AccuGrade®

Grade Control System for Motor Graders

AccuGrade® Systems	
for Motor Graders	**AccuGrade Cross Slope, AccuGrade Sonic, AccuGrade Laser, AccuGrade ATS, AccuGrade GPS**
Machine Compatibility	
Machine Model	**12H, 120H, 135H, 14H, 140H, 143H, 16H, 160H, 163H, 14M, 16M**

AccuGrade® Grade Control System for Motor Graders

AccuGrade Grade Control Systems simplify grading, improve accuracy, increase productivity, minimize material usage, and lower operating costs.

AccuGrade® Attachment Ready Option (ARO) Machine

The AccuGrade ARO machine simplifies system installation and reduces machine downtime. The AccuGrade system is designed and integrated into the machine systems and controls to optimize performance and reliability. **pg. 4**

AccuGrade® Cross Slope

The Cross Slope System uses three machine-mounted sensors to calculate cross slope of the blade. The system combines automated controls with manual elevation adjustments to achieve desired cross slope. **pg. 6**

AccuGrade® Sonic

The Sonic System uses ultrasonic sound waves and a sonic elevation sensor to measure distance and calculate elevation. The system features automated blade adjustments for automatic elevation control and built-in vertical guidance indicators for manual control. **pg. 7**

Features and Benefits

AccuGrade delivers a wide range of customer benefits designed to: increase operator efficiency and productivity, improve accuracy, reduce material costs, reduce surveying and labor costs, and lower overall operating costs. **pg. 14**

Fine grade with greater accuracy and control with AccuGrade technology solutions for motor graders. AccuGrade begins with the basic cross slope system. System flexibility allows elevation control to be combined with cross slope control to meet a wide range of site-specific grade requirements.

- *AccuGrade Cross Slope – cross slope control*
- *AccuGrade Sonic – 2D elevation control*
- *AccuGrade Laser – 2D elevation control*
- *AccuGrade ATS – 3D elevation control*
- *AccuGrade GPS – 3D elevation control*

AccuGrade® Laser

The Laser System leverages laser technology to create an accurate grade elevation reference over the work area. The system features automated blade adjustments for elevation control with tight tolerances and built-in elevation/grade display indicators for manual control. **pg. 8**

AccuGrade® ATS

The ATS System uses an Advanced Tracking Sensor (ATS) with target recognition to track a machine and determine precise blade positioning. The system features fully automated blade adjustments for automatic elevation control. **pg. 10**

AccuGrade® GPS

The GPS System uses Global Positioning System (GPS) satellites to determine precise blade positioning. The system features fully automated blade adjustments for automatic elevation control, and vertical and horizontal guidance light bars for manual control. **pg. 12**

✔ *New Feature*

AccuGrade® Attachment Ready Option (ARO) Machine

The AccuGrade ARO machine integrates the AccuGrade system into the machine systems and controls to optimize performance, reliability and productivity.

AccuGrade for Motor Graders. Caterpillar is helping customers revolutionize the way they move material with new technology solutions for earthmoving machines. Solutions that provide greater accuracy, higher productivity, lower operating costs, and more profitability.

The AccuGrade System is designed and integrated into the machine and hydraulic systems to create an automatic blade control system that allows operators to grade with complete accuracy.

The system uses intelligent, machine-mounted sensors to calculate precise blade slope and elevation information.

The integrated electrohydraulic valve control module uses information received from the sensors to make automatic adjustments to the blade. Depending on the configuration of the AccuGrade elevation control system (single or dual control), the system allows the operator to select which side of the blade to control – right, left, or both sides.

Automatic blade control allows operators to improve efficiency and productivity by achieving grade faster and in fewer passes than ever before, reducing the need for traditional survey stakes or grade checkers.

AccuGrade Attachment Ready Option (ARO) Machine. The factory AccuGrade ARO machine makes system installation and setup quick and easy and optimizes performance and reliability.

- Hydraulic control systems are integrated into the machine hydraulics for maximum performance and dependability.
- AccuGrade controls are integrated into the machine controls and levers for reliable operation and precise control.
- A valve control module delivers precise, automatic control of the blade functions.
- A power module provides clean, filtered DC power to all system components.
- Wiring harnesses and cables are routed during assembly for improved wear protection and better reliability.
- System is designed to withstand vibration for long life in rugged working environments.
- Safety interlock feature is built in for added protection during automated operation.

Plug and Play Capability. The system uses a Controller Area Network (CAN) designed for plug-and-play capability. This allows components to be quickly and easily added or removed. Common connectors provide a flexible system, fully upgradeable from single cross slope to dual elevation control. Moving the add-on systems from one machine to another is easy. Simply mount the components, connect, calibrate, and the system is ready to operate.

Applications. The AccuGrade® system is designed for a wide range of construction earthwork applications, from bulk earth moving with high production rates to finish grading with tight tolerances. Field-proven and versatile, the two-dimensional grade control systems are ideal for fine grading of roads requiring precise crown work, and sites with flat surfaces, single slopes and dual slopes, such as building pads, parking lots, roads and highways. The three-dimensional systems are ideal for complex 3D designs, such as golf courses and roads with superelevations.

System Flexibility. The basic system provides cross slope control. The operator selects which side of the blade to activate for automatic control and controls elevation manually.

When combined with AccuGrade elevation control technologies, the system provides automatic elevation control to one or both sides of the blade. The operator can choose any combination of control to meet specific job requirements.

