

# Longwall Shearers





## Taking the Shearer to the Next Level

Your shearer is the most critical part of your longwall production process. That's why high-performance longwall operations demand shearers that deliver the highest productivity, availability and reliability. Cat® shearers were always designed to meet these demands. But Caterpillar has taken them to the next level.



### Survival of the Fittest

To do this, we invested heavily in refining our successful range of shearers. We started by reviewing and analyzing all more recent shearer installations and setting goals to improve productivity, availability and reliability. This was not a redesign, but an evolution – keeping the best tried-and-tested features of the existing design while using the latest findings from science and technology to improve features and add new ones.

### Shear Performance

With high-powered ranging arms and haulage units, Cat shearers cut and load up to 5 000 tonnes (5,500 tons) per hour and more, depending on mining conditions. The unique, one-piece mainframe design offers maximum structural integrity and service life. The mainframe is available as a split unit in the event of transportation limitations. Featuring the superior Jumbotrack shearer haulage system, the shearer also offers advanced integrated automation and communication options.

## Key Improvements

Cat shearers incorporate numerous new features and benefits. These are presented in the following pages by category. The key improvements include:

- Extremely powerful PMC™ Evo-S control system with state-of-the-art Ethernet communication
- Improved innovative downdrive design
- Ranging arm with longer service life
- Further development of the modular haulage and electrical control box
- Enhanced power pack with easy access
- Online vibration monitoring with VibraGuard™
- Clear wiring and use of plug and play for easy maintenance
- Trapping Shoe Ix (Insert Exchange) for longer service life, safe and easy to replace
- Future-proof design allowing upgrades – such as stronger ranging arms and haulage units or addition of coal sizer – during rebuild
- Mainframe designed to handle 1 200 kW (1,930 hp) ranging arms and 200 kW (320 hp) haulage units – EL3000 only





## Mainframe made for Muscle...

The unique mainframe of the Cat shearer is one of its key features. The fabricated structure of the mainframe with cast ranging-arm hinge points results in an extremely robust design not only to meet the toughest mining conditions and ensure reliability and long service life, but also to handle even higher cutting and haulage forces in the future. The mainframe of the EL3000 is designed to allow retrofit of 1 200 kW (1,930 hp) ranging arms and 200 kW (320 hp) haulage units. A split mainframe is available in case of transportation limitations.

### Benefits:

- High structural integrity and absorption of all cutting and haulage forces, providing maximum protection for all major units
- Maximum protection of electrical boxes, providing the highest level of flameproof integrity
- Improved access for maintenance and ease of overhaul and repair
- Versatility of application due to fully modular construction
- Flexible and cost-effective equipment management
- Independent unit exchange and selective overhaul
- Long service life
- Low operational costs
- High reliability

## Innovative Trapping Shoe

Trapping shoes attach the shearer to the haulage rack system, part of the armored face conveyor, allowing the shearer to be hauled up and down the face. A new type of trapping shoe developed by Caterpillar – the Trapping Shoe Ix – offers numerous advantages over the conventional design:

- Greater safety and ease of handling during replacement
- Faster replacement
- Greater flexibility
- Longer service life
- Lower operating costs

The patent-pending Trapping Shoe Ix continues the Caterpillar principle of designing products with separate structural and wear parts to allow quick and easy replacement of surfaces subject to wear. The new design cuts the weight that has to be handled during replacement from more than 500 kg to less than 50 kg per insert, and cuts the time required for exchange to a fraction of the previous time. Because the weight handled is so much lower, changeout can take place anywhere along the face – previously this work had to be done at the gate ends, where heavy lifting equipment was available.

## Extended Service Life

The inserts have the same wear area as conventional shoes and are articulated. This – combined with the fact that the shoe does not have to exert as much pressure, resulting in a lower point load – means less wear. Field tests of the Trapping Shoe Ix showed its service life to be 50 percent longer than conventional trapping shoes.



