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THE ESSENCE OF PERFORMANCE BOATING

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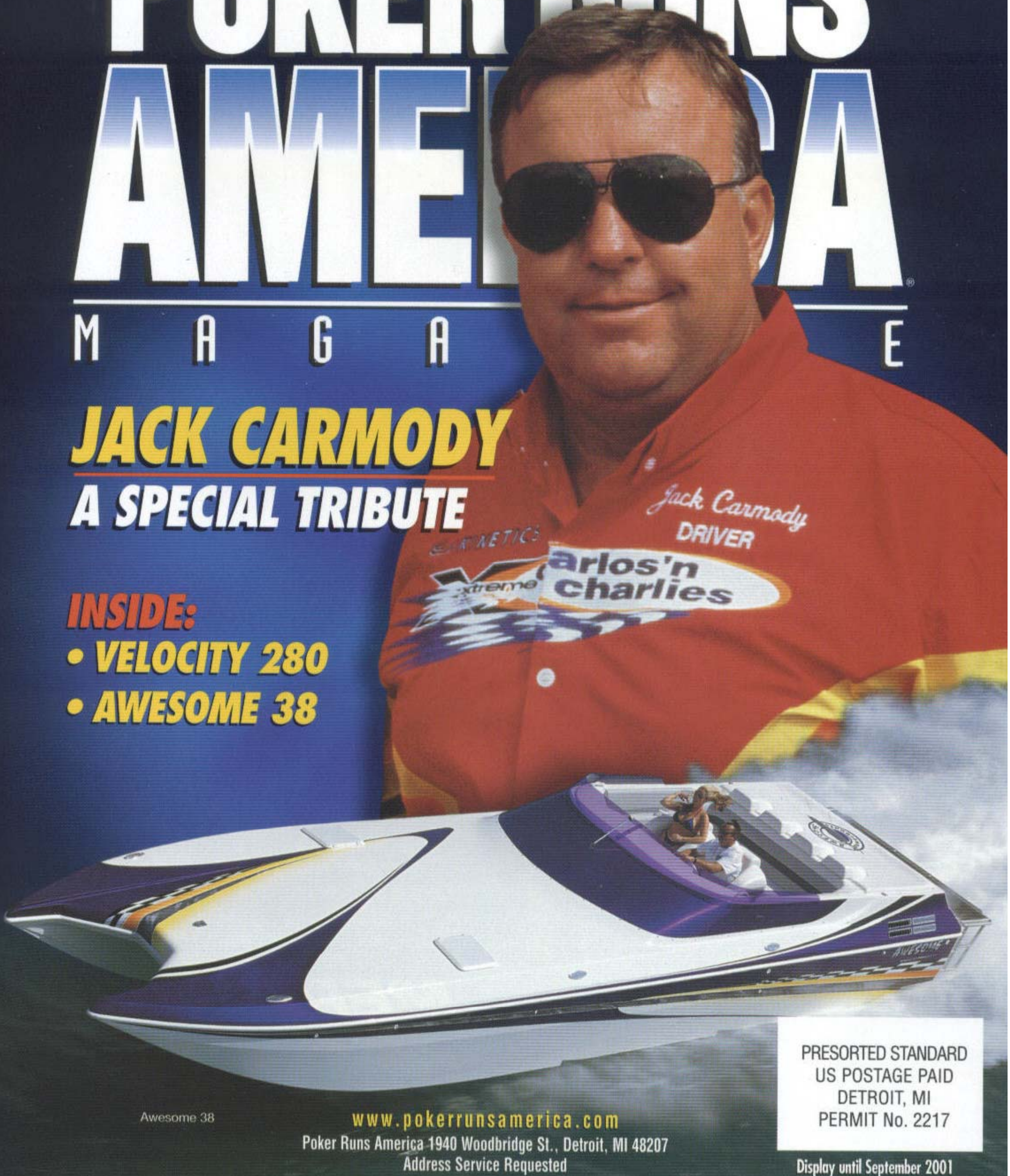

JACK CARMODY
A SPECIAL TRIBUTE

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Awesome 38

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TURBINATOR
There was plenty of action on the high seas at the inaugural Poker Runs America spring event in Sarasota, Florida. Buddy Wilkins' Turbinator is a 43-foot Black Thunder with some mighty awesome power - twin gas turbines (1400 horsepower each!) built by Marine Turbine Technologies, Franklin, LA. Read more about gas turbines in the special feature on page 52. Photo © BOATPIX.

