

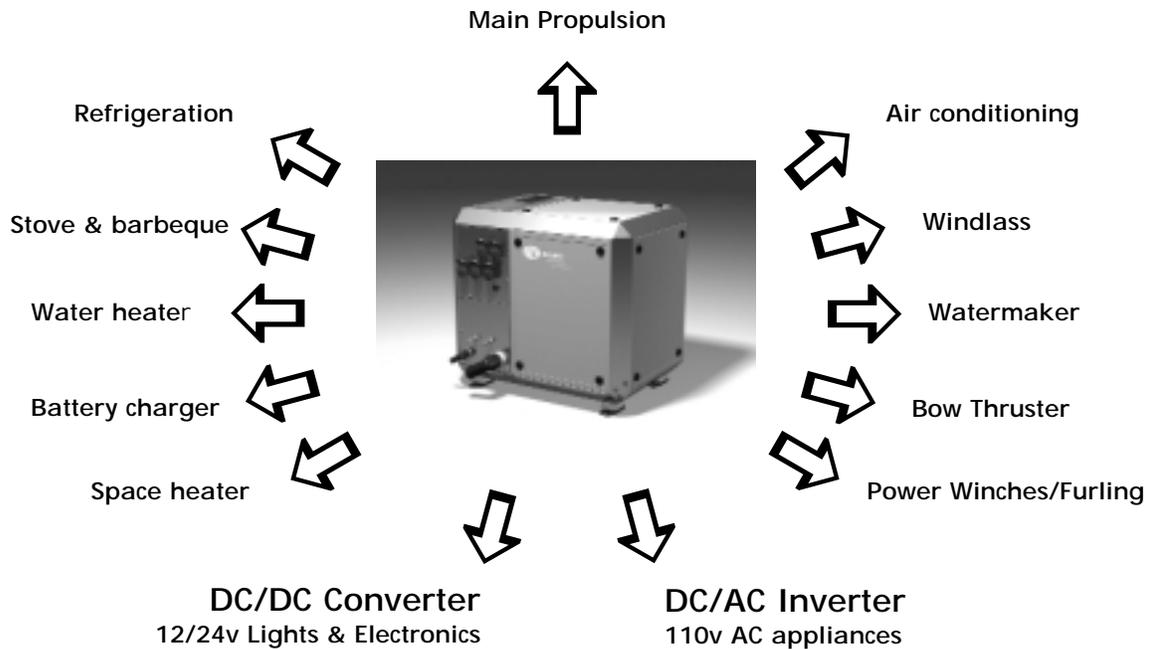


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# INTEGRATED POWER SYSTEMS

## OSSA POWERLITE



*Less weight, smaller size, superior reliability, greater flexibility, quieter operation, unmatched warranty. (and that's just the start)*

*Welcome to the world of OSSA Powerlite®*

*OSSA Powerlite is not just one product but an entire family of new lightweight, high-performance power components and accessories that work together to offer revolutionary performance and reliability in a highly integrated system. The OSSA Powerlite system starts with a series of remarkably quiet and lightweight high voltage DC (115v - 230v) diesel generators. These unique, permanent magnet generators vary their speed to exactly match the power required by a wide range of new OSSA Powerlite® compatible accessories.*

With OSSA Powerlite, technological sophistication, high performance and mechanical simplicity go hand-in-hand. The payoff for you, the end user, is substantial:

- Weight savings of 50%+ when compared to current systems.<sup>1</sup>
- Variable-speed operation saves fuel, increases engine life and reduces noise.
- Physically smaller accessories (including air conditioning, refrigeration, bow thrusters and more) offer more mounting options and better space utilization.
- Electric propulsion (diesel-electric or hybrid) option leads the way to the future.
- "House bank" battery recharging in as little as 20 minutes.<sup>2</sup>
- OSSA Powerlite® Approved vendor certification program assures compatibility of future product offerings from other vendors.
- Unparalleled factory warranty on all OSSA Powerlite components and accessories ensure that every thing works, AND works together. Extended warranties up to 10 years are available.

<sup>1</sup> Since OSSA Powerlite components and accessories are typically lighter than competitive products, the more completely you integrate the system the greater your weight savings will be.

<sup>2</sup> Under development - The OSSA Powerlite Ultra-Rapid Battery Charger incorporates a proprietary pulse charge algorithm to safely recharge all types of batteries from 50% to full charge in as little as 20 minutes.

### OSSA Powerlite® Generators - The heart of the OSSA Powerlite system.

For years, engineers have sought a way to capture the incomparable power density and high efficiency of neodymium permanent magnet generators without using a lot of bulky and unreliable electronic power conditioning. Unfortunately, while this type of generator offers tremendous advantages in weight and performance, it produces power which is incompatible with normal 115/230vac accessories. To get around this problem engineers were forced

to add "power conditioning" electronics which reduced the reliability and efficiency while adding weight and cost. The resulting generators lacked the very advantages they had sought to gain.

With the introduction of the OSSA Powerlite system, it is now possible to capture the remarkable performance of neodymium permanent magnet technology WITHOUT the use of extensive power conditioning. With weight reduction of up to 50%, size reduction of 30%+ and energy efficiency exceeding 96%, OSSA Powerlite generators are like nothing else on the market. (The technology is so unique that the US Army has created a special category in their purchasing specifications to cover it.) In addition to these immediately apparent performance advantages, customers will grow to appreciate their OSSA Powerlite generator even more once they start using it.

- *We don't fudge the numbers* - OSSA Powerlite generators are always rated for continuous duty. Our 14.5kw generator will provide 14.5kw hour after hour, day after day. Other generators typically produce only 60% to 80% of their labeled capacity under continuous operation.
- *Variable-speed technology offers many benefits* - Less fuel, less noise and less wear on the engine. Remember, the major cause of pre-mature engine failure in generators is under and over loading. With OSSA's variable speed technology the generator adjusts its speed and power output to exactly match the requirement of your load.
- *Patent-pending fresh water stator cooling system* - Keeping the generator winding temperature below 130° F is vital for long-term stator reliability. Other marine generators use air (noisy) or sea water (corrosive and dirty). We have developed our own patent-pending system which uses the engine's own fresh-water circuit to effectively transfer heat to the main seawater heat exchanger.
- *Safety first* - One of the many advantages of using high-voltage DC voltage (rather than AC or low-voltage DC) to drive your high power accessories is safety. Extensive international testing indicates that the electrical shock hazard of DC power is 4 to 5 times less than that of the equivalent AC voltage. Also, by avoiding the use of excessively high currents, the fire danger associated with overheated wires and connector is dramatically reduced.

OSSA Powerlite® generators are currently available in 6kw, 9.0kw and 14.5kw models. Ultra-light 3.5kw and 28kw versions are scheduled for release in summer 2005 with a 150kw model coming in fall 2005. Standard nominal voltages are 115 and 230. Custom DC voltages are available by special order.

