Reed Business Information.

52 Pros evaluate IR's compact loader

66 Basic Ford F-350 still built tough

70 Latest nuances in backhoe design

CONSTRUCTION EQUIPMENT®

April 2006
ConstructionEquipment.com

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Smarter Rollers

Successful in Europe, intelligent compaction aims for converts here

p. 38

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Cover photo by Ralph Cole©

FEATURES

COVER STORY: Paving Report

38 Intelligent Compaction: Outsmarting Soil and Asphalt

Many soil and asphalt compactors, despite their brutish appearance, are quite smart. For example, some can continuously report (and record) a relative compaction value for virtually all points on the jobsite. Now, roller manufacturers have systems that add another dimension to these capabilities, that is, the ability for the machine to automatically adjust its compaction effort, based on a material's state of compaction. This "intelligent compaction" process is attracting great interest.

HANDS-ON EARTHMOVING

52 Ingersoll Rand's WL-440 Keeps Up with a Pro

The popularity of compact wheel loaders has taken off in the past few years, the result of their versatility, maneuverability on congested jobsites and, perhaps, their relative affordability. Professional operator Tom Rush and veteran technician Rick Bewsey take a close look at a contender in this growing market segment–the Ingersoll Rand WL-440, a 13,200-pound machine with 73 net horsepower and a standard hydraulic coupler.

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SPECIAL REPORT

56 Attention Centers on Crane Operators

Do you know if your crane operators are qualified? Today, as never before, fleet managers are asking themselves this question before they allow an operator to climb into the cab of one of their cranes. Over the past decade, the spotlight has turned full and square onto the subject of the qualifications of construction-equipment operators (and, in particular, cranes).

HANDS-ON TRUCKING

66 Basic F-350 Offers Deluxe Performance

Some jobs demand tough but simple trucks. Tough can be had, but there's nothing simple available anymore. Cutting back on exterior and interior niceties may result in trucks that look plain-Jane, even if they're far from it under the skin. Case in point: This Ford F-350 Super Duty Crew Cab XL, which was among many displayed at a Ford demo that Truck Editor Tom Berg attended last summer.

BUYING FILE

70 Two Types of Buyers Drive Backhoe Design

Two different kinds of backhoe-loader buyers dominate sales of full-sized machines, and their different expectations may have polarized the hydraulic-system designs in this most popular of true earthmovers. In order to take market share in this relatively high-dollar, high-volume category, manufacturers must appeal to both groups.

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Coming next month, join us for our web-based seminar on shop overhead, featuring Mike Vorster and Preston Ingalls. Go to ConstructionEquipment.com to register for this free event, to be broadcast on April 26, at 11 a.m. until noon CST.

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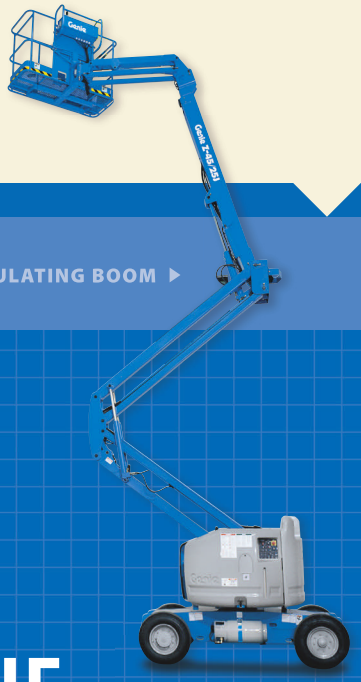

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Condition-Based Maintenance

Equipment professionals often compare oil analysis to human blood tests. A blood test can indicate high cholesterol; oil analysis can reveal high levels of metals. The comparison breaks down, however, when we understand that oil inevitably becomes contaminated. Metals enter the system through normal wear. The trick is determining when contamination threatens the system that oil is designed to protect.

Most professionals understand the importance of oil analysis, and we would wager that this simple test is carried out by the majority of fleets in operation today. But according to Diego Navarro, service marketing manager for John Deere Construction and Forestry, many managers fail to properly analyze the tests they requisition.

Rod Sutton, Editor in Chief

That's what Navarro told attendees at the annual conference for the Association of Equipment Management Professionals, calling oil analysis an "underutilized" tool. According to statistics Navarro highlighted, 91 percent of hydraulic pumps that fail within the first 4,000 hours fail because of contamination, and 48 percent of bearings fail because of poor lubrication and contamination.

Those numbers should motivate managers to educate themselves on how best to use the analysis they pay to have sent their way. An oil-analysis report contains dozens of numbers, indicating levels of metal, water and so forth. Tracking those numbers over time reveal system trends.

Termed condition-based maintenance, this strategy allows managers to accurately predict a system's failure point and enables them to repair before failure. We've advocated this machine-management strategy in *Construction Equipment* both on this page and in our articles and departments, especially Mike Vorster's Equipment Executive. It's a sound strategy, and it extends machine life and operational efficiency. Navarro cited university studies that indicate condition-based maintenance can control 70 percent of premature wear.

In January, we published an article on how to read these reports. You can find that article at ConstructionEquipment.com, along with other articles we've written about oil analysis. Just type "oil analysis" in the search box.

If properly read, oil-analysis reports can lead managers to awareness of oil contamination far in advance of system failure. And with that kind of knowledge, managers can ensure those systems will perform when needed each and every time.

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MARKET WATCH

By KATIE WEILER, Managing Editor

We're making it quicker for you to obtain more information on products by going to ConstructionEquipment.com/info. Sign up for our monthly MarketWatch eNewsletter at ConstructionEquipment.com.

Volvo

The new B-Series includes MC60B, MC70B, MC80B, MC90B and MC110B. Operating capacities range from 1,350 to 2,250 pounds. Volvo says it has redesigned/upgraded 33 areas in the new line. Operators can choose between foot-and-hand mechanical controls or hand-operated hydraulic pilot controls.

For more information, visit ConstructionEquipment.com/info

John Deere

Oscillated stereo steering speeds the cycle times of the 98-hp 344J compact wheel loader by allowing tight turns with large loads. Steerable wheels reduce the amount the loader has to articulate into a turn, so the machine is more stable maneuvering under load. The standard return-to-dig feature automatically returns the bucket to a preset level. Closed-center, load-sensing hydraulics eliminate power waste, and control-lever efforts are easier and more precise with excavator-style controls.

For more information, visit ConstructionEquipment.com/info

JCB

JCB introduced the Teletruk industrial forklift into the North American market. It is a two-wheel-drive hydrostatic machine that uses a telescopic boom — not a vertical mast. It has a load capacity of 7,000 pounds. JCB says the telescopic-boom feature provides forward reach that enables the Teletruk to perform where a vertical-mast forklift cannot.

For more information, visit ConstructionEquipment.com/info

International

International completes its XT Series with the 10,000-pound MXT. Capable of towing 8 tons, the truck is rated at 300 horsepower and features a chassis-payload capacity of 2 tons. The 4x4 MXT will go into production in summer '06. MSRP for the MXT is $69,000 to $85,000. The RXT, scheduled for production in March '06, is available in a 5th wheel version to accommodate trailers. The 310-hp truck can tow 14¾ tons and has a payload capacity of 4.5 tons.

For more information, visit ConstructionEquipment.com/info

Market Watch

Bobcat

A speed-management feature available on medium-frame Bobcat loaders with selectable joystick controls is said to provide more consistent loader and attachment performance while minimizing strain on operators. The feature can be activated from inside the cab, and operators can select their required travel speed in small increments from 0 to 7 mph, while maintaining driveline torque and full hydraulic power.

For more information, visit ConstructionEquipment.com/info

Allen Engineering

The Razorback 500B riding trowel has Generation III hydraulic power steering. The 56-hp diesel engine powers two non-overlapping rotors through a mechanical-drive system. Ten-feet wide, the trowel features two, five-bladed spiders.

For more information, visit ConstructionEquipment.com/info

Terex Roadbuilding

The Terex | CMI SF2204B HVW paver now comes with optional side kits that enable contractors to build barrier and parapet walls, curb and gutters, sidewalks and cart paths. Weighing 53,000 pounds and powered by a 250-hp engine, the paver has the power and weight necessary to construct large parapet and median barrier walls when equipped with the mold attachment.

For more information, visit ConstructionEquipment.com/info

Ingersoll Rand

Titan 8820 is designed for asphalt and concrete base. Weighing 19.3 tons, the paver can install roller-compacted concrete, cement-treated base, non-treated base, stone, soil cement and asphalt. The paver can place material up to 43 feet wide and 12 inches thick.

For more information, visit ConstructionEquipment.com/info

Mustang

Model 2026 and 2041 skid-steer loaders replace models 2022 and 2032. The 2026 weighs 4,000 pounds, has an operating load of 1,050 pounds, and delivers 35 horsepower with a three-cylinder Yanmar diesel. The 2041's operating load is 1,350 pounds, and it has a 46-hp four-cylinder Yanmar diesel. New features include new air cleaner and hydraulic-filter systems, improved drive control with a 25-percent control effort reduction, and a new engine cover and rear door.

For more information, visit ConstructionEquipment.com/info

Caterpillar

The 416D IL, based on the 416D backhoe-loader, is a 1-cubic-yard industrial tractor with a 3-point hitch with down pressure and a box blade. Operator seat rotates 22.5 degrees from forward. Box blade has five controllable functions: raise, lower, float, tilt and pitch. It has three pilot hydraulic controllers. The machine is powered by a 74-hp Cat 3054 diesel and all-wheel drive.

For more information, visit ConstructionEquipment.com/info

Morbark

Weighing 82,000 pounds, the 4600XL Track Wood Hog comes equipped with a Caterpillar 325L undercarriage and features a hammermill that is 14 percent larger than its predecessor. With engine options up to 860 horsepower, the unit incorporates Morbark's Iqan feed system. An optional satellite modem allows Morbark technicians to remotely access machine data for analysis and problem diagnosis.

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April 26, 11a.m.-12 p.m. CST

Wasted maintenance dollars are low-hanging fruit that, if picked up, can improve shop operation costs. But unless equipment managers know what they're looking for, that can't happen. They need benchmarks. *Construction Equipment*, together with the Construction Financial Managers Association, conducted exclusive research to establish those benchmarks for shop overhead.

We'll give you insight into the numbers, and ways to use benchmarks in your own shops. Rod Sutton, editor in chief, will lead a discussion on shop overhead where you'll hear:

- **A presentation of the *CE* benchmarks**
- **Strategies and best-practices from firms in construction as well as other industry sectors**
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- **Strategies on how to use benchmarking to reduce maintenance costs and boost company profitability**

Intelligent Compaction: New Technology in Roadbuilding

May 17, 12 - 1 p.m. CST

Intelligent Compaction has been successful in Europe for years, and now this technology is on its way to North America. Intelligent Compaction enables vibratory rollers to automatically adjust energy output while providing detailed documentation of compaction quality. *Construction Equipment* featured this technology in April, and we now bring together a panel to further explore and explain this technology. We'll discuss:

- **An overview of intelligent compaction**
- **Highlights from the FHA's strategic plan for intelligent compaction**
- **How intelligent compaction improves road construction**
- **Federal plans to demonstrate intelligent compaction technology on a national basis**
- **What Minnesota's demonstrations have revealed**

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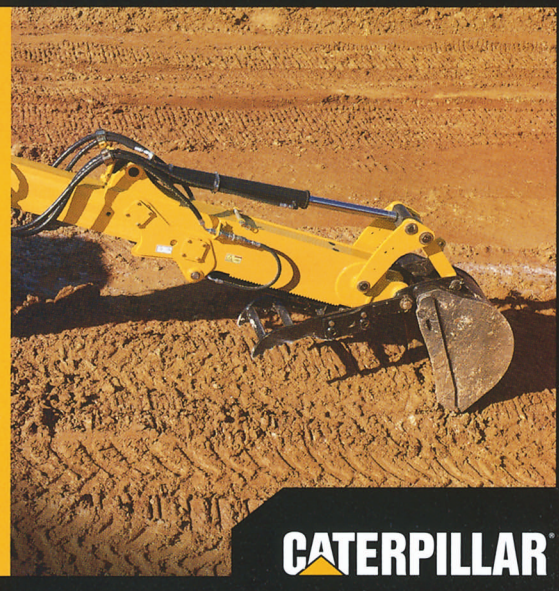

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SPECIFICATIONS

MODEL	NET POWER	STANDARD DIG-DEPTH
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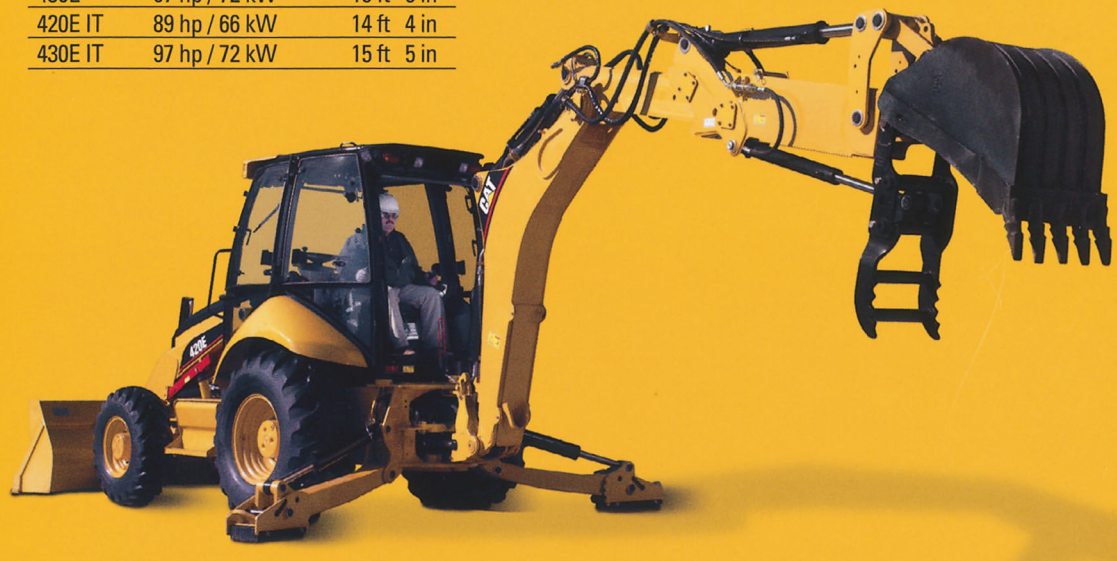
420E	89 hp / 66 kW	14 ft 4 in
430E	97 hp / 72 kW	15 ft 5 in
420E IT	89 hp / 66 kW	14 ft 4 in
430E IT	97 hp / 72 kW	15 ft 5 in



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Hyundai

The new, biggest excavator in Hyundai's line is the R500LC-7 with a base-model weight of 107,580 pounds. It's powered by a 353-hp Cummins Tier 3 QSM11-C. Bucket sizes range from 1.8 to 4.71 cubic yards. The tracks expand to a 9 foot-8 inch width and retract to 7 feet 10 inches for transport. A new intelligent instrument cluster features Integrated Self-Diagnostic Logic.

For more information, visit ConstructionEquipment.com/info

Skyjack

Compact 6826 and 6832 RT scissor lifts feature working heights of 32 and 38 feet, respectively, and have a 68-inch-wide stance. Models come standard with dual-fuel engine, four-wheel drive, and 5-foot rollout extension deck. They can drive at full height with deck extension fully extended and offer up to 1,250-pound platform capacity.

For more information, visit ConstructionEquipment.com/info

Terex Roadbuilding

Terex | CMI CB2003 paver has a variety of profile inserts allowing it to be used for curb-and-gutter, sidewalk and barrier work. The 133-hp paver weighs 25,000 pounds and has all-track steering, which allows users to swing the paver's legs into position rather than shifting them. Self-storing trimmer raises up to 8 inches above work zone.

For more information, visit ConstructionEquipment.com/info

Manitou

The three-wheeled SL415 Twisco telehandler, with overall width of 66 inches, steers from the single rear wheel, pivoting around the inside front tire for a turning radius of just 88 inches. It weighs 5,250 pounds, so it can be trailered behind a pickup truck. It's suited for rough terrain with three drive wheels, 10 inches of ground clearance, and differential lock. Powered by a 50-hp Perkins diesel, it has maximum lift height of 13 feet and nominal capacity is 2,800 pounds.

For more information, visit ConstructionEquipment.com/info

Caterpillar

The first three models of Cat's D Series excavators feature Tier-3 engines with ACERT technology. The 188-hp Cat C7 in the 324D L (54,660 pounds) is 12 percent more powerful than the 322C it replaces. The 325D L gets a 204-hp C7 with 8 percent more horses than the 325C, and the 330D L (79,700 pounds) with a 268-hp C9 is 9 percent more powerful than the 330C. Hydraulic pressure is turned up to 5,080 psi, delivering more stick-digging force and more bucket-digging force, depending on model.

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RENTAL NEWS

ARA Inducts Three to Hall of Fame

The American Rental Association (ARA) recently inducted three men into the Rental Industry Hall of Fame during The Rental Show held in February.

The honorees were Dan Kaplan of Daniel Kaplan and Associates, Morristown, N.J.; Leo Swan of Equipment Development Co./EDCO, Frederick, Md.; and the late Howard Burnett, Salt Lake City, Utah, a founder of ARA.

The Rental Industry Hall of Fame honors individuals who have worked in the rental industry for many years and have made outstanding contributions at the national or international level. Nominations are taken from throughout the rental industry every fall.

MANUFACTURER NEWS

Chevron to Give Away a Custom Motorcycle

Chevron will give away a custom-made, 1700cc $45,000 Frontier touring motorcycle. The bike, from Thunder Mountain Motorcycles, wears a custom Delo paint scheme to promote Chevron's heavy-duty motor oil.

"We are temporarily turning our attention from eighteen wheels to two in an attempt to thank the markets that have been so good to us," said Nicole Fujishige, lubricants marketing manager, Chevron Products Co.

The Delo Bike sweepstakes kicks off Feb. 9, 2006, and runs through Nov. 1, 2006. U.S. residents can enter and review sweepstakes rules on the Delo Bike website (www.delobike.com), or enter via computer terminals in the Delo Truck.

See the Delo Bike as it travels across the country during the 2006 Delo Truck tour (www.delotruck.com).

INDUSTRY NEWS

Manitowoc Welders Win Awards at Welding Show

What are the chances of two people from the same company winning the 2005 American Welding Society's Professional Welders Competition? Two welders from Manitowoc Crane Group did just that. Scott Braun and Troy Yeager won first and second place, respectively, in the competition. A total of 133 welders from various U.S. industries took part in the event held during the FABTECH International & AWS Welding Show in Chicago.

Jim Hoffman, Manitowoc's welding engineer, said the results of the contest were a fitting tribute to the excellent work done at the Manitowoc weld school.

MANUFACTURER NEWS

Banner Year for JCB

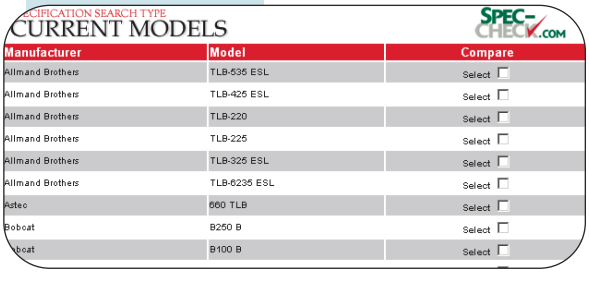
JCB was busy last year. The privately owned company, based in the United Kingdom, celebrated its 60th anniversary, while also producing 45,000 machines (20 percent more than in 2004), cranking up production of its new 444 diesel engine, breaking ground for a new factory in China and acquiring Vibromax, a German producer of compaction equipment.

