

# Marine

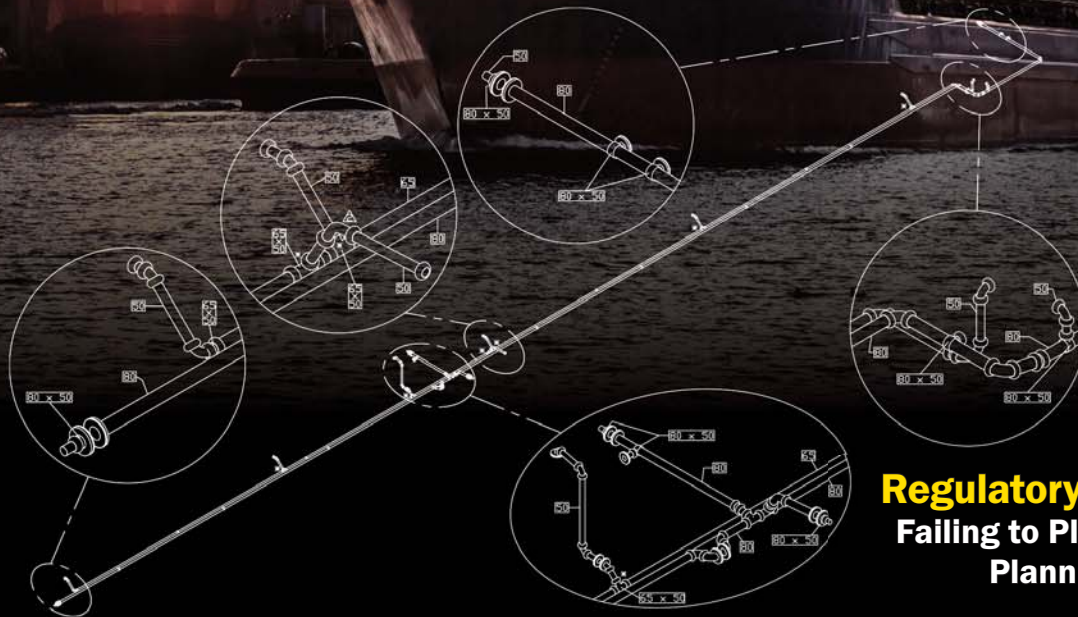
## News

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### Boatbuilding, Construction & Repair

*Better Newbuilds Demand  
New Tools & Technology*



**Regulatory Report:**  
Failing to Plan Means  
Planning to Fail

**Coatings:**  
Uniform Colors for Series  
Build Projects

**Boatbuilding 101:**  
Keep it Simple

# BOATBUILDING 101:

## Keep it Simple

In an era of increasingly complicated regulations and sophisticated technologies disrupting the workboat sector, one piece of the equipment – the Keel Cooler – remains as possibly the most important and at the same time, the simplest piece of hardware on the water. Likewise, much the same way as it was more than 70 years ago, Fernstrum remains the standard.

**By Joseph Keefe**

**F**or today's workboat sector, the most pressing issue facing operators is arguably comprised of meeting and paying for the advent of so-called 'Tier' emissions standards. The American subset of 5,500 towboats additionally faces the subchapter M towboat rules and new requirements for hardware installation and physical construction. The one thing they shouldn't have to worry about is engine cooling solutions.

The Keel Cooler, out of sight below the waterline, may be the most important piece of equipment on the boat. Without it, engines can't perform and freight and people don't get from point A to point B. As EPA Tier levels march on from 1 to 2 and all the way to 4, the mighty keel cooler has matched strides to make sure that cleaner air doesn't also mean poorly performing or out-of-service boats.

Similarly, subchapter M rules that center on hull penetrations represent a potential challenge for operators that employ keel coolers. Already in compliance with the U.S. Coast Guard's tough subchapter K requirements (for passenger vessels),

what comes next will be nevertheless be business as usual for R.W. Fernstrum & Company. That's because Fernstrum, the oldest name in the marine cooling sector, is also its most experienced. Selling into every workboat sector up to a maximum engine output of 10,000kW, there is a keel cooler for any marine hull, and Fernstrum will custom engineer one to match. With no moving parts, the keel cooler is the ideal and simple solution for today's workboats even as other equipment becomes increasingly complicated and otherwise difficult to maintain.