- Cross Slope
- Laser/Cross Slope
- Dual Laser
- Sonic/Cross Slope
- Dual Sonic
- Sonic/Laser
- GPS/Cross Slope
- Dual GPS
- ATS/Cross Slope

AccuGrade Technologies.

- AccuGrade Cross Slope – 2D cross slope control
- AccuGrade Sonic – single or dual, 2D elevation control
- AccuGrade Laser – single or dual, 2D elevation control
- AccuGrade GPS – single or dual, 3D elevation control
- AccuGrade ATS – dual, 3D elevation control

AccuGrade® Cross Slope

Combines automated controls with manual adjustments to achieve desired cross slope.

Operation. AccuGrade Cross Slope is a grade control system designed to control surface cross slope. Machine-mounted sensors are used to calculate necessary blade slope positioning to achieve desired cross slope of the surface. The system makes automatic adjustments to the left or right lift cylinder, typically performed by the operator. The in-cab display delivers all of the AccuGrade Cross Slope information the operator needs to quickly and easily spread or cut material at the correct cross slope. The operator can select which side of the blade to control automatically and swap direction on the return pass without readjusting the settings. Elevation is controlled manually by matching grade, or automatically by adding an elevation control device.

Cross Slope System. The basic cross slope system automatically controls the slope of the blade to maintain desired surface cross slope.

Cross Slope with Elevation Control. AccuGrade Cross Slope can be combined with one or more of the AccuGrade elevation control technologies, such as AccuGrade Sonic, AccuGrade Laser, AccuGrade GPS, or AccuGrade ATS for automatic control of elevation and cross slope.

Machine-Mounted Sensors. AccuGrade Cross Slope uses three machine-mounted sensors – a blade slope sensor, mainfall sensor, and rotation sensor – to calculate necessary blade adjustments to achieve desired cross slope of the surface perpendicular to the direction of travel.

• Blade Slope Angle Sensor. The blade slope angle sensor is mounted at the back of the circle. It is used to measure the slope of the blade.

• Mainfall Sensor. The mainfall sensor is mounted to the machine frame or chassis. It measures pitch of the machine, which is used to calculate the cross slope. This is the same type of sensor used to measure blade slope angle.

• Blade Rotation Sensor. The rotation sensor is mounted on the hydraulic hydra-valve swivel and measures circle rotation or blade rotation to calculate cross slope.

System Accuracy. The cross slope system offers selectable accuracies for matching tolerances to specific grade and application requirements.

Applications.

- New road construction
- Road maintenance
- Road ditches
- Embankments
- Sports fields

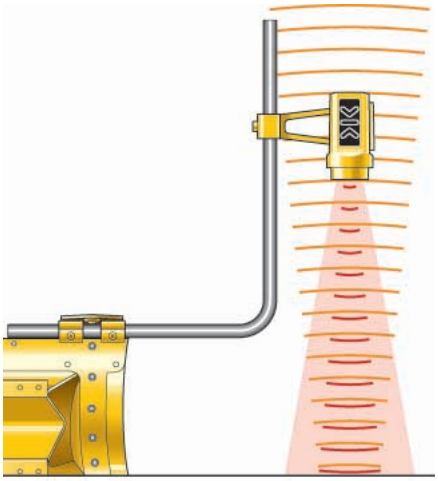
AccuGrade® Sonic

Ultrasonic sound waves calculate elevation from a physical reference point, such as a stringline, curb or gutter, to maintain elevation.

Operation. AccuGrade Sonic is a grade control system designed to control surface elevation. The sonic system uses an ultrasonic sensor to maintain the blade at the same relative vertical distance to an external reference, such as a string line or curb and gutter. The system makes automatic elevation adjustments typically performed by the operator. The operator simply steers the machine to maintain the sensor over the external reference.

Single Sonic System. When combined with AccuGrade Cross Slope, the single system provides automatic blade adjustments to one side of the blade for automatic control of elevation and cross slope.

Dual Sonic System. When two sonic sensors are used, the system provides automatic elevation control to either side of the blade. The system typically uses only one sensor at a time. This allows the operator to control which side of the blade to control and change direction without relocating sensors.



Sonic Sensor. The ultrasonic elevation sensor is secured to an L-shaped pole that can be mounted above either end of the blade. The sensor locks onto and traces a string line, previous pass, curb and gutter, existing road surface, or previously cut ground via ultrasonic sound waves. A sound pulse is emitted from the sonic sensor to the physical reference. The sound wave is bounced back to the sensor, which measures the elevation. The sensor matches the physical reference; therefore, external reference accuracy can effect system accuracy.

Grade Display. The sonic display functions as a stand-alone grade display and provides visual feedback to the operator. The grade display is located on the front panel of the sonic sensor and shows where the blade is relative to grade. Amber LED arrows indicate "above grade" and "below grade"; green indicates "on-grade".

In-Cab 2D Display. The in-cab display/control box delivers all system information to the cab. Grade display indicators provide vertical guidance to the operator and indicate which direction to move the blade to achieve grade. The monitor numerically displays cut/fill requirements.

Applications.

- New road construction
- Highway maintenance
- Airport runways
- Building pads
- Road ditches
- Embankments
- Indoor applications

System Accuracy. The system offers selectable accuracies for matching tolerances to specific grade and application requirements.

AccuGrade® Laser

A rotating laser creates a grade elevation reference plane over the work area to maintain precise elevation control.

Operation. AccuGrade Laser is an elevation control system designed for precise grade control with tight tolerances using a laser transmitter and receiver(s).

