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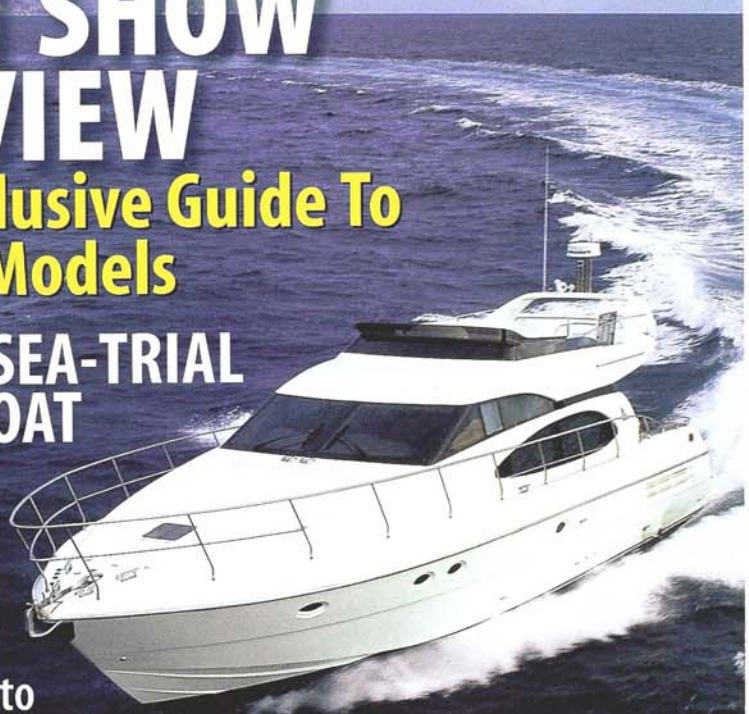

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fuel filters

BY ROBERT J. MALLOY

Do in-line fuel filters boost performance or simply lighten your bank account?

The facts do not change just because we ignore them. The same goes for the laws of nature. When it comes to fuel filters that tout an increase in performance and efficiency, the claims often require us to suspend our belief long enough to separate some cash from the family savings. Having been separated from wads of cash over the years, I am skeptical of "strap-'em-on-and-run-better" claims.

Although good marine mechanics will tell you nothing performs better than a finely tuned and maintained engine, fuel enhancers have always appealed to boat owners who are looking for a quick fix. Keeping this in mind, we decided to put some of these claims to the test.

PHOTOGRAPHY BY DAVID STAHL

a side trip to the Cousteau Underwater Park near Pigeon Island on the west coast of Guadeloupe.

Guadeloupe is divided into two geographically distinct halves, Basse Terre and Grand Terre, which are separated by a channel through a mangrove swamp. From Pigeon Island we hoped to hire a taxi and explore the rain forest on Basse Terre and hike to La Soufriere, the volcano that dominates that side of the island. Thinking that plan might be too ambitious, we rented a car the day we boarded the boat and drove to Basse Terre where we tracked down the 350' Carbet waterfall in the rain forest on the volcano's southwest slope and were rewarded with a taste of the island in all its tropical glory.

It was clear our first day out we wouldn't make all the stops on our float plan. Our first passage, to Marie Galante, was accomplished mostly under power. We arrived off the little town of St. Louis too late to go ashore. That night, over dinner in the cockpit, we concluded that rather than explore Marie Galante, we would buy a day and head for the Saintes for a night and then on to Dominica.

A stop in Grand Bourg, Marie Galante's easygoing commercial center, allowed us to clear customs for Dominica. Dan's high school French proved indespensible. With the breeze light, we made for the Saintes. Late in the day, we anchored in a cove at the foot of a small headland named Pain du Sucre just south of the town of Bourg des Saintes on Terre D'en Haut. We barely had time to experience a fine snorkel along the shore of the cove before the sun set over Terre D'en Bas across the channel.

We enjoyed an excellent French meal in the open-walled restaurant at the Le Bois Jolie hotel, which overlooks the cove.

After two windless days in the Guadeloupe archipelago, we were ready for some rock 'n' roll. The boat was comfortable and well-maintained, but we lusted for sailing. As we put the French charm of the Saintes behind us and Dominica's near-mile-high central mountains on the bow, we anticipated another slow, motorized passage. But as the high clouds cleared and the sun climbed, the breeze began to build. Within an hour we were overpowered and reaching across the 20-mile passage at nearly eight knots. The slick, brown surface of the Caribbean had lumped up and returned to its familiar gas-flame blue. The snow skiers on the boat likened the bumpy ride to a run down a slope of blue moguls—a weak analogy, maybe, but the knee-flexing, spirit-lifting exhilaration of the experience was close enough.