In addition, the company was awarded a $140 million contract to supply the U.S. Army with an undisclosed number of High Mobility Engineer Excavators (HMEE), which are basically backhoe-loaders capable of speeds to 57 mph.

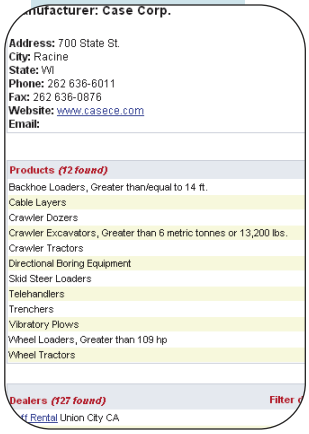
At a recent meeting of JCB dealers, the company displayed more than half of its 220 different machines at its new Dove Valley engine plant in Derbyshire, England.

Choose from the list of categories and subcategories to find all information the site has to offer on a specific type of equipment.

From Specifications in the horizontal navigation bar, compare specs on 63 types of construction and forestry equipment at no charge.



From Find Dealers & Manufacturers in the horizontal navigation bar, drill down to manufacturer contact information, the products made by the company, and dealers as available.



Find the latest in equipment introductions, as well as news and links to recent machine-evaluation and new-product articles at ConstructionEquipment. com's homepage.

Read information on maintaining and managing fleets, as well as magazine archives, in the horizontal-navigation bar.

Scan headlines from news around the country. Click on the headline and read more pertaining to construction, equipment and related topics.

Shop-Overhead Webinar at Redesigned CE.com

ConstructionEquipment.com will host a free webcast on how to use benchmarks to judge shop overhead. Exclusive research gives insight into the numbers, perspective on their meaning, and specific ways to use benchmarks in your shop.

Rod Sutton, *Construction Equipment*'s editor in chief, will lead the discussion. Joining him will be Mike Vorster of Virginia Tech, who teaches the Construction Equipment Institute and writes "Equipment Executive"; and Preston Ingalls of TBR Strategies, a consultant specializing in improving maintenance reliability.

The webcast will include:

- Presentation of the *Construction Equipment* benchmarks
- Strategies/best-practices from firms in construction and other industry sectors
- Ideas on how to track costs
- Strategies on how to use benchmarking to reduce maintenance costs and boost overall company profitability

The webcast will take place April 26, 2006, from 11 a.m. until noon CST. To register, visit Construction Equipment.com.

CE's website redesign

ConstructionEquipment.com — the online resource for equipment professionals — relaunched in January with a new design. Above are screen captures that illustrate how to find the information you need for equipment purchases, maintenance and management, as well as the latest on product introductions.

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"The biggest difference is the speed. The operator is always asking for four or five trucks. That's telling me that production is going way up.

"The machine runs cooler and is easier on ther operator and doesn't wear him down by the end of the day."

Sam Craghead, Craghead Building Co., Riverton, UT

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LETTER TO THE EDITOR

Where Are Mini-Skid Test Results?

I read your equipment review of the mini-skids [in Feb. '06 issue]. You obviously spent a considerable amount of time reviewing and testing each machine. Why is hardly any quantitative information given for each machine other than the manufacturers' specs? How about the carry time for each machine, the horsepower or hydraulic pump output, weight, speed, etc. I can get manufacturers' literature from any salesperson.

How can a purchaser use information like average trenching performance when comparing machines? When you run a test like the load & carry up a ramp to dump into a truck, why can't you give specific results for each machine? I guess I don't understand what variable would prevent you providing that info to readers. Obviously if one machine is spec'd larger than another, you would not do "head-to-head" comparisons, but giving an average load & carry result of all seven machines makes no sense to me. Sorry to beat you up on this, but it is very difficult to find good non-manufacturer data on construction equipment — info that is available for autos, boats, cycles.

Is the information available from your tests on individual machines? Thank you.

— Jeff Krueger
RENTALEX, Kalamazoo, MI

Dear Jeff:

We did intend to publish the actual performance numbers we collected for each machine. But once on site, we realized that some of these machines are more difficult to operate than others. Because of time constraints imposed by the way we had organized the event, the manufacturers had, literally, just a few minutes to instruct the operators about the use of their machines. Some manufacturers, we learned later, kept their explanations basic, choosing not to mention the more technical features of the machine — features that could well have enhanced production in the hands of a more experienced operator. We don't say a "better" operator, because the people at Local 150 are the best. But as any good operator will tell you, you need time to get comfortable with a machine and to fully understand its features before you can make it sing. But we didn't have the luxury of that amount of time.

Had some of the manufacturers come to you, as they did to us, and said that the performance of their machines would've been considerably better had this or that feature been used, then how would you have handled the data? We thought their comments made sense; it appealed to our sense of fair play; and gave us pause.

So we decided to average the data in order to give potential buyers a glimpse into an area that had never been investigated, to wit: Are these mini-skids real machines? Can they do any real work? We did resolve those questions. Could we have done better? Yes. Anytime we leave a reader with questions like yours, we haven't done our job thoroughly enough. We will take your comments into consideration for our next test.

— *The editors*

The newly enhanced formulation in Delo Extended Life Coolant/Anti-Freeze now delivers even more miles and hours with no need to add an Extender. 750,000 miles/15,000 hours now come standard with every piece of equipment using the enhanced Delo ELC formulation. Add to that improved corrosion protection and lower electrical conductivity along with the same great heat transfer properties, and you will soon understand why Delo ELC is the clear leader in ELC technology. We'd like to tell you more about how Delo ELC can promote critical uptime for your equipment and allow more downtime for you.

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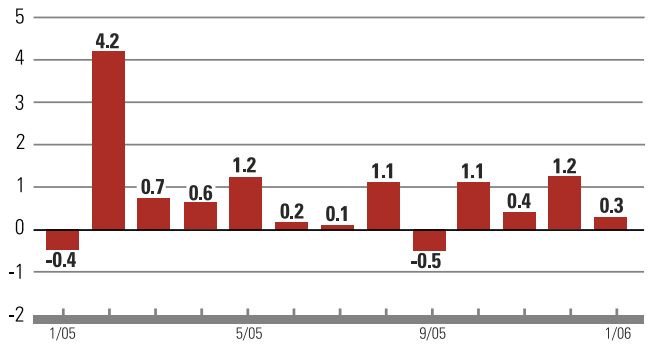
Status & Forecast

By JIM HAUGHEY, Director of Economics

⟷ PUBLIC CONSTRUCTION SPENDING

Public construction spending continues to expand at about an 8 percent annual rate, which will persist through 2007. Education will expand faster than in 2005, offset by slower highway growth. Water and sewer construction spending will continue at the recent 12-13 percent annual pace. Income and sales tax receipts will exceed budgeted collections again this fiscal year and will provide a new source of project funds at the close of fiscal years a few months ahead.

(% change from previous month)

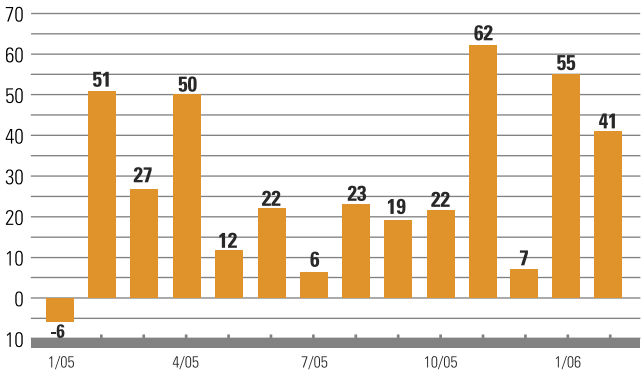


Source: U.S. Department of Commerce

↑ CONSTRUCTION EMPLOYMENT

Spending on commercial construction projects, mostly retail, has not kept up with cost increases for the past two months. This will reverse quickly. A 10.6 percent spending gain is expected for the full year based on the 26 percent rise in the value of commercial starts in 2005 reported by Reed Construction Data. Through February, starts are nearly 13 percent from the first two months of last year. Shopping centers and malls remain the fastest growing part of this market.

(Change in jobs, thousands)

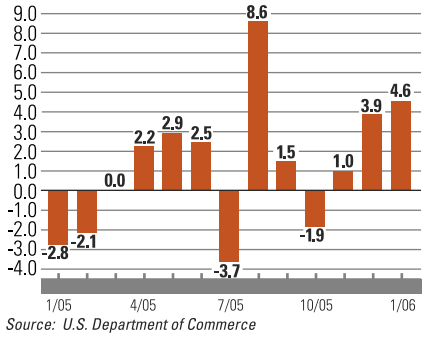


Source: U.S. Department of Labor

↑ CONSTRUCTION EQUIPMENT SHIPMENTS

Equipment shipments jumped almost 9 percent in the last two months after three months of little change. Much slower growth is expected for the rest of the year. January orders were 19.5 percent below peak orders late last year, and the shipments backlog has declined more than a week. Equipment availability will remain tight for buyers and renters well into next year, especially for the type of equipment used for highways, bridges and nonresidential building construction.

(% change from previous month)

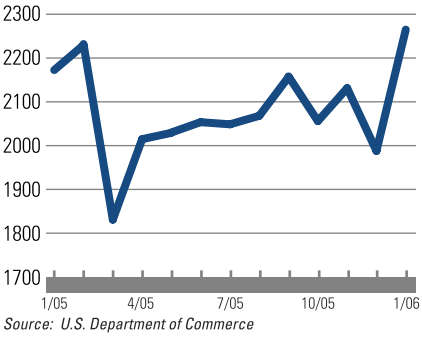


Source: U.S. Department of Commerce

↑ HOUSING STARTS

Favorable weather and a bunch up of multifamily projects lifted housing starts to 2.28 million in January from an average of 2.07 in the last eight months. Starts will be declining from this level through 2007. Already home builders are reporting reduced model-home traffic and increased sales cancellations. Inventory of unsold homes has risen enough to delay beginning some new home developments. Jobs in residential contracting were unchanged in February after three years of strong monthly increases.

(Annual rate, thousands)

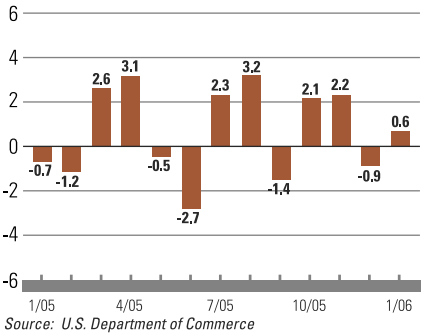


Source: U.S. Department of Commerce

⟷ COMMERCIAL CONSTRUCTION SPENDING

Spending on commercial-construction projects, mostly retail, has not kept up with cost increases for the past two months. This will reverse quickly. A 10.6-percent spending gain is expected for the full year based on the 26-percent rise in the value of commercial starts in 2005 reported by Reed Construction Data. Through February, starts are nearly 13 percent from the first two months of last year. Shopping centers and malls remain the fastest growing part of this market.

(% change from previous month)



Source: U.S. Department of Commerce

For the full text of this month's economic analysis, check Magazine Archives/Economics at **ConstructionEquipment.com**

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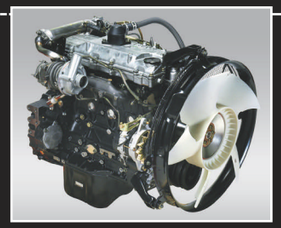
All Good Things Come in 3's

Meet the New Zaxis Dash-3 from Hitachi.

IMPROVEMENT: ENGINE



Isuzu's Tier-III engines not only comply with all emissions standards, they now feature four-valve OHC and a new common-rail fuel-injection system. The results are up to 11-percent increased engine output, 6-percent increased torque, and 8-percent reduced fuel consumption. A strengthened cylinder block and ladder frame increase engine life.

IMPROVEMENT: HYDRAULICS

Hitachi's Dash-3 hydraulics are smarter and more responsive to bucket resistance. Multiple sensors instantly feed automatic micro-adjustments for increased hydraulic power to maintain steady, sure movements. Boom, stick, and bucket cylinders feature regenerative flow for faster down movements, extremely fine control, and multitasking.

IMPROVEMENT: CAB

A bigger, quieter, more accessible cab with improved legroom, more visibility, and an improved digital monitor system makes the Dash-3 excavator even more pleasurable to operate. The monitor provides quick access to the machine's performance history and diagnostics.

Faster, greater productivity, and more comfortable — three amazing ways Hitachi has raised the bar yet again in excavator performance.

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By WALT MOORE, Senior Editor

Intelligent Compaction: Outsmarting Soil And Asphalt

North American jobsites are approaching this concept cautiously

Although the intelligent-compaction (IC) concept as applied to asphalt rollers has its critics, Bomag has a number of its BW190AD-4 HF models operating in North America with the company's Asphalt Manager, an IC system designed specifically for asphalt pavements. According to Bomag, the IC system works reliably in this application.

The quick — but not exactly complete — definition of intelligent compaction (IC) applies to vibratory rollers that automatically adjust their energy output, so as neither to under-compact nor over-compact materials. Thus, theoretically, IC yields precise and consistent results across the jobsite, while providing detailed documentation of compaction quality.

Are these not answers to the very petitions included in the prayers of all those responsible for compaction? Further, we're assured that IC is accepted as established technology in a number of western European markets. Might we reasonably expect, then, that roller users in North America are lining up to buy such machines?

So far, lines have been short on this side of the Atlantic. We hasten to add, however, that short lines at present indicate nothing negative, either about the technology or the machines available — or soon to be so — for North American jobsites.

At this writing, Ammann, Bomag and Dynapac all have IC machines ready for work in soil and aggregate, and Ammann and Bomag have asphalt models as well. Caterpillar plans to officially introduce an IC soil machine next year, and an asphalt model a year or so after that. Sakai's intentions are to be in the North American market with both types of IC rollers sometime in 2008, and Dynapac is developing an asphalt machine that will be available soon, says the company, first in Europe and then globally.

(Industry speculation is that Ammann will no longer market soil compactors in North America under its own name, but will supply these machines to a major U.S. manufacturer for marketing under that company's brand. Unclear at this point is whether this transfer will include IC soil machines. Our best intelli-

gence says that Ammann will continue to market its asphalt machines in North America under its own name and, if so, Ammann's IC technology will remain available here.)

Although the estimated 20- to 30-percent price premium for IC models versus their conventional counterparts may be an issue for some users, slow sales at present seem more the result of the North American market still warming to the technology. Perhaps what's happening here is that the potential benefits of IC are so compelling, that those who stand to benefit from more precise, more consistent compaction want verification that the process can deliver what it promises.

Among those looking for the facts are the Federal Highway Administration (FHWA) and a growing number of state departments of transportation, Minnesota in particular. The FHWA now has in its hands a 160-page study — "Intelligent Compaction: Strategic Plan" — which details the technology and its potential benefits, identifies research needs and presents a national implementation plan.

The Minnesota DOT, in 2004 and 2005, extensively evaluated IC soil rollers from Bomag, Ammann and Caterpillar on state test sites, and continues to research the subject. According to John Siekmeier, P.E., senior research engineer in the Minnesota DOT's Office of Materials, certain of the state's roadway contracts in 2006 will require the use of IC machines on granular soils.

Also this year, both the National Cooperative Highway Research Program and the Transportation Pooled Fund Program will be starting studies regarding the use of IC rollers on soil structures, and the latter group's study also will encompass the roller's application in aggregate and on asphalt pavement.

Defining "intelligence"

For all of their sheer brute mass and power, vibratory soil and asphalt rollers have been getting smarter for decades.

In the mid-1970s, for example, Swedish manufacturer Geodynamik developed its Compactometer, a device (still being marketed in increasingly "smarter" versions) that measures the drum's movement and processes the resultant signals to provide a continuous relative value for a material's level of compaction or "stiffness." (Stiffness is loosely defined as a measure of a material's ability to resist deformation under load). This process has become known in Europe as "continuous compaction control" (CCC), and is widely used, along with a recording and documentation system that logs the measured values.

The Geodynamik system also reports drum frequency and monitors the "double-jump" condition, which occurs when the drum acquires so much energy that it begins to move upward during a vibratory cycle before hitting the ground, thus skipping every other impact. A machine operating in this manner may damage both itself and the material it's compacting.

The Geodynamik system and similar proprietary CCC systems, such as Dynapac's Compaction Analyzer (DCA), have gone a long way toward keeping the roller operator informed about the compaction process. And in some instances, these computerized systems are available with GPS assistance and can be retrofitted to existing units.

"Intelligent" innovations might also include, for example, the oscillatory-vibration system, which moves the drum in a rocking motion (versus conventional vertical vibration). According to Carl Pettersson, Geodynamik's managing director, the company initially developed the idea in the 1980s. More recently, Hamm has developed a proprietary oscillation-compaction system, which, says the company, prevents over-compaction by changing the drum's effort when material begins to firm. The system does this, says Hamm, by virtue of the physics designed into the drum's eccentric-weight system.

Also, in yet another display of intelligence, Ingersoll Rand's large DD-158HFA asphalt

The cab of this Bomag BW213-4 BVC roller, which is fitted with the company's VarioControl system — an IC system for soil machines, incorporates the machine's basic control panel (center), the VarioControl operating panel (lower right) and the Bomag documentation system (upper right).

The Geodynamik CompactoBar provides a continuous value relative to material stiffness. The basic technology behind this instrument is at the heart of today's intelligent-compaction systems. In the early 1990s, Geodynamik developed an IC system that adjusted not only amplitude and frequency, but also machine speed. The idea lost momentum, says Carl Pettersson, the company's managing director, because of market indifference and the cost of electronics at the time.

compactor allows the operator to select from a range of eight amplitude settings. Then, the machine automatically adjusts frequency "to the optimum performance setting."

As smart as the machines have become through the use of these and numerous other innovations, however, the "intelligent-compaction" process goes beyond preceding developments. Here's a definition synthesized from several sources:

An intelligent-compaction roller is a vibratory model that continuously measures and reports the stiffness of material, while simultaneously and automatically adjusting its compaction effort based on those measurements, imparting more energy to soft areas and less (or no) energy to hard areas. The roller also is equipped with a documentation system that allows real-time correction of the compaction process, while providing a permanent record of compaction results, including stiffness values for virtually every point in every lift.

Compaction Definitions

Exciter Mechanism: The system of rotating eccentric weights within a roller's drum that causes the drum to move in an off-center motion.

Frequency: The rotational speed of the exciter mechanism, typically measured in vibrations per minute (vpm).

Amplitude: A measure of the drum's movement, in thousandths of an inch, from its centered position. A drum that moves (or vibrates) vertically will travel as far above the surface as it does below the surface. In this instance, amplitude is usually reported as half the total travel.

Rotary Exciter: An exciter mechanism that causes the drum to move off-center in a circular or elliptical motion.

Oscillatory Exciter: An exciter mechanism that causes the drum to rock fore and aft on the surface.

Directed Exciter: An exciter mechanism that usually causes the drum to move vertically. (In some instances, the direction of movement can be changed through a 90-degree arc from vertical to horizontal.)

Double Jump: A condition in which the drum skips every other impact, because it has acquired so much energy that it begins to move upward during a vibratory cycle before hitting the ground.