A laser transmitter is set up on the work site and creates a constant grade reference over the work area. A digital laser receiver is mounted on the machine and senses the laser signal as the machine moves across the work site.

The system captures elevation information and calculates the blade adjustments necessary to achieve grade. The system makes automatic elevation adjustments typically performed by the operator and provides automatic blade control to one or both sides of the blade. The operator simply steers the machine. The system also calculates cut/fill requirements for manual blade control.

Single Laser System. When combined with AccuGrade Cross Slope, the single laser system provides automatic blade adjustments to one side of the blade for automatic control of elevation and cross slope.

Dual Laser System. When two laser receivers are used, the system provides automatic elevation control to both sides of the blade for fine grading with tighter tolerances.

Laser Transmitter. A laser transmitter is mounted on a tripod so the laser beam can rotate unobstructed above the machine. The laser transmits a plane of light above the work area, which allows several machines to work effectively in any direction using one laser transmitter.

Laser Receiver. An all-new digital laser receiver is mounted on an electric mast above the cutting edge and is used to detect the laser beam. The receiver picks up the position of the laser's reference plane position relative to finish grade and measures height deviation from the on-grade location to the laser beam strike. The receiver sends blade position information back to the system to calculate necessary adjustments. A full 360 degree laser detection range allows the receiver to pick up the laser signal from any direction on the work site while the machine is working.

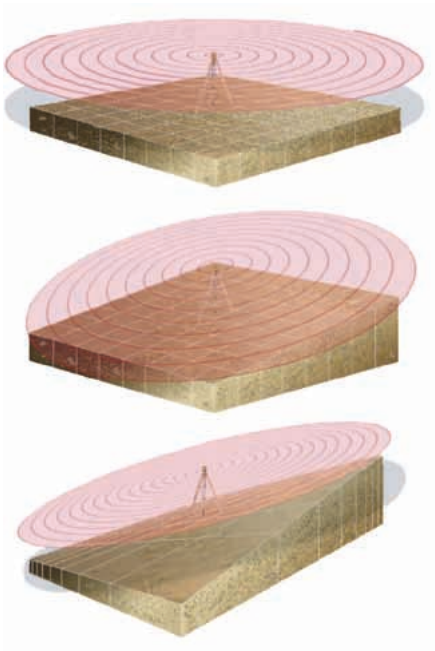
Electric Mast. An electrically adjustable telescopic mast is used for mounting the laser receiver above the blade's cutting edge. A mast riser is used to raise the mast above the cab. The mast is powered by an electric motor, which allows the operator to raise and lower the mast from inside the cab to precisely position the receiver above the cab for unobstructed laser reception.

In-Cab 2D Display. The CB420 or all-new CD610 in-cab displays with easy-to-read grade indicators and elevation display delivers all system information to the cab for easy viewing by the operator. Simple controls offer easy set-up, operation and access to system menus, allowing the operator to focus on productivity. Grade indicators provide vertical guidance to the operator and indicate which direction to move the blade to achieve grade. The monitor displays numeric cut/fill requirements for manual control. Refer to technical specification pages for compatibility chart.

Controls. System controls are integrated into the machine controls and levers for easy access and control. All-new M Series joysticks make the AccuGrade grade control system an even more powerful tool. Push button operation allows the operator to easily switch from manual mode to automatic mode.

1) Automatic/Manual Mode Button. Allows the operator to choose between automatic and manual mode. In automatic mode, the system automatically controls blade elevation adjustments. In manual mode, the operator manually controls the blade, while using cut/fill information on the in-cab display and grade indicators to guide blade movements.

2) Remote Offset Switch. Allows the operator to adjust elevation offsets at a preset distance from the design plan to optimize cutting depth in various soil conditions or accommodate sub base fill requirements.



Applications.

- Flat Planes
- Single Slopes
- Dual Slopes
- Cross Slopes
- Building Pads
- Parking Lots
- Sports Fields
- Indoor Applications

AccuGrade® ATS

Advanced Tracking Sensor (ATS) tracks blade positioning and provides precise elevation adjustments for fine grade control.

Operation. AccuGrade ATS is a high-accuracy dynamic tracking system that uses an Advanced Tracking Sensor (ATS) to track a machine and monitor blade positioning. An ATS instrument on the work site is used to track a target, which is mounted on the blade of the machine, to determine precise 3D positioning.

Active target technology allows the system to reliably lock onto and track the intended target. This ensures the correct machine is being tracked and eliminates false lock-ons to other active machine targets, survey crews, or reflective surfaces. Built-in search intelligence allows the system to quickly search for and find the target when the lock is lost due to a passing vehicle or other interruption.

The ATS instrument continuously measures the target's position and transmits real-time positioning data to the operator via the in-cab display, which shows the exact position of the blade in relation to the design.

The system combines the position of the target with the known position of the instrument, machine measurements and sensor outputs to calculate precise positioning of the blade tips. The system uses the positioning data to calculate desired elevation and cross slope. Cut and fill values are computed by comparing the position of the blade with the design file. The system makes automatic blade adjustments typically performed by the operator and provides automatic blade control to one or both cutting edge tips.