### **KEEL COOLERS 101**

According to Dale Gusick, Fernstrum's Export Sales Manager, a keel cooler or a box cooler are the same thought process. "It is a closed circuit cooling system for a marine engine. It is similar to a radiator on a car or truck except we're underneath the vessel," explains Gusick. "And we're in direct contact with the ambient water – providing a direct water (coolant) to water heat transfer. This eliminates sea water or ambient water from coming into the vessel

## MARINE CONSTRUCTION TRENDS



(L-R) Dale Gusick, Dave Peura, Frank Bjorkman & Sean Fernstrum

for heat exchangers.”

Inland operators have options when it comes to cooling requirements. That said; most inland marine vessels tend to be keel cooled because of the dirty, shallow water environments that they operate in. Dale Gusick puts the question into perspective, saying, “If they were heat exchanged, there would be constant problems with heat exchangers clogging, plugging, pumps failing, overheating and eventually the engines could be damaged. A new marine engine today is typically going to have two cooling circuits because of the new Tier level requirements.”

It turns out that challenging inland conditions – shallow, silty, turbid, debris filled environments – are the perfect application for keel coolers. That type of environment is a primary reason it was developed. Back in 1944, the U.S. Navy supplied landing craft for a mock assault of Iceland which was intended to prepare for the logistical nightmare that was later to be the Normandy landings. Sean Fernstrum, President of R.W. Fernstrum, told *MarineNews* in March, “Less than half of the craft made it ashore because ice was

sucked into the intakes and strainers and consequently cracked engine blocks. Sean’s grandfather (Robert Fernstrum), then the Chief engineer at Gray Marine, was given the task of fixing it. What he came up with was the prototype of our packaged keel cooler.”

In reality, the Navy didn’t start using keel coolers until after the war. Company President Sean Fernstrum explained, “My grandfather received an order for 10,000 units in 1945. He had nowhere to build them, no one to do the work, and due to rationing, getting silver and copper nickel proved challenging. When the war ended, the contract was cancelled. Subsequently, in between WWII and Korea, he received the landing craft order. All of the landing craft at Inchon, for example, had keel coolers installed.”

Today’s keel cooler is typically mounted in a recessed arrangement on the side of the vessel. The coolers remain out of harm’s way, protected with guards and grills. Bjorkman adds, “The vast majority of these inland vessels typically end up with side mounted, recessed installations.”

## MARINE CONSTRUCTION TRENDS

### HIGH SPEED VESSELS

Beyond the inland freight markets, keel coolers have many applications. Indeed, and contrary to some perceptions, another ideal keel cooler application involves the so-called 'high speed vessel' sector. A high speed vessel entails anything that operates typically at speeds of 15 to 40 KT. Within that range can be found ferries, pilot boats, and rigid inflatables. Nevertheless, a common misperception is that the cooler will cause too much drag on the high speed vessel. Dale Gusick says that's just not true. "We have done tank model testing where we ran three different types of hulls, one fitted with a properly installed keel cooler, one with no keel cooler and another with an improperly installed keel cooler. In the end, the testing demonstrated that a properly installed keel cooler in a recess did not impact the speed of the vessel. A final coat of bottom

paint restricted a vessel's performance more than a properly installed keel cooler."

Today, most of Fernstrum's heat transfer testing occurs in-house, electronically with software or in test tanks at the Fernstrum facilities.

### EVOLVING WITH THE INDUSTRY

Horsepower has nothing to do with the size or shape of a keel cooler. Nevertheless, as operating conditions on board have changed, so too, has the keel cooler. The variables that have had the most impact involve the heat being generated by today's engines, as they evolved from Tier 1 to Tier 4. Frank Bjorkman explains, "Today's coolers look outwardly very much like they did in the past. We've made changes internally to help strengthen the unit. The other thing that has changed – in part because of the

**When installing a keel cooler without a recess, fairing blocks and side plates provide protection and help improve streamlining. Protective side plates with openings eliminate seawater flow restrictions.**



### **Ideal GRIDCOOLER Keel Cooler applications**

Bridge erection boats (BEB)	Ferries (23-24 knots)	RIBs (Zodiac Canadian Coast Guard)
Bristol Bay gillnetters	Pilot boats (15-20 knots)	Inland Pushboats / Assist Tugs
Crew boats (15-25 knots)	Police and SAR (Search & Rescue)	Freight Landing Craft

Tier changes – we’ve gotten into much larger units. Additionally, the manufacturing techniques that we use improved over time.” Hence, Fernstrum coolers evolved to a more rugged and durable standard. That’s because a 100 HP engine 40-50 years ago would require a small cooler. Today and in order to meet the emissions regulations, that system could be twice as big.

