GET ON THE DIESEL WAGON

Is your shop one of the thousands that service diesel engines in light trucks and passenger vehicles? If not, you're missing out on a growing segment of business that currently provides a nice profit—and will increase in the future!

The only things that separate your shop from those facilities repairing diesels are training, repair information, marketing and experience. We can offer help with training and repair information, but the marketing and experience are up to you.

A Little Diesel History

In the late 1880s, German inventor Rudolph Diesel began looking at mechanical alternatives to the inefficient (about 10% to 12%) steam engines of the day, the predominant means of power.

Gasoline engines of that time were just beginning, and were very finicky. Everything had to be nearly perfect in order for the engine to run smoothly: The carburetion mixture and induction had to be just right. The electrical system had to produce a strong spark. The spark plugs had to be clean and properly gapped. The gasoline had to be clean and free from debris and contaminants. The fuel cracking process had to be consistent to produce proper combustion. Even when all those factors were correct, the combustion, operating temperatures and waste products created more problems, requiring maintenance or repair.

Diesel began to experiment with internal combustion designs that would not require such precise conditions, would operate on a wider variety of plant-based biomass fuels and would be more efficient in energy conversion.

In 1892, Diesel filed for a patent at the German Imperial Patent Office and received it a year later. His engine was based on the compression of air in a cylinder to a point where it would ignite injected fuel. After five years of development, he demonstrated his "effficient thermal engine" at the 1898 Paris Exhibition. It operated on peanut oil at a fuel efficiency level of 75%.

Later, in the 1920s, when durable injection pumps were developed, the de-

Photo courtesy Jaguar Cars

By Tom Nash

Predicted record high gasoline prices this summer have consumers seriously looking at diesel alternatives. Will you be prepared to repair these vehicles, or will you have to turn them away?

sign was adapted to trucks in Europe. Meanwhile, gasoline engines had completely taken over the industry on both sides of the Atlantic. It wasn't until 1936 that the first mass-produced diesel automobiles appeared—the Type 260D by Mercedes-Benz. Since then, the use of diesel vehicles has grown steadily in Europe.

On this side of the pond, a diesel industry was slow to develop. The American license to produce Diesel's engines was acquired in 1898 by none other than Adolphus Busch, the St. Louis brewing baron, but little was done to promote use of the odd engines.

In 1919, Clessie L. Cummins purchased manufacturing rights to the diesel engine and improved the injection metering system. However, it and subsequent designs used petroleum-based fuel. Ironically, an engine design conceived as being operated with biomass fuel became locked into a petroleum-powered destiny. To this day, Cummins has continued to promote the diesel engine and carry the banner of Rudolph Diesel on high.

Jump forward to 1973 and the OPEC petroleum embargo. Long lines at service stations, higher-than-ever prices and limited fuel supplies convinced American drivers to look at imported vehicles with economical diesel engines. The trickle of Mercedes-Benz, Peugeot, Isuzu, Volkswagen, Audi, Volvo and Datsun vehicles with diesel engines hit our shores.

Among domestic automakers, General Motors produced the infamous Oldsmobile diesel engines from 1978 to 1985 for use in its vehicles. Ford used some International diesels, too. These older style diesels were difficult to start, required warmup times longer than the average driver's patience, were very noisy, belched soot and required on the driver's part a high tolerance to the odor of diesel fuel when refueling. When the cost of gasoline receded, so did the public's desire for diesel-powered cars.

Heavy-duty pickup trucks were a different matter. Since many were used for fleet, construction, farm and industrial purposes, their drivers didn't mind the inconveniences of noise and odor in exchange for torque, durability, economy and low maintenance. The loyalty to diesels in the heavy-duty pickup arena continues today. In fact, over 60% of full-size heavy-duty (¾- and 1-ton) pickups sold last year were diesel-powered.

What's Up With Diesels?

Diesel engines are getting extremely popular in Europe, as well as globally. Europeans buy diesel-powered passenger vehicles 35% of the time (over 40% in Great Britain). This figure has risen from just 15% in 1991. When light trucks are added in, the number rises by about 10%.

High fuel costs (don't complain; the U.S. is among the lowest-priced gasoline markets for consumers) have driven the European and global market steadily toward diesels. The desire to have clean air has also been a factor in thickly crowded European cities.

