

Fully loaded

With business booming in the surface loading sector, Anna Hayes reviews the equipment on offer

While large rope shovels remain the tool of choice where mine operators need to move large volumes of waste material and/or ore, hydraulic excavators appear to be gaining ground in many markets and wheel loaders remain popular in smaller mines and quarries.

There are reports of rising demand for large rope shovels from former developing regions such as Brazil, Russia, India and China, particularly where the life of a mine is anticipated to be long and there is greater availability of reliable power.

"The paradigm is clearly shifting. Where there once was limited investment in smaller-capacity mining equipment and systems, there is now a willingness to invest in smart, productive, best-in-class mining technology that delivers low cost-per-ton performance," according to Diane Lane of P&H Mining Equipment.

"With greater electric power availability, mines in those regions are positioned to seize the economic advantages of applying electric mining shovels."

Ruth Haws, product manager, electric shovels, at Bucyrus, also tells *Mining Magazine* of higher demand for shovels. "We are seeing increasing electric mining shovel interest in large, long-life mines located in markets that traditionally purchased hydraulic equipment, especially in Southern Africa," she says.

However, hydraulic excavators and wheel loaders are gaining ground in some markets. According to the Liebherr Mining team, hydraulic excavators are replacing smaller-capacity rope shovels in many mines in Russia: "Lots of our Russian customers are new customers who want to replace old rope shovels, equipped with bucket capacity below 50m³, by hydraulic excavators."

This is confirmed by IMZ-Kartez moves to expand its range of larger rope shovels.

Randy Aneloski, marketing specialist at Caterpillar Global Mining Division, tells *Mining Magazine* of growing demand for wheel loaders: "Caterpillar large wheel loaders are now selling at, or near, record levels as mining companies increase production in response to high minerals commodities prices. Large wheel loaders continue to be a part of almost every mining plan due to their mobility and versatility, compared to rope shovels and hydraulic excavators."

However, demand does vary across different

regions, according to David Nus, global segment director, mining, quarry and aggregates, at Volvo: "Wheel loader/excavator preference varies a great deal around the world and is related to culture in many places. If anything, Volvo sees an increasing tendency for excavators in mining applications," he says.

"Business is quite strong in industrial minerals, where we actually see a slight trend to smaller wheel loaders if anything. There is a recognition that bigger is not always better and comes at a cost. As equipment becomes more reliable, efficient and productive across the board, some have found they can downsize one step and still do the job, but at a lower cost basis."

The emphasis is more about getting the right range of products to improve mine productivity, according to Christian Shorr-Golsong, product marketing manager, hydraulic excavators, at Bucyrus: "All shovel types have their specific advantages and hence their place in the mine. What we see is that customers carefully check the overall situation and needs of the mine and, together with Bucyrus, detailed analysis is performed to determine the most cost-efficient solution."

ELECTRIC ROPE SHOVELS

The electric rope shovels market is dominated by three major manufacturers – P&H, IZ-KARTEX and Bucyrus.

