hour day.

The nomogram can be used in this manner to optimize barrier height (given a fixed location) or to optimize its location (given a fixed height).

The above result applies to a condition where no reflected sound reaches the worker's station. If there is any reflected sound, these transmission loss values will not be achieved unless adjacent reflecting surfaces (walls, ceiling, other equipment in the area) are also acoustically treated.

Controlling noise at the receiver

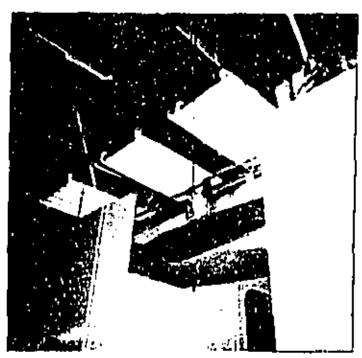
Most commonly used measures for receiver noise control are ear plugs or ear protectors. These, however, are classified by OSHA as "temporary" noise control solutions; OSHA requires "permanent" solutions. And the only permanent method of reducing noise at the receiver position is to build a partial or complete enclosure around the receiver or listener. An enclosure for a listener is very similar to an enclosure for a noise source.

The basic difference between the two is that an employee enclosure must provide an environment in which the employee can function efficiently and comfortably. This usually means that lights, windows, and a ventilation system must be provided for a complete enclosure. These items may degrade the overall acoustical performance of the enclosure due to sound leaks and to the lower noise reduction values of doors and windows. Therefore, greater emphasis must be placed on the details of designing and building an employee enclosure than is the case of a noise source enclosure.

The use of Fiberglas insulation in stud and joist cavities of an enclosure, plus the liberal use of caulking to seal air leaks, is an excellent start in the design of an employee enclosure. In many instances, controls and dials may be installed in an employee enclosure to further reduce the amount of time necessary for an employee to spend outside the enclosure in a noisy environment. Doors and windows should, if possible, be located on the side away from the noise source, and provision for ventilation should be located and constructed so that they will not conduct noise into the enclosure.

Refer to OCF Pub. No. 5-BL-9474, "Controlling Noise in Buildings."

Portable modular personnel enclosures provide quiet environments for workers in noisy plant areas.



Ceiling baffles incorporate Fiberglas material and perforated metal.

Damping compound effectively quiets hoppers, conveyors, and other material handling equipment.

Example 3.
Controlling noise at the receiver

Step 1(A):
The same motor is producing the same noise levels at the worker's station (Line 1, right); a motor enclosure is impractical; the path of sound reaching the worker's station is such that a barrier or partition will not block sufficient sound. Therefore, the worker's station is to be enclosed. Referring to the data on the following pages, we find the sound transmission loss values for a wall constructed of 3⅝" metal studs with ½" gypsum board on both sides are as shown on Line 2, right (From table II-7, p. 30).

While the resulting 70 dBA (Line 3) sound level inside the enclosure is within OSHA noise exposure limits for an 8-hour day (see Fig. 3, p. 4), it is still considered too noisy. Therefore, it is decided to add acoustical treatment to the construction.

Step 1(B):
Addition of 3½" of Fiberglas Building Insulation to the stud cavity of the enclosure will provide additional sound transmission loss values. The total transmission loss (metal stud and gypsum board wall plus Fiberglas Building (Insulation) is listed on Line 5 at the right (From table II-7, p. 30).

Subtracting the total effective transmission loss values from the noise levels before treatment, we find that the noise level within the worker's enclosure can be reduced to 65 dBA (see values on Line 6).

Example 3	OCTAVE BAND CENTER FREQUENCIES, Hz						
Step 1(A)	125	250	500	1000	2000	4000	dBA
1. Noise level before treatment	108	103	99	104	101	85	107
2. Sound transmission loss, plain wall	-25	-28	-42	-49	-50	-40	
3. Noise level after treatment	83	75	57	55	51	45	70
Step 1(B)							
4. Noise level before treatment	108	103	99	104	101	85	107
5. Sound transmission loss, insulated wall	-28	-39	-52	-56	-58	-46	
6. Noise level after treatment	80	64	47	48	43	39	65

This calculated dBA reading is well within OSHA exposure limits. It can also be expected to result in a noise level within the enclosure approximating that of a normal, moderately noisy office. The results apply to an enclosure without sound leaks, without a plate glass window facing in the direction of the noise, with a door also facing away from the noise source and acoustically treated, and with all ventilation and other openings, properly treated to avoid sound leaks. If leaks exist, these sound transmission loss values will not be achieved.

Controlling noise within plant boundaries

With the passage of new Federal, State and local noise ordinances, it is becoming more important that objectionable noise be prevented from being transmitted beyond adjacent property boundaries. This is especially true where residential areas are adjacent to plants.

There are several ways to contain noise within the boundaries of a noisy industrial operation. Noise-producing equipment can be located within a central zone of the plant or building. Another way to contain sound within the boundaries of a plant is to use exterior building shells with fairly high sound transmission loss values. In most instances, a pre-engineered building with Fiberglas insulation should suffice. A metal or gypsum roof deck with Fiberglas insulation should also be sufficient to contain or exclude noise within or from a building.

If an exterior wall must possess high sound transmission loss values at low frequencies, masonry walls will be effective.

Because of the relatively poor sound transmission loss values of doors, windows, and other openings in the exterior shells of industrial buildings, such penetrations should be kept to a minimum in building design. In order to prevent noise from leaking through doors and windows of existing buildings, it may be necessary to build barriers or sound baffles in front of such openings. As is the case for barriers used to block direct sound transmission, exterior door or opening baffles should have Fiberglas insulation, properly protected against weather and abuse, on the sides that face the noise source. Openings such as air vents may be effectively treated with Fiberglas duct liners, wraps, or Fiberglas Duct Board in place of standard sheet metal.

After acoustical treatment of these dust collectors, nearby residents are no longer bothered by noise.

O-CF ceilings, screens, wall panels, & background masking will assure speech privacy in an open office.

Controlling noise in adjacent office areas

Disconcertingly high noise levels are often encountered in office areas adjacent to noisy industrial operations. Even though such noise levels may not approach the exposure limits established by OSHA for an 8-hour day, they may be of sufficient intensity to distract and annoy office occupants, interfering with efficiency and making speech communication difficult. In fact, noise levels of 55 to 60 dBA are generally considered excessive for the office environment.

Owens-Corning has pioneered in solving the problems of speech communication and speech privacy in the open office, with a "tuned" combination of Owens-Corning Sound Dividers, Glass Cloth Ceiling Panels, and background masking sound systems. Installed under the guidance of an acoustical expert, these components of the open office speech privacy "package" are also effective in reducing other sounds in, or entering, the office area.

Owens-Corning Wall Panels, applied to office walls, can provide additional noise reduction and further contribute to quiet in offices next to industrial areas.

For a full description of the Owens-Corning open office acoustical "package," refer to O-CF Publication 1-AC-6666, "Speech Privacy in the Open Office."

Design Guidelines for control of reverberant sound

Owens-Corning Fiberglas Corporation manufactures a wide range of products that can be effectively employed to reduce excessive reverberant or reflected noise. Two approaches may be used.

1. Where the overall steady state noise level must be reduced, control of the reflected and reverberant sound field itself is usually the best solution.

2. Where reverberant noise produces echoes in such spaces as arenas, gymnasiums, and auditoriums, or where speech intelligibility from a public address system must be improved, control of the reverberation time is usually the best approach. Reverberation time is the interval required for a sound to decay 60 dB after it has been stopped. Generally this interval should be between 2.0 and 2.5 seconds, in order to avoid echoes that interfere with speech intelligibility.

Most reverberant sound problems will involve a combination of these two approaches.

For a thorough investigation of the acoustical environment that is to be treated, sound absorption coefficients should be considered at octave band center frequencies of 125, 250, 500, 1000, 2000, and 4000 Hz. Or, if a sound occurring at a particular frequency is known to be the major offender, calculations at that frequency alone may suffice. Also, a rough approximation of the solution to a reverberation noise or reverberation time problem may be accomplished using sound absorption characteristics of the environment at 500 Hz. When complex problems are encountered, Owens-Corning recommends the services of an experienced, qualified acoustical consultant.

The following procedure may be used for estimating Owens-Corning acoustical control products in amounts and arrangements sufficient to control the noise problem:

1. Determine the existing sound absorption coefficients for the walls, floor and ceiling of the room or area to be treated. This will establish baseline information for solving the reverberant noise problems.

2. Establish the design requirement for the room or area, considering such criteria as OSHA noise exposure limits or reverberation time desired.

3. Consult the data on pages 22-27 of this manual to obtain sound absorption coefficients and values, as well as for other property data, for the products under consideration.

On the following page will be found procedures to be used in controlling reverberant sound levels and reverberation time for the specific application. These procedures are followed by an example illustrating how they are applied.

Worksheet for solving reverberant sound problems

The sabins of absorption in a room are calculated according to the following procedure:

	WALL	CEILING	FLOOR
1. List areas of room surfaces.			
2. List sound absorption coefficient for each room surface.			
3. Multiply Line 2 by Line 1 to compute sabins.			
4. Add results on Line 3 for total sabins, all room surfaces.			
5. List sabins for people in room.			
6. List sabins for space absorbers.			
7. Add Lines 5, 6, 7 to find total sabins for room.			

Ⓐ To determine reduction in reverberant noise levels produced by adding sound absorbing material to a room, use the following procedure:

1. Determine total sabins for untreated room.
2. Determine total sabins for room with added acoustical treatment.
3. Divide Line 2 by Line 1.
4. Take the logarithm of Line 3.
5. Multiply Line 4 by 10 to get reduction in reverberant noise level.

The noise reduction in Line 5 can be improved successfully by adding sound absorbing material to the room and again completing steps 2 thru 5. The practical upper limit for reduction of the reverberant noise levels is 10 to 12 dB. If estimates are in excess of this amount, they should be carefully analyzed.

Ⓑ To determine the reverberation time in a room, use the following procedure:

1. Calculate the volume of the room in cubic feet.
2. Multiply Line 1 by .05.
3. Determine total sabins for room.
4. Divide Line 2 by Line 3 to obtain reverberation time in seconds.

Ⓒ To determine the amount of sound absorbing material to be added to a room in order to achieve a desired reverberation time, use the following procedure:

1. Calculate the volume of the room in cubic feet.
2. Multiply Line 1 by .05.
3. List desired reverberation time in seconds.
4. Divide Line 2 by Line 3 to obtain total sabins required in room.
5. Determine sabins for untreated room.
6. Subtract Line 5 from Line 4 to get sabins of absorption to be added.

Additional sabins given on Line 6 will provide desired reverberation time. Select acoustical materials to provide this added absorption from the acoustical data on pages 22 through 27 of this manual.

Example:

Determine the change in the reverberant sound level and in the reverberation time at 500 Hz in a 200' x 100' x 30' room with a wood deck ceiling (sound absorption coefficient = .14), concrete floor (sound absorption coefficient = .01) and gypsum wallboard (sound absorption coefficient = .03) when half of the walls are covered with Nubby Glass Cloth Board (sound absorption coefficient = .73), a suspended Fiberglas Ceiling is installed (sound absorption coefficient = .90) and ¼" pile carpet (sound absorption coefficient = .15) is placed on the floor.