Sean Fernstrum perhaps explains it best, saying, “In the past, a new engine type might be expected to be standard for two or three decades, now those changes are coming every five years. This has created some confusion for the OEM’s and customers in keeping track of where they are in a multi-year planning stage for a vessel.

In the case of the increasingly popular GE Tier 4 engine, for example, the low temperature circuits require a tremendous amount of surface area in comparison to an SCR Tier 4 engine. When that happens, Fernstrum merely takes technical data from the engine company and engineers a solution to match. “It’s about heat generated and the flow rate of the coolant versus the temperatures that we have to hold. The closer we are to the ambient water temperature, the more surface area we need to cool that engine.” says Peura.

For any operator, especially those in sectors where downward freight rates are exacerbated by regulatory pressures, the need for robust, reliable and simple equipment is a must. Those boxes, however, have long ago been ‘checked’ by Fernstrum. Depending on the maintenance cycle that a particular vessel might be going through, routine maintenance might dictate some new gasket sets, or possibly an anode update. In actual practice, however, Dale Gusick says the GRIDCOOLER Keel Cooler holds up admirably. “We frequently see a life cycle of 20 years for a copper nickel keel cooler. That said; we get calls from customers every week about keel coolers that have lasted 30 to 40 years. They (the vessel) may have even repowered a couple of times. And, sometimes, those vessels end up in developing countries after having been sold to overseas buyers.”

### **THE IDEAL KEEL COOLER INSTALLATION**

It wasn’t that long ago that as few as 6 to 8 keel cooler models could cover 60% of the inland river boats. Fernstrum today still stocks some of those models so that customers have access to them. Today, the vast majority of Fernstrum’s output is custom-designed for a vessel or a series of vessels. Much like the trend in designing fit-for-purpose hulls to match the new wave of thrusters for inland applications, every Fernstrum keel cooler is designed on a myriad of variables. Those variables will include the particular propulsion package, the operating environment, the water temperature itself, intended service and many other factors. “Some of these designs can take years to come to fruition, it’s fascinating to watch it all come together,” says Sean Fernstrum.

Frank Bjorkman agrees. “We work very closely with naval architects on the design aspects and installation of keel coolers. As a result, we are seeing better installations than we did 20 and 30 years ago. We also work closely with engine OEM’s before the release of a new engine to help determine how changes may impact the cooling system for the vessel.

Where a new vessel experiences cooling issues, it is often due to the wrong diameter of piping, too many turns or elbows; all things that can cause pressure losses. “That’s the kind of thing that we work with our customers on,” says Dave Peura, adding quickly, “We look at all the engine data, heat projections, flow rates, design temperatures of the engine, and then we look at application data – minimum hull speed at full rated power, sea water temperature, we even look at whether it will be fresh water or 50% cooling antifreeze being used in the system. All of that – and more – plays into sizing of a keel cooler.”

### **LOOKING AHEAD**

The Fernstrum business calls for looking back, planning for what comes next, and as Sean Fernstrum likes to stress, staying diversified. To that end, he says, “Ferries have always been a staple of ours, and they seem to be coming on stronger. As is usually the case in the marine sector, as one sector rises, another falls.