Potential IC benefits

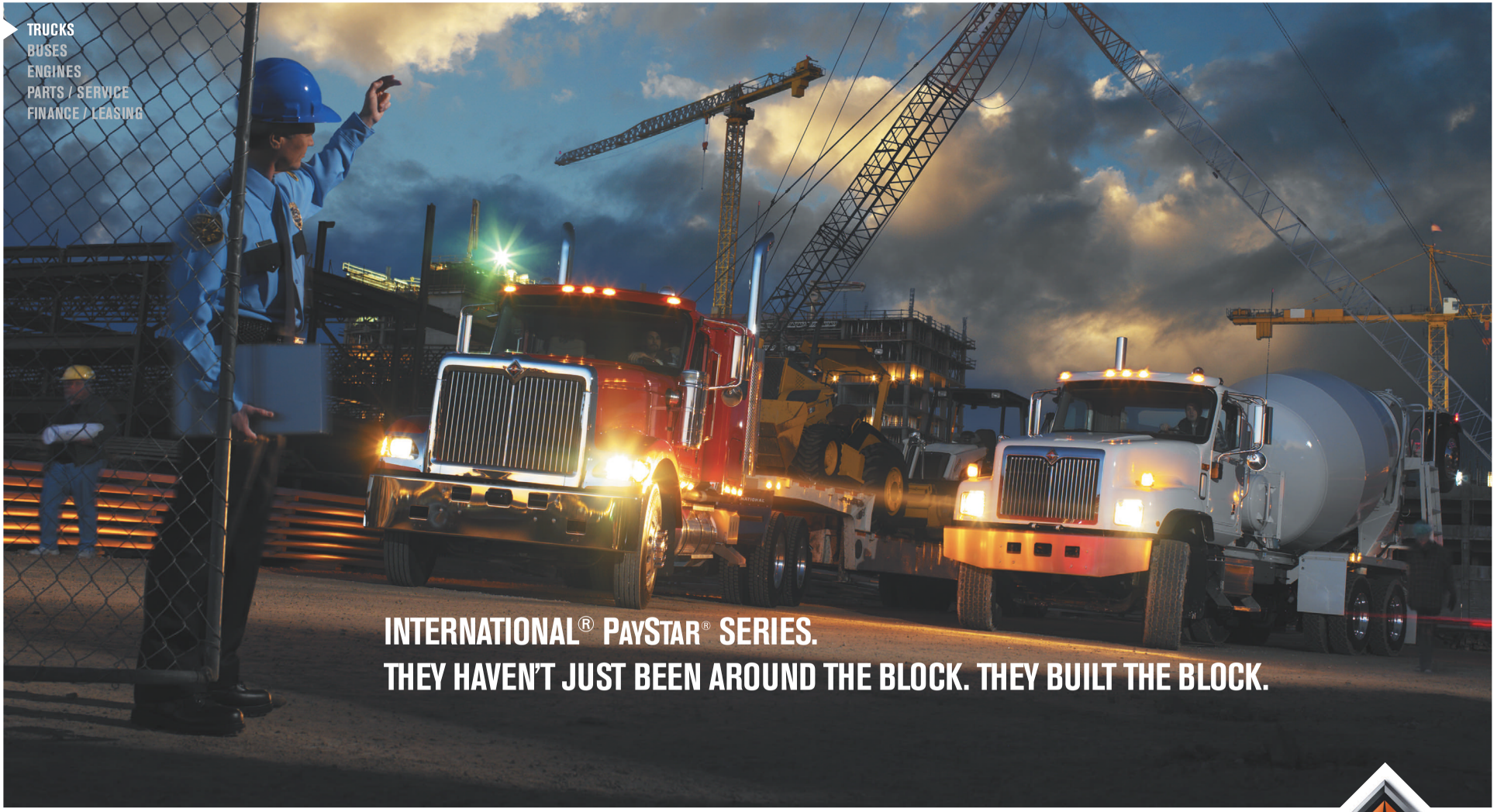
Among the potential benefits of IC rollers, says the FHWA study, is increased productivity, "because compaction energy is customized, based on measured stiffness. The result, says the study, "is a more rapid increase in compaction during initial passes, which may mean fewer passes to reach target values." The IC roller also may have the capability to compact deeper lifts, says the study, "because the magnitude of maximum amplitude that is used during the initial roller passes is significantly increased when compared with conventional rollers."

That last statement squares with what we heard from Bomag's Steve Wilson, marketing services/product manager, who told us that the Bomag BW213-4 soil compactor equipped with VarioControl, the company's IC system for soil machines, produces 82,000 pounds of centrifugal force at a 0.094-inch amplitude. This compares with the conventional 213's rating of 67,000 pounds at a 0.079-inch amplitude.

The results of potentially having to make fewer passes may include savings in time, fuel and machine maintenance. Some make the point, too, that because the IC roller's compaction forces diminish as material approaches target values, less energy (and less resultant stress) is reflected back into the machine's structures and drive train, thus potentially reducing wear and tear.

Hand-in-hand with increased productivity, says a Minnesota DOT study, is the prospect of improved compaction quality — on two fronts. First, because IC rollers have the potential to eliminate over-compaction and under-compaction, applying additional effort only if necessary, they actually are exercising a form of process control, similar, say, to a factory's computerized machining center, which constantly checks the quality of its own work. This control produces more uniform compaction, says the study, provided soils are within the moisture-content range necessary to achieve the target compaction.

"Second," says the study, "several demon-



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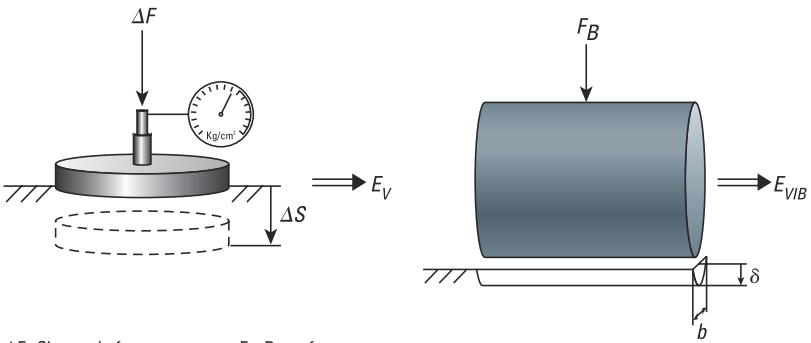
stration projects have illustrated that compactors equipped with IC capability, like conventional compactors, cannot compact all soils under all conditions. Soils with moisture contents far from optimum, with soft or wet underlying materials — or other problems — cannot be compacted to target levels. Because of the surface-covering documentation that the IC roller provides, however, these problem areas may be identified and corrected before being covered by additional lifts." (Of course, a standard roller with a documentation system could also provide this benefit.)

Analogy of Bomag's "Vibration Modulus" (E_{VIB}) To "Deformation Modulus" (EV)



ΔF=Change in force
Δs=Change in subsidence
F_B=Drum force
b=Width of drum impression
δ=Subsidence

In our research, we came across a graphic depiction of how Bomag explains the stiffness value reported by its intelligent-compaction systems. The measurement is based on a soil-test procedure (the plate-loading test) that correlates force to ground deformation or subsidence. The Bomag measurement accounts not only for the depth of subsidence, but also for the area involved. We've modified the illustration slightly with the addition of the plate-loading mechanism.

Less checking, good records

Documentation provided by the IC process also offers the prospect of streamlining quality control. Since the IC roller automatically checks virtually every spot on the jobsite for compaction results, just a handful of manual spot checks may be required for confirmation.

Without this extensive verification, however, considerably more quality-control checks must be made (but still relatively few when compared with the IC roller's thorough coverage). Conducting numerous manual checks — whether by soil-replacement tests, asphalt coring or quick-reading gauges — can potentially be time-consuming, expensive and perhaps even risky on busy jobsites with a fleet of fast-moving construction machines.

Full documentation of compaction results also may serve as the contractor's proof of performance if pavement-warranty issues arise, and these documented results may be the basis, too, on which states potentially may award bonuses or assess penalties for compaction-work quality.

In addition, says Minnesota's Siekmeier, "intelligent compaction provides comprehensive data on the mechanistic properties of all materials compacted, permitting links between design, construction and performance. For example, the data record produced by the compactor, which covers all areas and all lifts, will be essential to the pavement-management process. Long-term performance may be correlated with the properties produced during construction."

Among the ultimate payoffs of the IC process, though, is the potential for creating structures that have longer useful lives. European experience, says the Minnesota DOT's research, "clearly demonstrates that greater compaction uniformity increases the useable life of pavement systems, and similar benefits occur with embankment compaction and buried-structure backfill."

Design generalities

Probably safe to say in regard to IC rollers generally is that most (but not all) use accelerometers (force/motion sensors) to measure drum movement relative to the machine frame, then employ proprietary software to calculate a stiffness value from these signals. Except for Sakai's proposed IC asphalt system, double-drum IC rollers use (will use) force-control for only one drum.

Although you'd have to take up the specifics with individual manufacturers, most would likely say that their measured stiffness values correlate well with accepted soil compaction tests, such as the Proctor method, provided soils are relatively homogeneous, granular in nature, and within acceptable moisture-content parameters. Some say also that

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their stiffness values for asphalt correlate well with commonly used density-measuring methods for this material, such as the Marshall test. But others, in truth, are still working on more closely determining the correlation between stiffness values reported for asphalt with those derived from conventional methods.

The IC system's software uses stiffness measurements (determined by the vibratory drum's reaction with the material beneath) as a reference for controlling the drum's energy imparted to the material. At least one manufacturer, however, is experimenting with an IC system that will not be based on drum vibration, but will instead correlate the drum's rolling resistance with material stiffness. If the system is found viable, it may allow the IC concept to extend to non-vibratory machines and may provide an alternative method for padfoot machines to determine stiffness values when working in cohesive soils.

In most instances, the recording and documentation systems that form an integral part of the IC package can be either the conventional type (requiring the operator to manually start and stop the recording process along a measured length of the jobsite), or the GPS-based or robotic-total-station-based type, which automatically provide centimeter-level positioning. As the IC process becomes more widely used, GPS-based systems likely will predominate, but conventional systems (or the ability to revert to a conventional system) will still be viable in areas not conducive to good GPS signals.

Ongoing investigation

Intelligent compaction is not without its critics, and much of that criticism is directed at the questioned effectiveness of IC systems working on asphalt pavements. For example, some contend that for compacting hot-mix asphalt, IC technology is not sufficiently developed to recognize the difference between stiffness created by an increase in the material's level of compaction, and that created by the cooling of the mix and the subsequent loss of asphalt-cement fluidity.

Others question the IC system's ability, when working on thin lifts, to distinguish between surface stiffness and that of underlying layers, whether base materials or previously placed mats. And, there are those who maintain that accelerometers, the basic sensors in IC systems, do not work effectively at measuring asphalt stiffness. Of interest here is the Geodynamik Asphalt Compaction Documentation (ACD) system, which uses proprietary algorithms, not accelerometers, to assess the compaction level of asphalt. Also, the Dynapac IC system for asphalt (currently being developed) will not use accelerometers.

Another criticism leveled at IC rollers is that they are unable to provide reliable stiffness measurements when the drum is in the process of adjusting its force. Proponents of the IC approach, however, counter that systems (which vary amplitude to vary force) are designed to select a "fixed" amplitude during the adjusting process and, thus, can be trusted.

Criticism aside, the combination of academic research, in-field experimentation and actual experience of contractors using IC machines — both on soils and asphalt — will surely, meticulously and objectively, help sort out the true capabilities of the IC process.

Measuring Compaction: Fundamental Changes

Adding to the scope of evaluating the IC process on North American jobsites is the related issue, being pursued by a growing number of engineers and researchers, of how best to measure a material's level of compaction.

On the soil side, for example, the widely used Proctor method, which determines "dry density" as an indicator of compaction, seems to be yielding ground to methods that instead measure material "stiffness," which is loosely defined as a measure of a material's ability to resist deformation under load.

Stiffness also seems to be the basis for calculating an even more fundamental material property, "modulus," which scientific types agree is the most accurate and independent means for judging deformation and, thus, a material's level of compaction. The modulus discussion is complex, and becomes even more so when dealing with the differences in granular and cohesive soils.

One of the most articulate investigators in this area is Jean-Louis Briaud, PhD, P.E., and professor of civil engineering at Texas A&M University, who has written extensively about soil modulus and has developed a measuring instrument, the Briaud Compaction Device (BCD), designed to quickly determine a value for soil modulus. If you're interested, a Google search for "Briaud Soil Modulus" will turn up several of his works, including those on modulus, the BCD and intelligent compaction.

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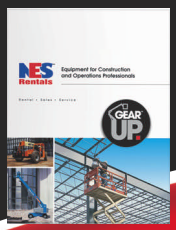

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Bomag

Bomag has two IC systems: VarioControl for soil machines and Asphalt Manager for pavement machines. The two systems are similar in that the exciter mechanism is contained within a housing that can be rotated through an arc of 90 degrees (via a slewing motor) to change the direction (vector) of the drum's force. As the material-stiffness-measuring system senses that compaction is increasing, the drum's force (which remains constant, because amplitude and frequency remain constant) is automatically vectored from a primarily vertical orientation to a primarily horizontal orientation.

Both Bomag systems, in their automatic mode, allow the operator to pre-set maximum compaction-force levels, and in their manual mode, the systems allow the operator to select from six exciter positions (force values) to closely match material characteristics.

The Minnesota Department of Transportation has been investigating intelligent-compaction soil machines for the past two years and continues to do so. The Bomag (pictured), fitted with the company's VarioControl system, was set up to run with a GPS-based documentation system on the Minnesota site.

The value Bomag uses to report measured material stiffness is the "vibration modulus" or E_{VIB}, which, says the company, is measured in Mega-Newtons per square meter (MN/m^2). One Mega-Newton is equivalent to about 224,800 pounds of force. Bomag's Asphalt manager system also monitors mat temperature and allows parameters to be set in order to alert the operator when critical temperatures are approaching.

Although Ammann apparently will no longer market soil compactors in North America, a domestic manufacturer, already branding Ammann machines, may take on Ammann's IC soil machines and preserve the technology.

Ammann

Ammann defines its IC system, the Ammann Compaction Expert (ACE), as an electronic measuring and control system that automatically adjusts the amplitude and frequency of a vibratory roller to suit material characteristics. Thus, says the company, areas with lower "load-bearing capacity" are compacted with high effective amplitude, and hard areas with low effective amplitude. Amplitude is adjusted "as flywheels in the exciter system twist against each other," and frequency is adjusted "to the resonance of the ground."

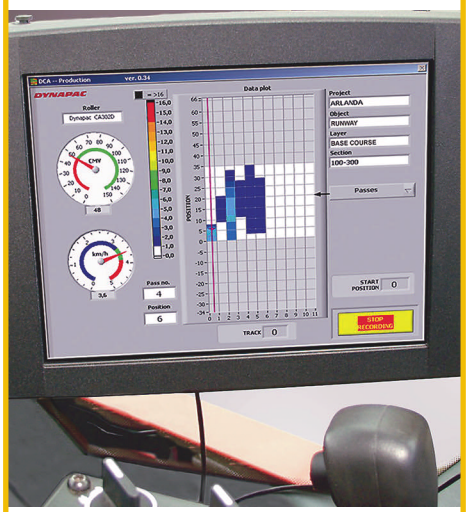
Similar to the vibration-modulus value determined by the Bomag system, the ACE system determines "dynamic ground-bearing capacity" by equating the drum's action to a "plate-loading" test, in which a circular pad is pressed into the soil with a known force, and then the resulting deformation (or subsidence) in the material is measured. Ammann reports this measurement as the "kB" value, which is measured in MN/m.

When the ACE system is used on an asphalt machine, says Ammann, the first strip is compacted with the ACE system switched on, and a first kB value is determined (in relation to the subsoil) that can be memorized by the system. An infrared temperature gauge in the ACE asphalt system can prevent operation when the mix is "too hot, too cold, or when the material is in a critical temperature (tender) zone."

Dynapac

The Dynapac Compaction Optimizer (DCO) system, automatically adjusts the drum's amplitude "from zero up to a maximum, depending on the state of compaction." The DCO system most always should be operated in the automatic mode with maximum force values selected, says Dynapac, but the system does allow manual operation, and in that mode, provides the selection of six amplitudes or force values.

According to Ingmar Nordfelt, research manager for compaction and paving techniques at the Dynapac International High Comp Center in Karlskrona, Sweden, the Dynapac IC soil roller measures and reports a "dynamic stiffness value," identified as the Compaction Meter Value (CMV). The CMV, he says, has been used in Europe since the 1970s, and is a "well accepted and proven" indicator of the soil's relative state of compaction. The company's IC asphalt machine, currently being developed, will not use accelerometers to measure material stiffness, because Dynapac research, says Nordfelt, indicates that this approach is potentially unreliable.



Dynapac's IC system for soil machines reports measured stiffness values as a Compaction Meter Value (CMV), shown on the upper gauge.

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Caterpillar's IC soil machine is planned for introduction in 2007 and will feature a GPS-based documentation system as standard equipment. The machine will adjust drum force by infinitely varying amplitude from zero to a pre-set maximum, and the system will automatically select from three frequency settings to match the amplitude band.

Caterpillar

Caterpillar calls the IC system being developed for its soil machines a "continuously variable amplitude" system, which can automatically adjust the drum's amplitude from zero to a maximum — a maximum that stays comfortably away from the double jump, says advanced product development manager Robert Ringwelski. But along with variable amplitude, the Cat IC system also will employ three frequency settings, one of which the system will automatically select depending on the amplitude range in which the drum is operating.

Adjusting the drum's force by varying the amplitude provides a huge advantage, says Ringwelski, because the zero amplitude setting allows the exciter system to remain spinning at all times. This means, he says, that the machine need not continually expend the tremendous energy required to restart the exciter's weights each time the machine reverses direction. Restarting the vibratory mechanism requires a significant amount of the engine's horsepower, he says, and requires that the exciter's hydraulic drive system run at near relief pressure until full momentum is achieved. All of this has the potential, he says, of allowing the use of smaller engines that use less fuel.

Geodynamik

Geodynamik's Asphalt Compaction Documentation (ACD) system is not technically (by our definition) classed as intelligent compaction, because it does not alter drum force. We include it here, however, because the system takes a different approach to measuring and reporting an asphalt mat's level of compaction.

The system, says Geodynamik, does not take into account the stiffness of the sub-grade, because the compaction value reported is not based on dynamic measurements taken by accelerometers. Instead, says the company, the ACD system uses a patented algorithm for calculating "compaction points," which are closely related to the energy imparted to the asphalt. The algorithm takes into account roller type, drum parameters, roller speed, temperature of the mat and time.

The calculated asphalt-compaction value (ACV) reported by the ACD system, says Geodynamik, also allows for the compaction effect from the paving screed and from static rollers. Thus, says the company, the ACV is related to the compaction energy imparted to the thin asphalt layer and is, therefore, not influenced by variation in sub-grade compaction quality.

Sakai

Sakai is presently testing IC machines, and according to the company, a working soil-roller prototype should be available for demonstration projects late this year. An asphalt model for demonstration should be available by mid-year 2007. The company plans to begin marketing the machines in North America sometime in 2008.

According to Sakai, the basic operating principle of its IC models is that of adjusting amplitude, and the stiffness values reported by these units will be based on a measure of the material's "dynamic modulus." Accelerometers are the basic sensors employed for both the soil and asphalt models, and on the latter, the IC system will be used in both drums. The Sakai systems will allow the operator to pre-set maximum force values when establishing compaction targets and, like most other competitive IC systems, will have provision for a manual mode.

According to Sakai, the basic operating principle of its IC models is that of adjusting amplitude, and the stiffness values reported by these units will be based on a measure of the material's "dynamic modulus."

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By WALT MOORE, Senior Editor

Ingersoll Rand's WL-440 Keeps Up with a Pro

Professional operator Tom Rush gives this Ingersoll Rand compact wheel loader a workout and offers his opinions

For this installment of Hands-On-Earthmoving, Ingersoll Rand graciously loaned us a brand new WL-440 wheel loader. The company's dealership in Villa Park, Ill., a Chicago suburb, delivered the machine to *CE*'s test site, the Apprenticeship and Skill Improvement facility that Local 150 (International Union of Operating Engineers) maintains in Plainfield, just southwest of Chicago. Our evaluators were Local 150 operator/instructor Tom Rush and technician/instructor Rick Bewsey, who, after spending half a day with the WL-440, gave the loader generally high marks for design and performance, but did have a few suggestions for change.

