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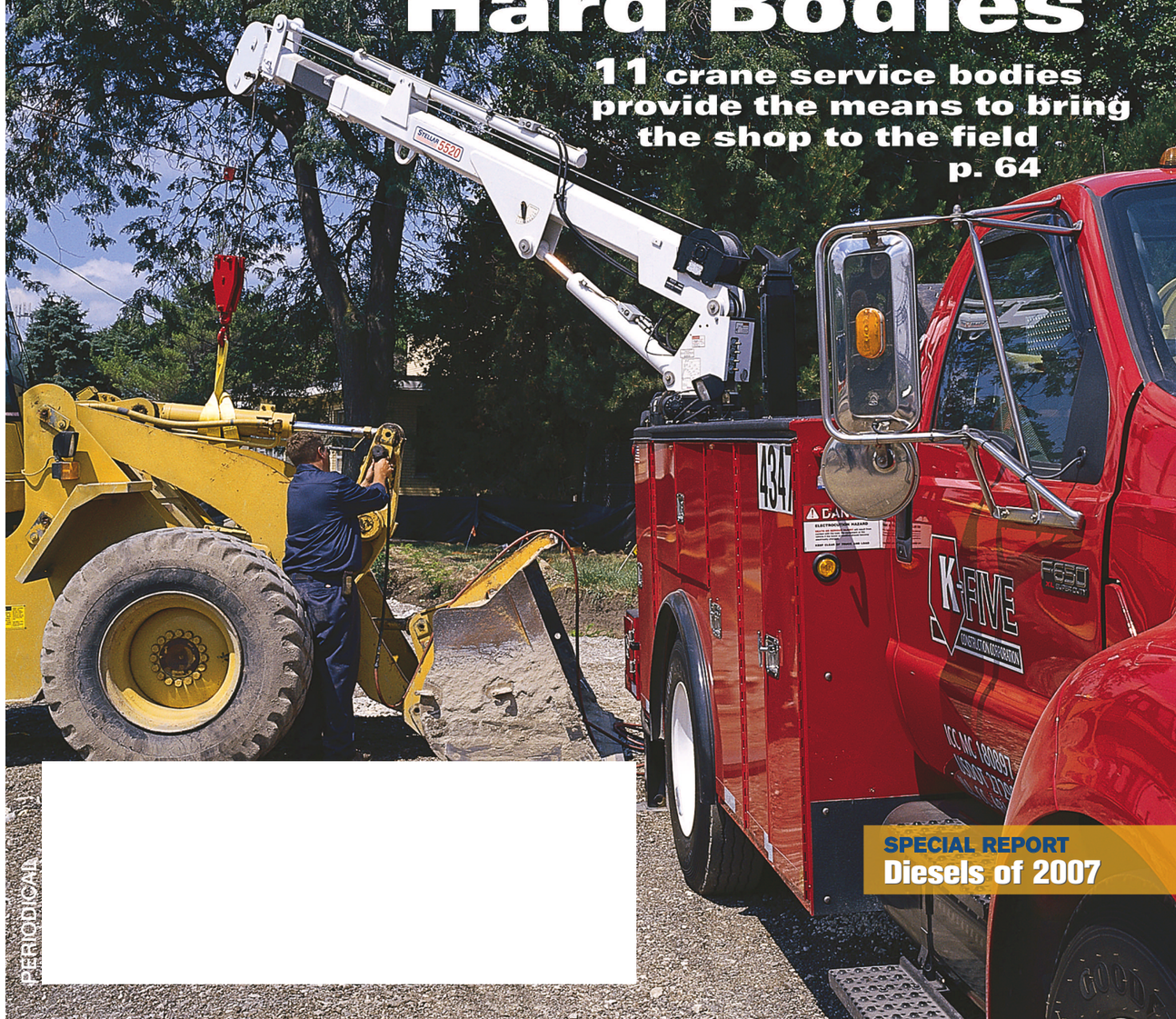
Ideas and Insight for the Equipment Pro

Hard Bodies

11 crane service bodies provide the means to bring the shop to the field
p. 64



SPECIAL REPORT
Diesels of 2007

PERIODICAL

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Diesels of 2007

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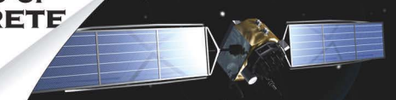

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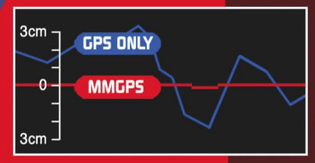

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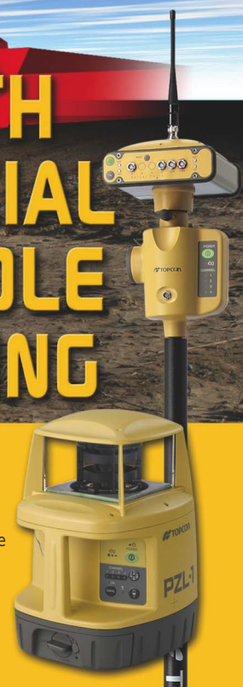

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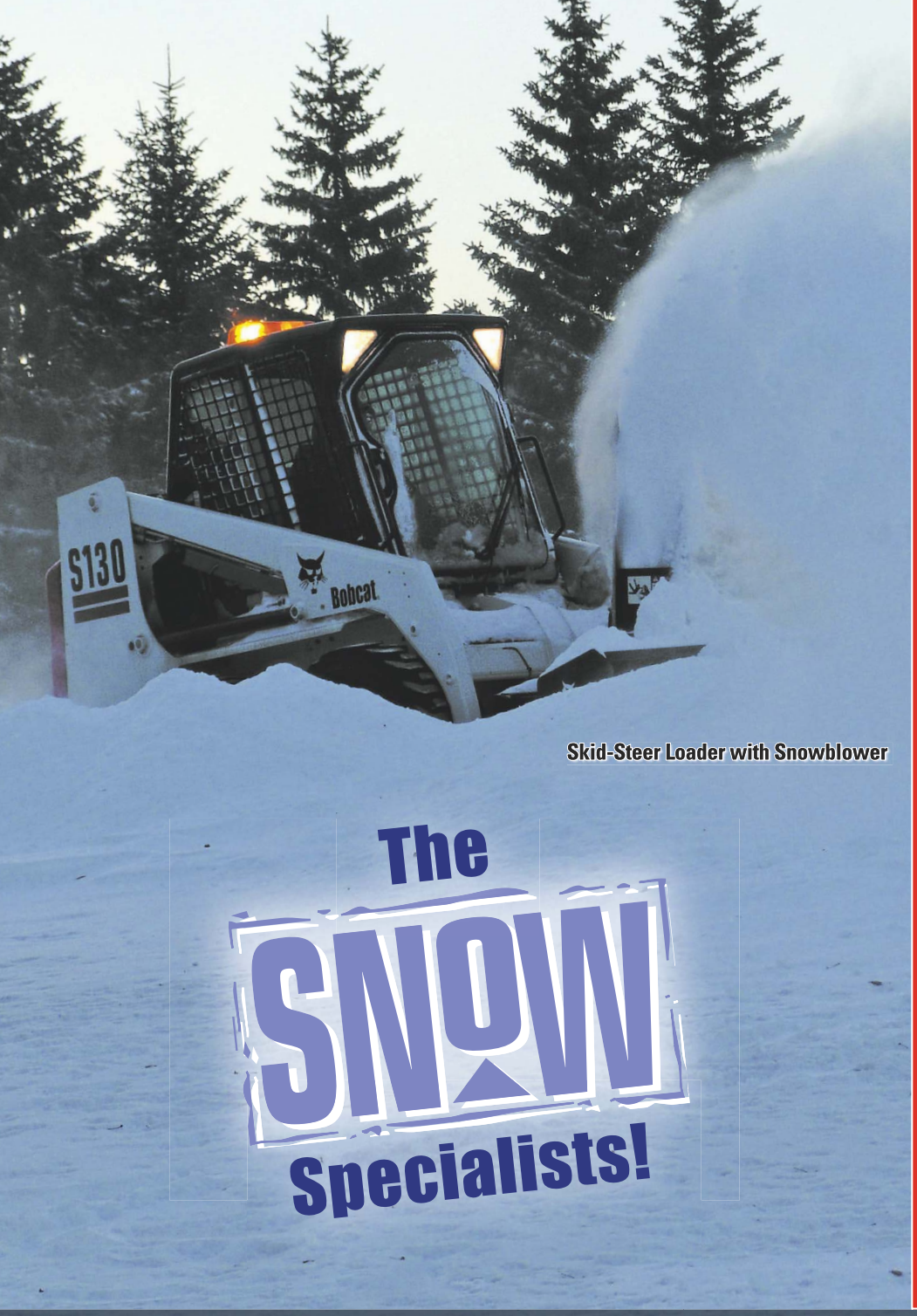

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CONSTRUCTION EQUIPMENT

November 2005 • Vol. 108, Issue 11

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PRODUCTION HEROES

HANDS-ON TRUCKING

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Asset Ammunition

Two months ago in this space, we challenged equipment managers to start planning for upcoming shortages in equipment as various market forces came to bear on supply. Turns out an unforeseeable force brought its own weight to bear on equipment supply: Hurricanes Katrina and Rita.

According to some managers, disaster-relief efforts are sucking inventory out of normal distribution channels already struggling with order backlogs. One fear: construction activity in the rest of the country may be delayed for lack of machines. Preliminary results from our Annual Report and Forecast indicate a strong business outlook and strong fleet-expansion rate in 2006.

Rarely has fleet management become so important and the understanding of operating costs so crucial.

Rod Sutton, Editor in Chief

Operating costs put managers to the test because they can be variable. And, if you ask a manager what single variable he'd like to control, more often than not it's equipment operators. The person behind the sticks has enormous influence on a machine's operating cost.

We've watched our friends at Local 150 of the Operating Engineers for two years, and we've seen what the experts can do. It's what the less-talented do that equipment managers would like to change. That's why we're in the middle of an ongoing series called "Production Heroes" (see page 20). These articles illustrate operating techniques that not only improve overall project production and efficiency, but also reduce wear and tear on the machine. If the operator applies the iron correctly, component life and operating costs will be optimized.

Of course, identifying techniques is only the first step; they must be applied. For managers who control or have direct influence over operators, they can have a conversation or make a procedural change. For those managers who have little or no influence, they must figure out how to communicate these techniques to the operations side.

Our intent is that the "Production Heroes" series will provide some ammunition for those who must take this fight across departmental or divisional lines. Use the articles to show operations folks what can be gained, and how to gain it. For those who don't need to fight, take these articles directly to the field.

Machine operators can extend equipment life with some simple changes. And the way the supply channel looks these days, equipment has to last its maximum life.

Rod

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For information circle **5**


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A SUMMARY OF THE MONTH'S PRIMARY MACHINE INTRODUCTIONS AND MODEL CHANGES

MARKET WATCH

By KATIE WEILER, Managing Editor

Vermeer

A new family of ride-on trenchers features a track undercarriage, which is supplied through a commercial alliance with ASV. RTX350, RTX450 and RTX650 are tracked versions of the RT lineup, featuring lower ground pressure, increased traction in certain ground conditions, and greater stability, according to the company. Tracks offer the ability to maintain a straighter trench when digging.
For information circle **195**

JCB

With the Robot 180T skid-steer introduction, it brings the number of tracked models offered to three. Operating capacity is 1,800 pounds, and the machine is powered by a 60-hp turbocharged diesel engine. Measuring 66 inches across the tracks, the 180T has a turning radius of 81 inches.
For information circle **196**

Elliott Equipment

The 32-ton-capacity Model 32117 has a 117-foot-long, four-section boom with 127-foot tip height. Features include: largest swing cab in its class, extensive glass in cab, and thumb throttle engine speed control. The unit has electric over hydraulic controls for enhanced control over load. It comes with a 12-month parts/labor warranty; five-year structural warranty.
For information circle **197**

Miskin

A pull-type WaterWagon has a capacity of 5,100 gallons of water. It features a heavy-duty suspension that can handle rugged conditions. The water pump is driven with the tractor's hydraulics. The wagon can self-fill from a ditch or canal or can be top-filled by traditional methods.
For information circle **198**

Market Watch

Miskin

DumpWagon is described as basically the back part of an articulated dump truck with a tongue on it. The unit features similar high-oscillating suspension found on self-propelled ADTs. A typical configuration is two DumpWagons in a train (50 tons) behind a 425-hp four-wheel-drive tractor with duals, with a total of 16 tires on six axles.

For information circle **199**

Ernest Industries

The Shortstop 3.5 Mixer from Ernest Industries is designed for delivery and placement of small loads. Designed for a 26,000-pound, non-CDL chassis, it has low clearance height, low curb weight, and maneuverability. It can be loaded from a standard batch plant or a small trailer-type concrete blender.

For information circle **200**

Komatsu

A new line of compact utility loaders starts with the 9,590-pound CD30-1. Powered by a Komatsu 4-cylinder, direct-injection, turbocharged 84-hp diesel, the loader has an operating load of 2,380 pounds at 35 percent tipping load; a tipping load of 6,800 pounds; and bucket breakout force of 4,978 pounds. Standard two-speed transmission allows the operator to match ground speeds with the work at hand, the company says.

For information circle **201**

TerraTrack

The RangeRunner all-terrain work vehicle's optional front and rear auxiliary hydraulic system allows hydraulic attachments to be added through quick-pin receiver hitches. With 1,650 square inches of track surface supporting the 1,580-pound vehicle, the unit can transport people and cargo while maintaining a ground pressure at or below 1.0 psi, according to the company. A single T-handle controls speed, turning and braking.

For information circle **202**

Komatsu

A full line of scrap-processing and bulk material handling machines includes six models. Packages are available in the PC270LC-7, PC300HD-7, PC400LC-7, PC600LC-7, PC750LC-7 and PC1250LC-7 excavator models. The Series features elevated cabs, strong structural components, front window guards for protection from debris, and improved stability.

For information circle **203**

Maintainer

A new series of cranes ranges from 8,600- to 14,000-pound lift capacities and all have 24 feet of hydraulic reach. The five models include the following features: hex boom for weight reduction and increased strength, self-locking pivot pins, compact anti-2-block system, and self-lubricating quick change wear pads. They also have composite bearings in pivot locations, composite sheaves, and self-locking swivel load-block hook.

For information circle **204**

Hyster

Fortis H40-70FT Series lift trucks range from 4,000 to 7,000 pounds and match the engine with the proper transmission for specific applications. Pneumatic-tired trucks have a redesigned hydraulic system with simplified componentry and routing away from heat sources.

For information circle **205**

Bobcat

The Toolcat 5600 utility work vehicle offers four new attachments, rear hydraulic and power take-off kits, and an improved drive system. In addition to 25 approved attachments, the machine can now use a rotary cutter, sweeper, landscape rake, and combination bucket. Bobcat says the ability to attach rear hydraulic and PTO kits increases the versatility of the unit.

For information circle **206**

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SUPPLIER NEWS

Vermeer Adds Four Allies

Vermeer has joined with four separate companies in a series of alliances designed to build on complementary strengths, according to the company.

■ ASV becomes the exclusive rubber-track undercarriage supplier for select products in Vermeer's line of utility trenchers, directional drills, and other products.

■ Harr Technologies will provide more than 170 culvert-cleaning attachment tools for horizontal directional drills that Vermeer will distribute through its dealer network. Vermeer will handle all aspects of manufacturing, invoicing, sales support, service, distribution and marketing.

■ McLaughlin vacuum excavation products will be distributed exclusively through Vermeer's dealer network. Vermeer dealers will provide sales, distribution, product support, and parts and service with support from McLaughlin. Products will carry the Vermeer name and logo.

■ Vac-Tron vacuum excavation machinery will be distributed exclusively through the Vermeer dealers, who will provide sales, distribution, product support, and parts and service. The products will be branded Vermeer/Vac-Tron and include more than 50 models.

Vermeer will distribute more than 170 culvert-cleaning tools from Harr Technologies, ranging in size from 6 to 110 inches.

DEALER NEWS

Boot Camp for Trimble Dealers

Several of Trimble Construction's field stations focused on the company's new GCS900 Grade Control System. The system can be used with the Trimble Smart GPS antenna, which can be combined with a new laser receiver or used with a construction total station.

The 500 or so Trimble Construction dealers who attended the company's "Boot Camp 2005" event in mid-September have been "armed," so to speak, with the details of the company's latest products and with hands-on training to help customers apply these new systems in the field.

Trimble worked with the Ohio Operating Engineers (OOE) to set up 10 training stations on the OOE's expansive facility near Dayton, Ohio. During the four-day training event (two sessions were conducted), dealers rotated among the field stations to receive personalized training from the Trimble experts. Field training was supplemented by classroom sessions at Trimble's facility in Dayton.

EMISSIONS UPDATE

CITGO Selects Green Plus for TxLED

CITGO Petroleum selected Biofriendly's Green Plus diesel fuel additive to formulate Texas Low Emission Diesel (TxLED). CITGO was ready to deliver TxLED fuel to its customers in October.

Green Plus is approved by the Texas Commission on Environmental Quality (TCEQ) as an emissions-reduction solution for both on- and off-road use. It can be used to comply with the new TxLED law that went into effect October 1 in trucks, construction equipment and other diesel equipment in the 110 Texas counties designated by the U.S. EPA as non-attainment areas (areas which have consistently surpassed the ozone and other air-pollution limits).

Green Plus has logged more than 150 million miles of on-road/on-ocean use and is available commercially worldwide. For more information, please visit http://www.biofriendly.com/.

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INDUSTRY NEWS

Mark Your Calendars for Intermat 2006

Next year, the world's big equipment tradeshow is Intermat 2006. It takes place April 24 to 29 at the Paris-Nord Exhibition Centre in Paris, France.

The organizers expect 200,000 visitors from 160 countries, and almost 1,500 exhibitors, 75 percent of whom are international. To register, visit http://www.intermat.fr/en/2006/index.htm.

MANUFACTURER NEWS

JCB to Build 57-mph Backhoe

JCB has been awarded a contract expected to be worth up to $140 million to supply the U.S. Army with a backhoe-loader capable of convoy speeds up to 57 mph. The contract award by TACOM, the U.S. Army Tank-automotive and Armaments Command, follows a three-year development program. Full production is expected to commence in 2007 at JCB's Savannah, Ga., facility, and deliveries are scheduled to continue until 2012.

G.I. Joe's new backhoe rolls with full suspension and anti-lock brakes. It can lift 2 tons and dig about 13 feet deep.

The High Mobility Engineer Excavator (HMEE) vehicle combines backhoe-loader capabilities and JCB's Fastrac agricultural tractor, which has full suspension and anti-lock brakes. The 12-ton HMEE will boast a 5.9-liter diesel engine, four-wheel drive, four-wheel steer, lift more than 2 tons, and dig to a depth of almost 4 meters.

MANUFACTURER NEWS

Mack Shows Hybrid Electric Heavy-Duty

Prototype's electric motor helps the diesel launch the truck and recharges the batteries during braking. A full hybrid — able to launch the truck on electric power alone — is next.

Mack displayed on Capitol Hill a prototype hybrid electric powertrain for Class 8 heavy-duty trucks that is said to be the precursor to future commercial vehicles. The power train drives an Air Force R-11 6,000 gallon refueler truck built on a Mack RD 6x4 chassis.

The electric motor assists the diesel in launching the vehicle and regenerates energy during braking. This electrical energy is stored in the vehicle's batteries and is used in place of diesel fuel.

The Air Force refueler was developed under a $1.2-million Department of Defense contract Mack received through Southwest Research Institute. Subsequent funding will build on knowledge gained thus far to develop a full hybrid system that can launch a heavy-duty truck with electric power only. The diesel engine will not be required to idle while the vehicle is stopped. This provides even greater reduction of fuel consumed and noise levels associated with vehicles that stop frequently, such as refuse trucks. Most of this additional development is being performed in Hagerstown at Volvo Powertrain North America, supplier of engines to Mack Trucks.

Delo® 400 SAE 15W-40. It's known throughout the industry for providing maximum durability. In fact, Delo easily exceeds the service requirements of all major diesel engine builders. No wonder it's the engine oil so many equipment owners demand. And because it exceeds OEM requirements, Delo enables you to increase profits through longer engine life. What's more, all Delo products come with the Chevron Delo Warranty Plus Bumper to Bumper Protection. The choice is clear: Delo.

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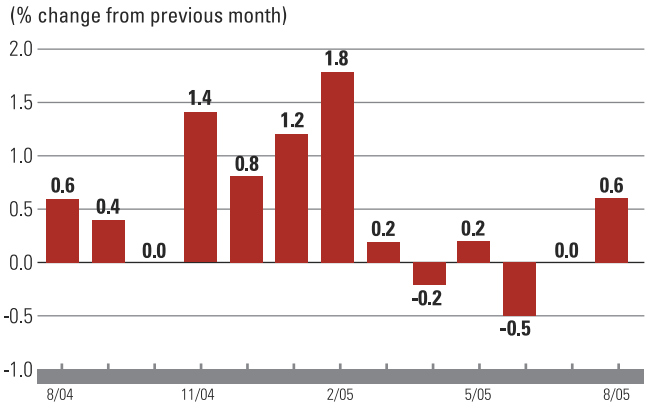
For information circle **10**

By JIM HAUGHEY, Director of Economics

↑ TOTAL CONSTRUCTION SPENDING

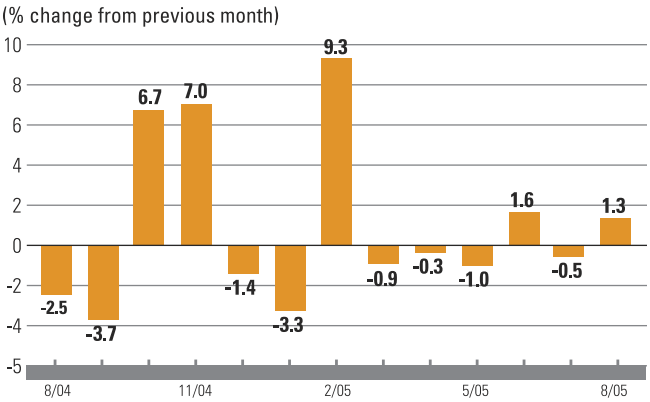
Spending increased 6.2 percent in the year ending in August with the expansion pace picking up in the most recent Census Bureau estimates. Residential is slowing; nonresidential has begun to expand. Yet the 4-percent gain in construction employment estimated by the Bureau of Labor Statistics over the same period suggests stronger growth in construction activity. We expect market growth as measured by the Census Bureau to rise to a 7-percent annual rate through the end of '06.



Source: U.S. Department of Commerce

↑ HIGHWAY CONSTRUCTION SPENDING

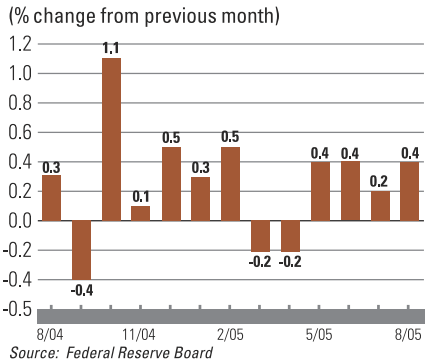
Spending, after inflation, is steady at a modestly high level in the second half of 2005. But it is set to expand at about a 5-percent inflation-adjusted rate next year. This turnabout will be driven by the increased flow of federal money from the new highway bill, emergency repair work in the Gulf region, and much higher state and local government budget balances after several years of soaring tax collections as the economic expansion matured.