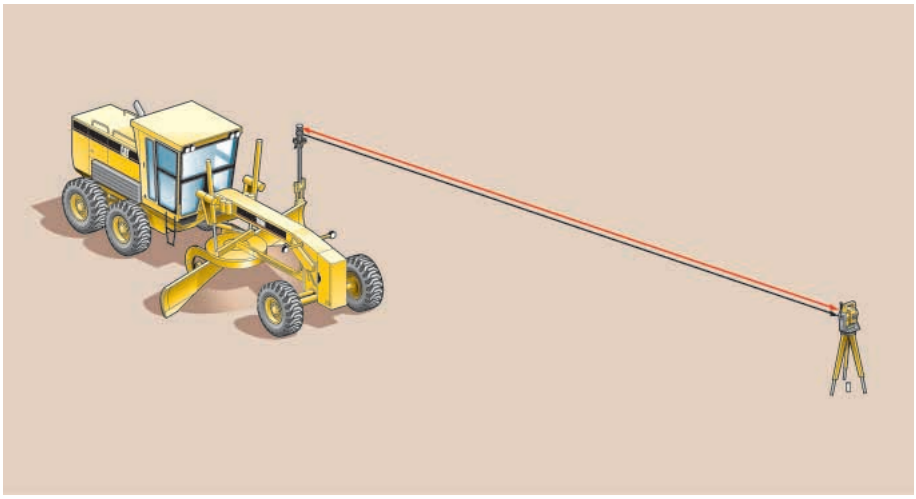
AccuGrade ATS puts the information the operator needs to complete the job in the cab. The operator simply steers the machine to achieve fine grade surfaces with high-precision accuracy.

ATS System. When combined with AccuGrade Cross Slope, the ATS system provides automated blade adjustments to one or both sides of the blade for automatic control of both elevation and cross slope.

ATS Instrument. The ATS instrument is a robotic total station that makes high-precision measurements of the azimuth, altitude and distance to the target. Specially designed servomotors work with the tracking software to allow the instrument to track a target moving at typical machine speeds. If the target is lost, the instrument predicts the speed the target is moving so it can relocate the target.

ATS Target. An ATS target is mounted on an electric mast above the motor grader cutting edge. The target has an LED, which is the target for the tracking system, and a prism, which is the target for the electronic distance measuring (EDM) system. The prism and LED must be in perfect vertical alignment, so the instrument can locate and track the target, and measure the distance.

Electric Mast. An electrically adjustable telescopic mast is used for mounting the target above the blade's cutting edge. A mast riser is used to raise the mast. The mast is powered by an electric motor, which allows the operator to raise and lower the mast from inside the cab for precise positioning of the target above the cab for unobstructed ATS signal reception.



AccuGrade ATS

Radio. Two communications radios are used to form a radio link between the ATS instrument and the machine. The radio on the ATS instrument is used to send target position information to the radio on the machine. The machine radio also allows the operator to send operation commands from the AccuGrade system on the machine back to the ATS unit.

In-Cab 2D/3D Display. An all-new display has a 27 percent larger screen, with a processor that is five times faster and improved display buttons.

The display with keypad allows the operator to interface with the system using push buttons and a color monitor. As the machine operates the operator can view real-time information, such as machine location, blade position and elevation relative to the design plan. The system uses 3D design files that are stored on a compact flash data card and inserted into a slot below the keypad. The new display provides improved access to the data card, with a quick-release door and environmentally sealed card slot.

Applications. Ideal for producing fine or finished grade surfaces.

AccuGrade® GPS

Global Positioning System satellites provide precise location information for elevation control with centimeter level accuracy.

Operation. AccuGrade GPS uses advanced Global Positioning System (GPS) technology to deliver precise blade positioning information to the cab. Using machine-mounted components, an off-board GPS base station and Real Time Kinematic (RTK) positioning, GPS provides the information necessary for the system to accurately determine blade positioning with centimeter level accuracy.

AccuGrade GPS computes the positioning information on the machine, compares the position of the blade relative to the design plan and delivers that information to the operator via an in-cab display. Information such as: blade elevation; how much cut/fill is necessary to achieve grade, visual indication of the blade's position on the design surface and a graphical view of the design plan with machine location.

AccuGrade GPS puts all the information the operator needs to complete the job in the cab, resulting in a greater level of control. Vertical and horizontal guidance tools visually guide the operator to desired grade.

Automated features allow the hydraulic system to automatically control blade adjustments to move the blade to grade. The operator simply uses the light bars to steer the machine for consistent, accurate grades and slopes resulting in higher productivity with less fatigue.

Single GPS System. When combined with AccuGrade Cross Slope, the single GPS system provides 3D grade control across the full width of the blade. The system uses a 3D position from the GPS receiver in combination with information from the cross slope sensors on the machine to automatically control elevation and cross slope.