The WL-440, weighing in around 13,200 pounds, is a compact model that was added to the Ingersoll Rand earthmoving line about 18 months ago, along with its slightly smaller companion model, the WL-350. The WL-440 we had on site produced 73 net horsepower from a transverse-mounted, four-cylinder, turbocharged Duetz BF 4M-2011 diesel engine. Early this year, however, the engine was changed to an 82-hp, turbocharged Kubota V3300-DI-T.

The loader uses a closed-circuit hydrostatic drive system (separate from the implement hydraulic system) that employs a variable-displacement hydraulic pump driven directly from the engine. The pump supplies oil flow to a single, two-speed hydraulic drive motor attached to a gear set at the front of the rear differential. Power reaches the front axle via a slip-tube shaft connected at the gear set with a universal joint.

An optional four-speed drive system uses two-speed axles in conjunction with the two-speed drive motor. This high-speed-travel

Local 150 operator/instructor, Tom Rush, found the Ingersoll Rand WL-440 wheel loader's hydraulic functions powerful and fast, and he liked the machine's controlled hydrostatic braking action when lifting the throttle near the truck.

Photos: George Pfoertner®

("speeder") system allows a top end of 22 mph, versus 12.4 mph for the standard system. The speeder option is advantageous, says Georg Seyrlehner, global product marketing manager, if the unit is frequently driven between work sites or is used on large developments to deliver materials or to make relatively long load-and-carry runs.

Assessing features

Both Local 150's Rush and Bewsey agreed that the WL-440 has quite a list of impressive features, including parallel-lift loader linkage that automatically keeps the bucket (or pallet forks) level throughout the lifting arc. The linkage is simpler in design than many parallel-lift systems, but, like most of these systems, maintains nearly constant power (breakout force) from the bottom to the top of the lift path.

Complementing the parallel-lift system is a standard hydraulic coupler that simplifies attachment changes. To swap work tools, from a bucket to forks, for example, the operator must first manually switch a small valve at the coupler from its auxiliary to its coupler position. Two buttons on the front of the joystick then power the coupler's locking pins. Once the valve is returned to its auxiliary position, the joystick buttons control the attachment's hydraulics, such as those for a multi-purpose bucket.

Attachments presently available include forks and numerous buckets, including multi-purpose and side-dump versions. According to Seyrlehner, the WL-440 can be equipped in the field with a fourth spool to provide continuous flow in the auxiliary-hydraulic system for powering attachments such as rotary brooms. (The standard third spool controls the coupler and bucket hydraulics.) Also, he says, the company is currently working to broaden its range of available attachments.

In operator Rush's opinion, the WL-440's cab is, overall, well designed. He liked our test machine's dual-entry doors, deeply curved one-piece windshield (giving a panoramic view forward), tilting and height-adjustable steering column and hydraulically cushioned seat. The cab is roomy and quite comfortable, says Rush, and it affords excellent visibility all around.

Operator Tom Rush was impressed with the WL-440's ability to aggressively engage a reasonably tough stockpile without wheel spin. Axles feature a limited-slip differential, which automatically transfers power to the wheel with better grip. The machine also has a brake/inching pedal that allows the operator to control ground speed irrespective of engine speed.

But, Rush, as do all operators, has his specific likes and dislikes about the details of machine design, and he admits that every operator has opinions about what makes for comfort and convenience in the cab. With that qualifier, Rush did confess that he was lukewarm about the WL-440's rocker switch at the top of the right joystick for making directional shifts.

The expansive front window of the WL-440 provides a good view to the bucket and work area. Controls are straightforward once understood. A switch at the lower left of the panel locks out implement hydraulics — a safety feature. When activated, the lockout disables the joystick, including directional shifting capability, but a switch next to the lockout allows shifting the machine to permit travel.

"It's a small point," he says," but I find that if you're doing a multi-function operation with the joystick, it's difficult to shift without giving up a degree of hydraulic control. I would prefer a separate lever for directional shifts, along with a disconnect pedal."

A couple other cab details Rush noted included the close proximity of the control stalk (turn-signal/horn/lights) to the steering wheel. With gloves, he says, the operator may inadvertently trip the lever. He also questioned if the cab's skylight could be covered. He appreciates the overhead visibility afforded by the window at the forward edge of the cab roof, he says, but there might occasions when blocking the sun would make things more comfortable.

At the controls

When performing basic dirt-work chores with the WL-440, Rush was generally impressed with the machine's performance. Exercises involved digging from a stockpile of moist, tightly compacted clay/loam soil, loading a single-axle truck and making a number of load-and-carry cycles.

"The machine has a lot of hydraulic power.

Local 150's Tom Rush, left, and Rick Bewsey agreed that the WL-440's routine service points were quite accessible. But they did have suggestions: Install a green fuel cap (the industry standard), because the inattentive might miss the decal on the firewall; install a sight-gauge for hydraulic oil, because the checking method (a small dipstick that requires removal with pliers) is unhandy; and, if the dipstick remains, give specific instructions on the lube chart for checking procedure.

I found that it hesitated just a bit in this heavy material when initially engaging the pile — during that instant when you're slightly raising the boom to load the front tires and beginning to curl the bucket. But, that said, the bucket comes up through the pile with a great deal of power."

As Rush maneuvered with a full bucket, he commented on what he considered the WL-440's excellent stability and precise steering. After a number of passes at the stockpile, he said he was impressed with the machine's apparent good design in splitting engine power between the hydraulic system and the wheels.

"There was plenty of power to push into the pile with no problem, but not so much that the tires would spin. We've found that a tire can lose 35 to 40 percent of its life when our apprentice operators spin the wheels."

When doing truck loading, Rush commented favorably on the WL-440's hydraulic speed and the machine's overall controllability.

"I could basically cycle as fast as I wanted. Hydraulic response is fast when approaching the truck and, again, the machine exhibits a good balance between tractive effort and hydraulic power. I also like how the hydrostatic system reacts when approaching the truck — lifting the throttle gives a natural, smooth braking effort."

Rush did comment that a return-to-dig control would be handy (it's an option), and also that the load-and-carry ride was a bit hard (ride-control is an option, too). The WL-440's bucket does, however, have "level" indicator bars on its sides.

A feature that Rush and Bewsey both questioned, however, was that of the WL-440's float-control system. A three-position switch on the right-hand panel has "off," "impulse" and "continuous" settings for float, which means that the loader mechanism is made hydraulically neutral and can follow (or float with) ground contour in such operations as back dragging.

In the impulse mode, the loader mechanism remains hydraulically active until a trigger switch on the front of the joystick is depressed. Pulling the trigger instantly places the boom in float, and it drops to the ground. Both Local 150 instructors agreed that the impulse mode would be a convenient feature in the hands of a seasoned operator. Because they work with novice operators, however, they raised the concern that rookies, perhaps experimenting with the controls, might place the float switch in the impulse position, then inadvertently engage the trigger when loading a truck and drop the boom.

Back on the positive side, though, Rush was again impressed with the WL-440's performance, this time with pallet forks. He used the forks to handle a heavy steel test fixture in the Local's equipment yard, and then transported a large section of concrete pipe.

"The machine was absolutely stable when equipped with forks; it lifted with plenty of power and kept the load level."

When asked to sum up the WL-440's overall performance, Rush did so succinctly:

"Everything considered, you have to remember that a machine this size probably isn't going to be used continually in heavy dirt work. But I think it would be an asset in any operation that needs a utility machine that can handle a variety of moderate tasks — maybe even some heavy-duty jobs." CE

Operator Tom Rush thought that the WL-440 did an excellent job when handling material with forks. The machine, he says, is quite stable in these applications, lifts with power and keeps the load level.

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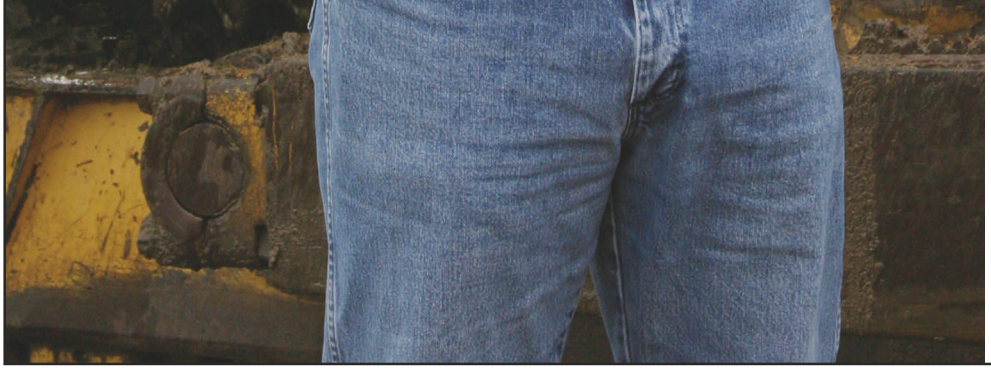

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By GRAHAM BRENT, Executive Director, NCCCO

Attention Centers on Crane Operators

Even as federal mandates are discussed, states are taking action on certification and training

"It's 7 a.m. Do you know if your crane operators are qualified?"

Today, as never before, fleet managers are asking themselves this question (or variations of it) before they allow an operator to climb into the cab of one of their cranes. Over the past decade, the spotlight has truly turned full and square onto the subject of the qualifications of operators of construction equipment (and, in particular, cranes). And the related issues of certification and training have not been far behind.

Managers are realizing they can no longer rely merely on an operator's opinion of his or her ability to operate a particular piece of equipment before they roll it out of the yard. Even a supervisor's assessment may be suspect, particularly if he has little direct experience on cranes, or if he is relying largely (but quietly) on the operator's opinion as the basis of his own.

And while operator experience is vitally important (especially documented evidence of a safe track record), owners of cranes that today leave their manufacturers' assembly lines with an unprecedented array of sophisticated features providing unparalleled versatility are asking, "how relevant is the experience an operator may bring to a construction site to the particular operating characteristics of my machines?" Cranes have changed over the past decade as in none previous, and attitudes toward the qualifications of the person in the "hot seat" are shifting into top gear in an effort to catch up.

Of course, some companies have had effective crane operator evaluation programs in place for many years. But they are in the minority. And while the "cowboy mentality" persists in many parts of the country, the gradual realization that cranes are simply no longer built to take the brutal handling that has been a characteristic of the "good ol' boy" school of lift-equipment operation is contributing to a sea change in industry's approach to crane-operator qualifications.

There's simply too much at stake to continue making assumptions about a crane operator's ability to handle a crane safely in what is inherently a hazardous occupation. This is why more firms are investing in comprehensive training and independent, third-party evaluation. And for those who still view this financial outlay as a cost rather than an investment in the safety/productivity of their workplace, there is the added incentive of licensing requirements in a dozen states, including arguably the most

Manufacturers have equipped cranes with more sophisticated controls, leaving too much at stake if left to untrained operators. Comprehensive training and third-party evaluation are a must.

populous (in crane terms), California.

Although a federal requirement may be in our future, the ASME B30.5 American National Standard for mobile and locomotive cranes laid the basis for operator qualifications more than a decade ago: Operators must meet physical standards, pass a written examination, and demonstrate their skill on a hands-on test. Specifically, the ASME B30.5 mobile-crane standard requires operators to "demonstrate their ability to read, write, comprehend, and exhibit arithmetic skills and load/capacity chart usage, in the language of the crane manufacturer's operation and maintenance materials."

If ever the case needed to be made for structured, professional training, load charts would be at the center. For load chart interpretation cannot come via osmosis or simply through prolonged exposure to crane operations; it has to be taught. Knowledgeable crane experts all agree: There is no more abused, misunderstood or just plain ignored aspect of mobile-crane operations than the crane's load chart, a fact the National Commission for the Certification of Crane Operators (NCCCO) can confirm based on its experience of administering more than 200,000 tests over a 10-year period. Without a thorough understanding of a

Four Areas of Knowledge

NCCCO written test questions are grouped into four main areas, or domains:

- Domain 1: **Site**

For example, operators must know site hazards such as electric power lines and piping. They must know the proper use of mats, blocking or cribbing and outriggers or crawlers as they affect the suitability of supporting surfaces.

- Domain 2: **Operations**

Operators, for example, must know how to pick, carry, swing and place the load smoothly and safely on rubber tires and on outriggers/stabilizers or crawlers.

- Domain 3: **Technical Knowledge**

Examples include the knowledge of the effect of side loading, and the principles of backward stability.

- Domain 4: **Manufacturers' Load Charts**

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The C-DAC Journey

In 2003, the Occupational Safety and Health Administration formed the Cranes & Derricks Advisory Committee (C-DAC) to overhaul 29CFR 1926.550, Subpart N, of its Safety and Health Regulations for Construction. The 119-page consensus document that the hand-picked committee of subject matter experts developed over a one-year period was submitted to OSHA for review after its last meeting in July 2004.

If its provisions are adopted, it will require crane operators to be certified by an accredited crane operator testing organization or qualified by an audited employer program. Similar provisions pertain to signal persons. The speed of issuance of any final rule will depend on whether a small business review will be required, and the degree of public comment the proposed rule, when published, elicits.

mobile crane's load chart, an operator cannot have an accurate picture of either its capabilities or its limitations. Foolhardy indeed is the operator who ignores the rating chart in today's high-tech, versatile machines — his first mistake can indeed be his last.

The prospect of a federal mandate doesn't seem to be restraining state initiatives, however. Three states (California, Hawaii and New Jersey) have introduced licensing requirements in recent years, and a similar number (Minnesota, Nevada and Pennsylvania) have enacted laws or plan to do so. Others are contemplating draft legislation.

One feature all these new rules share is a desire to verify the quality of the licensing or certification process. A license is only as good as the process followed to develop the examinations used to test crane-operator knowledge and skill. A "certified" operator may be no more competent than an uncertified operator if the certification consists of little more than, say, a 20-question true/false test, with coaching in the correct answers provided by the instructor. It's often pointed out that barbers have to be licensed in most states, yet crane operators most often do not. But how comfortable would you feel sitting in the chair of a practitioner certified by the Sweeney Todd Training Institute?

That's why, more than 30 years ago, an audit process for organizations that certify personnel was developed by the National Commission for Certifying Agencies (NCCA). NCCA has since been joined by the American National Standards Institute (ANSI) in providing a means of accreditation to certifying bodies such as the National Commission for the Certification of Crane Operators (NCCCO).

Four Tasks Determine Skill

CCO practical exams for construction cranes address three categories: lattice-boom cranes; telescopic-boom cranes below 17.5 tons with fixed cab, and above 17.5 tons with swing cab; and tower cranes.

They consist of four tasks that increase in the skill required:

1. Place overhaul ball in stop circle.
2. Follow hand signals.
3. Place overhaul ball in barrels.
4. Negotiate zigzag corridor with test weight.

Questions to Ask Your Training Vendor

- Where and when are training classes held? Do you have to go to their site, or do they come to you?
- How many hours does the training last? What's the cost?
- How many instructors are certified or at least have passed the certification written examinations, and in what specialties?
- What is the average class pass rate?
- Does the training provider also offer practical exams?
- Can the training provider offer a complete training and certification package by working in concert with the certification organization?

Both the CCO mobile/tower crane operator certification programs are accredited by NCCA.

Compliance with the detailed psychometric and management system requirements of NCCA or ANSI ensures the certification issued by an accredited organization has been professionally developed and administered to the highest standards, and that the tests used during the examination process are fair, valid, reliable and (just as importantly) legally defensible.

Training and professionally developed certification (or licensing) can be a powerful "one-two punch" in the effort to ensure all equipment operators are qualified. The effectiveness of this winning combination has been most clearly seen in recent years in the Canadian province of Ontario. Between 1969 and 1978, crane and rigging fatalities in the province accounted for almost 20 percent of all construction fatalities. This rate has more than halved since then. Accounting for this remarkable improvement has been the introduction in 1979 of mandatory training for all crane operators as a part of the licensing process.

There is every reason to expect a similar result in the United States, but only if the various mandatory and voluntary means of becoming certified follow professional methods of exam development and, thereby, stimulate the need for training. Since the introduction of its national mobile crane operator certification program in 1996, the National Commission for the Certification of Crane Operators (NCCCO) has witnessed a veritable explosion in the training available to crane operators.

Although NCCCO does not provide training (in order to preserve its third-party, independent status as a certification organization), it maintains on its website a list of firms that do. In 1996 there was one firm listed; at last count there were 60 from 21 states, 47 of which operate nationwide. And the number is growing almost daily. Add to that the train-the-trainer classes often used by firms wishing to develop in-house programs, and the opportunities for training have never been greater.

The decision on whether or not employers need to provide training is, of course, one that the Occupational Safety and Health Administration, industry standards, and just plain good sense has already made. If good sense is enough for some, others may need the "carrot" offered by the insurance industry's premium discounts for certified operators, or the "stick" that state or federal licensing may provide. Either way, training and certification of crane operators is here to stay. And that's a good thing — not just for those working in/around lifting equipment, but for all those whose lives may be temporarily, or permanently, affected by the often devastating consequences of a machine operated by an untrained, uncertified, inexperienced — and therefore unqualified — crane operator.

States That License (or plan to)

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- Colorado (2008?)
- Connecticut
- Hawaii
- Massachusetts
- Minnesota (2007)
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- Oregon
- Pennsylvania (2008?)
- Rhode Island
- Utah (2008?)
- West Virginia

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By TOM BERG, Truck Editor

Basic F-350 Offers Deluxe Performance

Plain-Jane trim is only skin deep, as Ford's F-350 Super Duty comes with comfort, performance and a high capacity for work

TEST SET

Truck: 2006 Ford F-350XL cab-chassis 4x2, 6-passenger Crew Cab, GVW 13,000 lb., payload 5,700 lb. (including passengers and truck body), GCW 23,500 lb.

Engine: Ford-International 6-liter Power-Stroke turbodiesel, 325 hp and 570 lbs.-ft.

Front axle: 4,850-lb. Twin I-Beam on coil springs

Rear axle: 9,750-lb. on leaf main and auxiliary springs, w/3.73 ratio

Tires & wheels: Continental LT245/75R17E on steel discs

Brakes: 4-wheel hydraulic w/hydro-boost power

Body: Dealers 12-foot diamond-plate steel w/ in-bed fifth-wheel hitch and rear hitch receiver

Some jobs demand tough but simple trucks. Tough can be had, but there's nothing simple available anymore. Any modern motor vehicle must meet customer demands for performance, economy and comfort, along with government emissions limits. These conspire to make for highly complex products that are bristling with technological advancements.

However, cutting back on exterior and interior niceties results in trucks that look plain-Jane, even if they're far from it under the skin. Case in point: This Ford F-350 Super Duty Crew Cab XL, which was among many displayed at a Ford demonstration last summer. Its XL interior included vinyl-covered seats and rubber floor mats, so it looked like it could be hosed out. All the electronics on and under the dashboard and probably under the floor would preclude the hose treatment, though. No, "wipe-out" is a better term to describe its interior package.

The truck's XL trim is Ford's base level, and it was built to work. It didn't pretend to be anything fancy, and that's why I was drawn to it. It sat in a row of other F series trucks on display at a dealership in San Antonio, Texas, on an oppressively hot and humid day last summer. Inside a nearby air-conditioned tent, Ford marketing executives were remarking on the success of the F series since that designation first

appeared in 1948. Ford and its dealers have sold more than 28 million Fs in the past 57 years, they said.

The series now ranges from F-150 to F-750 in nomenclature and 6,500 to 33,000 pounds in GVW ratings. The executives, jubilant from record sales through July '05, were gunning for more. But the hurricanes of late summer and spiking fuel prices in early autumn seriously slammed sales, and 2005 numbers closed at 901,463 — still the third best year in the 57-year history of the product line.