Source: U.S. Department of Commerce

↑ INDUSTRIAL PRODUCTION INDEX

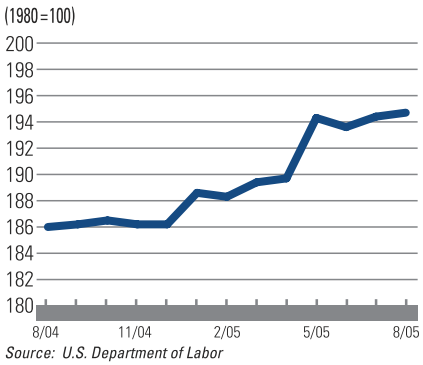
Factory production schedules have recovered to a 4-percent-plus annual growth pace with businesses now building inventory again. Production gains are expected to briefly surge to a 6-percent pace around year-end from the combined impact of restocking and materials ordered for post-hurricane rebuilding. Then production gains will ebb to a 3.5-percent annual pace late next year as higher credit costs slows overall economic growth.



Source: Federal Reserve Board

↔ CONSTRUCTION EQUIPMENT PRICE INDEX

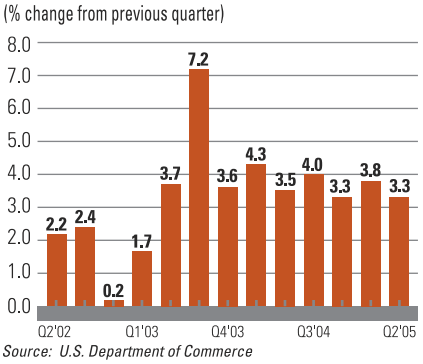
Equipment price increases have slowed in the last few months, but this is likely a brief pause. Steel prices have begun rising again and equipment manufacturers' order backlog stretched to 11 weeks late in the summer with a new surge in orders that raises manufacturers' pricing power. An order volume that presses available capacity will be maintained by the expected pickup in heavy and nonresidential construction spending and hurricane clean up and rebuilding needs.



Source: U.S. Department of Labor

↓ GROSS DOMESTIC PRODUCT

Economic growth is slowing from 4 percent-plus to near 3 percent over the next 18 months. This is the underlying trend that results from the slowing of productivity growth as the economic expansion matures. However, inventory trimming dropped growth to 3.3 percent in the spring, and inventory investment raised growth to an estimated 3.7 percent in the summer. The hurricanes will cut growth to 3 percent in the fall and then boost it to over 4 percent early next year.



Source: U.S. Department of Commerce

For the full text of this month's economic analysis, check Economic Outlook at **ConstructionEquipment.com**

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By LARRY STEWART, Executive Editor

Doze More Dirt

Challenge conventional thinking and reevaluate your production dozing.

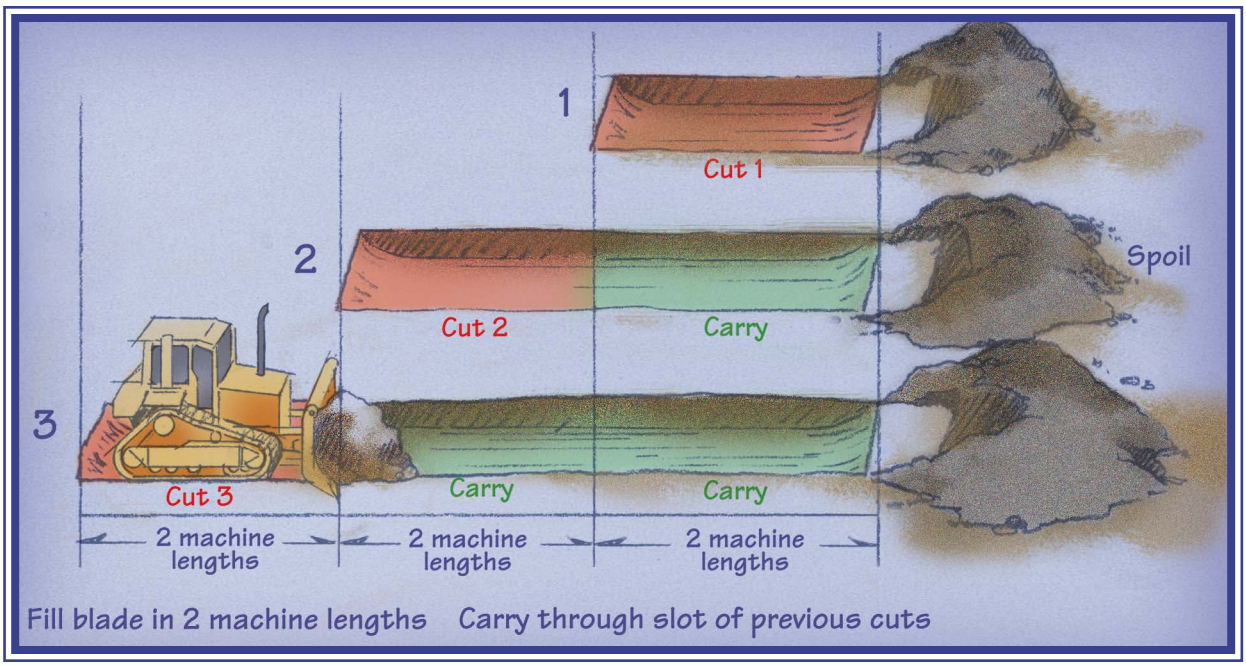
Making every move count calls for working back to front

Steep hourly cost makes operating efficiently more important to crawler dozers than most other construction equipment. The cost is largely associated with undercarriage wear, so the best dozer operators make every move count whether they're doing production earthmoving, finishing or clearing land.

Some of the best ideas for improving dozer productivity defy operators' assumptions.

"A lot of operators who are doing production dozing think they should make long cuts. They want to see dirt boil or roll in front of the blade," says Brad Van De Veer, senior product

Doze Front to Back



The most effective way to bulldoze volumes of dirt is to start two tractor lengths from the end of the intended cut. Fill the blade as quickly as possible in first gear — usually within two tractor lengths — and start a spoil pile. On the second pass, back up two tractor lengths further than the start of the first pass, fill the blade again, then carry the load through the slot created in the first pass. Repeat the process, carrying the load further with each pass, until the slot stretches the length of the intended cut. The walls of the slot can extend the tractor's blade load by as much as 30 percent.

consultant at Caterpillar's Edwards Demonstration/Application Center. "In reality, the blade will only hold so much dirt. Once it's full, you start losing dirt off both sides of the blade, leaving windrows that will have to be moved again. It wastes horsepower and fuel, and it can cause track slip and undercarriage wear.

"You should be able to get a full load on the blade in two lengths of the tractor at the most — and that applies to any size tractor. Once the blade is full, you stop cutting and slide the dirt in front of the blade."

Short, aggressive cuts set up what is perhaps the most energy-saving way to doze dirt — what Caterpillar calls "front-to-back or slot dozing."

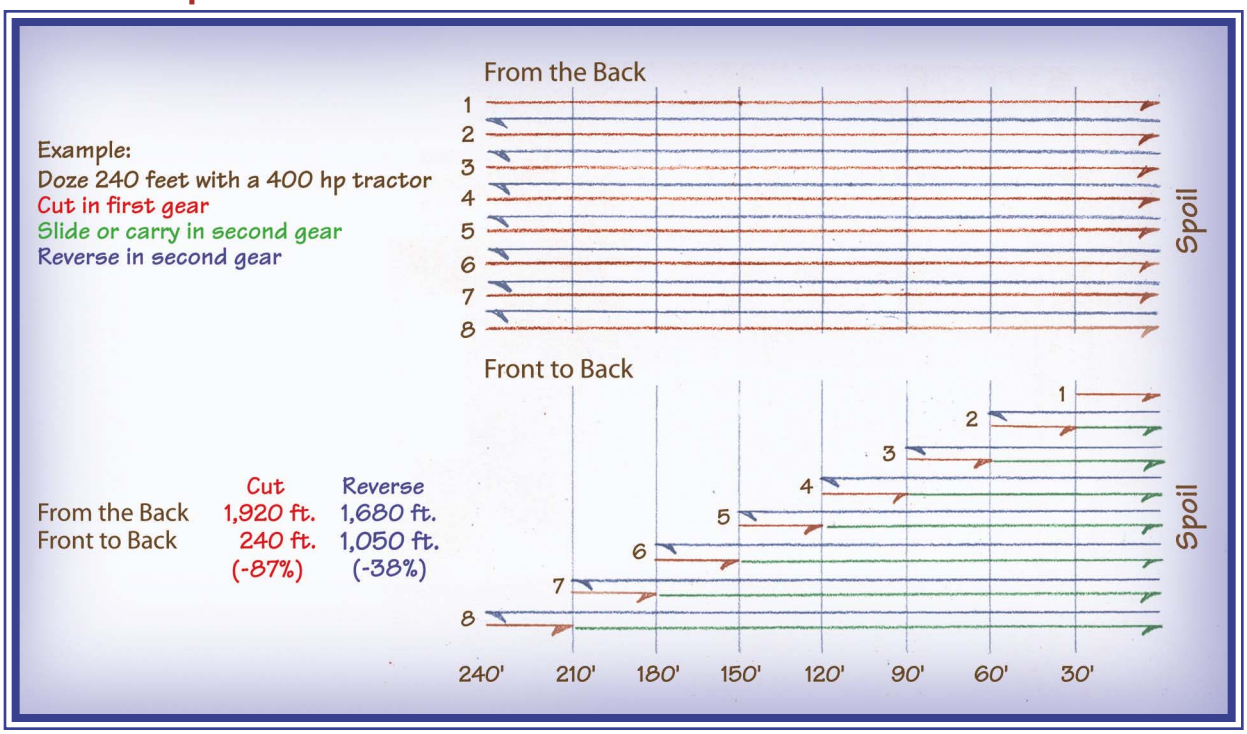
"You start one to two tractor lengths back from where you're going to move the dirt, instead of on the opposite side of the field," says Van De Veer. "Fill the blade and start a pile or fill the area."

The next step is to back up one to two tractor lengths behind the start of the first cut, fill the blade, and slide the load, or carry it, through the slot created by the first pass and deposit it on the spoil pile. Use first gear to aggressively fill the blade. In small and medium sized tractors, shift up to second when sliding the load. Repeat the process, sliding a full blade load through the slot further with each pass.

Working in the slot increases blade load by as much as 30 percent and prevents material from falling from the blade.

Front-to-back dozing cuts undercarriage costs. Instead of backing the entire length of the cut after each push, you only reverse the trac-

Start at the Spoil



Front-to-back slot dozing cuts undercarriage costs as it improves productivity. Driving in reverse causes the worst track wear. Working front to back, you only have to reverse the tractor the distance of the previous push plus two tractor lengths.

Compared to backing up the entire length of the cut, this reduces reverse operation — by 38 percent in the example of a 240-foot cut. It reduces operating costs, and increases dirt-pushing time.

tor the distance of the previous push plus one or two tractor lengths.

"Running in reverse causes the most undercarriage wear, and it's the most unproductive time in the work cycle," says Van De Veer. "Working front to back, you reduce the amount of reverse operation, which decreases operating costs and increases productivity."

Van De Veer says slots can be dug as deep as the blade is high.

After the first slot is completed, back up to about two tractor lengths from the spoil and move over, leaving about one-third of a blade width between the edge of the blade and the first slot. This berm will hold material in front of the blade on the second slot.

After the slots are cut to the desired grade, the work pattern reverses for clearing the berms.

"You want to work from the rear of the cut, or the opposite end from the spoil, rather than front to back," says Van De Veer. "Load up the blade quickly, and use blade tilt to steer into one of the slots to carry the load to the pile or fill."

A criss-cross pattern will help keep the cut level: If you slide the load up the left slot on the first pass, swing into the right slot on the second pass, and then back to the left slot on the third.

Some simple techniques will make fine grading more efficient, too.

A videotape called *Tips From the Pros: Crawler Dozer* from VISTA Start Smart Training recommends: "When finishing or dressing, working with a partially loaded blade is better than working with an empty one. It smoothes out the ride and distributes fines across the blade.

Load only half of the blade to keep windrows on one side of the machine. The blade can overlap previous passes to act as a depth guide.

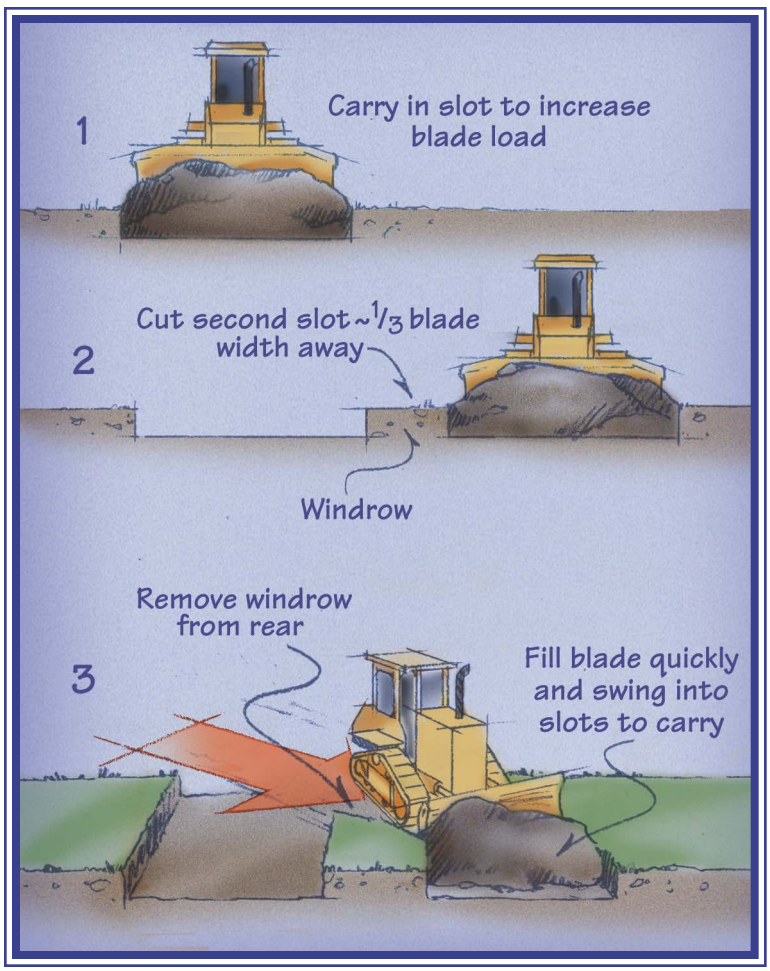
"The smoothest finishing jobs happen when dirt is worked from at least two different directions [passes oriented at 45- to 90-degree angles to each other]," according to VISTA. "It's the same principle as an orbital sander on wood. Irregularities get smoothed out if attacked from more than one direction."

Van De Veer adds a special reminder to stay alert when finishing.

"When you're finish dozing, you usually have grade checkers or other laborers on the ground, you're working in a confined area with grade stakes, and maybe curb and gutter or drain tile. You can get pretty focused on the blade and the job in front of you, but you have to pay attention behind when backing up."

A crawler dozer's basic design makes the machine a prime candidate for working where

Slot Dozing



Start a second slot by backing up about two tractor lengths from the spoil and moving over, leaving about one-third of a blade width between the edge of the blade and the first slot. This berm will hold material in front of the blade so you get the slot-dozing benefits on the second slot. After the slots are cut to grade, remove the berm from the rear of the cut — the end opposite the spoil. Load the blade quickly, and then swing into one of the slots to carry the full load to the pile. Alternating slots used to push the berm forward will help keep the cuts level.

other machines fear to tread. They're not immune to danger, though.

"Low center of gravity and power in the tracks make crawler dozers excel in slope work — working in areas that other machines can't or shouldn't touch," says VISTA's *Tips* videotape. "But know your machine's limits. Rollovers are a leading cause of injuries and fatalities."

Caterpillar's equipment-training program for crawler dozers admonishes operators to work more slowly on slopes, keep attachments low, and work up and down slopes if possible.

"Don't think you can jump clear of a tumbling machine," warns VISTA. "Always wear your safety belt and make sure the ROPS is in good condition.

"When pushing dirt off a high wall or a steep slope, don't push each load over the edge," the *Tips* video recommends. "Leave one blade load at the edge to act as a stop. Let the second blade-full push the first one over the edge. This keeps your machine back away from danger."

When you're working down a slope, remember that gravity can be your friend.

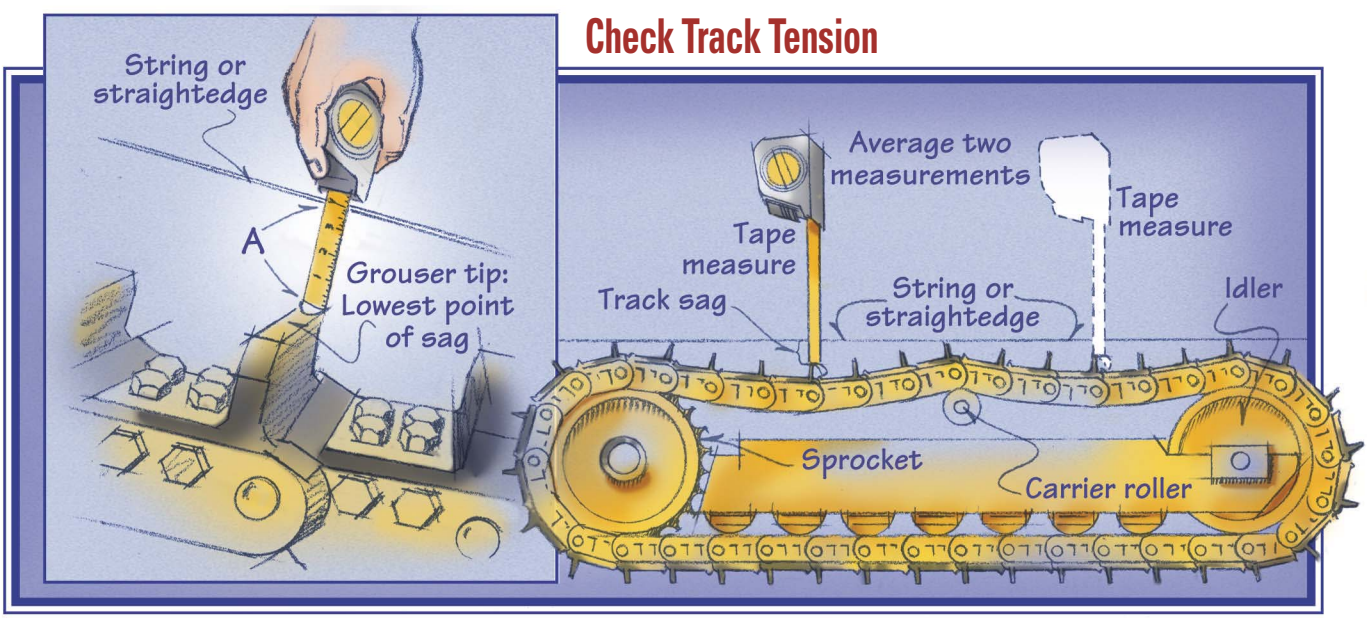
"Pile several loads at the brink of the hill, then push them down the hill in one pass," VISTA recommends. "You'll be able to move more material.

"Keep the machine under control at all times. Many newer machines have hydrostatic transmissions with automatic holdback. But on machines with torque converters, never coast downhill in neutral, and don't change gears while going downhill. Save the wild rides for the amusement park."

Van De Veer reminds slope workers to check machine manuals for recommended adjustments to oil levels. Working on certain inclines, a sump that's not properly filled can leave the oil-intake high and dry and the engine starved for lubricant.

Clearing trees is another potentially dangerous job for which crawler dozers are remarkably suited. Make sure the dozer's falling-object protective structure (FOPS) is in good condition.

Look for a tree's natural direction of lean. It will be the best direction to push the tree.



Tight track chain wears up to three times faster than normal. Most tracks with carrier rollers should sag 2 inches (check operator's manuals for a machine' s specification). To measure sag accurately, coast to a stop without braking. Then lay a straight edge over the grousers, or stretch a string from the idler to the sprocket. Measure the distance (A) to the grouser tip at the lowest point of sag. Measure to the bottom of each valley on either side of a carrier roller and average the numbers. Always measure and adjust chain tension under working conditions — clean track will tighten up as soon as mud starts packing sprockets.

Adjust the direction of fall to avoid obstacles. Check the tree for dead branches that could fall.

Sever roots with a series of V cuts. VISTA recommends leaving the roots on the intended direction of fall untouched. They should act as a hinge, controlling the tree on its way to the ground.

Push the tree over with the center of the cutting edge, raising it high to improve leverage.

"When the tree starts to fall, reverse the dozer quickly to avoid the rising root mass," says VISTA's *Tips* video.

Large stumps can be uprooted in similar fashion. Although with no risk of a tree falling on the machine, you can V cut roots all around the stump for easier removal.

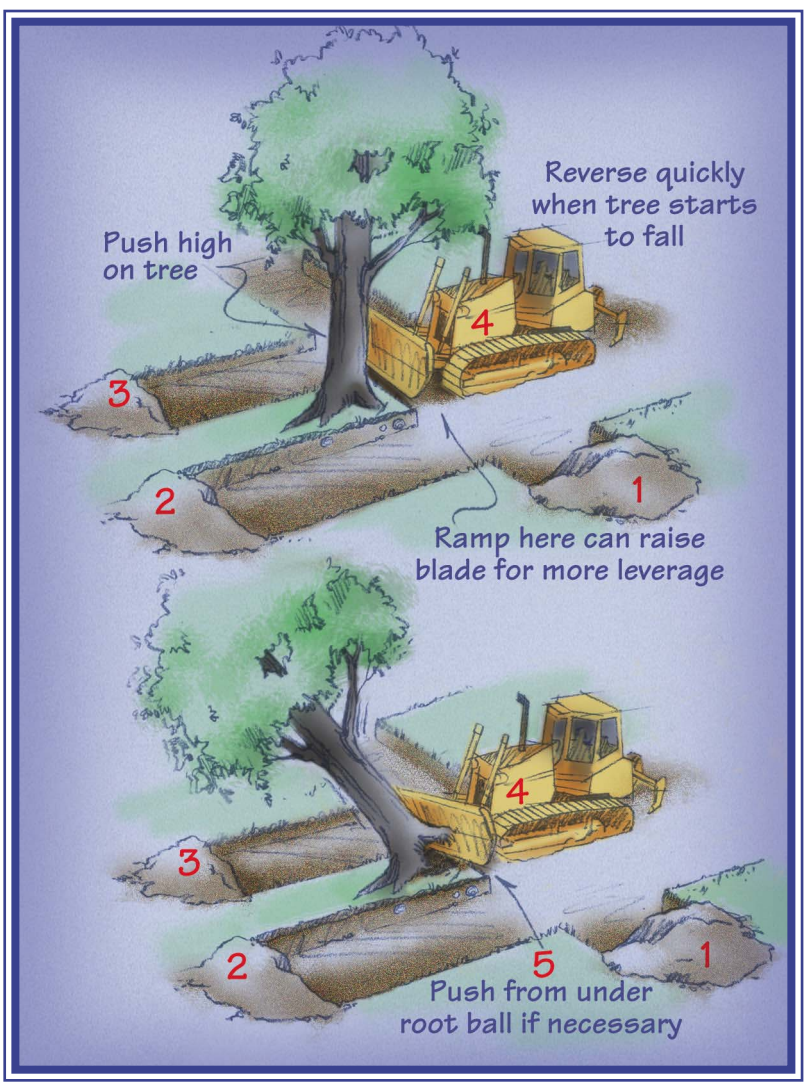
One key that operators hold to improving crawler-dozer efficiency has nothing to do with operating technique. It's maintaining track-chain tension, and it can reduce undercarriage wear by 50 percent. Caterpillar field surveys have found 20 percent of tracks too tight.