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OUR COVER PHOTO OF JACK CARMODY WAS TAKEN BY JAMIE RUSSELL, PROFESSIONAL OFFSHORE PHOTOGRAPHY 281/334-6553

FAST FORWARD

Steve Sandler explains the pros and cons of gas turbines in high performance powerboats.

Gas turbines are gaining in popularity in high performance boating applications. The main reason - power-to-weight ratio. A gas turbine capable of producing 4,500 hp weighs less than 1,000 pounds. This is less than a reciprocating gasoline engine that is practically limited to less than 1,200 hp on pump gas.

The gas turbine is also generally much smaller than a similarly powered reciprocating engine. A diesel reciprocating engine capable of outputting 4,500 hp would fill a room and outweigh all but the heaviest performance boats.

As a guy with a strong scientific bent, I like turbines for other reasons. While they do have inherent disadvantages, I believe that with future advances in material sciences, turbines will become even more popular in small high-speed marine craft. This article addresses the pros and cons of gas turbines as applied to high performance powerboats.

Why I like turbines is best answered by pointing out what I don't like about reciprocating engines. First of all, most engines are

Left, Ted McIntyre of Marine Turbine Technologies. Above, Howard Arneson's red-hot turbine-powered Skater.

PHOTO © MAGGIE FERRARI, FERRARI COLOR

used to generate a rotational force, or torque, to turn a shaft. Propellers and wheels mounted on such shafts propel our boats, planes and cars.

A reciprocating engine derives its power from a combustion process that drives a piston down a cylinder, thereby creating a linear force. By connecting the piston off center to a shaft, the shaft is made to rotate to produce the required rotational force. At some point the piston has to change direction and move back up the cylinder. Think about the stresses on the crankshaft, bearings and journals.

Furthermore, because the piston moves up and down, the entry of the fuel and air charge, ignition, and the exit of the exhaust gas have to be timed. This requires valves, ports, injection systems and ignition systems. These add complexity, rob power, and reduce reliability.

Given these factors, doesn't it seem advantageous to start with a rotational force? The turbine does exactly that.

Development of the concepts on which gas turbines are based date back to about 100 years BC. The Egyptians developed a toy consisting of a circular chamber with nozzles around its circumference. Heating the chamber caused the air inside to expand. The heated air exiting the nozzles caused the chamber to rotate. Throughout the ages, inventors sketched and developed steam, wind and water turbines. The windmill is a simple turbine. In 1790, the first patent for a turbine engine, incorporating many of the features of the modern gas turbine, was granted. The first modern gas turbine was designed in 1872. Working models were tested in the early 1900s.

PHOTO © MAGGIE FERRARI, FERRARI COLOR

Howard Arneson

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Buddy Wilkins - Owner of Turbinator

Buddy Wilkins has been a speed nut since the age of 16. He has had a number of Ferraris including one with 1,300 hp. He had a 43-foot Black Thunder with twin 650 hp blower motors. "The top speed was okay at 78-mph but reliability was poor. The engines always needed a tune-up and rebuilds occurred too often," said Wilkins. "I wanted a luxury go-fast with reliability."

Buddy was told about turbines and referred to Ted McIntyre by a friend. He made the decision to give them a try. He likes the Black Thunder for its comfortable interior and ordered a new one specifically configured for the T-53 turbines. He calls his new boat Turbinator, a 100-mph condominium.

Wilkins is completely satisfied with his new boat. Shifting gears with his foot controlled braking system hasn't been a problem. Neither has the surface drive system configured by McIntyre. He admits that heat, noise and fuel consumption are negative factors. He handles the noise with a 6-headset sound system. At his 4,500-rpm idle speed, he burns lots of fuel. As for throttle response, he experiences some lag at lower speeds but says that from cruising speed at 96 percent wide open throttle, advancing the throttles provides the feeling of being launched by rocket.

Wilkins advises that users of turbine power take the time to fully understand gas turbine operation. He cautions that, "Since fuel puddles in the combustion chamber, it is important to get it out of the engine before starting. Proper starting procedures must be followed for safety."