Tough, but simple

This F-350 was a cab-and-chassis model with some hefty running gear, including dual wheels at each end of the rear axle, and a GVW rating of 13,000 pounds. I imagined the vehicle going to work for a construction contractor who'd send it and its crew to hot, dusty sites with supplies tied onto its steel flatbed body. They'd get there in fair comfort and decent style, even though the truck was about as plain as they come.

Its paint was the staid "Oxford white" that's common on Fords. There was no chrome exterior trim, and the plastic grill and bumper covering were a dull, dark grey. Silver would look nicer and the chrome-plated noses on fancier models make them smile, but for sure this one will never rust. In the cab, vinyl covers on the two bench seats appeared tough and easy to wash, though a lot of buyers might never bother with that. The four-door cab was long and wide enough that six burly guys could seat themselves comfortably and, in spite of the plain seat coverings, they'd ride in reasonable style.

My ride in the F-350 was relatively short, but long enough for me to appreciate its quickness and comfort. Its air conditioning was powerful, and the truck rode well, was quiet, and handled easily. The seats looked simple but were rather supportive, and a fold-down armrest in the front had a storage compartment and even a pair of cup holders. The rear seat folds to make room to stow tools and other items

This four-door Crew Cab has two vinyl-covered bench seats that might get sticky in summer but were nonetheless supportive and almost cushy. A rear seat folds to accommodate tools and other cargo.

New interior offerings since last summer include this cloth and Vinyl bench without the armrest. All-Vinyl coverings are now offered only on optional bucket seats.

The dashboard and instrument panel are handsome and functional, and rotary HVAC switches are easy to understand and use. Bench front seat includes a fold-down armrest with cup holders.

A stout, steel flatbed can carry cargo or, with its gooseneck hitch uncovered, pull a trailer weighing up to 16,700 pounds.

Under all the shrouds, pipes and accessories is the PowerStroke V-8 diesel, which makes as much as 325 horsepower and 570 lbs.-ft. So the truck really scooted and was clean-burning to boot.

best kept locked up. That vinyl might get hot and sticky on one's backside, but the air conditioning makes it bearable.

The instrument panel was as well equipped as any SuperDuty truck. The rotary HVAC switch knobs are big and their functions easy to understand; high-end models get push buttons that you have to study to use, at least at first, but such controls are considered upscale, even if they're more difficult to use. I always frown when I look at F series' engine-condition gauges because they're not numbered, and needles swing into "normal" ranges that you hope are okay. Then again, F series gauges have been this way forever and the trucks still get down the road.

Power options

Triton gasoline V-8 and V-10 engines, recently updated with three-valve-per-cylinder heads and other advances and paired with a smooth TorqShift five-speed automatic transmission, are standard in F-250 and F-350 SuperDuties. This F-350 had the International-built Power Stroke diesel. The 6-liter (363-cubic-inch) V-8 diesel makes as much as 325 horsepower and 570 pounds-feet, so the truck really scooted, more than keeping up with auto traffic on the nearby streets and freeways on San Antonio's far east side.

Comparable diesels from GM and Dodge are stronger, but Ford says its Power Stroke is tuned to deliver more usable power and torque at low and midrange revs where most engines spend most of their working lives. It's quiet and almost smoke-free. A demonstration a year before at Ford's Arizona proving grounds shows that the diesel pulls trailers with authority and stops them quickly, too, thanks to an optional electrical brake unit that's built into the dash and works with the truck's own brakes.

The TorqShift five-speed works well with either the diesel or the Triton gas engines I drove at that demo. There's a trend toward six- and even seven-speed automatics in autos, and I think it's overkill, as any fuel economy and performance gain is offset by greater complexity and, eventually, higher repair costs. Five ratios seem just about right for most uses, and even a modern four-speed automatic is entirely adequate, it seems to me.

Like other builders, Ford builds its cab-chassis vehicles with body builders in mind. Frames are kept "clean" and plug-in electrical boxes make mounting and wire connections fairly easy. This truck had a locally fabricated flatbed fashioned of heavy gauge diamond-plate steel. In its center was a fold-up plate covering a ball hitch for a gooseneck trailer, and there was another ball hitch at the rear for a tongue-type trailer.

A weighty backhoe or small excavator could ride easily on an equipment trailer behind the F-350. That loaded trailer could weigh as much as 16,700 pounds and still be within the truck's towing capacity, according to Ford specs. The truck alone could carry 5,700 pounds on that flatbed (less passengers and the body's own weight), so it's got a strong constitution.

I doubt that anybody driving this Ford will ever complain about lack of carrying or towing capacity, or power, or much of anything. It's a nice truck just as it sits, and your dealer will happily sell you a more nicely trimmed XLT or Lariat version. They'd be fancier, but they wouldn't work any harder than this plain-Jane version. CE

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By LARRY STEWART, Executive Editor

Two Types of Buyers Drive Backhoe Design

Manufacturers press productivity and value frontiers using pilot controls and open- or closed-center hydraulics

Two very different kinds of backhoe-loader buyers dominate sales of full-sized machines (dig depths of 14 feet and larger), and their very different expectations may have polarized the hydraulic-system designs in this most popular of true earthmovers. The relatively small group of volume buyers from government agencies and large rental fleets are looking for a bombproof machine and tend to be price sensitive. Owner/operators and small-business buyers, while certainly motivated by value, are willing to pay a little extra for proven production-improving features.

In order to take market share in this relatively high-dollar, high-volume machine category, manufacturers must appeal to both groups. They've done so admirably with technologies that can be added to machines as standard equipment. For example, the most recent new backhoe designs (from Caterpillar, New Holland and JCB) have replaced foot controls for extending sticks and auxiliary hydraulics with switches mounted on control levers. They employ finger and thumb dexterity to improve control and clear the floor for more comfortable footing.

Pilot hydraulic controls represent another kind of challenge to backhoe OEMs. These circuits are plumbed in between control levers and the valves on the backhoe's main operating circuits. When you move a joystick in the cab, it activates a pilot hydraulic circuit, which in turn moves a spool on the main-pressure valve. Pilot hydraulics require less lever effort to manipulate the backhoe.

Main pressures in backhoes have climbed to a point where lever effort can influence productivity. Eight of the 35 backhoe models 14-foot and larger have hydraulic-system pressures of 3,500 psi or higher. All eight are available with pilot hydraulic controls, mostly as an option.

Why not make pilot hydraulics standard equipment? One reason is operator preference. Backhoe-loaders have been controlled by levers linked to main valves since their invention, and lots of operators claim they can feel pressure spikes in the hydraulic system when a bucket hits a hard object, like a natural-gas line. Some say pilot hydraulics insulate the control levers

List price jumps to nearly $135,000 for machines over 17 feet in backhoe dig depth, with an hourly rate of more than $54.

Average Backhoe Costs

Dig Depth (feet)	List Price	Hourly Rate*
14 to < 15	$71,964	$29.53
15 to < 16	$87,759	$36.23
16 to < 17	$94,813	$38.35

Monthly ownership cost (based on list price and 4.25 percent interest) plus operating expenses (including fuel at $2.49 per gallon and $40.18 per hour for mechanic's wages) divided by 176 hours.

Source: www.EquipmentWatch.com, 800-669-3282.

to that feedback from the bucket.

Another reason for keeping pilot hydraulics optional is their cost. Nevertheless, most manufacturers (Cat, Deere, JCB, Komatsu, Terex and Volvo) sell at least some of their machines with standard pilot-operated hydraulic controls.

"The inclusion of pilot controls has had the biggest impact on the industry in the last 24 months," says Bob Tyler, with John Deere. "Operator comfort becomes increasingly more important as businesses try to keep their best operators. With pilot controls, operators are less fatigued at the end of the day, and more productive as a result."

Deere makes pilot hydraulics standard on the 17-foot 710G, a machine that, by virtue of its size, is clearly targeted at buyers who are willing to pay for backhoe productivity. But pilot hydraulics are optional on the 15-foot 410G and 14-foot 310SG. They're not offered on the base-model 310G.

Only JCB and Komatsu make pilot hydraulics standard across their full-sized backhoe offering. The other manufacturers retain some models without the feature. Caterpillar, for instance, doesn't offer pilot controls on the 416E, but makes them standard on the 420E and 430E.

Splitting the product line has become common in recent months. Since the first of this year, Volvo made pilot hydraulics standard equipment on the BL70 but doesn't offer the option on the lower-spec'd BL60. Terex announced that it would begin installing pilot controls as standard equipment on the TX970 and TX870, leaving the feature as an option on the smaller TX860 and TX760.

If this is indeed an indication of OEMs fielding a price leader for one set of buyers and a full-featured machine for another, it's also possible that the buyer dichotomy may shape some backhoes' basic DNA.

There is notable inconsistency in hydraulic-system designs used on today's full-sized backhoes. Long-time backhoe-loader OEMs such as JCB, Case and New Holland use open-centered hydraulic circuits with fixed-displacement gear pumps. Those who began manufacturing backhoes more recently, such as Caterpillar, Komatsu and Terex, use closed-center hydraulics.

Caterpillar redesigned most of its frame structures, including switching to an exterior-sliding extendable dipper stick that made way for secure mounting of bucket thumbs at the factory.

THE JCB BACKHOE LOADER voted *'The Greatest Earthmover Ever'*

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The JCB Backhoe Loader was recently featured on an episode of *The Greatest Ever* on the Discovery Channel and beat nine other remarkable pieces of construction equipment to be named ***'The Greatest Earthmover Ever.'***

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14-Foot Backhoe Specs (by dig depth)

Model	Dipper Stick Lift* (lb.)	Loader Breakout Force (lbf)	Hydraulic Flow (gpm)/ Pressure (psi)	Operating Weight (lb.)
New Holland B95	**5,870**	**15,057**	40 / 3,045	14,440
John Deere 315SG	5,785	10,300	28 / **3,625**	14,700
Case 580M 2	3,750	9,480	28.5 / 3,050	13,359
Case 580M Turbo 2	3,750	9,480	28.5 / 3,050	13,359
John Deere 310G	4,446	8,100	28 / 2,750	12,800
Caterpillar 416E	5,106	9,014	34.8 / 3,292	14,960
Caterpillar 420E	5,722	10,076	43 / 3,611	15,474
JCB 214e	4,945	11,730	29 / 3,300	13,046
Case 580 Super M Plus 2	4,680	9,480	28.5 / 3,050	14,905
Case 580 Super M 2	4,680	9,480	28.5 / 3,050	14,285
John Deere 310SG	5,785	10,210	28 / **3,625**	13,500
JCB 214	5,400	12,638	39 / 3,300	15,593
Komatsu WB140-2N	5,678	12,790	**43.6** / 3,000	16,600
Komatsu WB140PS-2N	5,678	12,790	**43.6** / 3,000	16,600
Terex TX760B	3,466	10,485	37.5 / 3,250	14,975
Terex TX860B	3,466	12,291	42 / 3,250	15,964
Volvo BL60	5,121	10,004	30.6 / 3,190	16,564
Volvo BL70	5,754	12,037	42 / **3,625**	**17,800**

* Lift capacity at 8-foot height

Source: www.Spec-Check.com

This sample includes machines with 14- to 15-foot standard dig depths, the biggest-selling size range. All are powered by diesels in the 80- to 90-net-hp range, with the exception of Deere's base-model 310G and Cat's 416E with 70 and 74 horses, respectively. Komatsu and JCB also build 14-footers with all-wheel steer and four equal-sized tires. For specifications on all backhoe-loader sizes, visit ConstructionEquipment.com.

John Deere started a shakeup several years ago by adding machines with closed-center hydraulics to a lineup that had always used open-center designs.

For Deere — one of the venerable names in backhoe-loader manufacture — to design larger backhoe-loaders with closed-center systems and retain 14-foot machines (the 310G and SG) with open-center hydraulics, there must have been convincing market research measuring a significant customer base for both.

The newest entrant to the backhoe market, Volvo, is making similar moves. Volvo first brought the BL70 with a closed-center system, but followed with open-center hydraulics in the BL60. The two machines are nearly identical structurally — same dig depth and basic dimensions — but the BL60 has a little less engine and hydraulic horsepower.

It's extremely unlikely that an OEM would redesign a system with a higher-cost pump that has even the slightest perception, right or wrong, of shorter life if there was also a strong operator preference for another type of system.

It's much more likely that a closed-center circuit — technology that drives all full-sized excavators — is a very good choice for production earthmoving. Thanks to Caterpillar bringing it to backhoe-loaders in the 1980s, the challenge to other OEMs competing in the product category has been to either make their open-center systems perform more like closed-center systems, or to build a closed-center system that's cost effective for these smaller machines.

All of the JCB backhoes, New Holland's B115, and Volvo's BL60 use open-center circuits with load-sensing valves that can vary pump flow with oil demand. When flow requirements fall, the valve signals one of these machines' twin hydraulic pumps to shut down, reducing the amount of energy the machine wastes pushing hydraulic oil over relief. The feature is similar to the interaction between a variable-displacement pump and the main valve in a closed-center system.

There should be lots of new machines to evaluate between now and the end of 2007, when under-100-hp engines will have to comply with EPA's Tier 3 emissions limits. Real-world issues such as dealer support and operator acceptance should influence those purchase decisions more than pilot hydraulics or closed-center circuits, but it is encouraging to see that sophisticated technologies are shaping the kind of backhoes available. In the end, the industry gets a choice of more-productive backhoes. CE

Web Resources

Specifications	ConstructionEquipment.com
Case	www.casece.com
Caterpillar	www.cat.com
JCB	www.jcb.com
John Deere	www.deere.com
Komatsu	www.komatsuamerica.com
New Holland	www.newhollandconstruction.com
Terex Construction	www.terexca.com
Volvo	www.volvoce.com

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Gallery of Backhoe-Loaders

NEW HOLLAND

Precision Swing, Pistol Grip Improve Control

With the introduction earlier this year of the new B Series backhoe-loaders, New Holland enhanced its pilot-control option with Precision Swing Control. Backhoe boom strength was increased, even as its profile was narrowed to improve the operator's view to the trench. A new pistol-grip controller for the loader's four-in-one bucket improves control. A proportional-flow rocker switch on the handle controls the four-in-one jaw. Air conditioning has been upgraded to provide up to 25 percent more air flow.

Number of models: 4

New models: B95, B95LR, B110 and B115

Product-line features: The B95 has the best loader-bucket breakout force among 14-footers, and only Caterpillar's new 420E generates more stick-digging force. The B95's backhoe also outreaches most 14-footers at maximum dump height. The B95LR is the base B95 with the longer stick off the B110, making it a fuel-efficient 15-footer. Both B95 derivatives offer bucket breakout force improved by 8 percent.

For more information, visit ConstructionEquipment.com/info

CASE

Super M+ Takes a Wide Stance

Case introduced its 580 Super M+ and upgraded its remaining three backhoe-loaders to Series-2 status early in 2004. The 580 Super M+ is 11 inches wider and the stabilizer pads deploy 1 foot 8 inches farther apart than the Super M. Cab and ROPS are 3 inches wider. Case introduced it to reach customers looking for a wider stance, but who don't need all features of the 590 Super M.

Number of models: 4

New models: 580M 2, 580 Super M 2, 580 Super M+ 2, and 590 2

Product-line features: For Series 2, Case used its Tier-2-certified diesel, increasing displacement from 3.9 to 4.5 liters. Oil-change interval was doubled to 500 hours. Backhoe swing torque and breakout force increased by 10 percent, and loader reach increased by 9 percent.

For more information, visit ConstructionEquipment.com/info

KOMATSU

Excavator Design in a Backhoe

Komatsu delivers power to the backhoe with the same Hydrau-Mind hydraulic design as its excavators. The system makes excavator-style electronic-over-hydraulic control an option on all of the company's backhoes. Two work modes — power and economy mode — offer the option of improved fuel economy for lighter workloads.

Number of models: 5

Product-line features: Flow from the variable piston pump is managed by a "Load-Independent Flow Divider" main valve that keeps the speed of each function independent even when load resistance varies. Komatsu's backhoe-loaders are manufactured at the company's plant in Newberry, S.C.

For more information, visit ConstructionEquipment.com/info

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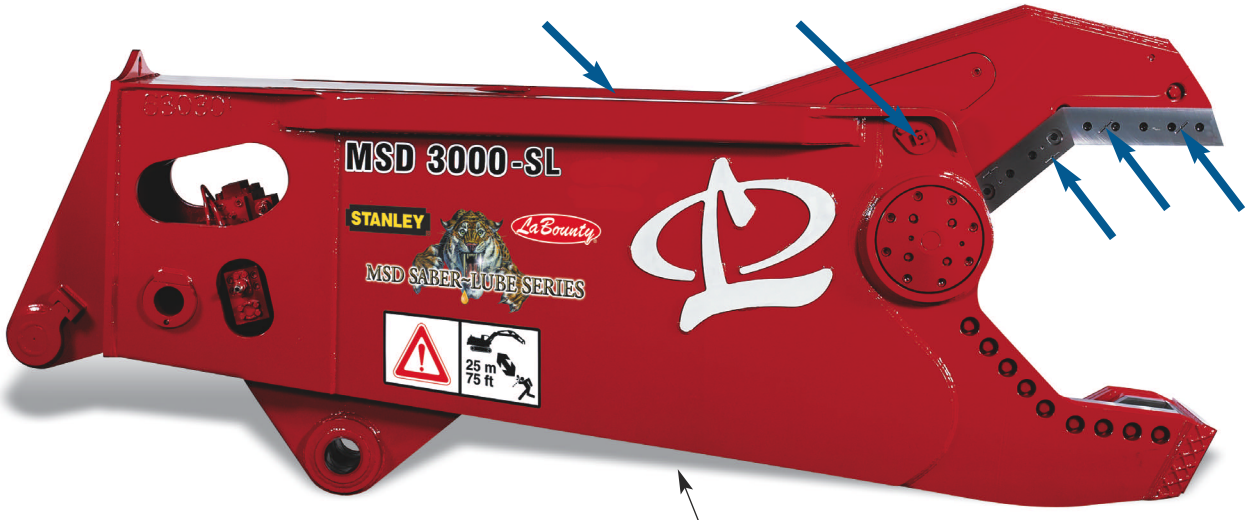
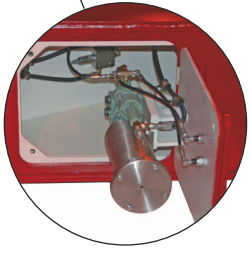


With the MSD Saber-Lube Series Shears, You May As Well Send Your Maintenance Personnel to Operators' School.

This new line of mobile shears employs a simple, yet revolutionary, automated lubrication system that delivers lube to several areas of the upper jaw and blades while the shear is in operation.

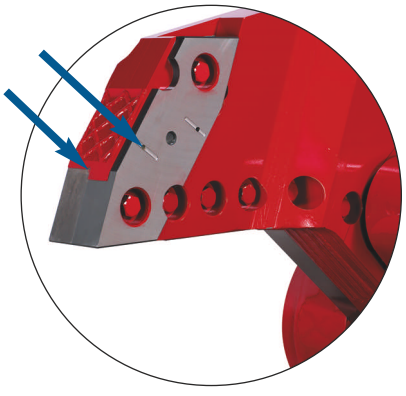
Extensive field testing has proven to:

- **Double** the blade life.
- Cut build-up welding time on the jaw areas by **half**.
- Reduce downtime by **two weeks** or more per year.
- Convert blade friction to usable cutting power (increase up to **10%**).
- Less welding means less heat build-up cycles, resulting in longer component life.
- Reduced noise.
- Easier removal of wear parts.
- Smoother hydraulics reduces shock loading in the shear and excavator hydraulics.
- World wide patents pending.



