

January 2010

Vocational Report

SCR Systems Designed with Bodies in Mind

One of the challenges facing truck manufacturers who'll use selective catalytic reduction on their EPA-2010 diesels — and that's most of them — is finding places on vehicles to mount new exhaust aftertreatment equipment. Each SCR-equipped truck will have a urea tank, dosing chamber, and fluid and electrical lines added to the oxidation catalyst and particulate filter already used with '07-spec diesels. The new equipment will occupy several cubic feet, and that concerns upfitters who want "clean" areas behind truck cabs and along frames so they can mount bodies without modifying them to fit around hot exhaust parts.

Not to worry, manufacturers' representatives told upfitters at the National Truck Equipment Association's Product Conference last fall. As they did with the '07 stuff, engineers spent many hours designing a host of SCR configurations to accommodate almost any size and type of body. Designs differ among manufacturers and truck classes, with domestic builders generally offering more systems than the importers. Reps said heavy and medium-heavy tractors usually have enough frame space to handle the added equipment, while medium-duty straight trucks will vary in how equipment is placed. Light trucks and pickups are simpler because they vary less in overall layout and their SCR gear is smaller.

Tanks for the liquid urea — which manufacturers call diesel exhaust fluid, or DEF — will range from about 3 to 23 gallons on light- and medium-duty trucks. Tanks will be a bit bigger on heavies. Tanks will be made of a special plastic because DEF, though non-toxic, would corrode metal. In all cases the DEF tanks will be sized to correspond with fuel-tank capacities, because DEF dosing will be at the rate of 1 to 3 percent of fuel consump-



Most SCR components of the exhaust system on this medium-duty Freightliner M2 are under the cab, while the tailpipe runs up the right rear. This leaves the frame clear for easy mounting of big bodies. Freightliner showed more than two dozen configurations to mount the components at the NTEA show.

tion, engine makers have said.

On some trucks the DEF tank will crowd out some fuel capacity if no other space can be found on the chassis. For instance, depending on chassis and body configuration, a 75-gallon fuel capacity might have to be cut to 50 or 60 gallons, so the fuel tank will have to be topped off more often. The DEF tank must also be replenished every once in a while, perhaps weekly or bi-weekly. In practice, it probably makes sense to top off the DEF whenever the truck's in for fueling.

SCR-equipped trucks will have special gauges and warning systems to remind drivers to attend to the new fluid, and engines will begin losing power and trucks will eventually slow to a crawl after DEF tanks run dry. These are sensor-activated, electronically controlled limits that the government insists on to remind forgetful or careless drivers to keep fluid in the special tanks.

Light trucks

On diesel-powered Ford and General Motors pickups (and Ford and GM vans), the exhaust system is long

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enough for an SCR dosing chamber to be added ahead of or behind the DPF. Ford's SuperDuty pickups will have the urea tank and filler neck on the left side of the chassis with a tube crossing over to the dosing chamber on the right, and Ford SuperDuty cab-chassis models will have that tank on the right side. Wiring for sensors and a fluid heater will lead under the hood.

On Dodge Cab-Chassis trucks, the dosing chamber will replace a second muffler (also called a resonator) used in current models. (Dodge 2500 and 3500 pickups will continue to use NOx-adsorbing equipment that's already '10-legal.) Like competitors, Dodge engineers said they have tried to keep frames and back-of-cab areas clear. But 2 inches of clearance will be needed behind cabs to accommodate the urea tank's filler neck, and a heater consumes more space (see photo).

SCR-equipped Sprinter vans and cab-chassis vehicles, which are sold by certain Freightliner and Mercedes-Benz dealers, will also have SCR gear. Because exhaust systems are hung horizontally on their frames, the dosing chamber gear will be placed along the length of the system, similar to domestic vans, pickups and cab-and-chassis trucks, while the DEF tank will go elsewhere on the chassis. Dodge dealers might still have Sprinters for sale, but these are all pre-2010-spec diesels without SCR equipment (and with the dissolution of



The Freightliner "I-Box" system combines oxidation catalyst-DPF cylinder with SCR dosing chamber and connects them with "switchback" elbows. Exhaust backpressure is well within allowable parameters, engineers say.

business between companies, Daimler is no longer supplying Dodge-badged Sprinters to Chrysler).

Medium-duty trucks

Most builders of midrange trucks have designed "compact" cube-shaped SCR packages that go beneath cabs and behind passenger steps of their trucks. Here one

piece of gear is placed above another, and exhaust gas flows from one to another, then, almost completely cleansed of pollutants, moves through the tailpipe and into the atmosphere. Usually gas flows in this order: engine to the DEF dosing chamber, then through an elbow to the oxidation catalyst and DPF (the two are usually combined into one cylinder), then through another elbow and out the tail pipe. That pipe can go vertically up the cab corner or hung horizontally on the frame. A few builders put the dosing chamber downstream of the DPF; the SCR process seems to work either way.

As with '07-spec diesels, there is no muffler, because the DPF's honeycomb structure silences the engine's combustion explosions while catching particulates and motor-oil ash.

One might think that this switchback arrangement of chambers and piping would choke off the engine, but builders say that back pressure is well within acceptable limits. Driving the 2010-powered trucks confirms that they have good power and torque.

Sometimes the DEF tank sits next to the SCR cube and sometimes it's on the other side of the truck. Either way, the fuel tank and battery box can be placed under the cab on the driver's side, which will leave the frame and back-of-cab area clear of obstructions for close body mounting. Or, if a truck body won't drape over the frame rails, as with a beverage or utility body, the fuel tank and batteries can be hung on the rails and a van or reefer body can be placed right behind the cab. This would allow more fuel capacity.