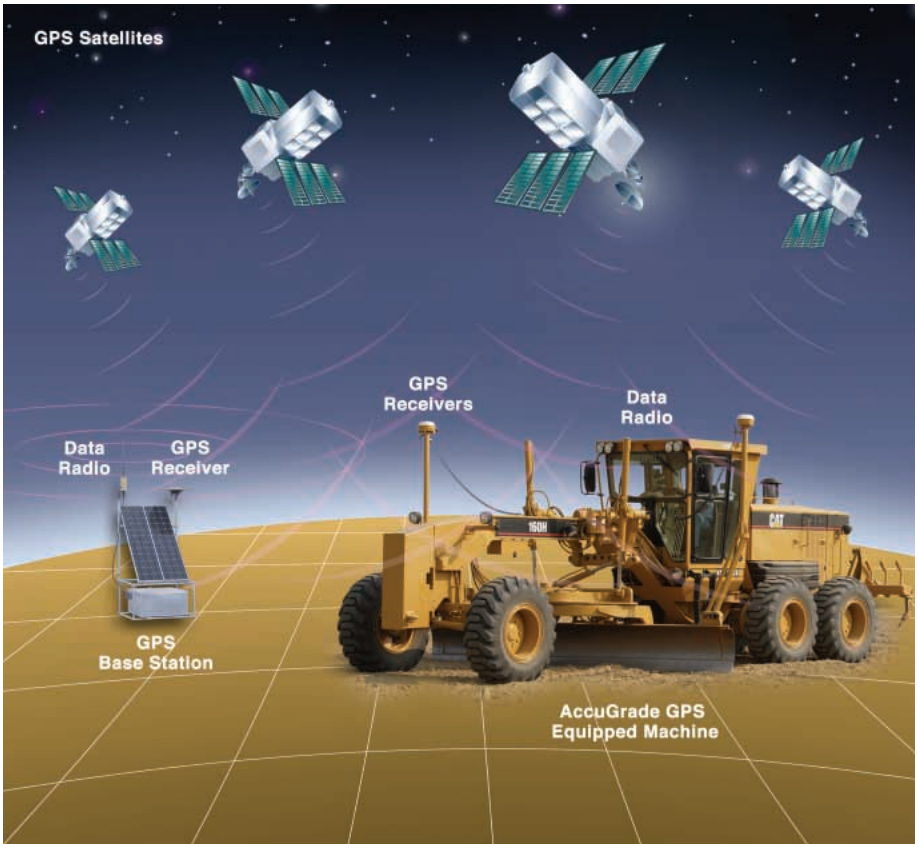
Dual GPS System. The dual AccuGrade GPS system provides 3D grade control across the full width of the blade. The dual GPS receiver configuration allows the system to automatically control blade adjustments for automatic control of elevation and cross slope.

GPS Receiver – MS980C. The receiver is mounted on a mast above the cutting edge. GPS satellite signals are received by the GPS receiver to generate a 3D position. This information, in conjunction with machine dimension information, is used to determine the precise horizontal and vertical position of the blade in real-time.

GPS Receiver – MS990C. The all-new MS990C is the next generation GPS receiver designed as a modular component in the AccuGrade grade control system. Its rugged design includes features to maximize the new modernized GPS signal structure including L2C and L5 tracking capabilities. The MS990C is also able to use satellites in the GLONASS satellite constellation to augment the GPS solution and provide increased availability and up time to the operator. The MS990C includes improved technology that provided faster RTK initialization times, better tracking and accuracy characteristics over a broader range of operating environments.

Mast. A rugged aluminum mast is used for mounting the GPS receiver above the blade's cutting edge for optimum GPS satellite reception.

Radio. The communications radio is mounted on the cab of the machine to ensure maximum signal reception. The radio receives real-time Compact Measurement Record (CMR) data from the GPS base station radio for calculating high-accuracy GPS positions. Radio broadcast frequencies work in all weather conditions. This allows AccuGrade GPS to accurately control blade operation in fog, dust and at night.



In-Cab 2D/3D Display. An all-new display has a 27 percent larger screen, with a processor that is five times faster and improved display buttons.

The display with keypad allows the operator to interface with the system using push buttons and a color monitor. As the machine operates the operator can view real-time information, such as machine location, blade position and elevation relative to the design plan. The system uses 3D design files that are stored on a compact flash data card and inserted into a slot next to the keypad. The new display provides improved access to the data card, with a quick-release door and environmentally sealed card slot.

Light Bars. Three light bars are mounted in the machine cab and provide vertical and horizontal guidance to the operator.

- Two vertical guidance light bars visually indicate where the blade tips are relative to grade.
- The horizontal guidance light bar indicates blade location relative to the selected horizontal alignment.

Controls. The controls are conveniently located. They are used to activate the automatic/manual operating modes and increment/decrement switches.

GPS Satellites. Positioning information from GPS satellites is received by the GPS base station and the machine mounted GPS receivers. The satellites constantly transmit their positions, identities and times of signal broadcasts.

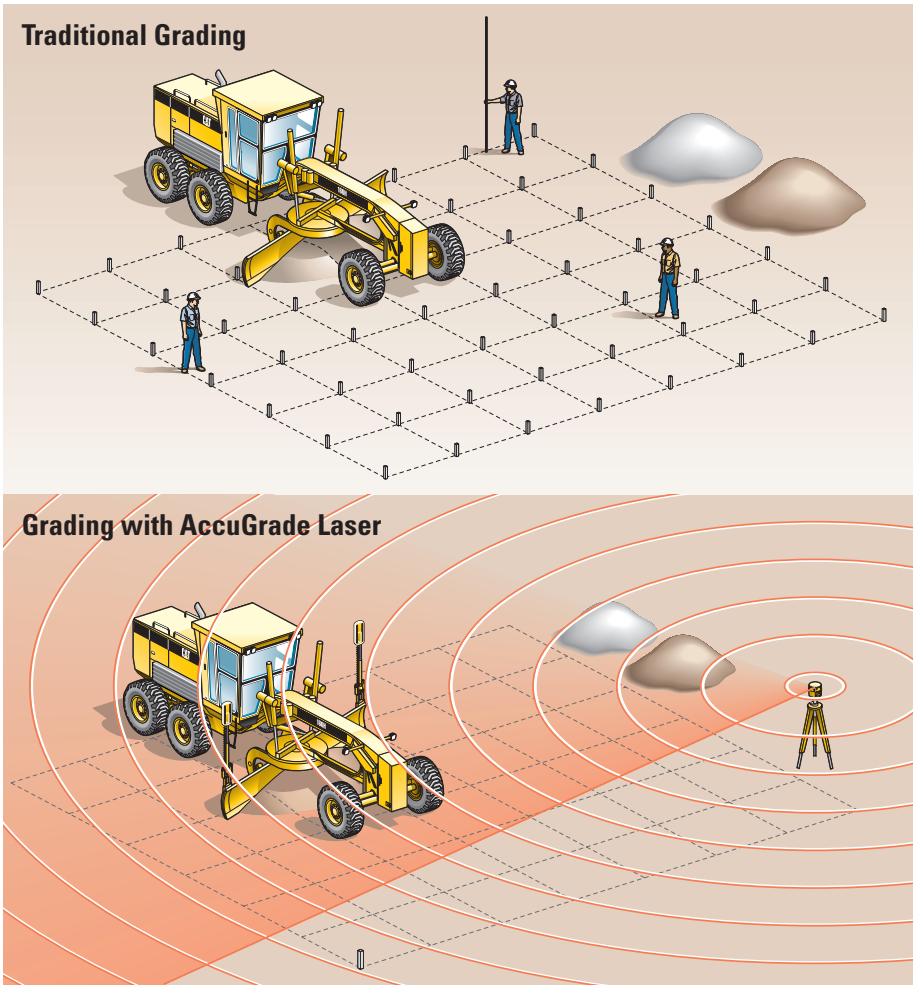
GPS Base Station. The GPS base station is located within radio range of the work site. It consists of a GPS receiver, GPS antenna and radio. The horizontal position (latitude, longitude) and the vertical position (height) of the base station are fixed to known reference points. The base station receives information from the GPS satellites. This information, along with the base station's known position is sent to the machine via the communication radio and is used by the machine's GPS receivers to calculate centimeter level accuracy positioning.

