



SOUND ATTENUATION - DIESEL POWERED EQUIPMENT

Introduction:

Diesel-powered equipment, with its many advantages, does have the drawback of being somewhat noisy. When placed in a room / enclosure with poor sound-absorption characteristics, this noise can be deafening and quite disturbing to those who find themselves in its environs.

As a manufacturer of removable insulation blankets, we often get inquiries as to whether we can provide sound attenuation as well. The answer is yes. Firwin offers removable blankets, composite foam barrier materials, insulation boards, and barrier curtains for sound attenuation. The right choice depends on a number of factors particular to each situation.

Background: What is Sound?

Sound is a change in atmospheric pressure that is interpreted by the ear. The sound pressure level heard by a person in a room is determined both by the sound power radiated by the source of the sound and the acoustic characteristics of the room.

The most common way of measuring sound is in Decibels [dB] which measure both sound power and sound pressure levels and are expressed in logarithmic terms. **Tolerable noise is accepted as 85dBs.** Sound has to be further analyzed into frequency levels [Hz Hertz], which for convenience are separated into 8 or 9 octaves on a frequency scale.

Factors to Consider:

In order to engineer sound attenuation solutions, ideally, both the dB ratings and Octave band Frequency Analysis report are needed. This enables an Acoustics Engineer to address the complete situation within the practical limitations of the available materials and constraints of the individual case.

Insulation solutions are based on using combinations of materials to absorb sound, to offer barriers to sound, and to close up places where there is sound leakage.

1. Some materials, such as Fiberglass and Mineral wool, are particularly good in absorbing higher frequency sound in the 1000 to 4000 Hz ranges.
2. Others, such as loaded membranes, are more effective in the frequency ranges below 1000Hz.
3. Sound will leak through openings where no sound insulation is in place.

Solutions:

Typical solutions for Engine Generator sets in engine rooms or containers are to insulate the walls with absorption materials made from fibrous glass/mineral wools or open cell foam panels butted tightly against each other. However this concentrates mainly on the upper Hz range and not the lower Hz range, so often composites such as Firwin BTM14C are used which offer better attenuation over the full octave spectrum. Composites include absorption materials and barrier materials together with a decoupler layer to separate the barrier from the room/container wall.

Where space considerations limit the use of wall/ enclosure insulation Firwin makes Removable Insulation Blankets for the manifold, turbo and exhaust piping/ silencers etc contained inside the room/enclosure. These blankets contain composites to bridge the full frequency band. Some of our customers use both wall insulated and engine and exhaust blanketed approaches together to achieve the best solution. These blankets have both heat and sound insulation properties with a side benefit of energy conservation.

Conclusion:

Firwin can supply suitable insulation boards, Removable blankets, Composite foam barrier materials, and Barrier Curtains to address your sound attenuation needs.

Remember every sound problem has to be addressed separately!



Sound Attenuation - Points for Consideration

1. Thickness of the materials used will affect the attenuation,
2. All panels must be butted up to each other to assure that there is no sound leakage.
3. Engines and other equipment must be mounted on compression mounts to stop vibration and sound transmission.
4. Baffle chambers and good Silencers are also important.
5. Where space is at premium and enclosures cannot be used Removable Insulation blankets with built in barriers are an answer. Because the Sound Insulation package is installed directly on the equipment the attenuation is usually limited to no more than 8/10dB [provided the installation is done with care and diligence]
6. Very often space and economic limitations will mean that the ultimate practical possible solution is not attainable.
7. Each project should be regarded as a separate case due to the multiplicity of variants from application to application.

Sound Attenuation

In order to give some perspective to the effect of Sound barrier materials and their effectiveness over a full Octave band we show data for some typical material used.

Comparative charts of two typical absorber materials showing NRC [Noise Reduction Coefficients]

| Material | Frequency [Hz] | | | | | | NRC |
|--------------------------|----------------|-----|-----|------|------|------|-----|
| | 125 | 250 | 500 | 1000 | 2000 | 4000 | |
| Fibrous Glass | | | | | | | |
| 4lb/cu.ft | | | | | | | |
| 1" Thick | .07 | .23 | .48 | .83 | .88 | .80 | .60 |
| 2" thick | .2 | .55 | .89 | .97 | .83 | .79 | .81 |
| Fibrous Glass | | | | | | | |
| 11lb/cu.ft | | | | | | | |
| 1" thick | | .29 | .86 | .95 | .92 | .95 | .75 |
| Polyurethane Foam | | | | | | | |
| [Open Cell] | | | | | | | |
| 1" | .14 | .30 | .63 | .91 | .98 | .91 | .70 |
| 2" | .35 | .51 | .82 | .98 | .97 | .95 | .82 |

Chart showing STC [Standard Transmission Loss Coefficient] for a Composite used for lining Engine Rooms and Containers

| Material | Transmission Loss dB | | | | | | | STC |
|----------|----------------------|-----|-----|-----|------|------|------|-----|
| | 80 | 125 | 250 | 500 | 1000 | 2000 | 4000 | |
| BTMM14C | 22 | 22 | 22 | 32 | 44 | 50 | 56 | 34 |