The sabins of absorption in the room are calculated according to the following procedure:

UNTREATED ROOM	WALL	CEILING	FLOOR
1. List areas of room surfaces.	18,000	20,000	20,000
2. List sound absorption coefficient for each room surface.	.03	.14	.01
3. Multiply Line 2 by Line 1 to obtain sabins.	540	2800	200
4. Add results on Line 3 for total sabins, all room surfaces.	3,540		
5. List sabins for people in room.	—		
6. List sabins for space absorbers.	—		
7. Add Lines 5, 6, and 7 to get total sabins for room.	3,540		
ACOUSTICALLY TREATED ROOM			
1. List areas of room surfaces.*	16,800*	20,000	20,000
2. List sound absorption coefficient for each room surface.	.03 & .73	.90	.15
3. Multiply Line 2 by Line 3 to get sabins, each half of walls.	252 + 6132	18,000	3,000
4. Add results on Line 3 for total sabins, all room surfaces.	27,384		
5. List sabins for people in room.	—	*Wall area reduction	
6. List sabins for space absorbers.	—	is due to installation	
7. Add Lines 4, 5, and 6 to get total sabins for room.	27,384	of suspended ceiling.	

Ⓐ To determine the reduction in reverberant noise levels produced by adding sound absorbing material to the room, use the following procedure:

1. Determine total sabins for untreated room.	3,540
2. Determine total sabins for room with added acoustical treatment.	27,384
3. Divide Line 2 by Line 1.	7.74
4. Take the logarithm of Line 3.	.89
5. Multiply Line 4 by 10 to obtain reduction in reverberant noise level.	8.9 ≈ 9dB

To determine the change in the reverberation time in the room described in Example when it is acoustically treated as described, use the following procedure:

Ⓑ UNTREATED ROOM

1. Calculate the volume of the room in cubic feet.	600,000
2. Multiply Line 1 by 0.05.	30,000
3. Determine total sabins for room.	3,540
4. Divide Line 2 by Line 3 to obtain reverberation time in seconds.	8.47

Ⓑ ACOUSTICALLY TREATED ROOM

1. Calculate the volume of the room in cubic feet.	560,000*
2. Multiply Line 1 by .05.	28,000
3. Determine total sabins for room.	27,384
4. Divide Line 2 by Line 3 to obtain reverberation time in seconds.	1.02

*Volume has been reduced by installation of suspended ceiling.

Using the acoustical data to select solutions to noise problems

The acoustical data presented in the following pages of this brochure was generated from tests conducted in the Owens-Corning Acoustical Laboratory or from tests conducted by independent acoustical laboratories. Test procedures followed recognized, industry-accepted standards. The data is explained and organized to be helpful to almost anyone confronted with a noise control problem—engineer, architect, contractor, or acoustical consultant. Values published are the result of the most recent tests using the latest accepted procedures and test methods.

It is not intended, nor would it be possible, that this data be sufficient to solve all industrial noise control problems. Such problems are complex, requiring detailed analysis and measurement and usually capable of solution only by an acoustical consultant. For the relatively straightforward types of industrial noise problems, however, this data will be of assistance to the plant engineer, designer, and fabricator of noise reduction enclosures and barriers, and/or a qualified contractor.

Acoustical product & application guide.

Product or System	Acoustical Data Table No.	Selection Guide Page No.
MATERIALS USED AS SOUND ABSORBERS		
Fiberglas Building Insulation	I-1	35
Fiberglas Noise Barrier Batts	I-2	35
Fiberglas 700 Series Insulations	I-3	35
Insulation Products for Acoustical/Thermal Applications	I-4	37
Fiberglas Appliance Insulations	I-5	35
Fiberglas Metal Building Insulations	I-6	35
Fiberglas Roof Form Board	I-7	38
Automotive Insulation	I-8	38
Glass Fiber-Board (High Density)	I-9	—
Aeroflex Duct Liner	I-10	39
Fiberglas Duct Liner Board	I-11	38
Fiberglas Navy Board	I-12	—
Insul-Quick Insulation	I-13	36
Fiberglas Wall Treatments	I-14	—
Fiberglas Film-Faced Ceiling Panels	I-15	36
Fiberglas Glass Cloth Ceiling Panels	I-16	36
Owens-Corning Sound Dividers	I-17	36
Owens-Corning Wall Panels	I-18	36
Miscellaneous Fiberglas Materials	I-19	—
MATERIALS USED FOR SOUND TRANSMISSION LOSS		
Fiberglas-Reinforced Plastics	II-1	—
Typical Building Materials	II-2	—
Special Constructions	II-3	—
Plywood Enclosures	II-4	—
Owens-Corning Fiberglas Pipe Insulation	II-5	38
Owens-Corning Kaylo Pipe Insulation	II-5	38
Owens-Corning Duct Wrap Insulation	II-5	39
Metal Building Walls	II-6	—
Metal Stud Wall Constructions	II-7	—
Wood Stud Wall Constructions	II-8	—
Miscellaneous Materials	II-9	—
MATERIALS USED IN ACOUSTICAL TREATMENT OF DUCTS		
Aeroflex Duct Liner	III-1	39
Fiberglas Duct Board	III-2	39
INL-25 Flexible Duct	III-3	39
Aeroflex Duct Liner (radiated noise)	III-4	39
Fiberglas Duct Liner (radiated noise)	III-5	38

*Owens-Corning Fiberglas Corporation does not manufacture acoustical components from Fiberglas-reinforced plastics. It does supply fibrous glass reinforcement products (continuous strand rovings, continuous and chopped strand mats, chopped and milled fibers) and polyester resin systems to custom fabricators of FRP panels and moldings of all kinds.

Selection of products based on their acoustical properties

Products listed in the table (at right) are generally well suited for noise control applications of varying kinds. Some are excellent sound absorbers, and are therefore best suited for application within enclosures or on exposed surfaces along the noise path. Others, having excellent sound transmission loss properties, may be better suited for blocking sound paths or for excluding sound from an enclosure. Some are suited for general industrial use; while others are designed for specific application such as ceilings, air-handling systems, or pipes. Mechanical, physical, and other properties such as fire safety and temperature limitations may control their applicability to certain noise control problems. The Product Selection Guide (pages 34 through 39 of this brochure) provides additional data and references which may be helpful in selecting the best product for the intended service.

The following pages provide examples of how to use the selection data, the tables of acoustical properties of listed materials, and the three steps in "SPR" noise control:

- Controlling noise at the source;
- Controlling noise along its path;
- Controlling noise at the receiver, or listener.

Acoustical data
Section I.
Sound Absorbing Materials

Table I-1.
Sound Absorption Coefficients,
(3) Fiberglas Building Insulation.

Product Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
3.5" (R-11) (Paper exposed to sound)	4	.38	.98	1.20	.62	.36	.24	.80
3.5" (R-11) (Insulation exposed to sound)	4	.34	.85	1.09	.97	.97	1.12	.95
6 0" (R-19) (Paper exposed to sound)	4	.71	1.16	.85	.61	.41	.26	.75
6 0" (R-19) (Insulation exposed to sound)	4	64	1.14	1 09	.99	1 00	1 21	1.05
3.5" (R-11) (Paper exposed to sound)	7	.78	87	90	71	40	.32	.70
3 5" (R-11) (Insulation exposed to sound)	7	80	.98	1.01	1.04	98	1.15	1 00
6.0" (R-19) (Paper exposed to sound)	7	84	.92	94	.64	.45	.34	.75
6 0" (R-19) (Insulation exposed to sound)	7	86	1 03	1 13	1 02	1.04	1 03	1 05
3.5" (R-11) (FRK facing exposed to sound)	4	56	1.11	1.16	.61	40	.21	.80
6.0" (R-19) (FRK facing exposed to sound)	4	.94	1.33	1 02	.71	.56	.39	90

Table I-2.
Sound Absorption Coefficients,
(3) Fiberglas Noise Barrier Batts.

Product Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
2.5" (R-8)	4	.21	.62	.93	92	.91	1.03	.85
3.5" (R-11)	4	.38	88	1.13	1 03	.97	1.12	1.00
2.5" (R-8)	7	59	84	79	.94	96	1.12	.90
3.5" (R-11)	7	.73	.98	.98	1 05	1 08	1.15	1.05

Table I-3.
Sound Absorption Coefficients,
(3) Fiberglas 700 Series Insulation.

(1) Mountings:
• No. 4—Material placed against a solid backing such as a block wall.
• No. 7 (Modified)—Material placed against 24 gauge sheet metal over a 16-inch air space. This mounting configuration is typical of a sheet metal enclosure with insulation on one side (Data includes facings exposed to sound source, if specified)
• No. 7—Material placed over a 16-inch air space. (Data includes facings exposed to sound source, if specified)
• No. 6—Material placed over 24 ga. galvanized sheet metal with 1-inch air space

(2) Facings:
• FRK: Foil-faced laminate with glass fiber reinforcing and a kraft backing.
• ASJ (All-Service Jacket): An embossed laminate of white kraft facing with glass fiber reinforcing and a foil backing.

(3) All tests were conducted according to ASTM C423-77. Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method Sound absorption coefficients for each sample were measured over ⅓ octave bands and are reported at the preferred octave band center frequencies.

In some cases, the measured sound absorption coefficient is greater than 1.00. As recommended by the test method, these values are reported as measured and not adjusted. The corresponding NRC for a material may also be greater than 1.0 according to the ASTM test method. The Sound Absorption Coefficients of these materials are not significantly affected by coverings such as expanded metal, metal lath hardware cloth, screening, or Fiberglas cloth When other coverings, having less open surfaces are required, consult an O-CF representative.