3D Design Software. Flat and sloping planar surface design files can be created on board the machine. More complex designs require 3D design software. Typically, engineering and surveying firms create complex 3D site designs.

Office Software. The office software manages and converts engineering survey data for use in machine format. It is the interface between the machine system, site managers and design engineers. Design data is exported from the office software onto a data card for use by the AccuGrade system. AccuGrade Office software is the recommended software for managing and converting design files.

Features and Benefits

AccuGrade® is easy to use and delivers a wide range of customer benefits.



Increases Productivity and Efficiency.

- Increases productivity by up to 50%
- Reduces guesswork and costly rework by moving dirt right the first time
- Reduces survey costs up to 90%
- Increases material utilization
- Reduces operating costs
- Extends the work day

Worksite Safety.

- Removes grade stakers and checkers from the worksite and keeps them away from the heavy equipment
- Designs can include avoidance zones with audible warnings

Assists with Labor Shortage.

- Reduces labor requirements and costs
- Customers can get the job done more quickly and efficiently
- Reduces need for staking and grade checkers
- Empowers operator and improves operator confidence by delivering grading information to the cab

Improves Employee Satisfaction and Retention.

- In-cab display brings elevation control to the cab
- Empowers operator with real-time results
- Real-time feedback on progress increases job satisfaction, eliminates guesswork and reduces operator stress
- Improves operator skills and takes performance to the next level
- Investing in the latest technology leads to a sense of value and trust in the operator

Increases Equipment Versatility.

- Plug-and-play connections allow fast, easy conversion from cross slope, to sonic, to laser, to ATS, to GPS grade control system
- Provides consistency and accuracy, turning your production machine into a fine grading machine

Integrated into Cat® Machines.

- Proven, optimized on-board electronics and hydraulics systems
- Components designed into machine to maximize reliability
- Integration into cab and controls increases ease of use
- Safety interlock (park brake, system health, idle time)
- Cat Dealer Network provides unmatched service and support

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 systems to the application and obtaining responsible, knowledgeable support.

AccuGrade Systems

for Motor Graders	AccuGrade Cross Slope, AccuGrade Sonic, AccuGrade Laser, AccuGrade ATS, AccuGrade GPS
Emissions and susceptibility	CE compliant

Machine Compatibility

Machine Model	12H, 120H, 135H, 14H, 140H, 143H, 16H, 160H, 163H, 14M, 16M

Blade Rotation Sensor

Working range	± 160°	
Network connector	6-pin	
Electrical input	9 to 32V DC	
Reverse voltage protection	to 36V DC	
Load dump protected	ISO 7637 compliant	
Humidity	100%	
Sealing	IP68 sealed to 34.48 kPa (5 psi)	
Operating temperature	–40° C to 85° C –40° F to 185° F	
Storage temperature	–40° C to 100° C –40° F to 212° F	
Length	120 mm	4.7 in
Width	135 mm	5.3 in
Depth	49 mm	1.9 in
Weight	1 kg	2.2 lb

Angle Sensor

Working range	45º	
Electrical input	9 to 32V DC	
Network connector	6-pin	
Reverse voltage protection	to 36V DC	
Load dump protected	ISO 7637 compliant	
Humidity	100%	
Sealing	IP68 sealed to 34.48 kPa (5 psi)	
Operating temperature	–40° C to 85° C –40° F to 185° F	
Storage temperature	–40° C to 100° C –40° F to 212° F	
Height	68 mm	2.7 in
Width	93 mm	3.7 in
Length (with connector)	104 mm	4.1 in
Weight	0.8 kg	1.8 lb

Sonic Tracer

Detection range	300 to 1300 mm	
Detection position	Linear, within 1 mm	
Grade display	LED indicators	
Electrical input	10 to 30V DC	
Input connector	6-pin, bulkhead	
Operating temperature	–28° C to 70° C –19° F to 158° F	
Storage temperature	–34° C to 85° C –30° F to 185° F	
Temperature compensation	Thermistor	
Humidity	90%	
Sealing	Water resistant	
Height	165 mm	6.5 in
Diameter	76 mm	3 in
Weight	0.4 kg	0.9 lb