Continuous Capacity	Dimensions L x D x H*	Weight (w/ Sound Enclosure)	Engine (cylinders)	dB(A) @ 3 meters
3.5 kw (preliminary)	25.0 x 18.0 x 18.0	140 lbs.	Kabota (1)	63
6.0 kw	24.5 x 20.5 x 23.72	295 lbs.	Perkins (2)	62
9.0 kw	27.5 x 20.5 x 23.7	350 lbs.	Perkins (3)	61
14.5 kw	28.5 x 20.5 x 25.0	395 lbs.	Perkins (3)	63
28 kw (preliminary)	30.0 x 28.0 x 26.0	467 lbs	OSSA (3)	63
150 kw (preliminary)	N/A	880 lbs	OSSA Powerlite (8)	N/A

\* Adding optional secondary mounting isolators increases height by 1.5"

NOTE: OSSA Powerlite generators are guaranteed with OSSA Powerlite and OSSA Powerlite Approved accessories. They cannot be used to power conventional AC appliances and may or may not be compatible with non-approved DC accessories.

#### OSSA Powerlite® accessories - Putting the power to work.

Key to the OSSA Powerlite concept is the development of a wide range of innovative accessories which seamlessly integrate with our generators. These accessories typically feature OSSA Powerlite proprietary brushless DC motors technology and offer tremendous weight and space savings over conventional technology. A number of accessories are fully developed and available for sale with new ones being introduced regularly. Like OSSA Powerlite generators, all OSSA Powerlite accessories represent major advances in the state of the art. While specific features vary from product to product, all offer;

- *Guaranteed compatibility* - Gone are the days when you have to worry about whether your generator is

going to reliably start that new air conditioner you want. With OSSA Powerlite, all components are specifically designed to work together with no surprises.

*. Run reliably from virtually any power source* - To maximize your weight savings and performance, you'll want to use an OSSA Powerlite generator to drive your accessories. However, OSSA Powerlite accessories can also be run from any normal AC input regardless of frequency. No more worry about sagging line voltage when connected to shore power and international travel is a breeze.

*. No inductive startup "surge"* - Conventional AC appliances such as air conditioning and refrigeration require an in-rush of 5x - 6x the normal running current to start. If the generator is not sufficiently oversized, or the local wiring cannot supply this surge, the appliances cannot start reliably. Because OSSA Powerlite accessories are not powered by conventional induction motors, no inductive surge is required so that generator and wiring need not be oversized.

*. True variable-speed operation* - Like our generator, OSSA Powerlite accessories vary their speed to match the load. For example, the compressors and fans in our air conditioners run faster in the noon heat and slow down as the temperature falls. As the compressors and fans slow down, they require less power. If you are running the system from an OSSA Powerlite generator it will respond to the lower power requirement by also slowing down. The result is less fuel, noise and wear and tear.

*. Less size and weight* - OSSA Powerlite accessories are smaller and lighter than their conventional AC-powered counterparts. How much smaller depends on the accessory. However, the difference is nearly always substantial. A 20 HP OSSA Powerlite propulsion motor will be 75% lighter and smaller than a conventional AC motor of similar power output.

Versatility is a hallmark of the OSSA Powerlite system. The various system components can be mixed and matched to meet your exact needs. Whether you are upgrading your old boat or building a new one. You may just be looking for a great air conditioning/generator combination or, perhaps you are converting everything - electric drive, bow thruster, air conditioning, windless, battery charging - the works. In either case, OSSA Powerlite is for you. Remember, OSSA Powerlite accessories are also compatible with conventional AC power sources. This means you can even run them from a traditional AC generator.

OSSA Powerlite and OSSA Powerlite Approved accessories cover virtually every major power component found on today's yachts and include:

- Air conditioning / heating
- Ultra-Rapid battery chargers
- Windlasses
- Scuba compressor
- Refrigeration
- Emergency "get-home" drives
- Power winches
- Electric stoves / ovens
- Propulsion motors
- Bow thrusters
- Watermakers

### **Outstanding warranty coverage - On site "swap-out" for up to 10 years**

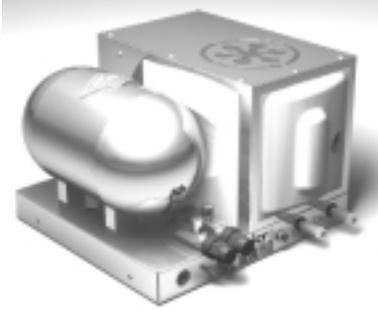
If you have ever felt short changed by a warranty claim on a marine related product you are not alone. The Marine Retailers Association of America (MRAA) has identified poor warranty coverage and problematic repairs as the major source of customer dissatisfaction in the marine industry.

The OSSA Powerlite system lends itself to addressing the problem in very effective way. Of course, the best way to address warranty problems is to prevent them from arising in the first place. Industry surveys indicate that the majority of problems which develop during the first year of operation can be traced to system incompatibilities and poor installations. Because OSSA Powerlite components are specifically designed to work together, the problem of incompatibility between systems is eliminated. The ready compatibility improves the quality of the initial installation, significantly reducing the number of early problems. In the event a repair is needed, OSSA Powerlite has adopted a centralized repair model for anything beyond minor corrections. Centralized repair removes the responsibility for locating a technically proficient service agent from you, the customer. If a problem cannot be quickly and easily addressed on site, the defective product is simply removed and shipped to a central location for repair. Experience has shown that centralized repair is consistently of higher quality and takes less time than field repair. How long will the repair take? Typically, a lot less time than you are used to. Customers who need to be fully functional as quickly as possible, can choose to have a replacement pre-shipped for on-site "swap-out". Since OSSA Powerlite accessories are designed for easy installation and removal, even the most unskilled technician can quickly change out the part.

For customers who wish to have their own component repaired, the defective part is shipped to the nearest central repair facility. The problem is quickly diagnosed and any needed repair is performed, bringing the part back to the original factory specification. Every repair is fully tested before the product is returned to the customer for reinstallation. All OSSA Powerlite products come with outstanding standard warranty terms. Extended terms up to 10 years duration are available at an additional charge for those customers who desire them.

REFRIGERATION AND AIR CONDITIONING

## REFRIGERATION SYSTEM



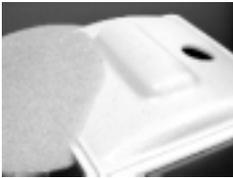
*Glacier Bay, Inc, the marine industry's premier refrigeration system manufacturer, is pleased to introduce the Micro HPS™ - a new kind of marine refrigeration system.*

*The Micro HPS™ represents the most significant advancement in marine refrigeration technology in the past 30 years and blurs the line between small, hermetically sealed DC constant-cycle units and large, high-powered DC holding plate systems.*

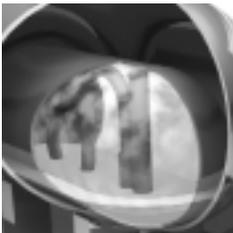
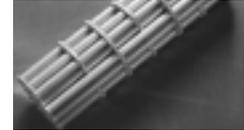
### **Open-drive energy efficiency in a hermetically sealed system -**

The unique Masterflux® compressor, patented Spider-Coil™ evaporator, and other enhanced features combine to make the Micro HPS™ the first 100% hermetically sealed system capable of matching Glacier Bay's legendary energy efficiency levels.

