

CAESultra for Mining



Machine Compatibility

Machine Family

Scrapers, Loaders, Dozers,
Shovels, Motor Graders,
Hydraulic Excavators,
Track-Type Tractors

CAESultra for Mining

CAESultra for Mining is a versatile technology tool that can help miners maximize their operation.

CAESultra for Mining

Advanced GNSS technologies for mining equipment improve machine efficiency, maximize mining potential, increase productivity and improve mine safety. **pg. 4**

On-Board Components

CAES on-board components keep the operator informed with real-time information, which provides greater control and empowerment. **pg. 6**

Off-Board Components

CAES off-board components ensure communication with operators, planning for projects, and production reporting. **pg. 7**

Maximize your mining operation by using CAESultra to improve ore recovery, decrease survey costs and increase productivity and profitability.



Applications

CAESultra for Mining can be used in many applications to increase machine productivity, decrease costs and improve ore recovery. **pg. 8**

Features and Benefits

The CAESultra for Mining system links the operator to the office, improving productivity and profitability. **pg. 9**



CAESultra for Mining

Allows machine operators to mine more safely, efficiently and accurately.



Caterpillar is helping customers revolutionize the way they mine and manage their operation with technology solutions that provide greater accuracy, higher productivity, lower operating costs and increased profitability.

The CAES system is one such solution. It is a high-technology earthmoving tool that allows mines to operate more productively and safely.

Using Global Navigation Satellite System (GNSS) technology, machine-mounted components, a radio network and office management software, this state-of-the-art machine guidance system delivers real-time productivity information to machine operators on an in-cab display.

By monitoring ore bodies, bench height, volume of material cut and filled, and cycle times, operators have the information they need to maximize the efficiency of the machine.

Applications. The CAES system is an ideal tool for mine planning, engineering, surveying, grade control and production monitoring applications. For example, the CAES system can be used for:

- Haul road and bench construction and maintenance
- Production dozing
- Leach pad construction and maintenance
- Reclamation
- Ore grade control and material identification
- Coal load out terminals

The system is meant for use on scrapers, loaders, dozers, shovels, motor graders, hydraulic excavators and track-type tractors.



Operation. The CAES system uses GNSS technology, a wireless radio communication network, and office software to map mines, create terrain models, locate a machine's position and track volume and productivity with complete accuracy.

The receiver uses signals from GPS and GLONASS satellites to determine precise machine positioning. Two receivers are used to capture and collect satellite data – one located at a stationary spot on the site, another located on the machine.

Signals from the ground-based reference station and on-board computer are combined to remove errors in satellite measurements for centimeter-level accuracy.

Using the radio network and office software, terrain data is transmitted from the machine to the office. Terrain data may also be shared from machine to machine.

The in-cab display then provides the operator with an overhead and cross-sectional three-dimensional surface view of the color-coded work plan and precise machine location. The software continuously updates terrain and machine position information as the machine traverses the site.

The CAES system gives the operator the ability to control production by monitoring progress on the in-cab display, which is configurable for various mining applications.

In ore control applications, the color display graphically shows the operator ore boundaries and bench height.

In grade control applications, the color display graphically shows the operator cut, fill and grade work to be done according to plan. As the machine works, the screen changes color. Green indicates when the operator has achieved plan grade.

By providing immediate feedback on the accuracy of each pass, CAES operators have the information and confidence they need to work more efficiently, productively and profitably.



Office Software. CAESoffice software, productivity tools and METSmanager work together to convert, verify, and transmit design data. Productivity tools allow users to create reports on utilization, materials and volumes. METSmanager allows communication among machines and the office, and converts files from mine planning software.

On-Board Components

CAES on-board components are built-to-last and provide operators with real-time information.



GPS Receiver. The all-new MS990C is the next generation GNSS receiver from Caterpillar. The antenna and receiver hardware have been combined into one durable component built to withstand working in the harsh mining environment.

This base station GNSS receiver is used to send corrections across the radio network. The system computes positions with centimeter-level accuracies to ensure precise machine location. Mines with deep pits or locations in the far northern and southern hemispheres will benefit from the receiver's ability to use satellites in both the GPS and GLONASS constellations, providing increased position availability for the system.

The new design of the MS990C also includes faster RTK initialization times, better tracking and accuracy characteristics over a broader range of operating environments, and features to use the new modernized U.S.-based GPS satellite constellation.

Communications Radio. The rugged radio is used for transmitting and receiving real-time data. The radio is used to send design data to machines, and receive terrain files, diagnostics and productivity information from machines. It also sends GNSS corrections from the base station to the machine receiver on a dedicated channel. Under normal conditions, the 900 MHz radio broadcasts data up to 10 km (6.2 miles) line-of-sight. Coverage can be enhanced with a network of repeaters, which allows coverage over a broader area. Optimized for mining applications, the radio features error correction and high-speed data transfer, ensuring optimum performance.