Operators are crucial to long undercarriage life because chain tension can require more-than-daily maintenance. Chain tension is judged by measuring sag — the amount that the track hangs down between the sprocket and the idler, or the idler and carrier roller. Operator's manuals include the recommended amount of track sag, and describe how to adjust chain tension.

There is no regular interval for checking chain tension. When mud starts packing in the sprockets — whether it rains, or the tractor hits a wet layer of earth, or the haul trucks start dumping wet spoil in the fill — someone has to stop and adjust chain tension.

Conditions may change again before the day's out — the spoil starts coming dry, or the tractor moves to higher ground, or the sun heats up and the wind starts to blow. To keep the loose chain from binding in front of the idler, the tension must be adjusted again.

Felling a Tree



On the side of the tree opposite the intended direction of fall, make a V cut deep enough to sever some of the large roots. Repeat on sides two and three, leaving roots on the side of the tree toward the direction of fall to act as a hinge. Raise the cutting edge high to push down the tree. A small earth ramp on the pushing side can provide the leverage to push larger trees. Back up quickly when the tree starts to fall to avoid the root ball. If the tree doesn't go completely down on the first push, push again from under the root ball.

Training Resources

For more information about the range of operator training available from the sources in this story, contact the following companies:

Caterpillar Equipment Training Solutions
(800) 962-6628
www.cat.com

VISTA Training
(800) 942-2886
www.vista-start-smart.com

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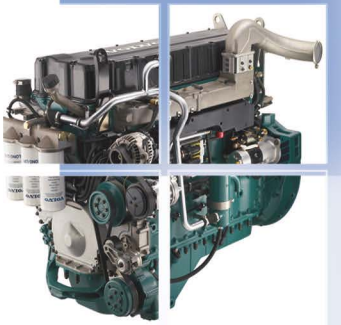
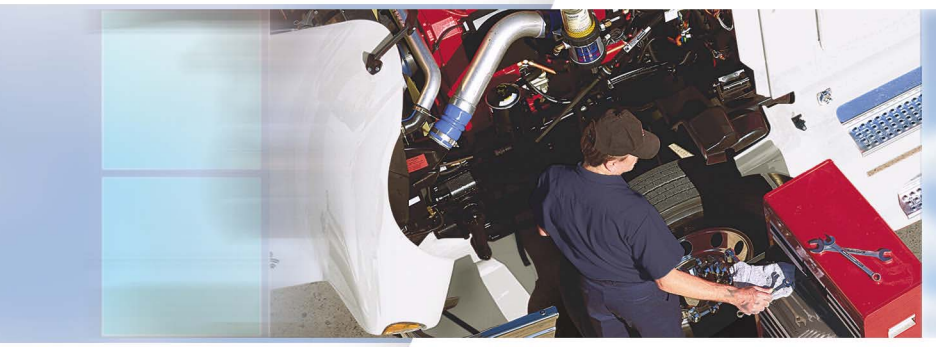


In order to attain the latest emissions levels, diesel engines are relying on aftertreatment devices and fuel formulations to create a systems solution. How are truck and equipment manufacturers integrating those ingredients and what will it mean to fleet managers?

Recipes for Reduction



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CONSTRUCTION EQUIPMENT

Recipes for Reduction

NOVEMBER 2005

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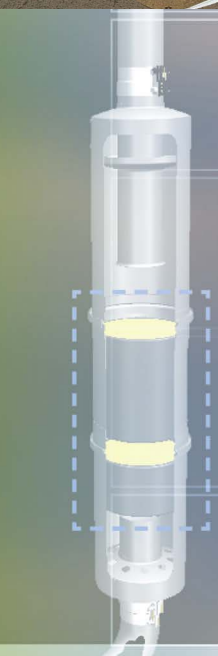


By LARRY STEWART, Executive Editor

Diesels Lunge Toward the Emissions Goal Line

With 90 percent of pollutants removed from diesel exhaust, government and industry unleash an all-out effort to do away with the final foul fraction

The Clean Air Act that created the Environmental Protection Agency in the early 1970s set a distant, ambitious goal to clean America's air enough to protect public health, especially for babies, the elderly, and others with respiratory weakness.

Manufacturers of heavy-duty diesel engines have cut nearly 90 percent of pollutants leaving their products' exhaust stacks, and they are striving to clean up what may turn out to be the hardest 8 percent of all.

SEPTEMBER 2006

Ultra-low-sulfur diesel fuel (15 parts per million sulfur) required for highway diesels. EPA estimates this highly refined fuel will cost 4.5 to 5 cents per gallon more than 500-ppm-sulfur diesel.

The next major deadline for on-highway trucks, EPA emission standards for 2007, brings draconian change. Allowable levels of the most critical diesel pollutants — nitrogen oxides (NOx) and particulate matter (PM) — are both to be cut by a factor of 10. The PM limit applies across the board in 2007, while the NOx limit will be phased in through 2010. Manufacturers will even be expected to control crankcase emissions.

To support the technologies necessary to produce this extraordinary change, EPA will impose a limit on sulfur allowable in diesel fuel. Today's on-highway fuel at 500 parts per million (ppm) sulfur will foul the catalytic filters and traps that are necessary to meet the NOx and PM limits. Highway diesel fuel sold at the terminal can include no more than 15 ppm sulfur as of July 15, 2006. Retail fuel stations and wholesale purchasers will get this ultra-low-sulfur diesel (ULSD) in September.

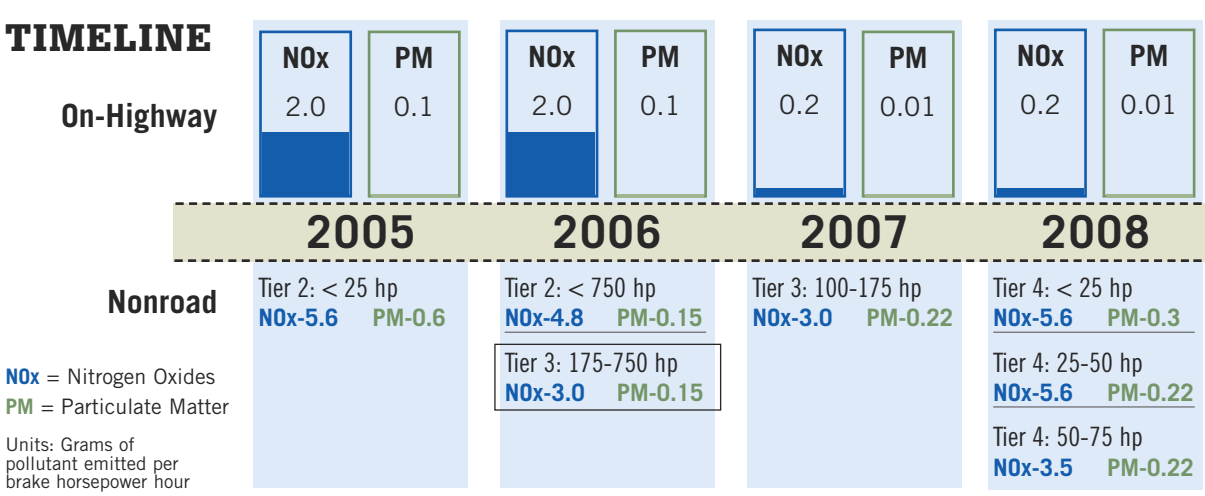
2007

Lower sulfur diesel fuel (500 ppm sulfur) required for non-road diesels.

Effective June 2007, non-road diesels, which include construction and agricultural equipment, will be required to burn the equivalent of today's low-sulfur fuel at 500 ppm sulfur. By June 2010, non-road equipment will be restricted to using ULSD.

It's no coincidence that off-road equipment will have to use the same fuel as on-highway

TIMELINE



NOx = Nitrogen Oxides
PM = Particulate Matter

Units: Grams of pollutant emitted per brake horsepower hour

2010

Compared to 1988 engines, both NOx and particulate emissions from new on-highway diesels are reduced by about 98 percent

Ultra-low sulfur diesel fuel (15 ppm sulfur) required for non-road diesels

trucks. They will likely be using much of the same emissions-reduction technology by then. Most of the disparities in exhaust limits between construction equipment and highway trucks will gradually disappear by 2011. In that year, on-highway NOx is expected to be 0.2 grams per brake horsepower hour and PM will be 0.01 grams. Non-road engines from 175 to 750 horsepower, under Tier 4 regulations, will be allowed only 0.4 grams of NOx and 0.02 grams of PM. By 2014, 75 to 750 horsepower non-road engines will be allowed just 0.3 grams of NOx and 0.015 grams of PM.

Implementation of non-road engine-emissions limits had been a progression. Each tier was phased in by horsepower rating over several years. Tier 1 standards were completely implemented by 2000. More-stringent Tier 2 standards will be in full effect in 2006. Tier 3 limits began being phased in this year for some makes of over-175-hp diesels and will be complete in 2008.

Tier 3 NOx standards are similar to the 2004 on-highway limits. But new standards for PM were never adopted, so the limits remain the same as in Tier 2. It allowed a variety of solutions for off-road equipment.

Caterpillar is one of the only engine makers to choose exhaust aftertreatment devices, just as they have been with truck engines. Charge-air coolers have become common in construction equipment, though, as the cooling of intake air lowers combustion temperature and moderates NOx production. Some designers have chosen to use exhaust-gas recirculation, claiming the more complex technology delivers improved performance in certain engine sizes.

In 2004, EPA signed the final rule introducing Tier 4 emission standards for non-road engines, which are to be phased in from 2008 to 2015. Tier 4 slashes PM and NOx emissions by an additional 90 percent and brings them to near parity with on-highway engines.

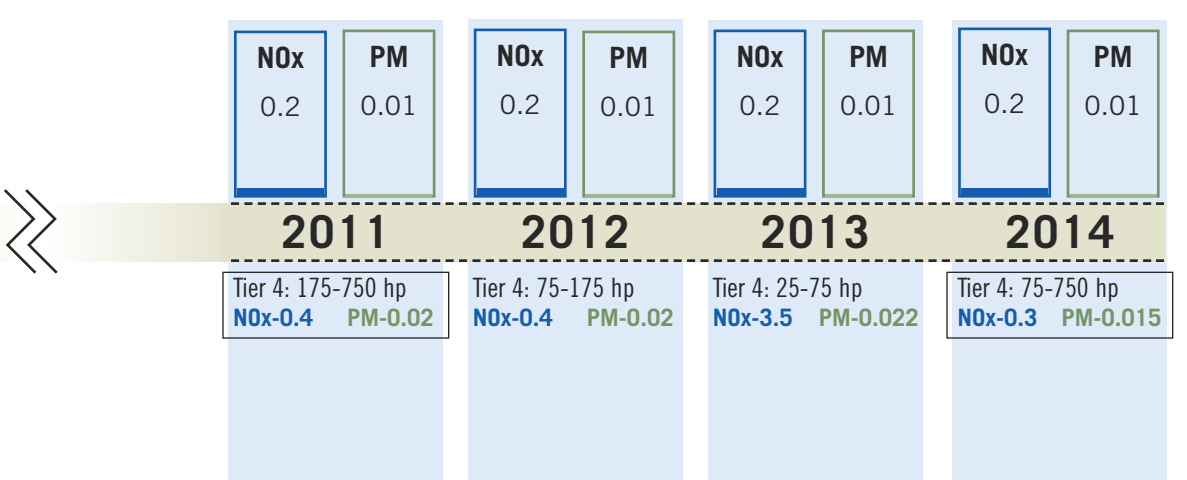
At the time of signing the 1998 rule that introduced Tiers 1, 2 and 3, the EPA estimated that NOx emissions in 2010 would be reduced by about a million tons per year — equivalent to taking 35 million passenger cars off the road. Now EPA anticipates that when the full inventory of older non-road engines are replaced by Tier 4 engines, annual emissions will be cut by an additional 738,000 tons of NOx and 129,000 tons of PM. By 2030, 12,000 premature deaths would be prevented annually.

Costs for added emission controls for most off-road equipment was estimated at 1 to 3 percent of the total equipment price. The EPA also estimates that the 2007 on-highway emission standards will raise vehicle costs $1,200 to $1,500, compared to the typical cost of a new heavy-duty truck at up to $150,000.

EPA estimates that the average cost of ULSD will be 7 cents per gallon more than today's on-highway fuel. The agency expects that cost to be offset somewhat by 4 cents per gallon in anticipated reduction of maintenance costs due to cleaner-burning low-sulfur diesel.

2030

The full inventory of non-road diesels are replaced by Tier 4 engines, reducing NOx emissions by more than 1.7 million tons per year. Every year, 12,000 premature deaths are prevented. ***Source: EPA***



By TOM BERG, Truck Editor

Trucks Make Room For New Diesels

Engines are cleaner, but it took some extra equipment to make it happen. Now truck makers are wrestling that equipment onto their chassis

Cummins' can is smaller and should present no special problems. In some applications, a can's particulate trap and oxidation catalyst might be split into separate parts to facilitate installation at various chassis locations.

Meeting the 2007 emissions limits has been trouble enough for the engine builders, but putting all necessary exhaust-cleansing equipment aboard a truck chassis — a process called "packaging" — is among the many tasks now being handled by engineers at the truck manufacturers.

They are close to being done with this aspect, and a few took time to describe what 2007 trucks will look like. The engineers confirmed what we guessed, that the dump truck with a close-coupled body and multiple pusher axles, which many *CE* readers operate, is the most difficult configuration on which to package the new equipment. But they emphasized that they're dealing effectively with this and other types of trucks and tractors.

Engineers have assembled prototypes using '07 engines and exhaust aftertreatment devices, and say that preproduction vehicles will be ready for road testing way before the January '07 deadline. They say the new models with the new engines will

work fine, but will certainly cost more than now. How much more is the big question, and nobody yet knows or is willing to talk about it.

Two approaches

Design and installation of engines and aftertreatment equipment have taken two distinct routes: Caterpillar and non-Caterpillar. The non-Cat approach is simpler, many truck makers say. Cummins, Detroit and International engines will use essentially what they now do to meet limits — cooled exhaust-gas recirculation, variable-geometry turbochargers, oxidation catalysts, and other equipment to reduce NOx and other pollutants. They will use higher rates of EGR and more capable combustion design to further cut NOx. And they'll add an exhaust filter to remove tiny particulate matter from the exhaust stream.

Volvo will take a similar approach with "heavier" EGR and the particulate filter, or PF. It will drop its unique V-pulse system that pushes exhaust and air into the manifold and instead use a VG turbo. Volvo and Mack will share common engine "platforms" for '07 and will each tune their models to suit their customers.

Many PFs used by these builders will be in an assembly that will also contain the oxidation catalyst. This assembly looks like a muffler that's slightly larger than the catalyst-muffler now employed. Some applications will require mounting the PF and catalyst separately. The PF and catalyst functions also quiet the exhaust, so no muffling baffles or chambers are needed. Some engineers call the combined assembly a "can," because it's not much larger than now, and mounting it on a truck presents no special problems.

Caterpillar's approach to '07 is somewhat more complex and more difficult to package on a chassis. Cat says it will use cooled exhaust-gas recirculation, something that it has avoided with its ACERT products (though competitors claim that ACERT's variable valve timing is used to achieve internal EGR). Caterpillar calls its version of EGR "clean gas induction" (CGI) because it introduces cleansed exhaust gas, not "dirty" gas, into the engine.

CGI takes filtered gas from the end of the Cat PF and sends it back to the engine. Gas travels through a pipe about 2.5 inches in diameter that generally follows the exhaust piping back to the engine compartment. Total travel varies with the truck model, but 8 feet might be typical. The gas is injected into inlet air downstream of the turbocharger and ahead of the charge-air cooler. Thus the gas is cooled along with compressed inlet air.

Although the exhaust gas heading back to the engine is stripped of particulates, it still contains trace amounts of other impurities, including acids, that can damage the aluminum charge-air cooler (also called the aftercooler). Cat people say that stainless steel would shrug off those impurities, so its '07 aftercoolers would probably have to be made of that material. This will add weight and cost, but such an aftercooler will also be more durable and long-lasting.

The can housing Cat's PF will no longer need an oxidation catalyst, which now generates heat to

No More 'Straight Pipes'

Dual exhaust stacks will be difficult with many installations and impossible with others. Also out is the substituting of "straight pipes" for mufflers, which of course won't be mufflers anymore.

For years, some owner-operators and small fleet guys have yanked off mufflers and installed chrome-plated, big-diameter straight pipes. They can make a racket — or sound good, depending on how your mind's ear is tuned — and in many states are legal because turbochargers are considered noise-reduction devices.

Come 2007, though, mufflers will be gone because the exhaust "can" containing the particulate filter will take its place. The filter, and oxidation catalyst where still used, will cut noise, but it will also clean the exhaust. Removing the can will therefore make the exhaust dirtier, and it is likely to result in citations and hefty fines for anyone who does it.

remove particulates, because the '07 PF will periodically burn off accumulated soot particules. This "regeneration" uses a bit of diesel fuel that's electrically ignited. Other builders' PFs will also use fuel-fired regeneration, and engines with less steady operation, such as those in construction trucks, will need more than those in highway tractors. But while most will still use an oxidation catalyst, Caterpillar's can contains only the PF and a chamber to gather filtered exhaust gas for the CGI pipe.

Still, a Cat can is larger than those needed by non-Cat diesels, engineers say. An '07 Cat can is 14.2 inches in diameter, compared to 13 inches for a current Cat catalyst-muffler. An '07 Cummins can is 13.7 inches in diameter compared to 11 inches now. The larger diameters of the '07 assemblies include a ¾-inch wrap of insulation, totaling 1.5 inches, to retain heat and protect an errant hand or arm.

Although internal temperatures of 900 to 1,000 degrees Fahrenheit during regeneration will be common with the cans, the insulation will hold down external temperatures to about the same as now — too hot to comfortably touch, but not enough to seriously burn someone unless he hung onto it.

Most heavy-duty diesels including Cats will need one can, which can be mounted horizontally on the frame or vertically, in a stack. Customers wanting dual exhausts might not be able to get them unless the can is hung under the cab, and tail pipes then run up each corner of the cab. This will be easy with some truck models but difficult with others. Where this arrangement is possible, it should also be easy to mount any desired body.

The stack on a Caterpillar-powered International 5000i tractor has a large-diameter "can" with a special pipe that returns filtered exhaust gas to the engine's air inlet. There's room here, but it might not be on a dump truck with a close-coupled body and pusher axles. One solution is a cove on the corner of a close-coupled dump body, or moving the body away from the cab.

Double cans

Yet Cat C15 diesels rated higher than 550 hp, or 520 hp at International, will need two particulate filters. Each of these is 11.1 inches in diameter; in prototypes, two of these cans are mounted next to each other and joined by a dispersal chamber at their inlet end and a collection chamber at their outlet end. Such a unit is bulky, and has to be hung under the cab if there's room, or if not, behind the cab or from a frame rail.

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If the double can is on the side of a rail, it might displace a fuel tank, which would have to go to the other side of a truck. This might displace the battery box, so batteries would go behind the cab or be dispersed elsewhere on the chassis. This is likely with any short-wheelbase truck or tractor, or with a multi-axle dump truck, which has little extra frame room. Buyers of heavy-haul tractors often order over-550-hp engines, and such vehicles usually have enough frame space to accommodate a double can.

Although a big multi-axle dump truck would present problems for mounting the double can, few buyers actually order Big Power C15s. The most popular Cat engine for a heavy dumper is now the C13, which will need only a single exhaust can. If the can must go in a vertical stack, its large diameter might require a cove in one corner of the body, something already done on a few dump bodies for existing catalyst-muffler assemblies. Modifying a cab corner with a cove is possible but pricey, and impossibly expensive as a production option. Dual exhaust stacks would be difficult with a single vertical can, but some insistent buyers might ask for dual cans, with one 11.1-inch-diameter can on each stack. That wouldn't be cheap, either.

Most '07 engines will reject more heat because greater amounts of exhaust gas will pass through special coolers. These are gas-to-water devices where heat is transferred to coolant in the engines' water jackets, then carried to radiators. Truck radiators will be slightly bigger to push this extra heat into the atmosphere, but their larger size might not be noticeable.

Some builders will avoid enlarging the noses of their trucks by using deeper radiators. These will extend farther downward, and engineers will have to be careful not to go too far down so vehicles which travel off road, like our dump-truck example, will still have sufficient ground clearance. You can bet that the builders will watch this, but it wouldn't hurt for you to check it, too.

How Much More for 2007 Diesel Engines?

At industry meetings discussing the 2007 diesels, the question of price inevitably comes up, but thus far the question hasn't been answered. Engine builders won't quote numbers because they say truck makers set the final prices. Truck manufacturers have complained that engine builders hadn't given them numbers from which to compute list prices. By now the cost figures on engines themselves should be known, but work continues on packaging and testing, so the final numbers still aren't in.