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz.						
701, plain, 1" thick	4	.12	.28	.73	89	.92	.93	.70
701, plain, 2" thick	4	.24	.77	1.13	1.09	1 04	1.05	1.00
701, plain, 3" thick	4	43	1.17	1 26	1.09	1 03	1 04	1.15
701, plain, 4" thick	4	73	1.29	1 22	1 06	1 00	.97	1.15
701, plain, 1" thick	Mod 7	.38	34	68	82	.87	96	.70
701, plain, 2" thick	Mod 7	.44	66	1.07	1.06	99	1 06	.95
701, plain, 3" thick	Mod 7	.53	96	1.19	1 07	1 05	1 03	1 05
701, plain, 4" thick	Mod 7	.61	1 10	1 20	1.11	1 08	1.09	1.10
701, plain, 1" thick	7	.56	.85	70	89	93	1.06	.85
701, plain, 2" thick	7	76	1 02	98	1 07	1 04	1.20	1.05
701, plain, 3" thick.	7	77	1 08	1.16	1 09	1 05	1.18	1.10
701, plain, 4" thick.	7	87	1 14	1.24	1.17	1.18	1.28	1.20
703, plain, 1" thick	4	03	.22	.69	.91	.96	.99	.70
703, plain, 2" thick	4	.22	82	1 21	1.10	1.02	1 05	1.05
703, plain, 3" thick	4	.53	1.19	1.21	1.08	1.01	1.04	1.10
703, plain, 4" thick	4	.84	1.24	1.24	1.08	1 00	.97	1.15
703, plain, 1" thick	Mod. 7	.33	28	62	.88	.96	1.04	.70
703, plain, 2" thick	Mod 7	38	63	1 10	1.07	1 05	1.05	95
703, plain, 3" thick	Mod 7	45	.98	1.17	1.06	1 00	1 02	1 05
703, plain, 4" thick	Mod 7	62	1 10	1.15	1.05	.99	1.01	1.05
703, plain, 1" thick	7	.65	94	.76	.98	1.00	1 14	.90
703, plain, 2" thick	7	66	.95	1 06	1 11	1.09	1.18	1.05
703, plain, 3" thick	7	66	.93	1.13	1.10	1.11	1.14	1 05
703, plain, 4" thick	7	65	1.01	1 20	1.14	1.10	1.16	1.10
705, plain, 1" thick	4	.08	25	74	.95	.97	1.00	.75
705, plain, 2" thick	4	.19	.74	1 17	1.11	1.01	1.01	1.00
705, plain, 3" thick	4	54	1.12	1.23	1.07	1 01	1.05	1.10
705, plain, 4" thick	4	.75	1.19	1.17	1.05	.97	98	1.10
705, plain, 1" thick	Mod. 7	.32	30	.66	.90	.95	1 01	70
705, plain, 2" thick	Mod. 7	39	.59	1.06	1.08	1.05	1.13	.95
705, plain, 3" thick	Mod. 7	.49	.93	1.15	1.06	.99	1.00	1.05
705, plain, 4" thick	Mod. 7	.57	1.06	1.13	1.02	.94	1.00	1 05
705, plain, 1" thick	7	.68	91	.78	.97	1.05	1.18	95
705, plain, 2" thick	7	62	.95	.98	1 07	1 09	1.22	1.00
705, plain, 3" thick	7	.66	.92	1.11	1.12	1.10	1.19	1.05
705, plain, 4" thick	7	.59	.91	1.15	1.11	1.11	1.19	1.10
703, FRK faced, 1" thick (2)	4	.12	.74	.72	.68	.53	.24	.65
703, FRK faced, 2" thick	4	.51	.65	.86	71	.49	.26	.70
703, FRK faced, 3" thick	4	84	.88	.86	.71	.52	.25	75
703, FRK faced, 4" thick	4	88	.90	.84	.71	.49	.23	75

(Table I–3 continued on next page.)

Table I-3 (continued)
Sound Absorption Coefficients,
(3) Fiberglas 700 Series Insulation

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz.						
703, FRK faced, 1" thick	Mod. 7	.31	.45	62	.65	.51	28	.55
703, FRK faced, 2" thick	Mod. 7	38	.51	83	73	53	.37	65
703, FRK faced, 3" thick	Mod. 7	56	.74	74	.67	48	23	65
703, FRK faced, 4" thick	Mod 7	70	.78	73	67	46	24	65
703, FRK faced, 1" thick	7	48	.60	80	82	52	35	70
703, FRK faced, 2" thick	7	50	61	99	83	.51	35	.75
703, FRK faced, 3" thick	7	.59	64	1 09	81	50	.33	75
703, FRK faced, 4" thick	7	61	69	1 08	81	48	34	75
705, ASJ faced, 1" thick (2)	4	.18	73	43	58	39	30	55
705, ASJ faced, 2" thick	4	61	45	35	32	.48	.31	40
705, ASJ faced, 3" thick	4	66	46	47	40	.52	31	.45
705, ASJ faced, 4" thick	4	65	52	42	36	49	.31	.45
705, ASJ faced, 1" thick	Mod 7	.25	48	28	57	39	30	45
705, ASJ faced, 2" thick	Mod 7	38	.36	39	37	56	38	40
705, ASJ faced, 3" thick	Mod 7	.48	44	40	31	52	29	.40
705, ASJ faced, 4" thick	Mod 7	60	39	34	29	47	30	.35
705, ASJ faced, 1" thick	7	45	.30	23	50	34	51	35
705, ASJ faced, 2" thick	7	53	40	31	54	33	51	40
705, ASJ faced, 3" thick	7	54	43	33	.58	.37	54	.45
705, ASJ faced, 4" thick	7	62	49	33	54	35	.50	45

Table I-4.
Sound Absorption Coefficients,
Insulation Products for
Acoustical/Thermal Applications

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
101-1"	4	16	24	49	.61	69	74	50
103-1"	4	16	26	49	60	70	.76	50
105-1"	4	.14	26	56	69	.78	83	55
107-1"	4	15	29	63	78	86	94	.65
109-1"	4	16	30	71	85	92	95	70
111-½"	4	06	08	30	55	72	87	40
113-½"	4	06	08	34	60	77	91	45
301-1½"	4	10	33	54	64	65	69	55
303-2½"	4	26	65	93	97	89	.93	85
501-1"	4	12	29	59	70	74	79	60
501-2"	4	20	67	1 08	99	93	96	90
503-1"	4	04	29	70	86	91	92	.70
503-2"	4	24	66	1 04	1 00	1 03	1.00	95
505-1"	4	12	36	70	88	89	92	.70
505-2"	4	29	72	1 13	1 06	1 00	1 02	1 00
507-1"	4	05	28	75	95	.99	95	.75
507-2"	4	19	79	1 13	1 08	1 02	99	1 00
721-1"	4	12	28	73	89	92	93	70
723-1"	4	03	22	69	91	96	.99	70
725-1"	4	08	25	74	95	97	1.00	75
721-2"	4	24	77	1 13	1.09	1 04	1 05	1 00
723-2"	4	22	82	1 21	1 10	1 02	1 05	1 05
725-2"	4	19	74	1 17	1 11	1.01	1 01	1 00

Table I-5
Sound Absorption Coefficients,
(3) Fiberglas Appliance Insulations.

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
HT-26, 1"	4	.18	.53	.89	92	.96	1 04	.85
HT-26, 4"	4	.56	1.18	1.09	.98	97	1.12	1.05
HT-23, 1¼"	4	.16	49	1.00	1.05	1.00	1.12	90
HT-23, 2½"	4	.41	1.12	1 38	1.18	1.10	1.10	1 20
RA-26, 1"	4	.18	.33	.65	.83	.86	.87	.65

Table I-6.
Sound Absorption Coefficients,
(3) Metal Building Insulation.

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
Metal Bldg. Insulation, 2"	4	.21	.63	1.10	.74	.33	.17	.70
Metal Bldg. Insulation, 3"	4	.38	.98	1.20	.62	.42	.24	.80
Metal Bldg. Insulation, 4"	4	.56	1.22	1.08	.64	.48	.23	.85
Cert. R-5, 1½", Vinyl 25 facing	Mod. 7	.33	.55	1.08	.94	.50	.37	.75
Cert. R-5, 1½", FSK facing	Mod. 7	.32	.52	1.12	.70	.36	.29	.70
Cert. R-5, 1½", VRF heavy duty facing	Mod. 7	.33	.48	1.07	.60	.33	.25	.60
Cert. R-5, 1½", VRF light duty facing	Mod. 7	.33	.48	1.07	.60	.33	.25	.60

Table I-7.
Sound Absorption Coefficients,
(3) Fiberglas Roof Form Board.

Product Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
1", plain	4	.04	.24	.70	.98	.99	.95	.70
1", mat faced	4	.13	.32	.81	.99	.97	.90	.75
1", plain, perforated metal panel	4	.29	.54	.71	.95	.93	.83	.80
1.5" adhered to gypsum slab	4	.25	.49	.98	.99	.91	.85	.85
2", adhered to gypsum slab	4	.33	.67	.99	.99	.94	.90	.90

Table I-8
Sound Absorption Coefficients of
Automotive Insulation

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
RF 210, 1"	4	.05	.24	.52	.66	75	.81	.55
RF 210, 1½"	4	.11	.30	.74	.87	.93	.95	.70
RF 220, ½"	4	.01	.12	.33	.56	.68	.83	.40
RF 220, 1"	4	.07	.26	.65	.86	.91	.93	.65
RF 240, ½"	4	.02	.08	.30	.58	.72	.89	.40

Table I-9
Sound Absorption Coefficients,
Glass Fiber Board
(High Density)

Product Type & Thickness	Mtg. (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
18-20 pcf glass fiberboard, ⅛" + 1" Type 723 Insulation	4	.15	.50	1.00	1.00	.97	.90	.85
18-20 pcf glass fiberboard, ⅛" + 1" Type 501 Insulation	4	.15	.61	.93	1.03	1.01	.88	.90
18-20 pcf glass fiberboard, ¼" + 1" Type 723 Insulation	4	.12	.64	.99	1.03	.97	.90	.90
18-20 pcf glass fiberboard, ¼" + 1" Type 501 Insulation	4	.26	.67	.94	1.04	.99	.89	.90
18-20 pcf glass fiberboard, ⅜" + 1" Type 723 Insulation	4	.13	.63	1.02	1.08	1.02	.95	.95
18-20 pcf glass fiberboard, ⅜" + 1" Type 501 Insulation	4	.21	.68	.99	1.08	1.05	.93	.95
18-20 pcf glass fiberboard, ⅛" + 1" Type 703 Insulation wrapped in 1.5 mil polyolefin film	4	.14	.57	1.08	1.01	.89	.65	.90
18-20 pcf glass fiberboard, ⅛"	7	.69	.77	.80	1.00	.96	.72	.90

(1) Mountings:
- No. 4—Material placed against a solid backing such as a block wall.
- No. 7 (Modified)—Material placed against 24 gauge sheet metal over a 16-inch air space. This mounting configuration is typical of a sheet metal enclosure with insulation on one side. (Data includes facings exposed to sound source, if specified)
- No. 7—Material placed over a 16-inch air space. (Data includes facings exposed to sound source, if specified)
- No. 6—Material placed over 24 ga. galvanized sheet metal with 1-inch air space.

(2) Facings:
- FRK: Foil-faced laminate with glass fiber reinforcing and a kraft backing.
- ASJ (All-Service Jacket): An embossed laminate of white kraft facing with glass fiber reinforcing and a foil backing.

(3) All tests were conducted according to ASTM C423-77, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. Sound absorption coefficients for each sample were measured over ⅓ octave bands and are reported at the preferred octave band center frequencies.

In some cases, the measured sound absorption coefficient is greater than 1.00. As recommended by the test method, these values are reported as measured and not adjusted. The corresponding NRC for a material may also be greater than 1.0 according to the ASTM test method. The Sound Absorption Coefficients of these materials are not significantly affected by coverings such as expanded metal, metal lath hardware cloth, screening, or Fiberglas cloth. When other coverings, having less open surfaces are required, consult an O-CF representative.