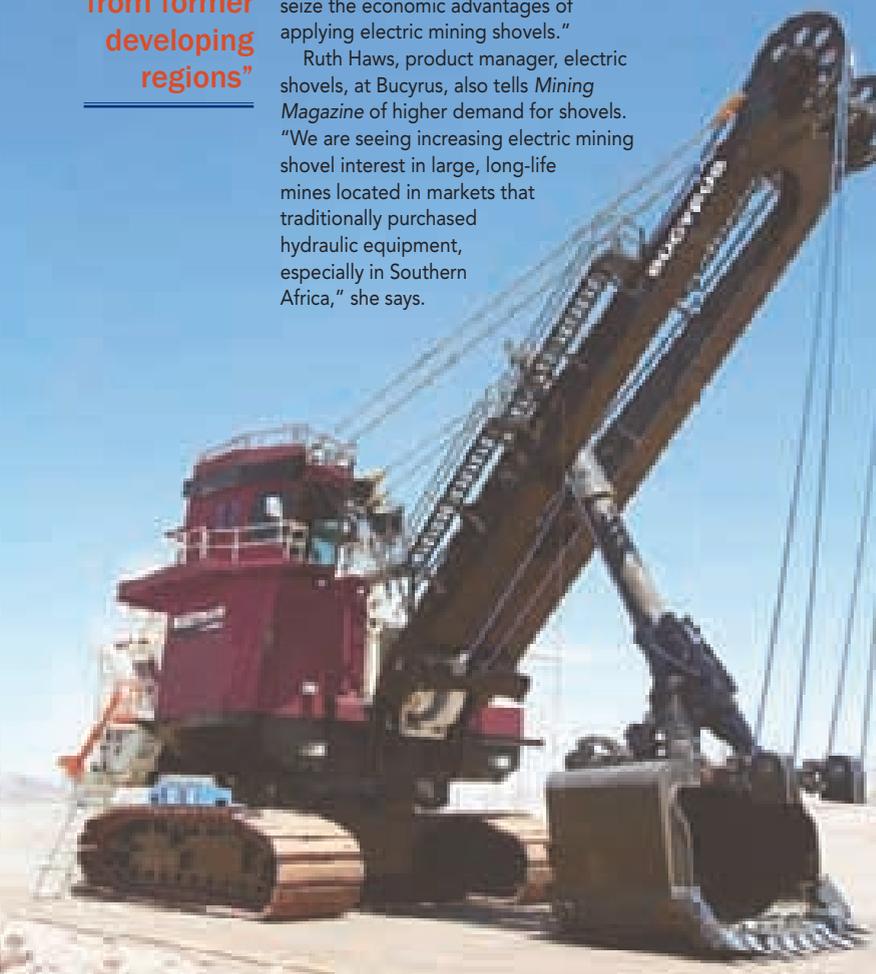
• P&H Mining Equipment

P&H Mining Equipment offers a range of six electric mining shovels of nominal dipper capacities, from 25.5-61.2m³, and typical payloads of 45.4-108.9t. P&H shovels are equipped with performance-optimising dippers, tailored to the mining environments in which they are deployed.

P&H has engaged with mine operations management and a mining engineering research partner to develop high-efficiency dippers for coal overburden and hard-rock copper ore-loading operations. These dippers feature fast-fill and reduced-energy performance, which help mines to increase productivity. A new dipper optimised for oil-sands loading operations is soon to be introduced.

Modular components and systems enable simpler and faster assembly, inspection, maintenance and upgrades, while the electrical and mechanical systems

"There are reports of rising demand for large rope shovels from former developing regions"



Bucyrus 495 HR2 electric rope shovel



Hitachi EX2500 hydraulic excavator

are designed and built to withstand severe-duty mining environments.

Historically a provider of DC-drive machines, P&H is upgrading its range with high-performance AC-drive systems from ABB. The move to AC was supported by the introduction of P&H Centurion supervisory control and data-acquisition (SCADA) technology. The 4100C BOSS shovels, used extensively in oil-sands loading operations, were the first to be upgraded to AC drive. In 2010, AC-drive 4100XPC shovels began to be deployed, and AC-drive 2800XPCs will soon follow.

P&H 2800-class shovels are the best-sellers, but sales of the 4100-class shovels are reaching similar levels. The 2800 shovels are well matched with 181t haul trucks, while the 4100-class shovels offer three-pass loading with 218t haul trucks.

The firm reports good demand in all major mining regions, particularly in South America. P&H shovels are being used in copper, coal, iron ore, oil sand and gold operations.

• Bucyrus

Bucyrus offers AC IGBT drive technology as standard across its range of six electric rope shovels: 495HR², 495HF², 495HD, 395HR, 295HR, 295HD and 182M. The machines offer payloads of 18-109t.

The latest model, the 495HR², is a 109t payload machine. It features a redesigned Bucyrus cab; free-floating, tubular handle front end with deck-mounted crowd machinery; planetary propel; swing and hoist gearcases. It is also available with the HydraCrowd and LatchFree dipper systems, which improve machine productivity and reduce downtime.

The LatchFree dipper system, launched in 2009, eliminates the latch assembly, replacing it with a strong, steel link that is mounted to the dipper back – away from material flow. The system reduces maintenance time and increases reliability by reducing unplanned downtime.

The HydraCrowd system extends the major maintenance interval to two years. It uses a hydraulic cylinder, rather than crowd/retract ropes, to move the dipper in and out.

The redesigned cab is the product of a multi-year collaboration between Bucyrus, mining companies and shovel operators. It offers a smooth, comfortable ride with an ergonomic, adjustable operator's seat with fully pneumatic suspension system, low-effort joysticks and dual display screens optimised for driver comfort. It also enhances safety with line of sight, dual ingress/egress doors, and a second trainer emergency stop. Bucyrus is also looking at retrofitting older cabs with its new operator's seat and controls.