The rowdy sail was an appropriate transition from genteel Guadeloupe to untamed Dominica. As we rounded the Cabrits, two small volcanic humps that form the headland that secures the north end of sweeping Prince Rupert Bay, Portsmouth came into view. Portsmouth lies at the foot of 4,747' Morne Diablotins, Dominica's highest mountain. It is the island's second-largest town after the capital, Roseau. Its waterfront is strewn with rusting hulks blown ashore by Hurricane Luis.

The cruising guides promised an assault by the boat boys as we approached the island. The first appeared in his wooden skiff before we entered the bay. The boat boys provide concierge services to visiting yachts. They'll usher you through customs, get vegetables and ice, arrange a taxi tour of the island and, of course, do the Indian River trip. None of this would pose a problem for seasoned cruisers, but in keeping with the vaguely edgy feel of the place, there is an implied threat that if you don't hire one of them, your boat and belongings may be at risk. We picked Edison for his honest face.

There are 365 rivers in Dominica, one for each day of the year

The morning after our Indian River adventure, Edison arranged a taxi tour for us. With a West Indies vs. Britain cricket match on the radio, we set off to see as much of the island as time allowed. Our tour took us around the north and east coasts through coconut and banana plantations, the island's main cash crops. Most of Dominica's bananas are exported to England. The copra from the coconuts is exported to make oil, soaps and cosmetics. The windward coast is dramatic with numerous black-sand beaches and soaring headlands.

The island's rain forest and mountains combine to produce an abundance of waterfalls. Our original destination was Emerald Pool, a waterfall with a clear pool at its base and banks bathed in blossoming tropical flowers. We hoped to see some of Dominica's interior attractions, such as the Boiling Lake and the Valley of Desolation, but with time working against us, we decided instead to visit famous Trafalgar Falls.

Trafalgar Falls, which is depicted on the Eastern Caribbean $5 bill, is just beyond the last traffic light in Roseau. Like the Indian River, we were obliged to hire a guide we didn't really need to navigate the short trip from the parking lot. But after a long, hot day in the van, swimming in the pool at the base of the falls was an unparalleled pleasure. We arrived back in Portsmouth at dusk after a ride along the island's steep-sided west coast. Regretting we hadn't scheduled more time on Dominica, we departed the next morning.

Our return trip to the Saintes was nothing like the sail down. A promising breeze faded into a sweaty motor-sail. But about halfway across, we noticed a disturbance on the surface of the water a quarter-mile ahead, then another, and another. We soon found ourselves in the middle of a sprawling pod of sperm whales. They appeared to be having a fine time, splashing and rolling in the swells. We had our day running the blue moguls. Maybe they were having theirs. □

Contact: Sunsail, Dept. Y, 980 Awald Dr., Ste. 302, Annapolis, MD 21403. (800) 327-2276; fax (410) 280-2406.

fuel filters

THE CHALLENGE

To reduce the number of variables in the testing, we selected the most efficient engines and test boats we could find. The *Wiley Lawton*, a 46' Bertram sportfish with twin Detroit 8V71TI engines came from diesel engine guru Jimmy Cleveland of Cleveland Marine Diesel in Tarpon Springs, Fla. It was equipped with an EPS1000 high-tech exhaust system prototype from Ecosound, which is supposed to eliminate exhaust back pressure and increase the overall performance of the Detroits. The 450 hp 71TIs, since they recirculate 80 percent of the in-line fuel at a flow rate of 100 gallons per hour (gph), are the least likely to be affected by any filter-type product.

Cleveland's mechanics brought the *Wiley Lawton* to maximum operating efficiency, and we ran a week of sea trials to establish the base-line figures. Our test protocol required that we tightly monitor exhaust emissions and fuel flow. Greg Braswell of EnviroServe Inc., an emissions testing group, handled the emissions numbers. He hooked up his ENERAC system to the exhaust collector box, then we established baselines by more sea trials. Bob Dowell of Marine Maintenance Systems did the fuel flow figures. Bob is one of the top electronics and meter mechanics in Florida, and he calibrated the Floscans on the *Wiley Lawton* for maximum accuracy.