Table I-10
Sound Absorption Coefficients of Aeroflex Duct Liner

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
Aeroflex Type 150, 1"	6	.13	.51	.46	.65	.74	.95	.60
Aeroflex Type 150, 2"	6	.25	.73	.94	1.03	1.02	1.09	.95
Aeroflex Type 200, ½"	6	.10	.44	.29	.39	.63	.81	.45
Aeroflex Type 200, 1"	6	.15	.59	.53	.78	.85	1.00	.70
Aeroflex Type 200, 2"	6	.28	.81	1.04	1.10	1.06	1.09	1.00
Aeroflex Type 300, ½"	6	.09	.43	.31	.43	.66	.98	.45
Aeroflex Type 300, 1"	6	.14	.56	.63	.82	.99	1.04	.75
Aeroflex Type 150, 1"	4	.06	.24	.47	.71	.85	.97	.60
Aeroflex Type 150, 2"	4	.20	.51	.88	1.02	.99	1.04	.85
Aeroflex Type 300, 1"	4	.08	.28	.65	.89	1.01	1.04	.70

Table I-11
Sound Absorption Coefficients of Duct Liner Board

Product Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
		Octave Band Center Frequencies, Hz						
1"	6	.13	.51	.71	.97	1.01	1.15	.80
1½"	6	.25	.72	1.05	1.04	1.02	1.08	.95
2"	6	.31	.81	1.16	1.09	1.06	1.13	1.05

Table I-12.
Sound Absorption Coefficients, Miscellaneous Materials.

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
			Octave Band Center Frequencies, Hz					
Concrete block, unpainted	4	.36	.44	.31	.29	.29	.25	.35
Concrete block, painted	4	.10	.05	.06	07	.09	.08	.05
Navy Board, 1"	4	.07	.29	.82	1.00	.96	.90	.75
Navy Board, 1"	7	.60	.79	.71	.87	.92	1.05	.80
Navy Board, 2"	7	.53	.68	.74	.73	.72	.60	.70
Foam (open cell), ½"	4	.06	.12	.25	.57	.84	.90	.45
Foam (open cell), 1"	4	.13	.26	.48	.90	.95	.88	.65

Table I-13.
Sound Absorption Coefficients, Insul-Quick Insulation.

Product Type & Thickness	Mounting (1)	125	250	500	1000	2000	4000	NRC
			Octave Band Center Frequencies, Hz					
Insul-Quick Insulation, 2"	4	.21	.66	1.16	1.11	.99	1.18	1.00
Insul-Quick Insulation, 2"	7	.79	1.03	1.01	1.11	1.10	1.32	1.05
Insul-Quick Insulation, 2"	Mod. 7	.33	.57	1.10	1.10	1.03	1.28	.95

Table I-14.
*Sound Absorption Coefficients, Fiberglas Wall Treatments.**

Product Type & Thickness	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
Type 723, 1" thick, unfaced (1)	06	.20	65	.90	.95	98	.70
Type 723, 1" thick, + ¼" pegboard (2)	.08	32	1.13	.76	.34	.12	65
Type 723, 1" thick, + ⅛" pegboard (3)	.09	.35	1.17	58	24	.10	.60
TIW Type I, 1" thick, unfaced	.11	.33	.70	.80	86	.85	.75
TIW Type I, 1" thick + ¼" pegboard	.08	.41	1.00	.82	26	.32	.60
Nubby Glass Cloth Board, 1"	.04	21	.73	1.00	1.01	90	.75
Linear Glass Cloth Board, 1"	.03	.17	.63	.87	.96	.96	.65
Type 723, 2" thick, unfaced	.18	.76	1.16	1.07	1.02	1.02	1.00
Type 723, 2" thick + ¼" pegboard	26	97	1.12	.66	.34	.14	.75
Type 723, 2" + perforated metal (4)	.18	.73	1.14	1.06	.97	.93	1.00
Type 723, 1" + 1" Linear Glass Cloth	18	.71	1.19	1.08	1.04	1.02	1.00
Type 723, 1" + 1" Nubby Glass Cloth	25	76	1.16	1.06	99	.97	1.00
TIW Type I, 2" thick, unfaced	.25	.75	1.03	1.07	.95	1.00	95
TIW Type I, 2" thick + ¼" pegboard	.26	89	1.16	.58	.26	.17	.75
TIW Type I, 2" + perforated metal	25	64	1.03	97	.88	.92	.90
TIW Type I, 1" + 1" Linear Glass Cloth	.23	.72	1.12	1.09	1.03	1.02	1.00
TIW Type I, 1" + 1" Nubby Glass Cloth	26	75	1.14	1.09	1.00	1.00	1.00
1" Air Space + 1" Linear Glass Cloth	04	26	78	1.01	1.02	.98	.75
Type 723, 3" thick, unfaced	53	1.17	1.19	1.03	1.02	.102	1.10
Type 723, 3" thick + ¼" pegboard	.49	1.26	1.00	69	37	.15	.85
Type 723, 2" thick + 1" Linear Glass Cloth	59	1.12	1.19	1.05	1.00	1.04	1.10
Type 723, 2" thick + 1" Nubby Glass Cloth	50	1.12	1.18	1.02	.99	.97	1.10
TIW Type I, 3" thick, unfaced	.46	1.03	1.20	1.06	1.02	1.10	1.10
TIW Type I, 3" thick + ¼" pegboard	.53	1.16	97	.51	.32	.16	.75
TIW Type I, 2" + 1" Linear Glass Cloth	48	1.00	1.18	1.05	1.00	1.03	1.05
TIW Type I, 2" + 1" Nubby Glass Cloth	.51	1.01	1.17	1.03	98	.99	1.05
2" Air Space + 1" Linear Glass Cloth	17	.40	.94	1.05	.97	.99	.85
Type 723, 4" thick, unfaced	1.00	1.16	1.10	1.00	.98	98	1.05
Type 723, 4" thick + ¼" pegboard	.80	1.19	1.00	.71	.38	.13	.80
Type 723, 3" thick + 1" Linear Glass Cloth	.88	1.15	1.11	1.02	93	.98	1.05
Type 723, 3" thick + 1" Nubby Glass Cloth	.75	1.17	1.12	1.02	1.02	97	1.10
TIW Type I, 4" thick, unfaced	57	1.21	1.23	1.06	1.06	1.05	1.15
TIW Type I, 4" thick + ¼" pegboard	.70	1.29	94	.58	.37	.19	.80
TIW Type I, 3" + 1" Linear Glass Cloth	.77	1.19	1.18	1.05	1.05	1.12	1.10
TIW Type I, 3" + 1" Nubby Glass Cloth	71	1.16	1.16	1.05	1.02	.92	1.10
3" Air Space + 1" Linear Glass Cloth	.19	.53	1.03	1.04	.92	1.00	.85
Type 723, 5" thick, unfaced	.95	1.16	1.12	1.03	1.04	1.06	1.10
Type 723, 5" thick + ¼" pegboard	.98	1.10	99	.71	.40	.20	.80
Type 723, 4" + 1" Linear Glass Cloth	.87	1.08	1.08	1.03	1.04	1.04	1.05
Type 723, 4" + 1" Nubby Glass Cloth	.88	1.06	1.07	1.05	1.00	.96	1.05
TIW Type I, 5" thick, unfaced	.83	1.32	1.16	1.04	1.06	1.07	1.15
TIW Type I, 5" thick + ¼" pegboard	.78	1.22	.89	.63	.34	.14	.75
TIW Type I, 4" + 1" Linear Glass Cloth	.77	1.15	1.10	1.02	1.01	1.02	1.05
TIW Type I, 4" + 1" Nubby Glass Cloth	.79	1.18	1.11	1.01	1.00	.98	1.10
Type 723, 6" thick, unfaced	1.09	1.15	1.13	1.05	1.04	1.04	1.10
Type 723, 6" thick + ¼" pegboard	.95	1.04	.98	.69	.36	.18	.75
Type 723, 5" + 1" Linear Glass Cloth	1.04	1.10	1.11	1.04	1.09	.99	1.10
Type 723, 5" + 1" Nubby Glass Cloth	.92	1.08	1.08	1.04	1.03	1.01	1.05
TIW Type I, 6" thick, unfaced	.93	1.35	1.17	1.10	1.09	1.04	1.20
TIW Type I, 6" thick + ¼" pegboard	.95	1.21	.88	.64	.36	.17	.75
TIW Type I, 5" + 1" Linear Glass Cloth	.87	1.16	1.08	1.06	1.04	1.02	1.10
TIW Type I, 5" + 1" Nubby Glass Cloth	.92	1.15	1.07	1.05	1.01	.93	1.05
5" Air Space + 1" Linear Glass Cloth	.41	.73	1.02	.98	.94	.97	.90
Type 723, 6" + 1" Linear Glass Cloth	.86	1.02	1.10	1.04	1.06	1.10	1.05
Type 723, 6" + 1" Nubby Glass Cloth	.85	1.02	1.09	1.06	1.05	1.04	1.05
TIW Type I, 6" + 1" Linear Glass Cloth	95	1.14	1.09	1.07	1.03	.99	1.10
TIW Type I, 6" + 1" Nubby Glass Cloth	94	1.14	1.06	1.04	1.01	.94	1.05

*All material combinations installed and tested against a solid wall (i.e. #4 mounting). In some cases, the measured sound absorption is greater than 1.00. As recommended by the test method, these values are reported as measured and not adjusted. The corresponding NRC for a material may also be greater than 1.0 according to the ASTM test method.

(1) Absorption values would be unchanged for open facings such as wire mesh, metal lath, or porous fabric.
(2) Perforated with ¼" holes, 1" o.c.
(3) Perforated with ⅛" holes, 1" o.c.
(4) 24 gauge, $\frac{3}{32}$" holes, 13% open area.

Note: Equivalent thicknesses of Owens-Corning 501 Insulation may be substituted for TIW Type 1 in this table, providing equal or better sound absorption coefficients.

Table I-15
Sound Absorption Coefficients of Standard and Energy Saving Ceiling Panels, Film Faced

Product Type & Thickness	Mounting (1)	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
Shasta ⅝"	7	68	.76	.60	.65	.82	.76	.70
Shasta ¾"	7	72	.84	.70	.79	.76	81	.75
Shasta 1"	7	76	.84	.72	89	85	.81	85
Random Fissured ⅝"	7	.70	.75	58	63	78	.73	70
Random Fissured ¾"	7	68	.81	68	78	.85	80	80
Random Fissured 1"	7	.74	85	68	.86	.90	79	80
Stonebrooke 1"	7	56	.63	.69	83	71	.55	70
Stonebrooke 2"	7	.52	82	.88	91	.75	.55	.85
Stonebrooke 3"	7	.64	.88	1 02	.91	.84	.62	.90

Table I-16
Sound Absorption Coefficients of Glass Cloth Acoustical Ceiling Panels

Product Type & Thickness	Mounting (1)	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
Nubby ¾"	7	.73	.93	72	.91	1.07	1 13	.90
Nubby 1"	7	59	93	77	.97	.99	1.10	.90
Nubby 1½"	7	64	.86	92	1.02	1 02	1.15	.95
Omega ¾"	7	71	82	65	83	86	1.05	80
Omega 1"	7	71	89	76	98	.98	1.06	90
Omega 1½"	7	.74	.90	85	1 03	1.00	1 03	.95

Table I-17.
Sound Absorption Coefficients of Owens-Corning Sound Divider.

Product	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
Sound screens, 5 feet high	.20	41	1 01	99	98	98	85

Table I-18.
Sound Absorption Coefficients of Owens-Corning Wall Panels.