2D Display – CB420

Display screen	128 × 64 pixel, LCD	
On-grade indicator	Green	
Above/below grade indicator	Amber	
Operating temperature	–29° C to 60° C –20° F to 140° F	
Storage temperature	–40° C to 80° C –40° F to 176° F	
Humidity	100%	
Sealing	IP54 sealed	
Electrical input	9 to 32V DC	
Input connector	6-pin	
Network connector	6-pin	
Remote switch connector	6-socket	
Data connector	9-socket	
Length	295 mm	7.7 in
Width	130 mm	5.1 in
Depth	102 mm	4 in
Weight	1.4 kg	3 lb
Language capabilities	Chinese, Dutch, English (UK & US), Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish	

2D Display – CD610

Display screen	320 × 240 pixel, LCD	
On-grade indicator	Green	
Above/below grade indicator	Amber	
Operating temperature	–40° C to 85° C –40° F to 185° F	
Storage temperature	–40° C to 85° C –40° F to 185° F	
Humidity	100%	
Sealing	IP68 sealed to 34.48 kPa (5 psi)	
Electrical input	9 to 32V DC	
Network connector	70-pin	
Length	221 mm	8.7 in
Width	140 mm	5.51 in
Depth	71 mm	2.8 in
Weight	1.59 kg	3.51 lb
Language capabilities	Chinese, Danish, Dutch, English (UK & US), Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish	

Laser Receiver

Detection angle	360º	
Detection range	231 mm	9.1 in
Detection accuracy	1.5 mm	0.06 in
Transmitter speed	270 to 1,320 rpm	
Grade display	LED grade indicators	
Operating temperature	–40° C to 71° C –40° F to 160° F	
Storage temperature	–55° C to 85° C –67° F to 185° F	
Sealing	IP68 sealed to 34.48 kPa (5 psi)	
Electrical input	9 to 32V DC	
Network connector	6-pin	
Height	292 mm	11.5 in
Width	168 mm	6.6 in
Depth	213 mm	8.4 in
Weight	2.8 kg	6.3 lb

Electric Mast

Position repeatability	± 1 mm	± 0.04 in
Typical speed	30 mm/sec (1.2 in/sec)	
Operation	12 and 24V	
Operating temperature	–29° C to 60° C –20° F to 140° F	
Storage temperature	–40° C to 80° C –40° F to 176° F	
Humidity	100%	
Sealing	IP54 sealed	
Electrical input	9 to 32V DC	
Network connector	10-pin	
Input connector	6-pin	
Height retracted	1640 mm	5 ft 5 in
Height extended	2900 mm	9 ft 7 in
Base diameter	240 mm	9.4 in
Weight	25 kg	55 lb

2D/3D Display – CD700

Display screen	177.8 mm (7 in) QVGA, 480 × 234 pixel, LCD	
Electrical input	9 to 32V DC	
Network connector	39-pin	
Memory drive	Compact flash	
Operating temperature	–20° C to 80° C –4° F to 176° F	
Storage temperature	–40° C to 85° C –40° F to 185° F	
Sealing	IP68, sealed to 34.48 kPa (5 psi)	
Width	230 mm	9.06 in
Height	170 mm	6.69 in
Depth	101 mm	3.98 in
Weight	3 kg	6.61 lb
Language capabilities	Chinese, Danish, Dutch, English (UK & US), Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish	

GPS Receiver – MS980C

Horizontal accuracy	20 mm	0.78 in
Vertical accuracy	30 mm	1.2 in
Operating range	Up to 10 km (6.2 miles)	
Network connector	16-pin	
Electrical input	9 to 32V DC	
Operating temperature	–40° C to 70° C –40° F to 158° F	
Storage temperature	–55° 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

GPS Receiver – MS990C

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 32V DC	
Operating temperature	–40° C to 70° C –40° F to 158° F	
Storage temperature	–55° 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

Light Bars

Input connector	4-pin	
Operating temperature	–40° C to 85° C –40° F to 185° F	
Storage temperature	–40° C to 100° C –40° F to 212° F	
Sealing	IP68, sealed to 34.48 kPa (5 psi)	
Height	174 mm	6.9 in
Width	53 mm	2.1 in
Depth	32 mm	1.2 in
Weight	0.22 kg	0.5 lb

Communications Radio

Operating range	Up to 10 km (6.2 miles)	
Technology	Spread spectrum	
Data rate	High speed	
Input connector	8-pin	
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

ATS Target

Working range	750 m	2,460 ft
Network connector	6-pin	
Electrical input	10.5 to 35V DC	
Length	173 mm	6.75 in
Length (with shockmount)	260 mm	10.25 in
Diameter	105 mm	4.15 in
Weight	1.06 kg	2.4 lb
Weight (with shockmount)	2.5 kg	5.5 lb

Power Control Module

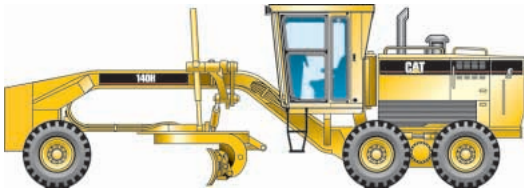
Electrical input	9 to 32V DC	
Load dump protection	ISO 7637 compliant	
Over-current protection	15 amps	
Output	3 circuits, 15-amp	
Operating temperature	–40° C to 71° C –40° F to 160° F	
Storage temperature	–55° C to 85° C –67° F to 185° F	
Humidity	100%	
Sealing	IP68 sealed to 34.48 kPa (5 psi)	
Input connector	8-pin	
Output connector	8-socket	
Height	64 mm	2.5 in
Width	89 mm	3.5 in
Length	213 mm	8.4 in
Weight	1 kg	2.2 lb

AccuGrade® Systems

*Requires Cross Slope System

Note: Displays and communications radios must be ordered separately from system kits.

