

AccuGrade® Compaction

GPS Mapping and
Measurement for
Soil Compactors



AccuGrade® Compaction

Compaction Measurement,
GPS Mapping

Machine Compatibility

Machine Model

CS563E, CS573E, CS583E,
CS663E, CS683E

AccuGrade® Compaction GPS Mapping and Measurement for Soil Compactors

The AccuGrade® system simplifies compaction, increases productivity, lowers operating costs and documents compaction results.

Compaction Measurement System

- ✓ The Compaction Measurement system measures drum movement to determine soil stiffness. This new Compaction Measurement system provides operators, contractors and project owners with a variety of benefits that increase production and simplify job-site documentation. **pg. 4**

AccuGrade® Attachment Ready Option (ARO)

- ✓ The AccuGrade ARO machine simplifies system installation. The AccuGrade system is designed and integrated into the machine systems and controls to optimize performance and reliability. **pg. 5**

AccuGrade® GPS

- ✓ The GPS System uses Global Positioning System satellites to determine precise machine position. **pg. 6**

100% compaction quality control and quality assurance using AccuGrade Compaction. System flexibility allows the AccuGrade electronic components to be easily interchanged to meet a wide range of application and site-specific compaction requirements.



AccuGrade Office Software

- ✓ AccuGrade Office software manages and converts engineering and survey data for use in the machine. It also imports and stores compaction data from the machine for analysis of the compaction values. **pg. 8**

Features and Benefits

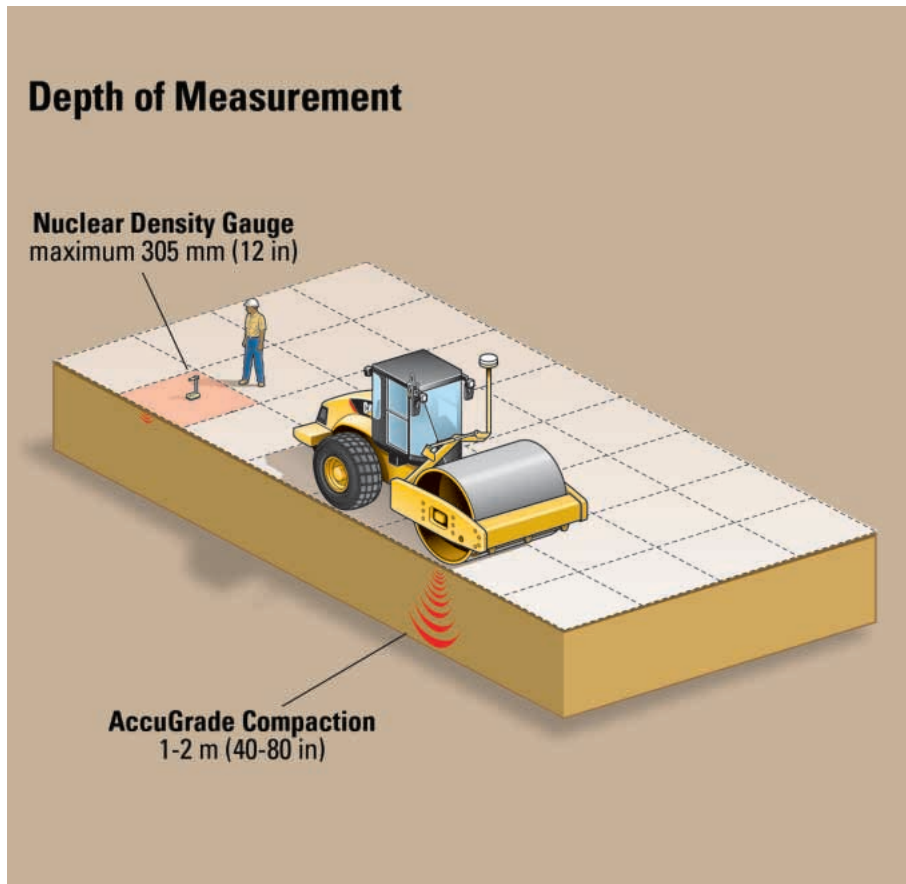
- ✓ AccuGrade Compaction delivers a wide range of customer benefits that increase operator efficiency and productivity, improve accuracy, reduce material costs, reduce surveying and labor costs, and lower overall operating costs. **pg. 9**



✓ *New Feature*

Compaction Measurement System

The Compaction Measurement system measures compaction to optimize machine productivity and improve job quality.