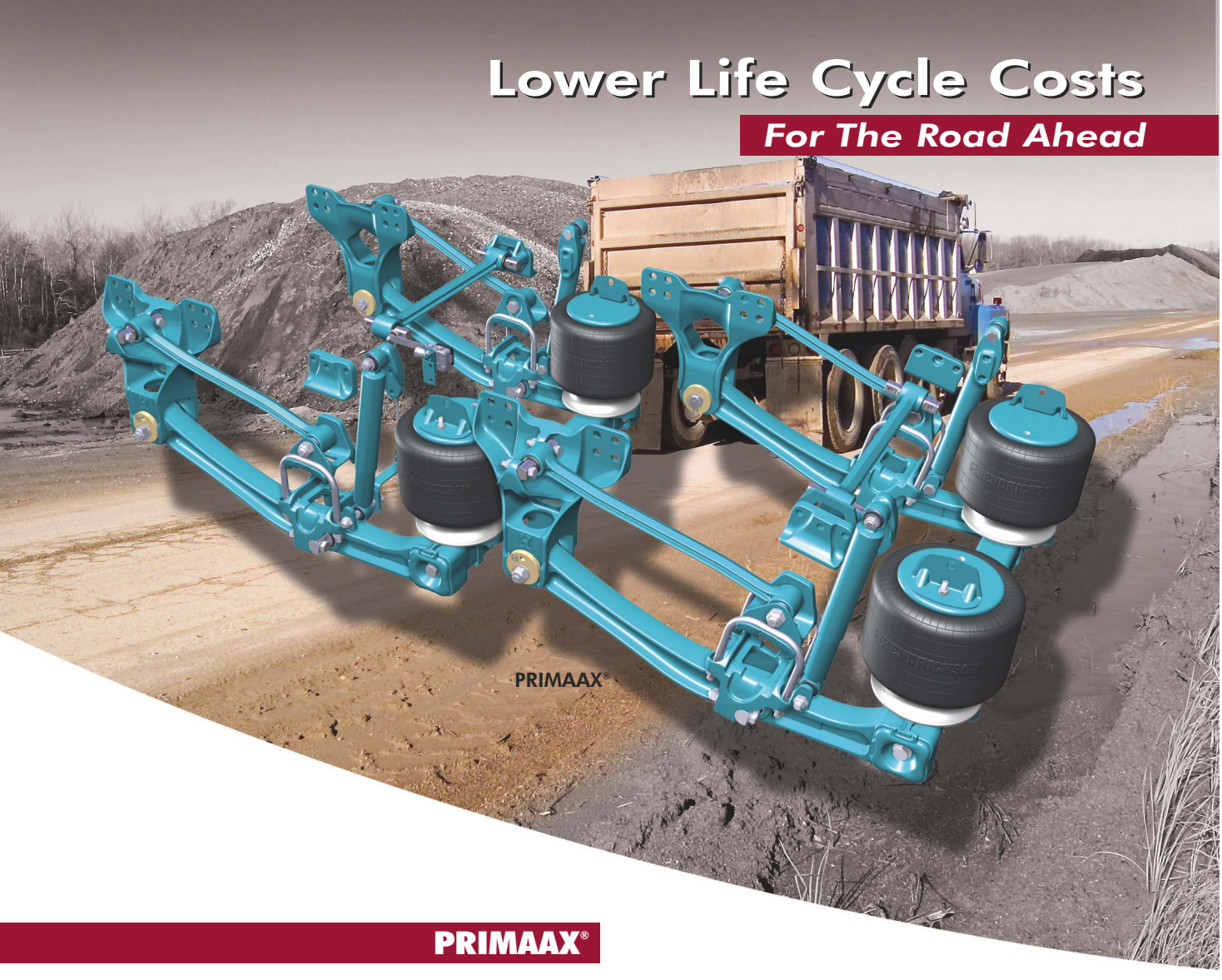
We've heard of possible price increases ranging from $5,000 to $15,000 per Class 8 truck. Final numbers should be closer to the lower figure, because truck makers realize that buyers will stand for only so much, especially since their '02/'04 experience.

In the months before the October '02 deadline, customers ordered many thousands of trucks ahead of their normal replacement schedule. This "pre-buy" enabled them to avoid price hikes of $4,000 to $6,000 per vehicle, and to sidestep any troubles with the new engines. Then they either stopped ordering, causing a big downturn in sales and manufacturing, or bought engines temporarily exempt from the new mandates. In less than a year, such customers resumed regular purchases. Manufacturers don't want a repeat of the pre-buy/slump, but observers think some pre-buying may already be happening.

Another factor that might limit '07 price increases is that builders have been steadily increasing prices. Some of it is to cover higher prices for components and materials, but it might also be to partially recoup development money and to amortize total costs over a longer period. So anyone buying now, whether out of actual equipment need or as a pre-buy, might be effectively subsidizing the 2007 engines.

Lower Life Cycle Costs

For The Road Ahead



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For The Road Ahead™

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By WALT MOORE, Senior Editor

Aiming for Squeaky-Clean Stacks Off-Road

Regulations for off-road diesels lag those for on-highway just a bit, but the target is identical — huge reductions in NOx and PM emissions

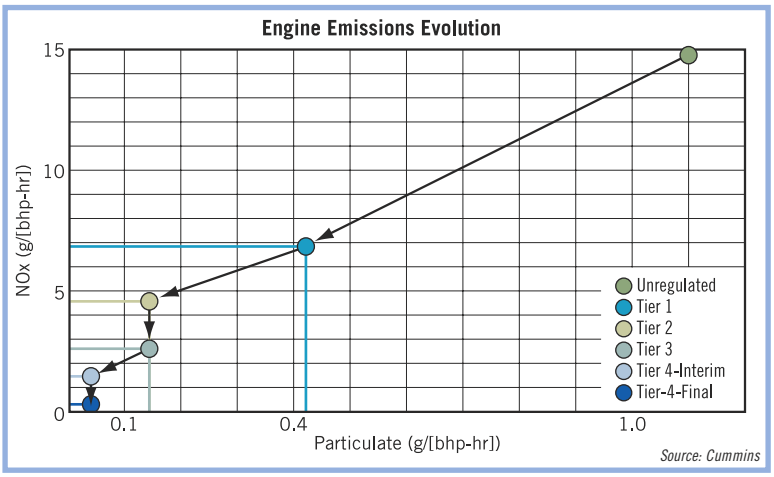
Although we didn't specifically ask the question in recent conversations with a number of companies that build off-road diesel engines, we're pretty sure that none uses a crystal ball to help bring off-road diesel engines into exhaust-emissions compliance. But they might be tempted, considering the difficult challenge of continuing to reduce two stubborn pollutants in diesel exhaust — particulate matter (PM) and oxides of nitrogen (NOx) — that concern clean-air regulators worldwide.

Standards for regulating exhaust emissions from off-road diesels, as you may know, are being phased in over an approximate 20-year period, which began in 1996 and will conclude, as it stands now, in 2015. The process is divided into five Tiers — 1, 2, 3, 4-Interim and 4-Final. The implementation of the various Tiers is staggered, based on horsepower ratings, but between January 2005 and January 2008, off-road diesels from 49 to 751 horsepower must become Tier-3 compliant.

Generally, Tier-3 standards for this large group of engines require an approximate reduction in NOx of 40 percent from Tier-2 levels, while PM levels remain essentially the same. The specific technology being applied to reach Tier-3 compliance differs, not only from manufacturer to manufacturer, but also within a manufacturer's own line in order to satisfy the divergent needs of engine-using customers.

Tier-3 standards, generally speaking, have forced nearly a 60-percent reduction in NOx from 1996 levels, and an approximate 65-percent reduction in PM. But consider this: Tier-4-Final standards for a large group of engines used in construction machines will require reductions in PM and NOx on the order of about 90 percent from Tier-3 levels.

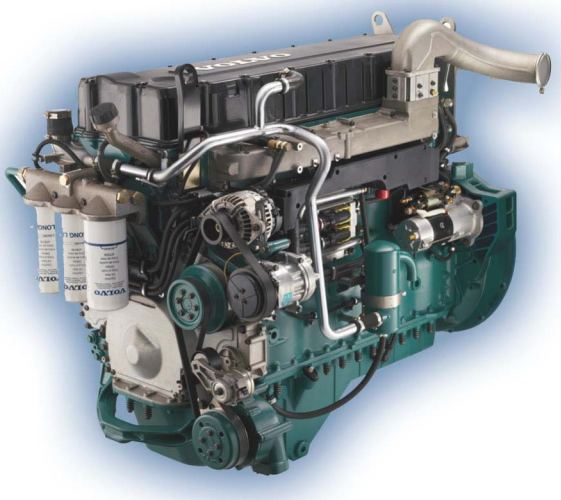
Without minimizing the hard work and technical innovation required to attain Tier-3 compliance, the looming Tier-4 standards seem to be the toughest nut yet to crack. Tier-4-Interim standards, which will take effect for a large group of engines in 2011 and 2012, require a 10-fold reduction in PM, along with a two-fold drop in NOx. Tier-4-Final standards, which will follow in 2014 and 2015, require yet another five-fold decrease in NOx.



Breathing easier with Tier 3

Doug Laudick, product manager at John Deere Power Systems, sums up the basic challenge for engine makers as they continue to bring cleaner engines to market:

"If you look at all our customers," says Laudick, "including our own John Deere factories, there are two things they want — performance that meets or exceeds the previous tier, and fuel economy that meets or exceeds



Volvo Construction Equipment has employed a Tier-3 solution that encompasses a new high-pressure fuel system, new fixed-geometry turbochargers, "switchable" internal exhaust-gas-recirculation system, new camshafts, enhanced electronic control and new coolers. The company's Tier-3 technology is identified as Volvo-Advanced Combustion Technology (V-ACT).

the previous tier. They don't want to sacrifice either one."

Satisfying those basic customer expectations, however, is complicated by economics, says Laudick. Some customers are willing to pay more for high performance, while others are quite cost-sensitive and want the lowest price — but without trading all that much performance.

Using John Deere Power Systems as an example of how manufacturers walk this tight wire, the company approached Tier-3 compliance from several directions. Its premium Power Tech Plus engines, for instance, with displacements of 13.5, 9.0, 6.8 and 4.5 liters, use four-valve heads, cooled EGR (exhaust-gas recirculation), variable-geometry turbochargers (for more precise combustion-air management) and a new electronic control module.

For more cost-sensitive markets, 2.4-, 3.0-, 4.5- and 6.8-liter engines also are available as Power Tech "E" models, with two-valve heads; full-authority electronic controls; standard or wastegate turbocharger (depending on displacement); common-rail or electronic-unit-pump fuel system; and air-to-air aftercooling. And as a third alternative, some versions of the 2.4- and 4.5-liter engines have mechanical fuel system options.

Komatsu also has a varied approach to meeting Tier-3 standards for its off-highway engines, which range in displacement from 3 to 78 liters. The company's "ecot3" (ecology and economy for Tier 3) emissions-control strategies are "based upon providing emissions reductions, improved fuel economy and overall performance in the particular engine and machine application."

All Tier-3 Komatsu engines do, however, use common-rail fuel systems, electronic control systems and air-to-air charge-air cooling. In addition, says the company, its patented combustion system is used in certain applications, as is cooled EGR on larger engines.

At Cummins, says Wayne Eckerle, executive director of research and technology, the company's overall design philosophy is to develop a range of technical solutions to meet the varying needs of engine customers, then to choose those most appropriate for the application. Cummins' basic approach to Tier-3, he says, was "sub-system optimization and system integration," which was accomplished largely with the company's "analysis-led" design process.

This process uses powerful software to analyze the combustion process by investigating a vast number of permutations involving fuel delivery, air management, electronic control and the physical design of system components. The engineer can then choose the optimum "recipe" for effective control based on application.

Using this approach, says Eckerle, Cummins has attained Tier-3 compliance for its off-road engines solely with "in-cylinder" techniques and, thus, the use of cooled EGR and variable-geometry turbochargers has not been required.

Volvo Construction Equipment has recently developed a new generation of Tier-3-compliant, heavy-duty engines, ranging in displacement from 9 to 16 liters, which are designed with the company's V-ACT (Volvo Advanced Combustion Technology) system. V-ACT, which also will be applied in similar fashion to a new range of medium-duty Volvo engines, consists of a number of emission-control techniques.

Included in the V-ACT arsenal, says the company, are new fixed-geometry turbochargers with improved flow characteristics, new fuel-injection system with high-pressure capability, new camshafts, a patented "switchable" internal exhaust-gas-recirculation system (I-EGR), an enhanced engine electronic control unit (E-ECU), new charge-air coolers and new radiators.

Caterpillar's approach for controlling off-road-diesel emissions is

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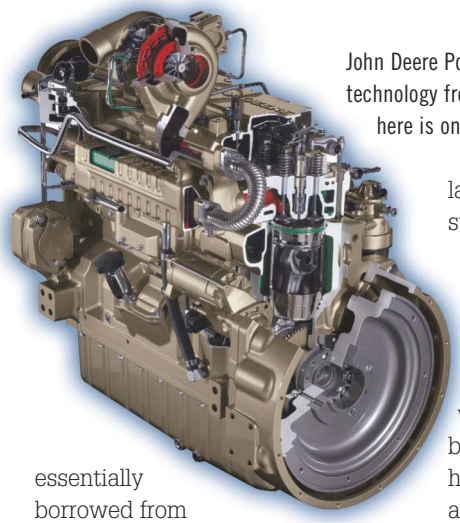


John Deere Power Systems, as have many other engine manufacturers, approached Tier-3 technology from several directions, based on meeting varied customer needs. Illustrated here is one of the company's PowerTech Plus engines.

essentially borrowed from technology developed for its on-highway diesels — ACERT (Advanced Combustion Emission Reduction Technology). According to Caterpillar, company engineers worked with approximately 125 variables and more than 10 million possible combustion combinations to find the "optimum balance of reduced emissions, engine performance, fuel efficiency and engine durability."

Depending on the specific application, the fuel system employed in the ACERT approach is either a Cat common-rail system or electronic unit injectors (either hydraulic or mechanical). Included in ACERT's air-management system are cylinder heads that provide unencumbered airflow to the cylinders, and waste-gate turbochargers. Electronic control for ACERT engines is provided by the company's ADEM A4 electronic control module. Tier-3 off-road diesels with ACERT technology, however, do not use an aftertreatment device in the exhaust stream (an oxidation catalyst) as do their on-highway counterparts.

From Tier 3 to Tier 4

In general, packaging Tier-3 engines into vehicles likely will create few problems, but may require a larger or better-managed cooling system to handle higher heat rejection. Fuel economy in Tier-3 engines, again generally speaking, is on par with Tier 2.

For some engines, replacing a Tier-2 mechanical fuel system with an electronic system may boost fuel economy. On the other hand, a well-tuned Tier-2 engine already using electronic control may take a slight fuel-economy hit. But not in every instance; at least one manufacturer reports fuel improvements ranging from 1 to 6 percent on engines already using electronic fuel systems, but now also incorporating cooled EGR and variable-geometry turbochargers.

According to Cummins' Eckerle, the common-rail fuel system continues to be a huge help when developing emissions-control solutions that preserve fuel economy. The system, which uses a separate pump to maintain fuel pressure via an accumulator, has two primary advantages, he says, namely, injection pressure is independent of engine speed, and fuel can be delivered to the cylinder in multiple pulses.

Multiple-pulse fuel injection (delivering the fuel for a single "combustion event" in sequential phases) has become an effective technique for emissions control. In addition, says Eckerle, the technique can make an engine more sociable by significantly reducing combustion noise. In the future, he says, common-rail systems may be refined with a "closed-loop" technology, which uses sensors to report what actually occurred during a combustion event, and then processes this data to further fine-tune combustion.

Although manufacturers are still investigating all possible alternatives for complying with Tier-4 standards, cooled-EGR and aftertreatment seem at this point, at least, to be among the most practical for most manufacturers. Aftertreatment devices are positioned in the vehicle's exhaust piping and designed to reduce PM and NOx that escape the best efforts of in-cylinder techniques.

Xinqun Gui, manager of engine technology for John Deere Power Systems, believes that the significant drop in PM for Tier-4-Interim likely will force after-treatment in the form of a particulate trap. The trap will catch and hold particulates in the exhaust; then, typically with the help of a catalyst, will "self-regenerate" (burn away collected soot) if exhaust temperatures of 300C are attained during at least 30 percent of the engine's running time.

If exhaust temperatures are insufficient for self-regeneration, a forced-regeneration system with appropriate controls will be required. What will not burn in the trap, however, is ash residue from the engine oil, which means, says Cummins' Eckerle, that the trap either must be sized to accommodate a lifetime of ash or, if smaller in size, must be "shaken out" periodically.

Attaining the NOx level for Tier-4-Interim also may require aftertreatment but, says Gui, "there are technologies that may provide NOx control without it. These include more sophisticated EGR systems, changes in fuel strategy and more refined turbochargers." Both Gui and Eckerle agree, though, that getting to the Tier-4-Final NOx level, at

the PM level required, may require NOx after-treatment.

Briefly, three basic types of NOx after-treatment are under consideration: the lean-NOx catalyst; lean-NOx trap, also called a NOx adsorber; and selective catalytic reduction (SCR). All of these devices use a catalyzed trap to hold NOx until regeneration takes place, and the regeneration process is essentially what differentiates the three.

The lean-NOx catalyst will regenerate with the addition of hydrocarbons in an oxygen-rich exhaust stream, but the NOx adsorber, although more effective, must be regenerated in an oxygen-deficient environment, thus requiring more sophisticated controls. The SCR device has a control system that continually injects an aqueous solution of ammonia (urea) for regeneration, and is generally used with a diesel oxidation catalyst to deal with "ammonia slip" — ammonia that escapes from the trap.

Both Eckerle and Gui agree, however, that a combustion technique that has been "kicking around for 25 years" (says Eckerle) may hold great potential for accomplishing much of Tier-4 PM and NOx control in-cylinder. The technique, homogeneous charge compression ignition (HCCI), is a technique for thoroughly premixing the fuel/air charge before it burns.

"If you can do this," says Eckerle, "you can operate at a very low NOx level. But it's a very difficult combustion event to control, and operating in a pure HCCI mode across the entire engine map is tough to accomplish. But, there are ways to achieve a less-than-perfect HCCI...and if you can tame this kind of combustion, then levels for Tier 4 are achievable in-cylinder."

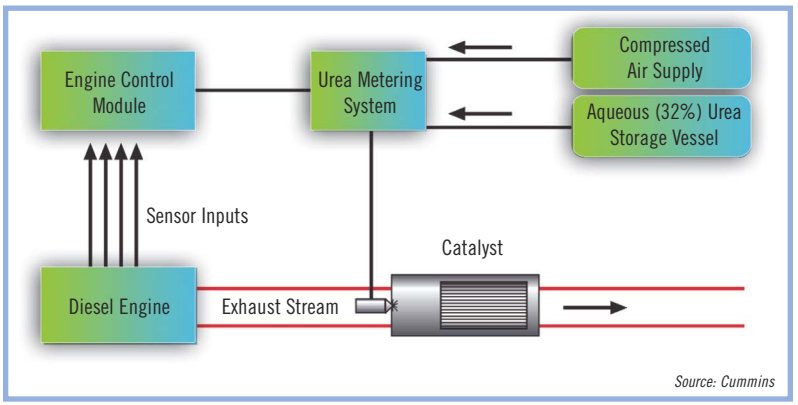
According to Deere's Gui, even though the combustion process in today's diesels has become extremely efficient and is measured in milliseconds, the combustion event typically is still long enough — and temperatures high enough — to promote the formation of NOx and PM. But combustion of a very uniform fuel/air mixture occurs so rapidly, by comparison, that its duration and temperature are such that the production of NOx and PM is substantially diminished.

"The technical barrier for HCCI," says Gui, "is control — making sure that each cylinder does the same thing and that each cycle of the same cylinder is consistent. This becomes the real challenge, yet HCCI offers the possibility of getting the engine's NOx level down to a point that potential NOx after-treatment systems could be vastly simplified."

And one more bit of technology that may be on the horizon — engine "electrification." Both Eckerle and Gui noted that the U.S. Department of Energy is working with engine manufacturers to capture unused energy from diesel fuel that goes up the exhaust stack as heat. Thermal generators, driven by exhaust heat, much like a turbocharger, could generate electricity.

That electricity could be used, says Eckerle, to drive accessories — water pumps, fans, hydraulic pumps and the like — to reduce parasitic loads on the engine. Or, says Gui, the electrical power generated also could be directed back into the crankshaft, assisting rotation, and thus easing the load on the engine's combustion system. Electrification of an engine, says Eckerle, could mean that a smaller engine could do the same work, or that the same-size engine could do more work. Either way, less fuel is used per unit of work, and the task of controlling emissions is mitigated.

Selective Catalytic Reduction (SCR)



This illustration shows the basics of selective catalytic reduction (SCR), a NOx after-treatment system using urea (ammonia) to remove NOx collected in the catalyst. Some European manufacturers are using this technology to meet on-highway exhaust-emissions standards.

By G.C. Skipper, Contributing Editor

Diesel's Partners in Reduction

Engines will only lower emissions so much, and the rest must come from advances in fuel, oil and aftertreatment

Still unanswered for equipment users is how much the new engine and accompanying technology will add to the cost of a new truck.

It's going to take more than just engine-design changes to meet the January 2007 federal deadline for low emissions standards set by the Environmental Protection Agency (EPA) for on-highway diesel engines. A combination of technologies must come into play, including a new ultra-low-sulfur diesel (ULSD) fuel, which will be nationally available in 2006; aftertreatment devices (particulate traps) now being developed for use with the fuel; and newly formulated oil that has a lower ash content.

To put a backdrop to what lies ahead, today's diesel engines emit 500 parts per million (ppm) of sulfur and the low-sulfur diesel fuel now on the market ranges from 15 to 30 ppm. That all has to change by 2006 when most of the on-highway ULSD fuel will be required to have no more than 15 ppm sulfur level at the pump. EPA prescribes similar reductions for off-road or construction equipment beginning in 2011.

The combination of '07 engines, ULSD fuel, particulate traps and low-ash oil, say the experts, will lower fine particle emissions by more than 90 percent and reduce hydrocarbons to near-zero level. The impact of these changes on fleet maintenance and operation is more difficult to quantify.

First of all, the 2007 engines will cost more, although engine manufacturers say it's premature to put a number on the price tag. Cyndi Nigh, Cummins' on-highway communications manager says engine pricing is confidential. "As a guideline, however, we anticipate a similar incremental increase to that of the 2002 product," she says.

At International Truck and Engine, Tim Shick, director of marketing, big-bore engine business, says the industry is "refining" the cost impact as it refines specific engine changes. "As always," he says, "the goal is to offer the best balance of performance, operating cost and initial cost along with emissions reduction."

Tony Greszler, vice president of engineering at Volvo Powertrain, says both Volvo and sister company Mack Trucks will add costs, but he didn't know what the total price of the truck will be.

Manufacturers also said all engines, including pre-2007, could

use ULSD. Even engines now in service, claimed one report, "will achieve small but significant environmental advantages with the new fuel." On the other hand, existing diesel fuel should only be used with '07 engines occasionally or for emergencies.

Volvo's Greszler says fuel economy may suffer slightly with the new fuel. "The only issue we've noted in the low-sulfur fuel is a slightly lower power density, meaning less energy per gallon," he says. "You have to burn a bit more of it to get the same [energy] out. We've seen a two- to three-percent difference." Other than that, Greszler says, tests using Volvo and Mack engines show that the engines work well with the fuel.

By contrast, Caterpillar has experienced fuel-efficiency improvements during its field tests, according to Jason Phelps, customer communications. "Our C7 and C9 engines used in concrete mixers, dump trucks and in vehicles that haul construction materials, are actually getting about three-percent improvement in our '07 engines." That improvement, he says, is the result of changes made in turbochargers, in the fuel system, as well as some software changes. Caterpillar's heavy-duty engines, the C13 and C15, are maintaining fuel economy, he says.

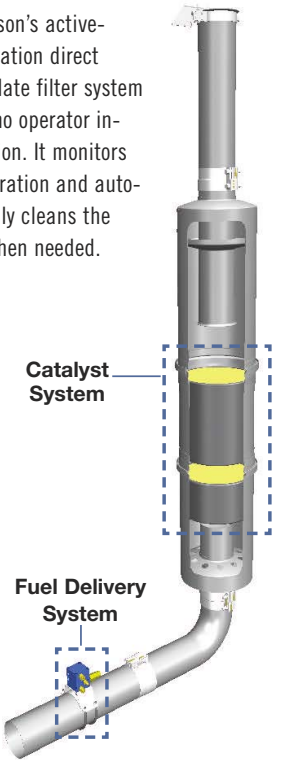
Not surprisingly, ULSD fuel will cost more, but nobody is offering an educated guess as to how much. Department of Energy statistics say the price increase will be between five and seven cents a gallon, Nigh says, "but that's DOE statistics, not Cummins. We don't know." International's Shick says individual fuel providers would set fuel prices.