Product	Mounting	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	NRC
Owens-Corning Wall Panels	4	.08	.30	88	1 06	1 04	97	80

Table I-19.
Sound Absorption Values in sabins / unit for Miscellaneous Fiberglas Materials.

Product Type	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000
23"x48"x1½" Fiberglas, 4.7 pcf wrapped with a plastic film hung vertically in rows 4" O.C. spacing (sabins / unit)	2.1	5 9	9 8	13 3	11.6	7.6
Pipe Insulation, 1" I.D., 3" O.D hung vertically in a single row—6" O.C. spacing (sabins / 9 ft. length)	33	1.24	3 49	5 93	7.35	8 90
Pipe Insulation, 1" I.D., 3" O.D. hung vertically—in a single row 12" O.C. spacing (sabins / 9 ft. length)	.22	1 13	3 69	7 83	9.52	10 32

(1) Mountings:

- No. 4—Material placed against a solid backing such as a block wall.
- No. 7—Material placed over a 16-inch air space. (Data include facings exposed to sound source, if specified)

Section II
Sound Transmission Loss Materials

Table II-1
Sound Insertion Loss in dB of Fiberglas Reinforced Plastics (1)*

Product Type & Thickness	125	250	500	1000	2000	4000	NIC
	Octave Band Center Frequencies, Hz						
FRP, ⅛" thick (1.13 psf) (2)	15	18	25	26	29	36	27
FRP, ¼" thick (2.08 psf)	19	22	28	31	32	25	29
FRP, ½" thick (4.20 psf)	21	27	29	34	27	36	29

Table II-2
Sound Insertion Loss in dB of Typical Building Materials (1)*

Product Type & Thickness	125	250	500	1000	2000	4000	NIC
	Octave Band Center Frequencies, Hz						
Plywood, ½" (1.33 psf) (2)	17	20	23	23	23	24	21
Plywood, ¾" (2.0 psf)	19	23	27	25	22	30	24
Sheet metal, 16 gauge (2.38 psf)	18	22	28	31	35	41	31
Sheet metal, 20 gauge (1.5 psf)	16	19	25	27	32	39	27
Sheet metal, 24 gauge (1.02 psf)	13	16	23	24	29	36	25
Gypsum board, ½" (1.80 psf)	18	22	26	29	27	26	26
Gypsum board, ⅝" (2.20 psf)	19	22	25	28	22	31	26
Single strength glass, 3/32" (1.08 psf)	15	18	25	26	28	29	26
Double strength glass, ⅛" (1.40 psf)	16	19	25	29	30	20	24
Plate glass, ¼" (2.78 psf)	20	25	26	30	23	30	27
Thermoplastic, ⅛" (.75 psf) (Acrylic Plexiglas)	14	17	22	24	27	34	24
Thermoplastic, ¼" (1.45 psf) (Acrylic Plexiglas)	16	19	26	27	30	29	27
Thermoplastic, ½" (2.75 psf) (Acrylic Plexiglas)	20	24	27	30	29	35	29
Lead vinyl (1.25 psf)	17	19	28	30	34	39	29

Table II-3
Sound Insertion Loss in dB of Special Constructions (1)

Construction Type	125	250	500	1000	2000	4000	NIC
			Octave Band Center Frequencies, Hz				
Lead vinyl, 1.25 lb/ft² + 2½" air space + lead vinyl, 1.25 lb/ft²	12	34	31	37	43	48	34
Lead vinyl, 1.25 lb/ft² + 2½" Fiberglas RB batt + lead vinyl, 1.25 lb/ft²	25	34	38	43	47	58	42
Sheet metal, 16 gauge + 2½" air space + sheet metal, 16 gauge	23	33	34	37	38	48	37
Sheet metal, 16 gauge + 2½" Fiberglas RB batt + sheet metal, 16 gauge	26	33	36	38	41	51	38
Sheet metal, 16 gauge + 2½" Fiberglas RB batt + sheet metal, 24 gauge	20	36	37	41	44	52	40
Sheet metal, 20 gauge, with 1" 475 FR duct board	18	17	30	38	47	55	32
Sheet metal, 20 gauge, with 2 layers of 1" 475 FR duct board	15	18	35	42	51	56	32
Sheet metal, 20 gauge, with 3 layers of 1" 475 FR duct board	16	23	40	46	52	61	31
Sheet metal, 16 gauge with 4½" thick InsulQuick with 4 inch Ribbed Aluminum (.040" thick)	31	45	48	58	64	64	50
Sheet metal, 16 gauge with 4½" TIW with 4 inch Ribbed Aluminum (.040" thick)	25	43	48	56	63	61	48
2 layers 1" 703 insulation	7	6	5	10	16	20	11
2 layers 1" 703 FRK insulation, back to back	9	10	7	15	23	31	14

*Sound insertion loss and transmission loss data for each sample were measured over ⅓ octave bands. The ⅓ octave band data was required according to ASTM test methods to determine the single number NIC and STC ratings. Data are reported only at the preferred octave band center frequencies.

(1) The sound insertion loss in this table is the difference between sound pressure levels measured at the center of a 2 foot square opening in the wall of a reverberation chamber excited by sound before and after a material is inserted in the opening.
(2) The surface weight of each material in pounds per square foot has been listed. Materials weighing the same as any of these materials would be expected to provide similar results.

Table II-4
Sound Insertion Loss in dB* of Plywood Enclosures (1)

Construction Type	125	250	500	1000	2000	4000	NIC
	Octave Band Center Frequencies, Hz						
Plywood enclosure, ½" unlined	13	11	12	12	13	15	13
Plywood enclosures, ½" lined with 1" OCF 703 board	18	17	23	30	38	>40	28
Plywood enclosure, ½" lined with 2" OCF 703 board	18	23	30	37	45	>50	34
Plywood enclosure, ½" lined with 4" OCF 703 board	19	29	38	47	58	·60	39
Plywood enclosure, ½" lined with 3⅝" R-13, full wall	17	25	29	36	41	>45	34

(1) Insertion loss data are the difference between the average sound pressure levels measured in a reverberation room before and after a plywood enclosure with exterior dimension of 3' x 4' x 5' is placed over the source of sound.

Table II-5
Sound Insertion Loss in dB* of Pipe Insulation (1)

Pipe Insulation	Insulation Thickness	250	500	1000	2000	4000
		Octave Band Center Frequencies, Hz				
Urethane (outer layer 1" thick) plus Fiberglas (inner layer), no covering	1" Fiberglas	0	3	11	15	21
	2" Fiberglas	0	5	13	16	24
	3" Fiberglas	1	5	14	16	23
Fiberglas with .06 lb/sq. ft. jacket	1" Fiberglas	0	5	9	14	20
	2" Fiberglas	0	6	13	20	27
	3" Fiberglas	2	8	15	22	29
Fiberglas with 0.25 lb/sq. ft. 16 mil aluminum jacket	1" Fiberglas	1	6	14	19	26
	2" Fiberglas	1	6	15	21	28
	3" Fiberglas	2	8	18	23	30
Fiberglas with 1.40 lb/sq. ft. jacket	1" Fiberglas	2	9	18	22	29
	2" Fiberglas	4	11	18	23	29
	3" Fiberglas	4	13	20	24	30
Kaylo—no covering	1½" Kaylo	0	2	6	9	12
	3" Kaylo	0	0	3	7	10
Kaylo with 0.25 lb/sq. ft. 16 mil aluminum jacket	1½" Kaylo	1	4	8	12	20
	3" Kaylo	0	3	6	10	17
Kaylo (inner layer—1½" thickness) plus Fiberglas (outer layer—1½" thickness) 0.25 lb/sq. ft. 16 mil aluminum jacket		I	8	20	21	28
Urethane with .06 lb/sq. ft. jacket	1" Urethane	0	0	0	1	9
	2" Urethane	0	0	0	2	10
	3" Urethane	0	0	1	3	10
ED-100 Duct Wrap (1" thick, FRK faced)	1 Layer	0	4	7	13	18
	2 Layers	0	8	13	20	30
	3 Layers	0	12	19	23	31
Thermal Insulating Wool (TIW) Type 1 (1" thick, FRK faced)	1 Layer	0	2	7	12	18
	2 Layers	0	6	12	16	23
	3 Layers	2	10	17	19	25

(1) Insertion loss data in this table are the difference between the average sound pressure levels measured in a reverberation room before and after a 12 inch diameter steel pipe containing a loudspeaker was covered with insulation.

*Sound insertion loss and transmission loss data for each sample were measured over ⅓ octave bands. The ⅓ octave band data was required according to ASTM test methods to determine the single number NIC and STC ratings. Data are reported only at the preferred octave band center frequencies.

Table 11-6
Sound Transmission Loss in dB of Metal Building Walls (1).

Construction Type	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	STC
Metal Building Wall	12	14	15	21	21	25	20
Metal Building Wall with 2" MB Insulation	11	15	16	29	31	37	24
Metal Building Wall with 3" MB Insulation	12	16	18	31	32	39	25
Metal Building Wall with 4" MB Insulation	11	17	21	34	35	42	27

Table II-7
Sound Transmission Loss in dB of Metal Stud Wall Construction (1).

Construction Type	Octave Band Center Frequencies, Hz 125	250	500	1000	2000	4000	STC
2½" metal studs, 24" O.C., ½" Gypsum wallboard both sides	18	25	42	47	51	41	37
2½" metal studs, 24" O.C., ½" Gypsum wallboard both sides, with R-8 Fiberglas insulation	24	41	52	58	58	47	45
2½" metal studs, 24" O.C., 2 layers, ½" Gypsum wallboard both sides	27	34	47	52	57	50	46
2½" metal studs, 24" O.C., 2 layers ½" Gypsum wallboard both sides with R-8 Fiberglas insulation	32	39	53	58	60	53	51
3⅝" metal studs, 24" O.C., ½" Gypsum wallboard both sides	25	28	42	49	50	40	39
3⅝" metal studs, 24" O.C., ½" Gypsum wallboard both sides, with 3½" R-11 Fiberglas insulation	28	39	52	56	58	46	44
3⅝" metal studs, 24" O.C., 2 layers ½" Gypsum wallboard one side, 1 layer ½" Gypsum wallboard on other side	29	35	48	51	53	46	45
3⅝" metal studs, 24" O.C., 2 layers ½" Gypsum wallboard one side, 1 layer ½" Gypsum wallboard on other side with R-11 Fiberglas insulation	34	43	52	56	59	49	49
3⅝" metal studs, 24" O.C., 2 layers ½" Gypsum wallboard each side	34	42	53	56	58	52	50
3⅝" metal studs, 24" O.C., 2 layers ½" Gypsum wallboard each side with R-11 Fiberglas insulation	40	48	59	60	62	57	56

(1) All tests were conducted according to ASTM E90-75, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions. The transmission loss for each sample was measured over ⅓ octave bands in order to determine a single number STC rating. Transmission loss data are reported only at the preferred octave band center frequencies.

Table II-8
Sound Transmission Loss in dB of Wood Stud Wall Constructions (1).