*Trapping Shoe Ix offers longer service life, greater flexibility, faster replacement, and greater safety and ease of handling during replacement.*



*The robust mainframe protects the electrical boxes from cutting and haulage forces; door handling system for easy access to the electrical compartments.*

## Power for the Toughest Mining Conditions

Our shearers cover a wide range of cutting heights and mining conditions. They have installed cutting power to provide world-class production in the toughest mining conditions: The EL3000 with a cutting power of up to 860 kW (1,380 hp) and the EL2000 with up to 750 kW (or 1,200 hp). A new 1 200 kW (1,930 hp) ranging arm is under development and can be retrofitted to existing EL3000 shearers during rebuild.

- High levels of installed power available in each class
- Cutting depth of 0.85 m and 1.0 m
- A range of cutter motors available to suit all mining conditions
- Compact design for optimum coal-loading performance
- Fast and accurate positioning of the ranging arm through two-speed technology and a more powerful lifting cylinder
- Modularity allows fast in-situ maintenance and repair
- Improved lubrication results in lower operating temperatures
- New, more robust cowl drives

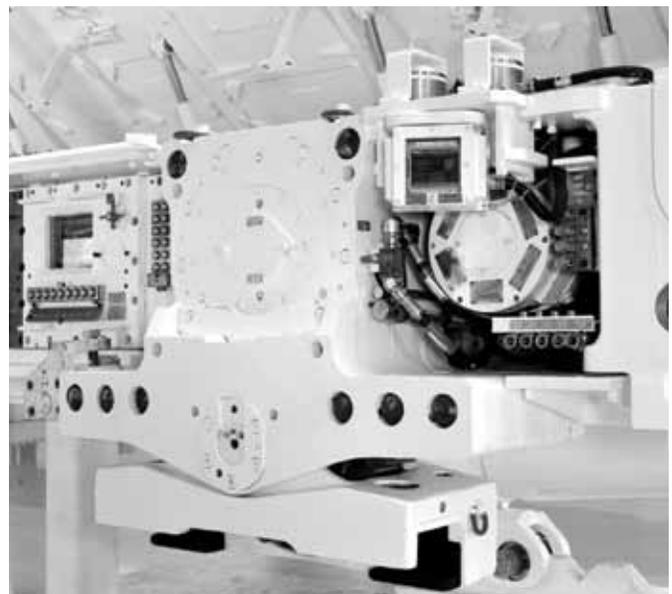
## Strong Arm

The safety factor for the ranging arm has been further increased. Gear rating, bearing life and redundancy have also been increased, leading to longer overhaul intervals based on typical usage.

## Downdrive

An innovative downdrive design results in longer bearing life, increased gear rating and greater modularity for simplified maintenance. Height adjustment of the shearer is relatively easy and is achieved with replacement of the downdrive to allow adaption to changing seam conditions. Every mainframe is designed to take the full range of downdrive arrangements to fit a wide range of seam heights.

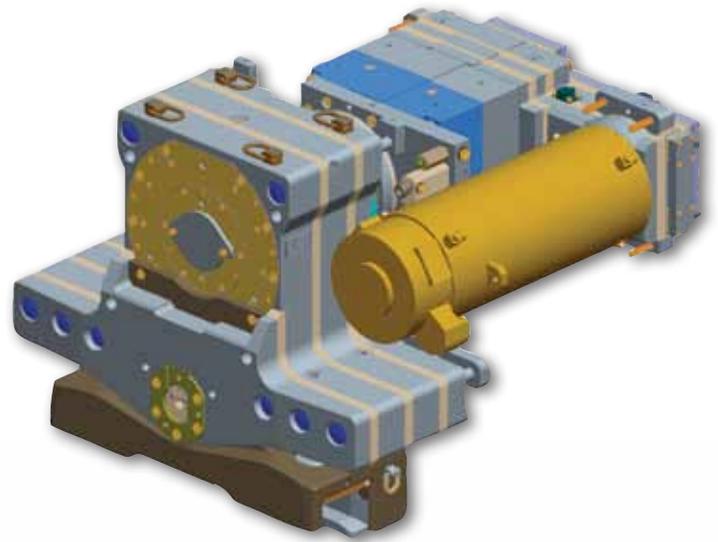
- Fully modular design
- Easy maintenance access
- Fully articulating shoe
- High pull and maximum life