Lube Reservoir and Pump located at bottom of shear. It can be filled externally and will hold up to an 18 hour supply.

Lubricant is expelled to the various areas of the shear (marked by the **BLUE** arrows). The blades are drilled and grooved to maximize lube dispersion.



Opposite side of upper jaw showing patent pending, reversible Saber Tip.

"I have been a **LaBounty** customer for a long time and have owned many of their shears. When they approached me about prototyping the Saber Lube Series Shear, I was skeptical at first. After watching it work, gathering input from my maintenance people and putting hard numbers behind the savings, we were amazed. The savings in maintenance and increase in added production easily pay for the added cost in a hurry. The shear also works smoother and is a lot quieter. I was so impressed in fact that I have since purchased two of them. This flat out puts **LaBounty** light years ahead of the competition."

– ***Ron Moore***, President, Timco Scrap Processing, Channelview, TX

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For more information, visit www.ConstructionEquipment.com/RS and enter **29**

CATERPILLAR

Factory-Installed Grade Electronics

Caterpillar's E-Series backhoe-loaders (introduced early this year) have the industry's first factory-installed electronics to support an automatic grade-reference system. Product Link and an entry-level AccuGrade system are options. The AccuGrade BHL Site Reference System adds position sensors to the backhoe's hydraulic cylinders and an inclinometer, which allow it to determine the position of the bucket relative to a known reference point, such as a grade stake, on the site. Caterpillar plans to introduce the BHL Laser System before year's end.

Number of models: 3

New models: 416E, 420E and 430E

Product-line features: Cat redesigned the frames, booms, sticks and axles for the E Series, and switched to an exterior-sliding extendable dipper stick. A new flow-sharing hydraulic valve meters oil evenly to all functions even when using several at the same time. Most backhoe forces increased 10 percent on the 420E and 430E.

For more information, visit ConstructionEquipment.com/info

JCB

Control Makeover Clears Floor

JCB refreshed its backhoe line's control system last August when it introduced JCB engines. One touch of a button activates JCB's pilot-hydraulic Precision Control System and an LED indicator confirms that the controls are active. Joystick control pods are mounted to the seat and can function even if the seat is not facing directly to the rear. JCB cleared the floor by moving the extendable-stick control to a switch on the right joystick, and the hammer-circuit control to a switch on the left joystick.

Number of models: 7

New models: 214, 214S, 215, 215S, 217 and 217S

Product-line features: The new JCB 444 four-cylinder, turbo-diesel has four valves per cylinder and direct fuel injection. The aspirated air cleaner uses fan suction to pull heavy debris from the intake, which JCB claims improves cleaning performance by 30 percent compared to the previous precleaner.

For more information, visit ConstructionEquipment.com/info

JOHN DEERE

Pilot Hydraulics on Larger Models

John Deere upgraded its two larger backhoe-loaders, the 410G and 710G, with low-effort pilot-hydraulic controls. The entire line is powered by Deere's wet-sleeve, Tier- 2-certified engines, although the 710G — the only backhoe-loader available with over 100 horsepower — is due for a repower before year's end to meet Tier-3 limits.

Number of models: 4

Product-line features: John Deere has adopted two different hydraulic-system approaches for its backhoe-loader line, reserving open-center circuits for the 310G and 310SG, but offering the fuel efficiency of closed-center systems with radial piston pumps and low-effort pilot-hydraulic controls on the 410G and 710G.

For more information, visit ConstructionEquipment.com/info

VOLVO

Standard Pilot Controls

In January, Volvo made pilot hydraulic controls standard equipment on the BL70, with mechanical controls available as an option. A new loader-control joystick features a proportional switch for auxiliary hydraulic control. The standard loader features a center-mounted bucket cylinder, but this year brings a new toolcarrier option for the loader featuring parallel lift and a hydraulic quick coupler for changing attachments.

Number of models: 2

New models: BL60

Product-line features: Volvo uses open-center hydraulics with a gear pump on the BL60 and a closed-center system on the BL70.

For more information, visit ConstructionEquipment.com/info

TEREX

Terex Goes All-Wheel Steer

Terex introduced the TX970B with all-wheel steer, four equal-sized tires, and a 15-foot backhoe at Conexpo last year. In February, Terex announced that pilot hydraulic controls would be standard on the TX970B and optional on the TX760B, TX860B and TX870B.

Number of models: 4

New models: TX970B

Product-line features: The Terex hydraulic design is unconventional, charging a closed-center system with a pair of gear pumps (most closed-center systems use a variable-displacement piston pump). A pressure-compensating valve senses the load in each circuit and automatically shuts down one pump when demand for hydraulic oil drops sufficiently.

For more information, visit ConstructionEquipment.com/info

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By WALT MOORE, Senior Editor

Chain-Type Trenchers

VERMEER

Vermeer's broad range of chain-type trenchers includes "ride-on" models with rubber tires and (more recently) rubber tracks, as well as large "track trenchers." The former category ranges in horsepower from 33 to 74, in maximum cutting depths from 48 to 60 inches, and in cutting widths from 6 to 18 inches. The latter ranges in horsepower from 125 to 600, in operating weight from 23,000 to 210,000 pounds, in cutting width from 7 to 48 inches, and in cutting depth from 6 to 18 feet. The 44-hp, fully hydrostatic RT450 shown here can dig to 60 inches and provides widths from 5 to 12 inches.

For more information, visit ConstructionEquipment.com/info

GROUND HOG

The T-4 trencher from Ground Hog is a small, operator-propelled, chain-type model designed for jobs requiring up to a 12-inch-deep trench. The machine uses replaceable carbide-tipped rock-type bits and will dig to widths of 3 to 3.5 inches. Three engine options are available: Briggs & Stratton; Honda and Robin.

For more information, visit ConstructionEquipment.com/info

ASTEC

The Astec line of chain-type trenchers ranges from a 13-hp walk-behind, to a 185-hp model also available with a rock saw. The 99.5-hp model RT960 shown here uses a hydrostatic ground-drive system that incorporates a two-speed hydraulic motor that drives through a two-speed planetary powershift transmission, allowing travel speeds to 10.5 mph. The machine features four-wheel steering, planetary axles and a hydrostatic, planetary-type trencher-drive system.

For more information, visit ConstructionEquipment.com/info

DITCH WITCH

Ditch Witch divides its line of chain-type trenchers into three categories: pedestrian (seven models); compact (three models); and heavy-duty (seven models). At the small end of the heavy-duty range is the RT55, powered by a 60-hp Deutz F4M-2011 diesel engine and featuring hydrostatic ground drive with planetary axles and optional four-wheel steering. The RT55 has an integral front counterweight that eliminates extended weight racks. The machine accepts chains from 6 to 12 inches wide and can dig to 62 inches.

For more information, visit ConstructionEquipment.com/info

PORT INDUSTRIES

The Hydramaxx HM2500 is a 38,000-pound, 425-hp machine that digs to 7 feet and has a trench-width spread from 10 to 28 inches. According to the manufacturer, the HM2500 features an "intermediate link design," which allows digging precisely to grade. The machine also features an automatic self-leveling system for trenching on slopes.

For more information, visit Construction Equipment.com/info

BARRETO

Barreto's all-hydraulic, walk-behind trencher line ranges from a 9-hp model with a maximum trench depth of 18 inches, to the model 1624-D4, which can trench to depths of 36 inches and to widths from 4 to 6 inches. The 1624-D4, available with a 16-hp Briggs & Stratton engine or a 13-hp Honda, features a four-wheel-drive system designed to improve traction in soft or slippery soil. The 1624-D4 weighs in at 1,000 pounds.

For more information, visit ConstructionEquipment.com/info

TRENCH-TECH

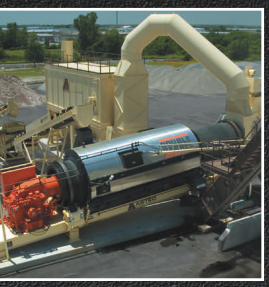
Horsepower ratings for the Trench-Tech line range from 275 for the model TT-2000, to 765 for the model TT-2700. Operating weight ranges from about 65,000 to 260,000 pounds. These big machines drive the trencher chain mechanically, via a proprietary four-speed system that, according to Trench-Tech, multiplies the engine's torque output by a factor of two. The TT-2700 shown here uses a Caterpillar 3412E diesel engine and provides boom-length options ranging from 8 to 24 feet. Cutting-width options range from 32 to 60 inches.

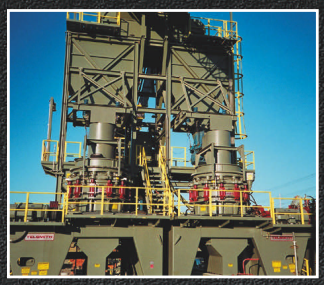
For more information, visit ConstructionEquipment.com/info

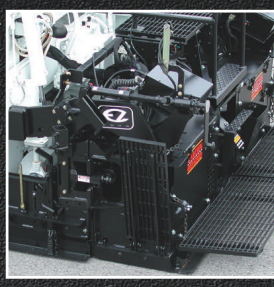
TRENCOR

Included in the Trencor chain-type trencher lineup are six models, ranging in horsepower from 250 to 1,500 and all featuring a mechanical chain-drive system that uses a multi-speed transmission and heavy-duty differentials. The model T1260HDE shown here has a 425-hp Caterpillar C15 diesel engine, can weigh up to 148,000 pounds, is available with chain widths from 16 to 42 inches, and is capable of digging to depths of 12 feet (at a 36-inch width). The T1260HDE can deliver chain speeds from 200 to 637 fpm.

For more information, visit ConstructionEquipment.com/info







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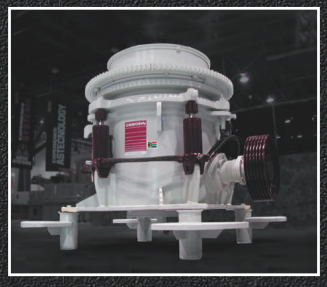

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For more information, visit www.ConstructionEquipment.com/RS and enter **32**

GEC

The GEC trencher is a small (275-pound) unit that is powered by either a 5-hp Briggs & Stratton engine or a 5.5-hp Honda. According to the manufacturer, George Evans Corp., the machine "digs a clean 3- or 4-inch-wide trench from 1 to 24 inches deep" and is suited to applications such as installing sprinkler systems, antenna systems and L.P. gas lines, as well as for handling general landscaping tasks. GEC models list for $1,907, or with the Honda engine, $2,227.

For more information, visit ConstructionEquipment.com/info

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PARSONS

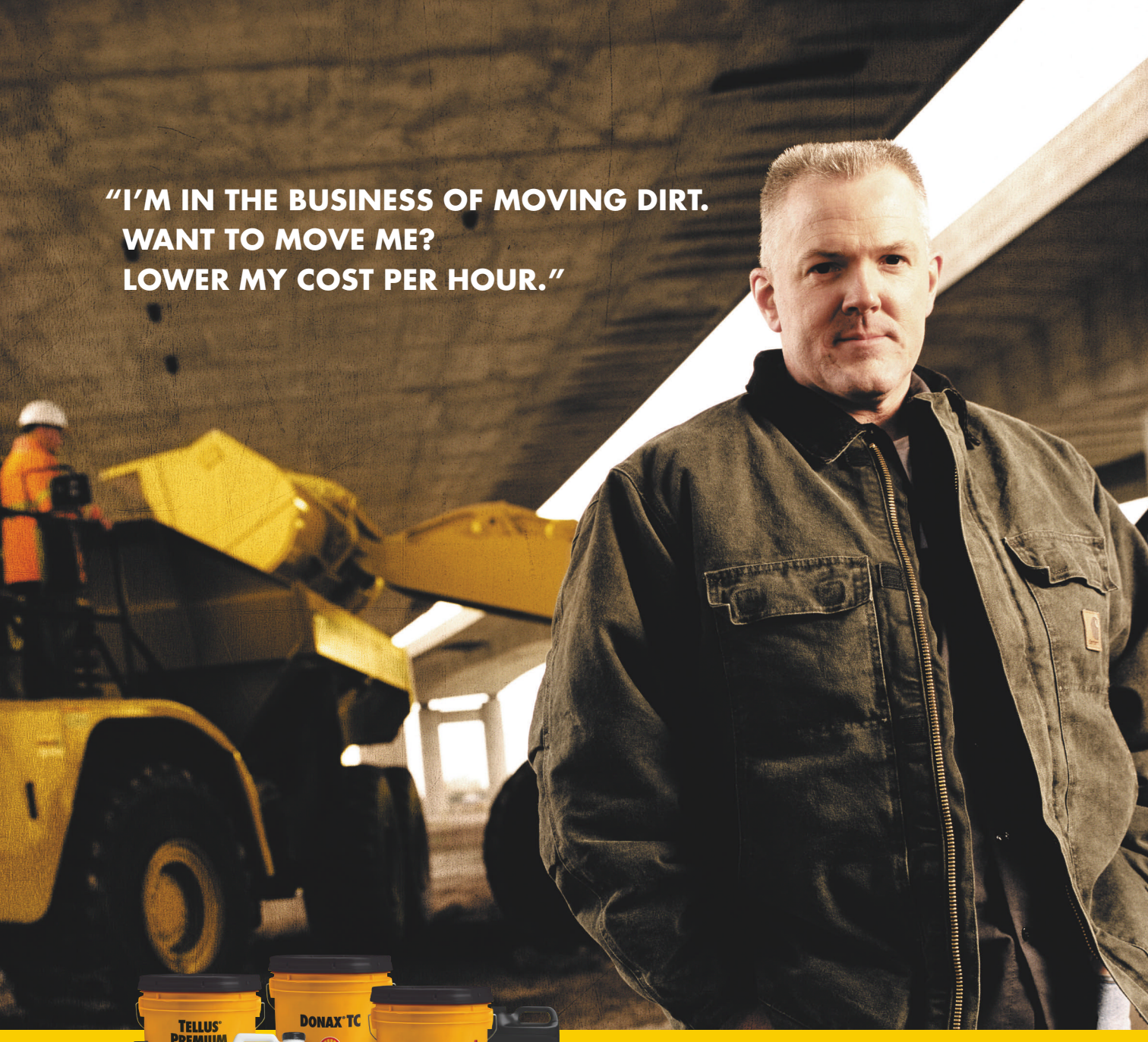
The Parsons trencher line, manufactured by Maxon Industries, includes six models, ranging in horsepower from 8 to 82 and in maximum digging depth from 30 to 108 inches. In the mix are three pedestrian and three ride-on models. The 700-pound T-130 shown here is the largest pedestrian model and uses either a 13-hp Honda or Briggs & Stratton engine. Digging widths range from 4 to 6 inches, and depths from 18 to 36 inches. It also has locking wheel hubs.

For more information, visit ConstructionEquipment.com/info

TESMEC

Big machines are plentiful in the Tesmec line of trenchers. The newest (and smallest), the TRS-700B Chainsaw, tips the scales at 29,000 pounds. This machine has 185 horsepower and is capable of depths to 8 feet in dirt, with widths from 10 to 18 inches. In rock, the machine can dig to 6 feet at widths from 8 to 24 inches. At the top end of the line is the 750-hp TRS-1675 Chainsaw, weighing as much as 268,000 pounds (depending on configuration) and capable of digging to 16 feet at a 60-inch width, and to 20 feet at 48 inches.

For more information, visit ConstructionEquipment.com/info



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NEW HOLLAND

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NEW HOLLAND

By MIKE VORSTER, Contributing Editor

Maintain the Aim

Keep in sight why an organization owns and operates equipment

Equipment managers play a critical role in a company's success. They manage and maintain the fleet as a major corporate asset and support construction operations by ensuring that equipment is available, reliable and able to complete construction on time and on budget.

They can, however, become so focused on equipment and equipment management that they lose sight of the fact that construction companies succeed by bidding competitively and producing safe, quality work. However much they may think otherwise, equipment management is not "the business." It is, or should be, a carefully focused organization with one principal objective: to provide efficient and cost-effective support to construction operations.

Personalities, experience, ambition and other factors often cause managers to lose sight of this and build empires or corporate organizations that focus more on internal score-keeping and politics than the real business of making money. When this happens, go back to basics, focus on why you own and operate equipment, and see how you can help the company succeed. Company success is all about getting work, building work and keeping the score.

Company success is all about getting work, building work and keeping the score

Getting work

Getting the work you want, when you want it and where you want it, is the first priority and requires that the company win at the bid table. Equipment costs and productivity can make the difference between success and failure; equipment managers must contribute. This is particularly true when it comes to setting owning-and-operating-cost rates. Nothing is achieved by taking two pages calculating an estimate for the cost of formwork for a bridge pier and then using a standard or inappropriate hourly rate for the scrapers that will be used to move 500,000 cubic meters of dirt.

Most companies base their estimates on standard internal equipment rates. These internal rates become an integral part of the estimating process, and conservative assumed values for factors such as utilization or residual market value can seriously impact a bid's competitiveness. Decisions, estimates or rules used to set internal equipment rates cannot be allowed to detract from the need to use accurate estimates based on hard data.

A conservative approach to residual market value is a good example. Many believe that it should be neglected in the rate calculation, "leaving the profit in the iron." The end result can easily be that the losses are in the jobs you never won due to unrealistic and overly conservative equipment-cost rates.

Another bidding problem arises when standard rates are not adjusted for jobs where equipment costs are likely to be different from the average experience built into the company's cost history. Average rates will cause estimators to under-cost the equipment and be competitive on jobs where actual conditions are worse than average, and over-cost equipment on easy jobs where costs or utilizations are likely to be better than average. The results can be disastrous: You win the jobs you do not want, and you seem to always lose the plum jobs where your fleet can really perform.

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

Equipment management fits in the cycle of work that fuels company success. Accurate costs enable estimators to bid competively enough to "get work." Traditional fleet management ensures the equipment is available to "do work." And tracking actual machine data enables managers to build accurate costs for use in the next bid.

The fact that internal rates have a direct impact on competitiveness means that rate setting cannot be based on arbitrary rules, conservative depreciation schedules, or procedures developed to balance the equipment account. Equipment managers must be directly involved, and they must ensure that rates reflect their best estimates for the actual owning-and-operating costs likely to be experienced.

Doing work

Completing construction on time and on budget requires that equipment managers achieve two basic goals. First, they must make sure that the right equipment is on the job at the right time, and second, they must keep it working with maximum reliability.

Having the right equipment, scheduling mobilizations, and ensuring that equipment is available at the right time requires more than water-cooler conversations and hurried phone calls. Equipment managers must be informed of needs well in advance and must work with projects to optimize utilization across the company as a whole. Planning, cooperation, and a commitment to the efficient use of company assets does more to improve fleet utilization and lower owning cost than any number of disincentives designed to charge projects for underutilized equipment.

Maximizing reliability and focusing on prevention rather than failure means that time must be set aside for preventive and mechanical maintenance when required. Equipment managers must ensure that the necessary downtime is scheduled, discussed and agreed to in advance and that impacts on production are minimized. Not every service needs to be performed at night or over the weekend. Similarly, not every service needs to be performed during a production shift. Again, cooperation, understanding and a focus on the company's best interests are better than complex rules as to who can stop a machine, when and for what reason.

Keeping the score

Equipment management is a data-intensive business. If you want to know the results, you must keep the score. Collecting accurate data and converting it into information improves decision making and establishes the benchmarks, standards and norms needed to move with confidence into the next "get work, do work" part of the cycle.

Accurate work-order-based machine histories that tell you what has been done, when and for how much are essential for planning the next repair, setting budgets, and establishing hourly rates. Data on hours worked, hours down and idle time drive fleet-assignment decisions, equipment-replacement decisions, and the entire job-costing process. Accurate fuel data underpins the preventive maintenance program and makes it possible to control a substantial portion of total operating cost. You simply have to keep the score: Your data are your eyes and ears.