**Tiny size, light weight and super quiet -** Gone are the days when you have to compromise on size, weight and noise to gain power and efficiency. With the Micro HPS™ you get it all. The condensing unit is only 13" x 12" x 9" high and weighs less than 38 lbs fully charged.



To ensure the quietest operation possible, Glacier Bay has developed unique *acoustic panels* which surround the compressor. These panels combine recycled glass with high-performance urethanes making them not only functional and attractive, but environmentally friendly as well. Our *water-cooled condenser* is computer optimized for maximum efficiency in tropical waters and built using cupro-nickel tube produced to our own demanding specifications. The *unitary receiver*, suction accumulator and liquid-phase subcooler design integrates the performance enhancing features typically seen on only large commercial systems into one ultra-compact package.



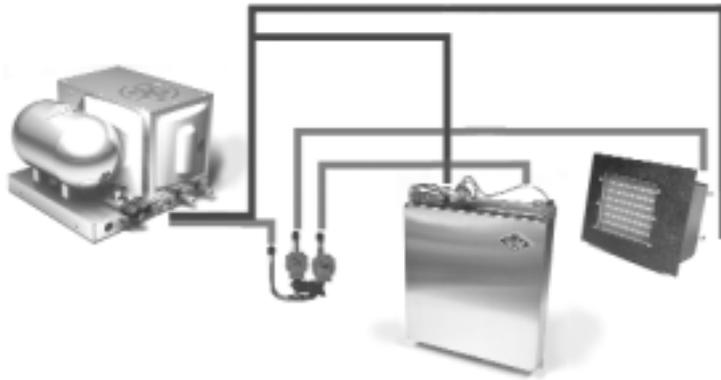
One important component of the Glacier Bay's Micro HPS unitary receiver is the dual-function, liquid-phase subcooler/suction accumulator. While it may not look particularly impressive from the outside, this device both protects the system compressor and greatly enhances energy efficiency.

**Compressor protection** is provided by the Suction Accumulator. During the "off" cycle, gaseous refrigerant condenses into liquid at the coldest part of the system (typically the freezer evaporator). With each system startup, this liquid returns suddenly to "slug" the compressor. This slugging does not immediately destroy a compressor but, over time, it significantly increases the wear on suction valves, pistons and connecting rod bearings. The suction accumulator function of our unitary receiver holds this liquid in a separate reservoir allowing it to boil off slowly and return only gas to the compressor inlet. The result is 100% protection against liquid slugging and greatly increased compressor life.

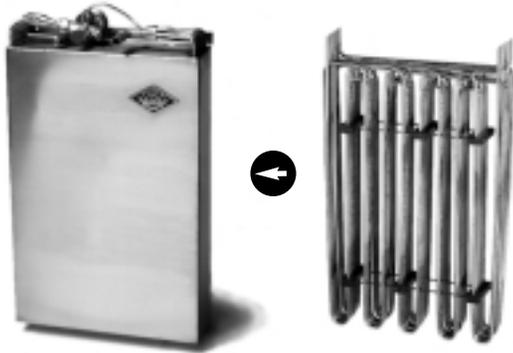
**Improved energy efficiency** results from our incorporation of a liquid-phase subcooling coil in the receiver assembly. This coil acts as a secondary heat exchanger (after the condenser) by using the cold gas returning from the refrigerator and freezer evaporators (holding plates) to further "subcool" the liquid refrigerant leaving the condenser. This heat exchange provides a colder, denser liquid refrigerant to the expansion valve for extra cooling power at no additional energy cost. By making more complete use of the residual cold gas (which is simply returned to the compressor on our competitor's systems), the liquid-phase subcooling coil adds one more reason why Glacier Bay refrigeration systems are the most energy efficient in the world.

## Cool multiple zones and even the largest freezers with ease -

The Micro HPS™ condensing unit has the capacity to cool virtually any number of separate boxes and still keep your ice cream hard in the tropics. You can even cool your cabin with the Arctic Air™ air conditioning option.



## Hybrid Eutectic Plates



Your Glacier Bay Hybrid Plates are very different from the evaporator and holding plates made by other refrigeration manufacturers and include several features exclusive to Glacier Bay. They bridge the gap between energy efficient but bulky holding plates and conventional space-saving but relatively inefficient evaporators. Our Hybrid Plate give you the best of both. They are comprised of a patented, 100% stainless-steel internal evaporator tubing coil known as the “Spider Coil” surrounded by a complex proprietary chemical eutectic solution (TSS +26 or TSS -8). By incorporating the Spider Coil evaporator coil and TSS eutectic solutions in a compact design, Glacier Bay Hybrid Plates give you the high energy efficiency of a traditional holding plate while taking up little more space than a flat evaporator.

## Spider Coil, a Patented, High-Efficiency Evaporator

To quickly and evenly remove heat from the eutectic solution, Glacier Bay has developed a radically different type of evaporator coil called “Spider Coil”. This patented coil uses four parallel runs of 1/4” OD stainless steel tubing rather than a shorter single run of 1/2” OD tubing as is typically used.

The unique design provides many times more effective surface area than traditional holding plate evaporator coils. This dramatically increased surface area allows faster heat transfer which, in turn, results in shorter system run times and improved energy efficiency. Of the many innovations unique to Glacier Bay refrigeration systems no single one is more responsible for our outstanding energy efficiency than the “Spider Coil” Hybrid Plate.

## Spider Coil Hybrid Plates - a Radically Different Approach to a Well-Known Problem.

It is an established fact among manufacturers of holding plate refrigeration systems that the limited heat transfer ability of standard evaporator coils dramatically reduces the overall efficiency of many marine holding plate system installations.

In an effort to correct the problem most manufacturers have, at one time or another, experimented with the use of “finned” type coils. Unfortunately testing quickly showed that, while the addition of this works well when the coil is surrounded by air, it doesn’t do a thing when the coil is encased in a liquid. In liquid-to-liquid heat transfer situations (as is found in holding plate applications), both the inner and outer surface areas must be increased simultaneously to improve heat transfer.

Until the introduction of Glacier Bay’s Spider Coil, refrigeration system manufacturers were restricted in their ability to improve evaporator coil heat transfer (and system efficiency) by the tubing length and size limitations. Surrounding the evaporator with a liquid solution (i.e. Holding Plate) improved the heat transfer but limited the amount of tubing because of the added bulk. Manufacturers who chose not to use a holding plate design suffered lower efficiency due to the poor thermal transfer of air.