Worried about fuel changes?

Fleet managers who remember the engine problems that cropped up in the 1990s, (seal leakage and other issues) when changes were made to diesel fuel, should not be worried this time around, according to engine manufacturers. Then, the seal leakage problem was caused by significant changes in the fuel aromatics level. "Processing of ULS fuel will have only a very minor impact on aromatics," International's Shick says. "Engine seal issues are not expected with ULS."

Volvo's Greszler agrees. "We have run a lot of ultra-low diesel in our products," he says. "In fact, Sweden [where Volvo's headquartered] has been almost all low-sulfur diesels for 20 years now. We don't expect to see any real problems, although there will have to be more flushing of the fuel delivery system, including the tank and the trucks. There is a potential for more debris to end up in the fuel filters. Filters may have to be changed more frequently during the transition."

At Cummins, Nigh says, there were injection-system leakage problems when diesel fuel was changed. "The seals were shrinking due to the levels in the sulfur making the elements in the seals contract," she says. "The seals were made of nitrile. What we did as a company was change the seal material from nitrile to vilon. Vilon doesn't have the significant difference in the swell between high- and low-sulfur fuel. We don't anticipate that this is going to be an issue at all."



Donaldson's active-regeneration direct particulate filter system needs no operator intervention. It monitors the operation and automatically cleans the filter when needed.

Federal regulations require ULSD fuel be available nationwide by the fall of 2006. The fuel is already available in certain parts of the country, such as Washington and California, where school buses and municipal vehicles are the primary users. Transit buses also use the fuel in metropolitan areas such as Chicago, Denver, Washington, New York City and some parts of Texas.

Once fleet operators start to use ULSD fuel, it has to be kept separately. "That really means flushing out the tank, the pumps and plumbing that deliver it," says Volvo's Greszler. "All this has to be cleaned out, because it doesn't take much current fuel to contaminate ultra-low sulfur."

Biodiesel is an alternative fuel, but engine makers differ on their

Cummins's particulate filter is part of a total system aimed at reducing particulate matter by 90 percent to meet federal mandates for 2007 engines.

counsel pertaining its use. International has not made a final determination, Shick says, and Caterpillar doesn't have an official stance, pending ongoing test to determine long-term benefits, according to Phelps.

Greszler, however, says Volvo has approved its '07 engines for up to B5 biodiesel (five percent pure biodiesel and 95 percent standard petroleum diesel). "Beyond that," he says, "it's very specialized because there are really no good controls on the fuel." Cummins has similar recommendations, Nigh says. "B5 diesel blend is suitable for use in a wide range of applications, she says. "There's no impact on engine performance, durability or maintenance. The only thing we caution fleet managers about is to ensure that the B5 is a consistent high quality standard."

Aftertreatment solutions

ULSD fuel will permit the use of aftertreatment devices, or particulate traps. Ted Angelo, director of product development for Donaldson, says government standards of a 90-percent reduction in particulate matter (PM) from today's levels is "a very difficult target."

"The most efficient way to remove PM is through the use of a particulate filter, or PTF," he says. "The problem is, like any other filter, PTFs will eventually clog unless they have a start-up treatment, or control, that goes with it."

Angelo identifies two basic forms of control. One is a passive filter that relies on a catalytic coating and sufficient temperature in the exhaust gas to remove the soot as it accumulates during vehicle operation. The second is an active system, used when the engine isn't producing enough heat or the exhaust chemistry is such that eventually the filters clog up. Active control monitors the system and initiates the heating process that burns the soot from the filter, he says.

Everybody most likely will use one of two active particulate-matter aftertreatments in 2007, Angelo says. Fuel burners combust right before the filter, and the heat burns the soot from the filter. The second active aftertreatment is fuel injectors, a technique preferred by Donaldson.

"This is a similar process, in that we inject diesel vapor into the exhaust gas," Angelo says. "The vapor passes over a diesel oxidation catalyst and that catalyst converts to heat and that heat burns the soot in the filter. We've evaluated both types and decided that fuel injection, with its compatibility with future generations for 'nox' aftertreatment control, is the best system for us."

Durability of such a system, says Angelo, is spelled out by the EPA. "The EPA has a caveat that they call 'useful life,' which says the system should function for 435,000 miles and/or 10 years," he says. "That's essentially the warranty period everybody has to meet."

In Donaldson's system, a stand-alone control unit monitors the operation and decides when it's time to regenerate, or burn, the soot from the filters. "It automatically does that without any operator intervention," Angelo says. "When it's complete, it resets itself, monitors, and waits for the next cycle. On some applications, that cycle could be daily. On others it might not be that frequent, depending on application and how cold or hot the vehicle operates," he remarked.

The off-road application of these on-road devices in 2011 will be "much more challenging," Angelo says. "Your typical over-the-highway tractor has either one or two cylindrical-shaped mufflers in the back of the truck, and that's the standard size and shape." But that doesn't hold true with off-highway equipment. "In trying to package one of these systems to marry different systems will make things interesting," he says.

Servicing aftertreatment devices boils down to simply maintaining the filters. "EPA has rules for this as well, Angelo says. "With on highway, the first ash cleaning can occur at less than 150,000 miles." Fleetguard, a sister company of Cummins, also manufactures aftertreatment equipment. Nigh says Cummins's 2007 engines will add exhaust aftertreatment to the 2002 versions. "Our aftertreatment will maintain the reliability and durability of performance that customers expect today," she says. "They'll have the same in 2007 [because now] we have [developed] the stable architecture."

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Cummins can move to Tier III with an in-cylinder solution and the only change is the addition of the exhaust aftertreatment, Nigh says.

"Right now we are testing the addition of the Cummins particulate filter, and that filter will be a maintenance item," she said. "Although the filter is designed to last the life of the engine, eventually it will have to be cleaned."

The cleaning service interval will vary, depending on application. "The ECM (electronic control module) will monitor as ash builds up in the filter. An in-cab display and diagnostic software will alert the driver when maintenance is needed," she says. Users can either have basic ash removed by a cleaning machine at a Cummins service location, or they can exchange the old particulate filter for a new one that is installed. Cummins does not recommend manual cleaning.

Federal standards also include the gases from the crankcase. Cummins uses crankcase ventilation, a simple, serviceable filter that separates the oil from the crankcase and then returns the oil to the oil pan. The filters, made by Fleetguard, will have to be replaced. Called EnviroGuard, it pulls oil out of the air, sticks it together and eventually that drip drops down and oil is returned to the oil pan, Nigh says.

Both the particulate filter and the EnviroGuard filter will have to be replaced every year, she says.

The key maintenance item for 2007, Volvo's Greszler says, is the particulate filter, which will require cleaning at a minimum of 150,000 miles. In a vocation operation, it would be 4,000 hours.

Aftertreatment devices, as well as changes in fuel and oil, will require continued attention to preventive maintenance in order to obtain the best operating costs for 2007 engines and trucks.

"The ash collected from the crankcase oil doesn't burn, and it collects in the filter," Greszler says. "At some point, that filter has to be cleaned out by essentially blowing air backwards through the filter. You have to pull the filter element out to do that, and that requires equipment to collect the ash. This is an additional maintenance item.

"We don't foresee any other real changes. Oil-change intervals should be comparable. Other than this, there should be no additional maintenance requirements."

Oil technology changes, too

Another piece of the puzzle in reaching federally mandated emissions standards is newly formulated oil. The new low-ash oil prevents particulate filter plugging and will be "backward compatible," Nigh says, meaning it can be used with older engines as well.

Another watchful area for fleet managers is the cooling system. "We haven't changed our cooling system requirements for present day engines or '07 engines," says Volvo's Greszler. "We are concerned that there is more heat load in the cooling system, so operators need to keep their cooling systems in good maintenance, which is what we recommend today. Properly maintaining the cooling system for '07 engines is probably a little more important, but there are no new requirements."

International's Shick agrees. "Good cooling-system maintenance according to OEM recommendations will continue to be a key component of a comprehensive maintenance program. Cooling-system capacities are increasing with increasing heat load. However, the coolant itself and maintenance requirements are not expected to change."

As far as engine and aftertreatment equipment manufacturers are concerned, the technological transition necessary to meet January 2007 on-highway emissions standards should be a smooth one — for them and for fleet professionals.

"We're way ahead of where we were in 2002, says Caterpillar's Phelps. "That's important for people to understand. It's not going to be like 2002. This is much less of a change, I think, that people are anticipating."

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By LARRY STEWART, Executive Editor

Volunteer Now Before You're Forced to Clean Fleet Exhaust

Better jump on today's incentives to clear diesel pollutants from your trucks and tractors before the regulators straightjacket your business with rules

If the state told you that you couldn't go to work before noon and barred any equipment that was built before 2003 from their projects, would you consider that a fair price to pay for clean air? Suppose they insisted that you use ultra-low-sulfur diesel fuel, which is only available in limited areas and costs up to 40 cents per gallon more than today's dyed on-highway fuel?

Sounds like a straightjacket, doesn't it? It's one that Texas tried to slip over the shoulders of contractors in the Dallas Metroplex and the Houston/Galveston area five years ago.

They did it in the name of clean air — a good cause. But contractors obviously did not participate in making those rules. When the ruling was announced, the local construction industry, galvanized by the Associated General Contractors (AGC) stepped in to interject some reason. Luckily, they prevailed — for the time being.

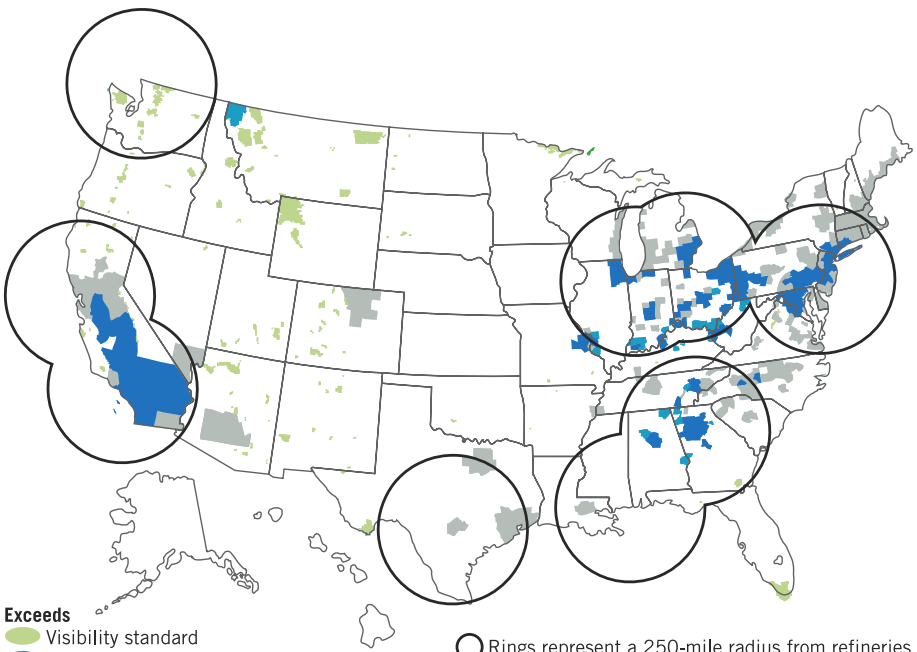
States are at the mercy of the Clean-Air Act and the Environmental Protection Agency (EPA). The Clean Air Act requires EPA to set air quality standards for pollutants considered harmful to public health and the environment, and EPA established standards for six criteria pollutants. Older diesel engines contribute substantially to two of them — nitrogen oxides, one of the main ingredients in ground-level ozone and smog; and particulate matter, a potential cancer agent.

EPA monitors air quality around the country and when an area does not meet the standards, it may be designated as a nonattainment area. Maps at www.epa.gov/airtrends/non.html are updated by October of each year to show current nonattainment areas by pollutant type. There are more than 120 nonattainment areas on the maps.

Nonattainment areas must develop plans to clean up their air by specific deadlines, and EPA must approve these State Implementation Plans (SIPs).

EPA has the power to withhold some federal funding from states that fail to act to clear the air in their nonattainment areas. Texas is dealing with an air-quality problem in its major metro areas, just as Atlanta, Chicago, Boston, southern California and most of the coun-

Ray Coburn (left) and equipment manager Mike Bowman take delivery of a new scraper engine. Coburn Equipment, a Chino, Calif., firm, is using Carl Moyer grants to repower tractors at the cost of rebuilding engines.



Source: U.S. EPA

Nonattainment areas — regions that do not meet air-quality standards established by EPA — must develop plans to clear their air by specific deadlines. If they fail, EPA has the authority to withhold federal funding for highways and other projects.

try's largest urban areas.

The Texas SIP included two rules that focused directly on the construction industry's contribution to clean air. The construction ban prohibited use of any diesel equipment before noon basically from April to October. A second rule accelerated the pace of replacement of older diesel engines.

"Construction companies could not have absorbed the financial impacts of these tactics and remained viable," says Bob Lanham, vice president with Houston-area contractor, Williams Brothers Construction.

The Texas construction coalition lobbied intensely and prevailed on the state legislature to replace the rules with the Texas Emissions Reduction Plan (TERP — see details at www.tnrcc.state.tx.us/oprd/sips/terp.html). The voluntary grant and rebate program is funded from a number of sources, "not the least of which is a one-percent fee on the sale, resale and lease of diesel equipment," says Lanham.

TERP includes rebates for on-road vehicles, both light and heavy duty, and several grant programs. One subsidizes replacing off-road equipment with new, cleaner-running machines. Another grant funds the cost difference between rebuilding engines and repowering the machines with new diesels. There are grants for buying retrofit exhaust filters and using alternate fuels.

The program is well received and generously funded, but Lanham says it must ultimately succeed. It must be so widely used that its effects in cleaning up the air in and around Dallas and Houston are measurable.

"Its failure could bring reconsideration of the rules it replaced," says Lanham. "Just as we had to change our culture and manner of thinking with regards to OSHA, the same mindset shift must occur again with the Clean Air Act."

A serious challenge that Texas contractors face is a unique air-quality problem focused on NOx. Texas' two nonattainment areas are among the very few whose only criteria pollutant is NOx. There are few retrofit options to combat NOx in construction equipment.

"In diesel technology, catalysts are still an emerging technology in nonroad engines," says Lanham. "They haven't been able to reach the same performance as in on-highway applications because of the transient load curve of most off-road equipment."

As a result, Williams Brothers and most other Texas contractors have spent their grants repowering or replacing equipment. Emissions are cleaned up, but there isn't enough money to repower the entire Texas fleet.

"We're trying to foster an atmosphere where emerging tech-

nologies for NOx reduction in off-road equipment can get to market faster," says Lanham.

Southern California struggles under similar NOx pressure as Texas, plus the weight of many other criteria pollutants. The state's Carl Moyer Program has provided $98 million thus far in incentives to reduce NOx and PM emissions from heavy-duty diesel engines. Funds are distributed through local air districts, which select projects. Grants cover a portion of the cost of putting cleaner engines in all applications (see www.arb.ca.gov/diesel/mobile.htm).

Most other nonattainment areas seem to focus on encouraging contractors to adopt simpler solutions for nonroad equipment — particulate traps and catalysts. The specifics remain at the discretion of each state's SIP.

"Lower emissions are required on the Dan Ryan project and I-294 tollway [in the Chicago area]," says Mark Lynes, equipment manager with Walsh Construction of Illinois. "All the big projects that come out in Cook County have this clause in them."

Lynes says contract specifications require any machine in the 50- to 300-horsepower range that will be on site for more than 30 days must either be retrofit with an exhaust catalyst or use diesel fuel with a sulfur content of 15 parts per million.

"There's a refinery in northwest Indiana that makes low-sulfur fuel, so we can get it here," says Lynes. "We pay about 45 cents in addition, with a delivery surcharge of about 15 cents per gallon. The refinery has to dedicate a truck to avoid contaminating it with higher-sulfur fuel."

Walsh has 40 to 50 machines running on ultra-low-sulfur diesel (ULSD) right now, and Lynes estimates the company is buying 15,000 gallons per month. There have been no problems thus far, but Walsh has only been using ULSD for about four months.

The company has nearly two years of experience with retrofitting exhaust traps. A demonstration program paid the cost of retrofitting seven machines with exhaust catalysts at the beginning of last-year's season. The number of retrofits in the Walsh fleet is up to 20 now.

"If it's a high-utilization machine that's going to burn lots of fuel, it's probably best to retrofit," says Lynes, comparing the retrofit alternative to burning ULSD. Deciding is a fairly simple matter of estimating how much fuel a machine will burn on a regulated project, multiplying that by the additional cost of ULSD, and comparing it to the retrofit cost.

"We just prepare the comparison for the project managers," says Lynes. "They make the decision, since they are ultimately going to have to pay for it."

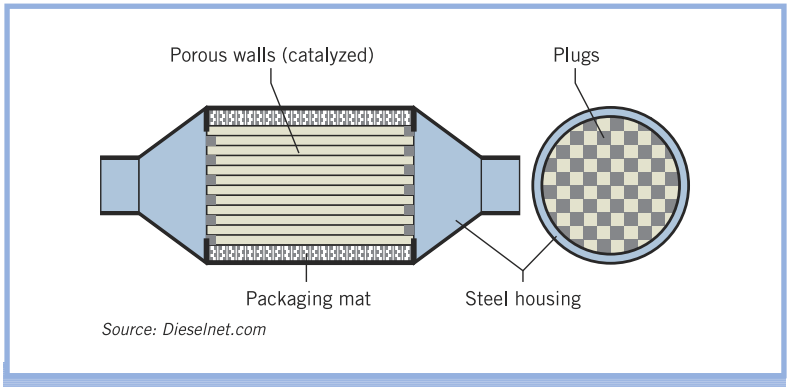
Contractors choose their retrofit solutions from catalytic oxidizers on EPA's verified-technology list (see www.epa.gov/otaq/retrofit/retroverifiedlist.htm and www.arb.ca.gov/diesel/verdev/verdev.htm)

"Depending on the size of engine, some of these things can be huge — big cabinets the size of a beer keg mounted outside the engine canopy," says Lynes. "But they're not all that hard to handle.

"You have to meet certain backpressure requirements from the engine OEMs, but we have had almost no trouble with the machines."

Lynes recommends going to the OEM's engineers on every retrofit.

"Make sure they know what you're doing and you know what



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they recommend," he says. "And make sure we don't void any warranties."

The company has never been required to repower machines.

"We have swapped out some machines in Atlanta, though," says Lynes. "Their specs require equipment with a minimum of Tier 2 engines, so we just switch things out in the fleet so they get newer machines."

A crucial difference between the situation in Chicago and Atlanta and what's happening in Texas and California is that contractors in Chicago and Atlanta have no choice but to reduce emissions. The Texas and California programs are voluntary.

"The construction industry supports TERP in Texas," says Ken Simonson, chief economist with AGC. "It's a good model for other states to follow, rather than using mandates, regulation, and bidding-preference approaches.

"Bidding preference is an approach that cuts out otherwise qualified contractors from bidding on projects, and it can cost states a lot more on contracts with a limited pool of qualified bidders."

Of course the industry supports voluntary clean-air programs, but lip service cannot replace real action to improve emissions quality.

"There is no huge voluntary movement to put this stuff on," says Simonson. "In cases where states are providing incentives or where localities have restricted bidding, contractors have not had a problem with compliance. But retrofits require making an investment in equipment that doesn't necessarily improve productivity. Contractors are looking for incentives from state and federal clean-air funds."

EPA recently launched its National Clean Diesel Campaign (www.epa.gov/cleandiesel/) to facilitate regional collaborations between businesses, government, and communities to provide incentives. Members of these initiatives have agreed to collectively leverage additional funds and take a local approach to diesel mitigation.

Uncle Sam is offering more than moral support for these collaborations. The federal government has made a number of recent moves to fund retrofit programs.

EPA created $1.4 million in grants intended to take advantage of more than $5.8 million in matching funds available through the West Coast Diesel Emissions Reductions Collaborative (www.westcoastdiesel.org/). The first of these grants freed up nearly $1 million of joint funding for a retrofit demonstration project in Sacramento. It will reduce diesel pollutants from heavy-duty equipment such as loaders, backhoes and excavators. Old mufflers will be replaced with lean NOx and particulate filter technology by Cleaire.

The Energy Policy Act of 2005 created the $1-billion Diesel Emissions Reduction Act, providing up to $200 million per year to reduce emissions from older trucks, buses, and off-road equipment. The Energy Policy Act also created a $100-million diesel-truck retrofit program that will fund up to half of the cost of modernizing large truck fleets.

"AGC lobbied successfully for, in the highway bill, a provision to allow CMAQ (congestion mitigation and air quality) funds to provide incentives for diesel retrofits for off-road vehicles," says Simonson, speaking of another new source of incentive cash. "Those funds were previously only available for on-highway vehicles."

Construction-equipment owners must make it a priority to participate in these programs if they hope to avoid business-stifling rules like those overthrown in Texas early in the decade. If nonattainment areas don't meet clean-air standards, voluntary programs will give way to regulation.

"States are inevitably moving toward tighter restrictions on diesel equipment," says Simonson, "and contractors will need to be part of the solution."

They will need experience with technology alternatives to formulate opinions about which are most effective. And those efforts will demonstrate a commitment to clean air that will give them real influence in the regulatory process.