Construction Type	Octave Band Center Frequencies, Hz						
	125	250	500	1000	2000	4000	STC
2x4 wood studs, 16" O.C., ½" Gypsum wallboard both sides	15	27	36	42	47	40	35
2x4 wood studs, 16" O.C., ½" Gypsum wallboard with R-11 Fiberglas insulation	15	31	40	46	50	42	39
2x4 wood studs, 16" O.C., 2 layers of ½" Gypsum wallboard on one side, 1 layer of ½" Gypsum wallboard on other side	17	32	40	45	50	45	38
2x4 wood studs, 16" O.C., 2 layers of ½" Gypsum wallboard on both sides	15	35	43	48	53	50	39
2x4 wood studs, 16" O.C., resilient channel one side, ½" Gypsum wallboard both sides	15	32	40	49	52	45	39
2x4 wood studs, 16" O.C., resilient channel one side, ½" Gypsum wallboard both sides, with R-11 Fiberglas insulation	22	40	53	57	58	50	46
2x4 wood studs, 24" O.C., ½" Gypsum wallboard both sides	26	30	42	48	51	42	42
2x4 wood studs, staggered construction, 24" O.C., ½" Gypsum wallboard both sides, with R-11 Fiberglas insulation	31	37	47	52	56	50	49
2x4 wood studs, 16" O.C., double stud construction, ½" Gypsum wallboard both sides	30	41	45	50	55	49	47
2x4 wood studs, double stud construction, 16" O.C., ½" Gypsum wallboard both sides, with R-11 Fiberglas insulation	32	48	57	63	64	61	56
2x4 wood studs, double stud construction, ½" Gypsum wallboard both sides, with 2 layers R-11 Fiberglas insulation	36	48	59	64	66	63	59

Table II-9
Sound Transmission Loss in dB of Miscellaneous Materials (1).

Construction Type	Octave Band Center Frequencies, Hz						
	125	250	500	1000	2000	4000	STC
Sheet metal, 22 gauge	16	20	24	29	35	43	29
Gypsum board, ⅝"	19	19	28	30	29	32	27
Aluminum panel	9	10	13	15	20	21	16
Aluminum panel with 2" Insul-Quick Insulation, Aluminum foil	12	15	21	29	36	39	26
Aluminum panel with 4" Insul-Quick Insulation, Aluminum foil	15	20	27	38	47	51	31
Aluminum panel with 2" Insul-Quick Insulation, sheet lead (1 PSF)	12	27	38	48	53	54	34
3/16" Steel wall	29	31	30	32	33	31	31
3/16" Steel duct wall, 4" TIW insulation, with 16 gauge sheet metal	42	44	43	50	54	60	49

(1) All tests were conducted according to ASTM E90-75, Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions. The transmission loss for each sample was measured over ⅓ octave bands in order to determine a single number STC rating. Transmission loss data are reported only at the preferred octave band center frequencies.

Section III
Duct & Duct Liner Materials

Table III-1
Duct Attenuation in dB per lineal foot of Fiberglas Duct Liner (1)

(1) = Tested at air velocity of 2000 fpm.
(2) = P/A 3 based on 12"x24" duct.
P/A 4 based on 12"x12" duct.
P/A 5 based on 8" x 12" duct.
P/A 6 based on 6"x12" duct.
P/A 8 based on 6"x6" duct.
*P/A = The inside perimeter of a lined duct in feet divided by the cross sectional free area of the duct in square feet.

		Octave Band Center Frequencies, Hz					
Product	P/A*(2)	125	250	500	1000	2000	4000
Aeroflex duct liner, Type 150, 1" thick	3	.5	.5	1.5	2.8	4.0	2.7
	4	.6	.8	2.0	3.4	3.9	3.6
	5	.5	1.2	2.1	3.4	5.1	3.8
	6	.2	1.1	2.4	3.5	3.9	3.7
	8	.4	1.7	3.1	4.0	4.8	4.4
Aeroflex duct liner, Type 150, 2" thick	3	.9	1.1	3.2	4.6	3.5	2.6
	4	.9	1.5	3.0	4.1	3.9	3.8
	5	.5	1.8	3.4	4.7	5.3	4.1
	6	.4	1.3	3.1	3.6	3.9	3.5
	8	.4	1.8	3.7	4.2	4.8	4.4
Aeroflex duct liner, Type 200, 1" thick	3	.7	.6	1.7	2.9	4.1	2.8
	4	.6	.7	2.0	3.4	4.1	3.7
	5	.2	1.1	2.1	3.5	5.3	3.8
	6	.3	1.0	2.4	3.4	3.8	3.4
	8	.4	1.7	2.9	3.9	4.6	4.4
Duct liner board, 1" thick	3	.4	.5	1.7	4.4	3.8	2.2
	6	.3	.9	2.7	4.7	5.2	4.1
Duct liner board, 2" thick	3	.6	1.0	3.8	4.7	3.6	2.3
	6	4	2.0	4.1	4.7	5.1	3.7

Note: Attenuation data for duct liners are based on sound pressure levels measured in a reverberation room after sound passes through a 10-foot specimen and enters the reverberation room. These tests were conducted according to ASTM method E477-73. Attenuation data for other duct systems may differ from these values, and may be higher or lower depending on the distribution of sound energy in various propagating duct modes, length of lined (or unlined) duct sections which create discontinuities in the boundary conditions along the perimeter, and exit conditions at duct terminations.

Table III-2
Duct Attenuation in dB per lineal foot of OCF Duct Board (1)

(1) = Tested at air velocity of 1200 fpm.
(2) = P/A 3 based on 12"x24" duct.
P/A 6 based on 6"x12" duct.
*P/A = The inside perimeter of a lined duct in feet divided by the cross sectional free area of the duct in square feet.

		Octave Band Center Frequencies, Hz					
Product	P/A*(2)	125	250	500	1000	2000	4000
Type 475 FR, 1" thick	3	1.1	.9	2.3	3.3	3.8	2.1
	6	.4	1.4	3.3	3.9	5.0	3.7
Type 800 FR, 1" thick	3	1.0	.8	2.4	3.4	3.9	2.2
	6	.3	1.4	3.4	4.1	5.2	4.0

Table III-3
Duct Attenuation in dB per lineal foot of INL 25 Flexible Duct

		Octave Band Center Frequencies, Hz					
Product	Dia	125	250	500	1000	2000	4000
INL-25 Flexible Duct 1¼ inch wall thickness	4"	.7	1.3	4.2	4.1	4.1	3.0
	5"	1.2	1.4	2.6	3.9	4.0	2.6
	6"	1.3	1.4	3.2	4.0	4.1	2.4
	7"	1.1	1.7	3.1	3.9	3.8	2.0
	8"	.8	1.3	3.3	3.6	3.3	1.9
	9"	.8	1.3	2.8	3.6	3.6	1.8
	10"	.6	1.1	3.0	3.4	3.0	1.7
	12"	.8	1.4	2.7	3.1	2.9	1.3
	14"	.3	.6	2.6	3.1	2.7	1.2
	16"	.4	.6	1.7	2.4	2.1	1.0

All tests were conducted according to the Air Diffusion Council, Flexible Air Duct Test Code FD72. The data presented here are reduced from insertion loss tests on a 9 foot length of duct at an air velocity of 2,500 feet per minute.

Table III-4
Radiated Noise Reduction for Ducts lined with Duct Liner(1)

Product Type & Thickness	P/A*(2)	125	250	500	1000	2000	4000
		Octave Band Center Frequencies, Hz					
Aeroflex Duct Liner, Type 150, 1"	3	10	14	20	25	31	32
	4	10	13	26	29	34	35
	5	5	13	22	26	30	31
	6	2	11	22	26	32	33
	8	2	10	14	20	24	29
Aeroflex Duct Liner, Type 150, 2"	3	13	16	24	30	36	37
	4	12	15	27	31	34	36
	5	7	17	24	26	30	33
	6	5	14	26	28	31	34
	8	3	11	16	20	25	28
Aeroflex Duct Liner, Type 200, 1"	3	10	13	23	28	30	27
	4	10	13	26	30	34	36
	5	4	14	24	27	30	32
	6	2	14	24	27	30	32
	8	2	14	19	25	29	34
Duct Liner Board, 1"	3	9	13	24	25	30	35
	6	4	16	26	30	33	36
Duct Liner Board, 2"	3	12	17	28	30	37	42
	6	4	16	23	28	33	34

Table III-5.
Radiated Noise Reduction of Duct Board (1).

Product Type & Thickness	P/A*(2)	125	250	500	1000	2000	4000
		Octave Band Center Frequencies, Hz					
475 FR, 1"	3	1	5	12	13	16	20
	6	3	11	15	18	22	25
800 FR, 1"	3	1	4	15	13	19	22
	6	3	11	20	18	24	26

(1) Radiated Noise reduction, sidewall attenuation, is determined in accordance with the Air Diffusion Council's "Flexible Air Duct Test Code FD72", paragraph 3.2.3. Tests were conducted on a 10 foot length of 24 gauge sheet metal duct with duct liner.

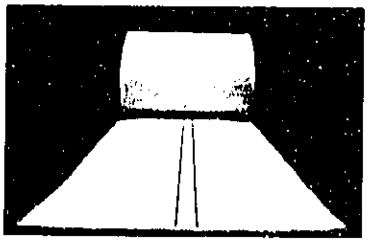
(2) = P/A 3 based on 12"x24" duct.
P/A 4 based on 12"x12" duct.
P/A 5 based on 8" x 12" duct.
P/A 6 based on 6"x12" duct.
P/A 8 based on 6"x6" duct.
*P/A = The inside perimeter of a lined duct in feet divided by the cross sectional free area of the duct in square feet.

Owens-Corning Acoustical Products Selection Guide

Products of Owens-Corning Fiberglas Corporation best suited for industrial noise control applications are described on the following pages.

Brief product descriptions are included in this selection guide; complete product data is included in the O-CF publications referred to in the guide. Copies of these publications may be obtained by using the prepaid inquiry cards in the back of this manual, or by calling your nearest Owens-Corning office (listed on the back cover).

Owens-Corning manufactures many other products which have not been included in this selection guide because of their limited applicability to industrial noise control problems. For a special application or a particular problem, contact a qualified acoustical consultant. Your nearest Owens-Corning Systems Building Organization Office can provide a list of consultants in your area and is prepared to assist in selecting the best materials for your application.

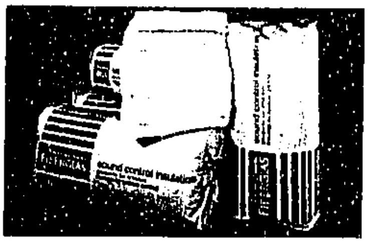


Fiberglas Metal Building Insulation

Use: These acoustical/thermal insulations are manufactured specifically for use in the roofs and side walls of pre-engineered buildings. They provide an effective moisture barrier to control condensation.

Description: Fibrous glass blankets faced with a choice of functional finishes. Available with "R" values of 5 to 13 in widths of 3, 4, and 6 feet, lengths of 50 to 200 ft.

Request O-CF Publication 1-MB-6310.