## TSS +26 and TSS -8, True Eutectic Thermal Storage Solutions.

All Glacier Bay holding plates come filled with our own high-capacity, ultra-stable true eutectic thermal storage solutions, TSS+26 (refrigerator) or TSS-8 (freezer). These new proprietary solutions are available only in Glacier Bay holding plates and provide up to 4 times more usable heat absorption capacity than the glycol, alcohol and

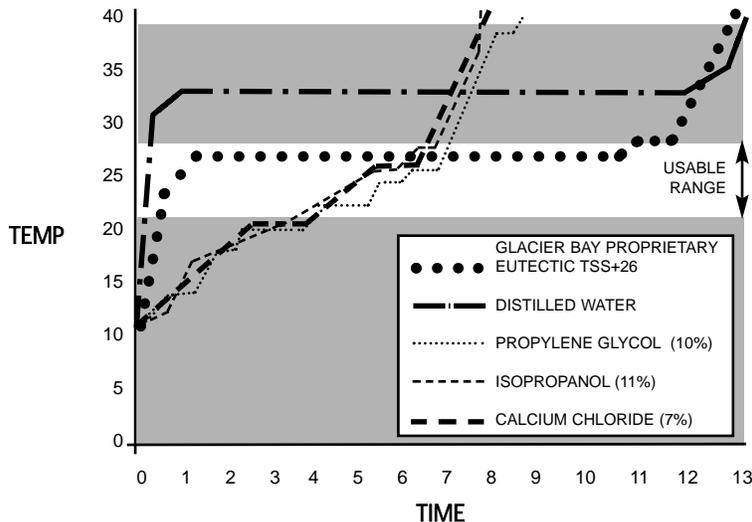
calcium/chloride mixtures used in traditional holding plates. Additionally, TSS +26 and TSS -8 maintain superb temperature stability throughout the thaw cycle.

### Only Glacier Bay Offers True “Eutectic” Plate Solutions.

“*Eutectic solution*”: a chemical formulation which changes state (i.e. freezes and thaws) without changing temperature. For example: Distilled water completely freezes and thaws at 32° F, therefore water is a “eutectic solution”.

“*Anti-freeze solution*”: a chemical formulation which changes state (i.e.. freezes and thaws) over a range of temperatures. For example: Propylene glycol/water mixtures begin to freeze at 32° F and reach maximum solidification at -28°F, therefore all propylene glycol/water mixtures are “anti-freeze” solutions. It is common practice for marine refrigeration manufacturers to routinely and incorrectly use the term “eutectic” solution to describe the chemical mixture contained in their holding plates. Their blends of water with glycol, alcohol or calcium/sodium chloride are not “eutectic” but rather “anti-freeze” solutions. While the difference in terminology might seem small, the practical difference between the two is dramatic. Just how dramatic can be seen in the accompanying chart, which compares the relative holdover times and temperatures of our competitor’s anti-freeze solutions with those of Glacier Bay’s TSS+26. Keep in mind that, while the holdover period shown is only valid for the test environment (i.e. box size, insulation and solution sample volume), the relative difference seen here will apply to any box in any environment.

### HOLDING PLATE THAW TEMPERATURES



### How The Tests Were Conducted

In this comparison, 400 ml samples of each solution were cooled to -10° F. As they thawed (over a period of several hours) the solution temperature was recorded. Distilled water (a true eutectic solution) is also shown for comparison purposes. In reviewing the chart the difference between “eutectic” and “anti-freeze” solutions is readily apparent.

**Advantage #1** Although all sample sizes were identical, the anti-freeze solutions thawed much more quickly than the TSS +26 sample. This is because the anti-freeze solutions have a much lower “latent heat of fusion”. In layman’s terms this means that they absorb far greater volume of anti-freeze solution (ie. much larger holding plates) than is required to provide the same amount of usable thermal storage as Glacier Bay’s TSS +26.

**Advantage #2** Glacier Bay’s TSS +26 solution maintains a very constant temperature throughout the thaw cycle. In a holding plate system the temperature of the refrigerated box is determined by the temperature of the holding/evaporator plate. In a typical installation the box temperature will be from 10° to 12°F above that of a holding plate and up to 40°F higher than an evaporator plate. When the temperature of the holding plate fluctuates so does the temperature of the box. The temperature stability of Glacier Bay’s TSS solutions ensures that your vegetables won’t freeze in the refrigerator and the ice-cream won’t melt in your freezer. Glacier Bay’s TSS true eutectic solutions and Spider Coil are just two of the many ways in which our research and innovation set us apart from the competition.

## GLACIER BAY STANDARD HYBRID PLATE SIZES

	PLATE SIZE
	L x W
#1	11"x16"
#2	11"x20"
#3	13"x24"
#4	15"x19"

\* The dimensions given include the space required for the expansion valve and fitting connections. All TrimLine Hybrid Plates are 2.25" thick with a .5" standoff. Plate sizes are total clearance required. These dimensions include the mounting flanges on the top and bottom and the clearance necessary for the connections. All plates are available in 26° F (refrigeration) and -8° F (freezer) eutectic temperatures. The Plates can be mounted in any position. Custom plates are also available

### Digital thermostat & optional ECM (Eutectic Control Module)

All Glacier Bay systems include digital thermostats as standard equipment for maximum reliability and optimum temperature control. The controls are not only attractive and convenient but rugged and practical as well. The precise settings possible with these controls (1/10th of one degree) give the accurate and repeatable control needed to gain maximum energy efficiency from your true eutectic hybrid plates.

Each Digital Thermostat comes with one temperature probe which is used to monitor the temperature of the holding plate and cycle the system as required. Since it is the temperature of the hybrid plate which is being monitored, the standard control normally displays the *hybrid plate temperature* not the box itself. However, an optional Box Temperature Probe can be added to any thermostat (including ECM Controls) which makes it normally display the *box temperature*. The plate temperature can still be read, when desired, by depressing one of the control buttons.



### ECM Control Option

Adding Glacier Bay's new microprocessor based digital controls brings more to your refrigeration system than just attractive displays and key-pad convenience. Through the use of an exclusive "Top-Off" operational mode these microprocessor based controls will:

- reduce battery drain up to 45% or more (average) in 12v & 24v DC powered systems.
- provide fully automatic "dual mode" system activation in 110v AC powered systems whenever the AC generator is on.

### What Is "Top-Off" Operational Mode?

Under normal operating conditions (i.e. battery or shore-power) the compressor of your Glacier Bay refrigeration system is automatically activated only when the hybrid plate eutectic solution is fully thawed. Once activated, the compressor will continue to run until the plate is solidly frozen before turning off. Depending on the total system configuration (plate size, box insulation, ambient temperature, etc.) the time between these compressor cycles may be 6 - 12 hours or more.