Depth Measurement. The Compaction Measurement system measures deep into the soil – typically 1 to 2 m (40 to 80 in) down, depending on soil characteristics and machine operation. This provides a better overall picture of soil stiffness than other compaction measurement devices, such as a nuclear density gauge or lightweight deflectometer, which measure to a depth of typically about 305 mm (12 in). Depth of measurement validates your compaction work and ensures that the entire lift meets stiffness requirements.

Compaction Measurement System. The Compaction Measurement system measures stiffness, or the ability of a material to resist deformation under a load, rather than density, or the weight of a material per volume. A controller package collects data from an accelerometer, which measures drum movement. The controller package converts the measurements into stiffness values, called Cat® Compaction Values, or CCVs.

The Compaction Measurement system helps the operator determine when the proper level of compaction has been achieved, but it can provide other benefits as well. The Compaction Measurement system can help the operator identify potential problems in the construction materials, such as hard spots, soft spots or moisture-related problems beneath the surface.

By alerting the operator to the presence of these anomalies, the contractor has the opportunity to investigate and, if necessary, fix the questionable areas, increasing the uniformity of the compacted materials. This results in overall job site savings in time and cost, eliminating potential rework. It also improves the quality of the work, as well as the life cycle of the subgrade, base and sub-base that support the paved surface.

AccuGrade Compaction, with its GPS mapping and measurement system can provide Quality Control/Quality Assurance documentation on a one-to-one basis, which can eliminate the need for test rollers and decrease the number of manual tests.



The Compaction Measurement system includes an accelerometer and a controller package.

- **Accelerometer** – The accelerometer measures drum movement. The data collected is sent to the controllers, where it will be converted to stiffness values.
- **Controller Package** – The Compaction Measurement system uses a controller package to convert data collected from the accelerometer to stiffness values, which are then sent to the graphic display unit.

AccuGrade® Attachment Ready Option (ARO)

Integrates the AccuGrade Compaction system into the machine systems and controls to optimize performance and reliability.

AccuGrade Compaction. Caterpillar is helping customers revolutionize the way they move and compact material with new technology solutions for earthmoving machines – solutions that provide higher productivity, lower operating costs and more profitability.

The system uses machine-mounted sensors to calculate the precise drum location and compaction.



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

- 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.

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. 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.



Mast. A rugged steel mast is used for mounting the GPS receiver above the drum for optimum GPS satellite reception. The mast deploys hydraulically with a hand pump. When not in use, the mast folds into a secure storage position, making ground-level removal of the GPS receiver easy. The mast includes all electrical wiring and harnesses.

Angle Sensor. An angle sensor mounts to the base of the mast. The angle sensor measures the left/right tilt of the drum to a range of $\pm 45^\circ$. This information is sent to the display unit's processor to provide greater positional accuracy.

Applications. The AccuGrade system is designed for a wide range of construction earthwork applications, including:

- Highway projects
- Residential road projects
- Commercial site preparation
- Building pad sites

AccuGrade® GPS

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



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

AccuGrade GPS computes the positioning information on the machine, compares the position of the drum relative to the design plan and delivers that information to the operator via an in-cab display. It also shows information such as visual indication of the drum'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.

Single GPS System. The single GPS system provides 3D grade control across the full width of the drum. The system uses a 3D position from the GPS receiver in combination with information from the angle sensor to determine drum position. The 3D position data also allows compacted grade to be verified.



GPS Receiver. The receiver is mounted on a mast above the drum. 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 drum in real-time.