The 496HR², along with the 495HF² and 495HD versions, are the most popular Bucyrus shovels, offering exceptional productivity and resulting in low unit removal costs.

• IZ-KARTEX

IZ-KARTEX, part of OMC, offers the EKG range of electric-drive quarry crawler shovels. Over the past decade, IZ-KARTEX has supplied more than 240 shovels, mainly to Russia and CIS, with only 7% going to the export market.

The company particularly supplies products to Russia, Ukraine, Kazakhstan, Uzbekistan, Mongolia, Vietnam, Korea, China, India and Iran. Some 39% of shovels are in use in ▶

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- coal mines, 33% are with non-ferrous metal operators and 24% in use for iron ore.

IZ-KARTEX is the only company to offer unified shovels of 18-20m³ and 23-35m³ capacity. It also offers customers a choice of rope, or rack-and-pinion systems, based on the same platform. Until 2009, IZ-KARTEX only made shovels with bucket capacities of 8-15m³, while other manufacturers' shovel capacities tended to start at 20-60m³.

While these smaller shovels were suitable for the Russian and CIS markets of old, in which mines tended to operate fleets of 120-136t trucks, there is now growing demand for more efficient, higher bucket-capacity machines. As a result, and with an eye on the export market, IZ-KARTEX is developing a new range of higher-capacity shovels.

The company's bestselling EKG-10 and EKG-15 models will be replaced by EKG-12K, EKG-18R/20K, EKG-32R/35K and EKG-50 units. The smaller, 10-20m³ machines will continue to be DC-driven, while those of 30m³ capacity and above will incorporate AC drives. The company claims that AC drives will result in increased reliability and reduce energy consumption by 15-20%.

The company commissioned the first EKG-12K shovels in 2009-10. Three EKG-18R shovels will be supplied in 2010-11, and the EKG-32R shovel will be available later this year.

HYDRAULIC EXCAVATORS & WHEEL LOADERS

Several manufacturers have launched new hydraulic excavator models. While most companies report high sales in the smaller classes of excavator, there remains considerable interest in larger models. The main focus of OEM research and development has been on updating engines to

meet US Tier 4 emissions requirements, and improving efficiency and safety.

The addition of vehicle health and payload monitoring systems, aimed at improving efficiency and productivity, highlights the rising emphasis on working with mine operators to get the lowest cost per tonne from machines.

• Liebherr

In the past 20 months, Liebherr has placed three new excavator models and one upgrade on the market. The firm now offers eight models, with bucket capacities of 7-42m³ (13-76t material weight) and engine power ratings up to 4,000hp.

With an operating weight of over 800t, the R 9800 is the new flagship of the Liebherr hydraulic excavator fleet. Driven by two 1,492 kW/2,000 PS 16-cylinder V-engines, the Liebherr R 9800 boasts a 42m³ bucket capacity. It offers fast loading cycles in conjunction with high digging and breakout forces, providing a high loading capacity index for 220t, 290t and 360t mining trucks.

Thiess recently took its third R 9800 to Peabody's Burton coal project in Queensland, Australia. This machine is operating with a 45m³ high production volume bucket, specifically designed to suit the overburden conditions at Burton. With this bucket, the machine achieves a three-pass loading of 220t class dump trucks. It has been shown to achieve cycle times of below 29 seconds and bucket payloads of 75t per pass.

The R 996 B has been updated with a redesigned backhoe attachment to achieve a larger bucket capacity of 36m³. It offers more productivity at a lower cost per tonne mined, and is suitable for 220t class trucks and above. The R 9100 100t excavator features a 6.8m³ bucket and is powered by a new Liebherr V12 diesel engine. With a

rated power output of 565kW (757hp), the engine complies with all USA/EPA Tier 2 emission limits and makes highly efficient, economical use of fuel.

Liebherr continues to strive to improve overall machine efficiency and reduce energy losses in hydraulic and sub-systems. The company has also made improvements to enhance safety. Most of the larger machines are fitted with 45° stair access, providing easy and safe machine access, and incorporate a structure in the upper carriage to protect against truck collision. Furthermore, emergency egress handrails are located at the front of the excavator while there is automatic ladder descent when an emergency stop is activated.