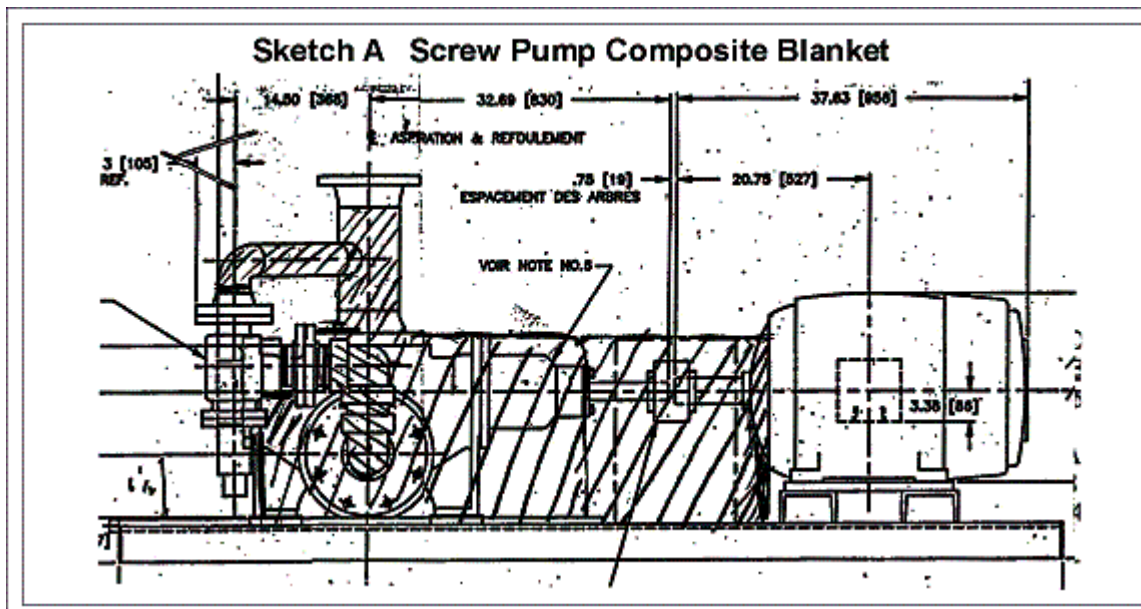
See attached data sheet for BTMM14C [this is only one of many variations of Foam/Barrier Composites] but this quality is the most commonly used for engines and generator wall/container linings for smaller Gen-Sets.



Sound Attenuation – Case Studies

Firwin Case Study #1

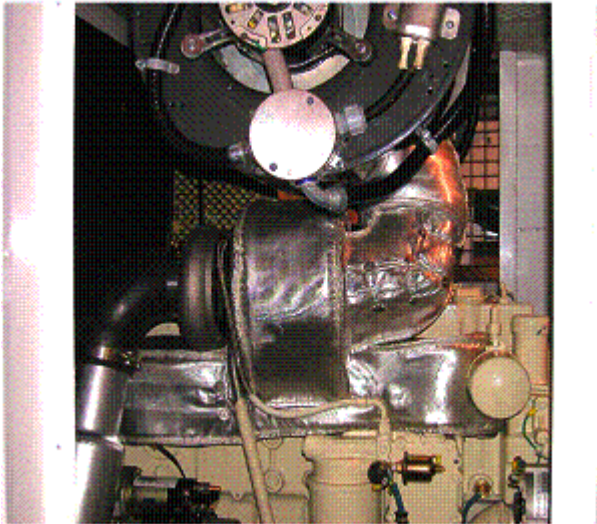
- Customer:** Large Hydro Corporation
Problem: High-pitched Sound of 110 dB on Screw pump used for pumping Glycol Coolant in Large Diesel Power Plant.
Requirement: Sound level had to be reduced to 85dB level to meet National Standard for Industrial plants. Easily removable blankets required for regular maintenance and inspection.
Solution: Velcro fastening removable sound blankets. Special attention to all pipe openings using tie-downs onto adjacent permanent insulation to ensure no sound leaks [see sketch A]. A muffler shroud was fitted on the end of the electric drive motor.
Result: After a full Octave band Sound analysis, the sound levels were reduced to an average of 85dB at 3 meters. Customer was satisfied with the result meeting the Industrial Standard.





Firwin Case Study #2

- Customer:** Quiet Diesel Generator Set Builder for the Movie Industry
- Problem:** Although the Container enclosing the generator-set had been lined with mineral wool boards the customer was not satisfied with the sound level outside the enclosure.
- Requirement:** Due to the size constraints required for the container size an innovative solution had to be found to attenuate the sound from the engine exhaust parts to 65 dB to 75 dB. Any cover on the Engine had to be able to be removed for maintenance and inspection.
- Solution:** Removable Sound blankets using a composite of 12 lb/ft³ fiberglass and high temperature heavy density membrane. SS Capstan rivets and SS lacing wire and drawstrings were used to tie down onto adjacent piping [see photo].
- Result:** End customer was satisfied with the results - this is a very demanding customer.