The Asian market, led by Isuzu engines, has also steadily increased its use of diesels for light trucks and passenger vehicles. In Asia, it's been more of a case of diesel fuel being more readily available than gasoline in many remote areas. Outside of the large cities, diesel is the preferred choice.

Although diesel engines have been around almost as long as motor vehicles, they have not become common in American automobiles, for several reasons:

- The low cost and broad availability of gasoline in the U.S.
- A robust U.S. economy, which has allowed drivers to afford gasoline, even when the price spikes upward.
- The premium cost of diesel engines.
- The clattering noise, odor and smoke of diesel engines.
- The extended warmup time needed for diesel engines.
- The less-than-pristine conditions at truck stops, where diesel refueling was normally done.
- The negative association of diesel engines with trucks and buses.

Why Are They Getting Popular *Now*?

The answer to this question is a combination of "pushing" by the automakers and "pulling" by the driving public.

The manufacturers are pushing diesels in North America because they want to lower their CAFE (Corporate

Photo courtesy FutureTruck

The University of Wisconsin's entry in the FutureTruck competition is powered by a diesel engine and electric motor hybrid system. "Moolander," as the UW team named it, has won the advanced technology event the last two years.

Average Fuel Economy) ratings. They also want to give the buying public more choice; to satisfy the moral issue of buyers being able to get a vehicle that's more environmentally responsible.

Environmental responsibility aside, Americans also want to consider our own economic situation. We realize we must lessen our dependency on foreign oil. And as individuals, we want the best mileage possible in our vehicles to keep our personal finances healthy.

Fuel cell vehicles still may be several years away from widespread use. Diesels and hybrids are here now, successfully doing what they were conceived to do—save fuel, run economically and emit fewer noxious fumes.

Diesel engines and gasoline/electric hybrids—such as the Toyota Prius and the Honda Insight and Civic—offer an instant way to achieve the desired results. The logical extension is for *diesel/electric* hybrids to arrive on the scene. This combination will offer the best mileage until the promise of fuel cells becomes a reality.

Diesel/electric hybrid technology has been used in the FutureTruck competition, an annual contest among students at several technology-oriented universities. The goal is to find ways to lessen emissions and create energy-saving vehicles. It's sponsored by the U.S. Dept. of Energy; Ford, GM and Daimler-Chrysler; automotive technology companies; and scientific organizations.

Called FutureCar for several years, the competition's focus is now on trucks. Each school is given a truck (currently a Ford Explorer) and is charged with creating the most technology-laden vehicle they can. The vehicles are tested for performance, design and manufacturing feasibility. Although fuel cells are used by some of the teams, diesel/electric hybrids have dominated the competition recently.

The University of Wisconsin at Madison has won the competition the last two years. UW's FutureTruck entry, nicknamed "Moolander," uses a 2.5L turbocharged, common-rail, direct-injection diesel engine that creates 134 hp and an AC induction motor that supplies 44 more horses.

The 'New' Diesel Technology & Its Benefits

The "new" diesel technology offers a number of advantages to increase the efficiency and acceptability of diesel engines:

•**Improved engine management systems.** Just as in gasoline engine management systems, a network of sensors is connected to a control module that constantly monitors engine and operating conditions and instantly adjusts to maintain optimum efficiency while controlling exhaust emissions.

•**Common-rail fuel systems.** The

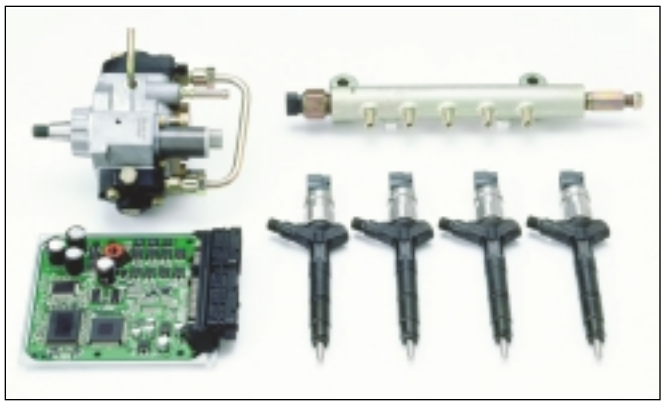

Photo courtesy Denso

The foundation of an efficient modern light diesel engine is the common-rail fuel system. The components displayed here are (clockwise from upper left): the high-pressure fuel pump, the accumulator (or rail), the high-pressure injectors and the control module.