• Komatsu

Komatsu offers five models of hydraulic excavator and three wheel loaders suitable for mining. The PC2000-8, PC3000-6, PC4000-6, PC5500-6 and PC8000 excavators offer shovel sizes of 12-42m³, with operating weights ranging from 200-732t. The smallest in the range is the bestselling PC2000-8, which is available with backhoe or loading shovel. Meanwhile, the 720t PC8000 offers a 42m³ backhoe bucket.

The mining wheel loaders are the WA900-3E0, WA900-3E0 and WA1200-6. All are designed and manufactured to be durable, reliable machines in the toughest mining applications, and sized to match truck capacities efficiently.

The recently released WA1200-6 wheel loader has an operating weight of 216t (477,100lb) and is powered by a Komatsu SAADA16V160E-2 engine, which delivers an engine net output of 1,765hp at 1,800revs/min. It features a new, dual-mode, active, working hydraulic system that allows the operator to select between normal and powerful loading, ►

“With an operating weight of over 800t, the R 9800 is the new flagship of the Liebherr hydraulic excavator fleet”

Caterpillar 993K wheel loader



Safety and monitoring systems

Growing reliance on vehicle health and payload monitoring, as well as increasing demand for safety systems is highlighted by the range of equipment available – often as standard – on surface loading equipment.

• P&H Mining Equipment

P&H Mining Equipment shovels are equipped with the Centurion supervisory control and data-acquisition system. Launched in 2004, Centurion is a fast, scalable communication, command and control system, which continuously monitors a neural network of over 500 input-output mechanical/electrical systems points throughout each shovel. It combines that data with shovel system optimising programmes to help raise productivity.

Centurion is a control platform that supports shovel performance optimising systems, including OptiDig, Payload measurement and Automatic Boom Soft-Setdown. P&H is developing more shovel systems – a technology including dipper-track collision avoidance, dig-to-bank distance optimisation and material dig-resistance monitoring.

P&H introduced the Prevail remote health-monitoring system in 2010. Built on the Centurion SCADA system, PreVail collects large volumes of electric mining-shovel system data. It uses advanced wireless technology to maximise shovel productivity and improve cost management.

• Bucyrus

Bucyrus offers three monitoring and control options for shovels. AccessDirect facilitates remote access to a machine's on-board computer via the internet, so maintenance personnel can analyse faults from afar and arrive on site ready to fix the problem, reducing downtime. AccessDirect also enables factory experts to remotely access and troubleshoot faults, resulting in superior response times and reduced time to repair.

MIDAS health-monitoring system optimises machine performance by providing logging and analysing data on a variety of machine variables. Paired with AccessDirect, MIDAS provides real-time monitoring of shovel operations and gives users a 3D model to watch the shovel in motion.

AccuLoad is a data-analysis system providing real-time feedback on dipper loads. AccuLoad's load calculation is accomplished without mechanical sensors, eliminating the need for recalibration. The system can be used to calculate material moved, to monitor truck overloading, or to allow operators to study their load and shift performance. It can also log operator performance data.

For the hydraulic excavators, Bucyrus is implementing a new electronic platform for the overall excavator-control systems. The CAMP system offers advantages in machine operation and service. The complete machine documentation is stored in the system as PDF files and can be easily accessed.

• Caterpillar

Caterpillar's VIMS and Advisor displays keep operators informed about loader production and machine health. All of the information can be transmitted to the office via a radio network, and much of the data can be reported via Cat Product Link via satellite or cellular networks. Included is payload and cycle time data.

Terrain for loading is a state-of-the-art machine-guidance system, which delivers real-time productivity information to operators of mine site loading equipment. Terrain features an in-cab display, satellite navigation technology, machine-mounted components, a radio network and fully integrated office software. Terrain gives operators the information they need to maximise the efficiency of their machines by monitoring orebodies, bench height, cycle times, and volume of material cut and filled. The system is available for use on wheel loaders, mining shovels and hydraulic excavators.

Cat Vision (rear vision camera) offers a wide view to the rear of the wheel loader. While the Cat Object Detection system uses a combination of radars, and in-cab display and cameras. Engine Idle Shutdown shuts the engine off automatically if it has been idle for an extended period with no machine movement, while Delayed Engine Shutdown can be activated to shut the engine down after it has gone through the required cooling period. The Fuel Management System reduces engine revs/min outside of the dig portion of the cycle.

• Volvo

Volvo offers CareTrack telematics, which provides remote and on-going access to all on-board performance and systems data. It works with both satellite and mobile phone communications, providing a high level of flexibility for customers. CareTrack also has an API function that enables data transfer to non-Volvo systems or from non-Volvo equipment.