Gary Montano - Owner of Fun Size

Gary Montano has been a longtime performance boater who likes innovation and being on the leading edge of technology. Prior to getting into turbines, Gary had a 46-foot Skater with twin 1,200 hp blower motors.

"The boat was great," says Montano. "It rode like a feather, was fast, and had terrific throttle response. But, with its 12,000-pound weight, it flew a lot in rough water and provided hard landings. I wanted something bigger, heavier and more comfortable."

Montano decided on a 50-foot Nor-Tech. At an expected 20,000-pound water ready weight, he would need lots of power to achieve the speeds he wanted. His desire to do something different led him to turbines.

He had Ted McIntyre install a pair of T-53's in his new boat. For transmissions, Ted provided crash boxes and foot-controlled, electrically activated, hydraulic brakes, with mechanical backup, to brake the turbine's output shafts for shifting. After fine tuning the fuel air mixture, turbine operation was flawless.

"We underwent months of testing in every conceivable condition," said Montano. "After we dropped the gear ratio to reduce torque through the Number Six Mercury drives, operation has been completely reliable. I've run about 100 hours. Reliability has been much better than with the blower motors."

Relative to disadvantages of turbines, Montano admits that heat is a problem. He docks bow first to keep the heat away from spectators. Relative to noise, he's found that once the boat is running, the noise is actually less bothersome than that with the blower motors. Fuel consumption, Montano finds, is about 15 percent greater than with the blower motors, but he is quick to point out that gas turbine fuel is cheaper. He prefers to use kerosene because it burns cleaner. On throttle response, Montano says that he notices some lag, much like with a turbocharged engine. This is to be expected with such a large boat.

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General Electric started its gas turbine division in 1903 and developed the turbocharger during WWI. GE's turbocharger led to the design of the first reliable gas turbine engines.

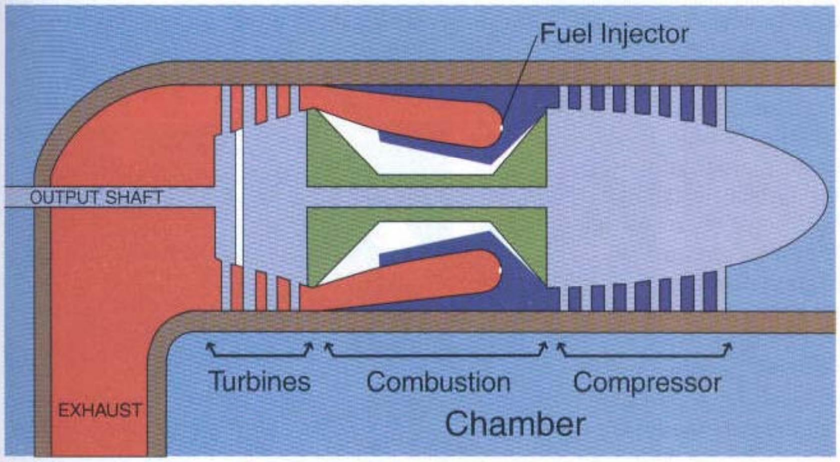
Turbines have also been used in marine applications since the early 1960s, such as the British Pegasus patrol boat which utilized Rolls Royce Proteus gas turbines. A decade later, the San Francisco Ferry, the U.S. LCAC hovercraft and the King of Spain's yacht all used turbine power. The Navy uses gas turbines for main propulsion and power generation in all DDG and FFG destroyers and frigates. Numerous other commercial and recreational examples abound, including, of course the Gentry Eagle

A gas turbine consists of three main sections: a compressor, a combustion chamber and a turbine. Air entering the gas turbine is first compressed in the compressor section. The compressed air entering the combustion section is mixed with a steady stream of injected fuel. Heat generated during compression ignites the mixture. The resulting hot gases expand through the turbine section to drive the output shaft. Typically, the output shaft is connected to the compressor to increase compression of the entry air. Some gas turbines have two sets of turbines in their turbine sections. The aft turbine drives the output shaft and the forward turbine drives the shaft connected to the compressor. These freewheeling turbines are popular in high performance boats.