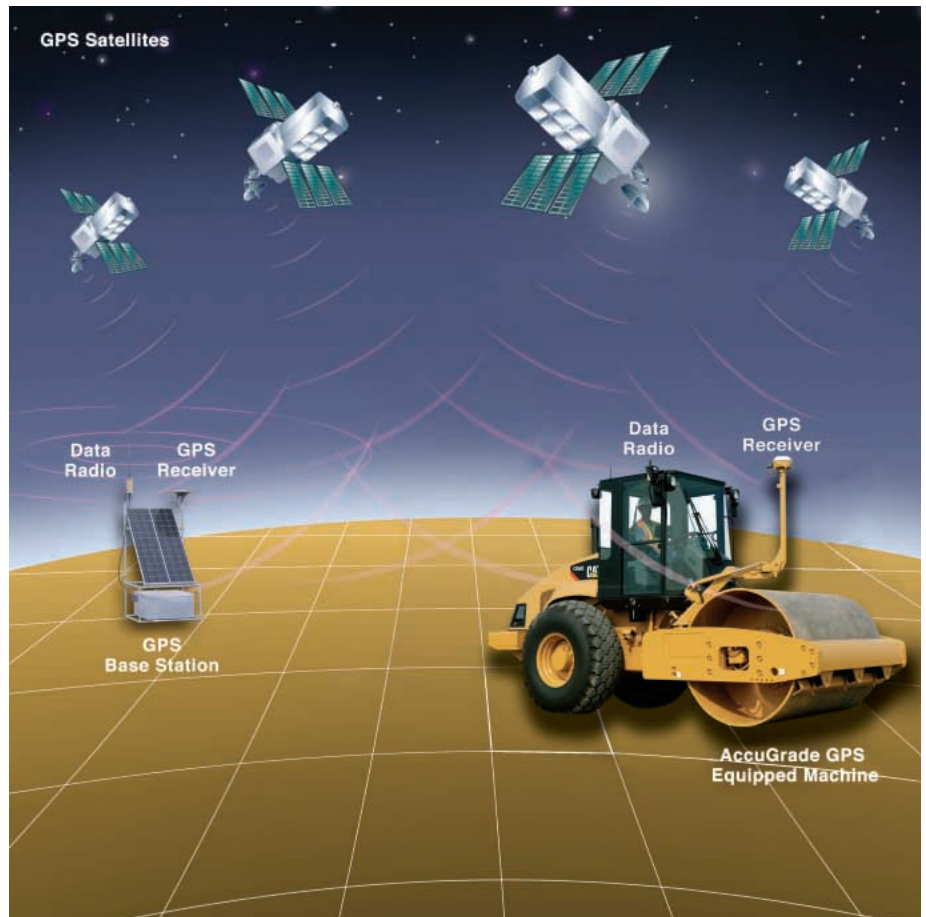
The all-new MS990C is the next generation GPS receiver designed as a modular component in the AccuGrade system. Its rugged design includes features to maximize the new modernized GPS signal structure including L2C and L5 tracking capabilities. The MS990C is also able to use satellites in the GLONASS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

The MS990C GPS receiver can also be used with the satellite based North American Wide Area Augmentation System (WAAS) and the European Geostationary Navigation Service (EGNOS) to determine the drum position using differential GPS without a GPS base station. This capability provides more job-site flexibility.

Radio. The communications radio is mounted on the cab of the machine to ensure maximum signal reception. It 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. The radio can also provide a two-way wireless radio network between the machine and a site office computer running AccuGrade Office software. Compaction data from the display unit can be transferred to the job site computer for analysis.



In-Cab 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 and speed, drum amplitude, vibration frequency, and number of passes, relative to the design plan.



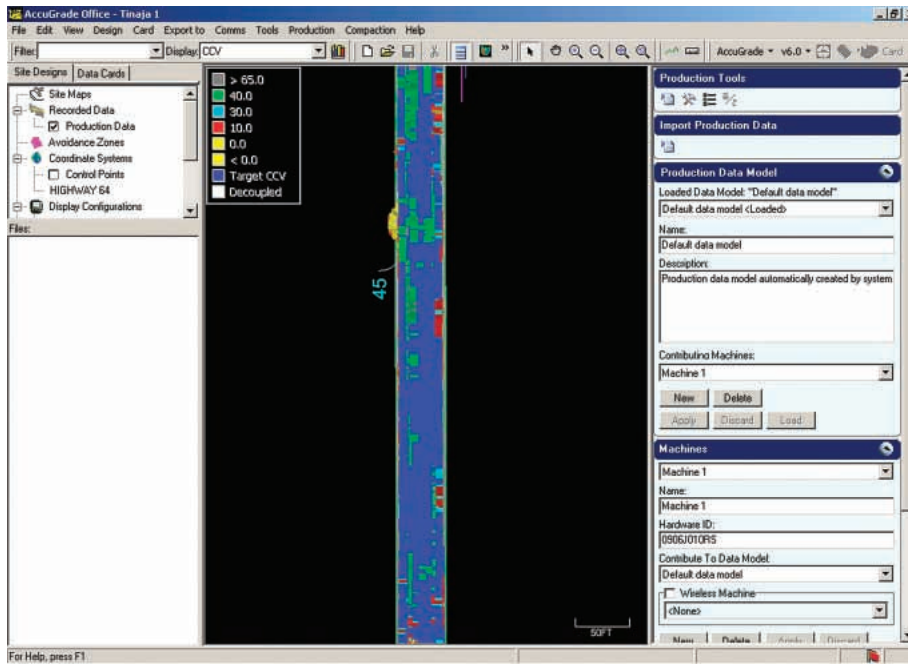
The system uses 3D design files that are stored on a compact flash data card and inserted into a slot next to the keypad. The new display provides improved access to the data card, with a quick-release door and environmentally sealed card slot.