Mine sites may also use an internet protocol radio network to connect CAES-equipped machines. A ruggedized Ethernet port on the CAES touch screen display is available for easy connection to third party radios.

CAES Touch Screen Display. The in-cab graphical display provides real-time operating information to the operator. Designed for simple operation, the 264 mm (10.4 in) custom configurable, integrated touch screen display allows operators to easily interface with the CAES system. The display uses the latest infrared touch screen and transfective backlight technology for superior viewing in bright light conditions and a broad-range dimmable backlight for viewing in low light conditions. Designed for reliable performance in extreme operating conditions, the unit is built to withstand shock and vibration and sealed to keep out dust and moisture.

Harnesses and Cables. Integrated harnesses and cables connect components to the machine's main electrical systems and are designed for easy installation.

Off-Board Components

CAES off-board components monitor progress and ensure communication with machine operators.

CAESoffice Software. The Caterpillar designed CAESoffice software enables mine management to monitor CAES-equipped machines and work progress throughout the site in near real-time. CAESoffice software uses maps, profiles, gauges and text displays in order to show the current state of work. CAESoffice software continuously updates and displays as-built surface information, including current elevation and mined material.

Productivity Tools. Productivity tools allows mine office personnel to track a multitude of productivity information about an individual machine or groups of machines. Examples of the types of productivity information available include volume of material cut and filled, machine utilization, cycles per hour and number of loads of each material type. As events happen, they are recorded in the CAES application so that both the machine operator and office personnel can view them. Using the CAES Productivity Report Generator program, reports can be created and archived at any time, as well as recalled and compared to improve machine use and mining efficiency. Report templates are provided and may be easily modified. New reports may be created using Crystal Reports.

METSmanager. This software package provides the user interface for the CAES system and controls all communications over the wireless radio network. It includes on-board file management, file conversions and machine configurations. METSmanager reads design files, converts them and sends them to the on-board display on the machine over the radio network. METSmanager also maintains the site models using data transmissions from machine to office and can be used to export terrain and progress lines, continuously updating the plan using data transmissions from machine to office.



GNSS Reference Station. A GNSS reference station is used to achieve the centimeter-level accuracy needed in a mining application. The reference station sends GNSS information over a radio link to the receiver on the CAES-enabled machine. Depending on which base station is used, a mine will be able to use satellites in both the GPS and GLONASS constellations to enhance signal availability and strength.

Radio Network. The off-board radios are used to seamlessly connect the office network to the on-board systems. The network contains one channel used for timely delivery of GNSS corrections to the on-board GNSS receiver. Another channel is available to send site plans to machines and receive productivity and diagnostic information from machines. The 900 Mhz network can work around hills or buildings reducing the necessary infrastructure and the range can be further extended by adding repeaters.

The CAES system has also been designed to work with mine-supplied internet protocol radio systems.

Applications

CAESultra for Mining can be used in many applications to increase machine productivity, decrease costs and improve ore recovery.



CAESultra is a technology system that can augment nearly any mining process in which a grade or slope is desired. The additional ore control feature allows mines to identify material at the face. Mines can achieve greater accuracy and productivity by using the CAES system in multiple applications, from dragline pad construction to reclamation. Some example applications include:

- **Production Dozing.** The CAES system is used in production dozing to remove overburden quickly and accurately. Using the CAES system, the operator cuts the overburden until achieving top-of-coal. This improves machine utilization and increases productivity.

*CAES application machine types:
Dozers and Track-Type Tractors.*

- **Leach Pad Construction and Maintenance.** The CAES system, when used in this application, ensures that the leach pad is built and maintained at the desired grade, improving ore recovery and minimizing dilution.

*CAES application machine types:
Scrapers, Dozers and Track-Type Tractors.*

- **Reclamation.** The CAES system, when used in reclamation operations, helps ensure the right amount of material is moved to return the surface to the desired topography. This allows for a faster reclamation process, lowering costs and improving profitability.

*CAES application machine types:
Scrapers, Loaders, Dozers, Motor Graders, Hydraulic Excavators and Track-Type Tractors.*

- **Ore Grade Control and Material Identification.** The CAES system used for ore grade control provides accurate profile and plan views of ore bodies, minimizing time spent to map ore grades. Ore control leads to better identification of loaded material, minimizing misrouted material and improving ore recovery and profitability.