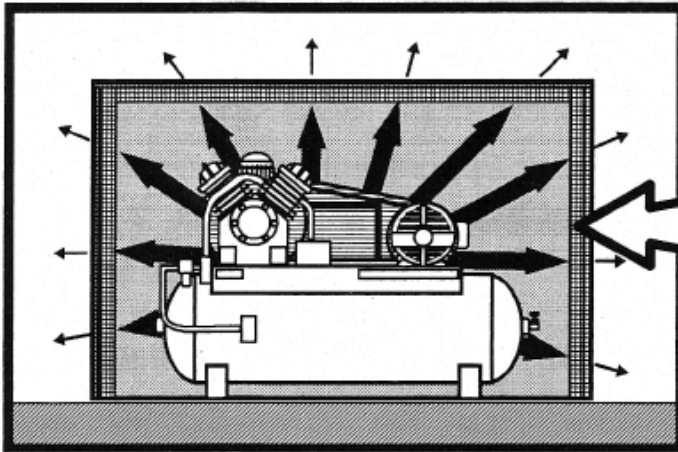
Firwin Case Study #3

- Customer:** Large Underground Mining Corporation
- Problem:** High-powered underground vacuum unit mounted on a truck. The sound level in the driver's cab was 95 dB and outside the cab 120dB. There were major complaints from both the drivers and the Health and Safety Committee. Due to the constraints of narrow and limited height mining tunnels/hauls regular enclosures were not feasible.
- Solution:** A combination of sound curtains, and removable sound insulation blankets [on the power pack, muffler, compressor and pipes]
- Result:** Sound levels in the cabin were reduced to 75 dB, outside the cabin to 105 dB on one side and 110 dB on the other. Although not entirely happy everyone agreed that within the restrictions of the situation there had been a marked workable improvement.



High Efficiency – Economical

NOISE ENCLOSURES



ELIMINATE COMMON NOISE PROBLEMS WITH SIMPLE, EASY TO CONSTRUCT ENCLOSURES.

Reducing noise at its source is the most desirable approach to noise control. A sheet metal or plywood enclosure lined with an acoustic composite is a cost effective way to solve industrial and OEM noise problems. AcoustiGuard™ Barymat 'BTMM-14C' and 'BV-14C' are versatile composites that can be incorporated into a wide variety of enclosure applications.

ENCLOSURES LINED WITH HIGH QUALITY COMPOSITES TO CONTAIN NOISE AT THE SOURCE.

BTMM-14C

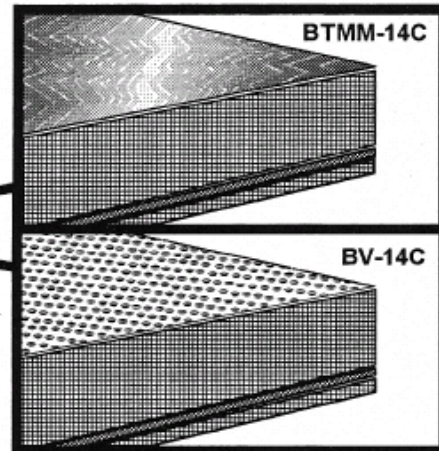
Metallized mylar facing provides high contamination resistance and light reflectivity. It is suitable for very dirty, wet or oily environments and can be exposed to direct spray.

BV-14C

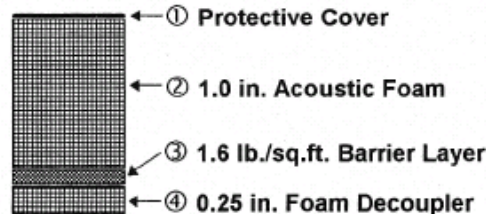
Perforated vinyl cover enhances acoustic properties resulting in superior absorption. Suitable for moderately dirty environments where it is not exposed to contaminants such as direct oil or water spray.

HIGH PERFORMANCE – 20 to 40 dBA Reductions

The use of AcoustiGuard™ composites in enclosures can reduce noise levels anywhere from 20 to 40 dBA. Careful preparation of all openings, seals and joints will eliminate noise leakage paths and maintain maximum performance.



COMPOSITE CROSS SECTION



① **Metallized Mylar Film – BTMM-14C** or **Perforated Vinyl Cover – BV-14C** faces in towards the noise source and protects the absorption layer from contamination.

② **Acoustic Foam** absorbs noise and prevents it from reflecting out of the enclosure.

③ **Barrier Layer** provides transmission loss, keeping the sound within the enclosure.

④ **Foam Decoupler** enhances the performance of the barrier – glued directly to the inside of the enclosure.