## Modular Haulage System

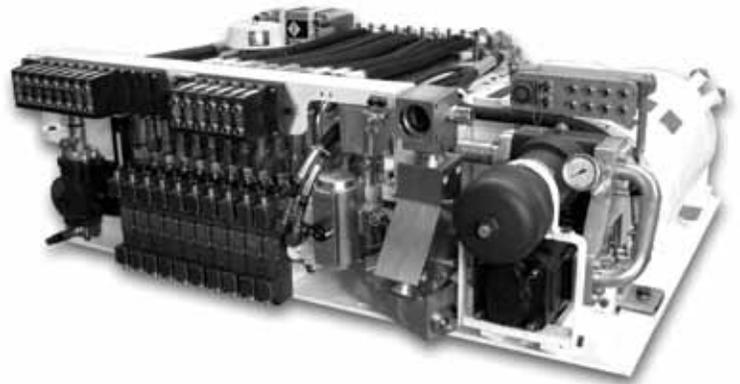
Caterpillar has further developed its modular haulage concept with increased power rating, gear rating, bearing life and redundancy, leading to longer overhaul intervals based on typical usage. The haulage system is a simple design capable of achieving cutting speeds of up to 32 m/min (105 ft/min), with improved reliability and longer service life. The fully modular haulage gearbox is located in the shearer mainframe and does not form part of the shearer structure. The haulage system offers:

- Simple construction, improved reliability and longer service life
- Fully proven load-sharing system
- Reduced cost



## Coalsizer

Cat shearers can be supplied with an optional rugged coalsizer, currently with up to 200 kW (320 hp) of installed power for maximum productivity in high seams or difficult mining conditions. The coalsizer can be ordered separately for installation during rebuild or overhaul.



## Packing More Power

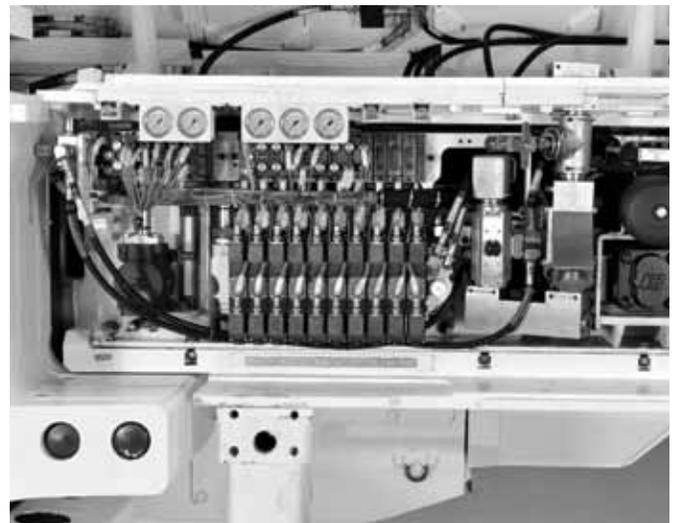
The power pack has been reengineered to provide increased functionality, optimized performance and better access to filtration units via simplified layout. Both of the following units are modular, with drawer units providing easy access and upgrade.

### Transformer Box

- Features closed-loop control with measurement of speed, not power
- Transforms to 600 V for haulage units' frequency converter motors
- Connectorized cables for reduced wiring and quick, clear installation
- Temperature monitoring and water cooling

### Control Box

- Plug and play
- Easy to maintain
- Quick and easy troubleshooting





*Haulage unit in testing to ensure highest reliability*



*Lubrication test under the most extreme conditions*

## Tested for Reliability

Downtime is extremely expensive for operators – costs continue to add up while nothing is produced. This is why Caterpillar ensures that our superbly engineered shearers are up to the job. That's why each shearer design – which is optimized for maximum availability – is subjected to rigorous in-house testing to ensure that there are no unpleasant surprises when units are in service. Shearer production quality assurance falls into three main categories: lubrication verification, endurance block load testing and production load testing.