Verified Retrofit Technologies

See the most up-to-date list of diesel retrofit technologies that the U.S. EPA has approved at www.epa.gov/otaq/retrofit/retroverifiedlist.htm

EPA also accepts retrofit strategies that have been verified by the California Air Resources Board (CARB). Information about CARB's Verification Program and their list of verified technologies can be found at www.arb.ca.gov/diesel/verdev/verdev.htm

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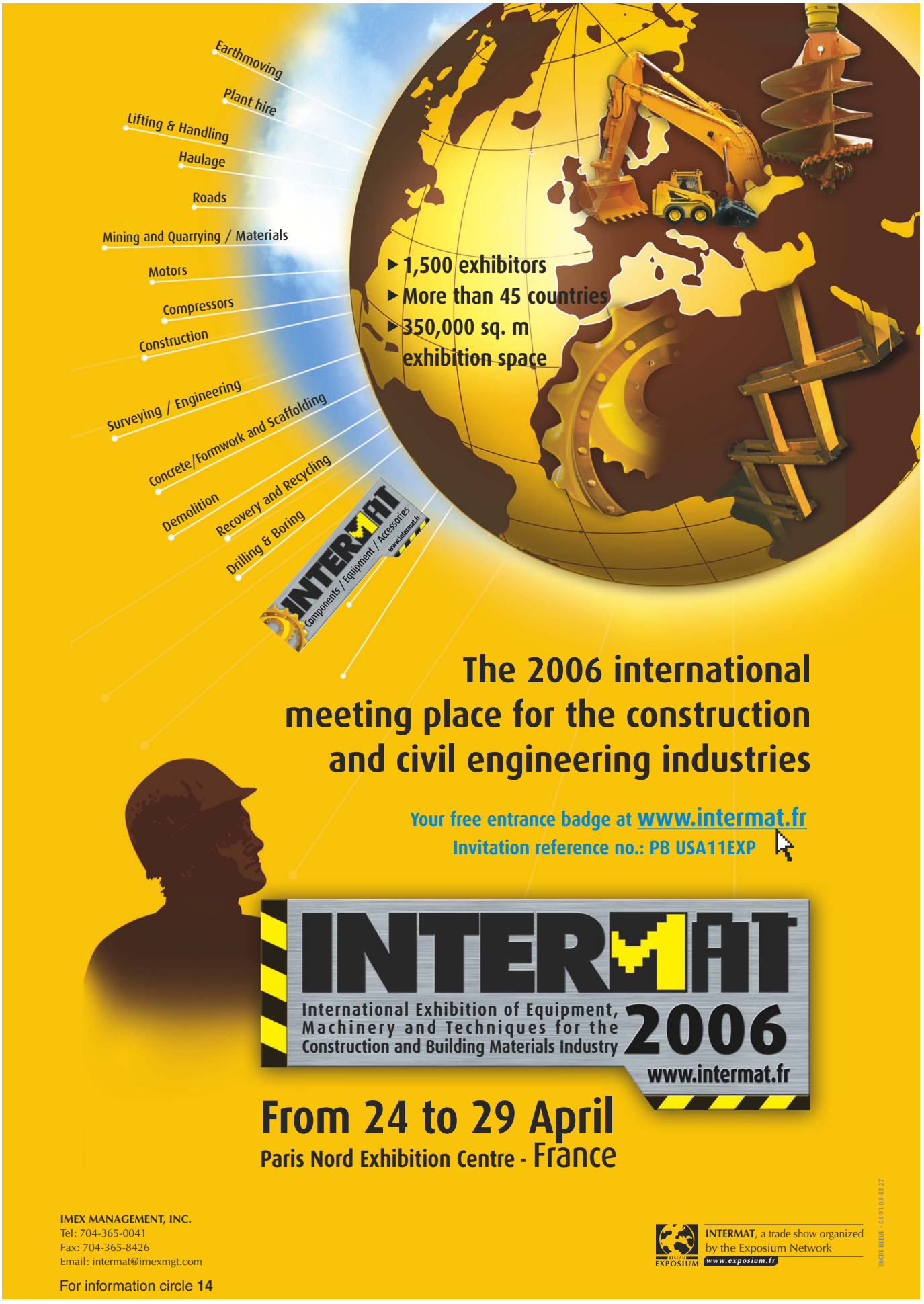
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By TOM BERG, Truck Editor

T800's Short, but Long On Comfort

The latest version of Kenworth's 'T8' is set up for snow plowing, but not on this 100-degree day in Texas

Front-engine PTO provisions include 19-inch frame extension and high-mount radiator, hood and cab. Wide wheels and tires still cut enough for decent turning ability.

What's big and tall and short at the same time? This Kenworth T800 10-wheel dump truck. It's a hefty Class 8 vehicle, but its cab sits high off the frame, and its hood slopes steeply to join the cowl and grill. That rakish angle, along with this vehicle's short wheelbase, make it look especially squat.

What's it doing in this article? It's got provisions for a front-engine power take-off, or FEPTO, a newly available option for T800s, plus KW's attractively redesigned interior trim. Those features are worth remarking on, and it has been more than a year since I drove a T8, so I took up PR manager Jeff Parietti's offer of a test drive just after the Great American Trucking Show in Dallas.

"Just after" meant first thing on a Sunday morning, which was fine because afternoon temperatures there had reached 100 degrees, with humidity in the 90s, and starting out early avoided the worst of the heat. On the other hand, the truck had just come off the show floor and its box was empty, and where on a Sunday morning do you find a load of stone or gravel to provide some realistic weight? You don't, so I can't say much about engine power or ride quality under load.

The morning drive

Of course, half a dump truck's miles are empty ones, and I can say that the T8 rode fairly well considering its 22,000-pound front end and not much distance to the rear tandems. Yes, it bounced over the bowed and occasionally broken concrete which covers so many miles of Texas highways, but not enough for me to complain about because the air-ride seat soaked up much of what the truck's various suspensions couldn't.

Even with no weight to give it a workout, the 350-hp Cummins ISL growled nicely when accelerating, just as big-bore Cummins models do. In fact, I thought it was an ISM until Parietti pointed it out in the specs list. The ISL is a heavy-duty, midrange-displacement diesel that doesn't use exhaust-gas recirculation and won't until 2007. Thus, it possesses simplicity that's highly desirable in these days of complex and expensive emissions-legal diesels.

The engine was mated to an Eaton Fuller 8LL transmission, which is fun to shift in most trucks and especially so in a Kenworth because the gearbox, lever and linkage between them are set up so well. Other builders should look at how KW does this and copy it. With no load, I ignored Low-Low range and Low gear, and usually started out in 2nd, 3rd or 4th, then used all four ratios in High range. Most of the time I could float-shift without the clutch.

This 10-wheeler was built for the Northeast, where most states allow high axle loads with little "bridge" between axles. It'll probably be bought by an operator who plows snow in winter, as its FEPTO provisions allow access to the front of the engine crank for a power take-off's drive shaft, done by mounting the radiator a few inches higher than usual. The 19-inch front frame extension provides room for a hydraulic pump, and the high-capacity front axle and suspension can carry a heavy plow and its mounts. That extra length from the frame extension is somewhat mitigated by a hood seven inches shorter than on other T800s.

Maneuvering with or without a plow should be fairly easy because while the hefty front axle had wide "duplex" tires, the wheels still turned rather sharply. That and a 188-inch wheelbase made this truck's turning radius reasonably tight. The wheel cut is an advantage of the setback axle, which was mounted 47 inches behind the nose and 66 inches behind the bumper.

I had to keep that extended bumper in mind when I encountered obstacles to the front-right, as I couldn't see the bumper even over the steeply sloped hood. I wish the steering wheel were an old-fashioned type with a thin rim and spokes because they'd look right with the truck's traditional styling, but they're thick and modern instead. Well, the wheel would probably be easier on a driver's belly and

All '06 KWs have new interior trim, and this truck has base-level Splendor package in gray. Four other colors are available.

The cab sits 3.5 inches higher than on other T800s, so each step's a legful. But grab handles outside and inside help.

TEST SET

Truck: Kenworth T800, short-hood conventional daycab, BBC 114 in., w/front-engine power take-off provisions, GVW 60,000 lbs., tare weight w/body 20,030 lbs.

Engine: Cummins ISL, 8.9 liters, 350 hp @ 2,100 rpm, 1,250 lbs.-ft. @ 1,400 rpm, w/Jacobs Engine Brake

Transmission: Eaton Fuller RTO14908LL 11-speed

Front axle: 20,000-lb. Dana Spicer EFA-20F4 on 22,000-lb. 3-stage taperleafs

Rear axles: 40,000 Dana Spicer DSH40 w/4.33 ratio, on 40,000-lb. Chalmers 854-40-H walking beam

Wheelbase: 188 inches

Tires & wheels: Bridgestone 425/65R22.5 M844F front, 11R22.5 M711 rear, on Alcoa New Generation discs

Brakes: Dana Extended Service S-cam w/Meritor Wabco ABS

Fuel capacity: 100 gallons

Body: Heil 14-foot steel tub

A polished metal threshold plate welcomes drivers aboard, and the new suspended accelerator is easy to modulate.

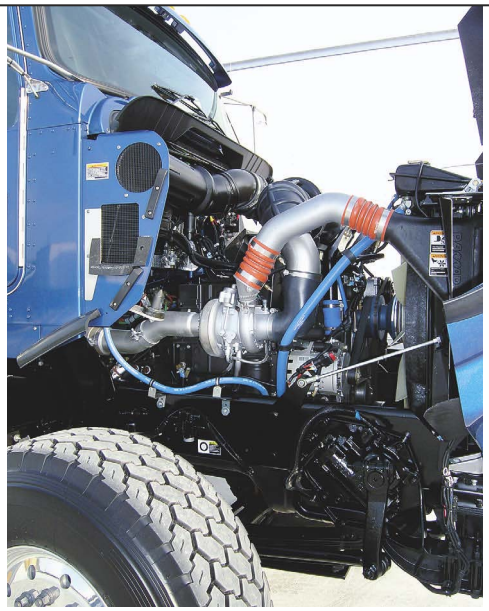
chest in a wreck.

The high-mounted radiator required raising the grill and hood, and the cab, too, so its cowl can line up properly with the hood's rear. The cab therefore sits 3.5 inches higher on the frame than on other T800s, KW says. It's noticeable as you climb the steps because each one is a legful. Grab handles outside and inside the cab helped me pull myself up. One handle is up near the end of the dashboard, but it was just as easy to grab the steering wheel.

Take a look inside

New interiors grace all of Kenworth's 2006 models, and this T8's surroundings were nicer than most dump truckers are accustomed to, even though it had the base trim called Splendor. Doors, dashboard, ceiling and walls were covered with nice grades of plastic and fabric. This interior was Slate Gray, which goes well with many exterior colors, including this truck's Concord Blue. Although product planners dropped tan for lack of orders, other available colors are Steel Blue, Bordeaux Red and Jet Black. KW's private-branded seats were bucket style with nice bolsters to keep the driver's and passenger's legs and upper body in place during turns. The driver's seat had multiple adjustments, but all I had to do was set the height and fore-aft position to be comfortable. If I were going to work in this truck, I'd figure out all the adjustments; surveys have shown that most drivers' complaints about seats can be traced to their ignorance of how they can be adjusted.

Pedals in the T8 were easy to reach, and a new suspended accelerator was easy to modulate as I could steady my foot against the floor or console while I pressed on the pedal. In previous Kenworths, the accelerator sits on the floor with its top surface uncomfortably high. The old accelerator is also shaped like the brake pedal and, while driving earlier KWs, I often found myself tapping the "gas" instead of the brake, or vice versa. So the new, lower-positioned, pad-shaped accelerator is a big improvement.



The Cummins ISL growls nicely and makes good power. It has no EGR and won't until 2007.

Gauges are recessed slightly and are set off with bright-metal rims, which add class without glaring in the sun. Gauge faces continue the same good basic design of black faces, white numerals and red pointers — nice looking and legible. It was too bright a day to see how they'd be illuminated, but it's probably effective. Switches are all rounded rockers that are also easy to use, though some are marked with unfamiliar international symbols instead of clearly worded labels. This is an auto-industry standard and supposedly bridges the language barrier. A regular driver quickly learns what each symbol means, but I wish I didn't have to.

Heater and air-conditioning controls use intuitively clear rotary switches, and I turned on the A/C as the morning progressed and the outside temps climbed. I didn't have to wish I could escape the heat because I knew I'd soon be on an airplane out of town, and meanwhile the Kenworth's A/C was powerful and the vents well positioned to let the chilled air blow comfortably over my body.

Life can be good, and it would've been had I spent all day in the KW. I was a bit reluctant to turn it in, and envy the person who'll be driving it for a living. CE

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By WALT MOORE, Senior Editor

At Your Service

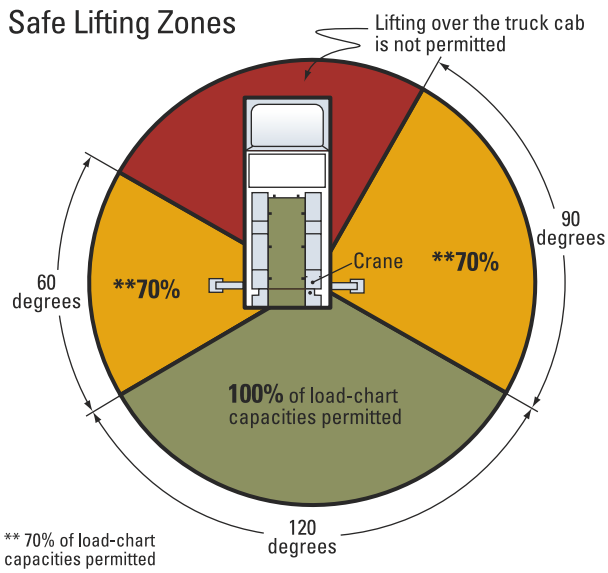
Carefully purchased, today's refined crane service bodies offer the prospect of bringing the shop to the field

Auto Crane's Titan 60 crane service body has a rating of 60,000 foot-pounds and can accommodate the company's 60,000-foot-pound-rated 10,006H Series telescopic-boom crane. The 10,006H has a maximum lift capacity of 10,000 pounds at a 6-foot radius, and its powered boom extends to 25.33 feet.

Maybe you've been there — in the middle of nowhere, all alone, with a cold wind chilling your bones as you try to pull a transmission up through the ROPS of a big earthmover. The life of a field-service technician can sometimes be quite lonely. And on those occasions, a well-equipped service truck with a capable crane may be the best friend around.

Fortunately for the world's field-service technicians, the selection of crane service bodies — and the telescopic-boom cranes that accompany them — has never been better. A number of manufacturers have been busy refining the design of crane bodies for greater strength, durability and operator convenience, while also reducing weight and (consequently) increasing cargo capacity. The telescopic-boom cranes used with these bodies also are being continually refined, yielding more lift capacity in a lighter-weight package that provides more line pull and faster line speeds.

"Controlling weight, while maintaining lift capacity, has really come into play in the design of these vehicles," says Tim Worman, product manager at IMT. "In some instances, cargo capacity is critical, so the real focus of design has become maintaining a structure that can handle crane requirements, yet allows for maximum payload."



Depending on the specific crane body, crane and chassis, the lift-capacity values stated in the load chart may need to be reduced when the crane is working in areas off the side of the vehicle. In the accompanying diagram, the zones in yellow require that load-chart capacities be reduced by 30 percent. In the green zone behind the truck, the load-chart capacities need not be reduced. Lifting over the truck's cab is always discouraged.

According to a number of crane-service-body manufacturers, leaner designs that yield more lift capacity and more payload appeal to a growing segment of buyers wanting capable packages that weigh less than 26,000 pounds, in order to avoid the commercial driver's license and attendant paperwork. But thrifty buyers also are concluding that leaner designs can yield economic benefits, in terms of lessening the load on the host vehicle, and subsequently, significantly reducing both routine operating expenses and repair costs. Plus, keeping the vehicle street-legal when hauling heavy loads avoids potentially big fines.

Refining the crane

Many of today's service cranes have been refined to incorporate a number of accommodating features, including radio-remote control, which may, in fact, be standard equipment on certain models. According to some manufacturers, radio-remote technology has become both reliable and affordable, making it a good system for simplifying crane control by eliminating the tether. But tethered control is still usually available for users who may work in radio-restricted areas.

Crane refinement in other instances may encompass changes in basic structures, such as the use of booms with a hexagonal cross section. According to Stellar's Gary Hanson, the "hex" design provides added strength, as well as reducing longitudinal flexing and side-to-side movement. A number of crane booms also now use a "flip sheave," — a sheave block at the tip of the boom that can be rotated from its normal perpendicular position to a position in line with the boom to facilitate reaching into confined areas.

Many service cranes today also exhibit substantially increased line pull, resulting mainly from refined hydraulic-drive systems that boost pressure and flow in the circuit controlling the winch drive motor. Hydraulic refinement, say some manufacturers, also enhances a crane's "restart" capability, that is,

IMT's redesigned Dominator II service body, engineered for use with Class-6 and Class-7 chassis, can accommodate cranes rated up to 60,000 foot-pounds. The new body uses an "inverted A-frame" substructure and includes such refinements as a larger workbench bumper, rain eves over compartment doors, and integrated front outriggers.

List-Price Ranges

Crane service body with crane (less chassis and installation): ..... **$20,500 to $70,000**

Service crane: ..... **$2,000 to $15,000**

the ability to stop a load in mid-lift, then to resume the lift in a positive fashion.

Yet another relatively recent change on some units is positioning the winch on the crane boom, instead of on its stationary base. Those that use boom mounting contend that this arrangement minimizes the risk of snapping the load line or damaging the boom, especially when stowing the crane. With the winch on the boom, the length of the load line between the winch and a hook stowed on the boom remains constant when raising or lowering the boom. With a mast-mounted winch, the operator must remember to compensate for changes in line length.

Less stress, more durability

All manufacturers of legitimate crane service bodies use a means of channeling the crane's weight and the lifting stresses it creates away from the body and the vehicle chassis. One method physically separates the crane-mounting structure from the rest of the body and connects this structure to a stout sub-frame (between the body and vehicle chassis) that directs forces into the outriggers. Other manufacturers use an "integrated" design approach, in which the crane-mounting structure is not physically isolated from the body, but still employs substructures to channel forces away from the body and into the outriggers.

But what you typically want to avoid, says Walt Van Laren, sales manager for Service Trucks International, is a utility body that has been reworked to accommodate a crane. Although these reworks may be skillfully done in some instances, says Van Laren, some are not, and crane forces will exact a toll on the integrity of the body and the vehicle chassis.

Auto Crane's Kyle Whiteis agrees: "Beware of bodies modified for a crane after the fact. When smaller cranes are installed on a service body that is not designed for a crane, the body may be reinforced, but all the stress still goes through the body."

In addition to refining the crane-mounting system, a process enhanced with such tools as finite-element analysis, most all other aspects of the body continue to be scrutinized by manufacturers in an effort to improve durability and operator convenience.

Included on a long list of such enhancements are larger, stouter workbench/bumper arrangements, material of heavier gauge for compartment structures, improved hinges and latches, improved corrosion-resistance measures and rain gutters. Also on the list are more weather-resistant electrical systems that feature diagnostic capability, easier-to-trace wiring and wire routing that avoids vulnerable spots.

Stellar Industries' new control panel can be mounted in various convenient locations in the truck, and more than one panel can be used — for example, one on the crane-compartment door (shown here) and another in the cab. The panel has a provision for optional pre-wired switches (with up to 20-amp capability).

Practical buying

As you may know, service cranes typically have both a foot-pound rating and a maximum rating. But from what *CE* gathered from conversations with several manufacturers, the position of the crane's boom when determining these ratings may vary from manufacturer to manufacturer. Some feel that the foot-pound rating (defined as the load in pounds, which, when multiplied by its respective distance from the centerline of crane rotation, yields the greatest value) is most practically determined with the boom in a horizontal position.

The maximum rating (such as when saying "this is a 10,000-pound crane") may be determined at the crane's minimum radius, that

is, when the boom is at its most vertical position. If so, you may want to ask where this radius places the hook. Is it so close to the body that lifting is impractical? A manufacturer that determines a maximum rating at a practical radius may have a lower number, yet equal or exceed the foot-pound rating of a crane with a theoretically higher maximum capacity.

Based on what we heard from manufacturers, probably the best way to decide how much crane you need is to determine what loads you're handling and at what distances. Then, look at the crane's load chart, which correlates capacities with lifting distances (radii), to determine if the crane has enough capacity (and reserve capacity).

When you are checking the load chart, also take a look at the accompanying "quadrant of operation" diagram, which looks like a pie chart. This diagram graphically shows you how the crane's capacity ratings may change as it rotates around its base. You might find, for instance, that capacities stated in the load chart must be reduced by 30 percent or more when lifting over the side of the truck.

A note here about electric versus hydraulic cranes may be useful. If a small crane (usually with rated capacities of 6,000 pounds or less) suits your needs, you may find both electric and hydraulic models available. Both IMT's Worman and Auto Crane's Whiteis caution that electric models usually are designed for intermediate duty, and that a hydraulic model may be the better choice if the crane is to be used regularly. Electric models are less expensive, but typically require a high-amp alternator and a dual-battery setup.

The size of the crane, say manufacturers, basically determines the minimum standards for the service body, which also has a "foot-pound" rating (determined by the manufacturer) that must correlate with the crane's rating. The size of the service body, in turn, determines minimum standards for the vehicle chassis. But, when sizing the chassis, keep in mind the weight you may add with equipment such as welders and air compressors.

You can, of course, rely on the manufacturer or the truck-equipment dealer to select a chassis that meets your needs. Or, you may elect to purchase your own chassis locally (usually to ensure you'll get good service from your local dealer).

But if you're buying your own chassis, Feterl Manufacturing's Darrel Gstohl recommends that you discuss required specifications with the manufacturer or truck-equipment dealer beforehand. A smaller chassis, in particular, he says, may not routinely be equipped with features needed for crane-service-body application, such as a transmission-mounted PTO, and must be specified when ordering the truck.

Crane Service Bodies and Service Cranes[+]

	Crane Body Models	Crane Models	Crane Capacity Range (ft.-lb.)	Crane Reach Range (ft.)*	Minimum GVWR (lb.)**
Auto Crane	6	13	6,000-60,000	5-25	5,200
Feterl	5	5	32,000-75,000	11-23	19,500
IMT	5	15	6,500-70,000	5.2-25.3	10,500
Knapheide***	5	—	—	—	15,000
Maintainer	n/a	7	11,000-87,900	20-24	19,000
STI	4	10	6,000-62,000	5-29	12,000
Stellar	7	10	10,500-70,000	7-28	11,000
Flannegan**** Western	—	8	6,000-25,000	8-20	6,000
Ideal Crane****	—	n/a	6,500-36,000	4-20	6,000

+ Not all manufacturers solicited provided specifications; see *Web Resources* for more detailed listings.
* Horizontal reach from center of crane rotation.
** Minimum Gross Vehicle Weight Rating of chassis to accommodate smallest crane.
*** Fits supplied cranes to manufactured crane bodies.
**** Manufactures only service cranes.

Web Resources

Specifications	ConstructionEquipment.com
Crane-Body Manufacturers	
Auto Crane	www.autocrane.com
Dakota Bodies	www.dakotabodies.com
Feterl	www.feterl.com
IMT	www.imt.com
Knapheide	www.knapheide.com
Maintainer	www.maintainer.com
Omaha Standard	www.omahastd.com
Reading	www.readingbody.com
STI	www.servicetrucks.com
Stahl	www.stahl.cc
Stellar	www.stellar-industries.com
Service-Crane Manufacturers	
Flannegan Western	www.fwcrane.com
Ideal Crane	www.idealcrane.com

Gallery of Crane Service Bodies

STELLAR INDUSTRIES

Hex Boom, Standard Radio Remote

According to Stellar Industries, the company was the first manufacturer in the crane-body industry to employ the hexagonal boom design on all its service cranes, and models rated at 6,000 pounds and more use all-hydraulic extension. Stellar cranes feature planetary-drive winches that provide line speeds to 60 fpm, "grease-less" bushings for reduced maintenance, 400-degree rotation via worm-gear drive and radio-remote control as standard equipment. Crane bodies, says the company, are built with an isolated crane compartment with a torsion-box understructure. A two-pass priming process completely immerses bodies in "electro-deposition" paint, and Imron 5000 paint is used for the finish coat.

For information circle **164**

MAINTAINER

Load-Sensing Hydraulics

The Maintainer range of service cranes includes models with rated capacities from 2,000 to 14,000 pounds. These models feature hexagonal booms, closed-center load-sensing hydraulics and an internally mounted "overstress" system. Options include a short or tall crane tower and wireless remote control. Among Maintainer's newest crane bodies are the models 6220 and the 6224, both with a 12,000-pound-capacity (62,000-foot-pound) crane and boom lengths, respectively, of 20 and 24 feet.

For information circle **165**

STAHL

Lock-Bolt Construction

Stahl manufactures an extensive line of service cranes, both electric and hydraulic, that ranges in foot-pound ratings from 6,000 to 48,000. The company's crane bodies feature an understructure of tubular-steel beams that extends into the right-rear compartment. According to the company, its patent-pending "lock-bolt" mechanical fastening system results in stronger joints than welded seams, eliminates 80 percent of conventional-body welding and provides enhanced corrosion resistance. Body options include an 18-inch-deep workbench style rear bumper, vented tank compartment and a master locking system.