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 and 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 communications radio and is used by the machine's GPS receivers to calculate centimeter-level accuracy positioning.

AccuGrade Office Software

AccuGrade Office software manages and converts engineering survey data for use in the machine as well as imports compaction data from the machine.



- View number of passes made by compactor in the plan view.
- View details of compaction data for each cell.
- Filter compaction data by compactor and date.

The Compaction Option is enabled through an optional add-on component to AccuGrade Office software. The component is distributed separately and is installed as an add-on to the base AccuGrade Office software.

AccuGrade Office Wireless Option.

AccuGrade Office Wireless Option for 900 MHz communications radios permits AccuGrade Office software to communicate wirelessly with compactors equipped with the AccuGrade GPS system.

AccuGrade Office software supports the following wireless communication features for AccuGrade GPS equipped compactors:

- Export designs from AccuGrade Office software to compactors with wireless communication enabled
- Display machine location in the AccuGrade Office plan view window
- Delete, rename and retrieve files on-board compactors
- Send text message to the machine display
- Retrieve screen snapshot from compactor display
- Retrieve diagnostic report from machine display

Wireless capability between machines and AccuGrade Office software is enabled through an optional add-on component to the AccuGrade Office software. The component is distributed on a separate CD, installed as an add-on to the base AccuGrade Office software and requires its own licensing and registration. An add-on wireless option key is needed to enable wireless communication on the machine.

AccuGrade Office Software. AccuGrade Office is a state of the art software that allows the user to import 3D design data, convert data for use on machines equipped with AccuGrade GPS/ATS, validate the data and then export data to AccuGrade machines using a PC compact flashcard.

Data Import. Importing data into AccuGrade Office software is the first step in preparing data for use with the on-board machine control and guidance systems. Imported files provide data for the designs, site maps, avoidance zones, display configurations, background data and coordinate systems exported to a grade control system. A number of surface, road, linework and field data/file formats can be imported into AccuGrade Office software.

Create Designs. Although the majority of design data is imported into AccuGrade Office software, the software also provides the capability to create new designs.

Organize Data. Once data has been imported into AccuGrade Office software, it is organized into the following categories:

- Design surfaces

- Background site maps
- Avoidance zones
- Display and machine configuration files
- Coordinate system
- Data Cards

Data Validation. Validating the data is critical for machine control and guidance systems.

Data Export. Once data has been imported, organized, and validated in AccuGrade Office software, the final step is to export the data for use with on-board machine control and guidance systems.

Exporting can be done directly to a hard drive or to a compact flash card, E-mailed to selected e-mail addresses, or wirelessly to a machine.

AccuGrade Office Compaction Option.

AccuGrade Office Compaction Option permits the user to view compaction data from compactors equipped with AccuGrade Compaction.

Specific features of AccuGrade Office Compaction Option include:

- View Caterpillar Compaction Value (CCV) measurements in plan view.

Features and Benefits

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

Enhanced Productivity.

- Identifies and alerts operator to areas needing additional compaction early in the construction process, eliminating rework and lost time
- Optimizes fuel consumption by eliminating unnecessary passes
- Real-time testing eliminates the need to stop and wait for testing results
- Extends the work day

Worksite Safety.

- Minimizes the need for geotechnical inspectors on the job site and keeps them away from the equipment

Assists with Labor Shortage.

- Reduces labor costs
- Customers can get the job done more quickly and efficiently

Improves Employee Satisfaction and Retention.

- Empowers the operator and improves operator confidence by delivering real-time compaction information to the cab
- Improves operator skills and takes performance to the next level