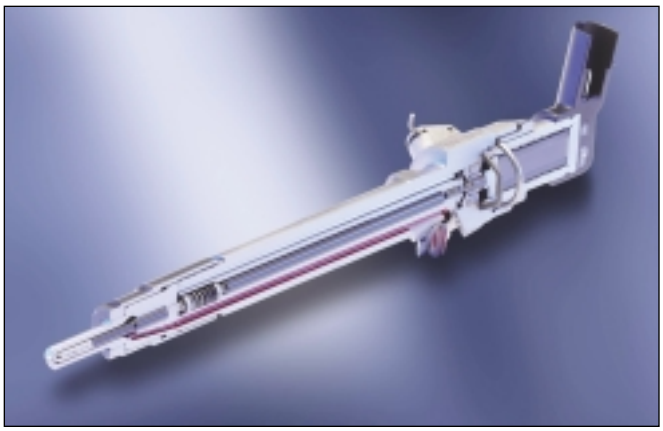

Photo courtesy Siemens VDO

The newest diesel fuel injectors have nozzles as fine as a human hair, open and close in milliseconds and operate at pressures up to 25,000 psi. This facilitates cleaner, more complete burning of fuel with minimal emissions.

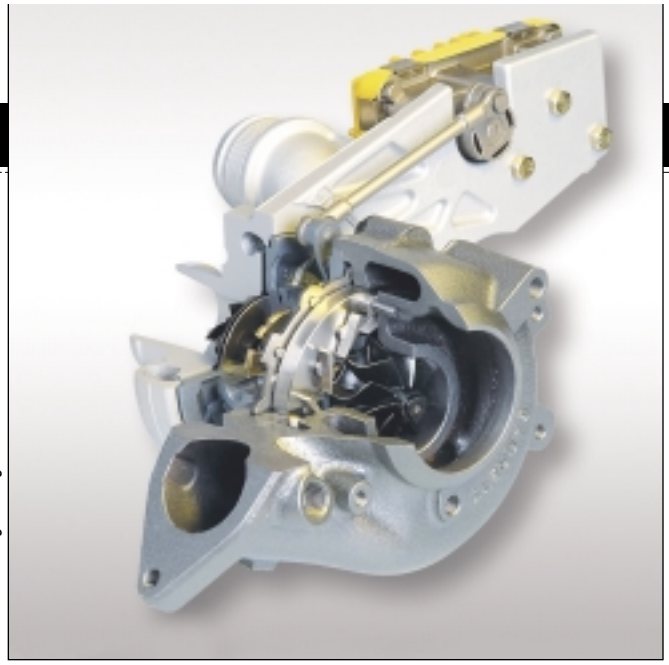

Photo courtesy Honeywell/Garrett

Electronically controlled turbochargers, such as this one from Garrett, adjust the angle of the vanes to meet changing ambient and operating conditions, and thereby force the correct level of air into the combustion chamber. This "variable geometry" ensures optimum efficiency.

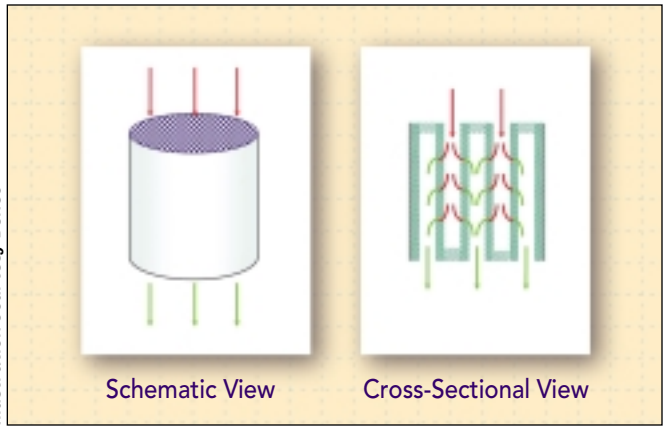

Illustration courtesy Denso

The diesel particulate filter (DPF) operates similarly to the catalytic converter on a gasoline vehicle. It traps the sooty exhaust particulate matter in its honeycombed closed-end cells while allowing the gases to pass through. A catalytic reaction causes the particulate matter (soot) to burn off at temperatures of 500° to 600°C.

new diesel common-rail fuel systems allow the fuel to be accumulated at proper pressure levels (as high as 25,000 psi) and ready to spray into the engine at consistent pressures, regardless of engine speed. This provides up to 30% better fuel economy.