ARO Machine



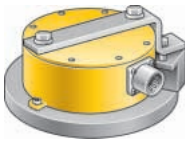
AccuGrade Attachment Ready Option (ARO) Machine

Cross Slope System

Power Module (H Series Only)

Mainfall Sensor

Crossfall Sensor



Rotation Sensor

2D Display – CB420 or CD610
See compatibility table.

2D/3D Display – CD700
See compatibility table.

Single Sonic System*

Sonic Tracer

2D Display – CB420 or CD610
See compatibility table.

2D/3D Display – CD700
See compatibility table.

Dual Sonic System*

Sonic Tracers

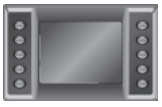
2D Display – CB420 or CD610
See compatibility table.

2D/3D Display – CD700
See compatibility table.

Single Laser System*

Laser Receiver

Electric Mast

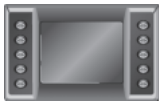


2D Display – CB420 or CD610
See compatibility table.

Dual Laser System*

Laser Receivers

Electric Masts



2D Display – CB420 or CD610
See compatibility table.

ATS System*

2D/3D Display – CD700
See compatibility table.

Communications Radio

Target

Electric Mast

Single GPS System*

2D/3D Display – CD700
See compatibility table.

Communications Radio

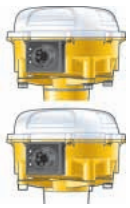
GPS Receiver

Mast

Dual GPS System

2D/3D Display – CD700
See compatibility table.

Communications Radio



GPS Receivers

Masts

Compatibility Chart

Technology and Display Configurations

Model	Cross slope	Sonic	Single laser	Dual laser	ATS	Single GPS	Dual GPS
12H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
120H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
135H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
140H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
143H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
160H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
163H	CB420/ CD700	CB420/ CD700	CB420	CB420	CD700	CD700	CD700
14M	CD610/ CD700	CD610/ CD700	CD610	CD610	CD700	CD700	CD700
16M	CD610/ CD700	CD610/ CD700	CD610	CD610	CD700	CD700	CD700

CB420

CD610

CD700

AccuGrade® System Kits

Standard equipment may vary. Consult your Caterpillar dealer for details.

AccuGrade Attachment Ready Option (ARO) Machine
- Weldments
- Wiring Harness
- Hydraulic Valves, Lines and Hoses
- Electronic Control Module
- Remote Switches
- Power Module (M Series only)

2D Kits:
- 2D Display Kit
  - CB420 or CD610 Display
  - Bracket
  - Wiring Harness

AccuGrade Cross Slope Kit
- Crossfall Sensor
- Mainfall Sensor
- Rotation Sensor
- Sensor Brackets
- Power Module (H Series only)

AccuGrade Sonic Kits
- Single Sonic
  - Sonic Tracer, Carrying Case
  - L-Pole
  - Mounting Bracket
  - Coiled Cable
- Dual Sonic
  - Sonic Tracer (2), Carrying Case
  - L-Pole (2)
  - Mounting Brackets (2)
  - Coiled Cable (2)

AccuGrade Laser Kits
- Single Laser
  - Laser Receiver, Carrying Case
  - Electric Mast
  - Shock Mount
  - Straight Riser
  - Adjustable Angle Bracket
  - Coiled Cable (2)
- Dual Laser
  - Laser Receiver (2), Carrying Case
  - Electric Mast (2)
  - Shock Mount (2)
  - Straight Riser (2)
  - Adjustable Angle Bracket (2)
  - Coiled Cable (4)

3D Kits:
- AccuGrade ATS Kits
  - 3D Display Kit
    - CD700 Display, Carrying Case
    - Bracket
    - Wiring harness
  - Communications Radio
  - Radio Mounting (H Series only)
  - ATS Target, Carrying Case
  - Target Mounting Collar
  - Electric Mast
  - Shock Mount
  - Straight Riser
  - Adjustable Angle Bracket
  - Coiled Cable (2)
- AccuGrade GPS Kits
  - 3D Display Kit
    - CD700 Display, Carrying Case
    - Bracket
    - Wiring Harness
  - Communications Radio
  - Radio Mounting (H Series only)
  - Single GPS
    - GPS Receiver, Carrying Case
    - Rigid Mast
    - Angled Riser
    - Adjustable Angle Bracket
    - Light Bars (3)
    - Coiled Cable
  - Dual GPS
    - GPS Receiver (2), Carrying Case
    - Rigid Mast (2)
    - Angled Riser (2)
    - Adjustable Angle Bracket (2)
    - Light Bars (3)
    - Coiled Cable (2)
    - Angle Sensor (Optional)
    - Angle Sensor and Coiled Cable (Optional)

Notes

Notes

AccuGrade® Grade Control System for Motor Graders

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at **www.cat.com**

Materials and specifications are subject to change without notice. Featured machines in photos may include additional equipment. See your Caterpillar dealer for available options.

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