Under most conditions, this full cycling of the plate is the best way to control the system since it provides maximum energy efficiency and minimum compressor run time. However, on those occasions when an excess of power is available (such as when the engine or generator is started) it is desirable to "short-cycle" the system by running it more frequently for much shorter periods of time. The ability to sense this available power (i.e. an engine running) and change operational modes is an exclusive feature of Glacier Bay's ECM Digital Control System.

### How Does The ECM Control System Reduce Battery Drain?

By short cycling the refrigeration compressor whenever the engine (or generator) is running, the Digital Control System automatically tops-off the holding plate(s) and maintains it in a fully-charged condition until the engine is shut off. Once the engine shuts off, the system switches back into its standard, full-cycle mode with a completely frozen hybrid plate.

Battery drain is reduced and overall system efficiency is increased since the excess power output from the alternator completely and effectively is re-directed into the refrigeration system. Without the “Top-Off” feature this power would normally go to waste.

**ADDITIONAL ECM DIGITAL CONTROL FEATURES INCLUDE:**

- . INDIVIDUAL REFRIGERATOR AND FREEZER BOX DEACTIVATION SWITCHES
- . BRIGHT LED PLATE TEMPERATURE DISPLAY
- . SPLASH-PROOF MEMBRANE CONTROL PANEL
- . TOUCH-PAD ADJUSTABLE SET POINTS AND DIFFERENTIALS
- . NON-VOLATILE MEMORY
- . SYSTEM STATUS INDICATOR LIGHTS
- . SAFE 12V DC CONTROL FOR 110V SYSTEMS

**Arctic Air air conditioning option**



Add air conditioning to your Glacier Bay refrigeration system. Arctic Air is an innovative, patented air conditioning option package which allows your Glacier Bay refrigeration system to automatically serve “double duty” as an efficient air conditioner for the 22-23 (average) hours per day when it isn’t needed for refrigeration.

How does it work? Because of our innovative thermal storage technology and outstanding efficiency, a Glacier Bay refrigeration system generally needs run only 1 to 2 hours per day to handle your boat’s refrigeration needs. This means that the compressor and other major components of the system are “off” up to 98% of the day. It is during this “off” time that the Arctic Air option automatically puts the refrigeration system back to work to provide air conditioning for the cabin.

The system controls are designed so that the refrigerator and freezer always have “priority” over air conditioning. If the refrigerator or freezer should require cooling while the air conditioner is activated the A/C will automatically switch off while the refrigerator and freezer holdover-plates are re-frozen. Once the cooling is no longer needed by the refrigerator, the unit automatically returns to air conditioning duty.

**“Arctic Air” Air Conditioning Option Specifications**

DIMENSIONS-UNIT(in.)	14.5w x 11.75h x 8.5d
DIMENSIONS-CUT OUT (in.)	8h x 8w
HOUSING CONSTRUCTION	PVC
WEIGHT (BLOWER ONLY)	8.75 lbs
REFRIGERANT GAS	HFC 404a
NUMBER OF FANS	1
AIR FLOW	190
AVERAGE FAN LIFE (hrs)	83,000
CAPACITY (btu’s/hr)	5,000 (1)

## MICRO AIR EP 20 AIR CONDITIONING

*The Glacier Bay Micro Air EP represents the evolution of marine air conditioning into a true Environmental Control System for yachts. The Micro Air EP20 (20k Btu/hr) systems provide a significant advancement over conventional air conditioning technology. However, to think of them only as air conditioners would sell them short. Micro Air EP systems not only control the temperature and humidity of the air inside the boat, they control the air quality as well.*

### The evolution of an industry.

For nearly 20 years the state of the art in marine air conditioners has been stagnant. The market has grown and, with it, the number of equipment manufacturers. However, the technology on which this equipment is based has changed very little. Now, with the introduction of the Micro Air EP series of marine environmental control systems, manufacturers and owners of quality yachts have a new and better alternative. Micro Air EP systems:

. *Incorporate continuously variable-speed (stepless) control of both the compressor and blower.* Unlike conventional air conditioning systems which "cycle" on/off, Micro Air EP systems automatically adjust the speed of both the compressor and blower to exactly match the heat load on the cabin. The result is exceptionally stable air temperature with minimum noise and power draw. Permit the user to set the humidity level most comfortable for them. For dryer air, the compressor runs the evaporator at a lower temperature to extract more water from the air. For those who want the air cooled but not too dry, the system raises the temperature of the evaporator in relationship to the air flow wringing out less water as it passes through the coil.

. *Have user-selectable CO<sub>2</sub> and VOC levels.* CO<sub>2</sub> is a natural by-product of respiration while VOCs (volatile organic compounds) can originate from molds, solvents, adhesives, exhaust and cooking. Recent studies have shown that even moderately elevated concentrations of either can bring about headaches, nausea, dizziness and a general feeling of malaise. While the problem can be serious on land (sick building syndrome), it is greatly magnified in the confined space of a boat where it can be a major contributor to "seasickness". The Micro Air EP systems constantly monitor CO<sub>2</sub> and VOC levels and automatically pull in enough fresh air to keep them to an acceptable level but not so much air as to make temperature control difficult.

. *Have three heating modes; reverse-cycle (heat pump) only, electric (resistance) only and a combination of the two.* Use reverse-cycle for maximum energy efficiency, electric only is you are hauled out on the hard or in extremely cold water or "both" when you want the maximum heating power under most conditions.

. *Discharge heat low and cooled air high.* Our computerized air distribution system lets you install discharge grills high and low then pre-select the ratio of air discharged out or each "cool" and "heat" modes. Once you have set the ratio you like, the system will automatically set it when ever you switch between heating and cooling.

. *Require smaller ducts than conventional A/C systems.* The "EP" in our name stands for "Elevated Pressure". Because the Micro Air EP system operate at higher pressures, it is possible to use duct diameters which are much smaller than those required by conventional air conditioning systems. The Micro Air EP20 you would generally use 5" duct (20k Btu/hr A/C systems typically use 8"- 9").

. *Are controlled through a very user-friendly touch screen interface.* This is one case when "powerful" and "sophisticated" doesn't mean hard-to-program. Unlike conventional A/C digital controls that require you to set parameters by pressing obscure combinations of a limited set of buttons, our touch-screen simply links you from screen to screen using text and graphics to allow you to quickly and easily access the parameters you wish to change. No need to dig through a manual to try to find the magic button combination. Once you have made your changes, the default screen gives you the operating status system and indoor environment at a glance.

. *Use a proprietary control algorithm to continuously monitor the indoor air quality and automatically adjust all system components.* For those used to a conventional A/C system clicking on and off, the Micro Air EP control system is a thing of wonder. Its sensors note even the smallest change in temperature, humidity and air quality and use that information to anticipate trends. By spotting small changes early it can then make minor adjustments to optimize the blower and compressor speeds and restrict or increase the flow of fresh air. By making these constant and small "tweaks" the system ensure an absolutely stable interior environment under all conditions.