For information circle **166**

FETERL

Isolated Crane Tower

Feterl's service-crane line, used on the company's five basic crane bodies, includes 15 models that range in maximum rated capacity from 6,000 to 14,000 pounds. Body features, according to the company, include heavy-duty 10-gauge construction, sleeved subframe, isolated crane tower, pressurized cabinets and a "Gang Lock" system that uses a one lock to secure all the compartments. Feterl's largest body, the model 14000, features 70-inch front cabinets with toolboxes streetside, and a large, vented "oxy/acty" compartment curbside. The deck area, says Feterl, has no wheel wells.

For information circle **167**

OMAHA STANDARD

Liberal Warranty

According to Omaha Standard, it offers "the longest limited warranty in the business." The warranty covers rust-through, hinges and latches for six years and all other body components for three years. The company's 8,000-pound crane body features a newly designed under-frame and crane compartment designed to "isolate the crane compartment from the remainder of the body." These bodies, says Omaha Standard, are intended for 2-ton trucks and above with 48-inch-high sidepacks. The bodies use double-panel doors with "rigid honeycomb polystyrene stiffeners" bonded between the panels for increased strength.

For information circle **168**

DAKOTA BODIES

Custom Engineering

Dakota Bodies will engineer "solutions to any type of modification or feature" the customer requires. Standard features for the company's crane bodies include double-panel door construction with intermediate stiffeners, the use of corrosion-resistant steel for critical body areas, stainless-steel door hinges and automotive-type weather stripping. Crane bodies feature a crane box made of 1-inch steel plate and integral, upright steel-tubing beams that work in conjunction with a tubular-steel understructure.

For information circle **169**

SERVICE TRUCKS INTERNATIONAL

Hex Boom, Integrated Design

Characterizing the construction of the four-model range of STI crane bodies, says the company, is an integrated crane-support structure that encompasses the body, crane tower, substructure and outriggers. The bodies feature all-welded construction and "Galvaneal cabinet construction." STI's cranes, which range in foot-pound ratings from 6,000 to 62,000, feature a hexagon boom design and double-reduction drive for rotation. "Integrated absolute filtration" of the crane's hydraulic system, says the company, adds to the overall reliability of the product.

For information circle **170**

Gallery of Crane Service Bodies

KNAPHEIDE

"Torque-Isolator" Crane Support

Knapheide crane bodies feature the company's "torque-isolator" crane support system. The reinforced crane box, in conjunction with a sub-frame, says the company, "transfers lift forces into the full-length torsion box sub-frame and outriggers – not the side compartments." Knapheide crane bodies also receive the company's "K-Coat" corrosion-protection treatment, which entails a 12-stage process resulting in an electrodeposition prime coat.

For information circle **171**

IMT

Patent-Pending Floor Design

IMT says the design for the floor of its crane bodies "maintains a unit weight that is the lightest in the market." The crane-body package features an integrated design (crane, body and air system) that allows doors to open during crane operation. The 15 service crane models also feature a lightweight design, are available with either radio-remote or tethered controls and use a boom-mounted winch. IMT's redesigned Dominator II crane body uses a new "under-deck" 35-gallon hydraulic reservoir, which increases the body's cargo area.

For information circle **172**

READING

Truss-Designed Understructure Accommodates Crane Stress

According to Reading, its tubular-steel understructure accommodates the added stress of crane operation and allows its Cranemaster 6000 and 8000 models to support service cranes of those respective capacities. The Cranemaster 6000 is suited to 15,000-pound GVWR vehicles, and the Cranemaster 8000 for 21,000-33,000 GVWR vehicles. Compartment doors are double-panel construction with internal reinforcement and feature a patent-pending, dual-mode sealing system. Other features include bolt-on stainless-steel hinges, a vented oxygen and acetylene compartment and galvanized bumpers.

For information circle **173**

AUTO CRANE

Radius Corners Reduce Stress

The 13-model range of Auto Crane service cranes feature full-hydraulic extension, planetary-drive winches (line speeds to 60 fpm), two-speed rotation and an FM remote control and tethered-pendant control as standard. The cranes are manufactured, says the company, with a "pre-paint and assemble" process, and the units carry a two-year warranty. The company's crane bodies feature a patented one-piece side-pack design; internal stainless-steel hinges; and double-panel, flush-mounted doors with radius corners, which, says Auto Crane, are more effective at dispersing stress than 90-degree door corners. And, says the company, its crane bodies allow the crane to work throughout its lifting radius with no need to "de-rate" its capacity.

For information circle **174**

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For information circle 15

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For information circle **16**

Sweepers and Brooms

CONEQTEC-UNIVERSAL

The Low-Profile Pickup Broom from Coneqtec-Universal uses a floating brush designed to follow ground contour. The dual-direction hydraulic motor powering the brush allows for either over-the-broom sweeping or dust-pan-type sweeping, and the unit features controlled down force. Available in widths of 60 and 72 inches, the broom can be fitted with a range of options, including gutter broom, caster wheels, sprinkler system and various brush configurations.

For information circle **151**

TERRAMITE

The Terramite TSS36 and TSS38 sweepers are available with brush widths of 6 and 8 feet and feature two 50-gallon water tanks to help with dust suppression. The units are powered by a 37-hp, liquid-cooled Kubota diesel engine and are designed for towing with a built-in, adjustable swing arm.

For information circle **153**

ELGIN

Elgin's Broom Bear sweeper uses a Freightliner M2 chassis and is built around a single-engine design (a Cat C-7 diesel rated at 230 horsepower). The big sweeper uses a rear-mounted main broom, which is hydraulically driven and measures 34.5 inches in diameter and 58 inches in width. The machine uses a hydraulically driven dirt conveyor and features a 4.5-cubic-yard hopper with a maximum dump height of 10 feet.

For information circle **152**

BOBCAT

Featuring a three-position manual angle adjustment and a high-torque hydraulic drive motor, the Bobcat angle-broom attachment is available in widths of 48, 68 and 84 inches. The attachment features flush-sweep capability on the right side and replaceable wafer bristles that are designed for debris cleanup and snow removal.

For information circle **154**

TENNANT

Tennant builds a complete line of sweepers, including the Sentinel street sweeper, which uses an 83-hp Caterpillar diesel engine (3054C) and allows speeds to 25 mph. The machine features a stainless-steel hopper and can reach up to 9.5 feet for discharge into large roll-off bins and dump trucks. A dry-dust control system meets PM-10 requirements and allows sweeping in freezing temperatures.
For information circle **155**

BROCE

Broce Broom's RJ-350, a hydrostatically driven machine powered by an 80-hp John Deere diesel engine, has a standard 90-inch sweeping width, and an optional 96-inch width. Features include a 150-gallon water-spray system, joystick controls, front hydraulic disc brakes, swing-out oil cooler and high-capacity fuel and hydraulic tanks. Options include a curb sweeper and a 7.5-foot-wide front-mounted blade to clear heavy material while sweeping, such as cleaning behind a milling machine.
For information circle **157**

SWEEPSTER

The Sweepster model CTH is designed to mount to commercial mowers. The hydraulically driven brush is an excellent snow-removal tool, particularly when removing snow from surfaces that could be damaged by snow blowers or blades, says the company, and using the sweeper often leaves surfaces completely clear of snow and slush. The sweeper is available in 4-, 5- and 6-foot widths with a large 26-inch diameter brush for maximum snow removal.
For information circle **156**

WALDON

Designed for easy access to engine and hydraulic components, the Waldon 250 SweepMaster uses no universal joints or chains and incorporates minimal wear items. The broom's 250-rpm rotation speed is designed for efficient sweeping on the first pass, and the single-pivot broom configuration is designed to keep the brush virtually clog-free.
For information circle **158**

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TELESCOPIC HANDLERS

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Lancaster, Ohio

"It has smooth operation and plenty of power. That's what we were looking for, and it has it all. Our 353 has the power to do it, do it well and do it quickly."

MIKE SCHLAUCH
Schlauch/Bottcher Construction, Inc.
Bozeman, Montana

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ANGELA SCHENK
AC Schenk Equip. Rental Ltd.
Ontario, Canada

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SCHWARZE

The Schwarze M6000 is available as either a single-engine (SE) or a twin-engine (TE) model and is available on both conventional and cab-over chassis configurations. The TE version uses an auxiliary, 75.5-hp Duetz diesel to power the sweeper's hydraulic system. The M6000 uses a scissor-lift-type dumping system that provides dump heights up to 11.5 feet. The sweeping system features a 58-inch main broom, squeegee-type elevator system, forward-facing gutter brooms and dust-suppression system.

For information circle **159**

SWEEPEX

The SweepEx TPB-900S Pro-Broom from TrynEx International is a 90-inch broom with a hitch that replaces the moldboard of a standard snowplow. The broom uses the snowplow's existing hardware and hydraulics, and has application for cleaning up dirt, leaves, standing water and general debris. The broom uses eight "poly-brush" rows that are designed to "tackle tough material buildups or push large, heavy objects."

For information circle **160**

M-B COMPANIES

The model LB rotary pickup broom from M-B Companies is designed to connect to skid-steer loaders or wheel loaders. Available in sweeping widths from 4 to 8 feet, material picked up is carried over the brush and deposited in the hopper, which can be dumped using the machine's bucket-dump function. The brush is powered hydraulically and provides sweeping speeds of up to 200 rpm. An optional high-torque brush motor is available.

For information circle **161**

TOW-VAC

The Tow-Vac sweeper is designed for pulling behind a pickup truck or utility vehicle. Its impeller, powered by a 5-hp Honda engine, consists of eight rubber blades, which create a vacuum action when raised slightly off the ground, or a sweeping action when touching the ground. The impeller is designed to pick up all types of debris – including wet sand, rocks, bottles, metal and bricks – and to deposit debris in an on-board hopper. The basic Tow-Vac retails for $12,740.

For information circle **162**

TYMCO INTERNATIONAL

Tymco International's DST-4 is fitted with the company's Duo-Skids pickup head, which provides an 82-inch sweeping path, together with 36-inch-diameter gutter brooms. The machine is designed to not only remove debris from the sweeping surface, but also to clean exhausted air to 99.999 percent of 0.5-micron-size particles, according to the company.

For information circle **163**

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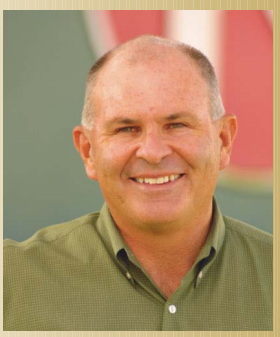
By LARRY STEWART, Executive Editor

Kimmins Saves $300,000 with Oil Analysis

Preventing failures and extending oil-change intervals save tremendously more than the cost of regular samples

PROFILE



Mike O'Brien

Kimmins Contracting

Headquarters:
Tampa, Florida

Specialties:
Underground utilities, phosphate-mine reclamation, demolition, and concrete/aggregates recycling

Fleet Value:
$50 million

Fleet Makeup:
350 units in fleet including 150 heavy earthmovers and 70 Class 7 and 8 trucks

Facilities:
One shop, four mechanics trucks, four lube service and fuel trucks

Equipment-Support Staff:
35 total including 32 technicians

Market Range:
100-mile radius around Tampa

As the Kimmins Contracting fleet began to age and catastrophic failures became a monthly event, Fleet Manager Mike O'Brien started looking for solutions.

"I have always been aware of oil analysis, but the company figured it was an added cost that we didn't need," says O'Brien.

Most of the fleet had been replaced in 1997, and most of those machines were still at work in 2001. Repair bills were beginning to demand an investment in failure prevention. O'Brien took bids from vendors for the company's lubricant supply, and the vendors brought about a change in management style.

"Management had been dead set against oil analysis, but the oil companies put presentations together that included sampling and sold them on doing it," says O'Brien. "Within the first year, we were able to prove the various cost savings they promised based on repair cost saved and an extended-drain-interval program."

O'Brien got five quotes from oil distributors. Mobil's price was in the middle of the bunch, and it included oil analysis, support from a lubrication engineer, and extended oil-drain intervals.

"There was a culture change," says O'Brien. "They weren't the least expensive, but Mobil included oil analysis in the price of the oil and seemed to be most knowledgeable, plus the Planned Engineering Service engineer was able to train our technicians.

"Analysis results will tell a story if you read them right."

The Mobil engineer's analysis insights were quickly tested, as Kimmins agreed to add 50 hours to its standard 250-hour oil-change interval.

"And the program was progressive. Eventually we were 100 hours over the 250-hour interval," says O'Brien. "We saved $50,000 to $60,000 in labor, oil and filters used in the first year [of their oil-analysis program, 2001] because we were doing fewer oil changes."

Remarkably, oil analysis has eliminated premature component failures even as oil-change intervals have lengthened and the fleet has continued to age.

"Last year we saved $125,000 on rebuilds that would have been catastrophic engine or transmission failures if we hadn't had analysis results to warn us," says O'Brien.

"Over four years, we have been able to identify a trend in engines and transmissions," he adds. "We can almost predict the hour when we're going to have to pull an engine or transmission, especially in

Photos: Bob Thompson©

Kyle Brant, heavy equipment technician, pulls an oil sample from a Komatsu grader's engine. Regular sample analysis allows Kimmins to extend oil-change intervals to 350 hours even while reducing engine repair costs by $125,000.

our more common pieces — the Cat or Komatsu equipment.

"We're at 10,000 to 12,000 hours on engines, although we've been out to 14,000 with some," says O'Brien. "Currently, a large portion of our equipment fleet is running with 15,000 to 20,000 hours."

Kimmins has begun to replace some machines since the oil-analysis program began, but they're doing it now because it's the most economical choice for very high-hour machines. Before oil analysis, big investment decisions were often made in reaction to emergencies.

"We were running things to destruction before — we'd have connecting rods bending or breaking and the rod goes through the block," O'Brien remembers. "And we had those kinds of failures once a month.

"In the last three years we haven't had any of that — none."

O'Brien quickly learned to watch for the appearance of sodium in engine oil, indicating the intrusion of coolant, accompanied by rising iron contamination. Or he would receive an alert when copper and iron concentrations began to rise in sync, anticipating bearing failures.

"The whole basis of sampling is wear trends," he says. "When we get a sample that shows high sodium, we immediately get a resample.

"We had a couple Peterbilt transport tractors with Cat 3406E engines in them and the oil-sample results on one came back with high sodium. We started sampling every 2,000 miles [instead of at every oil change, which is standard procedure]. At about 650,000 miles, we'd seen enough high sodium and copper that we decided to tear it down."

A quick look at the worn parts made it clear that they had averted a failure of the rod and main bearings.

"The second truck was a year newer," says O'Brien. "It started to show the same trends at 650,000 miles, so we saved a second failure."

He hastens to mention the savings involved in rebuilding a worn engine, rather than repairing a failed one.

"You could have the cost of a used or new block and no core credit on your busted block, a galled up crankshaft that's not reusable, no core credit on pistons or connecting rods, and you end up paying $8,000 to $10,000 extra for the catastrophic rebuild."

Jody Coombs, mechanic, changes the flywheel and ring gear on a John Deere 790 excavator's engine. Kimmins routinely keeps machines running out to 15,000 to 20,000 hours.

Oil analysis has redefined the economic life of Kimmins' equipment.

"We've gone from repairing failed engines at 8,000 hours to rebuilding worn components in the 12,000- to 14,000-hour period," says O'Brien. Rebuilds are $8,000 to $10,000 cheaper, and they've achieved it along with a 40-percent reduction in cost and labor for preventive maintenance, and by paying very close attention to oil-analysis results.

"In the past, if there was a problem with an engine or transmission, we weren't aware of it until something broke," says O'Brien. "With oil analysis, deciding when to rebuild is almost like reading a book — or like the machine is talking to you."

By MIKE VORSTER, Contributing Editor

The Intangibles of Fleet Average Age

Analysis will go only so far in determining how long to keep a machine; managers must also set and follow a style and philosophy

Mike Vorster
David H. Burrows Professor of Construction Engineering and Management at Virginia Tech.

Vorster will lead the Construction Equipment Institute (formerly the Equipment Executive Development Institute) Jan. 10-13, 2006, in Austin, Texas. For more information, contact Susan Beck at: sbeck@ reedbusiness.com or call 630-288-8494.

How long do I keep it" is a question that equipment managers ask every day. They know that replacing machines at a relatively young age reduces repair costs, shop labor and downtime, but it increases fleet investment capital. They also know that if they increase fleet age, capital expenditure comes down, repair parts and labor go up, and efficient repair facilities become critical for success. Striking a balance between a capital-intensive young fleet and a repair-intensive old fleet is more art than science. There are some analytical tools to help, but success comes from knowing the implications of fleet average age and finding a balance that suits your organization.

Calculating a machine's theoretical economic life is not difficult (see "How to Find the Sweet Spot" and "Cash is King, Even with Iron" at Construction Equipment.com). Although this provides a good starting point, it does not take into account intangible factors that cause practice to deviate from theory.

One factor is, of course, the nature of the industry. Careful analysis may show that it is time to replace two of the four twin-engine scrapers you own, but you do not have any scraper work scheduled after the current six-month project is complete. So, you keep the two older machines for another 1,000 hours and wait until you have more confidence about future work. Another equally important factor is the organization's financial situation. You may have ample work on the horizon, but capital budgets are spent and you cannot invest in new scrapers for a year or two. So, you replace a few key components and give the machines a thorough overhaul.

A third intangible is the equipment manager's style and personal philosophy on fleet. Some managers believe that the fleet should be "young and good," as this is an important part of the image they wish to project and an essential ingredient for success on the high-tempo, high-production jobs the company undertakes. Other managers believe that machines are built to last and can be kept forever if looked after with care and affection. They believe that appearance is not an issue as long as the job is done and that availability and downtime are not important if an extra machine or two is on standby.

The principal advantage of keeping the fleet average age young is that you will have lots of good iron that will work long hours on high-tempo jobs without delays and disruptions due to equipment failure. Reliability and uptime will be good, frequent replacements will make it possible for you to keep pace with the latest advances in technology, and every machine will be a billboard for the high standards set by your company. You will not need to establish large and complex repair facilities; the infrastructure you need to keep your fleet up and running will be small, simple and manageable.

On the other hand, the amount of capital tied up in your fleet will be high, and financial metrics such as return on investment will be difficult to achieve. High levels of capital expenditure together with the loans and leases needed to leverage equity will demand high annual financial costs. The fleet will have to work long hours to bring these down to reasonable levels, and weather and other factors will

Weigh the Pros and Cons

threaten your ability to maximize the investment you have in your fleet.

There are three things you must be good at if you want to keep your fleet average age low. First, you must understand equipment finance and have access to the funds necessary to maintain a healthy capital expenditure budget. Second, you must have the infrastructure needed to obtain and perform work at a high tempo. It is unlikely that the organization will make money if you do not utilize a strong, young fleet to the fullest extent possible. Third, you must have excellent dealer relationships and effective warranty administration in order to provide the support the fleet will need.

The advantages of letting average age increase are almost exactly the opposite to those of a young fleet. The capital invested will be lower, the annual cost of finance will not drive the organization, and it will not be critical to work long hours and undertake high-tempo jobs. Some of your fleet will be paid off, and you will not be as severely affected by periods of low utilization due to weather or work-load fluctuations.

There certainly are disadvantages associated with an old fleet. Reliability and availability can easily reach a stage where they impact operations, and you will need to own and operate substantial repair facilities. Shop facilities and other infrastructure will require investment, and you will need to manage the fixed costs associated with the facilities, labor and overhead. Long machine lives may cause the organization to fall behind the technology curve and become exposed to the risk of parts availability and cost.

Success at this philosophy also hinges on three things. First, running effective and efficient shops must become a core competency. The facilities must be first class, mechanic training must keep pace with turnover, and technology and capacity must be sufficient to support demand without compromising quality. Second, equipment selection is critical because you are buying for the long term. Parts and rebuilt components must be available, and total life-cycle cost is more important than purchase price. Third, operational planning will have to be flexible enough to accommodate the reality of downtime. Field crews will need to understand that availability will be less than perfect.

Clear understanding of these differing fleet philosophies will guide average-age decisions as much as will analyticals. Know where you want to be and develop a policy or style that suits your business and each group of machines in your fleet. It would seem appropriate, for example, that key production machines be kept young and reliable. It would also seem appropriate for highly stressed self-destructive vibrating equipment to be replaced on the early side while stable, simple and inherently reliable machines such as rigid-frame trucks can be kept for longer.

Once the philosophy is set, stick with it. Changing your policy or your style can be difficult, time-consuming and expensive. CE

	Young fleet average age	Old fleet average age
Advantages	- Able to work long hours on high-tempo jobs without delays and disruptions. - Good reliability and uptime. - Machines are company billboards. - No need for complex repair facilities. - Focus is on preventive maintenance, not on rebuilds.	- Not critical to work long hours and undertake high-tempo jobs. - Not severely affected by periods of low utilization. - Low capital investment in the fleet. - Annual cost of finance does not drive the organization.
Disadvantages	- High amount of capital tied up in the fleet. - Financial metrics are difficult to achieve. - Annual financial costs are high. - High utilization is necessary to cover annual financial costs.	- Lack of reliability and availability can adversely impact operations. - Substantial repair facilities are required. - Fixed costs associated with repair must be managed. - Machines could fall behind the technology curve.

Advantages weighed against disadvantages will enable managers to make a clear decision on fleet average age, basing it on philosophic as well as analytic thought.

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By WALT MOORE, Senior Editor

New Technology for Cat's Medium Loaders

Caterpillar's mid-range wheel loaders are equipped with Tier-3 engines, new hydraulics and more electronics

Caterpillar's four newest wheel loaders — 950H, 962H, 966H and 972H — exhibit considerable technical refinement, compared to their G-Series II predecessors. At the heart of these four models are Tier-3-compliant, C-Series Caterpillar diesel engines with ACERT technology, which encompasses, says Cat, advanced electronic control, precision fuel delivery and refined air management. These new engines, designed to provide constant net horsepower throughout their operating ranges, also use Cat's Engine Idle Management system, aimed at further optimizing fuel efficiency by matching idle-speed settings to the application.

Options for Cat's new medium wheel loaders include a rear-view camera, Autolube greasing system, high-intensity lighting, windshield-cleaning package (added steps and hand rails), and the company's next-generation Product Link equipment-management system.

Complementing the fuel efficiency of the new ACERT engines in these machines is a load-sensing hydraulic system that yields a stated 4- to 7-percent gain in fuel efficiency, compared to predecessor models. The new hydraulic system — which reacts to changing loads by automatically adjusting hydraulic flow to exactly match the implement's requirement — also yields a substantial increase in lift force (on the order of 20 percent more, says Cat).

New controls for H-Series models include electro-hydraulic implement levers, which feature "soft detents" and kick-out settings that are adjustable in-cab. In conjunction with the new hydraulic system, the redesigned controls also allow simultaneous lift and tilt functions for more precise bucket control. If the buyer prefers, an optional electro-hydraulic joystick controller is available and provides the same features as the standard controls.