## Lubrication Verification

Ranging arms and haulage units are subjected to an intense test regime to establish the optimum oil-level requirements to suit all mining conditions. The units are mounted on purpose-designed test rigs that are positioned to simulate the gradient of the underground seam. A suite of tests is performed with a range of different gradients and arm positions to represent even the most severe mining conditions. The units are operated until stable temperatures are achieved at all gradients. This establishes the minimum, maximum and optimum oil quantities for all conditions.

## Endurance Block Load Testing

This test applies loads far in excess of those encountered during normal mining operations, ensuring that the shearer can operate reliably at the installed power ratings. Ranging arms or haulage units are mounted on purpose-designed test rigs in a back-to-back configuration driven by a suitable test motor. The endurance block load test imposes loads from 100% to 175% to ensure that the ranging arm design meets the requirements of the most demanding applications. Input torque, losses and output torque are monitored during the test, as are bearing, gear and shaft temperatures. Vibration is monitored by dedicated sensors. Oil samples are collected at intervals for analysis, as the presence of metal in the oil can indicate excessive component wear. On completion of the endurance test, units are dismantled for a full internal and external inspection to verify that the design is fit for purpose.



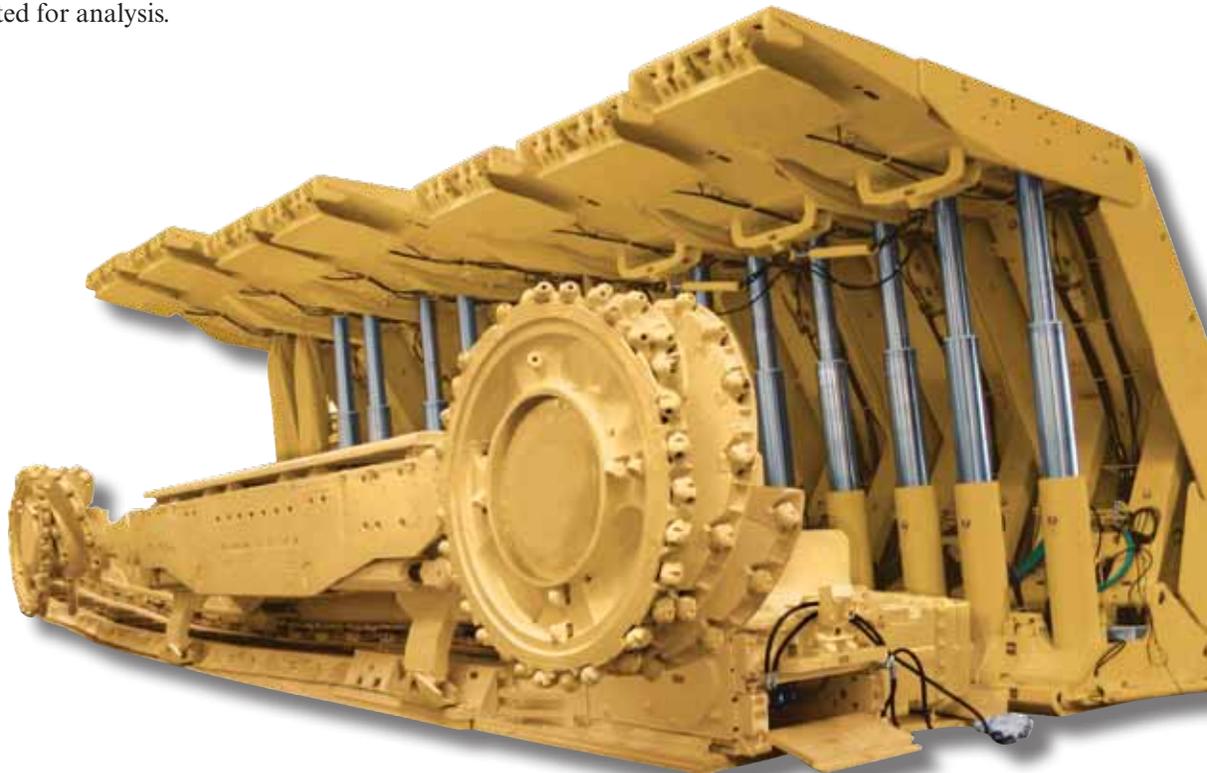
*Shearer in the last manufacturing stage getting tested before delivery to customer site*

## **Production Load Testing**

After successful endurance block load testing, the same test rigs are used to carry out production load testing of all ranging arms and haulage units. The test gradually increases the load up to full load. All temperatures and vibration points are monitored during the test, and oil samples are again collected for analysis.