•**Direct injection.** One difference between diesel and gasoline engines is in the way the fuel enters the engine. In a gasoline engine, the fuel is mixed with air prior to entering the cylinder during the intake stroke. The mixture is then compressed and ignited by a spark plug, creating the energy to drive the piston back down. Compressing the air/gasoline mixture limits the overall compression ratio and, therefore, the energy generated. If the compression ratio is too high, the mixture will ignite prematurely, resulting in knocking.

A diesel's compression ratio is higher since only air is being compressed. The diesel fuel is then injected directly into the cylinder and ignited by the pressure. More energy is generated.

•**High-pressure injectors.** The new high-pressure pumps and injectors allow for injection of fuel at higher-than-ever compression ratios, creating more complete burn and a higher level of energy. The result is more power and a cleaner exhaust.

•**Multiple spray patterns.** The consistent high pressures provided by the common fuel rail allow the high-pressure injectors to provide more than one spray per cycle into the cylinder, for more complete combustion.

The latest technology, piezo-actuated injectors operate under extremely high pressure and open and close so quickly that up to nine sprays per compression cycle can be achieved. This makes for smoother operation and reduces noise and vibration. It also reduces oxides of nitrogen (NO_X) and particulate matter (PM) levels.

•**Turbocharging.** A turbocharger, as we tend to think of it, boosts the power of the engine, but usually results in

Photos courtesy DaimlerChrysler

The Dodge Sprinter Van (left) is gaining fans for economy and durability as a people mover, delivery truck and Class B motorhome. Its 2.7L DOHC 5-cylinder intercooled turbodiesel (right) produces 154 hp and a torque of 243 ft.-lbs. A five-speed automatic transmission with overdrive transfers clean, quiet, economical power to the rear wheels.

more fuel being used. However, modern turbochargers, controlled by a module, can reduce the use of fuel by increasing the efficiency of the burn. The highly sophisticated turbocharging systems used on today's gasoline and diesel engines can be used to enhance performance or fuel economy—or both.

•**Particulate filters.** Diesel particulate filters (DPFs) are being used on the latest diesel vehicles. Part of the exhaust system, they trap particulate matter, then burn it off via a reaction with a catalyst. Since these catalysts are affected by sulfur, the DPF must be inspected and/or replaced at regular intervals.

•**New biomass fuels.** The promise of renewable energy sources over the prospect of depleting fossil fuels is driving scientists and researchers worldwide to experiment with alternative-fuel sources such as oil from soybeans, corn, sunflower seeds and other vegetables.

Among the benefits of these new technologies are:

•Even better economy and performance than with past diesel engines.

•Reduced noise and offensive odors.

•Lower carbon monoxide (CO), carbon dioxide (CO_2) and hydrocarbon (HC) emissions.

•Wider testing and use of biomass fuels.

The Downside

It's not all blue sky with diesels, however. Diesels emit higher levels of soot, or particulate matter, NO_X and nonmethane hydrocarbons (NMHC).

Photo courtesy DaimlerChrysler

Later this year, DaimlerChrysler plans to market the 2005 Jeep Liberty in the U.S. with a high-tech 4-cylinder 2.8L common-rail turbodiesel made by MV-Moteri, an Italian subsidiary of the Detroit Diesel Corp.

Diesel particulate filters capture and burn off most of these soot particles via a catalyst. However, NO_X and NMHC emissions are a different matter. To solve these problem areas, the EPA has mandated that diesel fuel with a sulfur content no greater than 15 parts per million (ppm) be available beginning June 1, 2006. This is a staggering 97% decrease in sulfur content from the current level of 500 ppm. If the ultralow sulfur level is met, the possibility of further advances in diesel emissions standards can be easily achieved.