## Unique, patented and proprietary technologies.

As an internationally known innovator in thermal management technologies, Glacier Bay knows that real advancement doesn't come from simply assembling off-the-shelf parts. That's why most major components used in Micro Air EP products were developed in-house. These include:

**Compressor** - All Micro Air models use a unique, variable-speed rotary piston compressor which offers nearly twice the highest power/weight ratio of conventional compressors.. Developed by Glacier Bay and now manufactured and sold by Tecumseh Products Company under the name "Masterflux", this compressor is powered by a brushless DC (BLDC) motor which allows it to change speed and adjust capacity to provide just the right amount of cooling for the load. Also, since BLDC motors do not have an "inductive surge" when they start, there is no need to oversize generator and circuit breakers.

**Blower** - The Micro Air blower is a vital component in our EP (elevated pressure) system. To meet our design goal of reducing the size of the air ducts, the blower had to provide greater air flow at higher pressure than the commercial blowers used in conventional A/C systems. Our high-speed, backward-curved impeller meets this requirement and does so while operating more quietly than conventional blowers at similar flow rates. Like our compressors, the Micro Air blowers use a permanent-magnet BLDC motor and controller to provide stepless speed control and allow air flow to be optimized for every environmental condition.

**Air-Side Heat Exchanger** - Micro Air EP products are the first marine cooling systems to incorporate an oven-brazed, 100% aluminum microtube heat exchanger. Glacier Bay, has developed a way to cost effectively apply this cutting edge technology in our compact climate control system. As a result, the air-side heat exchanger on a Micro Air unit achieves nearly twice the heat exchange capacity per volume as that of traditional aluminum fin/copper tube coils.

**Water-Side Heat Exchanger** - Glacier Bay has long been a leader in designing and building corrosion resistant tube-in-shell seawater heat exchangers for a variety of applications. The ones used in our Micro Air systems are an exceptionally compact design providing high efficiency whether the unit is operating in cooling mode in the tropics or heating mode in the Scandinavia.

**Computer Controlled Air Distributors** - While computer controlled air distribution is common in the largest commercial HVAC systems, Glacier Bay was the first to develop the simple, compact flow controllers needed to make it practical for private yachts. These distributors are used in three ways. They automatically regulate the influx of fresh air to keep cabin CO<sub>2</sub> and VOC levels to acceptable concentration. Or, used as a "Y" in the discharge duct, they can be set to optimize the proportion of airflow into different rooms or switch flow automatically between different outlets to discharge heated air low in the cabin and cooled air up high.

**Touch Screen User Interface and Control** - There is only one way to come up with a user interface and controller to regulate functions never before available - build your own. The common path of "private labeling" a generic digital control was obviously not an option for us. Nor was it one we would have ever considered. What was needed was a controller that was both attractive and rugged, as incredibly powerful as it was easy-to-use. What we came up with was a control that effortlessly translates a few easily entered user preferences into just the right combination of compressor speed, fan speed, air distribution and fresh air blending to create the most comfortable, stable and healthy environment imaginable throughout the vessel.

## SUPERINSULATION

## THERMAL SUPERINSULATION PANELS



*Glacier Bay, the world's premiere supplier of refrigeration equipment to the marine industry, has been involved in the development of vacuum assisted superinsulation materials since 1993. The results of this effort are our BARRIER superinsulation panels. Whether retro-fitting an existing box or building an entirely new one, Glacier Bay's BARRIER Ultra-R™ superinsulation offers a level of performance and reliability found nowhere else in the industry. BARRIER Ultra-R™ is a true aerogel-based vacuum insulation product which provides R-50 per inch, or 10x the insulation value of closed cell urethane foam.*

### **BARRIER Ultra-R™, A Significant Technological Advance**

BARRIER Ultra-R™ panels rely on high vacuum and a special aerogel core material to achieve their insulation value rather than “trapped air” as do conventional insulation materials. The outstanding thermal resistance (R value) of aerogel materials have been known since the 1930's. Since that time hundreds of millions of dollars have been spent by the U.S. government and private companies to commercialize it. While the performance was excellent, one problem always stood in the way - very high cost. As recently as the mid-1990's, aerogel sold for several hundred thousand dollars per cubic foot.

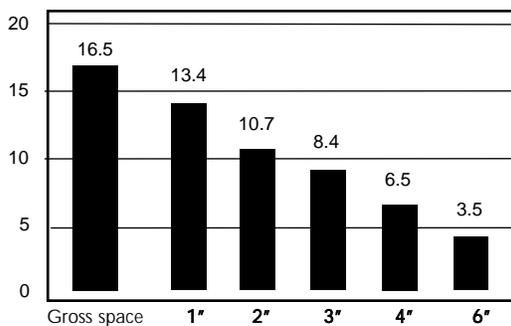
Now, research has provided a way to produce true aerogel material with a much simpler (and less expensive) process. BARRIER Ultra-R™ is the first commercially available vacuum insulation product to take advantage of this new, cost effective aerogel process.

### **Insulating Effectively**

The amount and quality of insulation have a tremendous effect on the performance of your boat's refrigerator and freezer system. Ideally, for boats that will be cruising in tropical climates the refrigeration insulation should have at least R-20 and the freezer insulation R-30. This equates to 4” of closed cell urethane foam in the refrigerator and 6” in the freezer. You'll far exceed these minimum values with just 1 1/8” of BARRIER Ultra-R™. At R50 (equal to 10” of foam) you'll get an extremely well insulated box offering superb performance under the most demanding condition.

With BARRIER Ultra-R™ you'll be amazed at the benefits gained in both lower energy use and increased useable box size. The following chart shows how much useable box space remains (starting with 16.5 cu. ft. gross volume) as you add more and more insulation.

### **USABLE BOX SPACE VS INSULATION THICKNESS**



As you can see from the chart above, by using BARRIER Ultra-R™ it is easy to double, triple or even quadruple your available box space - all while still improving the thermal quality of your insulation.

## **BARRIER Ultra-R™, the industry's leading insulation product**

BARRIER Ultra-R™ offers many advantages over traditional insulation materials including:

• *Extremely high "R" value* - BARRIER Ultra-R™ has ten times (10x) the thermal resistance (R value) of the best closed-cell urethane foams. Use the outstanding performance of Barrier Ultra-R™ to increase your refrigerator and freezer capacity, free up room for more cabinet space in your galley or reduce your refrigeration system's energy consumption.

• *Reliable insulation rating* - The R-50 rating of BARRIER Ultra-R™ is has been independently verified by ASTM-certified national testing laboratories in thermal tests designed to provide the same thermal conditions under which your marine refrigeration system operates. We do not artificially boost the "R" rating by covering the product with aluminum foil and testing it with a radiant heat source. Nor do we derive inflated numbers through inaccurate home-grown "ice-melt" tests.