• Liebherr

The R 9100 and R 9800 excavators have 10in displays, giving operators vital information on machine performance, including engine speed, coolant temperature and fuel level. A diagnostic menu is provided in multiple languages and there is an integrated rear-view camera.

• Hitachi

The Machine Information Center (MIC) from Hitachi comprises a data-logging unit that records all vital machine health information, including snapshots of various parameters prior to and after a fault or alarm has occurred. The WinDR service tool enables this data to be downloaded and analysed. The MIC also records machine performance data, including hours for the various functions, allowing reviews of performance and machine history data for various components to improve planning of operations and maintenance.

WinDR can run diagnostics on the machine to assist in troubleshooting issues and reduce downtime. The latest shovels are equipped with satellite devices that can transmit the summary data of the MIC to Hitachi's Global e-Service server.

For mine fleet-management systems, Hitachi has bought majority ownership in Wenco International Mining Systems. Wenco is developing a fully integrated system for the machines from dispatch, and high precision GPS to a full maintenance management system.

• Komatsu

Remote monitoring of Komatsu machines is via the Komtrax Plus system, which can be used with ORBCOMM to transfer vital machine data to land-based systems. This allows for rapid fault identification, as well as trend analysis and monitoring of operational parameters. By looking at trend data, predictive maintenance can be implemented to cut downtime.

• Modular Mining

Modular Mining is a Komatsu company that offers a range of solutions to the mining industry to aid safety and productivity. The flagship product, DISPATCH, is a fleet-management/haul optimisation system that has been available for over three decades. The company claims an average boost in productivity of 10% by reducing idle time for shovels and trucks.

The system applies material-blending constraints to ensure delivered material meets specification. Crew management tools schedule qualified individuals to operate equipment while auxiliary task-management tools manage activities such as clean-up and roadworks to help maximise equipment utilisation. DISPATCH integrates a number of features to improve safety, including speed zone enforcement, high-speed cornering alarms and GPS-based proximity detection.

Modular Mining's ProVision machine guidance system can now work as a standalone application, so a DISPATCH system is not required. It aims to increase planning and loading efficiency through on-board visibility of material delineation and bench-grade against plan. It issues alarms for misdirected loads. Face advance is calculated automatically, providing shift-by-shift excavator progress and eliminating manual surveys, while an on-board display of grade against plan translates to cleaner benches, minimising rework and equipment wear.

Major updates were recently released for the machine guidance range: ProVision 3 Shovel in September 2010, and Dozer 3 in January 2011. This introduced a shared digital-terrain model that allows multiple equipment to work on the same project. A new user interface boosts efficiency.

► while the optimum oil flow increases efficiency and reduces cycle times.

The engine rpm control system with auto-deceleration allows operators to set the speed at the optimum work performance level and control it smoothly with the accelerator. The variable transmission cut-off system for the left brake pedal is adjustable by a switch at the operator's seat. When loading, the low setting reduces brake impact to prevent spillage, while the high setting can be used for travelling.

• Hitachi

Hitachi offers six models of mining excavator, sized from 120-800t. All are available in either front shovel or backhoe configurations, except the EX8000-6, which comes in front-shovel configuration only. Bucket capacities range from 5.9-40m³.

Hitachi front shovels feature the auto-level crowd mechanism; a unique feature that allows for easy, one-level control of level crowding of the bucket into the digging face. This makes operating the shovel simple and more productive. It also allows for better ore control or selectivity of the material and better floor cleaning, saving time and money due to cut tyres on trucks.

Research efforts have been mainly targeted towards the release of new

machines incorporating the final US EPA Tier IV engine updates. The company is also looking to change the bucket capacity of some models, based on front attachment configuration.

The 114t EX1200 is popular with both mining and construction companies, and sells well to both types of customer. It has accounted for about 42% of sales since 2000. However, the 249t EX2500 and 522t EX5500 models are the current bestsellers for mining. This is because they offer the best match with current haul-truck fleets at the various mine sites.

The EX2500, which accounts for 22% of sales, matches well with 91t and 136t class trucks, while the EX5500 serves the 218t and 290t class trucks.

• Bucyrus

Bucyrus offers seven excavators, including the industry's largest, the 85t RH400. The RH400 has an operating weight of 980t and standard bucket size of 50m³. It is powered by a 4,500hp (3,360 kW) engine and can fill a 218t haul truck in three passes.