## **Proven Productivity**

This extensive range of tests ensures the highest possible availability of shearers in service and maximum return on investment for your longwall installation. Nothing is left to chance in ensuring that our shearers are unsurpassed in reliability.



# Unparalleled Control

## Industry-leading Automation from the Pioneer of State-based Automation

Caterpillar has developed a state-of-the-art distributed automation system for the control, monitoring and protection of the shearer. Its modular design allows it to be configured to meet individual control needs, from basic monitoring and protection to advanced automation and data transmission. The PMC™ Evo-S control system with state-of-the-art Ethernet communication and backup functionality allows the shearer to be operated even if the overall control system is not functioning. In 2002, State-Based Automation was invented and launched. Using this technology, Caterpillar now offers a comprehensive range of automation products as shown on page 15.



*Integrated end station display*

## Power and Flexibility

With extensive computer power installed and simple upgrade to new features, Cat shearer automation is fit for the future. Components connect into the network rather than directly to a central computer, simplifying installation, wiring, maintenance and troubleshooting. The shearer is equipped with a state-of-the-art industry PC in a flame-proof housing with plenty of computing power, allowing flexibility to upgrade to future features such as condition monitoring.

A Programmable Logic Controller (PLC) takes care of basic machine control tasks, ensuring that coal is mined. Unlike competitor systems, the modularity of the longwall system and control allow the longwall to operate in “fault-tolerant” mode, even when there is a problem with the overall automation system. In other words, integrated automation does not prevent control via individual PLCs in order to keep production up and running.



*Color display*



*Three shearers at different stages in the manufacturing process: From the shearer on the left which is ready for equipping to the one on the right which has successfully completed all test procedures and is being prepared for shipping.*

## The Net is the Control

The shearer control system uses a state-of-the-art Ethernet bus, resulting in a drastic reduction in wiring and a huge increase in flexibility. There are no interfacing problems, as equipment connected to the network only needs to be able to communicate via Internet Protocol. Commissioning, maintenance, upgrades and troubleshooting are much easier and faster, and equipment is self-configuring. The few cables that are used are standard Ethernet cables rather than application-specific cables – cutting costs and simplifying spare parts inventories.

Flameproof housings are no longer required, simplifying installation and speeding up maintenance. New modules are based on standardized CIOS™ modules (configurable input output system), resulting in a plug and play approach to upgrades. No reprogramming is necessary.

Remote control and diagnosis are also possible for all components. And because of the Ethernet-based approach, the failure of one component does not impact the whole system.

## Intrinsic Safety

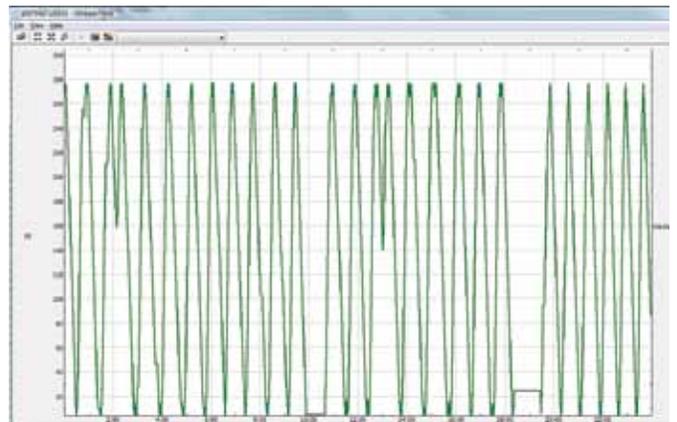
More components designed to be intrinsically safe means simpler installation and speedier maintenance. New modules are based on standardized CIOS™ modules, resulting in a plug and play approach to upgrades. Changes to the system only require commissioning changes – such as mounting and connection of sensors. No replacement of control software is required. Remote control and diagnosis are also possible for all components. And because of the Ethernet-based approach, the failure of one component does not impact the whole system. This not only supports the unique “fault-tolerant” mode, which allows the longwall to continue to operate when there is a problem with the overall automation system, but also, through systematic isolation, allows faulty units to be identified while production continues.