• *Longer product life* - The "R" value of common insulation materials continuously declines as they age. After 10 years, polyurethane foams may retain only 60% or less of their original insulative value. BARRIER Ultra-R™ is the only insulation product guaranteed for a full 25 years\*.

• *Excellent R-value even if punctured* - One unique and very appealing quality of the BARRIER Ultra-R™ aerogel core is that it maintains an R-value of 9, almost twice that of urethane foam, even if the panel were accidentally punctured. Other VIP core materials may decline to as little as R-3 in a punctured condition.

• *Impervious to moisture permeation* - According to some surveys, over 70% of boats one year or older suffer severely reduced insulation effectiveness due to moisture accumulation. Because BARRIER Ultra-R™ is a hermetically sealed and evacuated panel, it is not subject to the moisture saturation problems which destroy the performance of conventional closed cell foams.

\* BARRIER Ultra-R™ is warranted against catastrophic failure and loss of R-value for a period of 25 years from the date of purchase. For specific details on the conditions and limitations of this warranty contact Glacier Bay, Inc.

### **How to use BARRIER Ultra-R™**

BARRIER Ultra-R™ is made to order. There are no standard sizes and the panels cannot be cut "on site". BARRIER Ultra-R™ can be produced in virtually any flat size. Curved panels (to conform to hull curvatures etc.) are not possible. The finished panels are rigid and cannot be bent. To closely conform to curved surfaces use multiple panels. Holes for tubing, drains, doors, etc. can be accommodated.

• *New box construction* - BARRIER Ultra-R™ can be used alone or in combination with standard foams to achieve the desired insulation value. Additionally, BARRIER Ultra-R™ can be ordered with a fiberglass facing (optional) which can become the inside box liner. This eliminates the need for construction of a separate "liner" and makes for fast, low cost box fabrication. By adding one or more of our "Ready-to-Mount"™ hatches, you'll have a complete custom box "kit" that can be easily assembled on site. All that is required is to use our fiberglass corner kits or a thickened epoxy mixture to fillet the corners and hold the box in place.

• *To retrofit an Existing Box* - The high insulation value of BARRIER Ultra-R™ makes it possible to bring even the most poorly insulated boxes up to par with very little, and possibly no, loss in usable space. Retrofitting can be done in three ways:

1. Gain access to existing foam through surrounding cabinets and/or by removing the counter top. Use a sharp pole to dig out a "channel" into which you can slide the BARRIER Ultra-R™ panel(s).
2. Adhere BARRIER Ultra-R™ panels to the outside of the box cabinetry in concealed areas such as hanging lockers and engine rooms.
3. Adhere BARRIER Ultra-R™ and a liner material (Polypropylene or fiberglass) to the inside of the box.

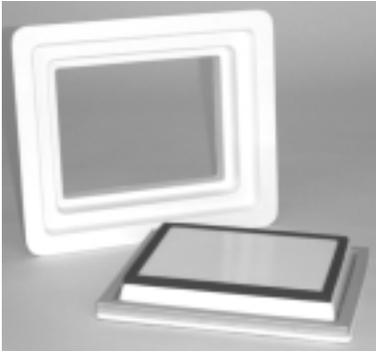
### **Ordering BARRIER Ultra-R™**

BARRIER Ultra-R™ may be ordered through any authorized Glacier Bay dealer or directly from Glacier Bay Inc. If you are purchasing a new boat we can work directly with your builder during the construction process. You will need to make either drawings or templates (recommended) of each individual panel you would like us to produce. We do not accept drawings of only the assembled box. Be sure to indicate the location and size of any holes you need for tubing, drains, doors or hatches. Also when choosing the optional fiberglass facing, please indicate on the drawings/templates which face is to be covered.

### **Pricing and additional technical assistance**

Glacier Bay publishes a separate price sheet which describes the formula used for calculating prices. More technical information can be found on our website at [www.glacierbay.com](http://www.glacierbay.com) or by contacting Glacier Bay.

## ICE BOX HATCHES (“READY-TO-MOUNT”)



*Build or re-build your refrigerator, freezer or ice box better than ever with the “Ready to Mount”™ hatch. Designed and manufactured by Glacier Bay, the world’s leading innovator in marine refrigeration products, the “Ready to Mount”™ hatch dramatically simplifies ice box construction and offers many important advantages over traditional lids.*

Features include:

1. Outstanding Insulation - A pre-installed BARRIER Ultra-R™ superinsulation panel gives the “Ready to Mount” hatch an R-50 insulation value, the equivalent of 10” of the best quality closed cell urethane foam.
2. Double Gaskets with Magnetic Seal - Two separate seals are used to make your box air-tight. The magnetic primary seal ensures that your hatch will maintain it’s “like new” seal performance for year after year.
3. Thin and Light - No more heavy, cumbersome hatches. The “Ready-To-Mount” Hatch lid is only 2” thick and weighs only 5 pounds (medium size).
4. Built to Last - Solid molded fiberglass construction takes any abuse without distortion or damage.
5. Long Lasting Good Looks - Pure white gel-coat retains a like-new appearance for the life of the boat.
6. No Frame Sweating - The low thermal conductivity of the molded fiberglass encasement gives added protection against sweating under even the most humid tropical conditions.
7. Sanitary Design - The pure white gel-coated fiberglass construction resists stains and abrasion. All corners are well radiused to avoid the crevices which hold dirt and mold. The gaskets are mounted to the lid itself to further prevent dirt build-up and permit easy washing.
8. Top or Side Mounting - The hatch is suitable for both top and front loading installations.
9. Easy Installation - “Ready-to-Mount” hatches make the hardest part of box building (or rebuilding) a breeze.

“Ready-To-Mount” Hatches are available in three standard sizes.

SIZE	OPENING DIMENSIONS*	
A	11.5" X 8.125"	(295mm x 206.375mm)
B	13.125" X 10"	(333.375mm x 254mm)
C	18.25" X 13.25"	(463.55mm x 336.55mm)
D	14.25" X 26"	(361.95mm x 660.4mm)
E	14.25" X 8.25"	(361.95mm x 209.55mm)
F	10" X 8.25"	(254mm x 206.375mm)
G	15.75" X 8"	(400.050mm x 203.2mm)

\* To calculate the box “cut-out” size add 4” to each dimension given.

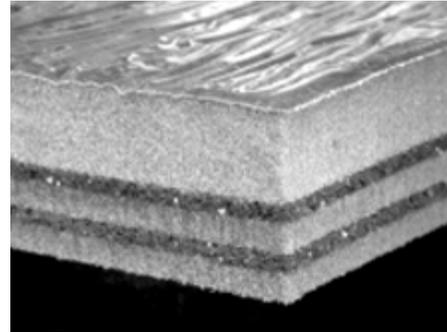
\* To calculate the total size of the base (including flange) add 6” to each dimension.