This new low-sulfur diesel fuel, combined with new technologies of turbocharging, advanced injection and combustion and exhaust particulate filters, will make diesel engines more acceptable to the American public.

Diesels Are Here

GM, Ford and DaimlerChrysler have offered a diesel engine in their heavy-duty pickups for the last several years. All three have been successful and have recently upgraded their engine designs and the engine management and exhaust systems to keep pace with rapidly advancing technologies.

While all three carmakers have made great strides in diesel car sales globally, DaimlerChrysler is also making its claim on the North American market. Last year, DC decided to eliminate its longtime Dodge Ram Van in favor of marketing the Sprinter van it has sold in other parts of the world since 1995 as a Mercedes-Benz product. It also had been available under the company's Freightliner brand on this continent for a couple of years.

The Sprinter's 2.7L 5-cylinder intercooled turbodiesel produces 154 hp at 3800 rpm and a torque of 243 ft.-lbs. at 1600 to 2400 rpm. The cast-iron block and head combination features a 20-valve DOHC design and is fueled by a common rail.

Large fleet operators such as UPS have given the Sprinter their stamp of approval by purchasing the truck in big numbers. Although sales of the Sprinter are primarily in fleets, the vehicle is beginning to find its way into the Class B motorhome market. The durable diesel

Photos courtesy Mercedes-Benz

Mercedes-Benz will be bringing over the E320 CDI turbocharged diesel sedan (left) as a 2005 model. Its 6-cylinder common-rail diesel engine (right) uses high-pressure direct injection and a variable vane turbocharger to create 201 hp and 369 ft.-lbs. of torque. M-B says low-sulfur fuel will meet emissions standards in all 50 states.

Volkswagen's Touareg SUV will soon come equipped with a 10-cylinder turbocharged direct injection diesel engine, which churns out 313 hp and an impressive 550 ft.-lbs. of torque. Other VW diesels will follow.

engine, mated with a Mercedes-Benz W5A 380 five-speed automatic transmission, provides the economy and durability sought after in motorhomes.

Later this year, DaimlerChrysler will begin building the Jeep Liberty with a 4-cylinder, 2.8L common-rail diesel (CRD), shipped in from Europe, for U.S. drivers. The diesel version, called "Cherokee" in Europe, has proven highly successful. Based on the success of the Liberty here, the possibility remains of also marketing a diesel-powered Grand Cherokee.

Mercedes-Benz, DaimlerChrysler's German counterpart, is launching the 2005 E320 model with a 3.2L common-rail, direct injection (CDI) engine this summer. It's the first diesel offering by M-B since the 300 Turbodiesel in 1999. Fitted with the 6-cylinder turbocharged CDI diesel, it boasts 20% better mileage, longer cruising range and faster 0-to-60 times than the gasoline-driven version.

Although Mercedes-Benz has sporadically exported diesel models to North America, Volkswagen currently is the only company successfully selling diesel-powered cars. Their nifty little 1.9L Turbo Direct Injection (TDI) engine has been so well-received here that it will soon be joined by a 2.0L TDI in the Passat and a 313-hp, 5.0L TDI V10 powering the Touareg SUV.

Training & Repair Information

To get started on the road to fixing diesels, your technicians need to get some training to learn the ins and outs of the various diesel systems. They'll also need repair information to help them along the path. Then, they should get certified to complete their credentials. Finally, once your technicians are firmly established in diesel repair, you need to make your customers and the general public aware of these new skills.

Training specifically for diesel engines and systems in light trucks and cars is hard to find just yet, but there are some bright spots. For example, Bruce Amacker of *Turbo Training* in Strongsville, Ohio, is a highly skilled and respected technician, and one of the very few people who provide training for light diesels. Turbo Training specializes in training courses and books on the repair of Ford 6.0- and 7.3L engines.

Amacker feels the diesel repair market is lucrative, but being ignored by many shops. "It's foolish to overlook the small diesel market," he says. "The owners of these vehicles want to keep them on the road, operating at peak efficiency. Many are small businesses, such as landscapers, delivery systems, light industry, etc. When these vehicles are off the road for repairs, they are not making money for the company.