The middle-range RH340B has a 567t operating weight machine and is the top-seller in its class. It offers a 61t payload capacity and engine output of 3,000hp (2,240kW), along with a standard bucket size of 34m³. The other models in the



range, in descending size, are the RH200, RH170B, RH120E and 13.6t RH40E.

The entire range, with the exception of the RH40, is available with either diesel or AC drive, allowing customers to choose the best solution. The diesel engine option allows machines to be moved easily without considering the availability of power supply or stability of voltage. Furthermore, although diesel is easy to get and transport to any area in the world, electric motors are cheaper to run and maintain.

All Bucyrus front shovels feature the patented TriPower system, as well as an independent, hydraulic oil-cooling system. ►

Komatsu
WA1200-6
wheel loader

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► • Caterpillar

Caterpillar has four large wheel loaders used in mines and quarries around the world. From the largest to the smallest, these are the 994F, 993K, 992K and 990H.

The 994F often serves as a primary production loader in large mines. According to Caterpillar, many mines that rely on shovels for most production loading also have a 994 as a back-up for shovels that are taken out of service for maintenance, and as a loading machine in smaller areas where a shovel would not be economical to use.

The 994 matches well with trucks of 136-227t capacity. The mobility of the wheel loader enables it to move from loading face to loading face quickly. The 994 is due to be updated with the Caterpillar C175 engine later this year.

The 993K is sized to match with trucks of 90-136t capacity; the 992K with 64-136t; and the 990H with 64t. The 992K and 993K are extensively used in coal-loading applications while the 990H is a popular primary loader in quarries.

Caterpillar only has one hydraulic excavator suitable for mining. The newly launched 390D is often used in small mines and quarries, where it is teamed with quarry trucks of 36-64t capacity.

• Volvo

Volvo equipment is used mainly in smaller mines. A wide range of excavators work in Asia, typically the EC210 (21t class) up to the EC700 (70t) crawler excavators. The EC700 is firmly established in coal, iron ore, industrial minerals, bauxite, nickel and phosphorous mining. The excavator range features a boom float that can be engaged via a simple toggle switch. It can reduce truck loading times while dramatically improving fuel efficiency.

The wheel loaders used in mining generally run from the L180 (28t) up to

the L350 (50t). Several of the large wheel loaders feature Volvo's Optishift technology, designed to increase operator comfort and machine durability while optimising fuel savings up to 15%.

Volvo has just introduced the first of its latest D-Series range of excavators and G-Series wheel loaders. These include major updates for Tier 4i/Stage IIIB emissions-regulated markets. The L220G offers a fuel-efficient and productive design, with a 20% increase in lifting force, 10% improvement in breakout force and stronger hydraulics.

The 35t L250G has been added to pioneer a new size class in the loader market. The L250G will optimise truck loading in some markets and be a strong face loader in conditions that require high break-out forces.

• Le Tourneau Technologies

LeTourneau offers six mining wheel loaders, all with hybrid technology, integrating a diesel-electric drive system.

The range includes the world's largest rubber-tyred, front-end wheel loader – LeTourneau's 2,300hp (1,715kW) L-2350. This offers a standard operating capacity of 72,576kg and a standard 40.5m³ bucket. Its large loading height allows centre-loading of haul trucks with payload ratings of 218-363t in five passes.

The L-1850 has an operating capacity of 54,431kg and a 30.6m³ bucket as standard. The L-1850 is designed to match haul trucks with payload ratings of 235-326t.



Powered by a 2,000hp (1,419kW) diesel engine, the L-1850's all-wheel, independent electric drive delivers positive traction and increased stability. The L-1350 is suited to 136-236t haulage trucks and has a standard bucket capacity of 22.9m³.

The L-1150 hybrid diesel-electric wheel loader was launched at the start of 2009. With a 19.1-24.5m³ bucket capacity and an operating payload of 34.47t, the L-1150 matches 109-181t haul trucks. It includes a redesigned cab, improved ergonomics and increased visibility.

The L-950 is the smallest loader, with an operating capacity of 24,494kg. It has a 1,050hp (783kW) diesel engine and 13.76m³ bucket as standard. The L-950 is suited to trucks with payload ratings ranging from 68-136t. ▼

Left: Bucyrus RH340B

Right: Volvo EC700 70t excavator

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