Accurate equipment cost and performance records help the company in two ways. First, and most obviously, they help to measure performance and make decisions within the equipment group. Second, and more importantly, they establish the equipment rates used in estimating.

If a particular class of wheel loader has a rate of $80 per hour and actual costs total $70 per hour, then you need to do two things. First, congratulate the equipment group on a job well done, and second, have the confidence to use $70 per hour in your next bid. This places your company in a competitive position. If you do not know your costs, you simply cannot produce a competitive bid. CE

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(fig. 1)

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By LARRY STEWART, Executive Editor

Cat Pours on the Excavator Power

New D-Series excavators pack more diesel and hydraulic horses

Caterpillar had to reengineer its over-100-hp excavators because the EPA's Tier 3 emissions limits apply to that size class in 2007, but they wanted more marketable features than just cleaner engines. Surveying excavator customers revealed a simple, overriding expectation: Do more with less. Cat responded by adding engine power, hydraulic power and weight to its D Series machines so they could do more than the C-Series machines they replace.

The 322C L becomes the 324D L. The C's 3126B diesel is replaced by a C7, rated at 188 horsepower — a 12 percent increase that raises the 324 to the same power rating as the 325C. The 325D L also swaps the 3126B for a C7, this time rated at 204 horsepower, for a 9 percent increase in power. And the C9 in the 330D L has been turned up to 268 horsepower.

The D Series lifting mode increases hydraulic pressure to 5,080 psi for 5 percent more lifting power, while reducing flow to improve fine-motor control.

Caterpillar boosted hydraulic power by raising system-operating pressure to 5,080 psi. Stick digging forces have increased from 5 to 9 percent, depending on the machine, and bucket digging forces are up 4 to 13 percent. Cat claims the changes improve cycle times by 4 percent and bucket fill factor by 8 percent.

The C Series eliminated work modes but Cat reintroduced one mode, a lifting mode, for the Ds. It increases hydraulic pressure 5 percent to 5,080 psi to give the machine more power for heavier picks, while reducing flow to improve control.

The 325D L lays down 8 inches longer track than the 325C L, and offers a new 12 foot-4 inch stick option.

The optional Tool Control System for auxiliary work tools will now allow operators to store flow and pressure settings for 10 attachments using the monitor in the cab. The new Pin Grabber Plus is a cast-steel quick coupler to replace the fabricated coupler. The design is compatible with existing Cat work tools and many competitive attachments. It also allows the operator to turn the bucket around to use like a shovel.

The new monitor is a full color liquid crystal display that can be adjusted to minimize glare. The graphical display is easier to read and navigate than the C-Series monitor — for both operators and maintenance people.

To improve serviceability and reduce maintenance costs, hydraulic return-oil filter service is doubled to 2,000 hours. Oil-pressure and sampling ports have been added to the hydraulic system, and all electric wires and connectors on the D Series are color and number coded. Cat maintained the 500-hour engine-oil change interval on the ACERT engines without increasing oil-sump capacity.

Caterpillar officials say they do not plan any additional price increases over what was announced in January.

For more information, visit ConstructionEquipment.com/info

Basic Specifications:

Cat 324D L, 325D L, 330D L Excavators

	324D L	325D L	330D L
Operating weight	54,660 lb.[1]	64,460 lb.[2]	79,700 lb.[3]
Net power	188 hp	204 hp	268 hp
Bucket dig force (SAE)	36,644 lb.	39,566 lb.	42,376 lb.
Max. digging depth	24 ft. 1 in.	25 ft. 8 in.	26 ft. 10 in.
Track length	15 ft. 2 in.	15 ft. 11 in.	16 ft. 6 in.

[1]Base machine; reach boom, 9 ft 8 in. stick, 1.44 cu yd bucket, 32 in. shoes.
[2]Base machine; reach boom, 10 ft 5 in. stick, 1.44 cu yd bucket, 32 in. shoes.
[3]Base machine; reach boom, 12 ft 6 in. stick, 1.56 cu yd bucket, 32 in. shoes

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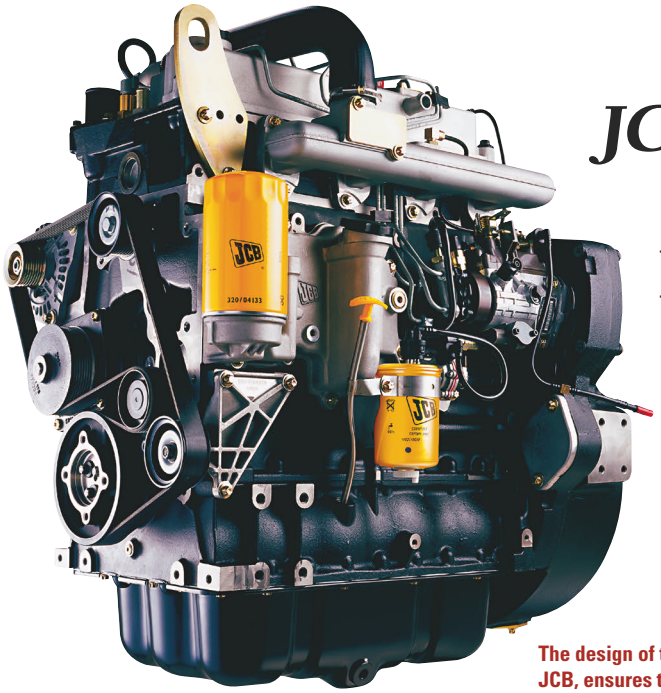
By WALT MOORE, Senior Editor



JCB Engine Update

Designed exclusively for off-road use, the 444 diesel engine now powers more than half of JCB's machines

The design of the new 444 diesel engine, says JCB, ensures that the mechanical, rotary-pump-type fuel system can be easily converted to a common-rail type to meet future emissions regulations.

Only 16 months ago, JCB began manufacturing its own 4.4-liter diesel engine at its new Dove Valley factory in Derbyshire, England, where production now stands at 100 units per day. At present, the new engine, Model 444, is used in more than half of the company's 220 different machines. According to JCB, the 444-engine project represents the largest single investment made by the company in its 60-year history — an estimated $140 million. The new engine was five years in development, says JCB, which included 100,000 hours of testing before its launch.

The production process at the Dove Valley facility, in fact, was developed simultaneously with the engine and is based on a "no faults forward" philosophy. This means, says JCB, that computerized control systems in the highly automated factory prevent an engine from moving to the next production station if a missing part or defective process is detected. In addition, every engine is "hot-tested" before shipment.

The design of the four-cylinder, four-valves-per-cylinder 444 is based on a 1.1-liter (67-cubic-inch) displacement per cylinder, with a bore of 103 millimeters (4 inches) and a stroke of 132 millimeters (5.2 inches). The performance range of the new engine includes 74- and 84-hp naturally aspirated versions, up to 100 horsepower in turbocharged trim, and 125 horsepower when a charge-air cooler is used with the turbo. Peak torque at 1,300 rpm is, respectively, 320, 425 and 525 Newton meters (236, 314 and 387 pounds-feet).

According to JCB, major design targets for the 444 included robust construction, high torque at low speeds, reduced sound levels and a basic architecture that would facilitate the next steps in emissions regulations. The 444, says JCB, uses a large crankshaft and an exceptionally stiff cylinder block, which is mated to a cast-iron "bedplate" that encloses the bottom of the block and accommodates the bottom half of the main bearings. The engine's structural stiffness reduces radiated noise, says the company, and the engine has an overall sound level of 89 dB(A) at one meter's distance at full load, and 78 dB(A) at idle. Further sound reduction results from rear-mounted timing gears and a specially designed oil pan.

Partners in the 444's development included Ricardo Consulting Engineers, AVL for combustion and emissions, and Cosworth (now Mahle Powertrain) for block and head machining. In due course, says JCB, an anticipated 20 percent of the 444's production may be marketed to third parties.

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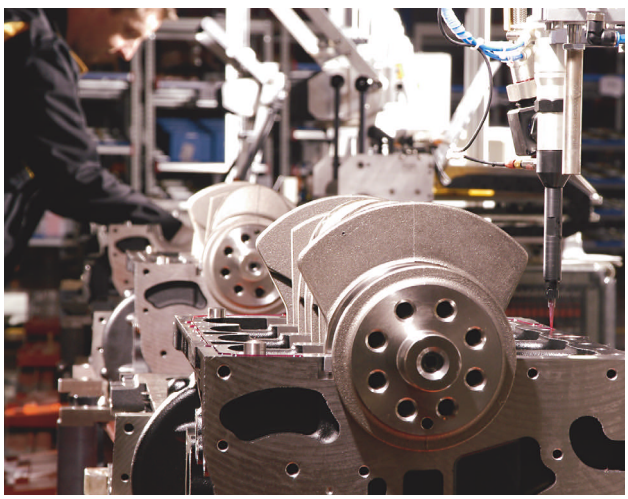

The highly automated Dove Valley factory uses a robotic machine to apply a precise bead of sealant to the bottom of the block before the bedplate is installed.

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By TOM BERG, Truck Editor

Toyota Tundra Is Bigger and Bolder Inside and Out

The ½-ton pickup will come with a choice of three cabs and two box sizes

Toyota's 2007 Tundra pickup will be bigger and bolder than the current model very much on purpose, as the company's extensive market studies showed that serious truck buyers want a large truck with strong work capability and lots of comfort. Thus the new model will be bigger in every direction, and it will be aimed at commercial users as well as consumers.

Market studies caused Toyota to make its upcoming Tundra larger in all dimensions to better compete with American Big Three pickups. The new Access Cab, shown here, has forward-hinged rear doors instead of the rear-hinged doors on the current model.

Executives with Toyota Motor Sales U.S.A. said the new full-size Tundra was designed and styled in America and will be built here, starting early next year. An Access Cab model displayed at a recent trade show is 10 inches longer, 5 inches higher and 4 inches wider than the current ⅞-size model, and is as big or bigger than the 150- and 1500-series American Big Three pickups which currently dominate the market.

The new Tundra will have a ½-ton payload capacity, as does the current model, but executives hinted that a ¾-ton version might come later. Tundra will come with a choice of three cabs and two box sizes, and be available with the current 4-liter V-6 and 4.7-liter V-8, plus a new 5.7-liter V-8 with a six-speed automatic transmission. High-capacity cooling and electrical systems, plus bigger disc brakes, and a heftier frame and suspensions will allow a Tundra with the 5.7 i-Force V-8 to tow up to 10,000 pounds, executives said.

Styling features a high hood and grill, a thick body with tall doors, fender flares and "character" lines, all to emphasize the ideas of size and power. The tailgate has dampers that ease it down and help raise it with only a few fingers. Gloved hands can easily work the large door handles and HVAC knobs.

Regular, Access and Double cabs will have more leg, shoulder and hip room than now. The new Access cab's rear doors will be hinged at the front, like the Dodge Ram Quad Cab.

The new i-Force 5.7-liter V-8 will be built in Alabama, as the current 4.7 V-8 is now. The new Tundras will be assembled in Indiana and Texas.

New Tundra's roomy interior will come in Base, SR5 and Limited (shown) trim packages. Large HVAC knobs are designed to be worked with a gloved hand.

Interiors will come in Base, SR5 or Limited trim levels, with standard and optional comfort and convenience packages as well as electronic equipment to suit individual buyers.

Executives hope to capture more commercial business with special fleet incentives, which are still being formulated and will be announced later. Meanwhile, they are pushing the workability of the current Tundra's regular cab with the 8 foot-2 inch bed. The truck bed is also 49 inches between wheel wells, so it can flat-carry 4x8-foot sheets of plywood or wall board, and up to 2,025 pounds of them, in spite of the truck's slightly more compact dimensions in other respects. Toyota executives underscored their new commitment to commercial customers by displaying that model and a prototype of the bigger Tundra at the National Truck Equipment Association's recent Work Truck Show in Atlanta.

As with current Tundras, the new vehicles will be assembled in Toyota's truck plants at Princeton, Ind., and San Antonio. The 5.7-liter V-8 will be built at the company's Huntsville, Ala., engine plant, which has been building the 4.7 V-8 since May 2003. Toyota's reputation for high build quality and vehicle durability have not been enough for the current Tundra to make serious inroads in the Big Three's pickup sales, but Toyota executives hope that will change with the new truck's large size.

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By LARRY STEWART, Executive Editor

Radio-Controlled Trowel Finishes 4,000 Square Feet a Day

Ninety-pound, radio-controlled dynamo works without requiring anybody to set foot on the slab

Tibroc says its Radio-Controlled Concrete Finisher can finish 4,000 square feet of concrete per day without requiring anybody to set foot on a slab. Forward, backward, rotation right and left, slide right and left, trowel speed and pitch are all controlled from a six-channel transmitter operating at 75 MHz. The remote control has a range of ¼ mile.

Trowel speed is variable from 1 to 120 rpm, and trowel pitch can be varied from 0 to 35 degrees. Electric motors adjust trowel pitch according to the operator's input from the remote control.

The Radio-Controlled Concrete Finisher is powered by a 50cc, 2.5-hp, four-stroke Honda engine. The spiders are chain driven, and the finisher carries an electric generator to supply DC power to its electrical components. Dual gyroscopes are built in for stability.

The hand-held remote control is powered by rechargeable batteries, and it comes with chargers and a protective aluminum case.

Tibroc's finisher is assembled in the San Diego area and retails for $4,999.99. Chris Corbitt, from Tibroc, says the company designed its first unit around residential-construction applications. Keeping its weight down to 90 pounds — about half that of most walk-behind power trowels — makes the unit light enough for one person to handle. He says larger models are on the drawing board.

For more information, visit ConstructionEquipment.com/info

Basic Specifications

Weight	90 pounds
Length	40 inches
Width	22 inches
Trowel speed	1 - 120 rpm
Trowel pitch	0 - 35 degrees
Remote	6-channel transmitter @ 75 MHz, ¼-mile range
Engine	2.5-hp Honda

Aluminum and stainless-steel construction keep the Radio-Controlled Concrete Finisher light and corrosion resistant.

Tibroc says one of its Radio-Controlled Concrete Finishers can outwork 10 men working manually.

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By TOM BERG, Truck Editor

Volvo's 2007 Engines Include Three Models And 22 Ratings

Although there will be a $7,500 surcharge, the new engines with horsepower ratings from 325 to 600 will be more fuel efficient

Volvo Trucks' 2007-model diesels will include three displacements and 22 ratings from 325 to 600 horsepower, all replacing its current model and one designated to go in its vocational VHD truck and tractor.

Most engines will be more fuel efficient than the current D12, but the high cost of developing the products to meet stricter exhaust emissions limits will be passed on to customers via a $7,500 per truck surcharge, the builder's executives said. By federal fiat, all '07 diesels begin production after Jan. 1, so will begin showing up in '07 trucks a month or two after that.

The new engines will include a D11 and D13, which will replace the current D12 by year's end, and the previously introduced D16. The D13 is the only engine to be offered in the vocational VHD series. Volvo will continue to offer the Cummins 15-liter ISX in '07 form in certain truck models.

The 12.8-liter D13, which will be Volvo's highest-volume engine model, will have eight ratings from 335 to 485 horsepower and 1,350 to 1,650 lbs.-ft. It weighs 2,550 pounds dry and will be used in VN tractors and in the VHD truck and tractor. The 10.8-liter D11 will come in seven ratings from 325 to 405 horsepower and torque of 1,250 to 1,450 lbs.-ft. At 2,175 pounds dry, it will be Volvo's lightweight engine and offered in VN highway tractors.

The 16.1-liter D16, introduced a year ago, will continue with updates for '07. It will have seven ratings from 450 to 600 horsepower and 1,650 to 2,050 lbs.-ft. Maximum horsepower will be 25 less than now and top torque will be down by 200 lbs.-ft because of the turbo's limited ability to deliver inlet air at '07 specifications. As now, the D16 will be available in long-hood VN highway and VT heavy-haul tractors. It weighs 3,070 pounds.

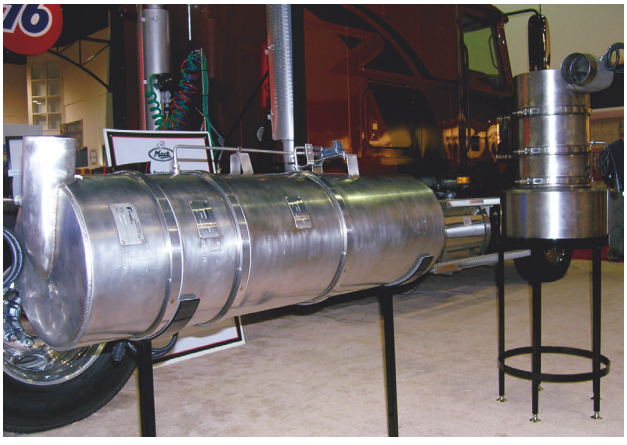
Volvo's diesels use the same "architecture" as MP series engines previously announced by Mack Trucks, Volvo's sister company. The two companies' engines will differ in operating characteristics, but all will be built at Volvo Powertrain's Hagerstown, Md., factory, which was refitted to produce them.

Volvo expects its upcoming D13 to be its highest-volume '07 diesel. It will be used in VN highway tractors and the only engine offered on the VHD vocational series. The D13's eight ratings range from 335 to 485 horsepower.

Like the D12, Volvo and Mack's new engines will use a variable geometry turbocharger with a sliding nozzle, an overhead camshaft, four valves per cylinder, one-piece rigid-deck cylinder head, and dual-solenoid fuel injectors.

To these were added a viscous damper on the camshaft and rear-mounted gear drain, which absorb torsional vibrations and route them to the flywheel; ultra high-pressure fuel system, with fuel injected at up to 35,000 psi; "precision flow" exhaust-gas recirculation, with a low-mounted jacket-water gas cooler; and steel "ladder" reinforcement of the main bearing area to handle higher combustion pressures.

There'll also be a dual-element diesel particulate filter, or DPF, which doubles as a muffler. This includes an oxidation catalyst to neutralize carbon monoxide, a "monolith" filter to strip out soot particles, temperature sensors to monitor regeneration that burns off the particulates, and inlet and outlet modules.



Horizontal and "compact" vertical diesel particulate filters will trap engine soot and ash, and double as mufflers. Both Volvo and Mack will use these exhaust aftertreatment devices.

Mack will also use this DPF, which will be made by Fleetguard. The device will be offered as a stack-mount unit and a "compact" version that will hang on the frame under the hood, just behind a truck's right-front tire.

Regeneration to burn off soot will occur passively, accomplished by high exhaust heat as the truck goes down the road, and actively, by using small injections of diesel fuel. Ash particles from motor oil will also accumulate in the filter, and will have to be periodically removed by compressed air in a special machine. This will require removing the DPF for servicing every 100,000 to 200,000 miles, depending on how the truck operates.

All models will need ultra low-sulfur diesel fuel to allow DPFs to live and meet the upcoming exhaust emissions limits. These will lower nitrous oxide, particulates and other exhaust ingredients by 90 percent or more.

Common architecture and design among the three engine models, and even some common parts, will allow technicians to service and repair the diesels using similar techniques, Volvo executives said. Reduced service and repair times should result from placement of parts and components for easy access and replacement.

Oil-drain intervals are up to 30,000 miles for the D11, up to 45,000 miles for the D13, and up to 50,000 miles for the D16. All will require CJ-4 motor oil, a new type that, like the ultra low-sulfur fuel, will be available later this year.

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Market Watch Lite

By HEATHER BURLINGAME, Senior Production Editor

We're making it quicker for you to obtain more information on products by going to ConstructionEquipment.com/info. Sign up for our monthly MarketWatch eNewsletter at ConstructionEquipment.com.