"And," Amacker adds, "the diagnostics for these light diesels is not difficult. If you can diagnose a gasoline engine, you can diagnose a diesel. Furthermore, there's good money in repairing light diesels. The average repair order on these light diesels is three times that of the average automobile. My repair orders on light diesels average over $900."

Robert Bosch Corp.'s new Diesel Service Center (DSC) program is a good way for independent automotive repair shops to get into light-duty diesel service. The program provides extensive training and technical support for diesel service.

Chuck Oliveros, proprietor of Williams Diesel Service Inc., in Ocala, Florida, feels that "any shop proficient in normal automotive gasoline engine service will find diesel service a simple extension of the work they already perform every day." In business for 14 years in Ocala, Williams is a light-duty diesel specialist shop that services mostly pickup trucks, delivery vehicles, some passenger vehicles and an occasional big rig Class 8 truck.

The shop performs engine work almost exclusively, although, says Oliveros, "we will occasionally do some chassis or brake work if the customer really needs it. We work on five or six vehicles a day, and if we could find more qualified technicians, we would turn out more vehicles."

Universal Technical Institute (UTI) has been training professional automotive technicians since 1965. The school offers classes in Diesel Engines, Diesel Fuel Systems and Diesel Accessories at three of its campuses: Houston, Phoenix and Glendale Heights, Illinois.

UTI claims that automotive/diesel technicians have triple the job opportunities over automotive technicians, receive 10% higher starting salaries and enjoy wider career choices in fleet, government and industrial sectors.

The website of the *Association of Diesel Specialists (ADS)*, a worldwide society of professional diesel technicians, offers guidance, training and assistance toward ASE certification. Although primarily concerned with larger truck, industrial, marine and locomotive engines, the site offers valuable information on all forms of diesel systems.

Diesel repair information is available from more sources than you might expect. The manufacturers of diesel-powered vehicles provide websites for repair information. Also, *Motor Information Systems* offers a complete range of repair information in book, CD, DVD and electronic forms. Engine manufacturers also offer help lines, and aftermarket books covering more popular vehicles and engines are available.

ASE Testing & Certification

Certification for diesel skills will improve any tech's credentials and credibility. Check out any licensing or certifications for your state, either in repair skills or emissions testing. The National Institute for Automotive Service Excellence (ASE) currently offers diesel engine technician certification only in the Medium/Heavy Duty Truck series. The Diesel Engine (T2) Test is taken by huge numbers of truck technicians.

No light diesel engine certification is available in the automobile series, but that's expected to change as more diesel-driven cars come to the market. According to Tony Molla, Vice President of Communications for ASE, "ASE is in a constant state of upgrading and reevaluating our testing series to reflect the real-world situation. We have been investigating the question of offering diesel certification for light-duty automobile engines for inclusion in our automobile testing series. We know that we may have to offer such a certification in the years to come, and want to be ready when that time arrives."

Marketing Your Shop's Diesel Skills

When diesel owners' vehicles need repairs, they're going to be attracted to shops that have training in diesel repairs, have experience with diesels, are certified to work on diesels and advertise those facts.

Proudly publicize your diesel skills in all your advertising, brochures and other printed material. Put it on your business cards and paint it on your signs. Mention it in any radio or TV ads and on your phone voice message system. If you have a website, put the fact that you're qualified to work on diesel vehicles right on your home page. Let people in local business and fraternal organizations know that they can bring their delivery vehicles, big pickups and other diesel-powered vehicles in for service and be sure they're going to get quality service.

Let's face it, diesel-powered vehicles are only going to increase in numbers. If you're not among those shops that are repairing diesel engines, you're not only cutting yourself out of a significant portion of the market, you're chasing customers to your competitors, as well.

Most likely, a family with a diesel-powered vehicle will also have a gasoline-driven vehicle or two in the garage. Consider this: Dad drives his Dodge Ram 3500 with a Cummins for his construction job, while Mom uses her Voyager minivan for errands and their teenage son motors to school in his Neon. Sound familiar? You bet. It's pretty common. And, if you exclude your shop from working on one of that family's vehicles, they'll probably find another shop that can handle all their needs. You're not just turning away one vehicle, but three. You can't afford to do that.

As you can plainly see, diesel technology is here and advancing, and training and repair information are available. All that's left for you to do is commit to repairing light diesel vehicles and "get on the diesel wagon." M