*Intrinsically safe CIOS™ block with state-of-the-art Ethernet communication*

### PMC™ Evo-S offers reliability from day one

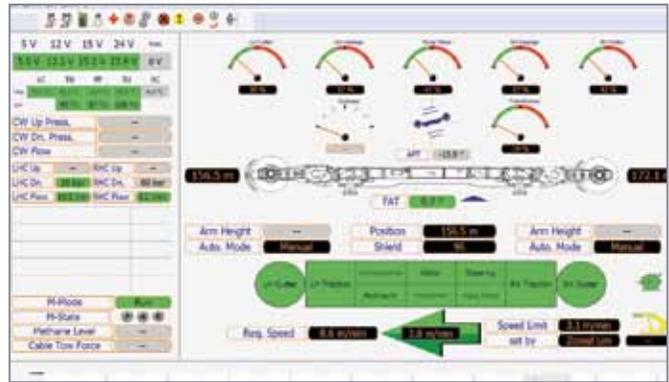
- Robust cables and plugs
- Minimized cabling due to network approach
- Vibration-tested components
- Designed for the working environment



*Consistent performance using advanced automation*

## Visualization

Visualization not only provides a graphical representation of current operating conditions, but can also display historical conditions and a graphic display of trends. An automated longwall is a highly complex system with many interacting components generating time-variant data. Visualization gives operators a better understanding of the overall system, allowing them to further optimize operations. VLongwall provides a system overview and access to the dedicated visualization modules VShield, VDrive, VPlow and VShearer. It also gives access to VTrend for trend analysis and VGraph3D for waterfall plots of the entire longwall.

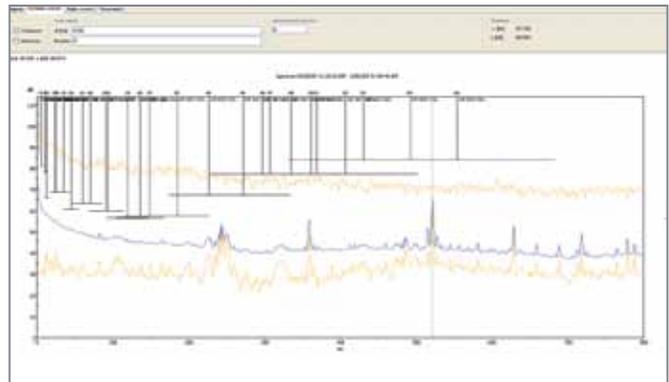


*VShearer allows parameter-setting and visualization of operational parameters and status of a Cat® shearer.*

## VibraGuard™

VibraGuard™ allows trained personnel to predict machine component wear, avoid unplanned downtime and set alarms to warn the operator if monitored machine components run the risk of damage. This comprehensive protection backs long life and high availability of your valuable mining equipment.

- Permanent online monitoring and protection of equipment instead of sporadic offline measurements
- Assists in the prediction of machine component wear
- Alarms warn the operator if monitored components are at risk of damage
- When utilized by trained personnel, VibraGuard™ makes repairs predictable and helps avoid unplanned downtime
- Repair work can be done largely without stress
- Allows timely procurement of spare parts
- Transfers data to a surface control center PC for detailed analysis and evaluation



## Modular Control offers Flexibility and Power

PMC™ Evo-S brings state-of-the-art processor performance underground. Designed by the market leader in shearer automation, the advanced Cat automation package allows improved utilization of manpower in a safe environment; with increased yield from any given seam section, faster haulage speeds, improved face management and increased life of all longwall equipment, including AFC and shields.