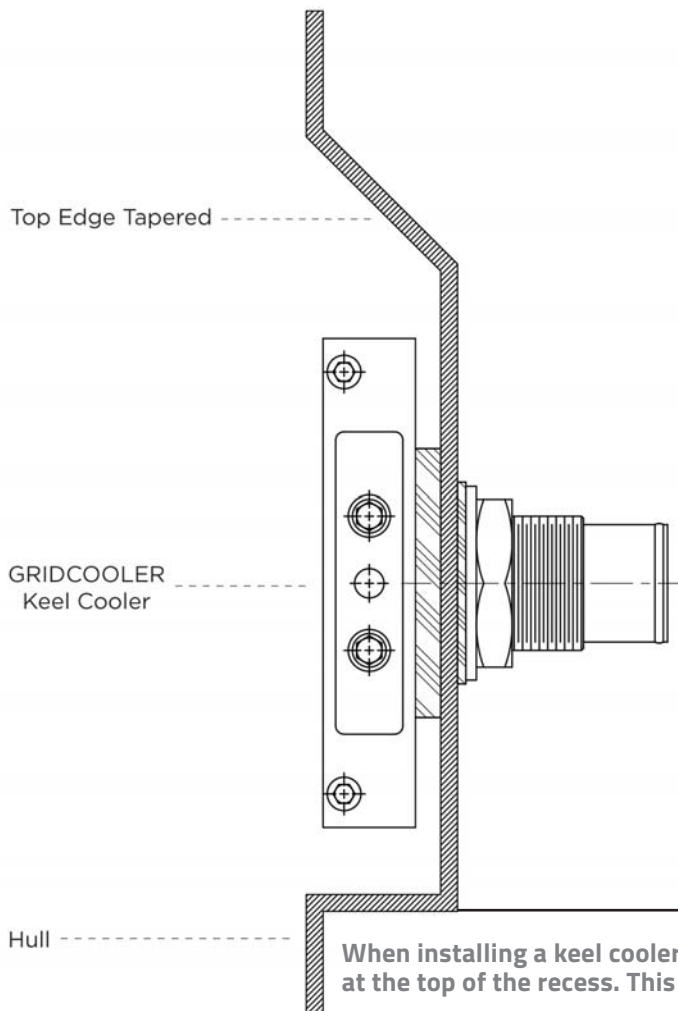
## MARINE CONSTRUCTION TRENDS

*"Today's coolers look outwardly very much like they did in the past. We've made changes internally to help strengthen the unit. The other thing that has changed – in part because of the Tier changes – we've gotten into much larger units. Additionally, the manufacturing techniques that we use improved over time."*

**– Frank Bjorkman, Fernstrum's Domestic Sales Manager**



### Side Mount Installation



We all rode that wave of the offshore industry, as significant as it was. But commercial fishing and some of these other sectors have worked to take off some of the edge from that loss from offshore. Diversification is an absolute must.”

Overseas, Fernstrum points to emerging markets that need energy. “These are really interesting markets – underwater tidal turbines, AUV’s and ROV’s. It’s been an interesting change that’s allowed us to work with some specialized projects – marine engineers and naval architects where there hasn’t been a previous market, so we’re breaking new ground in some of these applications.”

In smaller countries with developing economies, Fernstrum is seeing the return to landing craft – newbuilds and recycling old ones. “They use them as ferries moving people and equipment back and forth. And if the keel cooler is properly located and recessed into the vessel typically back towards the aft end of the vessel where the engines are, they are pretty well

**When installing a keel cooler on the side of the hull, create a beveled or tapered edge at the top of the recess. This promotes natural convection and allows heat to escape.**

## MARINE CONSTRUCTION TRENDS



Typical side mounted, recessed keel coolers on a shallow draft vessel. Mounting the keel cooler on the side of the hull helps prevent potential damage. When utilizing protective guarding, guarding should not cover more than 25% of open area.

protected even if they are on the beach,” says Gusick.

Separately and also within Fernstrum’s considerable export market experience, South American operators are increasingly demanding new build tonnage. And, when they do, those demanding Amazon conditions call for robust equipment. “We’re involved in several newbuildings down there right now. These include three large pushers for the Dreyfus group; all RAL design with GRIDCOOLER Keel Coolers,” explains Dale Gusick. With 18 active distributors and/or agents around the world, South America in particular has been a good market for Fernstrum.

For those U.S. yards that also produce tonnage for export, it isn’t unusual to see Fernstrum coolers on those vessels as they take last line for the Amazon, and beyond. Eastern Shipbuilding’s series-build Brevante class PSV’s were a perfect example. All had custom-designed Fernstrum box coolers fitted.

To a much lesser extent, the so-called ‘hour of power’ and hybrid propulsion revolution has also impacted the iconic keel cooler. But, for different – and says Dale Gusick – good reasons. He continues, “It’s going to impact us even more once people settle on something. The hybrid systems have brought in some

business because we’re cooling all of the electronics – converters, transformers, DC motors – on the vessels. All of that requires cooling. When you get into the true systems where batteries are now being used, we are currently doing some battery pack cooling on a ferry over in Denmark. So much of that is still in flux, and we’re not sure where it’s going to take us.”

### **BOTTOM LINE FOR THE SUBMERGED KEEL COOLER**

Out of sight, and because it has remained so reliable over time, Keel Coolers typically remain out of mind for shipbuilders and operators alike. Today’s version that evolved from a government plea to solve a critical issue during WWII remains similarly important.

Sean Fernstrum wrapped up an educational talk by declaring, “With all the complications that a vessel in operation may experience, it is reassuring to have equipment that’s efficient, effective, durable, and simple. The GRIDCOOLER Keel Cooler is a piece of equipment we strive to keep simple. Simplicity is hard. Making something complicated is very easy.” The operators of 5,500 subchapter M impacted vessels would probably agree.