THE CHALLENGERS

Our field of contenders included the Fuel Charger, Gas Master, Fitch Fuel Catalyst and Fuel Mag. These in-line products represent the two dominant theories of performance enhancement—metallic contact and magnetic field. We had two of each.

Each device was installed per the vendor's recommendations and each vendor inspected the installation prior to our testing. The various tests were to be conducted at idle, 1500 rpm, 1900 rpm, 2000 rpm and 2200 rpm. The 1500 figure is significant on the *Wiley Lawton* because it marks the speed at which the hull is struggling to get onto plane; that is, the engines are working their hardest and are the least efficient. At 2200 rpm, the *Wiley Lawton* is at wide open throttle and has the highest emissions level in its power curve. If we were to see any improvement, it would come at those two rpm thresholds.

LET THE GAMES BEGIN

Test day No. one was clear and calm. We set up our routes to allow 20 minute test runs at each rpm level without having to alter course while remaining in the lee of Anclote Key. To avoid prejudice, only one person in the crew knew which product was being tested on any run. The results surprised us.

The metallic devices, Fitch and Fuel Charger, performed well on emissions and fuel efficiency, the Fitch holding a slight edge in most of the test categories. Overall numbers showed that each metallic ion product decreased fuel consumption by about one gallon per hour. Floscan verification at the end of the test showed a variation of 1.4 percent, so the worst case fuel efficiency rating of these products was about 7 percent. These initial results were impressive.

The design differences of the two products, however, soon became apparent. Both are a long metal tube, and both rely on fuel-to-metal contact to impart metallic ions to the fuel, which is supposed to enhance the fuel (see sidebar). The Fuel Charger contains a series of screens and plated steel wool, which provide excellent fuel-to-metal contact at all flow rates. Fitch, on the other hand, uses a dimpled coating on the sides of the tube. At higher flow rates, the central column of fuel in the tube makes little or no contact with the metal walls and is not affected. The test results confirm this theory—the Fitch lost some efficiency at higher rpm.

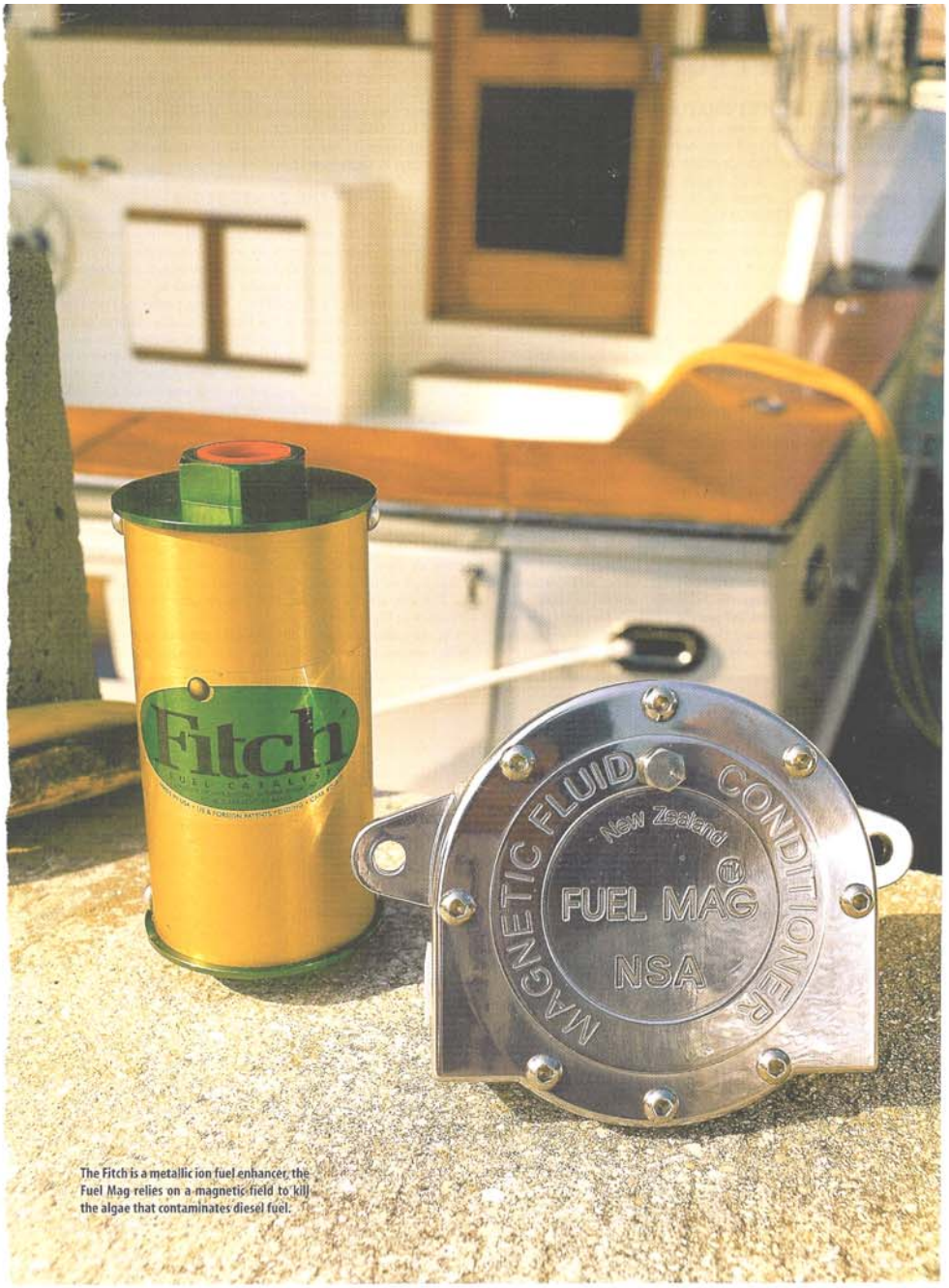
On the emissions side, both products reduced nitrogen oxide (NO_x) emissions, especially nitric oxide (NO). Sulfur dioxide