Loegering

The Versatile Track System (VTS) is now available for skid-steers with wheelbases less than 42 inches and engines in the 42- to 65-hp range. VTS rubber-track undercarriage is a bolt-on system for use on any brand skid-steer loader, the company says. Available with 12- or 15-inch-wide tracks, VTS can be bolted directly to the hubs in less than one hour. Adjustable components allow the system to be used on different machines.

For more information, visit ConstructionEquipment.com/info

MBW

The GP3550 travels 20 percent faster than the GP3000 it replaces, moving 110 fpm. Amplitude increases by 10 percent, and overall weight was cut by 15 pounds. Deck has a full roll cage with an optional water tank for asphalt compaction. Base plate is self-cleaning with an open-sided design that allows material to flow out and away from the belt/pulley assembly. As of January 2006, MBW will be changing its model designations. Models for soil compaction will have a GP prefix; asphalt machines will have an AP prefix.

For more information, visit ConstructionEquipment.com/info

Stanley LaBounty

Stanley LaBounty's MSD Series now has an automated blade-lubrication system, the Saber-Lube. The company asserts that the system doubles blade life, and cuts build-up welding time on the affected jaw areas in half. Lubrication allows the system to convert blade friction to usable cutting power, increasing it by 8 percent.

For more information, visit ConstructionEquipment.com/info

Morbark

The D 76 SP four-wheel-drive stump grinder has a 76-inch boom swing arc for more grinding and less repositioning, says Morbark. It transfers 95 percent of the power from the engine to the cutter wheel, and the hydrostatic system has 3:1 cooling capacity. The cutter wheel has a hexagon shape for low resistance and friction. Eight cutter teeth have four cutting edges each, which can be rotated for maximum life and changed quickly. It is powered by a 62-hp Caterpillar diesel.

For more information, visit ConstructionEquipment.com/info

Subaru Robin

The RGX Series generators joins the Power and Silent series. The compact gasoline units provide maximum outputs from 2,900 to 4,800 watts. Models with horsepower: RGX 2900, 6 hp; RGX3600, 7 hp; RGX4800 and RGX4800E, 9 hp. All but the RGX4800E has a standard electric start; the others have recoil start.

For more information, visit ConstructionEquipment.com/info

Amulet

StickGrip is a weld-on attachment designed to provide a low-cost grip for an excavator bucket, the company says. It provides a grip profile on the machine's lower dipper stick.

For more information, visit ConstructionEquipment.com/info

Market Watch Lite

Wacker

CT 36-9 and CT 36-8A walk-behind trowels feature 8- and 9-hp Honda engines and the necessary torque for low-speed floating. Other features include the gyroscopic safety sensor, gearbox brake and engine limiter combination to protect operators from a runaway handle. All models sport a new Pro-Shift pitch control, which offers infinitely variable transition for smooth pitch control. The design requires less force than before to adjust blade pitch over a range from 0 to 30 degrees. Handle options include one that adjusts easily to accommodate different operators' heights and a folding handle for easier storage and transportation.

For more information, visit ConstructionEquipment.com/info

General Equipment

The 240 hole digger is the first with four-stroke engine, says the company. Subaru Robin EH035 gasoline engine delivers 1.6 horsepower. Industry-standard 1-inch-diameter driveshaft connection accommodates earth augers from 2 to 8 inches in diameter. List price: $695; standard product warranty is 2 years.

For more information, visit ConstructionEquipment.com/info

Trimble

The SPS700 Robotic Construction Total Station, when used with its LM80 Layout Manager, allows contractors to perform layout tasks significantly more efficiently than with conventional mechanical systems, the company says. New robotic technology provides increased speed and longer battery life. It has direct reflex reflectorless distance measuring capability for one-person operation without a prism to measure inaccessible points and minimize manpower.

For more information, visit ConstructionEquipment.com/info

Blastrac

The 1-9DEZ portable, lightweight shot-blasting system prepares concrete surfaces prior to coating. It runs on 120-v power, and strips, cleans and profiles in one step, the company says. With a 9-inch blast pattern and a manual travel speed, it can prepare up to 275 square feet per hour. List price is $7,995, and it carries a one-year warranty.

For more information, visit ConstructionEquipment.com/info

Crysteel

Crysteel has three new dump bodies for the landscaping contractor. Landscape Tipper has a swing-out side door with a built-in retractable ladder for easy entry to the body. Deuce two-way dump body combines rear dumping and side dumping in one body. Using the side-dumping feature means an equipment trailer can stay attached to the truck, saving time. Conventional Tipper E-Series is a 2- to 4-cubic-yard body. Each carries a five-year warranty.

For more information, visit ConstructionEquipment.com/info

Stihl

The TS 800 Cutquik cut-off machine uses a 6.7-bhp, 98.5-cc stratified charge engine and 16-inch wheel for 9,000 rpm of cutting power. Five-point, dual-element antivibration system reduces fatigue. Long-term air filtration system minimizes downtime, maintaining 99.96 percent cleaning efficiency.

For more information, visit ConstructionEquipment.com/info

Ground Heaters

The Pureheat 1260 hydronic air heater produces 20 percent more heat than its companion model, the Sahara. Three Heat Xchangers are available: HX200 produces 200,000 Btu/hour; HX100 produces 100,000; or the HX50, at 50,000 Btu/hour. A variable-speed blower allows for heat to be provided where most needed. For jobsite compatibility, the unit runs on three different fuels: diesel, propane and natural gas. Conversion can be done in the field, in minutes, the company says.

For more information, visit ConstructionEquipment.com/info

Multiquip

The Moonlight unit inflates in seconds, and a plug maintains air pressure without the need for a fan. Rising to 10 feet high, lighting systems are available in 150-, 400- and 1,000-watt outputs and illuminate up to 100 feet. Bulbs last up to 10,000 hours, the company says, and they are stable in winds up to 55 mph.

For more information, visit ConstructionEquipment.com/info

Topcon

The GPT-8203M long-range reflectorless total station is designed for layout of formwork, structural components, anchor bolts, and other elements requiring accurate positioning, the company says. Onboard software and servo-drive help automate point stakeout. Reflectorless measurements can be made up to 1,200 meters; 7,000 meters with a standard prism.

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Market Watch Lite

Toro

For use with Toro Dingo utility loaders, a trench-filler attachment allows operators to fill trenches in a single pass. The unit has two sets of opposing augers that direct the spoils from the sides of the trench back into the hole. It then levels off the work area as it continues to push material forward, quickly filling the trench.

For more information, visit ConstructionEquipment.com/info

Komatsu

Komatsu replaced blended cellulose/synthetic hydraulic-filter media with 100-percent synthetic media, making its

filters longer-lasting and cleaner to replace. Eco-White filters are good for 1,000 hours of service, instead of the 250-hour change interval recommended with cellulose filters, and they more than double oil service life to 5,000 hours. They're half the size of cellulose filters, so they don't hang down in the hydraulic oil in the tank. The filter comes out relatively dry, rather than dripping contaminated oil into the tank.

For more information, visit ConstructionEquipment.com/info

Hilti

PR 25 Rotating Laser features an all-in-one remote control/receiver and a visible beam for indoors and weather protection for outdoors. It can be used horizontally, vertically, with an incline, and for laying out 90-degree angles. The PRA 25 remote/receiver can control the PR 25 from up to 325 feet away.

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Atlas Copco

The LHD 23 M hydraulic rock drill is designed for drilling, blast, anchor and rock-splitting holes. Weighing 54 pounds, the unit provides a high power-to-weight ratio with 48 ft.-lbs. of torque. Energy generated by the drill produces an impact rate of 2,400 to 3,000 blows per minute. Operator kickback is prevented by a built-in torque limiter.

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Wacker

The hybrid head series for HMS flex-shaft concrete vibrators combines round-head and square-head technology, which Wacker claims will move as much as 25 percent more concrete for better consolidation and high-speed liquification. The series includes the H 25HA (1-inch diameter), H 35HA (1 3/8-inch diameter), H 45HA (1 3/4-inch diameter, and the H 50HA (2-inch diameter), which replaces the H 55. An extended transition from square to round allows for easy removal of the vibrator head from narrowly placed reinforcement rods.

For more information, visit ConstructionEquipment.com/info

Bobcat

The snow-pusher attachment is available in 94- and 120-inch widths. The blade floats 2.3 inches vertically and tilts 12 degrees with +/- 4.5-degrees for pushing snow along the contour of the ground. The unit has abrasion-resistant skid shoes and a rubber cutting edge. A rear cutting-edge support provides durability by strengthening the cutting edge and the moldboard.

For more information, visit ConstructionEquipment.com/info

Leica

The SmartRover weighs 30 percent less than all other on-the-pole RTK GPS surveying instruments, according to company. It weighs 6.16 pounds. Consisting of the AT1230 SmartAntenna and 1250 Controller, SmartRover is designed for use with the SmartStation total station with integrated GPS.

For more information, visit ConstructionEquipment.com/info

Fleetguard

Fleetguard introduced a "user-friendly" filter design, using polymers to make it more dent-resistant than metals. Current filters in the FF, FS, LF and MK series will be replaced by new numbers with the same letter prefixes. These will be for applications on Case, Ford, GMC, International, Komatsu, KHD, Volvo and other engines. Filters have an easy-grip surface with ribs, flat "no-spill" bottom, and built-in one-way socket for removal with a 1/2-inch wrench.

For more information, visit ConstructionEquipment.com/info

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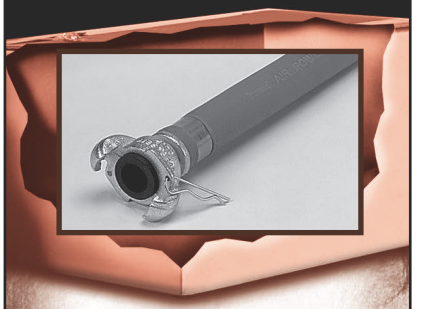

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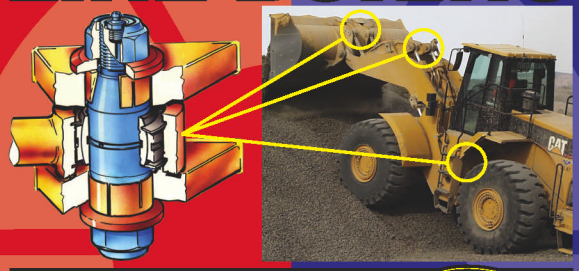

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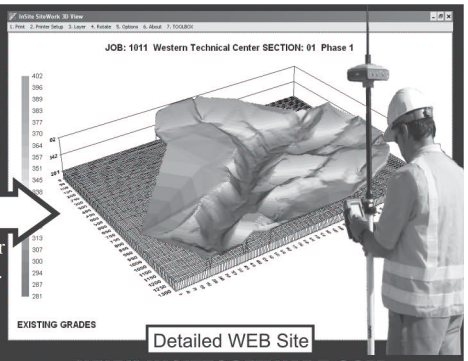

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By KEITH HADDOCK, Contributing Editor

Moore Speedcrane

This small niche-market crane became the forerunner of Manitowoc's modern line

After World War I ended, the Manitowoc Shipbuilding Co. of Manitowoc, Wis., started to look to diversify its product base. Spurred on by government contracts during the War, the shipbuilding side of the company's manufacturing facilities had quadrupled since its founding in 1902. The company had purchased the Manitowoc Steam Boiler Works and Manitowoc Foundry to expand its manufacturing capability.

In the early 1920s, as wartime government orders diminished, management found increased difficulty in utilizing the modern machine shop and other facilities built during the war.

Founding officers Charles C. West, Elias Gunnell, and L.E. Geer also owned an interest in the American Sand and Gravel Co. They observed a fleet of mobile cranes called "Speedcranes" busily excavating and loading materials. They concluded that the manufacture of these cranes would be just the thing to keep the machine shop busy.

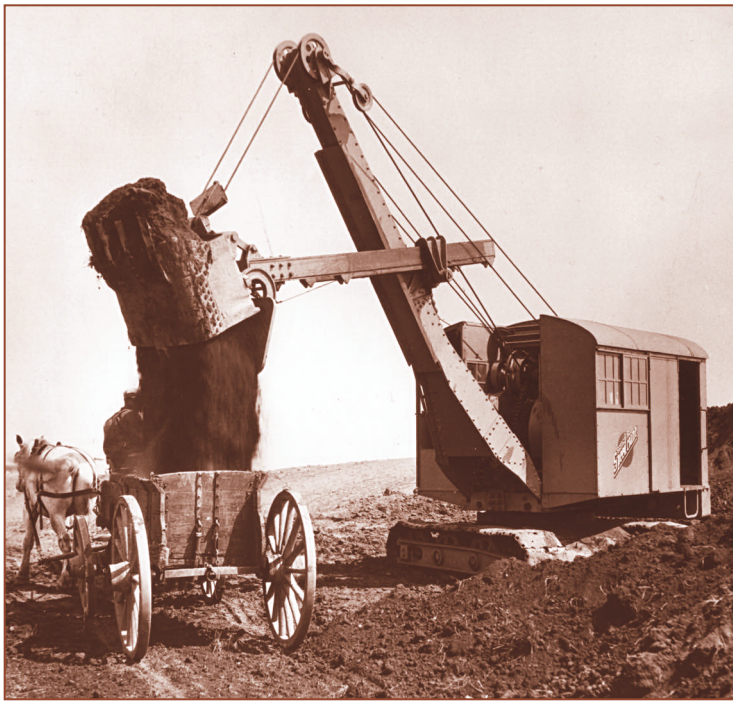
The cranes were built in Fort Wayne, Ind., for Roy and Charles Moore of Chicago, and they were interested in obtaining a new manufacturer. In 1925, Manitowoc Shipbuilding agreed to manufacture the cranes under the Moore patents. Roy Moore joined the Manitowoc staff as crane designer.

The Moore "Speedcrane" was a steam-powered, wheel-mounted machine that could operate as a 15-ton crane or carry a ¾-yard bucket. The first crane built in Manitowoc's factory was sold to the Reiss Coal Co. of Sheboygan, Wis., a long-time coal supplier to Manitowoc Shipbulding, for use as a material handler in its yard.

The crane worked well, but changes had to be made. Steam power was losing ground to internal combustion engines, so Moore soon redesigned his crane to accommodate a gasoline engine. He also beefed up the design with cast steel carbody to replace the original riveted construction and, because of Caterpillar's tractor success, introduced a crawler base for increased stability and traction.

The new machine, the first true Manitowoc universal crane/excavator, could be converted to operate as a crane, shovel, dragline or trench hoe. It was launched in 1927 as the model 125 (later called the 1500) with 1¼-cubic-yard capacity.

From this early model, Manitowoc gradually introduced a wide range of cranes and excavators incorporating the latest technology. A new drum clutch claiming superior smooth application to handle heavy loads more gently was designed, and a disc-type swing clutch was developed to lessen the wear and tear on clutches due to heating. In 1932, Manitowoc introduced the completely redesigned 1½-yard model 150 (later renumbered the 3000). In 1936, the former 1500 was upgraded to the 2000, a fully convertible excavator powered by a 115-hp engine and weighing just over 42 tons as a shovel.



The Moore Speedcrane could be converted to operate as a crane, shovel, dragline or trench hoe. Here, one operates as a shovel in 1928..

In order to fulfill a major submarine-building contract during World War II, Manitowoc's crane division built two Model 3900 cranes capable of lifting 30 tons at a 30-foot radius, its largest cranes to date. The 3900 and its upgrades remained in the product line for some four decades, and larger models of similar design were produced.

In the 1960s and 1970s, Manitowoc created an enviable name for itself in the surface-mining industry with its large diesel-powered shovels and draglines. Today, Manitowoc remains a world leader in heavy-lift cranes with capacities reaching to 1,000 tons.

You can read more about the evolution of construction equipment in Keith Haddock's illustrated books available in most bookstores. Also, consider a membership in the Historical Construction Equipment Association, www.hcea.net. Be sure to visit ConstructionEquipment.com for past Iron Works features.

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	DX300	DX340	DX420*	DX480
Operating Weight (lbs.)	66,579	76,721	92,370	106,900
Net Engine HP (SAE1349)	197	247	293	328
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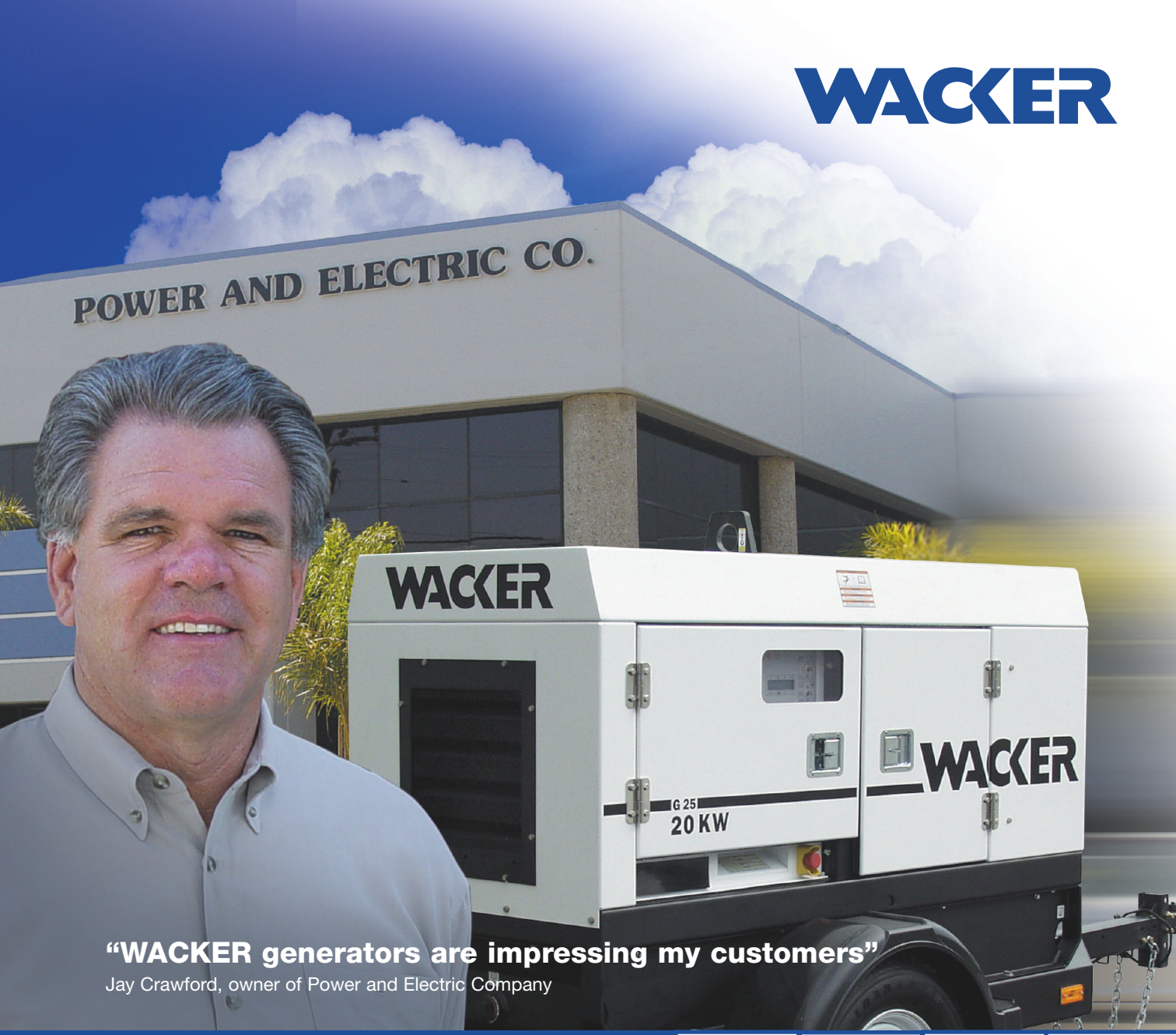

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