## ACOUSTIC SUPERINSULATION PANELS

*For over a decade the name BARRIER has been associated with the highest performance thermal insulation in the world. Now BARRIER Ultra-dB™ offers the same quantum leap in noise control technology. BARRIER Ultra-dB acoustic insulation is a carefully engineered soundproofing material intended for those applications requiring superior performance without the size and weight of conventional laminated foam and lead/vinyl products.*

**With BARRIER Ultra-dB™ acoustic insulation you get:**

- . Superior noise reduction with 48% less weight and 25% less thickness
- . The widest frequency control of any flexible sound insulation product
- . The highest quality polyether foam gives 4x the life of polyurethane
- . A powerful adhesive backing which eliminates the need for "hangers", even in overhead installations.
- . A uniquely engineered, seven-layer noise control solution



### Understanding sound.

Sound is a complex thing. Varying frequencies, amplitude, intensity, harmonics, pressure level, dB(a), dB(b), dB(c), dB(m), dB(v), dB(spl), sone scale, phon scale and on it goes. For tortured ears it all adds up to one thing - NOISE. Those of us trying desperately to get some peace and quiet may find it hard to believe that there isn't some magic material capable of just blocking it all off. Unfortunately, no such material exists.

While many materials block sound - no single material blocks noise. The problem is the frequency range. What we call "noise" nearly always consists of many different frequencies. Take, for example, a 3-cylinder diesel engine running at 2,800 rpms. The "noise" it emits includes frequencies ranging from 22Hz to over 11kHz. No single material can effectively block all these frequencies. The only way to attenuate this kind of noise is to select a combination of materials which work together to effectively control sound across a broad spectrum. In practice this is harder than it may seem since different materials grouped together change resonance characteristics and can respond in unexpected ways. When it comes to effective noise attenuation, it is the quality of the materials selected and the way in which they are combined that determines the performance of the finished product.

As with all Glacier Bay products, superior engineering is the secret to the superior performance of Ultra-dB.

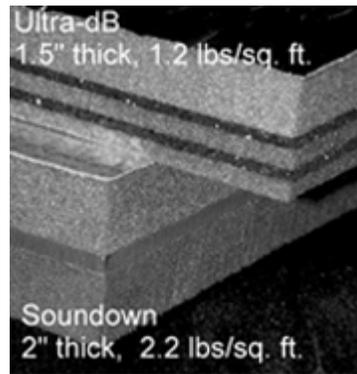
### The physics of multilayer insulation materials.

Noise is energy and, as you know, you can't just get rid of energy. What you can do is change its form. That's what acoustic (sound) insulation does. It changes the energy contained in sound waves into heat. The more effectively it does this, the greater the sound reduction. To understand why BARRIER Ultra-dB works so much better than our competitors, let's first take a look at the basics of multilayer sound-control technology.

Multilayer "foam-vinyl-foam" type laminates are an attempt by manufacturers to try to attenuate a wider range of frequencies than would be possible with one material alone. The individual layers are often described by their functionality as the "absorption-damping-decoupling" layers. The "absorption" layer (nearest the noise source) is comprised of foam which is of a density that allows it to be moved (i.e. vibrated) by higher frequency sound waves. Energy is required to move the foam and this energy comes from the sound waves themselves. The frequency of sound which most effectively moves the foam is that particular material's "resonant" frequency. Consequently, it is the resonant frequency which is the one best attenuated by the material. Because they are located nearest the noise source, absorption layers also help to inhibit the formation of standing waves.

The resonant frequency of foam is quite high - above 250 - 500 Hz depending on thickness. Frequencies lower than that pass through virtually unaffected. Attenuating these lower frequencies is much more difficult and is the primary function of the "damping" layer. The damping layer used in conventional sound materials is very heavy (lead or a filled vinyl of similar density) and relies on high mass to provide a lower resonant frequency and harness the energy contained in these waves. The waves hit the damping layer and, as with the lighter foam, make it vibrate.

Unfortunately, because of the weight of the damping layer, this vibration can create a new problem. If the vibrating mass is allowed to mechanically transfer energy to another surface (such as a wall or bulkhead) the noise is simply transferred through and radiated off the other surface. It is the job of the "decoupling" layer to prevent this from happening.



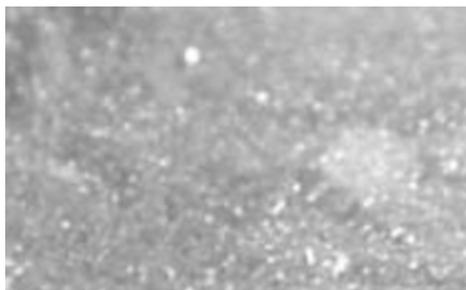
BARRIER Ultra-dB not only does a better job of reducing noise, it does so with less weight and space.

### The BARRIER Ultra-dB™ difference.

Conventional acoustic insulation materials work well if you use sufficient weight and thickness. There are many manufacturers but little difference between the performance of their products other than the differences in the thickness and weight. The design goal of BARRIER Ultra-dB was to provide better noise reduction in a thinner, lighter material.

The key to succeeding in this goal was to find a way to better attenuate low frequencies without resorting to the high mass of conventional damping layers. The uniform nature of these materials means that the entire sheet must resonate as a whole to dissipate energy. This not only limits the frequency range they can attenuate, but also requires the use of a thick foam "decoupling" layer to prevent this vibration from passing into the nearby structure.

BARRIER Ultra-dB solves the damping layer problem in a particularly ingenious way. Rather than using a uniformly molded sheet, our damping layer is a composite made up of randomly adhered elastomeric particles of varying sizes, shapes, weights, densities and durometers. When sound waves strike, depending on the frequency of the wave, different particles within the layer will resonate. At any given frequency only a fraction of the particles vibrate. Each vibrating particle is loosely suspended between other particles, most of which do not resonate at the same frequency. This permits the energy contained within the vibrating particle to be dissipated internally rather than through movement of the entire layer. The efficient nature of this internal energy transformation (particle movement into heat) means that less mass and volume is required in the damping layer and a thinner foam decoupling layer can be used.



Macro photograph of a typical "filled vinyl" damping layer shows its uniform structure.

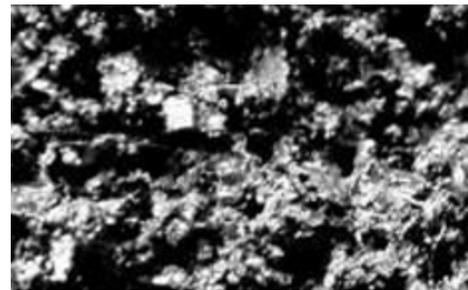


Image of the BARRIER Ultra-dB damping layer reveals its granular, non-uniform composition.

By sandwiching two of these unique damping layers and two thin decoupling layers, an exceptionally wide range of frequencies can be effectively attenuated with a minimum of mass and volume. The result is better attenuation over a wider frequency range.

Hear the difference on our website at: [www.glacierbay.com](http://www.glacierbay.com)

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