The Theory

The current claims regarding efficiency rely on making some adjustment to the molecular structure of diesel fuel. The molecules in diesel fuel look like long strings of odd-size pearls. One end contains a large carbon atom followed by several smaller hydrogen with a few sulfur atoms stringing along for the ride. The carbon chains wrap around each other like a treasure chest of pearl necklaces. At the point of combustion, swarms of oxygen atoms attack the necklaces. Every place an oxygen atom contacts a pearl on the necklace (in this case a carbon, hydrogen or sulfur atom), energy is released. Anything that avoids contact with an oxygen atom, usually by being buried deep in the cluster, ends up in the exhaust smoke. So, the more molecules exposed to oxygen at the instant of combustion, the better the burn and the better the performance. The better the burn, the lower the fuel emissions. A well-timed and tuned engine does this by aeration at the point of injection into the combustion chamber.

In our test scenario, as these necklace clusters race down your fuel line toward the combustion chamber, the pass through one of our challenger's products where profound changes are supposed to occur. The common theory that binds our challengers is that their product changes that necklace structure to expose more of the chain to the oxygen atom swarm. Gas Master and Fuel Mag claim to do it via a magnetic field; Fitch and Fuel Charger via contact with metal. In either case, the laws of nature still apply.

The set-up (above left) monitors exhaust emissions. Sensors feed data to computers (above and left), which analyze it and display the results. The disc in the technician's hand (top right) is the relatively powerful magnet from the Fuel Mag. If you put one on the back of his hand, it would stay.

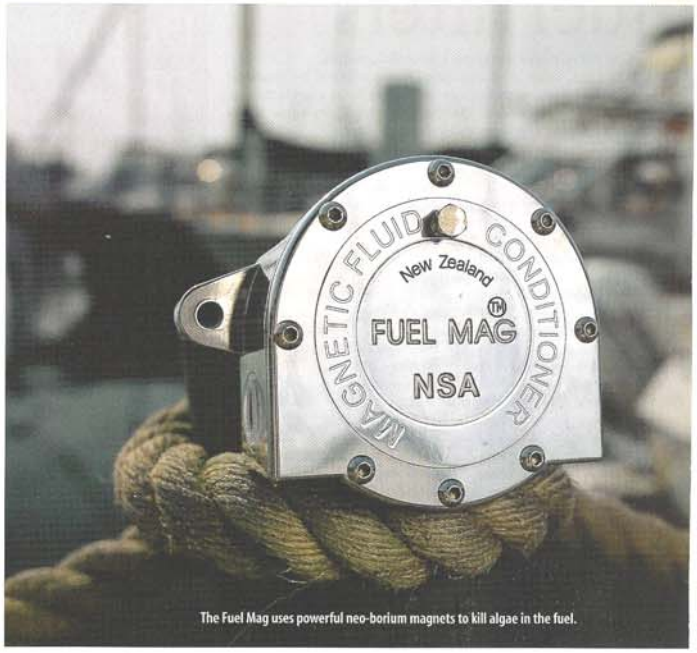


The Fitch is a metallic ion fuel enhancer, the Fuel Mag relies on a magnetic field to kill the algae that contaminates diesel fuel.