As shown in the table on page 15, automation systems match your needs – from basic to highly sophisticated – while remaining easy to install, operate and maintain. The modular control concept is:

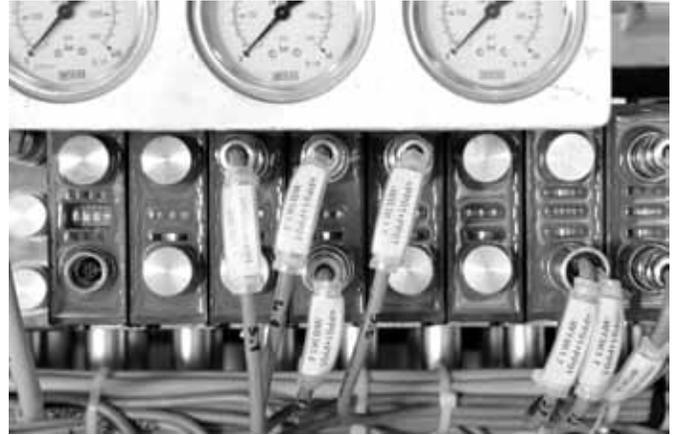
- Easily expandable based on modular design
- Ready for integration of highly sophisticated technologies and devices
- Equipped for XML-based interfaces to third- or fourth-party systems

### Making it Easy

- Cat self-configuring controls and standard interfaces such as Ethernet allow quick and easy system configuration changes with no programming effort
- Ready for future technologies such as high-quality condition monitoring, including vibration monitoring
- Easy and flexible adaptation to existing data environments
- Greater use of Ethernet, standard connectorization and PMC™ control family mean greater simplicity, reduced spares inventories and shorter downtimes
- Standardization and modularization allow quick and easy customization of components and systems

### Fast Troubleshooting

- Widespread use of intrinsically safe components allows large-scale fault diagnosis under power
- Remote access to most components down to I/O level
- Diagnosis from surface or by Cat Mine Control Center
- Managed switches and field bus coupler (FBC) allows selective routing:
  - Permits sequential disable and enable of components and/or communication routes
  - Isolation of faulty units until next repair shift allowing production to continue



*Intrinsically safe CIOS™ block with remote access down to I/O level*

### Less Maintenance Effort

- Widespread use of intrinsically safe components in PMC™ Evo-S reduces time-consuming opening of flame-proof housings in the event of faults.
- Quick and easy exchange of modules.

### Modularity is Strength

Modularity is a key feature of the Cat shearer. It results in independent major units, each driven by its own dedicated electric motor and housed within or attached to a robust mainframe unique to the Cat range. Control systems are also modular.

This modular design offers maximum availability – through “fault-tolerant” mode operation – and the flexibility to meet even the most demanding customer requirements by upgrading components such as the ranging arm.

## EL2000



## The Cat® Shearer Product Line

### EL2000

The EL2000 incorporates all the features and benefits that have been established with the Cat shearer range in a compact, rugged machine designed to meet the demands of high productivity in low- to medium-seam applications from 1.80 to 4.50 m (70 to 177 in.). High installed power is a feature of the EL2000 shearer, with up to 750 kW (1,200 hp) in a compact design. The haulage system is tailored to the needs of high-productivity medium-seam applications with up to 125 kW (200 hp) AC drives.

#### Benefits:

- High level of structural integrity provided by the unique Cat shearer mainframe design
- High-powered ranging arms with up to 750 kW (@ 50 Hz) of cutting power in a compact design
- Maximized coal cutting and coal clearance ability
- AC haulage system with up to 125 kW (200 hp) per haulage unit providing the necessary haulage force and speed for high-productivity medium seam applications
- Advanced automation for optimized performance and improved face management

## EL3000



### EL3000

The EL3000 shearer has been developed for medium to high seams to meet the requirements of the most demanding longwall installations in the world. World-class performance has demonstrated the practical capabilities of this machine. The EL3000 shearer mines seams of up to 5.50 m (216 in). It offers 2 x 860 kW (1,150 hp) of cutting power combined with haulage motors of up to 2 x 150 kW, with a 75 kW (100 hp) pump motor to provide a total installed power in excess of 2 000 kW and a production capacity of over 5 000 tonnes per hour. Some of the highest-producing longwall installations in the USA and Australia utilize Cat shearers.