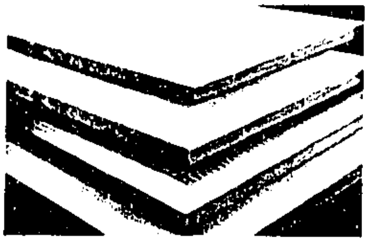


Fiberglas Noise Barrier Batts

Use: As sound energy absorbers inside wood or metal stud walls, to absorb noise within the cavity. Applied simply by pressing into place. They fit by friction; no adhesive or staples are needed. Exposed or covered with perforated metal, expanded metal lath, etc., they are excellent sound absorbers.

Description: Blankets of unfaced light-density fibrous glass insulation in 16" and 24" widths, 8 ft. long, 2.5" and 3.5" thickness.

Request O-CF Publications 1-AC-7197, 5-CW-7654

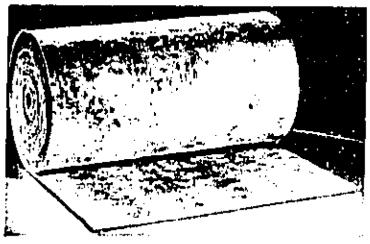


Fiberglas 700 Series Insulation

Use: As sound energy absorbers applied to the inside of noise enclosures, or to sound-absorbing barriers. They may also be used as space absorbers.

Description: Rigid to semi-rigid rectangular boards of fibrous glass insulation, available in various densities; unfaced, foil reinforced kraft faced, or all-service jacket sizes 2 x 4 feet, thicknesses 1" to 4".

Request O-CF Publications 1-IN-6964, 1-IN-6360.

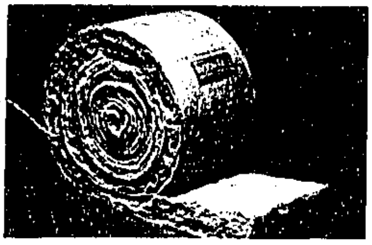


Fiberglas Appliance Insulation—Type RA

Use: As sound energy absorbers in housings or enclosures, or as space absorbers, exposed or covered with perforated or expanded metal, pegboard, etc.

Description: Porous, light-density, fibrous glass insulation, unfaced, in batts or rolls, thicknesses from ¾" to 5¾", in various densities.

Request O-CF Publication 1-AET-7799.



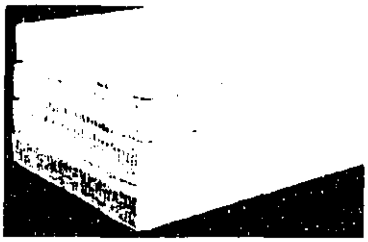
Fiberglas Building Insulation

Use: As sound energy absorber inside wood or metal stud walls, or in floors to absorb noise within the cavity. Exposed or covered with perforated metal, expanded metal lath, etc., they are excellent sound absorbers.

Description: Porous, light-density, fibrous insulation available unfaced or FRK-faced (Flame Spread 25). Also available with kraft or foil facings, which are combustible and should not be left exposed; cover with code-approved interior finish. Widths to fit 16" and 24" framing. Consult manufacturer's literature for facings, sizes, and thicknesses currently available.

Request O-CF Publications 1-BL-6066, 1-BL-9506, 5-BL-9033A, 5-BL-9328, and 5-BL-9329.

Thermal Insulating Wool

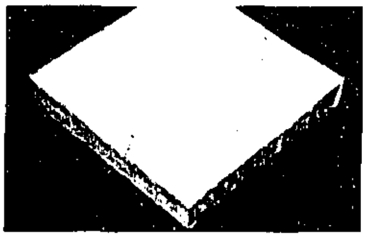


Use: As thermal and sound absorbing industrial insulation for temperatures up to 1000°F. Type I lightweight for use in panel systems, flexible wraps, ovens, or irregular surfaces. Type II metal mesh blankets, boilers, vessals, and industrial equipment.

Description: Type I, lightweight and flexible in rolls up to 4 inches thickness and 76 feet in length. Type II, semi-rigid in 24"x48" and 24"x96" sizes.

Request O-CF Publication 1-IN-5035.

Fiberglas Insul-Quick Insulation

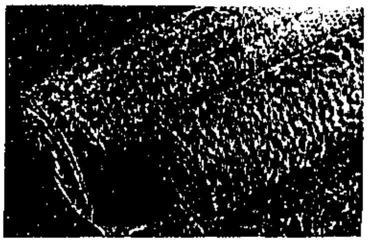


Use: As sound energy absorbers in high-temperature applications (to 950F). Designed for use on boilers, breechings, and heated equipment.

Description: Light-weight, semi-rigid boards of fibrous glass insulation, foil faced or unfaced, sizes to 4' x 8', thicknesses to 6".

Request O-CF Publication 1-IN-3381.

Aerocor PF-3300 Series Insulations

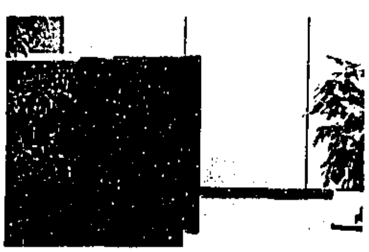


Use: As sound energy absorbers in equipment housings, or applied directly to noise-producing equipment.

Description: Flexible, resilient fibrous glass blankets in thicknesses to 4" and various densities.

Request O-CF Publication 1-AET-7800

Owens-Corning Sound Dividers and Wall Panels



Use: As sound barriers or as sound-absorbing wall treatments in office interiors. Sound dividers are free-standing, can be assembled in various configurations. Wall panels can be hung or applied with magnetic strips to all kinds of vertical surfaces.

Description: Acoustical panels, with Fiberglas sound absorbing cores, sound-blocking aluminum septum, and stain-resistant Dacron-polyester fabric finishes, available in various heights and lengths.

Request O-CF Publications 1-AC-7815 (Sound Dividers)
5-AC-7405 (Wall Panels)
5-AC-4250 (Wall Treatments)

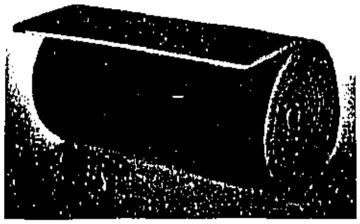
Fiberglas Ceiling Boards and Panels

Use: For application in standard exposed-T ceiling grids to provide acoustically and esthetically satisfying building interiors. Thicknesses to 3" provide effective thermal insulation and sound absorption at the ceiling line.

Description: Fibrous glass ceiling boards and panels available with decorative facings; vinyl film-faced, glass cloth. Size range from 2 x 2 feet to 5 x 5 feet.

Request O-CF Publications 1-AC-7523 (Glass Cloth Faced)
1-AC-6690 (Film-Faced)

Fiberglas Mat Faced Equipment Insulation

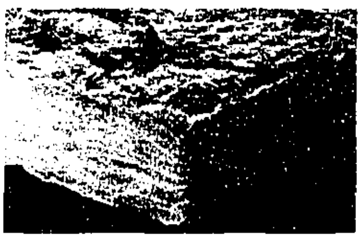


Use: As sound energy absorbers in housings or enclosures where moisture may be a problem.

Description: Flexible fibrous glass insulations having smooth, water-resistant facings. Available in 3 densities, supplied in rolls or slabs.

Request O-CF Publication 1-AET-7797.

100 Series Insulations

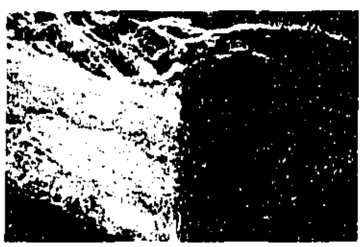


Use: Ideal for use in acoustical space dividers and surface treatments where a soft, upholstered look is required. 100 Series products can be used alone or in combination with other Owens-Corning acoustical products.

Description: Extremely flexible, resilient fibrous glass blankets bonded with a thermosetting resin. Available in several sizes, densities, and thicknesses. All products can be ordered black in color.

Request O-CF Publication 1-AC-9418.

300 Series Insulations

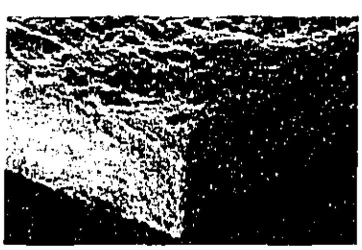


Use: In acoustical space dividers and surface treatments. 300 Series products should be covered with an abuse-resistant surface, and not used in direct contact with exterior fabric covering.

Description: Light-density (less than 1 lb./ft^3) fibrous glass, bonded in unfaced uniform pink blankets with a thermosetting resin.

Request O-CF Publication 1-AC-9419

500 Series Insulations

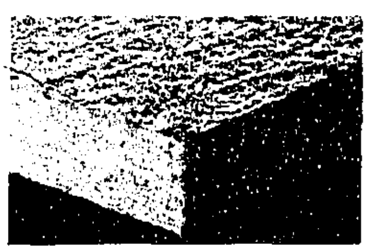


Use: Ideal for use as a core material in acoustical space dividers and surface treatments. 500 Series products should be covered by an abuse-resistant product, and not used in direct contact with exterior fabric coverings.

Description: Light-density yellow blankets of fibrous glass, bonded with a thermosetting resin.

Request O-CF Publication 1-AC-9420

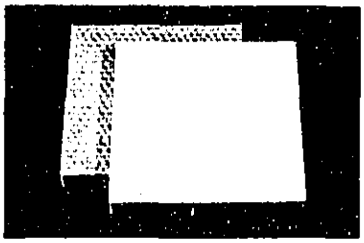
720 Series Insulations



Use: A core material in the manufacture of acoustical space dividers and surface treatments. 720 Series products can be used alone or in combination with other Owens-Corning acoustical products.

Description: Rigid to semi-rigid rectangular boards of fibrous glass insulation, available in various densities, plain or faced.

Request O-CF Publication 1-AC-9421

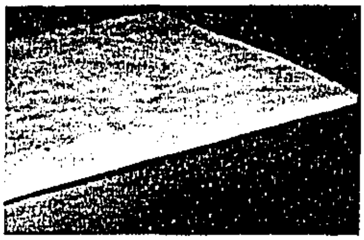


Fiberglas Roof Form Board

Use: As a permanent form for lightweight aggregate concrete and gypsum concrete poured-in-place roof decks. The system provides good sound transmission loss properties, while the Form Board provides good sound absorption.

Description: Lightweight, rigid fibrous glass boards in thicknesses to 2", widths of 24" and 32", lengths to 120".

Request O-CF Publication 1-RW-3947.



Fiberglas Automotive Insulation

Use: RF-200 Series is recommended for insulating headliners, sidewalls, underseats and paneling.

Description: Mottled light to medium brown, fine fibered, flexible, and resilient blanket of glass fibers bonded with a thermosetting resin to provide the dimensional stability and good handling characteristics required in automotive applications for temperatures up to 400F.

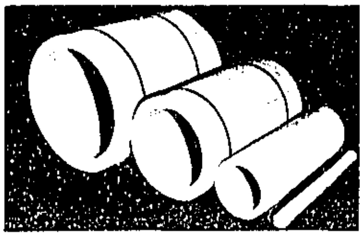
Request O-CF Publication 1-AET-7796.

Fiberglas 25 ASJ/SSL Pipe Insulation

Use: For all hot, cold, concealed and exposed piping operating from -60F to 650F in commercial and institutional buildings. Outdoor applications require additional weather protection.