(SO_2) emissions also decreased in parallel with the NO, a sure sign of cleaner combustion.

The numbers over the course of the tests began to prove the theorem that the metallic ions added more energy to the combustion process, increasing the efficiency and lowering the overall emissions. At this point, we passed the Fitch and Fuel Charger on the first level of testing.

The magnetic products didn't fare as well. Despite Gas Master's claims of a 30 percent increase in fuel economy, we were not able to duplicate those results. In fact, fuel economy remained flat while emissions increased slightly. The Gas Master is a square steel tube that houses opposing ceramic magnets. These are very weak magnets, and they had no appreciable effect on molecular alignment (see sidebar). Although these magnets are supposed to be permanent, we noted that they rapidly lost their charge when we exposed them to harmonic vibration similar to that found in the engine-room. Placing ceramic magnets in opposition also rapidly depletes their field strength. These characteristics caused the Gas Master to fail the level one testing.



The Fuel Mag uses powerful neo-borium magnets to kill algae in the fuel.

Fuel Mag is another story. Making no claims to increase the fuel efficiency, the Fuel Mag is a high-tech chrome can housing a powerful neo-borium magnet shaped like a doughnut. If you were to take two of these magnets, each the size of a pat of butter, and placed one on each side of your open hand, they would stick tight. What Fuel Mag does claim is fuel cleansing, and Bill Miller from Fuel Dynamics can put on a very convincing demonstration of his product's algae killing power. Killing off the algae, he says, increases the fuel's efficiency.

Fuel Mag on its own showed a moderate increase in efficiency and a decrease in emissions, lending some credence to the molecular alignment theory. But the numbers didn't jump out at us until we coupled it with a metallic ion product. Running the Fuel Mag in tandem with the Fitch produced the best all-around numbers of the day. We passed Fuel Mag with an asterisk to the next level.

LEVEL TWO: COST RECOVERY

This is where we separate the cash from the wallet. The primary test is the overall cost of a product vs. the cost savings over the life of the product. Of the three products that passed level one, the average cost is about $600 a unit. At an average savings of one gallon an hour at $1.50 per gallon, you would have to run 400 hours to break even on the retail price. Installation runs about $150, bringing your break-even point to 500 hours. Combining a metallic ion product with the Fuel Mag produces great numbers, but you'll have to an additional 450 hours to recover the cost. Total running time to break even is 950 hours.

Verifiable data as to the life of these products doesn't exist, though each vendor claims a minimum of five years. Fuel Charger bases its longevity on the use of platinum and palladium plating, but we didn't find any of those metals in the product, only nickel plate, which is softer and far less resistant to corrosion.

No vendor adequately addressed the problem of fuel contaminant coatings building up on the products, a real concern in marine diesels. Coating issues could significantly reduce the active life of the metallic ion devices, because the fuel would no longer be in direct contact with the metals. The Fitch device, which has been on the market the longest as the Walker Fuelsep, has not reported any deterioration in the product's performance related to coating, but more time has to pass before we would give unreserved blessings. Although Fuel Charger has the most effective flow design, it's screen and steel wool components may be inherently prone to coating and clogging. The corrosive effect the water in diesel fuel has on the nickel

FUEL FILTER FINDER

Fitch Fuel Catalyst	Fuel Charger	Fuel Mag	Gas Master
Dept. Y, 558 Lime Rock Rd., Lime Rock, CT 06039. ☎(888) 881-2774. Metallic ion, $600.	Dept. Y, 9500 Payne Rd., Sebring, FL 33872. ☎(800) 756-6756. Metallic ion, $695	Dept. Y, 707 Mullet Dr., #110, Cape Canaveral, FL 32920. ☎(888) 825-4239. Magnetic, $570.	Dept. Y, 6994 El Camino Real, Ste. 210 Calsbad, CA 92009. ☎ (619) 929-8118. Magnetic, $600.

plating also reduces the active life of the product.

Fuel Mag, because of its design, is not affected by contamination or corrosion, though its use primarily as a performance enhancer is questionable. On the other hand, its value an as anti-algae agent is proven and valuable.