Makers of walk-in van chassis have had to place SCR components within the confines caused by the bulky

Get Exhausts Right

Truck manufacturers' engineers say they have designed SCR exhaust configurations for every body and application they could think of, but others may be out there and they might have to do more.

In any case, buyers and upfitters must order a chassis with the correct exhaust system for each hauling or work job, because the system cannot be changed later.

Manufacturers issued the same warning for 2007 trucks, which came with then-new diesel particulate filters. Each exhaust system has to be certified with the federal Environmental Protection Agency, and EPA does not allow altering it except for the tail pipe. Even this has limits, because longer pipe and more bends can introduce unwanted backpressure. DPFs will also be used with 2010 diesels, and the addition of SCR dosing chambers complicates the situation.

Thus the days of taking a stock truck from a dealer's lot and changing its exhaust so it'll work with a big, bulky body are over. Get the exhaust system order right the first time, or forever regret what you're saddled with.

bodies, and sometimes these intrude slightly on the underside of bodies.

Where there's space behind the cab and along the frame rails, there are lots of possibilities. Freightliner reps showed more than two dozen SCR-equipment configurations using vertical, horizontal, in-line and cross-over placement of exhaust pipes, dosing chambers, DPFs and tailpipes, not to mention various mounting locations for DEF tanks and associated heaters and lines. Reps said engineers tried to think of every conceivable body and hauling application, but they might have missed some, so buyers and upfitters should confer closely about what arrangement would be best.

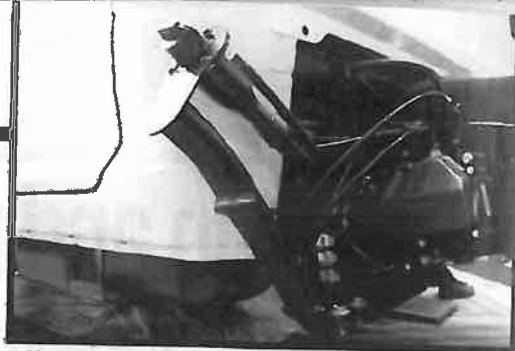
All of the above pertains to conventional-cab trucks, which offer fairly good packaging room because steer axles are forward on the chassis, under hoods and engines. Low-cab-forward trucks offered by Japanese builders have no hoods, and their steer axles are under the cabs. That means less room for SCR gear. However, as with all medium-duty trucks, engine sizes are limited, and so are SCR components that must deal with exhaust gases. None of the Japanese builders showed 2010-engined trucks at NTEA, but representatives said they'll use the same setups that are now at work in Japan, where they work well.

Heavy means big

Because Class 8 trucks use big diesels that exhale higher amounts of exhaust gas, their SCR components are also large. Bodies placed on heavy straight trucks are also big, and they come in many shapes. This will dictate how SCR gear is installed. In general, if there's room behind the cab, as with trash or concrete-mixer trucks, the new equipment might be stacked there. If bodies are close to cabs but the sides of frame rails are visible, like with vans or reefers, the gear will be hung on the rails.

If bodies hide the rails as on heavy utility trucks, or lift axles crowd them, as is sometimes the case with dump bodies, it's more likely that an under-cab compact cube design will be used. A "1-Box" SCR setup for heavy Freightliners and Western Stars measures roughly 2.5-foot square, and can be placed under the cab of a straight truck or cab-and-sleeper of a tractor. Other manufacturers have similar designs, but any large SCR cube might extend beyond the back of a day cab, which could require lengthening of the frame.

That was the case with the first pre-production 2010-engine vehicle, a dump truck that Mack built in 2008. Its SCR dosing chamber was placed near the coffee-pot-shaped diesel particulate filter, mounted behind the passenger steps on the right side of the cab (sister company Volvo will use the same setup on some trucks). The gear did protrude backward somewhat. That, plus the DEF tank on the left side of the truck, required the frame to be nearly a foot longer than similar trucks in the fleet of a customer who agreed to test the new SCR engine. The



DEF tank is under the cab of this Dodge Chassis-Cab model, and its filler neck (resting on a heavy tubular bracket) takes up about 2 inches behind the cab. Adjacent heater consumes more room, and the short electrical and fluid lines on this prototype design don't allow the heater to be moved far. Longer lines would provide slack to lower the heater and allow more room for mounting of, for instance, a utility body.



Prototype compact SCR system on this Hino conventional puts the DEF tank with its blue-capped filler neck just ahead of the stack formed by the diesel particulate filter and dosing chamber. Exhaust gases flow into the chamber, then the DPF, then out the tail pipe. Fuel tank on this chassis fits under the van body, but it could go under the cab on the driver's side, leaving the frame clear for mounting of a skirted body.

longer frame added some chassis weight, not to mention the extra weight of the gear itself.

Weight could well be more of a problem for many operators than the bulk of the equipment. SCR equipment will generally add 150 to 200 pounds to a light truck, 200 to 300 pounds to a midrange truck, and 300 to 600 pounds on a heavy. Those figures usually include the weight of diesel exhaust fluid, which, being two-thirds water, scales at about 9 pounds per gallon. Navistar International, which will not use selective catalytic reduction on its 2010 engines, is touting this as a major advantage for any weight-conscious operator. Competitors, however, say the extra weight of the SCR equipment will be offset by superior fuel economy.

It's likely that customers who value one advantage over the other will both be satisfied, though both will face substantial price increases for trucks with EPA-2010-legal diesels. As we've reported before, per-truck prices will be about \$3,000 to \$10,000 more than for one with a 2007 diesel. Clean air ain't cheap. ■