Description: A heavy-density Fiberglas pipe insulation wrapped with an "All-Service Jacket" (ASJ) vapor barrier. The jacket may be supplied with a "Self-Sealing Lap" (SSL) for sealing longitudinal joints, providing a positive vapor seal.

Request O-CF Publication 1-IN-5537

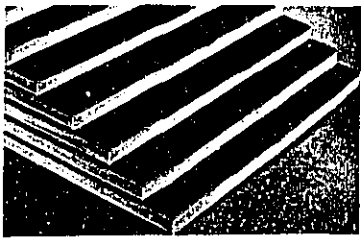


Kaylo 10 Asbestos-Free Pipe Insulation

Use: For application to heated piping operating to 1200F, including power and process piping, indoors or outdoors. (Outdoor applications require weather protection.)

Description: A rigid hydrous calcium silicate insulation, precision-molded in half-sections or segments.

Request O-CF Publication 1-IN-4350



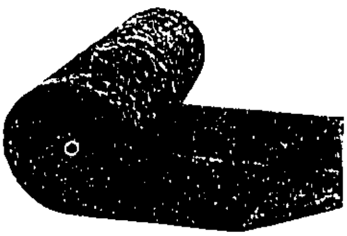
Fiberglas Duct Liner Board

Use: As acoustical and thermal insulation, applied as a liner for heating/cooling ducts up to 6000 fpm and 250F temperature.

Description: A semi-rigid fine glass fiber board coated on one side with a flame-resistant black coating. Thicknesses to 2". Board sizes to 4 x 6 feet.

Request O-CF Publication 1-MS-3557.

Aeroflex® Duct Liner

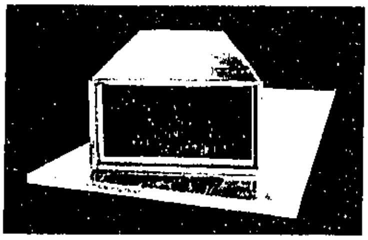


Use: As acoustical and thermal insulation, applied as a liner for heating and cooling ducts up to 6000 fpm and 250F temperature.

Description: Thermal and acoustical glass fiber insulation with flame-resistant black coating. Thicknesses to 2".

Request O-CF Publication 1-MS-8451.

Fiberglas Duct Board



Use: For fabricating all types of heating, cooling, or dual-service duct systems operating at up to 2400 fpm, 2" static pressure, 250F temperature. Thermal and acoustical performance is "built into" the product.

Description: A rigid fibrous glass board, with a heavy scrim-reinforced foil vapor barrier facing; 1" and 1½" thick; 3 densities available.

Request O-CF Publication 1-MS-6517.

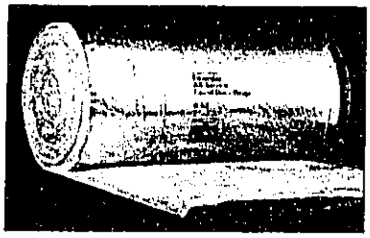
INL-25 Flexible Duct

Use: To connect air outlets with mixing boxes or trunk ducts, providing thermal and acoustical insulation.

Description: Flexible, light-weight fibrous glass duct with liner and reinforced foil vapor barrier jacket; diameters to 16".

Request O-CF Publication 1-MS-6747.

Fiberglas All-Service Duct Wrap

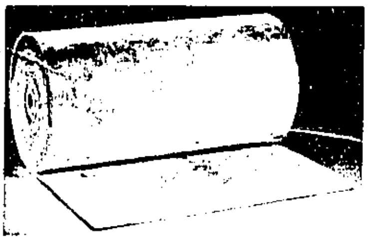


Use: To insulate residential and air conditioning or dual-temperature ducts operating at temperatures from 40F. to 250F.

Description: An inorganic blanket of glass fiber, factory-laminated to a reinforced foil kraft vapor barrier facing (FRK). A 2" stapling flange is provided on one edge. This faced product is designed to meet existing performance specifications as published by HUD/FHA, and others. Installed R-values are printed on the facing.

Request O-CF Publication 1-MS-9857.

Unfaced Duct Wrap



Use: As a thermal and sound-absorbing wrapping for application to hot, cold, and dual-temperature air-handling systems operating to 250F.

Description: A group of lightweight, resilient fibrous glass blankets, thicknesses to 2", roll widths to 48", faced and unfaced.

Request O-CF Publications 1-MS-5241 (Faced FRK-25)
1-MS-4780 (Unfaced)

To obtain Owens-Corning product information:

Use the inquiry cards at right. Enter publication numbers and product nomenclatures from the Selection Guide, pages 35 through 39. Enter name, company, address, and telephone number; affix stamp, and mail.

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△ *Mechanical Division Sales Office*
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MOBILE, ALABAMA area code 205
▲ 600 Bel Air Blvd., Suite 166, 36606 476-5571

NASHVILLE, TENNESSEE area code 615
▲ Two Maryland Farms, Suite 236 (Brentwood) 37027 373-2723

NEWARK, NEW JERSEY area code 201
○ 43-57 Harrison Ave. (Harrison) 07029 484-8800

NEW ORLEANS, LOUISIANA area code 504
○ 755 D. East Airline Hwy., (Kenner), 70062 721-7675
▲ 3525 N. Causeway Blvd. (Metairie), 70002 837-2902

NEW YORK CITY, NEW YORK area code 212
■ 700 White Plains Rd. (Scarsdale), 10583 472-3400

VIRGINIA BEACH, VIRGINIA area code 804
▲△ 629 Wesley Dr., Suite 105, 23462 463-0921

OKLAHOMA CITY, OKLAHOMA area code 405
▲△ 3037 N.W. 63rd St., Suite 203, 73116 848-6761
○ 4610 N. Cooper, 73118 528-2727

OMAHA, NEBRASKA area code 402
▲ 10407 Devonshire, Suite 100, 68114 397-2072

ORLANDO, FLORIDA area code 305
▲ 2021 Directors Row (Central Park), 32809 859-3690
○ 2021 Directors Row, (Central Park), 32809 859-7640

PHILADELPHIA, PENNSYLVANIA area code 215
○ 592 W. Swedesford Rd. (Berwyn), 19312 647-6110
△ 993 Old English School Rd. (Wayne) 19087 293-0572
● 592 W. Swedesford Rd. (Berwyn), 19312 647-6304
□ 997 Old Eagle School Rd. (Wayne), 19087 687-2020
▲ 997 Old Eagle School Rd. (Wayne), 19087 688-8650

PHOENIX, ARIZONA area code 602
▲△ 4502 N. Central Avenue, 85012 277-6217
○● 1880 W. Filmore Street, 85007 258-4541

PITTSBURGH, PENNSYLVANIA area code 412
■ Gateway Tower, Fort Duquesne Blvd., 15222 765-3750

PORTLAND, OREGON area code 503
■ PO Box 2718 (Milwaukie), 97208 620-1014
■ 14101 S.W. 72nd Ave. (Tigard), 97233 620-1014
○ 14101 S.W. 72nd Ave. (Tigard), 97233 620-1010
● 14101 S.W. 72nd Ave. (Tigard), 97233 620-1018

PROVIDENCE, RHODE ISLAND area code 401
○ 9 Newman Avenue (Rumford) 02916 434-7437

RALEIGH, NORTH CAROLINA area code 919
▲ 3200 Old Wake Forest Rd., 27609 872-0823

RICHMOND, VIRGINIA area code 804
▲ 1905 W. Huguenot Road, 23235 797-4472

ROCHESTER, NEW YORK area code 716
■ 11 State St. (Pittsford), 15434 381-0340

SACRAMENTO, CALIFORNIA area code 916
▲△ 11630 Fair Oaks Blvd. (Fair Oaks) 95628 961-3801
○ PO Box F, 64080 927-1341
● PO Box 13966-A, 95813 484-1868

ST. LOUIS, MISSOURI area code 314
● 1009 Executive Parkway, 63141 434-8510
○ 2464 Schuetz Road (Maryland Heights), 63043 432-3750
● 2462 Schuetz Rd., 63043 432-3795

SALT LAKE CITY, UTAH area code 801
▲ 5284 South 320 West, 84107 266-4214
○ 840 W. 2600 South St., 84119 972-1383

SAN ANTONIO, TEXAS area code 512
■ 8831 Tradeway Rd., 78217 828-9926
● PO Box 8316, 78208 225-4186
○ 3011 N. Pan Am Expy., PO Box 758 78293 222-9644

SAN BERNARDINO, CALIFORNIA area code 714
○ 456 Industrial Rd., 92408 825-7441
▲ PO Box 6346, 92412 824-2601

SAN DIEGO, CALIFORNIA area code 714
● PO Box 13188, 92112 236-1531
▲ 501 Maple St., 92103 239-2009

SAN FRANCISCO, CALIFORNIA area code 415
■ 477 Forbes Blvd., (South San Francisco), 94080 873-7950
○ 477 Forbes Blvd., 94080 952-0466

SANTA CLARA, CALIFORNIA area code 408
△ 3333 Bowers Ave., Suite 199, 95051 727-6744

SCARSDALE, NEW YORK area code 914
■ 700 White Plains Rd., 10583 472-3400
△ 700 White Plains Rd., 10583 723-0385

SEATTLE, WASHINGTON area code 206
■ PO Box 80009, 98108 762-4250
○ 6010 6th Ave. South, 98108 763-2800
● PO Box 80246, 98108 762-6900

SHREVEPORT, LOUISIANA area code 318
▲ Lane Bldg., 610 Marshall, Suite 613 71101 222-7100

SPOKANE, WASHINGTON area code 509
▲ Spokane Ind. Park, Bldg. 5 99216 924-6532
● Spokane Ind. Park, Bldg. 5, 99216 924-6011

SIOUX FALLS, S. DAKOTA area code 605
▲ 920 Paulton Ave., 57103 338-4520

SUMMIT, ILLINOIS area code 312
○ 5880 Archer Road, 60501 458-7730

SYRACUSE, NEW YORK area code 315
▲ 5858 E. Molloy Rd., 13211 455-6880

TAMPA, FLORIDA area code 813
■ 5422 Bay Center Dr., 33609 877-7616
○ 811 North 50th St., 33619 247-4802

TOLEDO, OHIO area code 419
■ Fiberglas Tower, 43659 248-8101

TULSA, OKLAHOMA area code 918
△ 3033 N.W. 63rd St., East Bldg., 73116 848-6761
○ 4610 N. Cooper, 73118 528-2727

WASHINGTON, D.C. area code 202
■ 900 17th St., 20006 296-3296
▲ 9111 Edmonston Rd., Suite 401, (Greenbelt) 20770 (Wash. D.C. branch) area code 301 345-7300

STEVENS POINT, WISCONSIN area code 715
■ 605 Post Rd., 54481 341-0603

WICHITA, KANSAS area code 316
▲ 250 North Rock Rd. 67206 683-5604

OWENS-CORNING FIBERGLAS CORP.
Fiberglas Tower, Toledo, Ohio 43659

Pub. No. 5-BMG-8277-A Litho U.S.A., June 1980

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