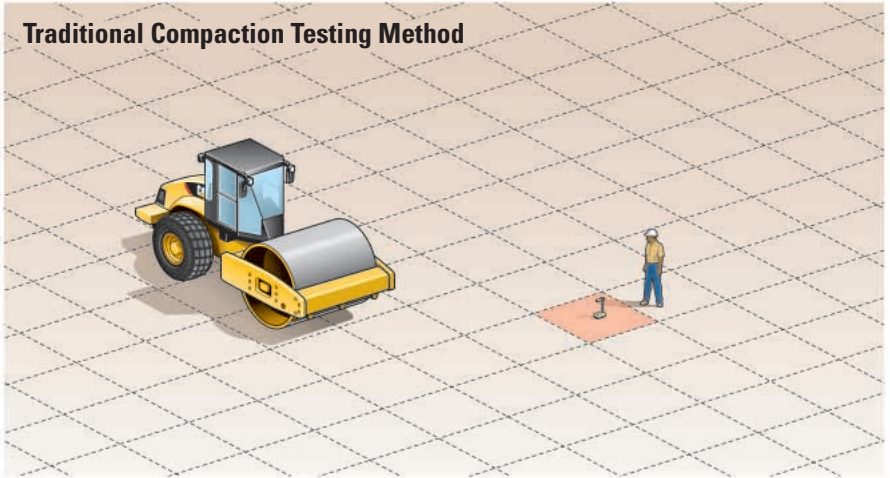
Increases Equipment Versatility.

- Leverages the same technologies and components as AccuGrade systems for Track-Type Tractors, Motor Graders and Hydraulic Excavators
- Plug-and-play connections allow fast, easy conversion of the GPS system

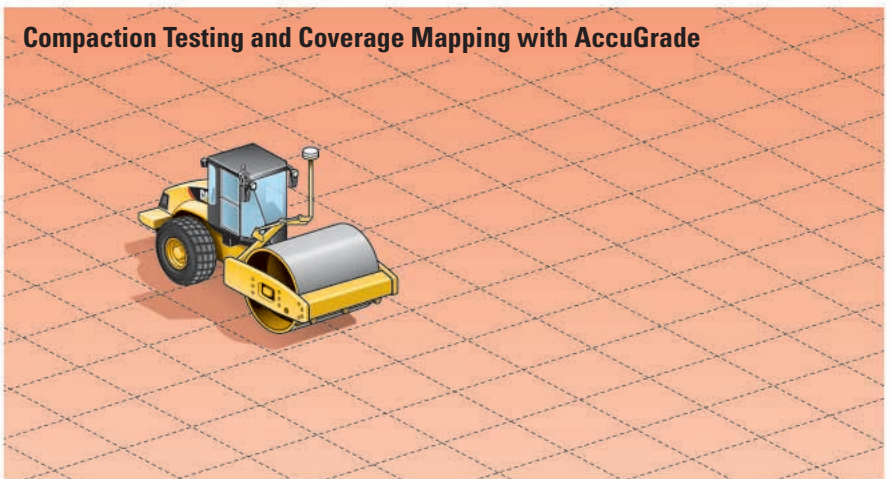
Integrated into Cat® Machines.

- Proven, optimized on-board electronics systems
- Components designed into machine to maximize reliability
- Integration into cab and control levers increases ease of use
- Cat Dealer Network provides unmatched service and support

Traditional Compaction Testing Method



Compaction Testing and Coverage Mapping with AccuGrade



Lower Owning and Operating Costs.

- Can eliminate the need for test roller, so there is less equipment to maintain and transport
- Lower testing costs, due to fewer samples to tag and store

Quality Control / Quality Assurance.

- Documents work completed
- Provides in-process control with the ability to monitor progress daily
- Provides electronic data for analysis
- Creates historical record of job site data to correlate with long-term results

Customer Support. The AccuGrade Compaction system is another offering in the AccuGrade suite of products by Caterpillar. All AccuGrade products are factory-integrated, sensor-independent, and dealer-supported. Caterpillar is raising the bar in the industry by backing its solutions with the renowned Caterpillar® dealer network.

AccuGrade® Compaction

	Compaction Measurement, GPS Mapping
Emissions and susceptibility	CE compliant

Machine Compatibility

Machine Model	CS563E, CS573E, CS583E, CS663E, CS683E
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Angle Sensor

Working range	45°
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

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	English (UK & US), French, German, Norwegian

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	-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

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

AccuGrade® Compaction

Compaction Measurement System and AccuGrade Attachment Ready Option (ARO) Machine



Single GPS System



3D
Display –
CD700



Communications
Radio



GPS
Receiver –
MS990C

AccuGrade® System Kits

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

Compaction Measurement System

- Accelerometer
- Controller Package

AccuGrade® Attachment Ready Option (ARO) Machine

- Angle Sensor
- Mast
- Weldments
- Wiring Harness

3D Kits:

- AccuGrade GPS Kit
- Communications Radio
- Single GPS
 - CD700 Display, Carrying Case
 - GPS Receiver, Carrying Case

AccuGrade® Compaction GPS Mapping and Measurement for Soil Compactors

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

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See your Caterpillar dealer for available options.

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