While the principles of gas turbine operation are quite simple, the components are not. Temperatures, and rotational speeds, at which turbines and compressors operate, make gas turbines difficult to design and costly to manufacture. Cost is certainly a deterrent to greater gas turbine popularity in our boating applications.

Also, since turbines operate at very high rotational speeds, they require significant reduction gears. The resulting output torque can wreak havoc on a typical

Turbine installation in Fun Size.



performance boat transmission.

In larger craft with high output gas turbines, the massive hydraulic transmissions required to handle the torque generally outweigh the engines. In smaller boats, such as high performance models, crash boxes are often used in place of hydraulic transmissions to avoid repeated transmission damage. While crash boxes make close quarter maneuvering and docking a nightmare with reciprocating engines, the situation is quite a bit better with free-wheeling gas turbines. Here, the output shaft can be slowed or stopped with a brake while the turbine continues to run. This allows the crash box to be shifted and the brake released to continue operation.

Gas turbines like constant loads and are not fuel efficient at low speeds. They operate most efficiently above two-thirds wide-open throttle and become fuel competitive with reciprocating engines near wide-open throttle.

While this may be the reason that automobile turbines haven't been more popular, it is less a factor in marine operation where engine loads at cruising speeds tend to be constant.

Gas turbines also require many times more airflow than reciprocating engines. The majority of this air is used for cooling. Yet, the additional airflow results in louder noise and greater difficulty in quieting it. The noise is typically more annoying at lower speeds. As speeds increase, the change in compressor blade angles changes the frequency of the sound resulting in noise that is generally less annoying.

If more air goes in, more air comes out. Exhaust gases are very hot, and with the high volume exhausted by gas turbines, heat can become a significant factor. This is true during operation near other boats and spectators, especially around marinas. In some performance boat applications, the fuel inefficiency, noise and heat problems are eliminated by the use of auxiliary power plants for low speed and close quarter operation. A big plus is the fact that gas turbines can operate at wide-open throttle all day long. Such operation would take its toll on a high performance reciprocating engine. This attribute, along with their reliability and much greater mean time between overhauls, should make gas turbines of great interest to high performance boaters.

Turbines are driven by air, which creates force proportionate to the square of the air speed. Thus, turbine power is low at low speeds and comes on like gangbusters as turbine speed increases. You may have experienced this effect with a turbocharged reciprocating engine.

Similarly there is some turbine lag when advancing the throttles to accelerate. The extent to which the lag is noticeable is a function of turbine power, boat design and setup, and weight. Lighter boats and catamarans will tend to notice the lag less than heavier boats and less efficient V-bottoms.

There are a number of specialists in marine applications of gas turbine power. The legendary Howard Arneson of Arneson Marine outside San Francisco, and Ted McIntyre of Marine Turbine Technologies, in Louisiana, are well known for their expertise and successes.

At a very young 80 years of age, Arneson has certainly logged more hours in a boat at speeds over 100 mph than anyone else. Virtually all these hours have been in one of his turbine-powered catamarans.

Arneson became interested in gas turbines in 1986. Since then he has outfitted and set up some 30 turbine-powered speedboats. In 1990, he demolished the speed record for the Mississippi River Run in his turbine-powered 32-foot Skater. Certainly, this event was significant in fueling the interest in marine gas turbines for high performance boats.

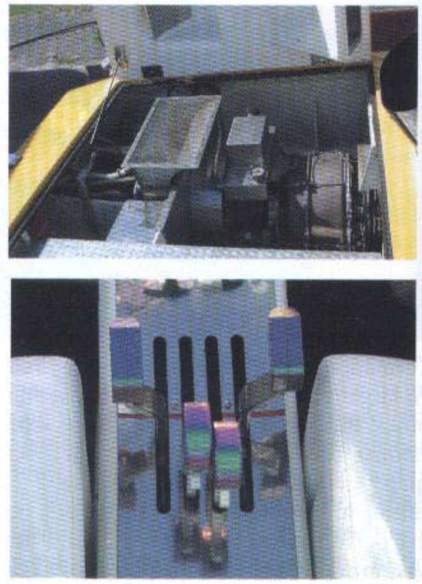
Arneson has installed gas turbines ranging in power from 450 hp to 4,500 hp. He handles the gas turbine disadvantages, namely heat, noise and inefficiency at low speeds, with auxiliary power for low speed and close quarter handling. He has used electric motors, outboards, and diesel generators powering the main propulsion drive, in such applications. Of course his drive system of choice is his Arneson Surface Drive. Arneson Marine sells a typical Lycoming T-53, 1,400-hp gas turbine for around $50,000 including the reduction gear and crash box. Installation is additional.