*CAES application machine types:
Loaders, Shovels and Hydraulic Excavators.*

- **Coal Load Out Terminals.** In coal load out terminals, material is pushed into a deep cone-shaped pit, often times, with overhead conveyor systems in area. Using the 3D avoidance zones feature, the CAES system alerts the operator of obstacles and hazards, increasing safety while simultaneously providing information about volume of material moved.

*CAES application machine types:
Dozers and Track-Type Tractors.*

- **Haul Road and Bench Construction and Maintenance.** A CAES equipped machine helps create and maintain haul roads and benches by providing a real-time design plan, reducing the need for surveying costs. Roads and benches created using the CAES system are smoother, at the right grade and slope, with minimal rework. These conditions aid in minimizing truck maintenance costs, extending machine tire life, improving water run-off and increasing fleet productivity.

*CAES application machine types:
Scrapers, Loaders, Dozers, Shovels, Motor Graders and Track-Type Tractors.*

Features and Benefits

CAESultra for Mining allows operators to mine more safely, efficiently and accurately.

The CAESultra for Mining system is a robust technology system that empowers the operator in the cab to move the right material the first time, ultimately improving productivity and profitability. Using this system, machines and the mine office are linked – ensuring the design as created by the mine engineers is being accurately executed in the pit. The CAES system is a versatile solution with multiple features and capabilities available to suit nearly any mining application.

Features of the CAESultra for Mining system include:

- Configurable on-board display for specific application
- “Virtual plan” visible at all times
- Color-coded cut and fill maps showing design vs. as-built surfaces
- Real-time productivity and volume calculations
- Color-coded ore bodies
- Operator login, job codes, delay codes and activity codes
- 3D avoidance zones and surfaces
- Ability to view other machine positions on the in-cab display
- Terrain modifications used and viewed by other machines
- Operator-determined points of interest for display and reporting
- GNSS receiver using both GPS and GLONASS satellite constellations
- Easy connection to 3rd party internet protocol communication network
- Machine production data for operator and office
- Near real-time terrain updates in office
- Interface with the Caterpillar® MineStar™ system
- Archived productivity data for office reporting



CAESultra is a technology system purpose-built to help miners improve productivity and profitability. Using the CAES system, mining customers experience productivity improvements of more than 25%.

Benefits of the CAESultra for Mining system include:

- Reduces rework by moving material right the first time
- Reduces ore dilution through material identification at the face
- Reduces operating costs
- Reduces survey costs
- Optimizes machine use
- Improves safety by reducing the need for survey ground personnel in the vicinity of machines

- Empower operators by putting design in the cab
- Increases productivity more than 25%

Customer Support. For more than 25 years, Caterpillar has been providing electronic and electrical components and systems for the earthmoving industry – real-world technology solutions that enhance the value of Cat® products, making customers more productive and profitable. Your Cat dealer is ready to assist you with matching machine guidance systems to the application and obtaining responsible, knowledgeable support.

Machine Compatibility

Machine Family	Scrapers, Loaders, Dozers, Shovels, Motor Graders, Hydraulic Excavators, Track-Type Tractors
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Communications Radio

Operating range	Up to 10 km (6.2 miles)	
Technology	Spread spectrum	
Data rate	High speed	
Operating temperature	-40° C to 70° C -40° F to 158° F	
Storage temperature	-55° C to 70° C -67° F to 158° F	
Humidity	100%	
Height	216 mm	8.5 in
Width	86 mm	3.4 in
Length	260 mm	10.3 in
Weight	0.9 kg	2 lb

GPS Receiver

Horizontal accuracy	10 mm	0.39 in
Vertical accuracy	20 mm	0.79 in
Operating range	Up to 10 km (6.2 miles)	
Network connector	16-pin	
Electrical input	9 to 32 V DC	
Operating temperature	-40° C to 70° C -40° F to 158° F	
Storage temperature	-50° C to 85° C -67° F to 185° F	
Height	147 mm	5.8 in
Width	232 mm	9.1 in
Depth	251 mm	9.9 in
Weight	3.8 kg	8.3 lb

CAES Touch Screen Display

Display screen	264 mm (10.4 in) LCD display, 640 × 480 transflective color VGA	
Electrical input	9 to 32 V DC	
Memory drive	64 MB Ram, solid state disk: internal 128 MB, external compact flash	
Operating temperature	-20° C to 70° C -4° F to 185° F	
Storage temperature	-50° C to 85° C -58° F to 185° F	
Humidity	100%	
Width	315 mm	12.4 in
Height	261 mm	10.28 in
Weight	3.17 kg	8.5 lb
Depth	93 mm	3.66 in

CAESoffice/METSmanager

PC requirements	Current PC configuration (minimal P4, 512 MB RAM, 80G hard drive, CDRom, dedicated serial port, Ethernet port 10/100, XP)
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