#### Benefits:

- High level of installed power provides high level of performance in the most arduous mining conditions
- AC haulage system capable in excess of 100 tonnes haulage force
- Heavy-duty, high mass for maximum stability and reliability in the most demanding applications

## EL4000



### EL4000

The EL4000 is designed for maximum production in high seams. It is based on the EL3000, but has a cutting drum diameter of up to 3.50 m and ranging arms that allow mining up to heights in excess of 7 meters.

Model Series	EL2000	EL3000	EL4000
Height range	1.80 m – 4.50 m 71 – 177 in	2.50 m – 5.50 m 98 – 217 in	4.00 m - 7.00 m 158 – 276 in
Typical machine length	13.75 m 45.1 ft	15.20 m 49.9 ft	16.70 m 54.8 ft
Installed power	1 900 kW (3,040 hp)	2 295 kW (3,680 hp)	2 295 kW (3,680 hp)
Available cutting power	2 x 500 kW 2 x 620 kW 2 x 750 kW	2 x 650 kW 2 x 750 kW 2 x 860 kW	2 x 750 kW 2 x 860 kW
Cutting drum diameter	1.40 m – 2.30 m 55 – 91 in	Up to 2.70 m Up to 106 in	Up to 3.50 m Up to 138 in
Haulage system	AC	AC	AC
Available haulage motors	2 x 125 kW 2 x 200 hp	2 x 150 kW 2 x 240 hp	2 x 150 kW 2 x 240 hp
Haulage speed	Up to 32 m/min Up to 105 ft/min	Up to 32 m/min Up to 105 ft/min	Up to 32 m/min Up to 105 ft/min
Haulage pull	Up to 920 kN Up to 100 tons	Up to 1 075 kN Up to 120 tons	Up to 1 075 kN Up to 120 tons
Coal sizer	100 kW (160 hp)	200 kW (320 hp)	200 kW (320 hp)
Pump motor	50 kW (80 hp)	75 kW (120 hp)	75 kW (120 hp)
Machine weight	Approx. 70 tonnes Approx. 77 tons	Approx. 105 tonnes Approx. 116 tons	Approx. 140 tonnes Approx. 154 tons
Body height	520 mm (20.5 in)	685 mm (27.0 in)	1 050 mm (41.3 in)
Operating voltages	2300 V 3300 V 4160 V	3300 V 4160 V	3300 V 4160 V
Applicable min. pan width	1 032 mm 40.6 in	1 132 mm 44.6 in	1 342 mm 52.8 in

## Specialized Shearers

Caterpillar also supplies shearers for specialized applications:

- Single- and double-drum low-seam shearer
- Three-drum shearer for selective mining

These shearers utilize the key feature of modular mainframe construction and are proven for coal and non-coal applications.

## Optional Accessories

Model Series	EL2000	EL3000	EL4000
Multi-piece mainframe	O	O	O
Cowl	O	O	O
Spall guards	O	O	O
Coal sizer 100 kW 200 kW	O –	O O	O O
Trapping Shoe Ix (Insert exchange)	● O	● O	● O
Shearer clearer	O	O	O
Spray bars	O	O	O
Central lubrication system	●	●	●
PMC™ Evo-S	●	●	●
Gate end data connection			
Powerline	●	●	●
Fibre optics	–	O	O
WLAN	●	●	●
IPC	O	O	O
Zone-based automation “Navigator 1”	O	O	O
State-based shearer automation “Navigator 2”	O	O	O
Integrated longwall automation with “Navigator 2 + 3”	O*	O*	O*
“Longwall Navigator” for improved face alignment and horizon control incorp. LASC Tech.	O*	O*	O*
VibraGuard™	O	O	O
Cameras	O	O	O
Condition monitoring	O	O	O

● = Standard equipment, O = Available equipment,  
O\* = Only with Cat longwall equipment

# Longwall Shearers

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at [mining.cat.com](http://mining.cat.com) and [www.cat.com](http://www.cat.com)

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