Ted McIntyre has incorporated gas turbine power in a variety of applications, including motorcycles, trucks, generators, and outboard and inboard engines for powerboats. His goal is to make gas turbines user friendly. To this end he has developed engine compartment sound proofing techniques, systems to reduce heat problems, and integrated braking systems to allow shifting of crash boxes for close quarter maneuvering. He has had contracts to develop such systems for the military and worked with gas turbine manufacturers. Ted sells a typical T-53 package with reduction gear, gearbox, charging and starting systems, instruments, and tail pipe for around $125,000. Installation is extra. Ted believes that gas turbines will become more practical for high performance powerboats in the future. Marine engines will not have to be built to the same standards as aircraft engines. This will reduce costs. New materials, economy of scale, and competition will add to cost reduction and increase user friendliness.

A brand new gas turbine, as delivered for aircraft use, would cost in the million-dollar range. Turbines used in marine applications are purchased from surplus. The purchaser really has to know what he's doing to get a usable and reliable unit. Units must be inspected and tested. This is good reason to leave such purchases to the experts.

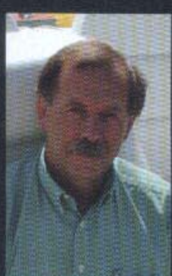
Bill Tomlinson, from Manotick, Ontario, has successfully undertaken this challenge. His turbine powered boat, "My Way", can be seen at poker runs in Southern Ontario and Florida. He has learned a great deal about gas turbines and with Ross Fedorki, of Brockville, Ontario, who was responsible for the design and construction of the turbine installation, has come up with some interesting innovations. Bill installed the turbine facing rearward in the boat to reduce driveshaft length. He also fabricated shift controls with micro switches to activate the braking system. His throttle controls include a stop to keep fuel flowing and the engine lit at ground idle. A lever must be pulled up to allow complete throttle back and fuel shut off. A micro switch at the throttle stop allows the brake to be applied only at the ground idle position. This saves the brake from burning up if applied when the turbine is producing too much power.

I believe that gas turbines have a rosy future in high performance powerboats. With experts like Arneson and McIntyre promoting them, and the pioneering Poker Runners adopting them, this future is near.



Turbine installation in My Way.

Bill Tomlinson - Owner of My Way



Bill Tomlinson has always liked turbine power but wasn't happy with the lack of user friendliness of the transmission systems required to handle the power. When he became aware of braking systems to make maneuvering with crash boxes manageable, he decided to re-power his 46-foot Skater with twin T-53 turbines. With his friend Ross Fedorki, Tomlinson decided to learn about gas turbines and undertake their acquisition and installation themselves.

"You've got to know how to purchase turbines and what you're doing for a successful turbine installation," he cautions. "Proper handling of heat and fuel are critical for safety. Every time you shut down, a cup of fuel drains out of the injectors. You have to collect it and get rid of it for safe starting."

Tomlinson likes the fact that gas turbines can run all day at wide-open throttle. He likes the throttle response. He trims up his Number Six Mercury drives when coming on plane. This allows the turbines to spool up to make more power for better acceleration. He hasn't found much difference in fuel efficiency and doesn't find the noise particularly bothersome once he gets to speed. He uses kerosene when possible because it burns cleaner. If he can't get it, he mixes diesel fuel with 20 percent of lead free gasoline for a cleaner burn.

Tomlinson is so pleased with his turbine boat that he has ordered a new one from Skater. This will be custom configured for a similar pair of T-53's. He's pulling out all stops to make this boat special. I've been in his current boat and, if the new one is going to be nicer, it's going to be a real showstopper. The new boat is expected to be ready this fall. That leaves me to wonder what he plans to do with his current boat. If you're looking for a beautifully outfitted 165-mph turbine powered catamaran, you should contact Tomlinson and try to talk him into selling it.