THE BOTTOM LINE

If you are a weekend captain who runs a genset more than the main engines, these products don't make sense. Avid fishermen and long-range cruisers would do well to have a look. Savings over many running hours at the ends of the power curve (trolling and cruising) can mount up quickly. The extended range to a cruising yacht also is a significant benefit.

These products are not a substitute for good maintenance and proper tuning. What we can say about all the successful challengers in our real-world test is that they are good for the environment and represent the beginnings of long-term preservation of air and water quality. Reductions of 30 to 40 percent in exhaust emissions that we saw in our tests is a strong recommendation for hooking one of these products into your fuel line, even if you only run 100 hours a year. □

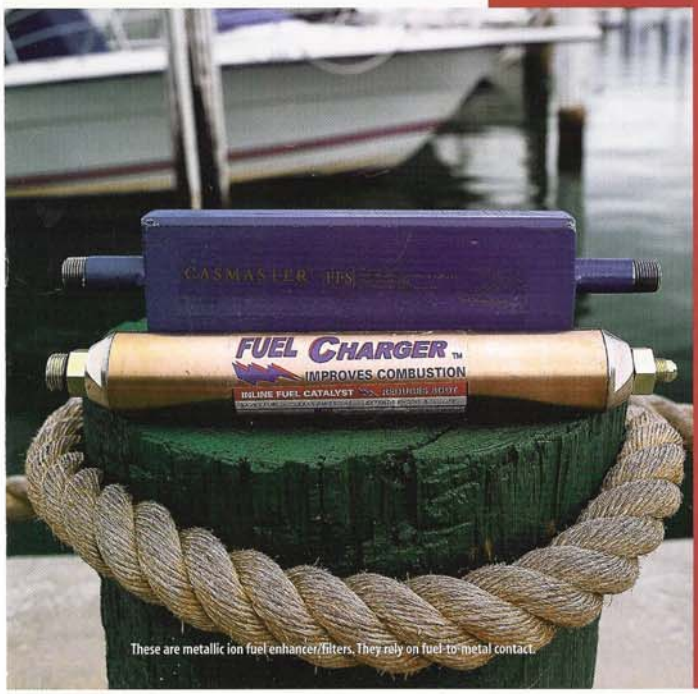
Robert J. Malloy *is a systems engineer and free-lance writer living in Florida. He welcomes questions and comments at rjmalloy@usa.net. You may also download complete test data sheets and summaries in PDF format from www.silversuncd.com/ yachting.*

Debunking Theories

The metallic products (Fitch and Fuel Charger) claim to induce some molecular shortening of fuel chains, a process that the petroleum industry calls cracking. It is similar to the process of converting crude oil into diesel fuel. The crude passes over a heated steel wool filter and is cracked into a lighter, more combustible fluid. To verify these claims, we contacted Dr. Jonathan Coyff, an authority on molecular physics from Novus Research in Houston, Texas. After reviewing the products and their claims, he replied with a polite but terse, "not possible."

Cracking a petroleum molecule requires a very high input of energy. In the crude oil example, this energy is heat—lots of it. Since neither product adds any energy to the system, it is highly unlikely that they make any fundamental change to the size, length or shape of the molecule. Instead, ion coating occurs in the Fitch and Fuel Charger. Both products use one or more of the "um" metals—platinum, palladium and chromium, along with nickel plating. We suspect that nickel alone is the active ingredient in the Fuel Charger. When diesel fuel comes into contact with one of these metals, ions are released from the metal and coat the exposed molecules with a volatile metal ion. The laws of physics say those ions add more energy to the burn when they are hit by the oxygen molecule. This causes the chains to fly apart at the instant of combustion, exposing more fuel to the oxygen swarm. Lower exhaust emissions will prove the theory.

Magnets are another animal, entirely. Brochures describing Fuel Mag and Gas Master claim that some realignment of the molecule occurs as it travels toward the combustion chamber. For that theory, we went to Dr. Hiro Tanaka of the Murubashi Institute of Japan. Dr. Tanaka admits that a field of sufficient strength would realign the fuel's molecules, with the heavier carbon ends going first into the combustion chamber. He warned that it would take a pretty robust field to do the job. We measured the field strengths of both products and sent design parameters and a technical paper from Gas Master to Japan. Although our expert agreed that Gas Master created some positive effects when it is applied to natural gas, it would be only because of a swirling effect of the gas stream, not because the unit realigns the molecules. Based on our field strength numbers, Dr. Tanaka doubted that Gas Master would have any effect on a liquid fuel.



These are metallic ion fuel enhancer/filters. They rely on fuel-to-metal contact.