H-series models also offer the choice of a standard steering wheel or the optional Command Steering system, which provides lock-to-lock steering through a steering arc of only 140 degrees. The optional system, says Cat, is a boon to operators in steering-intensive applications, such as short-cycle truck loading.

Yet another fuel-saving feature built into the new loaders is a refined cooling system, which uses an electronically controlled, hydraulically driven fan that automatically changes speed to match the machine's cooling requirements. The new system runs more quietly than conventional systems, says Cat, and also is more resistant to plugging and easier to service, thanks to a new corrugated and perforated swing-out grill. Maintenance enhancements include centralized grease-fitting blocks, remote pressure-checking ports and improved access to system filters.

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Basic Specifications

	950H	962H	966H	972H
Engine	Cat C7	Cat C7	Cat C11	Cat C13
Net HP	195	209	262	287
Operating Weight (lb.)	40,202	42,358	52,254	54,908
Breakout Force (lb.)	36,689	34,666	43,300	51,750
Bucket Capacity (yd^3)	3.3 - 4.6	3.5 - 5.0	4.5 - 5.5	5.0 - 6.0

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By ROD SUTTON, Editor in Chief

Vermeer Puts Tracks on Trenchers

One new model and two previous ride-on trenchers now feature rubber-tracked versions

New RTX350 rubber-tracked trencher digs to 48 inches and widths from 5 to 12 inches. Its sibling rubber-tired trencher, RT350, is also a new model for Vermeer.

Vermeer Manufacturing announced a series of alliances in September (see Managers Digest, page 15), but the most significant was an agreement that puts ASV undercarriages on Vermeer ride-on trenchers. The first three in this new family of tracked trenchers were unveiled at the International Construction and Utility Equipment Exposition (ICUEE): RTX350, RTX450 and RTX650.

Tracks give trenchers less ground disturbance, provide increased side-hill stability, flotation in soft or sandy soils, and the ability to maintain a straighter trench when digging, the company says. And, says marketing communications manager Tony Briggs, "better flotation gets the contractor out [working] more days."

Models RTX450 and RTX650 are simply tracked versions of the company's rubber-tired trenchers, RT450 and RT650. The RTX350 (along with its ride-on sibling, the RT350), however, is a new machine to the Vermeer lineup, available next month. The RTX450 will be available in January; the RTX650 in February. Briggs says the company is currently evaluating whether there is a need for tracks on other ride-on trenchers in the line.

Vermeer markets the 350s to the rental sector, calling them a "step up" in size from walk-behinds. A Cummins A1700 engine delivers 37 horsepower, and the units have disc/caliper park brakes and a 42-inch wheelbase. Cutters are supported by bolts through both side plates of the trencher chain assembly. The 350 trenches to 48 inches, and in widths from 4 to 12 inches.

Specs at a Glance

Manufacturer/ Model	Operating Weight (lb.)	Max. Cutting Depth (in.)	Cutting Width (in.)	HP (gross)	Ground Drive
Astec 360	3,906	60	6 - 12	32	Mechanical
Ditch Witch RT36	3,940	60	5 - 16	38	Mechanical
Vermeer RTX350	3,690	48	5 - 12	37	Hydrostatic

As with other ride-on trenchers, the RT350 and RTX350 have the company's exclusive forward/reverse ground-drive foot pedal that frees operator's hands to control the attachments, providing creep override instead of requiring the operator to shift between ground-drive controls and controlling attachments simultaneously.

Standard front attachment is a four-way backfill blade, and optional rear attachments include a high headshaft center-mounted trencher or hydraulic sliding offset trencher.

Operator features include a center-mounted seat, automotive-style steering, and easily accessible hydraulic test ports. An operator-presence system automatically shuts down the tractor when the operator leaves the seat with the attachment or ground drive engaged. All tractor and attachment controls are at hand for convenient operation. The hood is easily removable to allow quick and convenient engine servicing.

All RTX machines carry Vermeer's one-year/1,000-hour limited warranty.

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By LARRY STEWART, Executive Editor

The Tallest Boom A Drop-Deck Trailer Can Carry

Genie's Z135/70 puts 135 feet of platform height on an 8-foot-wide, 45,000-pound articulating-boom work platform

Genie set out to deliver the greatest access range and capacity that can be transported on a simple drop-deck trailer, and the result is the Z-135/70 articulating-boom aerial platform. It can raise 600 pounds to platform heights of 135 feet. A company press release says, "Genie's Z-135/70 offers the largest working envelope in the articulating boom market, providing a maximum working height of 141 feet, horizontal outreach of 69 feet 9 inches, and up-and-over clearance of 75 feet 6 inches."

With the boom raised to 75 feet, the 44,900-pound machine can reach almost 60 feet horizontally from its centerline. With the boom stowed, the unit is 42 feet 5 inches long and 10 feet 1 inch high. The machine is 8 feet 1 inch wide when its X-Chassis axles are retracted.

Every other big boom on the market, including Genie's machines over 80 feet tall, have telescoping axles. Each of the Z-135/70's wheels and wheel motors is mounted on a cast-steel arm that swings horizontally from a vertical pin on the frame. Hydraulic cylinders fold and unfold these arms to extend the width of the lift's footprint to 12 feet 11 inches. Electronic sensors monitor the arm and wheel positions and manage their proper alignment even when switching from two-front-wheel steering to two-rear-wheel steering to four-wheel or crab steering.

"When we produced the Superboom — the S-125 — six or seven years ago, we brought a number of technologies that affect how it operates, how it's serviced, how it is transported," says Brad Allen, product management team leader at Genie. "We used the same control system — the ALC 1000 system — on the Z-135/70, and the independent steering system with sensors for wheel position.

"We learned a lot in six or seven years, though, and one of the things was that sliding axles caused some people prob-

Biggest Articulating Booms

Make	Platform Height	Horizontal Outreach	Up-and-Over Clearance	Capacity (lbs.)	Weight (lbs.)
Haulotte HA100JRT	98′ 5″	69′ 11″	37′ 3″	551	45,853
JLG 1250AJP	125′ 0″	63′ 2″	60′ 6″	500	44,000
Genie Z-135/70	**135′ 0″**	**69′ 9″**	**75′ 6″**	**600**	**44,900**
JLG 150HAX	150′ 0″	79′ 3″	80′ 0″	500	57,000

The only boom taller than the Z-135/70 is JLG's 150HAX, and the 57,000-pound JLG is 11 feet 6 inches wide with axles retracted. The Z-135/70 — at 44,900 pounds and 8 feet 1 inch wide — is the biggest boom that can be transported on a standard drop-deck trailer.

Lifting Report

Left: Arms swing horizontally, extending the footprint to 12 feet 11 inches.

Right: The X-Chassis axles retract for a transport width of 8 feet 1 inch.

lems," Allen adds. "They've been on booms for 15 years — since booms went over 60 feet — and as machines got heavier, they caused maintenance problems. Not safety or reliability issues, but they could be inconvenient to service.

"That's why we introduced the X-Chassis. It has half of the moving parts."

The new jib, called Jib-eXtend, stretches the platform from a stowed length of 12 feet out to 20 feet and swings upward in a 70-degree arc and down 40 degrees. With the boom in the transport position, the jib can be raised to its maximum height without giving up any of the machine's three-mile-per-hour ground speed.

In a very real sense, the Z-135/70 is the result of what Allen calls "the best thing that's happened to Genie" — the purchase of the company by Terex.

"Terex resources have given us the opportunity to mature a little bit in how we approach product development and production," says Allen. "We're more thoroughly testing products, and we're better equipped to consider the breadth of customer applications during the design of a machine."

For the Z-135/70, that translated into the most expensive product-development process in Genie's history. Two prototypes and eight pre-production machines were tested extensively.

"One of the things that has happened since the Terex merger is that we've created the position of director of quality and put in a whole quality-management system," Allen says. "Almost three years after the merger, we have a much more active quality program. Anybody would have expected the exact opposite."

Suggested retail price for the Z-135/70 — with four-wheel drive, four-wheel steer and a 78-hp air-cooled Deutz diesel engine — is $364,000. An 80-hp Cummins or 86-hp Perkins are $2,100 options.

For information circle **150**

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For information circle **21**

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By WALT MOORE, Senior Editor

New Kubota Mini-Excavators Keep to Themselves

These three new models fill out Kubota's zero-tail-swing line

Kubota's 2006 mini-excavator lineup will include three new zero-tail-swing models — the Super Series U15, U25 and U45. These new machines will compete, respectively, in metric-ton classes 1.5, 2.5 and 4.5, with horsepower ratings of 13, 21 and 42.

Kubota's Super Series U45 mini-excavator, seen here at its introduction to Kubota dealers this fall, features a climate-controlled cab, deluxe suspension seat and two-pattern-control selection.

At the small end of the scale, the Super Series U15 is a 3,704-pound machine that digs to 7 feet 7 inches and features hydraulically adjusted tracks that can change in gauge width from 3 feet 3 inches to 4 feet 1 inch. With the touch of a single lever, says Kubota, you can reduce track gauge to navigate narrow spaces, or expand the gauge to improve stability. The U15 also features Kubota's Two-Pattern-Selection System, which allows operators to easily choose between ISO and SAE control patterns. This new mini provides two-speed travel and is equipped with an OSHA-certified ROPS/FOPS canopy.

The middle machine in the zero-tail-swing trio, the Super Series U25, has a maximum dig depth of 9 feet 3 inches and features Kubota's Intelligent Control System, which provides diagnostic readings, routine-maintenance alerts and current-operating parameters, along with a fuel-overflow-prevention display. Like its smaller U15 counterpart, the U25 is designed for two-speed travel, allows switching between ISO and SAE operating patterns and is fitted with a certified ROPS/FOPS canopy. The U25 also features a thumb bracket and an auxiliary line to the bracket, simplifying the installation of an optional hydraulic thumb that can be used to clamp difficult-to-handle materials.

The big gun in the three-machine release is the Super Series U45, which can dig to 11 feet 10 inches and features big-excavator design elements. At the heart of this model is a load-sensing hydraulic system that automatically regulates and distributes the optimum volume of oil to each cylinder, based on the weight of the load. Complementing the efficiency of the new hydraulic system is an auto-idle system, which, according to the company, reduces fuel consumption by as much as 10 percent.

To further boost the U45's overall versatility, it is fitted with an angle blade that has a float position. With the simple movement of the dozer lever, says Kubota, the hydraulic blade can be set 25 degrees left or right. The payoff is easy trench backfilling, which can be accomplished as the machine moves continuously forward. Without the angle blade, says Kubota, backfilling would necessitate repeated repositioning of the machine perpendicular to the trench.

For information circle **176**

By HEATHER BURLINGAME, Senior Production Editor

Pacbrake

Tune-up kits for Jacobs 675A, 680A and 680B engine brakes are a $67 investment in braking efficiency and safety. Normal wear over 300,000 miles can reduce engine retarding by 25 percent, and drivers often overlook the loss because it is so gradual. Pacbrake, maker of Jacobs Engine Brakes, says an overhaul with its tune-up kit will restore brake retarding and the driver will definitely notice the improvement.

For information circle **177**

TrynEx

The SnowEx V-Maxx 8500 bulk spreader has a polyethylene hopper to spread a variety of materials. Designed for use with pickups, flatbed trucks and dump-bed trucks, the spreader has a capacity of 2 cubic yards. The multi-angle hopper and an inverted "V" salt/sand baffle with attached vibrator allow for continuous material flow. A quick-pin hitch allows fast spinner-assembly removal.

For information circle **178**

Orthman Industrial

The Grade Mate Laser Grading System allows one operator to finish a fine grade to 50,000 square feet with accuracy to 1/4 inch, all in one day, says the company. The unit is ideal for final preparation of a large site for concrete. The maneuverable machine provides even grading, thanks to the distance of the cutting blade from the tractor. Features include a machine-mounted console to monitor functions and a full-width roller that compacts sub-base materials and eliminates tire tracks and scraper bounce.

For information circle **179**

Gorman-Rupp

The Off-The-Shelf (OTS) Program introduces a new line of submersible pumps. The line includes 23 models in sizes from 1 to 4 inches, including sump/utility, shedder sewage and contractor models. Depending on the pump model, the line delivers to 450 gpm and 90 feet of head.

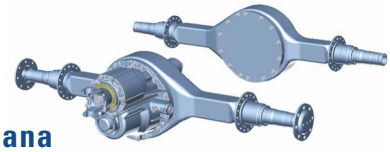
For information circle **180**

Meritool

The PowerPush 7000 dual-component, cordless tool is ideal for dispensing adhesives, including chemical anchoring for concrete. It is capable of dispensing highly viscous material in both hot and cold temperatures, says the company. The tool is battery operated and doesn't require a power cord or air hose. Variable dial controls for dosing and speed ensure that adhesives are not wasted. The anti-drip feature eliminates run-on by reversing pistons when the trigger is released.

For information circle **181**

Lite



Dana

A new drive-axle system consists of the Dana Spicer S21-170DE high-entry, single-drive axle and Dana Spicer R21BS reconfigurable tag axle. The combination of drive and tag axles means weight savings, says Dana, over a traditional tandem. The air bags of the tag axle are exhausted when the differential lock is engaged; this temporarily shifts all the weight to the driven axle at a low speed, which provides the same traction as a traditional tandem axle. Single-axle design requires fewer points of lubrication.

For information circle **182**

Hobart Bros.

The McKay ChromaWeld line of gas-shielded, flux-cored, stainless-steel welding wires expands the company's existing offering of McKay premium stainless products. Optimized for stainless-steel applications where weld-bead appearance is important, ChromaWeld products produce a bright, flat bead profile and optimal slag release and minimal spatter. They are available in .045- and $^{1}/_{16}$-inch diameters on 28-pound vacuum-sealed spools.

For information circle **183**

Kaesar Compressors

Kaeser's Mobilair M220 and M270 can operate for 14 uninterrupted hours, says the company. M220 rotary-screw compressor provides 750 cfm at 125 psig, and has a 236-hp Duetz engine. M270, powered by a 313-hp Mercedes-Benz engine, produces 950 cfm at 100 psig. Both carry a 48-month bumper-to-bumper warranty.

For information circle **184**

Honda Power Equipment

The company has introduced a new version of the WX10 lightweight water pump — the WX10K1, which replaces the WX10A4. The unit is powered by Honda's mini four-stroke engine. Through the use of a rotary slinger pumping lubrication system, the unit can be started, operated and stored in any position. Capacity is 37 gpm.

For information circle **185**

Trimble

The Construction Manager wireless solution uses GPS technology to locate and manage assets at sites via Nextel handheld phones. It also provides in-vehicle devices to optimize asset utilization and productivity of mobile assets. Users can download maps and site designs to their Nextel phones. Jobsite boundaries can be sent to the phone so that site managers are notified if a worker enters a hazardous or unsafe zone. The product uses one interface for both the handheld and in-vehicle components, allowing users to manage all assets from one software interface.

For information circle **186**

Boss

Plow Wings increase the width of a snowplow blade by 22 inches, says the company. The product attaches quickly and can be used with all the company's Power-V and Straight-Blade Snowplows.

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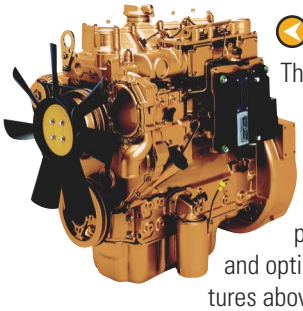


Caterpillar

The Tier 3 C4.4 ACERT diesel comes in mechanical and electronic versions. The mechanical has a two-valve head, rotary fuel injection pump, single vee-belt design and optimized inlet manifold temperatures above 75 bkW. The electronic has an electronic fuel-management system and is available with outputs from 62 to 112 bkW.

For information circle **188**

Lite

Coneqtec/ Universal

AP Pro Series Heavy Duty planers have a two-speed, direct-drive motor that allows shifting from high speed to high torque with the flip of a switch. A patented open drum eliminates remilling. A front-down design and center pivot eliminate bouncing and reduce noise and dust. Electric and hydraulic control options are available.

For information circle **189**

Leica

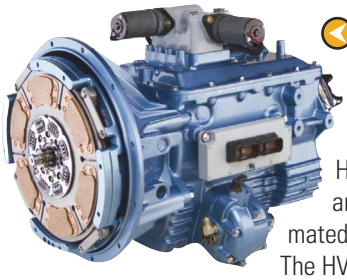
Digicat 200 works with Leica Geosystems' Digitex signal generator to enable location of buried services. With Digitex operating in 33 KHz mode, Digicat 200 enables plan position pinpointing and depth estimation from 0.3 to 3.0 meters and provides full 3D location of services.

For information circle **190**

ConocoPhillips

Ecoterra hydraulic fluid HVI 46 is designed for off-highway equipment. The company asserts low- and high-temperature performance with an ashless antiwear package. Hydrocracked base oils provide wear protection, rust and corrosion protection, solid foram resistance, and oxidation resistance. It is a multiviscosity oil, suitable for year-round use in a variety of machines.

For information circle **191**



Eaton

The Fuller UltraShift HV (Highway Value) joins the recently renamed UltraShift HP (Highway Performance) in an expanding family of automated medium-duty transmissions. The HV is designed for Class 6 and 7 vehicles with diesel engines in the 195 to 260 horsepower range. It handles torque capacities to 660 pounds-feet and loads to 33,000 pounds GVW. Electronic shift-protection and clutch-protection logic reduces the potential for drivetrain and clutch abuse. Vocationally tailored warranty coverage to three years is available, with unlimited mileage, parts and labor.

For information circle **192**

Weldcraft

The CS310 water-cooled, 310-amp TIG torch is part of the company's Crafter Series. The torch increases amperage output, but not torch size. The D-Handle design offers a self-indexing flat top that allows the operator to orient the torch by feel. ColorSmart hose sets help operators identify the different hoses. A reinforced rubber cable assembly provides flexibility — especially in cold weather. Standard price is $366 with a standard one-year warranty.

For information circle **193**

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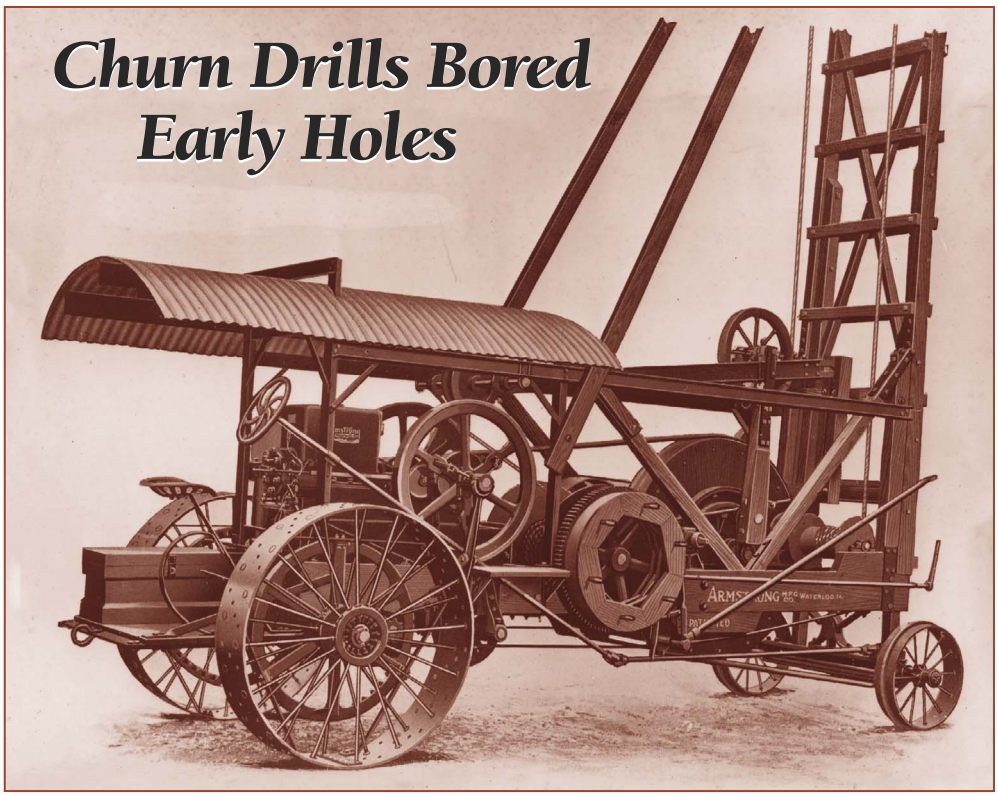
By KEITH HADDOCK, Contributing Editor

Churn Drills Bored Early Holes



This 1917 Armstrong No. 25 churn drill derives its name from the up-and-down repetitive action of the drill stem and bit, not unlike an old-fashioned butter churn. Churn drills could produce from 20 to 100 feet per day for a six-inch hole.

Today's massive Bucyrus blast-hole drills trace their roots to a company formed in 1868

Bucyrus International makes some of the largest and most powerful shovels, walking draglines, and blast-hole drills in the industry. Under its former name of Bucyrus-Erie, it manufactured a wide range of excavating machines. In the early 1930s, Bucyrus was supplying excavating machinery to customers who often encountered hard rock on their jobs and expressed a clear need for a blast-hole drill. Lacking a drill in its product line, Bucyrus looked around for a suitable machine and, in 1933, purchased the Armstrong Manufacturing Co. together with manufacturing rights to its well-established line of drills.

Armstrong was the successor of several earlier drill manufacturers. Its heritage dated to 1868 when Kelly, Morgan & Co. was formed to satisfy drilling needs of local farmers. Through a succession of owners and name changes, the firm emerged in 1910 as the Armstrong Manufacturing Co. Armstrong was a leader in the drilling industry and had developed a highly successful line of churn-type drills for water well and blast-hole drilling as well as drill tools and bit dressers.

The churn drill, called a "Special Overhead Spudding Machine," was typical of the drills that contributed to the company's prosperity. The principle of churn drill operation was quite simple. The gasoline or electric power unit drove a crank arrangement through a belt drive. This imparted reciprocating action to the hoist rope, which caused the bit to be continuously raised and dropped in the hole to break up the rock, clay and sand particles. The drill bit consisted of a steel rod sharpened to a chisel point. Water poured into the drill hole and formed a slurry from the churning action of the drill bit and the drill cuttings.

Armstrong achieved many patents and innovations. It developed and patented a series of rubber-mounted shock absorbers in the derrick head to absorb the shock of the drilling tools. In 1922, Armstrong introduced self-propelled drilling rigs on traction wheels and, in 1927, steel framed rigs began to replace those with wooden frames. The first Armstrong self-propelled drills with crawler tracks appeared in 1932.

For some 10 years after the takeover, Bucyrus sold drills under the brand name Bucyrus-Armstrong. New models such as the W-series water-well drills and the T-series blast-hole drills were introduced, each incorporating the latest technology. Bucyrus introduced the first commercially successful large diameter rotary blast-hole drill in 1952. With compressed air as a bailing agent, the 50-R was the first in a long line of R-series blast-hole drills on which today's Bucyrus high-production drills are based. Rotary drills gradually replaced churn-type drills, which had been a successful product for the company with more than 11,600 sold up to 1984.

You can read more about the evolution of construction equipment in Keith Haddock's illustrated book "The Earthmover Encyclopedia" available in most bookstores or from Park Communications, call 403-931-1670. Also, consider a membership in the Historical Construction Equipment Association, www.hcea.net.

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